Overview of the Horonobe International Project (HIP)

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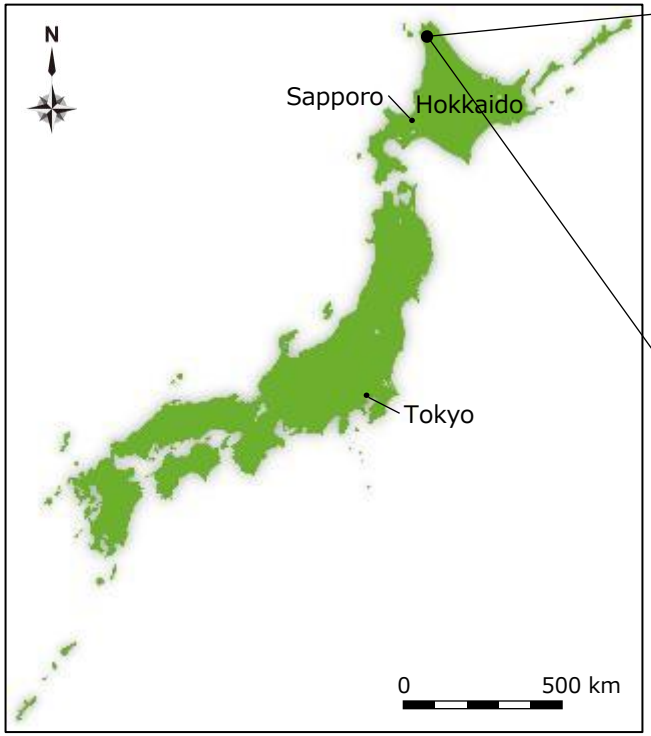
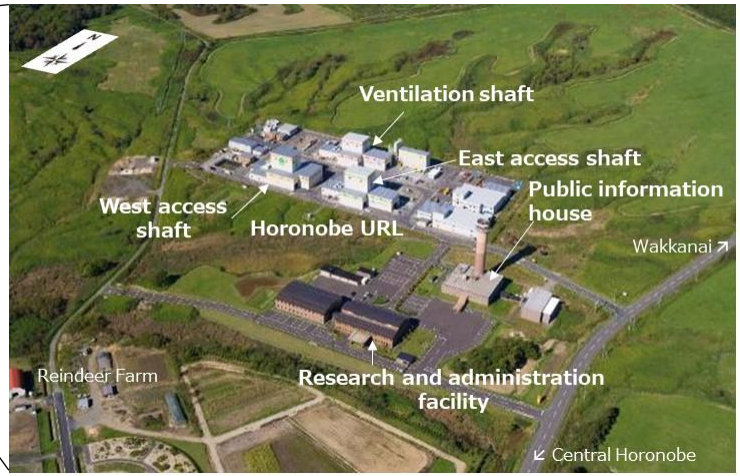
Seventh International Conference on Geological Repositories (ICGR-7): Empowering Progress in Developing Deep Geological Repositories

