The 10th IGD-TP Exchange Forum:
RD&D Challenges from Siting to Industrialisation

Programme and Abstracts

MINISTRY OF INDUSTRY AND TRADE

The event is held under the auspices of the Ministry of Industry and Trade of the Czech Republic

25–27 November 2025

Prague
Czech Republic

hosted by SÚRAO RADIOACTIVE WASTE REPOSITORY AUTHORITY

www.igdtp.eu

Content

Welcome

Following our last, highly successful, event in Zurich in 2022, we are delighted to host the 10th IGD-TP Exchange Forum on research, development and demonstration (RD&D) challenges faced by geological disposal programmes for radioactive waste.

This event provides a valuable opportunity for researchers, experts and practitioners from around the world to exchange experience, discuss new developments, explore ongoing RD&D priorities of waste management organisations (WMOs), and reflect together on future challenges for our community.

As the 2025–2026 Chair of the IGD-TP, I would like to express my sincere appreciation to my colleagues at SÚRAO, the Czech Radioactive Waste Repository Authority, for organising this event and to my WMO colleagues who have dedicated time and energy to its preparation. I would also like to extend my warm thanks to Galson Sciences Ltd for their excellent cooperation and support in the organisation and preparation of this Exchange Forum.

Finally, my gratitude goes to all supporting organisations and to each of you participating here today — your engagement and contribution make this event truly meaningful.

From the IGD-TP Chair

Markéta Dohnálková, SÚRAO

The IGD-TP

The Implementing Geological Disposal of radioactive waste Technology Platform (IGD-TP) is dedicated to initiating and carrying out European strategic initiatives to facilitate the stepwise implementation of safe, deep geological disposal of spent fuel, high-level waste and other long-lived radioactive waste. It aims to address the remaining scientific, technological and social challenges, and support European waste management programmes.

The IGD-TP was launched on 12 November 2009, initiated by the European Commission and waste management organisations. Now solely funded by the waste management organisations, the group welcomes all interested parties (industry, research and academia, research centres, technical safety organisations, non-governmental organisations, associations, SMEs, …) endorsing the IGD-TP Vision and willing to contribute positively and constructively to the group's goals, such as establishing and implementing the **Strategic Research Agenda** and participating in information exchange and knowledge transfer.

Our Vision is for industrialisation of radioactive waste disposal in Europe by 2040, via three pillars: (1) safe operation of the first geological disposal facilities in Europe; (2) optimisation and industrialisation of the planning, construction and disposal operations; and (3) development of tailored solutions for disposal of the diverse waste inventories in Europe.

RD&D Challenges from Siting to Industrialisation

We are delighted to hold the IGD-TP's 10th international Exchange Forum on research, development and demonstration (RD&D) challenges in geological disposal programmes for radioactive waste. Hosted by SÚRAO, the event is open to all IGD-TP members and stakeholders interested in geological disposal of radioactive waste.

Geological disposal projects are first-of-a-kind projects, span several decades, and are multi-billion endeavours. National waste management organisations (WMOs) are at different stages on the path to implementing geological disposal and each stage (site identification and investigation, licensing, construction and operation) has particular challenges. The national WMOs will share RD&D challenges that each is facing in their current activities and how these are being approached. The Exchange Forum is an opportunity to share lessons learnt and to discuss future research plans.

Our 10th Exchange Forum provides an excellent opportunity to:

- ➜ Discuss new issues and the status of WMO programmes.
- ➜ Learn about WMO emerging and ongoing RD&D priorities.
- ➜ Explore the potential for collaborative research with IGD-TP members and the broader radioactive waste community.
- ➜ Present a poster on your work in the field of geological disposal and take advantage of great networking opportunities.
- ➜ Visit research and disposal facilities in the Czech Republic.
- ➜ Experience the wonderful city of Prague.

Poster sessions will be held to showcase radioactive waste management RD&D that aligns to the IGD TP's **Strategic Research Agenda.** Exchange Forum participants are strongly encouraged to submit poster applications that are consistent with this goal.

Talks and posters presented at the Exchange Forum will be made available online where possible.

The third day provides an opportunity for attendees to tour the Bukov Underground Research Facility, the Richard Repository, or the laboratories at Research Centre Řež. Tour numbers are limited.

The EURAD Bureau will also host a separate meeting on the afternoon of 26 November. The aim of this meeting is to further develop the long-listed proposals for the second wave of EURAD-2 funding. Registration for this meeting is through the same registration system as for the Exchange Forum.

Organisation

LOCAL ORGANISING COMMITTEE

Lucie Hausmannová, SÚRAO (Chair of the Organising Committee)
Markéta Dohnálková, SÚRAO
Andrea Tothová, SÚRAO
Tereza Kašparová, SÚRAO
Tamara Baldwin, GSL
Liz Howett, GSL

SCIENTIFIC COMMITTEE

Tamara Baldwin, GSL
Markéta Dohnálková, SÚRAO
Anni Fritzell, SKB
Astrid Göbel, BGE
Liz Howett, GSL
Lucie Husmannová, SÚRAO
Tiina Jalonen, Nagra
Jon Martin, NWS
Jean-Charles Robinet, ANDRA

SESSION CHAIRS

Session 1

Emerging and ongoing RD&D priorities for those WMOs currently identifying a site – Part 1

Joaquín Farias Seifert, Head of International Cooperation and R&D Department, ENRESA

Joaquín Farias Seifert obtained his M.Sc. Mining Engineer from the School of Mines of the Polytechnic University of Madrid. Mr Farias Seifert is the head of International Cooperation and R&D since March 2020; he was Head of Coordination of Projects and R&D Unit in ENRESA (2018-20). He has been involved in ENRESA's R&D activities since 1994, being a member of the FEBEX (I & II) technical secretariat, and since 2004 he is involved in ENRESA's R&D coordination, including the participation in EURATOM FW Programmes. Mr Farias Seifert has been involved in in several projects co-funded by the EC since 1996.

Session 2

Emerging and ongoing RD&D priorities for those WMOs currently identifying a site – Part 2

Tiina Jalonen, Head of Digital Project and Data, Nagra

Tiina Jalonen is the Division Head of Digital Project and Data and a Member of the Executive Board at Nagra, Switzerland. She has more than 25 years of experience in radioactive waste disposal, safety case development, and RD&D programme management. Before joining Nagra, she served in several leading roles at Posiva Oy in Finland, including Deputy CEO and Senior Vice President, Development, overseeing the world's leading programme for final disposal of spent nuclear fuel. She has also chaired the European Implementing Geological Disposal of Radioactive Waste Technology Platform, served as Technical Secretary of EDRAM, and contributed to numerous international projects, publications, and conferences.

Session 3

Emerging and ongoing RD&D priorities for those WMOs currently identifying a site – Part 3

Session 4

Panel session on learning from WMOs that have selected a site

Astrid Göbel, Head of Section Research and Cooperations, BGE

Astrid Göbel is head of the Section Research & Cooperations at the Federal Company for Radioactive Waste Disposal (BGE). Before she joined the German Waste Management Organization in 2017, she worked for the Department Safety of Nuclear Waste Management, Federal Office for Radiation Protection since 2011. Her professional experiences cover programming and implementation of RD&D activities, scientific and committee work as well as project management and evaluation of disposal projects. She holds a degree in Geology from Technical University Berlin, specialized in areas of Deposit Sciences and Applied Geochemistry.

Session 5

Special session on emerging RD&D needs due to SMR proposals

Jon Martin, Senior Research Lead: Biosphere & Social Science, NWS

Dr Jon Martin has worked in the nuclear industry for 33 years, initially as a radiochemist supporting nuclear operations, then leading various teams in decommissioning, project management, nuclear operations and waste disposal. Since 2012 Jon has led the UK's research supporting the disposal of higher activity waste. His current role is to lead biosphere characterisation and research and social science in support of the UK's Geological Disposal Facility siting and development.

Session 6

Emerging and ongoing RD&D priorities of those WMOs implementing a GDF at a selected site

Lucie Hausmannová, R&D Coordinator, SÚRAO

Lucie Hausmannová graduated from the Faculty of Civil Engineering at the Czech Technical University in Prague, completing her doctorate in 2017. After that, she joined SURAO, where she was initially responsible for research and development of engineering barriers, and in 2023, she became the research and development coordinator. Her work also involves international projects, such as the EURAD project, and activities for the IGD-TP platform, where she serves as General Secretary.

Session 7

Panel session on the ongoing and changing RD&D needs as disposal facilities are constructed and operated

Anni Fritzell, Head of Research and Post-Closure Safety, SKB

Anni Fritzell is Head of Research and Post Closure Safety at SKB. She has been at SKB since 2015, working with repository design, development, research and post-closure safety. Earlier experience includes consultancy in nuclear safeguards (non-proliferation), nuclear power plant safety and safety documentation. Education: M Sc in Energy Systems engineering. Ph. Lic. in applied nuclear physics.

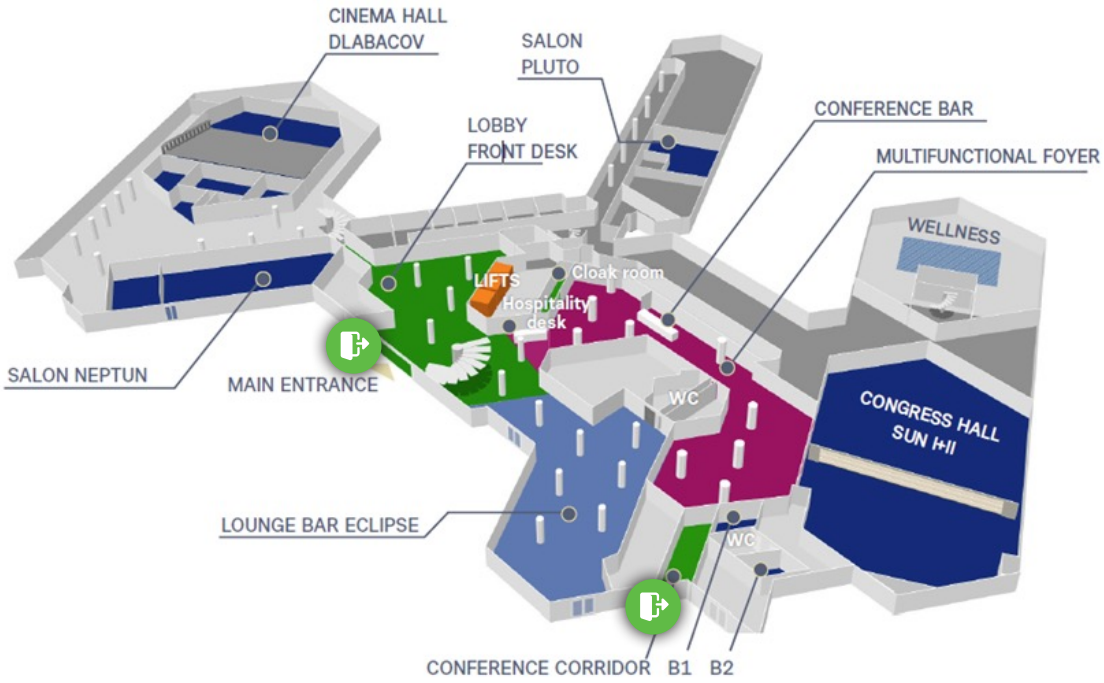
Meeting Spaces

All talks will be presented in the Congress Hall Sun on the ground floor. Refreshment breaks will be provided in the lobby space in the Multifunctional Foyer, with the posters displayed in the same area. Lunches will be provided on the first floor in the Nebula Restaurant.

Conference facilities

1 2 3

Floor plan
Ground floor



Conference facilities

1 2 3

Floor plan
First floor

Emergency exit

Programme

Time (CET)	Item	Chair / Speaker
Day 1 – Tuesday 25 November 2025		
08.30–09.30	Individual arrival, registration and refreshments	
09.30–10.00	**Welcome**	Lukáš Vondrovic (SURAO, Czech Republic) Tomas Ehler (Czech Ministry of Industry and Trade) Markéta Dohnálková (IGD-TP Chair / SÚRAO, Czech Republic)
10.00–10.40	**Emerging and ongoing RD&D priorities for those WMOs currently identifying a GDF site – Part 1**	Session chair: Joaquín Farias Seifert (ENRESA, Spain)
	SF and HLW Disposal Planning in Republic of Slovenia	Leon Kegel (ARAO, Slovenia)
	German Site Selection – Current Status and Moving Forward Towards Upcoming Milestones	Astrid Göbel (BGE, Germany)
10.40–10.45	**Poster elevator pitch – 30 seconds to pitch your poster!**	Presenters of posters 1–10 (optional)
10.45–11.10	Refreshment break and poster session	
11.10–12.30	**Emerging and ongoing RD&D priorities for those WMOs currently identifying a GDF site – Part 2**	Session chair: Tiina Jalonen (Nagra, Switzerland)
	The Netherlands Updates Roadmap for the Disposal of Radioactive Waste	Marja Vuorio (COVRA, The Netherlands)
	Status of the DGR Programme in Spain	Joaquín Farias Seifert (ENRESA, Spain)
	RD&D Priorities in Support of Site Selection in the UK GDF Programme	Jon Martin (NWS, UK)
	Research and Development Challenges in Support of Site Selection for the Czech Deep Geological Repository	Markéta Dohnálková (SURAO, Czech Republic)
12.30–12.35	**Poster elevator pitch – 30 seconds to pitch your poster!**	Presenters of posters 11–20 (optional)
12.35–14.00	Lunch and poster session	
14.00–14.40	**Emerging and ongoing RD&D priorities for those WMOs currently identifying a GDF site – Part 3**	Session chair: Astrid Göbel (BGE, Germany)
	Emerging and Ongoing RD&D Priorities for Belgium	Maarten Van Geet (ONDRAF/ NIRAS, Belgium)

Time (CET)	Item	Chair / Speaker
	Current Status and R&D Challenges in the Siting Program for a DGR in Hungary	László Molnár (PURAM, Hungary)
14.40–15.20	**Panel session on learning from WMOs that have selected a site**	Session chair: Astrid Göbel (BGE, Germany)
		Jean-Charles Robinet (ANDRA, France)
		Olivier Leupin (Nagra, Switzerland)
		Johanna Hansen (Posiva, Finland)
		Anders Ström (SKB, Sweden)
15.20–15.25	**Poster elevator pitch – 30 seconds to pitch your poster!**	Presenters of posters 21–30 (optional)
15.25–15.50	Refreshment break and poster session	
15.50–17.10	**Special session on emerging RD&D needs due to SMR proposals**	Session chair: Jon Martin (NWS, UK)
	Small and Advanced Modular Reactor Waste Generation and Management in EURAD-2 WP4 FORSAFF	Tim Schatz (EURAD FORSAFF WP Leader / VTT, International / Finland)
	Applying the IAEA's Deep Geological Disposal Roadmap to SMRs: Addressing Emerging Back-End Challenges	Karina Lange (IAEA, International)
	Potential Impacts of SMRs on Multinational Back End Cooperation	Jake Kinghorn-Mills (ERDO / MCM, International / UK)
	SMR RD&D Waste Treatment and Disposal Challenges from Czech Regulatory Perspective	Štěpán Kochánek (SÚJB, Czech Republic)
18.15	Conference Dinner 18.15 Meet in the lobby of the Hotel Pyramida to take a historic tram or group walk to the venue. 19.00 Dinner to commence at the Slivovitz Museum, an original Czech distillery.	

Day 2 – Wednesday 26 November 2025

08.30–09.00	Arrival and refreshments	
09.00–10.20	**Emerging and ongoing RD&D priorities of those WMOs implementing a GDF at a selected site**	Session chair: Lucie Hausmannová (SÚRAO, Czech Republic)
	Evolution of Andra's R&D for the Cigéo Project: Short and Long-Term Challenges	Stéphan Schumacher (ANDRA, France)
	Nagra's safety case: shaped and supported by decades of RD&D	Olivier Leupin (Nagra, Switzerland)
	Construction of the ONKALO Underground Rock Characterisation Facility and the Disposal Facility	Kimmo Kemppainen (Posiva, Finland)
	RD&D Priorities at SKB	Anni Fritzell (SKB, Sweden)
10.20–10.25	Group photo	
10.25–10.50	Refreshment break and poster session	
10.50–12.20	**Panel session on the ongoing and changing RD&D needs as disposal facilities are constructed and operated**	Session chair: Anni Fritzell (SKB, Sweden)
	ERAM Getting Real – Moving Towards the Construction of a Safe DGR	Matthias Mohlfeld (BGE, Germany)
	Evolving R&D needs at the Loviisa LILW repository	Frans Jansson (Fortum, Finland)
	RD&D support for the operating Bátaapáti intermediate depth geological repository	Péter Molnár (PURAM, Hungary)
	Challenges in Operation Disposal Facilities for Low- and Intermediate Level Radioactive Waste in the Czech Republic Over the Years	Milan Touš (SÚRAO, Czech Republic)
12.20–12.35	**Summary, award of best poster and event close**	Markéta Dohnálková (IGD-TP Chair / SÚRAO, Czech Republic)
12.35–13.30	Lunch	
13.30–18.00	**EURAD-2 Wave 2 proposal meeting – part 1**	
15.30–16.00	Refreshment break	
	EURAD-2 Wave 2 proposal meeting – part 2	

Day 3 – Thursday 27 November 2025

All technical tours depart from Hotel Pyramida.

06.30 Bukov Underground Research Facility

OR

08.00 Richard Repository
08.00 Research Centre Řež Laboratories

Speakers and Abstracts

Welcome

Lukáš Vondrovic, Managing Director, SÚRAO, Czech Republic

Lukáš Vondrovic is the Managing Director at SURAO with a professional background in structural geology, petrology, and applied research. He led the exploration of the crystalline basement in the Czech Republic and has been responsible for the construction and Phase I of the Research and Development activities at the Bukov Underground Research Facility. He also served as the Head of the Czech Deep Geological Repository project, Chair of the CRC Club, and is a member of the Radioactive Waste Management Committee (RWMC) Bureau under OECD/NEA. His work is closely linked to crystalline formations, where he oversees the geological characterization, repository planning, and related research activities.

Tomas Ehler, DG of the Nuclear Energy and New Technologies Section, Ministry of Industry and Trade, Czech Republic

Tomáš Ehler, Ph.D., MBA has been dealing with energy and energy policy for a long time. Up to now, he headed the Department of Nuclear Energy and Section of Nuclear Energy at the Ministry of Industry and Trade, and he is a member of the supervisory board of the electric power station Elektrárna Dukovany II, a. s. and is a member of expert committees in the field of energy, including those within the NEA OECD. Before joining the Ministry of Industry and Trade, he worked in the Czech Chamber of Commerce and in the Diplomatic Services of the Ministry of Foreign Affairs of the Czech Republic. He also worked in Berlin and Vienna, and, as a Commercial Counsellor, he headed the commerce and economic department of the Czech Embassy in the Federal Republic of Germany. Tomáš Ehler graduated from the Charles University in Prague and the Institute for Industrial and Financial Management and holds a Ph.D. in economics from University of Economics in Prague, where he also serves as an assistant professor.

Markéta Dohnálková, Head of Department for Deep Geological Repository Development, SÚRAO, Czech Republic

Markéta Dohnálková leads the Czech national programme for the development of a deep geological repository for spent nuclear fuel. She is responsible for the site selection process, repository design, and international collaboration. With a background in Geotechnics and Underground Construction, she has long been involved in the conceptual and technical design of the repository layout, integrating geological, engineering and safety aspects into the development of the Czech disposal concept. She currently serves as Chair of the Implementing Geological Disposal – Technology Platform (IGD-TP) for the 2025–2026 term.

Session 1

Emerging and ongoing RD&D priorities for those WMOs currently identifying a site – Part 1

Leon Kegel, Head of Planning and Development Section, ARAO, Slovenia

Leon Kegel works as head of the Planning and Development Section in Slovenian waste management organisation ARAO. He has 18 years of experience in the area of radioactive waste and spent fuel management and decommissioning of facilities. He has developed significant experience with the preparation and adoption of the national radioactive waste management policies and strategies through direct involvement with the development and implementation of the national programme in Slovenia. He is the person responsible for the preparation of Program of NPP Krško Decommissioning and Program of SF & RW Disposal, which are periodically jointly prepared with authorized organisations from Croatia. He is also one of the main contributors to preparing the safety assessment report for the LILW repository and its costing and investment documentation. He is a main counterpart from ARAO in the EURATOM projects, was a national liaison officer for the ARTEMIS mission to Slovenia, is the Slovenian delegate to OECD/NEA CDLM committee, vice president of the ERDO Association, member of the IAEA WATEC working group, representative in WNA and other organisations.

Abstract

SF and HLW Disposal Planning in Republic of Slovenia

The presentation by Leon Kegel from ARAO outlines the strategy of Slovenia for managing spent fuel (SF) and high-level waste (HLW) from the Krško Nuclear Power Plant (NPP) and the TRIGA Mark II research reactor. Guided by the National Programme for Managing Radioactive Waste and Spent Fuel (2023–2032), the strategy emphasizes safe storage and disposal, with ARAO leading efforts in monitoring international developments and planning a deep geological repository (DGR) or deep borehole disposal (DBD) for SF and HLW. The Krško NPP inventory includes 2,282 fuel assemblies, with ongoing SF transfer campaigns and a new storage facility operational since March 2023. The TRIGA reactor, operational until 2034, explores DBD and regional disposal options for its 84 fuel elements. The 4th revision of the Krško NPP disposal program includes studies on DGR and DBD costing, site selection methodologies, and stakeholder engagement. The aim is to identify geologically suitable sites by 2050, with DGR scenarios in hard rock (KBS-3V) or sedimentary formations. Challenges include siting issues, cost estimation and optimisation, while opportunities lie in international collaboration and innovative disposal technologies.

Astrid Göbel, Head of Section Research and Cooperations, BGE, Germany

Astrid Göbel is head of the Section Research & Cooperations at the Federal Company for Radioactive Waste Disposal (BGE). Before she joined the German Waste Management Organization in 2017, she worked for the Department Safety of Nuclear Waste Management, Federal Office for Radiation Protection since 2011. Her professional experiences cover programming and implementation of RD&D activities, scientific and committee work as well as project management and evaluation of disposal projects. She holds a degree in Geology from Technical University Berlin, specialized in areas of Deposit Sciences and Applied Geochemistry.

Abstract

German Site Selection – Current Status and Moving Forward Towards Upcoming Milestones

The Federal Company for Radioactive Waste Disposal mbH (Bundesgesellschaft für Endlagerung mbH, BGE) is entrusted with the implementation of the German radioactive waste disposal program. Hence, among other tasks the BGE takes the responsibility for the search for a site for a high-level radioactive waste repository. This also includes RD&D activities and taking the necessary precautions against damage according to the state-of-the-art in science and technology. The site selection procedure is a participatory, transparent, learning and self-questioning process. The repository shall ensure the safe containment of the disposed radioactive waste for 1 million years. Three host rocks are considered for deep geological disposal: rock salt, claystone and crystalline rock. The results of the first Step 2 in Phase 1 of the site selection procedure were published in 2020 in the so-called “sub-areas interim report”. It excluded areas in Germany from the repository search and identified 90 areas that are currently examined in more detail within Step 2 of Phase 1. In November 2024 the status of works on less suitable areas was published. In our presentation, we will present the current works and research activities and we will explain how we progress to achieve the goal to identify a number of favorable siting regions by 2027 in which then consecutively surface exploration will be carried out in Phase 2 of the site selection procedure. We will focus on remaining challenges and discussed options, in particular related to aspects of site characterization, preparation of exploration and research.

Session 2

Emerging and ongoing RD&D priorities for those WMOs currently identifying a site – Part 2

Marja Vuorio, Researcher, COVRA, The Netherlands

Dr Vuorio obtained her doctoral in Chemical Engineering, Physical Chemistry at the Aalto University, Finland (then Helsinki University of Technology). She has 20 years of experience in projects on long-term safety issues related to geological disposal, performance assessment and safety case work in Finland and in the Netherlands. She came to COVRA 2019 and works mainly in international collaboration topics, such as the ERDO Association and EURAD work.

Abstract

The Netherlands Updates Roadmap for the Disposal of Radioactive Waste

Recent nuclear renaissance has led to plans for new builds also in the Netherlands and discussions on the possible waste inventory in the future. The present waste management policy dates from the 1980s, when it was decided that the waste would be stored above ground for at least 100 years, which would give time to explore and develop disposal options, and accumulate funding for construction and operation of one deep geological disposal facility (GDF), which would take all the Dutch radioactive waste. A decision on the disposal method would be done between national options, GDF in rock salt or clay, or disposal in an international shared facility around 2100. Waste should be disposed of by 2130. Previous research programmes on disposal have largely concentrated on the technical matters; the newly planned approach will also include societal matters including the decision-making process. The plan is also to bring the date of the decision on the disposal method(s) closer; the ambition is a decision on a location and choice of disposal method(s) by 2050. Hereto, in addition to GDFs in clay or rock salt, also shallow and intermediate depth disposal facilities, as well as deep borehole disposal option, should be investigated. The Netherlands will continue to follow the dual track policy, that is, sharing disposal facilities remains an option.

Joaquín Farias Seifert, Head of International Cooperation and R&D Department, ENRESA, Spain

Joaquín Farias Seifert obtained his M.Sc. Mining Engineer from the School of Mines of the Polytechnic University of Madrid. Mr Farias Seifert is the head of International Cooperation and R&D since March 2020; he was Head of Coordination of Projects and R&D Unit in Enresa (2018-20). He has been involved in ENRESA's R&D activities since 1994, being a member of the FEBEX (I & II) technical secretariat, and since 2004 he is involved in ENRESA's R&D coordination, including the participation in EURATOM FW Programmes. Mr Farias Seifert has been involved in in several projects co-funded by the EC since 1996.

Abstract

Status of the DGR programme in Spain

Enresa, the Spanish radioactive waste management organisation, was created in 1984 by Royal Decree as a public company functionally linked to the ministry responsible for nuclear energy. Although the decree authorizing its establishment dates from 1984, the current governing legal instrument is a Royal Decree issued in 2014 (102/2014 of 21 February, on the responsible and safe management of spent nuclear fuel and radioactive waste).
The program for the Deep Geological Repository (DGR) for Spent Nuclear Fuel and High-Level Waste started early in 1985 and was scaled back in 2006. The program was important in terms of resources, considering both workforce (Enresa and other organizations such as universities, engineering services public and private), and costs. A summary of the results was reported and sent to the MITERD (current denomination of ministerial authority supervising Enresa) in 2013 to preserve as much as possible the skills and knowledge acquired.

Summarizing the main achievements were:

- As a result of a site search and selection plan (1986–96), an Inventory of Favorable Formations is available, and a wide geographic distribution of locations has been verified that, in principle, could be suitable for hosting an AGP.
- Development of Conceptual designs for a DGR in each of the lithologies of interest (crystalline rock and clay) (1990–2006).
- Development of performance assessment and safety assessment exercises of those conceptual designs. In addition to a preliminary assessment at the start of the DGR project, two rounds of assessment exercises were conducted for crystalline rock (1997 and 2000) and clay formations (1999 and 2003).

At the end of 2023, the 7th GRWP was approved by the Government. It includes the establishment of a new programme for the development of a DGR in Spain, which is expected to start operation in the 2070s. The programme consists of eight steps.

Jon Martin, Senior Research Lead: Biosphere & Social Science, NWS

Dr Jon Martin has worked in the nuclear industry for 33 years, initially as a radiochemist supporting nuclear operations, then leading various teams in decommissioning, project management, nuclear operations and waste disposal. Since 2012 Jon has led the UK's research supporting the disposal of higher activity waste. His current role is to lead biosphere characterisation and research and social science in support of the UK's Geological Disposal Facility siting and development.

Abstract

RD&D Priorities in Support of Site Selection in the UK GDF Programme

NWS is characterising and evaluating the suitability of a sub-sea location in the eastern Irish Sea for hosting the UK's Geological Disposal Facility (GDF). Seismic studies indicate the presence of a suitable rock mass in an environment likely to provide the required containment and isolation of this substantial radioactive inventory, however significant uncertainties require RD&D to clarify feasibility and costs in order to inform a site suitability recommendation. Hypersalinity and high sulfide geochemical environments require further RD&D to provide understanding of the properties of various engineered barrier materials. A broader front of RD&D supports potential future regulatory submissions in support of deep borehole characterisation of the site and accessways. This includes development of Site Descriptive Model v1, summarising the geological and biosphere characteristics of the site and evaluation of the long-term evolution of existing and proposed wasteforms under these chemical conditions.

Markéta Dohnálková, Head of Department for Deep Geological Repository Development, SÚRAO, Czech Republic

Markéta Dohnálková leads the Czech national programme for the development of a deep geological repository for spent nuclear fuel. She is responsible for the site selection process, repository design, and international collaboration. With a background in Geotechnics and Underground Construction, she has long been involved in the conceptual and technical design of the repository layout, integrating geological, engineering and safety aspects into the development of the Czech disposal concept. She currently serves as Chair of the Implementing Geological Disposal – Technology Platform (IGD-TP) for the 2025–2026 term.

Abstract

Research and Development Challenges in Support of Site Selection for the Czech Deep Geological Repository

The Czech national programme for deep geological repository (DGR) development is entering a crucial stage. By 2030, a final and a backup site must be selected to host the future repository for spent nuclear fuel and high-level waste. This decision must be based on robust scientific evidence, supported by a focused and evolving research and development (R&D) programme. This presentation will highlight the main R&D challenges currently faced in the Czech context, particularly in relation to geological characterisation, long-term safety assessment, and repository design. Emphasis will be placed on the need to integrate multidisciplinary data, manage uncertainties, and ensure that R&D outcomes provide a solid basis for decision-making in the site selection process.

Session 3

Emerging and ongoing RD&D priorities for those WMOs currently identifying a site – Part 3

Maarten Van Geet, RD&D Manager, ONDRAF/NIRAS, Belgium

Maarten Van Geet obtained a PhD in geology at the university of Leuven, Belgium in 2001. He immediately started at SCK CEN, the Belgian research centre on nuclear energy, to work on the characterization of clay materials as a barrier within a geological disposal system. This work covered host rock characterization, hydro-mechanical behaviour of bentonites and perturbations of the host rock, including the follow-up and installation of several in-situ experiments in the underground research laboratory HADES in Mol, Belgium. In 2007 he joined ONDRAF/NIRAS, the Belgian agency for radioactive waste management. He first was in charge of the research on perturbations of the host rock. In 2008 he became RD&D coordinator for geological disposal, including the management of the next safety case. In 2016 he became RD&D Manager, steering all Belgian RD&D on radioactive waste management (treatment and conditioning, surface disposal and geological disposal). Recently, in May 2024 he was assigned the additional task of Director of Euridice that is responsible for the exploitation and research in the underground research laboratory HADES.

Abstract

Emerging and Ongoing RD&D Priorities for Belgium

Belgium has a long history in nuclear applications, like, for example, half of the world-wide Ra production in the early 20th century and the first pilot facility for spent fuel reprocessing, resulting in a large variety of legacy waste. Moreover, Belgium still keeps a forerunners role in the production of radiopharmaceuticals, producing sometimes new challenging waste streams. As a result, Belgium has to take care of a large spectrum of waste types and considers the potentials of different types of repositories. For the surface disposal facility of LLW, a construction license was obtained and construction will start in 2025. For the large amounts of Ra-bearing long-lived LLW, a policy proposal to assess an intermediate depth disposal will be submitted to the government this year. And finally, in 2022 the long-term management of ILW and HLW in a geological repository was confirmed by Royal Decree and a large societal debate gave first input to propose a policy decision on the siting process. Consequently, the RD&D needed in Belgium covers a wide range of topics and is slowly shifting towards siting (intermediate depth and deep disposal) and optimisation (surface disposal). As the financing of the legacy waste and recently also of the waste of commercial nuclear power plants is the responsibility of the Belgian State, we performed an exercise on assessing the competencies we want to anchor in Belgium and the infrastructures we need now and in the medium term future. The results of this assessment will be presented during this talk.

László Molnár, Geologist, PURAM, Hungary

László Molnár has a PhD degree in geology and a postgraduate degree in nuclear environmental protection. Following his academic research, he worked five years in fields of water management and environmental consulting. In 2019 he joined PURAM, the Hungarian WMO as a geologist, where he is primarily responsible for developing geological and hydrogeological models for the operating LILW and the planned HLW repositories. László also contributed in compiling of the safety assessment of these facilities. He is currently involved in the preliminary characterization of a possible alternative formation for the HLW site and preparation of the site selection for the VLLW site.

Abstract

Current Status and R&D Challenges in the Siting Program for a DGR in Hungary

PURAM is responsible for management and disposal of all radioactive waste generated in Hungary. The siting programme of DGR is based on a reference scenario, which is currently the direct disposal of spent fuel in a DGR along with other HLW. The geological research program started over three decades ago, and – following a nationwide screening in 2000 - identified the Boda Claystone Formation (BCF) in SW Hungary as a potentially suitable formation. The known areal extent of the Permian BCF formation is about 150 km2. Its lithofacies represent an intermittent saline playa lake in a semidesert environment and mainly consists of albitic claystone. The BCF has low hydraulic conductivity with a very low bulk porosity of the intact rock matrix, which is elevated only close to the surface or to larger tectonic zones. Due to the high temperature and pressure load during its burial history, some properties of BCF indicate that this formation is closer to a crystalline rock than to typical clays, which was considered in the design and the choice of R&D methods in the siting programme. Based on site characterization results accumulated over the past decades, a preliminary safety assessment is currently under preparation with the aim of providing a general evaluation of BCF as a host rock of a DGR. Moreover, in 2022 PURAM initiated a detailed evaluation of the Kiscell Clay Formation (KCF), as the formation was ranked 2nd in the nationwide screening, but during the past decades, the site investigation was carried out only for the BCF. Given that this alternative formation—unlike BCF—is a more traditional, clayey host rock, compilation of exploration methodology presents new challenges for PURAM. The details of R&D challenges related to DGR site characterization will be introduced in our presentation.

Session 4

Panel session on learning from WMOs that have selected a site

Panellists

Jean-Charles Robinet, Head of the Waste, Radionuclides and Geoscience Unit, ANDRA, France

Jean-Charles Robinet is Head of the Waste, Radionuclides, Chemicals and Geoscience Unit in the Scientific and Technical Division at Andra (the French National Radioactive Waste Management Agency). He specializes in the transport and interaction of solutes and gases in clay-rock systems, as well as the multi-scale analysis of natural structures. Jean-Charles obtained his PhD in Geosciences from the University of Poitiers (France) in 2008 and has worked at Andra in the Scientific and Technical Division since 2009. From 2016 to 2021, he was Head of the Transfer Group and since 2022, the Head of the Waste, Radionuclides, Chemicals and Geoscience Unit.
From the outset of his career, Jean-Charles has coordinated several Andra R&D and national research groups focusing on chemistry and transfer in complex environments, as well as borehole survey programmes. He has also participated in several European projects concerning the migration of radionuclides in rocks and DGR, including FP6 FUNMIG, FP7 CatClay and EURAD WP FUTURE, and he is currently co-leader of the EURAD-II WP RAMPEC (Radionuclide Mobility Under Perturbed Conditions).

Olivier Leupin, Discipline Lead RD&D and Safety, Nagra, Switzerland

Dr Olivier X. Leupin holds a Ph.D. in Environmental Sciences from ETH Zürich and a Master's degree in Geoscience from the University of Bern. He completed his expertise in environmental and geological sciences with Post-Doctoral research at the US Geological Survey (USGS) in Salt Lake City and the University of Milwaukee before joining Nagra in 2007.
Currently, Dr Leupin leads Nagra's Safety and Performance Assessment group, overseeing the development of the post-closure safety cases. He also leads the RD&D program, supporting the strategic direction of Nagra's scientific activities. Dr Leupin serves as a lecturer in the Nuclear Engineering Master's program at ETH Zürich.

Johanna Hansen, Senior Advisor, Posiva, Finland

Johanna Hansen has an M.Sc. in Geology and Mineralogy. She started to work at Posiva 1997 and during her first years she coordinated site investigations at Hästholmen site as site manager. After selection of Olkiluoto site she has worked almost 25 years as Design and R&D coordinator with several topics like concept development (backfill and closure), full-scale demonstrations and monitoring like FISST and Trial Run. She also participates in the international co-operation activities like coordination of SKB-Posiva co-operation and represents Posiva in EURAD 2 General Assembly. She has coordinated FP7 Project DOPAS 2012-2016 and was Posiva representative in IGD-TP Secretariat 2023-2024. Currently she works as Senior Adviser in Engineered Barriers and Long-term safety.

Anders Ström, Senior Advisor, Asset Development Department, SKB, Sweden

Anders Ström is senior expert and advisor in final disposal solutions for spent fuel at SKB (the Swedish Nuclear Fuel and Waste Management Company). Anders has been actively involved in SKB's siting program since the 1990s, among other things Project Manager for the multidisciplinary site descriptive modelling conducted for the two candidate sites at Forsmark and Laxemar-Simpevarp. He is now among other things international coordinator of SKB and in charge of the close co-operation between SKB and Posiva for implementing robust disposal solutions according to the KBS 3 concept.

Session 5

Special session on emerging RD&D needs due to SMR proposals

Tim Schatz, Senior Scientist, VTT Technical Research Centre, Finland

Tim Schatz is a Senior Scientist at VTT Technical Research Centre of Finland. He has over 17 years of experience in nuclear waste management covering used fuel and low-, intermediate-, and very low-level wastes and including specialist work on the physico-chemical behavior of swelling clays in engineered barriers and contributions to disposal facility safety assessments. His recent focus has included waste management strategies for small and advanced modular reactors.

Abstract

Small and Advanced Modular Reactor Waste Generation and Management in EURAD-2 WP4 FORSAFF

Small and Advanced Modular Reactors (SMRs and AMRs) are being developed as part of the global effort to meet increasing energy demands. Although these technologies offer several potential benefits, their deployment faces notable challenges that must be addressed to ensure they are safe and economically viable. Among the most pressing concerns is the management of spent fuel and radioactive waste produced during both operation and decommissioning. This includes questions on predisposal strategies, potential reprocessing routes, and final disposal solutions. The diversity of SMR/AMR designs, technologies, and intended uses will have a substantial influence on waste management considerations and will shape the development of suitable technical solutions for both predisposal and disposal needs. These issues must be carefully considered in decision-making processes related to the integration of SMRs and AMRs into future energy systems. As part of the second phase of the European Partnership on Radioactive Waste Management (EURAD 2), Work Package 4: Waste Management for Small Modular Reactors and Future Fuels (FORSAFF) was established to address implementation challenges for a selection of SMR and AMR technologies. The primary aim of FORSAFF is to identify knowledge gaps and provide recommendations for future research regarding SMR/AMR waste generation and management. This presentation will provide an overview of ongoing FORSAFF activities focused on identifying SMR/AMR waste inventories including spent fuel or waste generated after reprocessing and assessing SMR/AMR waste predisposal and disposal strategies, and characterisation methods and modelling tools for SMR/AMR waste.

Karina Lange, Radioactive Waste Disposal Specialist, IAEA

Dr Karina Lange has a PhD in Civil Engineering and is currently the scientific secretary for the IAEA's Underground Research Facilities Network. Prior to joining the IAEA, Dr. Lange was a senior licensing officer and inspector at the Canadian Nuclear Safety Commission. As a radioactive waste disposal specialist at the IAEA, a major focus of her work is sharing technical expertise with countries at the initial stages of a radioactive waste disposal programme. She supports this work by coordinating scientific visits to existing sites in host countries, various training activities and workshops for technical specialists, and supporting Women in Stem initiatives.

Abstract

Applying the IAEA's Deep Geological Disposal Roadmap to SMRs: Addressing Emerging Back-End Challenges

The IAEA supports Member States in addressing spent fuel and radioactive waste management challenges associated with Small Modular Reactors (SMRs), including initial efforts related to disposal strategies. There are more than 60 SMR designs across 18 Member States, with a wide variety of technologies, implying the use of non standard fuels, for different applications detailed in the IAEA SMR Technology Catalogue (2024). The SMR designs listed in this catalogue vary from evolutionary variants of Light Water Reactors, that benefit from many decades of operating experience of the current fleet of NPPs; High Temperature Gas Reactors; Liquid Metal Fast Reactors including Molten Salt Reactors. SMR designs use a variety of fuel forms (e.g., oxide/ceramic, metal, TRISO, liquid fuel salts) having different fuel compositions (e.g., UOX (LEU, HALEU); Mixed U and Pu (oxide, metal, or salt); kernel particles), etc. In line with these, the IAEA Division of Nuclear Fuel Cycle and Waste Technology has launched a Coordinated Research Project (CRP SMR-COGS, T13021) to support Member States in anticipating for and addressing

the upcoming challenges for the backend of the fuel cycle of those SMR technologies with the main objective of developing a series of roadmaps on different fuel cycle options to support decision making process on SMR implementation. The end-point of the fuel cycle is the disposal of spent fuel when it is considered as a waste, the high level waste from reprocessing and the rest of generated wastes. The current deep geological programmes are based in the characteristics of the spent fuel and high level wates from the current fleet based on uranium oxide fuels up to 5% enrichment. The introduction of non standard nuclear fuels as HALEU, TRISO, molten salt fuels, etc… will bring new challenges to disposal programmes, although some of those materials have been already studied at some extent in different countries in the past. This talk will focus on key points regarding the impact of those nonstandard spent fuels and radioactive waste on the geological disposal programmes and to present some published results from previous studies.