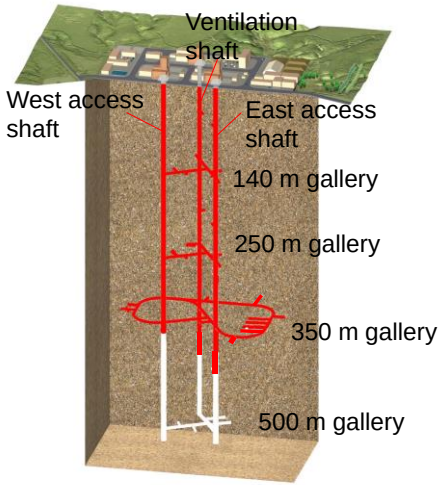
30 May 2024

Busan, Korea

Overview of Horonobe URL



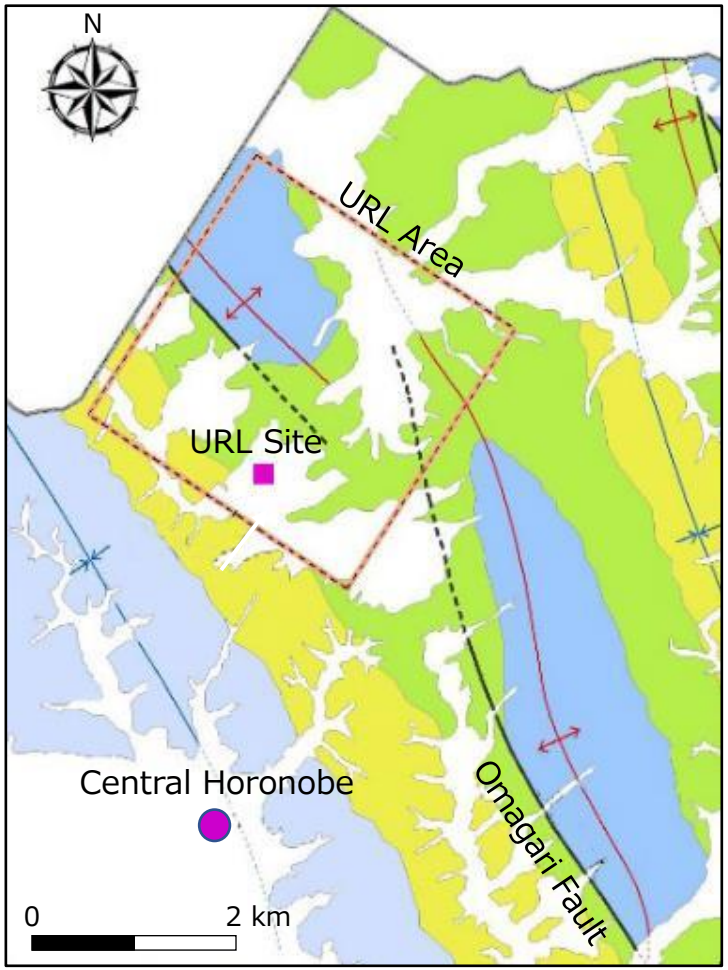




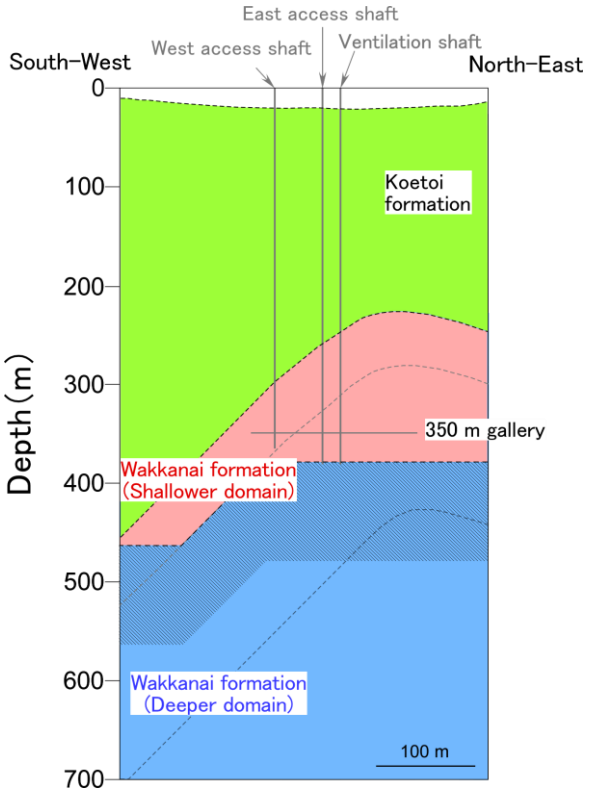
- The Horonobe URL is only the subsurface facility that can be utilised for R&D into the geological disposal of HLW in Japan and NOT a potential DGR site (i.e. Generic URL).