Jake Kinghorn-Mills, Senior Consultant, MCM Environmental Services Ltd, UK

Jake is a systems engineer with 4 years' experience as a client-facing engineer in the defence industry and 7 years' experience as a radioactive waste management consultant. He joined MCM in 2018 to develop his Nuclear Engineering MSc (KTH University, Sweden & Universite Paris-Saclay, France) thesis; "Using Requirements Management to Communicate Strength in Depth of Geological Disposal Facility Design".
Applying his systems engineering background and client-facing experience, Jake supports MCM with the delivery of requirements engineering, technical integration, programme coordination, stakeholder communication and knowledge management (KM) work to a range of clients internationally.
Jake has been a member of various cross-functional teams, following a logical 'systems thinking' approach to problem solving at the strategic and more detailed level. Most recently, he has directly supported: Nuclear Waste Services (NWS, UK) with its Site Evaluation programme in the UK; the ERDO Association (International) in the role of Secretariat; Nagra (Switzerland) with the development of its Disposal Programme Roadmap; the Office for Nuclear Regulation (ONR) with a holistic approach for KM improvement; and ERDO, in collaboration with the US Department of Energy (USDOE), on the study into the "Potential Impacts of SMRs on Multinational Cooperation at the Back End of the Fuel Cycle".

Abstract

Potential Impacts of SMRs on Multinational Back End Cooperation

There is a growing interest in Small Modular Reactor (SMR) commercialisation, representing a promising pathway towards continued use and/or expansion of nuclear power. Radioactive Waste Management (RWM) - including disposal, is an increasingly important consideration and, for all countries considering SMRs, safe and affordable solutions are a key goal. A recent study considers multinational aspects of the potential technical, strategic, political and commercial impacts of SMR commercialisation on the back end of the nuclear fuel cycle, focusing on Spent Nuclear Fuel (SNF). Using credible SMR designs and hypothetical, but representative, countries, the study explores the potential impact of SMR deployment on opportunities for multinational RWM and Deep Geological Repository (DGR) collaboration. Defining varied Multinational DGR (MNR) models and scenarios, the study explores the potential impact of SMR deployment on the feasibility of a multinational collaborative approach to SNF disposal and upstream enabling activities, assuming an open fuel cycle. The study concludes that widespread deployment of SMRs is likely in the near-term

and that SMR deployment is likely to make increase interest in MNR initiatives. A partnered approach to MNR development is compared with a commercial approach: the former is more likely to involve international SMR technology alignment, requiring strategic engagement prior to SMR deployment; and the latter will likely need to factor the acceptance of multiple SNF types into the MNR design process, introducing technical challenges. The greater number and geographical distribution of reactors resulting from SMR deployment will introduce new logistical RWM challenges and compound SNF security and safeguards concerns. However, novel challenges resulting from widespread SMR deployment are not seen as significant blockers to MNR realisation. The alignment of upstream activities, the scheduling of waste transports, the varied regulatory regimes, and the legal status of importing or exporting radioactive waste for disposal are key topics requiring further study.

Štěpán Kochánek, Director of the Section for Nuclear Safety (Vice-chair), State Office For Nuclear Safety (SÚJB), Czech Republic

Štěpán Kochánek works for the State Office for Nuclear Safety, the Czech regulatory body for peaceful utilization of nuclear energy and ionizing radiation, since 2003. Formerly he acted as a lawyer and head of the Legal Department, being responsible for legal affairs related to all aspects of nuclear safety and security, radiation safety, emergency management, transport of nuclear and radioactive materials and radioactive waste management. Recently, as the Director of the Section for Nuclear Safety, he is responsible for top management of all aspects of nuclear safety, nuclear security and radioactive waste management. He represents the regulatory body in national intragovernmental activities and bodies related to new nuclear builds and SMRs.
Stepan Kochanek participates as an expert on EU technical support projects in neighbouring countries (Armenia, Jordan, Ukraine, Western Balkan) and as a lecturer and external expert for the IAEA's Technical Cooperation Programme. He represents the Czech regulator in several NEA/OECD bodies and in WENRA. Mr. Kochanek holds Master's Degree in Law and Legal Theory.

Abstract

SMR RD&D Waste Treatment and Disposal Challenges from Czech Regulatory Perspective

The presentation aims to highlight the challenges associated with the deployment, assessment, and licensing of SMRs, particularly in terms of the requirements for the safe management of spent nuclear fuel and radioactive waste. It demonstrates the current state of deployment in the Czech Republic, the regulatory developments over the past two years, and the practical regulatory preparations for future licensing processes. It also outlines the directions of R&D that need to be addressed in this context, as well as the weaknesses in deployment that have already been identified.

Session 6

Emerging and ongoing RD&D priorities of those WMOs implementing a GDF at a selected site

Stéphan Schumacher, Director of Scientific and Technical Division, ANDRA, France

Stéphan Schumacher holds an engineering degree from the Nancy School of Geology. After five years in scientific software development, he joined Andra in 1996. There, he worked on performance and safety assessment, then on the long-term behavior of radioactive waste (vitrified waste, graphite, etc.),

before heading up the department responsible for studying radioactive waste and repository materials (clay materials, cementitious materials, metallic materials, ceramics). In 2018, he became Deputy Director of R&D, participating in the preparation and launch of the EURAD European Joint Programme on Radioactive Waste Management. Since 2022, he has been Director of the scientific and technical division. With over a hundred employees, this division leverages on exceptional research resources, such as the Meuse/Haute-Marne underground research laboratory.

Abstract

Evolution of Andra's R&D for the Cigéo Project: Short and Long-Term Challenges

In January 2023, Andra submitted its licence application for the French deep geological disposal known as Cigéo. Following a thorough technical review, the French Authority for Nuclear Safety and Radiation Protection (ASNR) and the Advisory Committee for Waste concluded that "the demonstration of Cigéo's safety, during operation and after closure, has overall reached the level of maturity required at this stage of the project." Preliminary construction work is scheduled to begin in 2026. The decree authorizing the creation of Cigéo, expected around 2027, will mark the start of its pilot industrial phase and the main construction activities. This transition from design to implementation represents a major shift in the challenges and priorities of Andra's R&D program.

In the short term, R&D will aim to:

- ➜ Provide scientific and technical input addressing Andra's commitments made during the review process (e.g. explosion risks, corrosion of metallic components, rock properties consolidation, monitoring devices, and seals);
- ➜ Support the industrialization of Cigéo's phase 1 by increasing technical maturity of the components and incorporating technical and economic optimizations;
- ➜ Support the pilot industrial phase by preparing and deploying monitoring tools, confirming industrial methods for underground construction, and ensuring that the phenomenological behavior of the disposal facility and its environment is as expected.

In the long term, R&D will also need to:

- ➜ Conduct forward-looking and adaptative R&D to integrate future developments and prepare future phases of Cigéo (including disruptive innovations, further optimizations, and scientific and technical elements to support adaptability and flexibility);
- ➜ Maintain scientific and technological watch, given Cigéo's operating lifespan;
- ➜ Maintain and develop expertise while capitalizing on knowledge.

Olivier Leupin, Discipline Lead RD&D and Safety, Nagra, Switzerland

Dr Olivier X. Leupin holds a Ph.D. in Environmental Sciences from ETH Zürich and a Master's degree in Geoscience from the University of Bern. He completed his expertise in environmental and geological sciences with Post-Doctoral research at the US Geological Survey (USGS) in Salt Lake City and the University of Milwaukee before joining Nagra in 2007.
Currently, Dr Leupin leads Nagra's Safety and Performance Assessment group, overseeing the development of the post-closure safety cases. He also leads the RD&D program, supporting the strategic direction of Nagra's scientific activities. Dr Leupin serves as a lecturer in the Nuclear Engineering Master's program at ETH Zürich.

Abstract

Nagra's safety case: shaped and supported by decades of RD&D

Nagra has recently submitted the general licence application for a geological repository designed to manage both high-level and low- to intermediate-level radioactive waste in northern Switzerland. A cornerstone of this submission is the post-closure safety case, which aims to demonstrate radiological safety over a timespan of up to one million years. The safety case represents a comprehensive synthesis of analyses, evidence, and arguments, collectively establishing why the repository will remain passively safe over the long term. In this presentation, Dr Olivier Leupin will outline the development of the safety case, built upon an assessment framework refined over decades. This framework integrates a wide range of essential components, including databases, waste inventories, detailed phenomenological analyses, engineering studies, geological syntheses of the site, and a narrative storyboard. These elements collectively underpin the demonstration of post-closure safety and substantiate the claim that the repository will meet stringent safety requirements.

Kimmo Kemppainen, Construction Manager, Posiva, Finland

Kimmo Kemppainen has worked at Posiva since 2003 in various geological and rock mechanics tasks. When the excavations of the ONKALO research tunnel began, the tasks included developing geological mapping methods and implementing the mapping. The tasks involved supervising the mapping team and coordinating work with construction operations. Planning and implementing rock mechanics studies through task rotation. He worked as a research manager for underground studies. He worked as a program manager for the Disposal Facility program since 2017 and is currently a construction manager in Posiva's production organization.

Abstract

Construction of the ONKALO Underground Rock Characterisation Facility and the Disposal Facility

The construction of the ONKALO underground rock characterization facility began with excavations in 2004. The scope of ONKALO included the access tunnel from the surface to the disposal depth, some of the technical facilities and connections related to ventilation and personnel shafts. Some of the underground infrastructure needed to promote the excavation work was implemented in connection with the construction of ONKALO. The excavation method used was the drill-blast method. The excavation process included, among others, probe hole boring, pre-grouting (if necessary), blast hole boring, blasting, loading of quarry rock, scaling and reinforcement works. In connection with the excavation of the access tunnel, five separate research niches were implemented along the access tunnel, where, among others, hydrological and rock mechanical studies and EBS installation tests were carried out. The construction of the disposal facility began in 2016 with an excavation contract, the methods were the same as in the implementation of ONKALO. In June 2019, Posiva decided to start construction of the disposal facility and the encapsulation facility, so that disposal can begin in the mid-2020s. The scope of implementation of the disposal facility included the rest of the technical facilities area, the connecting tunnels located at level -437, the canister shaft, the central tunnels of the first disposal panel, the first five deposition tunnels and the deposition holes of the first deposition tunnel. In addition to the excavation of the facilities, the building services of the entire facility were implemented, including ventilation systems and service and fire water and drainage systems. Access to the disposal facility was improved by installing an elevator in the personnel shaft, which is currently used to access

the underground facility. The commissioning of the disposal facility systems will be completed in autumn 2025. In addition, the construction and excavation during the last 20 years have provided the opportunity to do related R&D and different types of testing.

Anni Fritzell, Head of Research and Post-Closure Safety, SKB

Anni Fritzell is Head of Research and Post Closure Safety at SKB. She has been at SKB since 2015, working with repository design, development, research and post-closure safety. Earlier experience includes consultancy in nuclear safeguards (non-proliferation), nuclear power plant safety and safety documentation. Education: M Sc in Energy Systems engineering. Ph. Lic. in applied nuclear physics.

Abstract

RD&D Priorities at SKB

SKB is currently running two parallel facility programmes: The extension of SFR, the final disposal facility for short-lived low- and intermediate-level waste, and the new construction of a final disposal facility for spent nuclear fuel, SFK. The extension of SFR has an approved construction licence since 2024 and excavation of the new rock caverns has started. For SFK, the construction licence application was submitted in early 2025 and the review by the regulator is ongoing. The focus of RD&D activities has changed from research and development of concepts towards realisation and optimisation of the repository design and concepts, and to implement the scientific basis from the research programme into the post-closure safety analyses.
The methods of prioritising RD&D activities are briefly presented, and an overview is given of the most prioritised ongoing projects at SKB.

Session 7

Panel session on the ongoing and changing RD&D needs as disposal facilities are constructed and operated

Matthias Mohlfeld, Civil Engineer, BGE, Germany

Matthias Mohlfeld is civil engineer and has been working in the field of radioactive waste disposal for around 30 years. During this time, he has worked for various institutions whereby he was able to act both as operator and regulator and, in his respective role, oversaw both the German final storage projects and the search for a site for a final storage facility for highly radioactive waste. In addition to planning structures such as shaft closures and tunnel seals, his areas of expertise include the development of decommissioning and safety concepts and the evaluation of long-term safety analyses.

Abstract

ERAM Getting Real – Moving Towards the Construction of a Safe DGR

The final repository for low- and medium-level radioactive waste in Morsleben (ERAM) is currently in the licensing planning phase. A public hearing was held in 2011. Comments received from the public, experts, and the competent authority will be taken into account when revising the documentation and optimizing the concept. One significant change concerns the approach to the safety assessment of the final repository system. This is now based on verifiable data from actual structures (demonstration structures), whose properties are projected into the future through a systematic impact and process analysis. This makes it possible to show that the safety of the ERAM can be reliably achieved with what is technically feasible today. The presentation will discuss the experiences gained during the construction of the structures and the challenges involved in obtaining reliable data.

Frans Jansson, Design Engineer, Fortum, Finland

Frans Jansson is a physicist with almost 10 years of experience in long-term safety modelling and other related work, with an emphasis on low and intermediate level waste.

Evolving R&D needs at the Loviisa LILW repository

Abstract

In Finland, the waste producer has the responsibility to manage nuclear wastes produced, including the final disposal. Fortum disposes the low and intermediate level wastes (LILW) produced at the Loviisa nuclear power plant (NPP) in a repository located at the NPP site at a depth of approximately 100 meters. Having the whole chain from waste production, handling, transportation and disposal within a single organisation has proven to be an effective way to manage and dispose of produced LILW waste.
The original siting investigations at the site and the development of the disposal concept was carried out in the 1980s. The initial work included a preliminary safety assessment. Site investigations (e.g. drilling, hydrological measurements) were carried out to find an optimal location of the repository at the NPP site.
A monitoring program was developed to include studies on rock mechanics, groundwater composition, aging of structures and equipment, etc. This monitoring program is planned to continue during the whole operational period of the repository.
Other development work carried out during the operation of the repository includes, for example, improved packing efficiency of maintenance waste and constructing a solidification plant for liquid waste.
Currently, research and development are driven by uncertainties identified during the latest safety case (e.g. durability of concrete structures, performance of plugs, host rock stability, migration of C-14, etc.); the introduction of new waste types produced outside the Loviisa NPP (e.g. graphite,); possible design changes (e.g. backfilling material; containers for activated reactor components); and other smaller issues.
In the future, more research and development focus will be put on the disposal of decommissioning waste and extending the repository. As the repository nears the end of the operational period (towards the end of 2080s), the focus will shift towards repository closure.

Péter Molnár, Chief Research Engineer, PURAM, Hungary

Péter Molnár has a degree in geology and nuclear environmental engineering. He has been working as a research engineer and scientist in the area of site selection and characterization of radioactive waste disposal facilities for nearly 30 years. He managed hydrogeological characterization of the Bátaapáti and Boda sites, and also contributed to the conceptual design and safety assessment of these geological repositories. He joined the Hungarian WMO, PURAM in 2011 and was leading the Research Department till 2024. He is currently working on site selection for a new near-surface disposal facility and characterization of an alternative host formation for the planned DGR.

RD&D support for the operating Bátaapáti intermediate depth geological repository

Abstract

The Bátaapáti intermediate depth geological repository is intended for the final disposal of LILW. It has been excavated in a fractured granitic host rock at 250 m depth. The underground facility consists of a pair of inclined access tunnels (ramps), cross-tunnels along the ramps at every 250 m, a sub-horizontal tunnel

system and 6 disposal galleries.
The site was selected after a screening process in 1996, and following the surface-based site characterisation process, excavation of the access ramps started at the end of 2004. During the excavation, several R&D experiments were performed in side chambers providing site-specific parameters for the safety assessment and supporting the technical design. The first two large diameter disposal galleries were excavated in 2010, and after obtaining the operational licence, underground disposal of waste packages started in 2012. A phased implementation, i.e. simultaneous construction and operation activities, has been carried out since then.
RD&D activities in a disposal facility should continue during its operation, for several purposes:

- ➜ long-term hydrogeological and geotechnical monitoring data will improve the understanding of site conditions, helping to update and better calibrate numerical flow and static models;
- ➜ necessary to verify and increase accuracy of site-specific data obtained during the site characterisation phase, in order to reduce conservatism for further assessments of post-closure safety;
- ➜ investigate reasons for deviations from the designed/expected state of the implemented structures of the engineered barrier system (EBS), develop preventive measures;
- ➜ continue long-term experiments with materials and processes under repository conditions;
- ➜ testing and utilise latest achievements of scientific and technical development (new materials, methods etc.), demonstrate their suitability and applicability, support optimisation measures;
- ➜ reduce radiation exposure of the operating personnel (by shielding, logistics etc.) and better control of radiological discharges;
- ➜ reduce operational costs.

Examples of these types of RD&D activities at the operating Bátaapáti repository will be presented.

Milan Touš, Long-term Safety Specialist, SÚRAO, Czech Republic

Milan Touš graduated from the Faculty of Chemical Technology at the University of Chemistry and Technology in Prague, specializing in the Technology of Inorganic Materials (Glass, Ceramics, and Cements). After several years in a Ph.D. program, he began his professional career at the former Nuclear Research Institute in Řež as a Specialist in Radioactive Waste Management and Decommissioning.
For over a decade, he managed projects and business activities in institutional radioactive waste management as Deputy Head of Department, including decommissioning of Old Ecological Liabilities such as contaminated technologies, nuclear installations, and buildings.
He has participated in international projects, including radioactive waste transport for supercompaction and IAEA workshops on nuclear installation decommissioning. He has also served as an expert in several IAEA technical missions focused on radioactive waste management and decommissioning.
In the past three years, Milan has worked at Radioactive Waste Repository Authority (SÚRAO), initially as a Radioactive Waste Management Specialist. Since early this year, he has been leading the Department of Safety and Licensing, where his main challenge is to complete the Periodic Safety Review and renew operational licenses for three repositories.

Abstract

Challenges in Operation Disposal Facilities for Low- and Intermediate Level Radioactive Waste in the Czech Republic Over the Years

Disposal of radioactive waste, operation of appropriate facilities, and preparation of disposal solutions for current and future radioactive waste are key responsibilities of the Radioactive Waste Repository Authority (SÚRAO). SÚRAO operates two near-surface repositories (Richard, Bratrství) and one surface repository (Dukovany), all designated for low and intermediate-level waste.

The Richard repository, near Litoměřice, is part of the former Richard II limestone mine and has been used since 1964 for institutional radioactive waste from healthcare, industry, agriculture, and research.

The Bratrství repository, near Jáchymov in the Ore Mountains, is located in a former uranium mine and has been operated since 1974. It is used exclusively for institutional radioactive waste containing naturally occurring radionuclides.

The Dukovany repository, within the Dukovany nuclear power plant complex, covers 1.3 ha and uses reinforced concrete vaults. It has been operated since 1995 and is intended solely for low-level radioactive waste from the Temelín and Dukovany nuclear power plants.

Operating these facilities presents engineering, technical, radiation protection, and safety challenges. Tasks such as backfilling disposal chambers or vaults are complex due to underground or weather conditions, material demands, and safety requirements. Ensuring disposal capacity involves adapting already excavated chambers, opening new vaults, and relocating equipment like service crane or excavated ore.

A special challenge is the Periodic Safety Assessment and license renewal for all three facilities. Each repository is licensed based on its Safety Case, and legislation requires a safety review every ten years. To meet this requirement, a six-year project was launched to update the safety assessments of all operational repositories, incorporating the latest scientific and technical knowledge.

Poster Abstracts

Throughout the Exchange Forum the IGD-TP hosts a series of poster sessions that aim to showcase the cutting-edge radioactive waste management RD&D of our community. Posters are aligned to the IGD TP Strategic Research Agenda (SRA), which identifies the following Key Topics:

1. **Post-closure Safety Case**
2. **Wasteforms and their Behaviour**
3. **Technical Feasibility and Long-term Performance**
4. **Implementation and/or Optimisation**
5. **Safety of Construction and Operations**
6. **Monitoring**
7. **Methodologies for Site Characterisation**
8. **Strategy for Repository Project Development**
9. **Knowledge Management**

The posters will be set up in the meeting and refreshment area within the venue to increase visibility and attendee interaction. One of the significant advantages of a poster presentation is that it allows one-on-one time with the audience for exchange of information and to answer questions. Poster presenters are encouraged to verbally and visually convey the importance of their subject, including its implications and significance.

The poster sessions will coincide with the refreshment and lunch breaks, with all the posters being displayed for both days.
Presenters are to bring a hardcopy of their poster with them. The posters are to be A0 in size and will be displayed in portrait (vertical) orientation.

Advertise your poster in the elevator pitch sessions! To increase the visibility of your poster we are offering an opportunity to advertise your work in 30 seconds to the entire Exchange Forum audience. Without slides, can you pitch your poster in a few sentences? What makes your results new and exciting? What will entice the audience to come to your poster to find out more?

Win a prize! All Exchange Forum attendees will be provided with three stickers to attach to their favourite posters. What posters (and their presenters) are the most engaging and informative? The three stickers can be attached to one, two or three posters. The poster with the most votes by 1050 on Day 2 will win a prize, which will be announced in the final summary session.

Where possible, Exchange Forum posters will also be displayed on the IGD-TP website, increasing the visibility of your work. If you would like us to include your poster, then a PDF file copy of your poster must be provided by 15 November 2025 to **secretariat@igdtp.eu**.

Nº	TITLE	AUTHORS (presenter in bold)
	SRA Topic 1. Post-closure Safety Case	
1	Fundamentals of long-term safety assessments for a high-level waste (HLW) repository concept in crystalline rock	**A. Lommerzheim,** B. Frenzel, K.M. Mayer, C. Müller, M. Neuhaus, F. Schütz, A. Weitkamp, J. Wolf
2	Development of a pre-siting safety case for spent nuclear fuel disposal based on Taiwan's crystalline rock	**Chin-Hsiang Kang**, Ting-Syuan Kuo, Jheng-Jhong Lin, Yu-Ting Su & Tsai-Ping Lee
3	Validation of the safety analysis tool emos	**Mees Hoeksma**
4	Safety assessment approach of the Czech disposal concept	Zdena Lahodová, **Ondrej Mikláš**
5	Results from the IGD-TP PCCS-Project's Benchmark on Loading Curve Determination	Madalina Wittel, **Susanne Pudollek**
	SRA Topic 2. Wasteforms and their Behaviour	
6	The radioactive waste inventory: A key factor for planning the disposal of radioactive waste	**Marika Vespa**, Kirsten Haneke, Felix Lehnen, Sascha Bodenburg
7	The significance of inventory data during site selection procedures	Berit Rauscher, **Marika Vespa**, Kirsten Haneke
8	Strengthening Thermodynamic Foundations for Nuclear Waste Disposal Safety: The DITUSC Initiative	Stéphane Brassinnes, Xavier Gaona, Jenna Poonoosamy, **Eli Colas**, George Dan Miron
9	New waste streams from advanced reprocessing technologies	**Lumír Nachmilner**, Jan Uhlíř, Lucie Karásková Nenadálová
	SRA Topic 3. Technical Feasibility and Long-term Performance	
10	Numerical modelling of repository tunnel excavation in anisotropic shales	**Aldo Madaschi**
11	The differences of diffusion coefficients of I− and IO3- in compacted bentonite using various mathematical models of through-diffusion experiments in the laboratory	**Tsuey-Lin Tsai**, Shih-Chin Tsai, Chin-Hsiang Kang
12	Integrated Experimental Programme for Evaluating the Technical Feasibility and Long-Term Performance of the Engineered Barrier Systems planned in the Czech Deep Geological Repository Concept	**Jan Smutek**, Anna Golubko Miroslava Mecová, Martin Pospíšil, Miluše Zimolová
13	Developing a DGR programme in the Czech Republic: Technical Design, Surface premises Siting Methodology and Public Engagement	**Eliška Matušková**, Jaromír Augusta
14	Numerical modelling of steel waste package corrosion and mechanical strength	**Milan Hokr**, Lucie Baborová, Josef Novák, Jan Šembera, Vratisla Žabka, Martin Hasal, Zdeněk Michalec, Dušan Vopálka, Jan Stoulil, Eva Bedrníková, Petr Večerník

Nº	TITLE	AUTHORS (presenter in bold)
15	Engineered barrier 200C – High temperature in-situ experiment	**Jiří Svoboda**
16	Current Activities of SÚRAO at the Bukov Underground Research Facility	**Jan Smutek**, Anna Golubko, Miroslava Mecová, Martin Pospíšil, Miluše Zimolová
	SRA Topic 4. Implementation and/or Optimisation	
17	The Optimization of Materials and Technologies for the Disposal of Radioactive Wastes in Deep Geological Repositories - MATEO Project	**Jiri Stastka**, Radek Vasicek, Jiri Svoboda, Jaroslav Kruis, Petr Vecernik, Milan Zuna, Vlastislav Kaspar
18	Thermal and criticality safety modelling tools for geological repositories – key tools for repository engineering optimisation	S. Watson, A. Price, A. Paxton, J. Wu, S. Myers, V. Ballard, R. Mason, **C. Padovani**
19	Towards high fidelity numerical simulations of strongly coupled processes for repository systems	**S.V. Churakov**, A. Baksay, J. Brezina, A C. Dieudonn, E. Garcia, O. Kolditz; E. Laloy, N.I. Prasianakis, J. Samper
20	EURAD 2 OPTI - On a way to a mutual understanding about optimization	**Philipp Herold**, Anne-Catherine Dieudonné, Valéry Detilleux, Jiri Svoboda
21	ANCHORS - hydraulic mechanical chemical evolution of bentonite for barriers optimisation	**Nadia Mokni**, Xavier Pintado, Eric Simo, Patrik Sellin
22	Geotechnical deviation and formation of a fracture system in Konrad shaft 2	**Victoria Schettler**
23	A multi-level geological disposal facility to dispose of radioactive waste according to their hazard potential	Erika Neeft, **Marja Vuorio**, Ewoud Verhoef, Jeroen Bartol
	SRA Topic 5. Safety of Construction and Operations	
24	Geopolymers as a Sustainable Solution for Deep Geological Repositories	**Tomáš Černoušek**, Hana Kovářová
	SRA Topic 7. Methodologies for Site Characterisation	
25	Using limits of life to predict microbial activity and survival in engineered barrier systems	**Jessica Mackie**, Simon Gregory
26	Geological characterization of 4 potential sites for siting of the deep geological repository in the Czech Republic	**Marek Vencl**, Ján Kličtinec, Anna Macáková, Štěpán Straka, Ondřej Borovský
27	Development of a Hydrogeological Site Descriptive Model for Crystalline Rock: A Hypothetical Reference Case in Taiwan	**Yu-Hsiang Huang**, Ting-Xin Pan, Po-Yu Chuang, Chien-Chung Ke, Chin-Hsiang Kang
	SRA Topic 9. Knowledge Management	
28	Knowledge management using a requirement management system	Jeroen Bartol, **Marja Vuorio**, Ewoud Verhoef, Erika Neeft
29	International Evaluation of Lifecycle Strategies for NORM and Depleted Uranium Waste: Insights from 18 Countries	**Zoe McGrath**, Kelvin Browning

SRA Topic 1. Post-closure Safety Case

FUNDAMENTALS OF LONG-TERM SAFETY ASSESSMENTS FOR A HIGH-LEVEL WASTE (HLW) REPOSITORY CONCEPT IN CRYSTALLINE ROCK

A. LOMMERZHEIM[1*], B. FRENZEL[2], K.M. MAYER[3], C. MÜLLER[1], M. NEUHAUS[1], F. SCHÜTZ[2], A. WEITKAMP[2], J. WOLF[3]
[1] BGE TECHNOLOGY GmbH, Germany
[2] BGR, Germany
[3] GRS gGmbH, Germany
[*] Corresponding author: andree.lommerzheim@bge.de

A safety case is based on a comprehensive description of the repository system and a prognosis of its future evolution. Therefore, FEP catalogue and scenario development are basic tools for design and optimization of repository components as well as for performance assessment and radiological consequence analysis. In Germany, corresponding methodologies were developed for sedimentary rocks, but this methodology is not directly applicable to crystalline rocks due to specific differences in the rock characteristics and in the safety strategy. Therefore, a modified methodology has been developed in the R&D project CHRISTA III and tested at a generic data set including a site descriptive geological model, a safety strategy, a repository concept and an adequate FEP catalogue. Fractured crystalline rocks have significantly reduced containment properties. Therefore, the safety concept is based on a combination of long-term stable canisters and geotechnical barriers. To consider the consequences of the fractured host rock on the function of geotechnical barriers and on groundwater flow adequately, barrier and nearfield properties have to be taken into account in an integrated approach. Therefore, the new approach for scenario development in crystalline rocks is based on the definition of "initial groups" which describe in detail the local properties of the host rock and the components in the surroundings of the barriers. For the description of the expected system evolution, the initial groups were integrated as modules in the site descriptive model. During future system evolution the components of the initial groups will be affected by a spectrum of THMC processes from the nearfield and the farfield. The functionality of the barrier is also a key aspect for radionuclide mobilization and transport. Alternative scenarios can be derived from deviations from specific assumptions, less probable properties of initial groups and intensities of processes.
Referring to those scenarios, numerical tools for performance assessment and radiological consequence analysis have been successfully tested. Furthermore, the proposed systematic and transparent approach to scenario development increases transparency and thus may support the communication between implementer and stakeholders.

DEVELOPMENT OF A PRE-SITING SAFETY CASE FOR SPENT NUCLEAR FUEL DISPOSAL BASED ON TAIWAN'S CRYSTALLINE ROCK

CHIN-HSIANG KANG[1*], TING-SYUAN KUO[1], JHENG-JHONG LIN[1], YU-TING SU[1] & TSAI-PING LEE[1]
[1] Taiwan Power Company, Taiwan
[*] Corresponding author: u615536@taipower.com.tw

Taiwan Power Company (TPC) had safely operated six nuclear reactors for 40 years. As Taiwan's spent nuclear fuel (SNF) producer, TPC is responsible for managing all of the spent nuclear fuel and proposed the Spent Nuclear Fuel Final Disposal (SNFD) program in 2004. The SNFD program is divided into five stages, with the goal of completing the construction and operation of a disposal repository by 2055. TPC completed the first stage of the potential host rock characterization and evaluation in 2017 and published the Technical Feasibility Assessment Report (SNFD2017), referencing the KBS 3 concept. After 2018, the SNFD program entered the second stage. Besides promoting site selection and geological investigation work, TPC has also referenced IAEA guidelines and NEA-MeSA method to develop the pre-siting Safety Case and systematic safety assessment technologies.
TPC has developed a Features, Events, and Processes (FEPs) system for Taiwan's environments. This system is adapted from the NEA IFEP version 3.0 and further used for evolution and scenarios.

Furthermore, TPC develops a hypothetical site descriptive model (SDM) as reference case and the localized conceptual design of underground repository and engineered barrier systems based on the characteristics of Taiwan's crystalline rock surrounded by marble.
TPC integrated all developed models and engineering designs to perform a post-closure safety assessment, which included scenarios for earthquakes, corrosion and uplift, along with sensitivity cases. The results show that the reference repository and engineering designs can fulfil the safety function and mitigate radionuclide migration. In the sensitivity cases, the post-closure risk of harmful effects to a critical group is below the annual risk limit of 10^{-6} specified in Taiwanese regulations.

VALIDATION OF THE SAFETY ANALYSIS TOOL EMOS

MEES HOEKSMA[1*]
[1]NRG Pallas, The Netherlands
* Corresponding author: hoeksma@nrg.eu

EMOS is a FORTRAN-based program package developed for quantitative safety analysis of nuclear waste repositories in salt formations, originally developed by (a predecessor of) GRS Germany. In the Dutch-German research cooperation, ECN (now NRG PALLAS) added modules for salt creep and compaction. These developments were informed by experimental and theoretical work conducted at the High Pressure Laboratory of Utrecht University, where the long-term behaviour of salt under repository-relevant conditions was studied in detail.
EMOS has developed into a comprehensive multi-physics solver, capable of addressing the strongly coupled processes that govern repository performance. The code is capable of solving coupled differential equations describing salt creep mechanics, brine flow, and radionuclide migration through multiple repository segments. In the previous research programs, EMOS was validated through comparison with other modelling approaches for nuclear waste repositories in salt formations and was used to demonstrate repository safety over the required containment periods.
In the current work, we present a newly updated version of EMOS, in which the state-of-the-art salt compaction models developed under the ongoing COPERA program have been implemented. We also illustrate how the updated model compares to the previous version(s) of EMOS, highlighting the impact of the new compaction formulations on repository evolution scenarios.
This research links directly with the described strategic research agenda, key topics 1 (Post-closure Safety Case) and 2 (Wasteforms and their Behaviour).

SAFETY ASSESSMENT APPROACH OF THE CZECH DISPOSAL CONCEPT

ZDENA LAHODOVÁ1 & ONDREJ MIKLÁŠ[1*]
[1] SÚRAO, Department of safety assessment, Czech Republic
* Corresponding author: miklas@surao.cz

The main objective of the long-term safety assessment of the Czech disposal concept for spent nuclear fuel is to determine whether the proposed disposal system is compatible with the candidate site natural conditions in terms of safety. This is achieved by examining potential hazards and evaluating the collective capabilities of the reference site, engineering barriers and technical design to ensure all safety functions stipulated by legislation are fulfilled. The assessment includes an evaluation of the performance of individual components and their compatibility within the entire system. Ultimately, safety is determined by comparing estimated radionuclide releases and the resulting doses (or risks) with regulatory criteria and safety standards.
The safety assessment process is a structured, iterative framework. It begins with the definition of the repository's safety functions, followed by a detailed characterisation of the waste, the technical design and the geology of the site. The analysis then identifies relevant features, events, and processes, providing a basis for deriving normal and alternative scenarios representing possible future states of the system. These scenarios are analysed using computational models to simulate system behaviour. This includes evaluating the performance of engineering barriers and assessing potential radiation doses using transport models. The process concludes with a final evaluation to confirm that the analysis objectives have been met.

The assessment is based on the concept of a reference site, which is a hypothetical site whose parameters represent the typical environment of the Bohemian Massif at four potential sites. Therefore, while the geological environment is considered representative of candidate sites in the Bohemian Massif, it does not necessarily reflect the best or worst characteristics of the sites.
The results of the safety assessment will be utilized for the final and backup site selection process by evaluating, whether parameters of the sites, based on site investigation fall within the safety margins identified through the safety analysis.

RESULTS FROM THE IGD-TP PCCS-PROJECT'S BENCHMARK ON LOADING CURVE DETERMINATION

MADALINA WITTEL[1], SUSANNE PUDOLLEK1[*]
[1] Nagra, Switzerland
[*] Corresponding author: susanne.pudollek@nagra.ch

Post-closure criticality safety in a deep geological repository is a requirement in Switzerland and in many other countries that must dispose of highly radioactive waste like spent nuclear fuel. One of the main aspects to be addressed is the very long timescale (e.g. 1 million years in Switzerland) that must be considered typically in the criticality safety assessment.
Ensuring criticality safety of final disposal facilities requires the development, optimisation and implementation of dedicated technical and administrative measures. One potential administrative measure consists in deriving loading curves for loading the spent fuel in final disposal canisters, an approach used by several Waste Management Organisations (WMOs).
A direct comparison of the loading curves derived by each organisation is not trivial or straightforward. Aspects such as different repository design concepts, spent nuclear fuel inventories and assumptions made in the loading curve derivation methodology, etc, can have a large impact on the final result and a large variability between the different WMOs. Therefore, in the IGD-TP "Post-Closure Criticality Safety" (PCCS) Project, four Project Partners have launched a joint Sub-project with a view to understanding the observed differences. In view of this, a simplified benchmark comparison was carried out. First results of the impact of different pre-screened parameters on the resulting loading curves for simplified configurations from Nagra's contribution to this joint endeavor will be presented and discussed.

SRA Topic 2. Wasteforms and their Behaviour

THE RADIOACTIVE WASTE INVENTORY: A KEY FACTOR FOR PLANNING THE DISPOSAL OF RADIOACTIVE WASTE

MARIKA VESPA[1*], KIRSTEN HANEKE[1], FELIX LEHNEN[1], SASCHA BODENBURG[1]
[1] Brenk Systemplanung GmbH, Heider-Hof-Weg 23,52080 Aachen, Germany
[*]Corresponding author: m.vespa@brenk.com

The inventory of radioactive waste is a key factor for planning, designing, operating and closing a repository for radioactive waste (near-surface and deep geological repository). It remains crucial throughout the entire life cycle ranging from the first safety case through the site-selection procedure and up to the post-closure phase of a repository. Consequently, the development of an inventory database is a prerequisite in every waste disposal program.
Firstly, it essential to set the requirements for the inventory of the radioactive waste, considering the regulatory framework, the properties of the inventory including processes that may take place over various time scales, the data uncertainties and inaccuracies arising from conceptual models and the sensitivity of parameters. BRENK has developed an inventory model adaptable to the needs of the user.
Secondly, the development of an inventory database based on the requirements is crucial for all stages and performance assessments both for the operational and the long-term safety. BRENK

performs assessments of such databases for radionuclide and as well as other inventories, e.g. for disposal sites in Germany (Morsleben) and other European countries (e.g. Belgium, Switzerland) as well as mining legacies. Furthermore, BRENK performed thorough review and updated the Asse II mine inventory database, including radionuclide calculation modules (e.g., activity calculations, decay module, dose rates, degree of uranium enrichment and case distinctions).
Thirdly, the inventory database has to be verified against the radioactive waste, ensuring compliance with requirements criteria and long-term performance. The poster will give examples for various national programs. For example, BRENK performed long-term performance assessments for the planned near-surface disposal for the Ukrainian radioactive waste. The results showed that an optimisation of the disposal concept was necessary with regard to the buffer material retarding the Tc release.

THE SIGNIFICANCE OF INVENTORY DATA DURING SITE SELECTION PROCEDURES

BERIT RAUSCHER1, MARIKA VESPA1*, KIRSTEN HANEKE1
1 Brenk Systemplanung GmbH, Heider-Hof-Weg 23,52080 Aachen, Germany
* Corresponding author: m.vespa@brenk.com

The aim of the final disposal of radioactive waste is to ensure the best possible safety for the long-term protection (i.e. one million years) of humans and the environment from ionising radiation and other harmful effects. In Germany, the Site Selection Act (StandAG) regulates the procedure for determining the site with the best possible safety for a repository for high-level radioactive waste. One of the mandatory aspects of the StandAG is to perform various, preliminary safety assessments in order to assess the expected extent of safe confinement of radioactive waste. The foundation of these safety assessments is the radioactive waste itself, which has to fulfil the specification for disposal. In order to achieve this goal, a disposal capability model was created.
The project “InvEnd” focused on the generation of this disposal capability model for the German high-level radioactive waste. The first step was identifying the characteristics of the inventory required for the preliminary safety assessments. This task was achieved by analysing two main data sources: the generic but host-rock-specific concepts for a German high-level radioactive waste repository, and inventory data and approaches of other countries with technologically developed repository programmes. The identified various waste characteristics (e.g. geometry, chemistry, radiology and physics) were assigned to categories essential for carrying out the preliminary safety assessments (Primary) and data which validates the primary inventory data (Secondary). Thereafter, an evaluation of the impact of the identified characteristics on the results of the safety assessments was performed. Concluding, an assessment of remaining waste characteristics uncertainties, such as data uncertainty and conceptual uncertainty, was conducted.
The results of this study enable authorities and waste management organisations to identify the key data of high-level radioactive waste inventories that are essential for conducting safety assessments for waste disposal, even during early stages of site selection and planning.