English website:
https://www.jaea.go.jp/english/04/horonobe/index.html

Geological environments in / around Horonobe URL



Geological map around URL Area



Pliocene - Pleistocene
- Sarabetsu Formation (Alternation of conglomerate, ss and ms)
- Yuchi Formation (sandstone)

Miocene - Pliocene
- Koetoi Formation (diatomaceous mudstone)

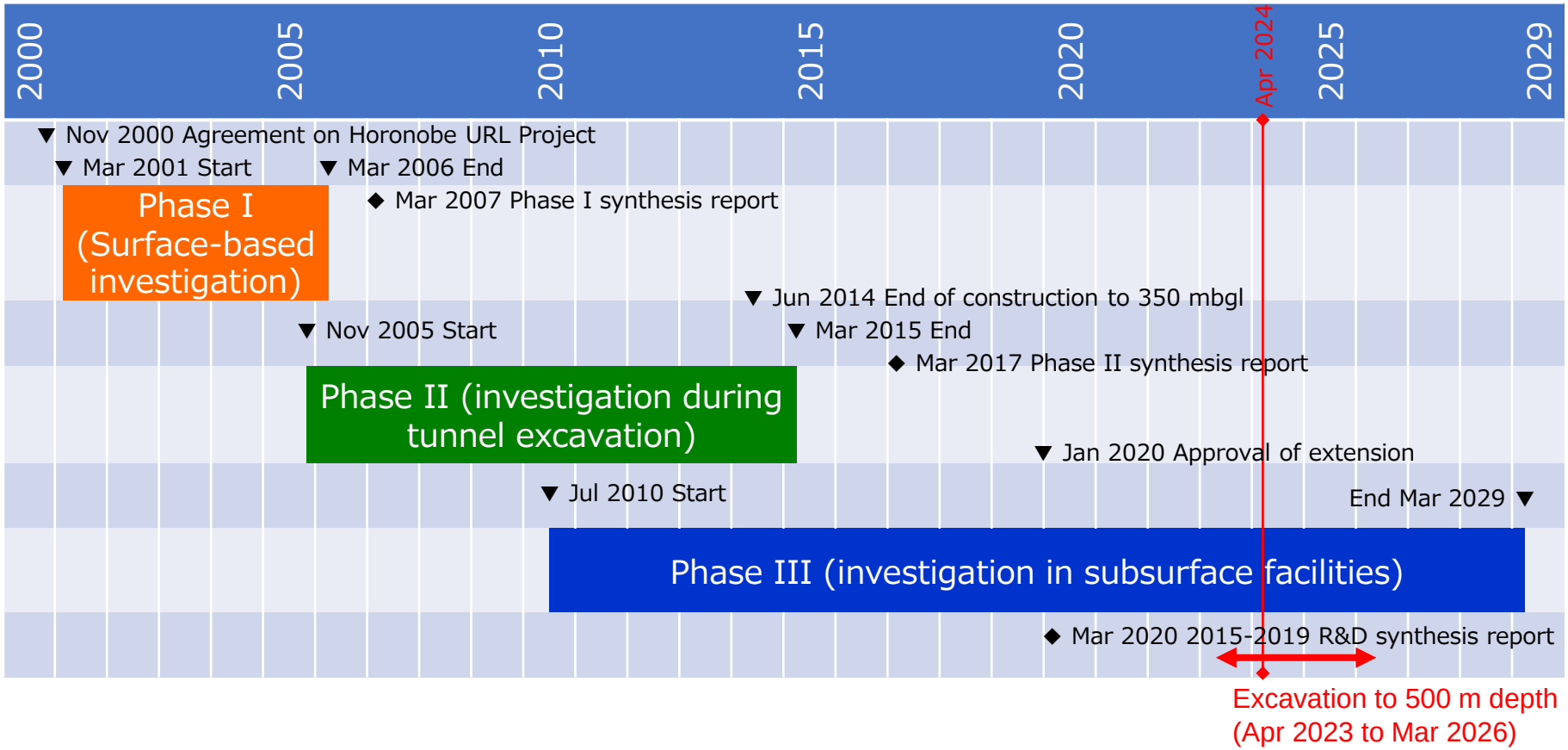
Miocene
- Wakkanai Formation (silicious mudstone)

250m Gallery

350m and 500m Gallery

- Wakkanai Fm and Koetoi Fm are categorised as a **soft sedimentary rock.**
- Groundwater contains **large amounts of dissolved CH_4 and CO_2.**
- **Deep saline water** is of seawater origin and older than 1Ma; **mixture of fossil seawater and freshwater.**

Timetable of Horonobe URL Project



- In Phase III, we focus on the systematic integration of the relevant technology option utilising the result of in situ survey performed in the URL and previous research results.
- Then, our goal is to establish the technological base for geological disposal in the light of technological trends in Japan and abroad until the end of March 2029.