STRENGTHENING THERMODYNAMIC FOUNDATIONS FOR NUCLEAR WASTE DISPOSAL SAFETY: THE DITUSC INITIATIVE

STÉPHANE BRASSINNES[1], XAVIER GAONA[2], JENNA POONOOSAMY[3], ELI COLAS[4*], GEORGE DAN MIRON[5]
[1] Belgian Agency for Radioactive Waste and Enriched Fissile Materials, Brussels, Belgium
[2] Karlsruhe Institute of Technology, Karlsruhe, Germany
[3] Forschungszentrum Jülich, Jülich, Germany
[4] Amphos21, Barcelona, Spain
[5] Paul Scherrer Institute, Villingen, Switzerland
* Corresponding author: eli.colas@amphos21.com

Development and Improvement of Thermodynamic Understanding for use in nuclear waste disposal Safety Case (DITUSC) is one of the strategic studies of the EURAD-2 project. Its primary objective is to provide a comprehensive reflection on the potential enhancement of scientific knowledge in the

domain of thermodynamic database development, to support the evaluation of long-term processes related to safety in the field of radioactive waste disposal. The primary objective of DITUSC is not solely limited to the identification of data gaps but also to critically assess and prioritise these gaps and define scientific strategies for filling them.
The collection of data gaps is gathered from various sources, including scientific evaluation by the partners, technical discussions with ongoing thermodynamic database projects, scientific interactions with other EURAD-2 work packages, exchanges with the wide scientific community at dedicated open workshops and, last but not least, direct input from interested end-users involved in the implementation of radioactive waste repositories.
The prioritisation of data gaps is carried out in consultation with representatives from the three EURAD colleges, with the intention of adopting a common position on relevant strategic future needs. Particular emphasis is given to the EURAD and IGD-TP Strategic Research Agendas, for example in line with the need of improved descriptions of radionuclide release and transport via development of thermodynamic models, including complexation effects. Efforts are dedicated to highlight how future R&D work may be integrated into these agendas to ensure a robust, scientifically defensible framework that guarantees chemical consistency across long-term safety assessments.
The outcomes of this analysis will be documented in a green paper setting the scope and discussing the key aspects and then in a white paper where the outcomes of the analysis will be presented.

NEW WASTE STREAMS FROM ADVANCED REPROCESSING TECHNOLOGIES

LUMÍR NACHMILNER[1*], JAN UHLÍŘ[1], LUCIE KARÁSKOVÁ NENADÁLOVÁ[1]
[1] CV Řež, Czech Republic
[*] Corresponding author: lumnach@gmail.com

Current efforts in the exploitation of nuclear energy consider the introduction of advanced reactor systems, including fast and molten salts reactors. These systems may also require new pyrochemical and pyrometallurgical reprocessing technologies resulting in the generation of new types of waste. This waste needs to be processed and eventually disposed of, but due to its radiochemical properties and chemical composition its waste management may be challenging.
The poster will provide an overview of potential types and basic characterisation of anticipated waste streams generating by pyrochemical and pyrometallurgical reprocessing technologies, in particular:

- ➜ Molten salt / liquid metal reductive extraction proposed as a separation method to be used for the molten salt fuel processing. The main principle of the technology is based on the selective molten-salt / liquid metal reductive extraction into liquid bismuth in multistage counter-current extraction system.
- ➜ Electrochemical separation is also proposed for molten salt reactor systems. There are two methods: cathodic deposition (electrowinning) or anodic dissolution (electrorefining). Both of these electrochemical processes allow for the separation of spent fuel components either in pure metallic form, or in the form of solid or liquid metal alloys, as well as in the form of mixed fluoride or chloride melts.
- ➜ Fluoride volatility method which is proposed for reprocessing of spent MOX fuel from fast reactors or LWRs containing high concentrations of plutonium. The separation process comes out from ability of uranium, neptunium and plutonium to form volatile hexafluorides, whereas most fission products (lanthanides) and transplutonium elements form non-volatile trifluorides. The arising products will thus be represented by gaseous phase containing U, Np, Pu and solid fluoride waste comprising fission products and the rest of transuranium elements (Am, Cm) captured on an inorganic high surface area sorbent, e.g. Al2O3 (alumina). Fluoride volatility method can individually separate uranium, plutonium, and potentially also neptunium. However, this technology (like hydrometallurgical PUREX) cannot individually separate americium and curium which then accompany the fission product stream.

SRA Topic 3. Technical Feasibility and Long-term Performance

NUMERICAL MODELING OF REPOSITORY TUNNEL EXCAVATION IN ANISOTROPIC SHALES

ALDO MADASCHI[1*]
[1] Nesol, Switzerland
[*] Corresponding author: aldo.madaschi@nesol.net

The Opalinus Clay, a Jurassic-age claystone, has been selected as the host rock for the Swiss deep geological repository (DGR) for radioactive waste, due to its favorable properties such as low permeability and self-sealing capacity. Its anisotropic mechanical behavior, stemming from its sedimentary nature, poses unique challenges for the design and long-term safety of underground excavations. This study presents a comprehensive numerical investigation of tunnel excavation in Opalinus Clay, focusing on the material's anisotropic and nonlinear behavior under realistic repository conditions.

An advanced constitutive model, the enhanced Anisotropic Damage Plasticity (eADP) model, is employed to capture key aspects of the claystone's behavior, including transversely isotropic elasticity, anisotropic strength and hardening, pre-peak hardening, and post-peak quasi-brittle softening. The model is calibrated through multi-objective optimization against a broad dataset of undrained triaxial tests with various bedding orientations.

Fully coupled two-dimensional hydro-mechanical plane strain analyses are conducted to simulate short- and long-term tunnel behavior. Simulations include a range of support pressures and generate Ground Response Curves (GRCs) to evaluate excavation-induced deformations. Tunnel geometries typical of repository designs—such as high-level waste tunnels, intermediate/low-level waste caverns, and vertical shafts—are analyzed at different depths and excavation directions relative to bedding planes.

The results highlight the significant impact of mechanical anisotropy on deformation patterns, support requirements, and lining responses. This numerical framework provides a robust tool for predicting tunnel performance in anisotropic shales, supporting repository design and contributing to the safety assessment of underground disposal systems. The findings offer valuable insights into optimizing excavation strategies and structural support systems while enhancing confidence in the long-term containment of radioactive waste in Opalinus Clay formations.

THE DIFFERENCES OF DIFFUSION COEFFICIENTS OF I^- AND IO_3^- IN COMPACTED BENTONITE USING VARIOUS MATHEMATICAL MODELS OF THROUGH-DIFFUSION EXPERIMENTS IN THE LABORATORY

TSUEY-LIN TSAI[1*], SHIH-CHIN TSAI[2], CHIN-HSIANG KANG[3]
[1] Department of Chemistry, National Atomic Research Institute (NARI), Taiwan
[2] Nuclear Science and Technology Development Center, National Tsing Hua University (NTHU), Taiwan
[3] Department of Nuclear Back and Management, Taiwan Power Company (TPC), Taiwan
[*] Corresponding author: polly@nari.org.tw

The key differences of diffusion behavior between the non-sorbing I^- ion and the weakly-sorbing IO_3^- ion were compared, which is a key consideration for the long term safety assessment of radioactive waste repositories.

- For I^- (Iodide), the diffusion coefficients in compacted bentonite ranged from 1.15×10^{-12} to 4.67×10^{-12} m²/s. This range is generally consistent with values found in existing scientific literature for non-sorbing anions. The study confirmed that diffusion is the dominant transport process for I^- through geological barriers.
- For IO_3^- (Iodate): A wider range of diffusion coefficients, from 3.83×10^{-13} to 1.91×10^{-11} m²/s was observed and overall were lower values, compared to I^-, suggesting that IO_3^- exhibits a different behavior than the purely non-sorbing I^-. The IO_3^- ion is weakly sorbing under aerobic conditions, which affects its transport behavior and can lead to slower movement.

The multiple mathematical models (CC-CC, CC-VC, and VC-VC) were employed to interpret the

experimental data. This approach strengthens the reliability of the results and provides a more comprehensive understanding of the diffusion process based on the following insights.

- ➜ Model Validation: By cross-checking the results with different models, the research demonstrates the robustness and internal consistency of the diffusion parameters obtained from laboratory experiments.
- ➜ Anion Behavior: The comparison highlights the crucial difference between a non-sorbing anion (I^-) and a weakly-sorbing one (IO_3^-). This distinction is critical for accurate safety assessments of repositories, as the sorption behavior of a radionuclide directly impacts its migration rate.
- ➜ Data Reliability: The studies emphasize that these techniques are a reliable way to measure the diffusion coefficients of non-sorbing or weakly-sorbing radionuclides, which is essential for ensuring the long-term safety of radioactive waste final disposal. The findings provide high-quality data that can be used to refine and improve safety assessment models.

INTEGRATED EXPERIMENTAL PROGRAMME FOR EVALUATING THE TECHNICAL FEASIBILITY AND LONG-TERM PERFORMANCE OF THE ENGINEERED BARRIER SYSTEMS PLANNED IN THE CZECH DEEP GEOLOGICAL REPOSITORY CONCEPT

JAN SMUTEK*[1], ANNA GOLUBKO[1], MIROSLAVA MECOVÁ[1], MARTIN POSPÍŠIL[1], MILUŠE ZIMOLOVÁ[1]
[1] SÚRAO, Czech Republic
* Corresponding author: smutek@surao.cz

SÚRAO is implementing its RD&D plan via a structured programme of in-situ experiments conducted at the Czech Bukov and Josef generic underground research facilities (URF). These activities are being complemented by laboratory research conducted by long-standing SÚRAO suppliers including various Czech research institutions and universities. SÚRAO is also involved in a range of international projects underway at the Grimsel Test Site (e.g. the HotBENT project) and is contributing to several work packages as part of the EURAD-2 programme (e.g. the RAMPEC and ANCHORS WPs).
The experimental programme focuses on the technical feasibility and long-term performance of engineered barrier systems (EBS), particularly the bentonite-based components and metal waste disposal packages. Key ongoing activities include the operation and dismantling of the Interaction Experiment at the Bukov URF, which is providing long-term data on bentonite-concrete interactions under repository-relevant conditions. Corrosion experiments, including the Pilot corrosion experiment underway at the Bukov URF and experiments conducted as part of the InCoManD EURAD-2 WP, are investigating the degradation behaviour of metal components in bentonite environments. These studies are essential for demonstrating the integrity of waste disposal packages over the repository lifetime.
The dismantling of the EPSP experiment (an in-situ model of the deep geological repository pressure and sealing plug) in the Josef underground laboratory is in the planning stage. Planned participation in the “RELABEN” and “ACS” projects will further enhance knowledge exchange and benchmarking. The poster presents selected results, highlights methodological innovations and outlines future directions in the field of the development and testing of EBS.

DEVELOPING A DGR PROGRAMME IN THE CZECH REPUBLIC: TECHNICAL DESIGN, SURFACE PREMISES SITING METHODOLOGY AND PUBLIC ENGAGEMENT

ELIŠKA MATUŠKOVÁ[1*] & JAROMÍR AUGUSTA[2]
[1] SÚRAO, Czech Republic
[2] Design department, operation of underground workplaces and mining safety of operational repositories department, SÚRAO, Czech Republic
* Corresponding author: matuskova@surao.gov.cz

This poster provides a comprehensive overview of the current technical design and ongoing development of the future Czech deep geological repository (DGR) for spent nuclear fuel and other radioactive waste. The DGR is being designed to provide a safe, multi-barrier disposal system that will meet all long-term safety requirements. We present the current design parameters of this system, which is intended to be located within a deep disposal horizon in a crystalline rock mass made up of

granite or gneiss. In addition, we introduce the current schedule for the Czech DGR program and detail the updated design of the DGR's surface premises.
A focus of this poster is also the methodology for selecting the DGR's surface premises. This systematic approach uses clearly defined rules and criteria—including standard criteria (legislative, safety, environmental, and technical requirements) as well as specific criteria that incorporate the views of all stakeholders. The methodology ensures a consistent design approach across all potential sites and helps to quantify differences between them. This systematic approach was applied to all four potential DGR sites, leading to the selection of suitable surface areas. Following this, the Radioactive Waste Repository Authority launched the Emotional Maps project. This innovative initiative was designed to gather feedback from residents on potential DGR sites for the DGR's surface facilities, access roads, and related infrastructure. The project allowed communities, who know their areas best, to identify important places, highlight regional specifics, and share concerns or suggestions. This valuable input from citizens helps to better understand what matters to the communities and ensures their perspectives are considered in the final design. The project's findings will be used to protect valuable natural and built-up sites and address identified problematic points in the DGR design.

NUMERICAL MODELLING OF STEEL WASTE PACKAGE CORROSION AND MECHANICAL STRENGTH

MILAN HOKR1*, LUCIE BABOROVÁ[2], JOSEF NOVÁK[1], JAN ŠEMBERA[1], VRATISLA ŽABKA[1], MARTIN HASAL[3], ZDENĚK MICHALEC[3], DUŠAN VOPÁLKA[2], JAN STOULIL[4], EVA BEDRNÍKOVÁ[5], PETR VEČERNÍK[5]
[1] Technical University of Liberec
[2] Czech Technical University in Prague
[3] Institute of Geonics, Czech Academy of Sciences
[4] University of Chemistry and Technology Prague
[5] ÚJV Řež
* Corresponding author: milan.hokr@tul.cz

The Czech disposal concept of spent fuel considers a double-case waste package, with the inner case of stainless steel and the outer case of carbon steel. We present several numerical models helping to predict the waste package lifetime.
Anaerobic corrosion of carbon steel in contact with saturated compacted bentonite is modelled as a 1D reaction-transport problem. Bentonite mineral and porewater composition is calibrated to laboratory analyses of Czech bentonite BCV (Ca-Mag type). The model is made in PHREEQC, using the Thermochimie database, and with additional couplings calculated by iCP (COMSOL-PHREEQC). The model considers varying corrosion rate as an effect of interface changes and includes transport properties change by corrosion product precipitation, with respect to prescribed reference rate. Carbonates are dominating corrosion products, in agreement with results of laboratory corrosion experiments. Sensitivity of model on numerical discretisation and on parameters of the kinetic corrosion product precipitation was additionally evaluated.
Mechanical strength is solved as an elasto-plastic problem with hardening, considering varying steel thickness due to corrosion. ANSYS is used for the calculations. The stress-strain curve is an approximation of the laboratory measurement. Two conditions for collapse are considered: (1) stress reaching the strength limit or (2) buckling stability calculation. Without effects at the weld of the container lid, the shape stability is the limiting condition regarding the minimum thickness. Then, the effect of the outer case collapse on the inner case strength is evaluated, variants of contact area between the two cylinders are used, resulting from the evaluated buckling mode deformation. Such load is less favourable than uniform stress applied in the reference model, but all cases keep the inner case under the yield limit.

ENGINEERED BARRIER 200C – HIGH TEMPERATURE IN-SITU EXPERIMENT

JIŘÍ SVOBODA[1*]
[1] Czech Technical Universitz in Prague, (ČVUT), Czech Republic
[*] Corresponding author: svobodaj@fsv.cvut.cz

The design of a deep geological repository (DGR) for high-level radioactive waste relies on an engineered barrier system. The current hard rock design involves a steel or copper canister surrounded by a bentonite buffer. The maximum planned temperature at the canister/bentonite interface is 100 °C. This restricts both the quantity of material that can be stored in one place and the spacing of canisters within the DGR.
However, an increase in temperature at the interface could lead to significant savings. Therefore, efforts are being made to explore this possibility. This effort also enhances the safety of the current design by extending the safe operating range.
Project Engineered Barrier 200C is investigating temperatures of up to 200 °C in laboratory and in-situ tests. The half-scale physical model has been operational since November 2019 till April 2024 at the Josef Underground Research Laboratory (URL) in the Czech Republic. It was dismantled afterwards. The aim of the experiment was to test the behaviour of the buffer component of an EBS system made from pelletised material at temperatures up to 200 °C. The material tested consisted of compacted BCV bentonite pellets, which were arranged around a cylindrical heater to simulate a canister containing radioactive waste at 200 °C.
The multidisciplinary dismantling of the experiment started in May 2024. The state of the experiment was documented and samples were taken for geotechnical, geochemical, microbiological and mineralogical analyses. The performance of the barrier was analysed as well. The bottom third of the experiment was left intact in-situ for further research on the long-term behaviour of the EBS.
The poster presents the results of dismantling the experiment, which demonstrate the behaviour of the high-temperature EBS system.

Acknowledgement
The team is grateful for the financial support provided to the project. The project is co-financed from the state budget by the Technology Agency of the Czech Republic under the THÉTA Programme, project no. TA ČR TK01030031, application guarantor SURAO.

CURRENT ACTIVITIES OF SÚRAO AT THE BUKOV UNDERGROUND RESEARCH FACILITY

JAN SMUTEK[*1], ANNA GOLUBKO[1], MIROSLAVA MECOVÁ[1], MARTIN POSPÍŠIL[1], MILUŠE ZIMOLOVÁ[1]
[1] SÚRAO, Czech Republic
[*] Corresponding author: smutek@surao.cz

SÚRAO, the Czech waste management organisation responsible for the development of the country's deep geological repository, relies on the timely preparation of technical solutions via the performance of research, development and demonstration activities in generic underground research facilities. SÚRAO's key research site comprises the Bukov Underground Research Facility (URF), which provides for the conducting of in-situ experiments in the crystalline rocks of the Bohemian Massif at a depth of 500 metres below ground level. The poster provides information on the activities currently underway in this underground laboratory. The Pilot Corrosion Experiment continues in the section of the laboratory that has been in operation since 2017, i.e. Bukov URF I. This experiment commenced with the emplacement of heated physical models in vertical boreholes aimed at the detailed investigation of the corrosion behaviour of candidate materials for the waste disposal package for spent nuclear fuel. The objective of the experiment is to obtain a decade-long dataset on the corrosion rates of selected metallic materials placed in Czech bentonite. In addition, one of the key phases of the Interaction Experiment is currently underway, i.e. its dismantling employing the core drilling and wire-saw cutting techniques for the recovery of the physical models from the rock mass. The blocks of rock that contain the physical models, along with the surrounding bentonite, are being transported to the surface laboratory to be subjected to systematic sectioning and the collection of samples for laboratory analysis purposes. In 2024, the excavation of a new section of the underground laboratory – Bukov URF II – was completed. The new system of laboratory corridors will be fully commissioned by the end of 2025.

SRA Topic 4. Implementation and/or Optimisation

THE OPTIMIZATION OF MATERIALS AND TECHNOLOGIES FOR THE DISPOSAL OF RADIOACTIVE WASTES IN DEEP GEOLOGICAL REPOSITORIES - MATEO PROJECT

JIRI STASTKA[1*], RADEK VASICEK[1], JIRI SVOBODA[1], JAROSLAV KRUIS[1], PETR VECERNIK[2], MILAN ZUNA[2], VLASTISLAV KASPAR[2]
[1] Czech Technical University in Prague (CTU), Czech Republic
[2] ÚJV Řež, a. s., Czech Republic
[*] Corresponding author: jiri.stastka@fsv.cvut.cz

The project's main objective is to establish a partnership between Czech and Korean institutions for the exchange of knowledge and experience regarding the final disposal of spent nuclear fuel. The joint focus of the project is optimising materials and technologies related to the use of granulated (pelletised) bentonite in constructing the buffer and backfill of a deep geological repository. The project runs from January 2025 to December 2027 and is divided into three key work packages: WP1: Material Optimisation; WP2: Transport Tests; and WP3: In-Situ Model. The Czech part of the project will seek to optimise an alternative construction solution for the buffer using granulated bentonite. This approach is expected to lead to significant time and financial savings. It also simplifies construction organisation and reduces uncertainty. Initial results demonstrate the sufficient compaction of Czech granular bentonite (Ca-Mg, Cerny Vrch deposit), achieving a dry density of around 1.6 g/cm³ for the compacted layer. The project focuses on gradually realising the first Czech in-situ experiment on a 1:1 scale in granitic rocks at the Josef Underground Laboratory. This experiment will comprise a fully featured in-situ model of vertical disposal. It will simulate the real-scale buffer thickness. The heater design reflects the actual size and power of a disposal package (e.g. 655 W after 65 years for Dukovany SNF). The model incorporates systems for saturation, monitoring (temperature, pressure and humidity) and conducting migration tests on gases. The monitoring data gathered will be crucial for specifying, preparing and validating a THM numerical model. Furthermore, the entire experiment will be digitally mirrored in BIM (Building Information Modelling) to facilitate data management and visualisation.
The project is co-financed with state support from the Technology Agency of the Czech Republic (TA ČR) under the project TQ16000084 in the SIGMA Programme (Sub-Objective 4).