Roles of Horonobe URL Project

- The Horonobe URL can enhance the understanding of the subsurface environment and also developing and testing relevant models and techniques under realistic conditions.

- The Horonobe URL can offer a platform for international collaboration, hands-on training, tailor-made courses.

These are great opportunities for the next generation to share and transfer knowledge and experience, to put skills into practice and gain more confidence.

Establishment of Horonobe International Project (HIP)

- JAEA developed a proposal for international cooperation through the framework of NEA joint undertakings, which will address common challenges and R&D topics of higher interest amongst radioactive waste management organisations and regulators in countries developing DGRs.

Main goals

1. Develop and demonstrate advanced technologies to be used in repository design, operation and closure and a realistic safety assessment in deep geological disposal, which are recognised as common international challenges.
2. Encourage and train the next generation of engineers and researchers by sharing and transferring a vast amount of knowledge and experience developed to date in relevant organisations worldwide.

Research tasks

Task A: Solute transport experiment with model testing

Task B: Systematic integration of repository technology options

Task C: Full-scale Engineering Barrier System (EBS) dismantling experiment

These are of great concern to many international organisations as recognised during the discussion at International Roundtable on the Final Disposal of High-Level Radioactive Waste and Spent Fuel (OECD/NEA, 2020).

The HIP was set up in February 2023 and will last until March 2029.
The proposed R&D programme will be taken forward in two phases:

- Phase 1: Feb 2023 to Mar 2025 ; and
- Phase 2: Apr 2025 to Mar 2029

Participating organisations

Organisation	A	B	C
BGE: Bundesgesellschaft für Endlagerung mbH	○	○	○
BGS: British Geological Survey	○	○	○
CRIEPI: Central Research Institute of Electric Power Industry	○		○
CSIRO: Commonwealth Scientific and Industrial Research Organisation	○	○	○
ITRI: Industrial Technology Research Institute	○		
JAEA: Japan Atomic Energy Agency *Operating Agent	○	○	○
KAERI: Korea Atomic Energy Research Institute	○	○	○
NUMO: Nuclear Waste Management Organization of Japan	○	○	○
RATEN: Regia Autonomă Tehnologii pentru Energia Nucleară	○		
RWMC: Radioactive Waste Management Funding and Research Center		○	○
SERAW: State Enterprise Radioactive Waste	○	○	○

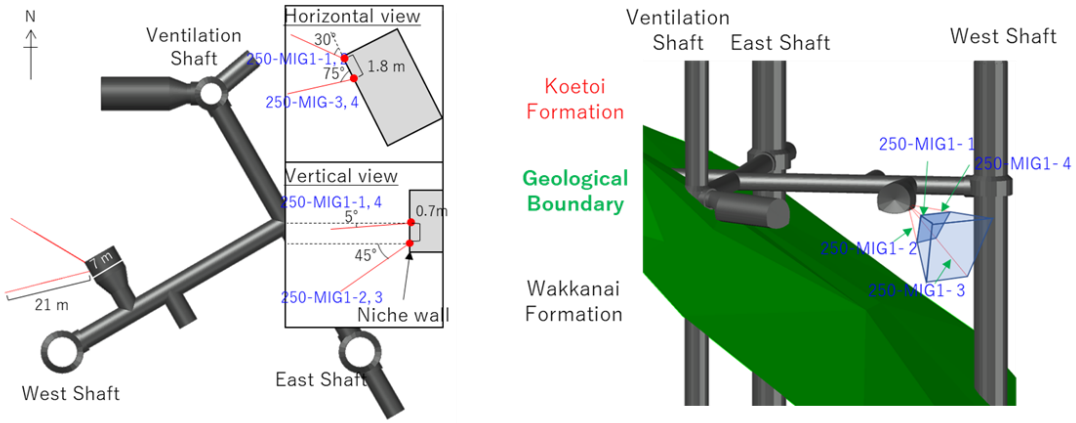
11 organisations from 8 countries / regions

Objective of Task A
Solute transport experiment with model testing

Assessing predictable capability of 3D solute transport models through *in situ* experiments to develop more realistic 3D solute transport models that can be applied to repository safety assessments for fractured sedimentary rocks.

Main result in 2023

- Preparation for tracer tests were performed. The data of geological and hydraulic condition was obtained for the setting of experiments at the 250 m Gallery.



Layout of the four boreholes for experiment at the 250 m Gallery

Boring survey for *in situ* tracer test

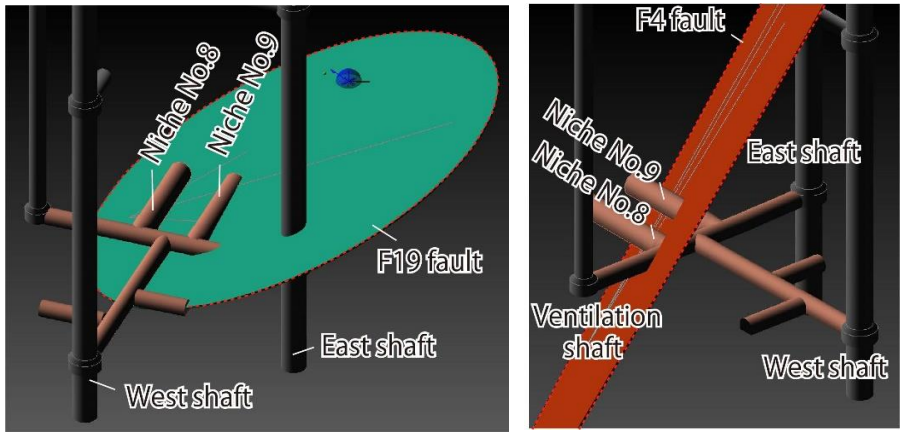
Photo of hydraulic test

Objective of Task B
Systematic integration of repository technology options

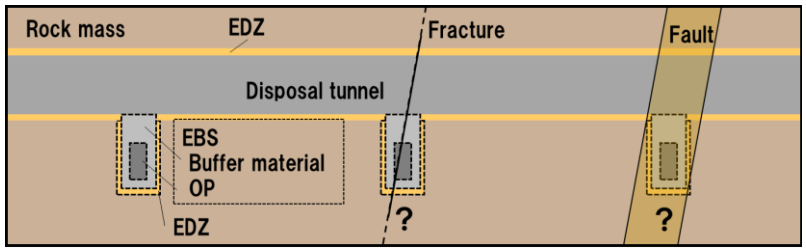
Demonstrating systematic integration of technologies for locating the disposal tunnels and pits / holes through developing technology options that could contribute to the operation of disposal sites and establishing criteria for locating the disposal pits / holes in suitable rock domains.

Main result in 2023

- Provisional criteria for the arrangement of pits and galleries were discussed on the basis of the advanced cases of SKB and NUMO.
- The distribution of faults or pre-existing fractures, the development of excavation damaged zone (EDZ) and groundwater inflow from the fracture was investigated prior to the excavation of the 500 m Gallery.



Predicted fractures in and around the 500 m Niches No. 8 and No. 9.



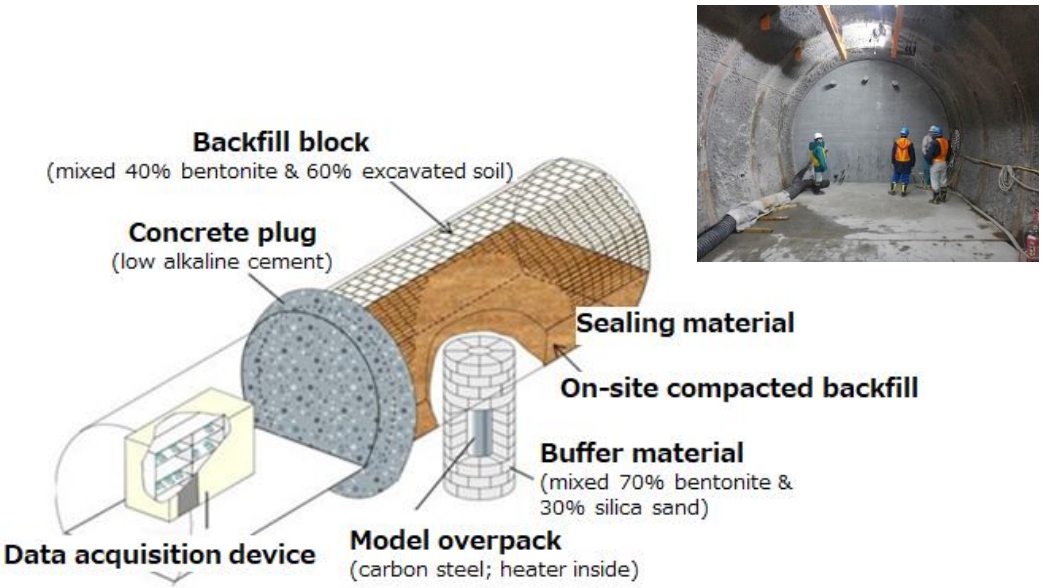
Schematic illustration of pit layout criteria