THERMAL AND CRITICALITY SAFETY MODELLING TOOLS FOR GEOLOGICAL REPOSITORIES – KEY TOOLS FOR REPOSITORY ENGINEERING OPTIMISATION

S. WATSON[1], A. PRICE[1], A. PAXTON[1], J. WU[1], S. MYERS[1], V. BALLARD[1], R. MASON[1], C. PADOVANI*[1]
[1] Amentum Clean Energy, United Kingdom
[*] Corresponding author: cristiano.padovani@global.amentum.com

Substantial progress in demonstrating that HLW and SNF can be managed safely through geological disposal has been made over the past decades, with notable developments in countries such as Finland, Sweden, France and Switzerland. In the case of SNF (which contain some residual fissile isotopes), an aspect that requires consideration is demonstrating that any risks associated with a hypothetical nuclear criticality are negligible (i.e. risks are very low in likelihood and tolerable in consequences). Substantial progress is also being made, in many countries, on the development of engineering solutions with respect to HHGW repository design, construction and operation. In this respect, progress with the licensing of several facilities worldwide suggests that solutions conceived to date are likely to feasible and practicable. A key driver for advanced disposal programmes over the next years, however, will thus be on the optimisation of such facilities from an engineering perspective. In this respect, a key aspect requiring consideration are design approaches aimed at reducing repository footprint and excavation volume (with knock-on effects on repository schedule, costs and environmental impact).
In this work we will present a range of studies on the thermal optimisation or radioactive waste repositories, focusing on SNF and Pu. The studies will seek to demonstrate how, given the thermal

conductivity of the host rocks and buffer materials typically considered in disposal programme worldwide, substantial gains in repository schedule, environmental impact and costs can be achieved by excavating disposal tunnels further apart and, by virtue of doing that, reducing the waste package spacing. Overall, the work will seek to generate valuable learning to geological disposal programmes worldwide by reflecting on key handles on repository optimisation, results of relevant studies to date, and tools available to drive further progress.

TOWARDS HIGH FIDELITY NUMERICAL SIMULATIONS OF STRONGLY COUPLED PROCESSES FOR REPOSITORY SYSTEMS

S.V. CHURAKOV[1*], A. BAKSAY[2], J. BREZINA[3], A-C. DIEUDONNÉ[4]; E. GARCIA[5], O. KOLDITZ[6]; E. LALOY[7], N.I. PRASIANAKIS[8]; J. SAMPER[9]
[1] Paul Scherrer Institute (PSI), Villigen, Switzerland
[2] TS Enercon, Hungary,
[3] TUL, Czech Republic,
[4] TU Delft, Netherlands,
[5] Enresa, Spain,
[6] Helmholtz Centre for Environmental Research - UFZ, Leipzig, Germany,
[7] SCK CEN, Mol, Belgium
[8] Paul Scherrer Institute (PSI), Villigen, Switzerland
[9] CICA & Civil Engineering School and Department, University of A Coruña, Coruña, Spain
[*] Corresponding author: sergey.churakov@psi.ch

Process-based numerical simulations are the basis for in-depth system understanding, analysis of experimental observations and their upscaling. Due to the complexity of the repository systems and the extended time-periods involved, modelling is the only way to evaluate the long-term evolution of the repository in situ conditions. Recent developments in the field of data sciences and computational efficiency of surrogate models on modern computer infrastructure opens the way for realisation of efficient coupled numerical models (Digital Twins) for real time numerical analysis of laboratory and field experiments, repository design, components optimisation and comprehensive safety analysis [1]. Such numerical tools are essential for repository conceptualisation and the repository design optimisation in both advanced- and early-stage waste disposal programs [2]. EURAD-II Work Package HERMES aims at development of open access tools for simulations of strongly coupled THMC Feature Events Processes in repository systems (nearfield and host rocks). Specifically, the focus is given to development of the surrogate models based on machine learning for specific aspects of THMC coupled models, data exchange between models at different scales, reduction of big data and extraction of constitutive relations from big numerical, experimental and monitoring datasets. In such models some orders of magnitude improvement in the computational efficiency is obtained by replacing the physical based solvers or its components with high fidelity surrogate models [3].

[1] Churakov S.V., et al. (2024) Environ. Earth Sci. 83:521. doi:10.1007/s12665-024-11832-7
[2] Kolditz O., et al. (2023) Environ. Earth Sci. 82:42. doi:10.1007/s12665-022-10675-4
[3] Prasianakis N.I., et al. (2025) Environ. Earth Sci. 84:121. doi:10.1007/s12665-024-12066-3

EURAD 2 OPTI - ON A WAY TO A MUTUAL UNDERSTANDING ABOUT OPTIMIZATION

PHILIPP HEROLD[1*], ANNE-CATHERINE DIEUDONNÉ[2], VALÉRY DETILLEUX[3], JIRI SVOBODA[4]
[1] Bundesgesellschaft für Endlagerung mbH (BGE), Eschenstraße 55, 31224 Peine, Germany
[2] Delft University of Technology, The Netherlands
[3] Bel V, Belgium
[4] Czech Technical University Prague, Czech Republic
[*] Corresponding author: philipp.herold@bge.de

The IGD-TP SRA identifies optimization during implementation of a DGR as one key topic. In the understanding of IGD-TP optimization concerns technical and economic aspects, but also increases in the robustness of post-closure safety demonstration and/or operational safety. Other stakeholders

are interested in optimization as well. Different stakeholders will have different objectives and strategies for optimisation. Differences can be noted between the different national programs as well. The strategic study "HLW Repository optimisation including closure (OPTI)" is part of the EURAD-2 programme and includes partners from research entities, technical support organisations, waste management organisations and civil society organisations. The participants of the study are discussing what optimisation in the context of a high-level waste (HLW) repository means and how an exchange between different stakeholders could be fostered. Right from the beginning, it was clear that safety stands above all other objectives for optimization. Optimization can be influenced by different drivers but only take place within a defined framework. This framework, in the WP OPTI defined as prevailing circumstances, includes the regulatory frame in the corresponding national program, including safety requirements. Further scientific, technical, economical and societal limits are given. The intersection defines the space for optimization. Optimisation is a stage-wise or level-wise process. The safety case gives the overall safety envelope for this process. In result all systems, structures and components of the DGR can be optimized. However, the WP OPTI focuses on specific key topics – comparable to the specific research topics in the SRA. The planned poster contribution will summarize the discussion in WP OPTI and will present key topics for optimization identified by the WP team.

ANCHORS - HYDRAULIC MECHANICAL CHEMICAL EVOLUTION OF BENTONITE FOR BARRIERS OPTIMISATION

NADIA MOKNI[1*], XAVIER PINTADO[2], ERIC SIMO[3], PATRIK SELLIN[4]
[1] Autorité de sûreté nucléaire et de radioprotection (ASNR), PSE-ENV/SPDR/LETIS, F-92260, Fontenay aux Roses, France
[2] Mitta Engineering Oy., Sweden
[3] BGE, Germany
[4] Svensk Kärnbränslehantering AB (SKB), Sweden
[*] Corresponding author: nadia.mokni@asnr.fr

The knowledge of long-term Thermo Hydro Mechanical Chemical (THMC) behaviour of bentonite-based components contributes, as a main factor, to the safety improvement, design, and optimisation of Engineered Barrier Systems (EBS) for all Deep Geological Repository (DGR) concepts. Whereas several bentonites are well studied and their sealing and retention properties have been investigated, a rising number of alternative bentonites and bentonite-based mixtures are under consideration across Europe that are not well investigated yet. Potential disruptions to the global bentonite supply chain (e.g., geopolitical issues, costs etc.) could severely restrict the supply of the well-studied bentonite. To mitigate this problem, a wide range of alternative bentonites and bentonite-based materials that can be used to seal a DGR without compromising its safety need to be characterised. In response to these challenges, the ANCHORS Work Package (WP), part of the European partnership on Radioactive Waste Management (EURAD2), has been specifically designed to address these issues. ANCHORS' main objective is to increase the optimisation potential of bentonite barrier systems and the robustness of the safety case 1) by qualifying the Hydro Mechanical (HM) behaviour of various kind of bentonite types and mixtures through laboratory experimental program 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 THMC repository environment. Additionally, this work package involves the establishment of a comprehensive database containing THMC material properties and representative numerical results for various kinds of bentonites and mixtures. These efforts ultimately contribute to the optimisation of DGR designs. To achieve those objectives, the WP is divided into four tasks. The laboratory testing task focuses on multiscale experimental characterization of various bentonite types and mixtures, emphasizing chemical loadings, heterogeneity, friction, and mixture optimization. It also includes analyzing aged bentonites from in situ tests. The modelling task focuses on improving constitutive models and numerical tools for bentonite barrier performance assessment, with particular attention to heterogeneity, temperature and chemical effects. Additionally, it aims to provide insights which can be used for confidence building in safety case applications by examining parameter sensitivity, long-term evolution and uncertainty propagation in large-scale bentonite barriers. The first two tasks focus on WP coordination and Knowledge Management (KM) specifically aim to capture knowledge relevant to the WP's Strategy Research Agenda topic and support its transfer to the EURAD-2 community and beyond through the KM program.

GEOTECHNICAL DEVIATION AND FORMATION OF A FRACTURE SYSTEM IN KONRAD SHAFT 2

VICTORIA SCHETTLER[1*]
[1] Bundesgesellschaft für Endlagerung mbH, Germany
[*] Corresponding author: victoria.schettler@bge.de

The Federal Company for Radioactive Waste Disposal mbH (Bundesgesellschaft für Endlagerung mbH, BGE) is entrusted with the implementation of the German radioactive waste disposal programme. Hence, the BGE takes the responsibilities for the development and implementation of the waste acceptance criteria, the construction, operation and closure of deep geological repositories for all types of nuclear waste.
At the Konrad mine work is underway on the construction of Germany's first repository for low- and intermediate-level radioactive waste to be licensed under nuclear law. This former iron ore mine is being converted for this purpose under the supervision of the Bundesgesellschaft für Endlagerung mbH (BGE). The final disposal of up to 303,000 cubic metres of low- and intermediate-level radioactive waste is set to begin in the early 2030s.
As a result of the evaluation of the geotechnical monitoring measures at the second level of the Konrad shaft 2, abnormal geotechnical behavior was identified in March 2020 in the transition area between the shaft and the filling point. To increase stability, a decision had to be made immediately regarding suitable measures and their implementation. The geotechnical assessment concluded that the installed GRP anchors had failed and the fully bonded steel anchors were in the area of their maximum load-bearing capacity. The scope of the rehabilitation work included replacement or additional anchoring, the reconstruction of concrete segments of the outer shell, or the backfilling of hollow spaces. With the completion of these measures, the excavation of the fill site could be resumed at the end of October 2020, with the excavation of the floor in the fill site area. In our poster presentation, we will lay out the taken measures and their impact. We will further have a view on next milestones and remaining challenges.

A MULTI-LEVEL GEOLOGICAL DISPOSAL FACILITY TO DISPOSE OF RADIOACTIVE WASTE ACCORDING TO THEIR HAZARD POTENTIAL

ERIKA NEEFT[1*], MARJA VUORIO[1†], EWOUD VERHOEF[1], JEROEN BARTOL[1]
[1] COVRA, Netherlands
[*] Corresponding author: erika.neeft@covra.nl [†] Presenting author

Netherlands is one of the few European countries that has successfully implemented the European INSPIRE Directive [1]. All publicly available data of underground/subsurface formations are compiled and accessible for any citizen and any company through the DINOLOKET website. The available information in DINOLOKET about Paleogene clays in the Dutch subsurface has recently been explored to research disposal of all types of radioactive waste into a single geological disposal facility (GDF) [2]. Several Paleogene clay layers are available at almost any location in the Netherlands. This presence allows low and intermediate level waste (LILW) to be disposed of nearer the surface than high-level waste (HLW). Apart from a single level GDF in clay also a multi-level GDF is therefore considered. Compared to a single level GDF, the multi-level GDF:
1) is more flexible to be adapted to changes in waste inventories;
2) has a higher certainty in cost estimate of disposal, since construction techniques for shallower disposal depths have already been demonstrated either through civil industry (traffic tunnels) or the underground research laboratory in Belgium;
3) reduces the footprint of disposal facility.

[1] EC, "Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)," Official Journal of the European Union L108 1-14 25.04.2007, 2007.
[2] E. A. C. Neeft, M. R. Vuorio, J. Bartol, E. V. Verhoef, C. McCombie, and N. A. Chapman, "COPERA Clay 2024 A Conditional Safety case and Feasibility Study," COVRA R25021, www.covra.nl , 2025.

SRA Topic 5. Safety of Construction and Operations

GEOPOLYMERS AS A SUSTAINABLE SOLUTION FOR DEEP GEOLOGICAL REPOSITORIES

TOMÁŠ ČERNOUŠEK[1*], HANA KOVÁŘOVÁ[1]
[1] Research Centre Řež, Husinec - Řež, 25068, Czech Republic
[*] Corresponding author: tomas.cernousek@cvrez.cz

Ensuring the long-term safety of deep geological repositories for radioactive waste is a critical challenge. Conventional Portland cement is unsuitable due to its high alkalinity, which is detrimental to the stability of bentonite barriers, while even low-alkaline concretes contribute significantly to CO_2 emissions. Geopolymers, based on alkali-activated aluminosilicates, represent a promising alternative. They exhibit higher durability and chemical stability, along with the benefit of low calcium content. In this study, we developed and characterized a novel low-alkaline geopolymer at laboratory scale. The results demonstrate improved mechanical performance and chemical resistance compared to cement-based systems, highlighting geopolymers as a more durable and environmentally responsible solution for the long-term integrity of deep geological repositories.

SRA Topic 7. Methodologies for Site Characterisation

USING LIMITS OF LIFE TO PREDICT MICROBIAL ACTIVITY AND SURVIVAL IN ENGINEERED BARRIER SYSTEMS

JESSICA MACKIE[1*], SIMON GREGORY[1]
[1] British Geological Survey (BGS), United Kingdom
[*] Corresponding author: jesmac@bgs.ac.uk

Potential for microbial activity within a geological disposal facility (GDF) needs to be considered by waste management organisations because microorganisms consume and produce gases, corrode metals, breakdown organic wastes and mobilise radionuclides, amongst other processes relevant to safety planning. The environment in and around a GDF, in particular the engineered barrier system (EBS), produces harsh conditions for microbial life. However, numerous studies have demonstrated that microbial communities have a remarkable ability to survive in extreme conditions, thus changing their local environment. Understanding what limits life within the EBS will give a better indication of when and where microbial activity is more or less likely.
The limits to microbial activity and survival were reviewed for the following relevant variables: temperature, pH, radiation, salinity, saturation, and availability of nutrients and energy sources. Where data allowed, limits were given specific to EBS materials or specific to microbial groups of interest. Using predictions of how each environmental variable changes during the post-closure phase, we outlined the times and locations when microbial activity is expected to be limited. A range of repository concepts relevant to high heat generating waste and lower heat generating waste in lower strength sedimentary rocks, higher strength rocks and in evaporites were considered. Finally, we suggest how data from multiple variables can be combined to improve our understanding of the potential for microbial activity to occur within the EBS.
We propose that these “limits to life” be combined with existing or new EBS environmental condition evolution models to give a better understanding of the activity and survival of microorganisms. This could be integrated into safety planning to identify the potential for microbial impacts on the containment of waste. It can also be used to identify gaps in knowledge of microbiology within the EBS and inform the design of future research programmes.

GEOLOGICAL CHARACTERIZATION OF 4 POTENTIAL SITES FOR SITING OF THE DEEP GEOLOGICAL REPOSITORY IN THE CZECH REPUBLIC

MAREK VENCL[1*], JÁN KLIŠTINEC[1], ANNA MACÁKOVÁ[1], ŠTĚPÁN STRAKA[1], ONDŘEJ BOROVSKÝ[1],
[1] SÚRAO, Czech Republic
* Corresponding author: Vencl@surao.gov.cz

SÚRAO is the state technical organization and it is responsible for the safe disposal of radioactive waste in the Czech Republic in accordance with the requirements of nuclear safety and environmental protection. SÚRAO currently operates low- and intermediate-level waste repositories Bratrství in Jáchymov, Richard, and Dukovany close to NPP Dukovany. The Czech DGR concept is based on a multibarrier system consisting of a steel canister, Czech bentonite buffer, and crystalline host rock. SÚRAO has been undertaking the site selection process since the 1990s, narrowing down 32 initial regions to four potential sites in 2020: Březový potok, Janoch, Hrádek, and Horka. The final site will be determined through a multicriteria evaluation, with an emphasis on favorable geological conditions. The Czech Republic decided to adopt a crystalline host rock concept based on the rock type composition of the region. All sites are situated within the Bohemian massif unit, comprised mostly of variscian methamorpohsed rocks with numerous plutonic intrusions.
Although geological investigations have been ongoing throughout the site selection process, the current focus is on obtaining detailed data at a depth of 500 metres, which is the projected depth for the Czech DGR. Advanced geophysical methods capable of delineating geological structures at depths of up to 1,000 metres are critical to this process. Extensive drilling campaigns involving multiple boreholes targeting lengths of 300, 600 and 1,200 metres are planned at each site. Each borehole will produce oriented drill cores and undergo comprehensive borehole testing to verify crucial geological features above, at, and below the intended DGR depth. In addition to drilling, complementary research activities such as detailed geological mapping and monitoring are ongoing. These methods aim to construct comprehensive 3D geological models for each potential site.

DEVELOPMENT OF A HYDROGEOLOGICAL SITE DESCRIPTIVE MODEL FOR CRYSTALLINE ROCK: A HYPOTHETICAL REFERENCE CASE IN TAIWAN

YU-HSIANG HUANG[1*], TING-XIN PAN[1], PO-YU CHUANG[1], CHIEN-CHUNG KE[1], CHIN HSIANG KANG[2]
[1] Advanced Geology Research Center, Sinotech Engineering Consultants, INC., Taiwan
[2] Taiwan Power Company, Taiwan
* Corresponding author: shawn.sinotech@gmail.com

Deep geological disposal at depths of 300–1000 m is internationally recognized as the most robust and reliable long-term strategy for the management of spent nuclear fuel. In Taiwan, crystalline rock formations have been proposed as a potential host environment. This study advanced hydrogeological data acquisition in Taiwan's crystalline rock regions and developed Site Descriptive Models (SDMs) through a hypothetical reference case.
The SDM was constructed by integrating multiple lines of evidence from both laboratory and field investigations, including gas permeability determinations of core samples, geophysical well logging, high-resolution flowmeter surveys, hydraulic properties determination from packer test and pumping test, soil property experiments, and long-term hydrological monitoring.
The characterization identified two major lithologies—marble and gneiss—and three hydrogeological units: Hydro-Structural Domain (HSD), and two Hydrogeological Rock Domains (HRD I and HRD II). Groundwater flow was assessed using a hybrid modelling approach. At the site scale, Discrete Fracture Network (DFN) realizations were upscaled into an Equivalent Continuous Porous Media (ECPM) model, whereas at the regional scale, a Continuous Porous Media (CPM) model was employed. From 500 Hydro-DFN realizations, quartile statistics of fracture connectivity and well intersections were evaluated, and the realization most consistent with Sinotech Flow Cell (SFC) measurements was selected as representative.
The results indicate that groundwater flow is primarily controlled by the steep regional topography, with dominant flow pathways extending from mountainous recharge areas toward the coastal discharge zones. The developed SDM significantly enhances the understanding of regional hydrogeological conditions and provides a scientific foundation for future safety assessments of potential high-level radioactive waste disposal sites in Taiwan.

SRA Topic 7. Methodologies for Site Characterisation

KNOWLEDGE MANAGEMENT USING A REQUIREMENT MANAGEMENT SYSTEM

JEROEN BARTOL[1*], MARJA VUORIO[1 †], EWOUD VERHOEF[1], ERIKA NEEFT[1]
[1] COVRA, The Netherlands
[*] Corresponding author: jeroen.bartol @covra.nl † Presenting author

A requirements management system (RMS) serves as a tool to identify and manage requirements, ensure traceability and transparency in decision-making, and facilitate communication among professionals from different fields of expertise. Because implementing geological disposal of waste is a lengthy process—often taking decades or longer—an RMS is needed to provide a framework to collect and manage all requirements placed on the disposal system and to ensure that they are met. It also ensures that inevitable changes in requirements and specifications over the lifetime of a disposal project are properly addressed and documented.
In the Netherlands, the first RMS was developed by COVRA during the OPERA research programme (2010 2017). It initially focused solely on disposal but, since the first phase of COPERA (2020–2025), has evolved into a comprehensive system covering the entire radioactive waste management process—from collection to final disposal. The updated RMS is structured into six levels. The first two levels contain requirements applicable to both disposal and pre-disposal activities (collection, treatment, and storage), while levels three and higher specify requirements tailored either to disposal or to particular pre-disposal steps. Collectively, these levels describe how the disposal system addresses requirements derived from regulations and policies.

INTERNATIONAL EVALUATION OF LIFECYCLE STRATEGIES FOR NORM AND DEPLETED URANIUM WASTE: INSIGHTS FROM 18 COUNTRIES

ZOE MCGRATH[1*] & KELVIN BROWNING[1]
[1] NRG, The Netherlands
[*] Corresponding author: mcgrath@nrg.eu

The poster will present the consolidated findings from an international questionnaire on the lifecycle management of challenging waste types, namely Naturally Occurring Radioactive Material (NORM) and Depleted Uranium (DU), performed under EURAD-2 WP-3: ASTRA. Contributions from 21 organisations across 18 countries were analysed, highlighting significant diversity in definitions, regulatory frameworks, and strategic approaches to the management, treatment, and disposal of these waste forms.
The results emphasise varying degrees of maturity in national strategies, with countries such as the UK, the Netherlands, Switzerland, and the Czech Republic demonstrating integrated lifecycle approaches that encompass waste minimisation, treatment, reuse/recycling, and conditional disposal options. Conversely, others remain in the early stages of strategy development, lacking safety cases or disposal programs, especially for DU, which is often regarded more as a resource than a waste.
The questionnaire revealed key technical and strategic challenges, including long-term safety demonstration, conditioning and packaging compatibility, and post-closure safety assessment. Countries pursuing deep geological disposal solutions highlighted concerns regarding radiotoxicity, waste acceptance criteria (WAC), and the implications for safety case development over timescales up to 1 million years.
As a follow-up to the initial findings, a second international workshop has been convened to advance knowledge sharing and collaborative development of disposal solutions. In this forum, the United Kingdom, Slovenia, and France will present their current technical and regulatory approaches for the safe disposal of NORM and DU waste. These contributions are expected to provide practical insights into repository planning, performance assessment methodologies, and the integration of reuse and backfill strategies into safety cases.
The study underlines the need for continued international engagement to harmonise disposal practices and enhance technical readiness for managing these complex waste streams. The poster will provide an overview of the study and the results of the final workshop held in September.

Exchange Forum Attendees List

First Name	Last Name	Organisation	Email	Attending	
				EF2025	EURAD2
Jochen	Ahlswede	Federal Office for the Safety of Nuclear Waste Management	jochen.ahlswede@base.bund.de		✓
Marcus	Altmaier	KIT	marcus.altmaier@kit.edu	✓	✓
Tamara	Baldwin	Galson Sciences Ltd	tdb@galson-sciences.co.uk	✓	✓
Amin	Bannani	GNS	amin.bannani@gns.de	✓	✓
Edgar	Bohner	VTT Technical Research Centre of Finland150	edgar.bohner@vtt.fi	✓	✓
Kelvin	Browning	NRG PALLAS	browning@nrg.eu	✓	✓
Christophe	Bruggeman	SCK CEN	christophe.bruggeman@sckcen.be		✓
Alexandr	Butovič	SATRA, spol. s r.o.	alexandr.butovic@satra.cz	✓	✓
Tomas	Bym	WSP Sverige AB	tomas.bym@wsp.com	✓	✓
Mirta	Čanak	Fund for financing the decommissioning of the Krško NPP	mirta.canak@fond-nek.hr	✓	
Kateřina	Černá	Technical University of Liberec	katerina.cerna1@tul.cz	✓	✓
Tomáš	Černoušek	Research Centre Řež	tomas.cernousek@cvrez.cz	✓	✓
Sergey	Churakov	Paul Scherrer Institute	sergey.churakov@psi.ch	✓	✓
Eli	Colas	Amphos 21	eli.colas@amphos21.com	✓	
Patrick	Cox	INTERA Geosciences UK Limited	pcox@intera.com	✓	
Gyula	Dankó	PURAM	danko.gyula@rhk.hu	✓	✓
Katalin	Dauner-Smudla	WSP Hungary Consulting Zrt.		✓	
Jimena	De Hita	Enresa	mjhf@enresa.es	✓	✓
Christophe	Debayle	ASNR - Autorité de sûreté nucléaire et de radioprotection	christophe.debayle@asnr.fr	✓	✓
Valéry	Detilleux	EURAD-2	valery.detilleux@belv.be		✓
Markéta	Dohnálková	SÚRAO	dohnalkova@surao.cz	✓	✓
Sabrina	Dollinger	NES			✓
Martin	Dostalík	Czech Geological Survey	dostalik.martin24@gmail.com		✓

First Name	Last Name	Organisation	Email	Attending	
				EF2025	EURAD2
Barbora	Drtinová	CTU in Prague	barbora.drtinova@fjfi.cvut.cz	✓	✓
Delphine	Durce	SCK CEN	ddurce@sckcen.be	✓	✓
Tomas	Ehler	Ministry of Industry and Trade (CZ)		✓	
Jon	Engström	Geological Survey of Finland	jon.engstrom@gtk.fi	✓	✓
Joaquín	Farias Seifert	Enresa	jfas@enresa.es	✓	✓
Maxime	Fournier	CEA	maxime.fournier@cea.fr		✓
Anni	Fritzell	Svensk Kärnbränslehantering AB (SKB)		✓	✓
Kateryna	Fuzik	SSTC NRS	kv_fuzik@sstc.ua		✓
David	García Cobos	Amphos 21	david.garcia@amphos21.com	✓	✓
José Luis	García-Siñeriz Martínez	Amphos21	jl.garciasineriz@amphos21.com		✓
Astrid	Göbel	BGE mbH	astrid.goebel@bge.de	✓	✓
Antonio	Guida	Amentum	antonio.guida@global.amentum.com	✓	
Amadé	Halász	PURAM	halasz.amade@rhk.hu	✓	
Johanna	Hansen	Posiva Oy	johanna.hansen@posiva.fi	✓	✓
Lucie	Hausman-nova	SÚRAO	hausmannova@surao.gov.cz	✓	✓
Philipp	Herold	BGE mbH	philipp.herold@bge.de	✓	✓
Charlotte	Hjorth	Danish Decommissioning	chhjo@dekom.dk	✓	✓
Mees	Hoeksma	NRG PALLAS	hoeksma@nrg.eu	✓	
Milan	Hokr	Technical University of Liberec	milan.hokr@tul.cz	✓	✓
Erika	Holt	VTT	erika.holt@vtt.fi	✓	✓
Yu-Hsiang	Huang	Sinotech Engineering Consultants, INC.	shawn.sinotech@gmail.com	✓	✓
Antti	Ikonen	Posiva Solutions Oy	antti.ikonen@posiva.fi	✓	
Elke	Jacops	SCK CEN	ejacops@sckcen.be	✓	✓
Tiina	Jalonen	Nagra	tiina.jalonen@nagra.ch	✓	✓

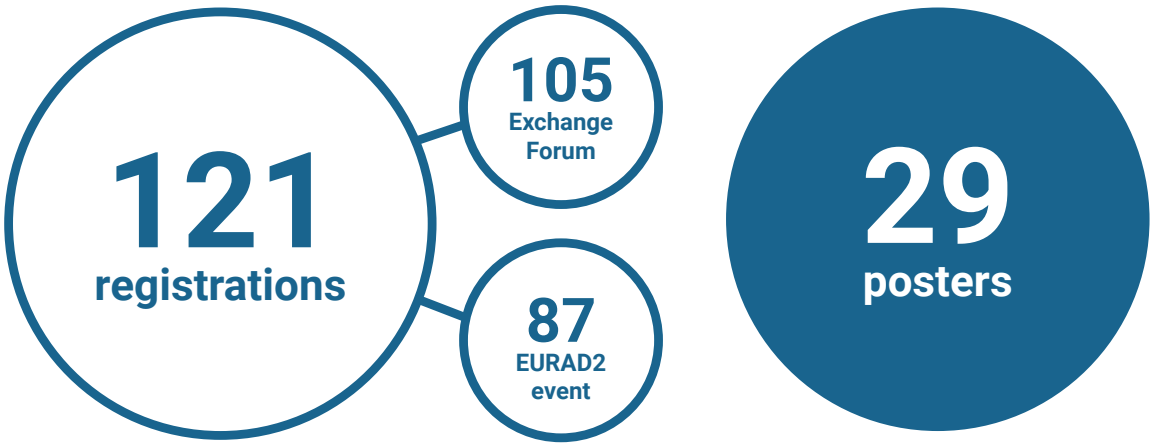
First Name	Last Name	Organisation	Email	Attending	
				EF2025	EURAD2
Frans	Jansson	Fortum	frans.jansson@fortum.com	✓	
Chin-Hsiang	Kang	Taiwan Power Company	u615536@taipower.com.tw	✓	✓
Lucie	Karaskova Nenadalova	Research Centre Rez, Czech Republic	lucie.nenadalova@cvrez.cz	✓	✓
Leon	Kegel	ARAO	leon.kegel@arao.si	✓	✓
Kimmo	Kemppainen	Posiva Oy	kimmo.kemppainen@posiva.fi	✓	
Jake	Kinghorn-Mills	MCM Environmental Services Ltd.		✓	
Lena	Koelbel	KIT	lena.koelbel@kit.edu	✓	✓
Štěpán	Kochánek	State Office For Nuclear Safety	stepan.kochanek@sujb.gov.cz	✓	
Anja	Kömmling	Bundesanstalt für Materialforschung und –prüfung (BAM)		✓	
Anne	Kontula	Teollisuuden Voima Oyj	anne.kontula@tvo.fi	✓	✓
Hana	Kovářová	Research Centre Rez	hana.kovarova@cvrez.cz	✓	✓
Marketa	Kucerova	Czech Technical University in Prague	marketa.kucerova@fsv.cvut.cz	✓	✓
Yevheniia	Kudriashova	SSTC NRS	yv_kydriashova@sstc.ua		✓
Karina	Lange	IAEA		✓	✓
Didier	Leonard	SCK CEN	didier.leonard@sckcen.be	✓	✓
Olivier	Leupin	Nagra		✓	✓
Chao	Li	INTERA Inc. Swiss Branch	cli@intera.com	✓	
Andree	Lommer-zheim	BGE TECHNOLOGY GmbH	andree.lommerzheim@bge.de	✓	
Konrad	Lotter	AGES – Austrian Agency for Health and Food Safety	konrad.lotter@ages.at		✓
Sarah	Louis	Bundesgesellschaft für Endlagerung mbH (BGE)	sarah.louis@bge.de	✓	✓
Jessica	Mackie	British Geological Survey	jesmac@bgs.ac.uk	✓	
Aldo	Madaschi	Nesol	aldo.madaschi@nesol.net	✓	
Marie	Maincent	French Embassy in Czech Republic		✓	✓
Erik	Marenčák	CTU in Prague	mareneri@cvut.cz	✓	✓

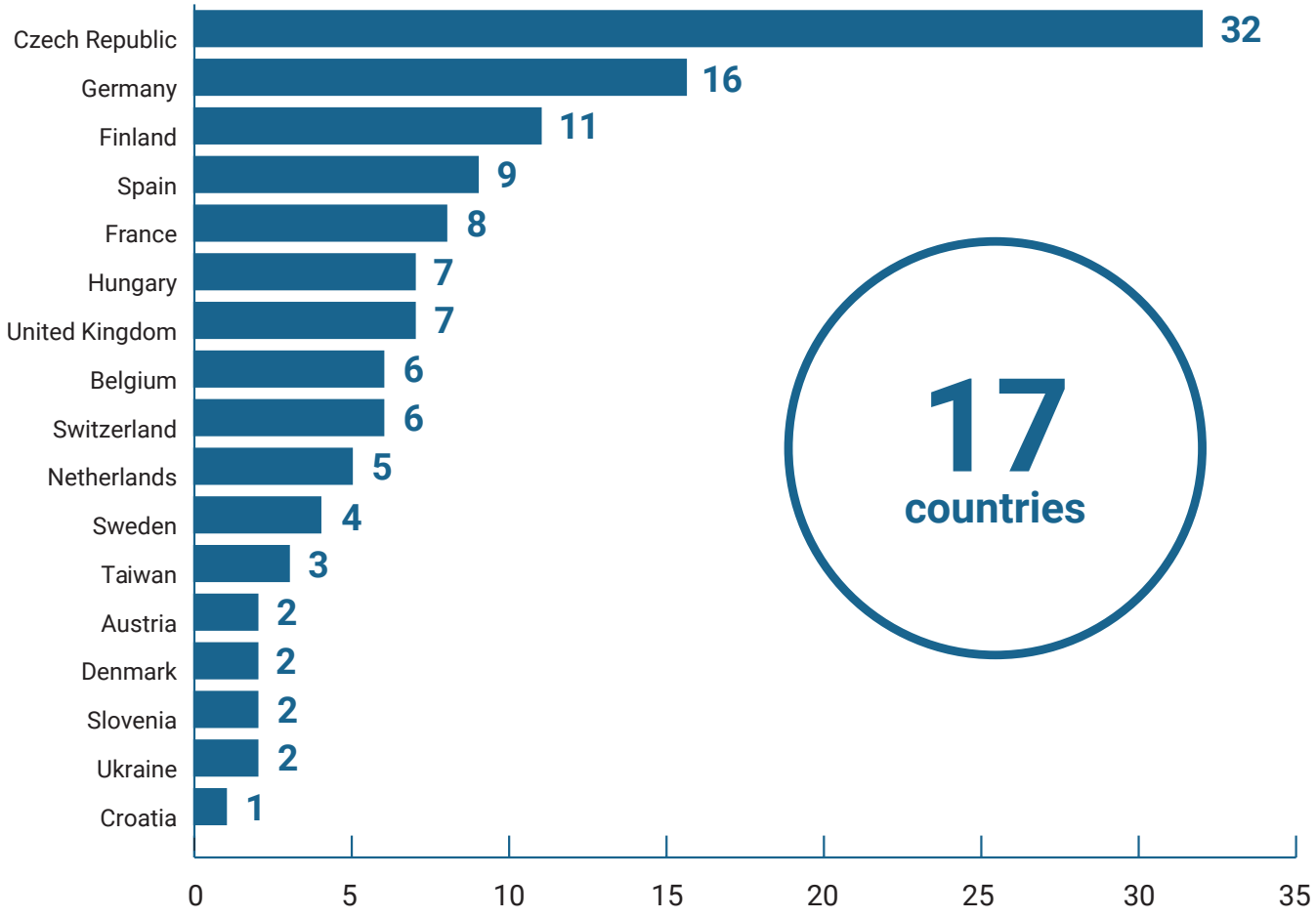
First Name	Last Name	Organisation	Email	Attending	
				EF2025	EURAD2
Jon	Martin	Nuclear Waste Services	jonathan.martin@nuclearwasteservices.uk	✓	✓
Georges	Matta	ASNR	georges.matta@asnr.fr		✓
Eliška	Matušková	SÚRAO	matuskova@surao.gov.cz	✓	
Juan Carlos	Mayor	Enresa	jmaz@enresa.es	✓	
Zoe	McGrath	NRG	mcgrath@nrg.eu	✓	
Matthias	Mohlfeld	BGE Bundesgesellschaft für Endlagerung mbH	matthias.mohlfeld@bge.de	✓	
Nadia	Mokni	ASNR	nadia.mokni@asnr.fr	✓	✓
László	Molnár	PURAM (Radioaktiv Hulladekokat Kezelo Kft)	molnar.laszlo@rhk.hu	✓	
Péter	Molnár	PURAM (Radioaktiv Hulladekokat Kezelo Kft)	molnar.peter@rhk.hu	✓	
Lumír	Nachmilner	Centrum výzkumu Řež s.r.o.	lumnach@gmail.com	✓	✓
Gerda	Németh	PURAM	nemeth.gerda@rhk.hu	✓	✓
Steen	Nordstrom	Danish Decommissioning		✓	
Olli	Nummi	Fortum	olli.nummi@fortum.com	✓	
Tyler	Oesch	Federal Office for the Safety of Nuclear Waste Management (BASE)	tyler.oesch@base.bund.de		✓
Naïm	O'Neill	Amphos 21 Consulting SL	naim.oneill@amphos21.com		✓
Cristiano	Padovani	Amentum	cristiano.padovani@global.amentum.com	✓	✓
Marek	Pekala	AMPHOS 21 CONSULTING, SPAIN	marek.pekala@amphos21.com	✓	✓
Leonie	Peti	Bundesgesellschaft für Endlagerung mbH (BGE)	leonie.peti@bge.de	✓	✓
Jaroslava	Pravdová	European Commission - Joint Research Centre	jaroslava.pravdova@ec.europa.eu	✓	✓
Aurelien	Prevost	French Embassy	aurelien.prevost@diplomatie.gouv.fr	✓	✓
Susanne	Pudollek	Nagra	susanne.pudollek@nagra.ch	✓	✓
Heini	Reijonen	Geological Survey of Finland	heini.reijonen@gtk.fi	✓	✓
Jean-Charles	Robinet	Andra	jean-charles.robinet@andra.fr	✓	✓

First Name	Last Name	Organisation	Email	Attending	
				EF2025	EURAD2
Tomas	Rosendorf	Ministry of Industry and Trade CZ		✓	
Silvia	Rueda Sanchez	Enresa	srus@enresa.es	✓	✓
Šárka	Šachlová	UJV Rez, a.s.	sarka.sachlova@ujv.cz	✓	✓
Timothy	Schatz	VTT Technical Research Centre of Finland	timothy.schatz@vtt.fi	✓	✓
Victoria	Schettler	Bundesgesellschaft für Endlagerung mbH	victoria.schettler@bge.de	✓	
Stéphan	Schumacher	Andra	stephan.schumacher@andra.fr	✓	✓
Nataline	Simon	ASNR	nataline.simon@asnr.fr		✓
Hedwig	Sleiderink	Ministry of Infrastructure and Water Management	hedwig.sleiderink@minienw.nl	✓	✓
Jan	Smutek	SÚRAO	smutek@surao.cz	✓	✓
Jiri	Stastka	CTU in Prague, Josef URL	jiri.stastka@fsv.cvut.cz	✓	✓
Anders	Ström	SKB – Asset development department	anders.strom@skb.se	✓	✓
Jiří	Svoboda	ČVUT FSv	svobodaj@fsv.cvut.cz	✓	✓
Louise	Théodon	Andra	louise.theodon@andra.fr	✓	✓
Milan	Touš	SÚRAO	tous@surao.gov.cz	✓	✓
Radek	Trtílek	ÚJV Řež, a. s.	radek.trtilek@ujv.cz	✓	
Tsui-Lin	Tsai	National Atomic Research Institute	polly@nari.org.tw	✓	✓
Maarten	Van Geet	ONDRAF/NIRAS	m.vangeet@nirond.be	✓	✓
Barbora	Vašková	Czech Technical University in Prague	vaskoba1@fjfi.cvut.cz	✓	✓
Petr	Večerník	ÚJV Řež, a. s.	petr.vecernik@ujv.cz	✓	✓
Marek	Vencl	SURAO		✓	
Marika	Vespa	Brenk Systemplanung GmbH	m.vespa@brenk.com	✓	✓
Holger	Völzke	Bundesanstalt für Materialforschung und -prüfung (BAM)	holger.voelzke@bam.de	✓	
Lukáš	Vondrovic	SÚRAO	vondrovic@surao.gov.cz	✓	
Marja	Vuorio	COVRA		✓	✓

Melinda	Wieser	WSP Hungary Consulting Zrt.	melinda.wieser@wsp.com	✓	
Nadja	Zeleznik	EIMV	nadja.zeleznik@eimv.si		✓
Milan	Zuna	UJV Řež a.s.		✓	

Conference Numbers





Conference Dinner

The Conference Dinner will take place on Tuesday, 25 November 2025, at the Slivovitz Museum, an original Czech distillery.
Address: U Lužického Semináře 116, 118 00 Prague 1. https://slivovitzmuseum.com/

You can choose how you would like to get there – by walking or by historic tram:

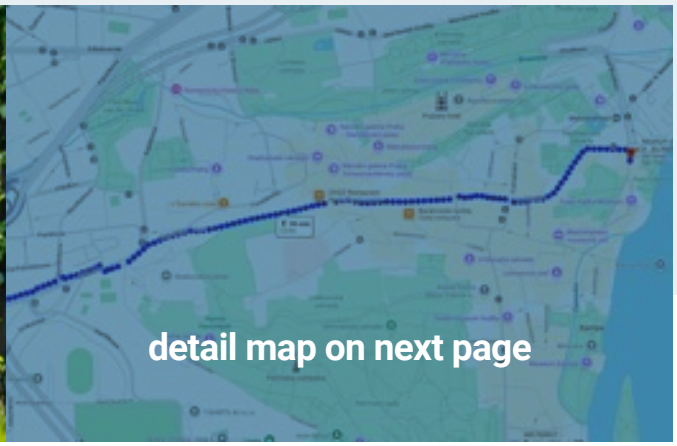
BY HISTORIC TRAM

18.15 – Meet in the lobby of the Hotel Pyramida to take a historic tram to the venue (approx. 15 minutes). Please note that the capacity of the historic tram is limited to 60 persons – get your ticket at the registration desk (first come, first served!). The tram will leave from Dlabacov station at 18.30.

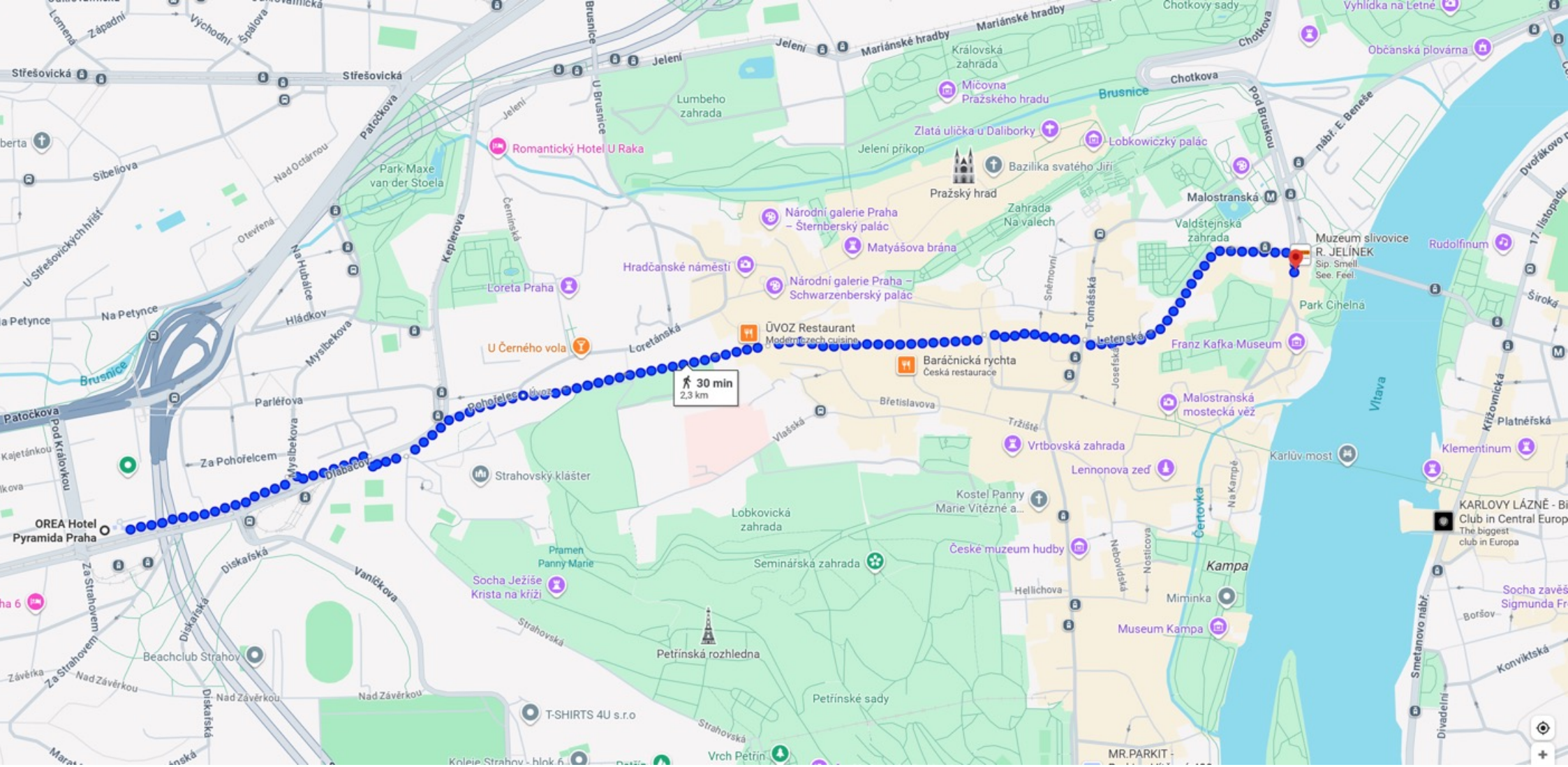
BY WALKING

18.15 – Meet in the hotel lobby. For those who prefer to walk, it is about a 30-minute scenic walk through the Prague Castle area. A SURAO representative will accompany the walking group, and a map will be provided.

Route here



19.00 – Dinner will begin (at the Slivovitz Museum)



Walking Route to/from the Conference Dinner – Departs at 18.15

It is about a 30-minute scenic walk through the Prague Castle area to the Slivovitz Museum. A SURAO representative will accompany the walking group.

Technical Tours

The technical tours on Thursday 27 November 2025 all depart from the Hotel Pyramida.
Please ensure you arrive promptly so we can depart at the stated time.

Bukov Underground Research Laboratory

The Bukov underground research facility (URF) is located 550 metres below the surface in the former Rožná uranium mine, which was the last uranium mine in operation in Central and Western Europe before its closure in 2017. Experiments are conducted at the Bukov URF aimed at obtaining data on the behaviour of the rock environment at the expected depth of the future deep geological repository. It is also used for in-situ testing of the materials being considered for the construction of the engineered barriers. The first section of the Bukov URF was put into operation in 2017 and the second section of the underground complex, which includes 13 test chambers, opened earlier this year.

Programme:

06.30	Departure by bus from the Hotel Pyramida
09.00	Arrival at the Rožná I former mine Dolní Rožínka: **map**
09.15–09.45	Coffee and presentation on SÚRAO and the Bukov URF
09.45–10.15	Preparation for the visit to the underground facility (change of clothes, safety training)
10.30–12.15	Visit to the underground facility (presentation of experiments)
12.30–13.15	Lunch and discussion
13.30	Departure by bus to Prague
16.00–17.00	Expected arrival in Prague (depending on traffic conditions)

Maximum number of participants: 25

Conditions of Entry:

Because the underground laboratories are located within the radiation protection controlled zone (with the potential presence of ionising radiation – former uranium mine), the personal details of all the participants are needed in advance (name, passport number, date of birth and company) in order to be granted permission to enter the facility. Visitors are provided with protective clothing and footwear on-site. Pregnant women, persons under 18 years of age and persons that suffer from claustrophobia or any other illnesses/conditions that could endanger their health during the visit are not permitted to enter the controlled zone. Visiting the Bukov URF may be physically and mentally demanding and/or stressful for those with such illnesses/conditions.

Access gallery BZ-XIIJ of Bukov URF I

Richard Repository

The Richard Repository has been in operation for over 60 years. Formerly a limestone mine, a secret Nazi factory and currently the oldest waste disposal facility in the Czech Republic, the Richard facility has been used for the disposal of intermediate and low-level radioactive waste since 1964. The facility is located near to the historic town of Litoměřice and is used for the disposal of so-called institutional waste (i.e. materials from the industry, healthcare and research sectors). Some of the waste is accepted for storage (rather than disposal) pending its final disposal in the planned Czech deep geological repository. The Richard disposal facility also includes a certified testing facility for waste packages and special form radioactive substances.

Programme:

08.00	Departure from the Hotel Pyramida
09.00	Arrival at the Richard disposal facility
09.15–09.30	Disposal facility entry information
09.30–11.00	Excursion + presentation
11.00–12.00	Refreshments
13.00	Arrival in Prague

Maximum number of participants: 24

Conditions of Entry:

Because the disposal facility is located within the radiation protection controlled zone (with the potential presence of ionising radiation), the personal details of all the participants are needed in advance (name, passport number, date of birth and company) in order to be granted permission to enter the facility. Visitors are provided with protective clothing on-site.
Pregnant women, persons under 18 years of age and persons that suffer from claustrophobia or any other illnesses/conditions that could endanger their health during the visit are not permitted to enter the controlled zone. Visiting the Richard disposal facility may be physically and mentally demanding and/or stressful for those with such illnesses/conditions.

Richard Repository

Research Centre Řež

Building on the experience of its parent company ÚJV Řež (the former Nuclear Research Institute), the Research Centre Řež (CVŘ) was established in 2002 to undertake research and development in the energy sector, especially in the nuclear field. A modern research base with expert teams, CVŘ also has a unique experimental infrastructure including the LVR-15 and LR-0 research reactors, process loops, hot cells and a full range of state-of-the-art laboratories.
Reactor LVR-15 (control room and reactor hall, hot cells) – The LVR-15 reactor is used primarily for irradiation of materials, production of radiopharmaceuticals and experiments using neutron radiography and other applications of neutron beams.
SUSEN hot cells – Hot cells instrumentation intended for scientific purposes (autoclave, blasting and fatigue machines, cycling machine, creeping machine) and preparation of samples (ES, EDM, CNC, sample preparation for microscopy), SEM, nanoindentor.

Programme:

08:00 Departure of bus from Hotel Pyramida
09:00 Arrival at CVŘež
09:00 Introduction and check-in at the ÚJV reception
09:40 – 10.45 Hot Cells (Group A) / LVR-15 Research Reactor (Group B)
10:45 – 12.00 Hot Cells (Group B) / LVR-15 Research Reactor (Group A)
12:00 – 12:45 Lunch and discussion
12.45 Departure of bus to Prague
13:45 Expected arrival in Prague (depends on traffic conditions)

Maximum number of participants: 32 (in 2 groups)

Conditions of Entry:

- ➜ Entrance to the UJV Group premises is at the visitor‘s own risk. UJV Group assumes no liability for damage of any kind occurring on the works premises.
- ➜ Each visitor, including accompanying persons, is issued an access authorisation badge and must be registered at the security checkpoint. Badges must remain clearly visible.
- ➜ Entering the premises under the influence of alcohol or any classified substance is prohibited. Furthermore, it is prohibited to bring in, be in possession of or consume alcoholic beverages or any narcotic or psychotropic substances on the premises. A visitor can be randomly selected for an alcohol or drug test.
- ➜ Filming or photographing on the premises or the publishing of anything heard or seen is strictly prohibited.
- ➜ Electronics including cell phones (switched on) and weapons including knives are not allowed. Prohibited objects can be stored in the assigned area.
- ➜ Tour participants must wear appropriate footwear – sturdy, low-heeled shoes, and trousers are expected. Woman may wear a skirt if they also wear tights.

Research Centre Řež
Hot Cell

General Information

ADDRESS OF THE EXCHANGE FORUM VENUE

OREA Hotel Pyramida Praha, Bělohorská 24, 169 00 Praha 6, Czech Republic
website map

ACCESS TO THE HOTEL

From Prague Airport (Václav Havel Airport):

- By public transport (around 45 minutes) – the tram station (Malovanka) is 150 metres from the hotel.
  map Prague public transport

- By taxi (20–25 minutes), depending on traffic.
  Official airport taxis and ride-hailing services (Bolt, Uber) are available directly in front of the arrivals hall. The approximate cost would be 400–800 Kč (15-30 €) depending on the time of day.

By car:

- The hotel is easily accessible from the D5 and D6 highways. Follow the signs towards Praha – Centrum (City Centre) and then to Břevnov. The OREA Hotel Pyramida offers on-site parking for guests (fees may apply).

PUBLIC TRANSPORT IN PRAGUE

Prague has a reliable and extensive public transport network, including metro, trams and buses. Here are the key points:

Tickets:

- You must have a valid ticket before boarding any tram, bus or metro.
- Tickets are time-based, not distance-based: (30 minutes / 90 minutes / 24 hours / 72 hours
- Tickets can be purchased at ticket machines, newsstands, or via the PID Lítačka app.
- Always validate your ticket when using paper tickets.

Metro:

- 3 lines: A (green), B (yellow), C (red).
- Runs roughly every 2–10 minutes during the day, less frequently at night.

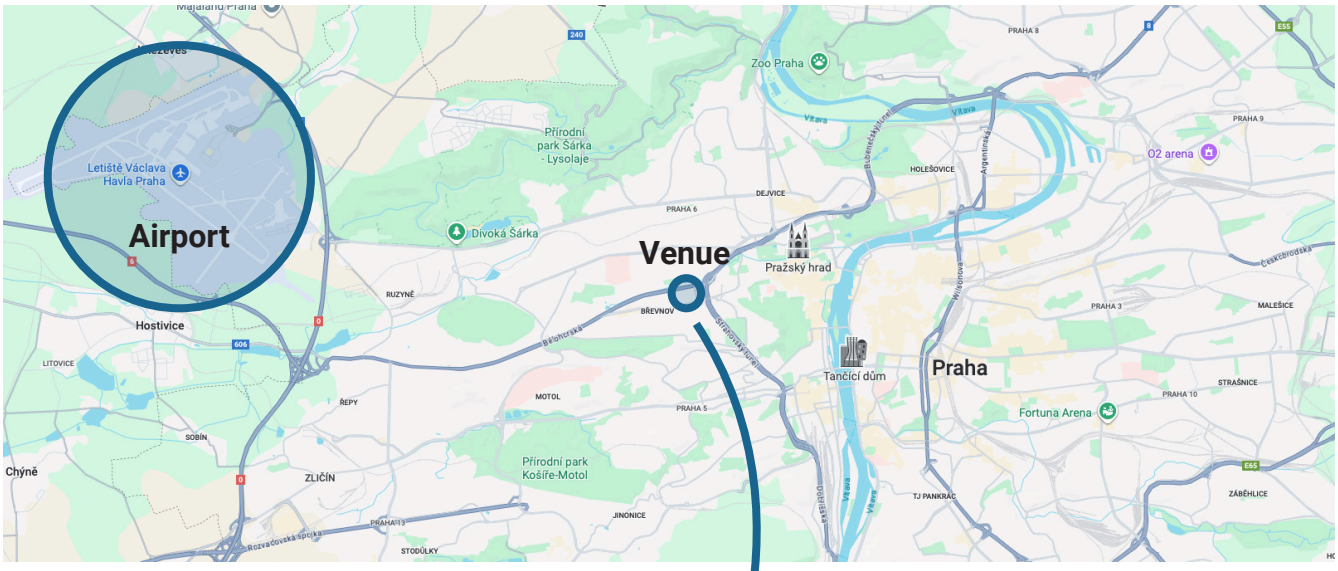
Trams:

- ➜ Extensive network covering most of the city.
- ➜ Day trams run frequently, night trams operate less often.

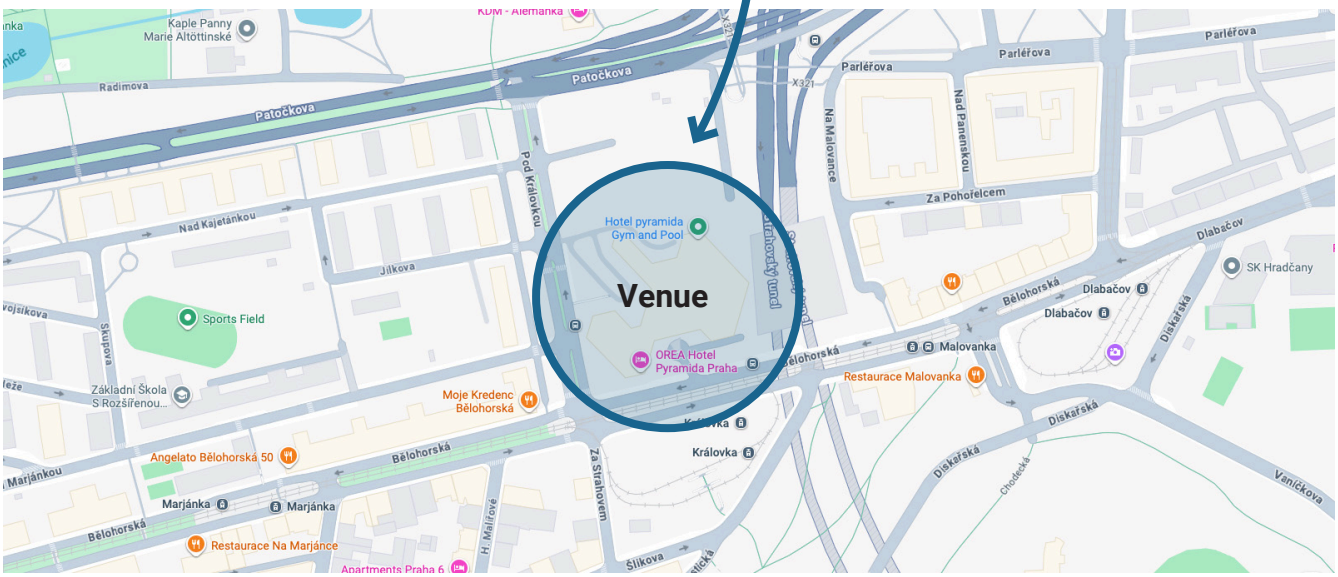
Buses:

- ➜ Serve areas not covered by metro or tram.
- ➜ Important for airport connections and outer districts.

Useful Links: **Prague public transport** **PID lítačka**



map



map

Practical Information

Registration Desk

The registration desk, located at the ground floor, will be open for registration and information during the following hours:

- Tuesday, 25 November: 08.30–17.30
- Wednesday, 26 November: 08.30–14.00

Badges

Attendees are requested to wear and display their conference badge at all times in the venue.

Wifi

Free wifi called Pyrmida (with no password) is available at the Exchange Forum.

Speakers

Speakers are required to provide the Secretariat with their presentation by 15 November 2025.

Posters

Authors are required to bring the hardcopy of their poster with them. It should be printed in A0 size in portrait (vertical) orientation. Authors are encouraged to discuss their posters during refreshment breaks and lunch. Take the opportunity to advertise your poster in the elevator pitch sessions! If your poster is to be displayed on the IGD-TP website, a PDF file copy of the poster must be provided to the Secretariat by 15 November 2025.

Your vote counts!

Your name badge contains 3 stickers. Please attach these to your favourite posters. What posters (and their presenters) are the most engaging and informative? Attach your stickers to one, two or three posters. The poster with the most votes by 10.50 on Day 2 will win a prize!

Refreshment Breaks

Refreshments will be served in the lobby outside the meeting room at the times specified in the programme.

Lunches

Lunches will be served in the Nebula Restaurant on the first floor at the times specified in the programme.

Conference Dinner

The Conference Dinner will be held on Tuesday, 25 November, 19.00–23.00 at the Slivovitz Museum, U Lužický Seminary 116, 118 00 Prague 1 https://slivovitzmuseum.com/
Please note that access to the Dinner is restricted to attendees who have specifically registered and paid for it. Late registration will depend on availability.

Technical Tours

All the technical tours leave on Thursday 27 November 2025 from Hotel Pyramida. See the programme and dedicated technical tours pages for the individual departure times.

Mobile Phones

Attendees are requested to switch their mobile phone to silent mode when entering the sessions.

Language

English is the official conference language.

Hotels

We recommend staying at the conference venue:
OREA Hotel Pyramida Praha, Bělohorská 24, 169 00 Praha 6, Czech Republic
hotel website
You will find more accommodation options via **the Prague tourism site**

Accessibility

We would like to make this event as accessible as possible. We strongly encourage you to contact us if you need further information or have any queries. The conference rooms and toilets are on the same floor and are wheelchair accessible. Lunches on the first floor are accessible also by elevator and are wheelchair accessible. Service animals are allowed.
For the technical tours, participants should be in reasonable physical condition as there are steps to climb and 1–2 hours walking with no seats in the underground facilities.

Luggage Storage

Luggage can be stored at the hotel reception.

Photography and Videos

Photos and videos will be taken during the sessions of the group as a whole. If you do not want to be recorded, please ensure you sit at the back of the room and also make yourself known to the photographer.

Secretariat Contact

During the event the urgent Secretariat contact number is +420 601 159 030.

Further Information

For any other questions please contact **secretariat@igdtp.eu**

Notes


igd·tp
hosted by
SÚRAO
RADIOACTIVE
WASTE REPOSITORY
AUTHORITY
www.igdtp.eu