Objective of Task C
Full-scale EBS dismantling experiment

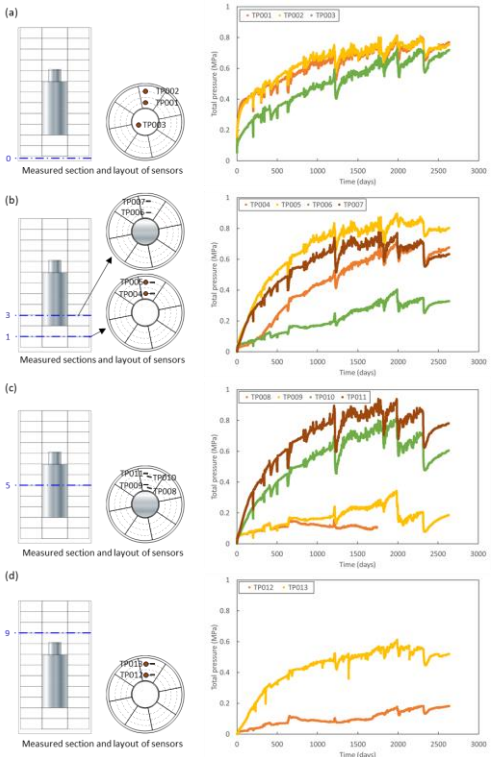
Testing and updating the Thermo-Hydro-Mechanical-Chemical coupled simulation codes by understanding the near-field T-H-M-C coupled processes in more detail through dismantling the previously installed EBS setup.

Main result in 2023

- Data acquisition of the Horonobe EBS experiment was continued.
- The information for elaboration of the dismantling experiment plan to update the dismantling plan was also shared.



Schematic image of the full-scale *in situ* EBS experiment



Example of acquired data (total pressure in the buffer material block)

Key messages

- The Horonobe URL can offer a platform for international collaboration, hands-on training, tailor-made courses for young professionals.

- The HIP is the good practice of the international collaboration using URL although it has just started last year. We will continue collaboration to maximize the result of our URL project and activate the communication among participating organisations.

Interested ? Please contact HIP NEA Secretariat (Soufiane.mekki@oecd-nea.org, chara.kaplani@oecd-nea.org) for more information on how to participate to the Joint Project.

ROLE OF UNDERGROUND RESEARCH LABORATORIES (URLs) IN DGR ADVANCEMENT AND STRATEGIES FOR PROMOTING KNOWLEDGE SHARING

→ IN THE CONTEXT OF RADIOACTIVE WASTE MANAGEMENT IN SWITZERLAND

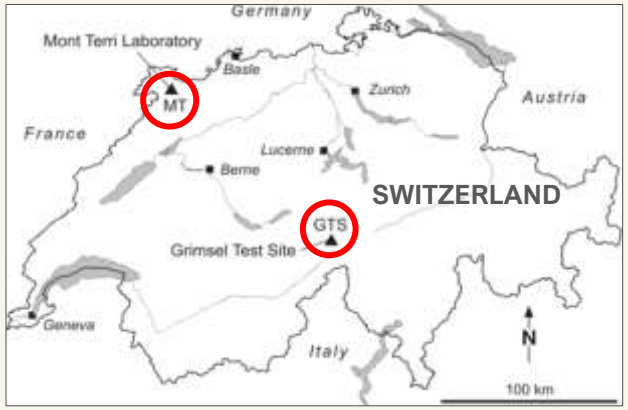
Ingo Blechschmidt, 30 May 2024

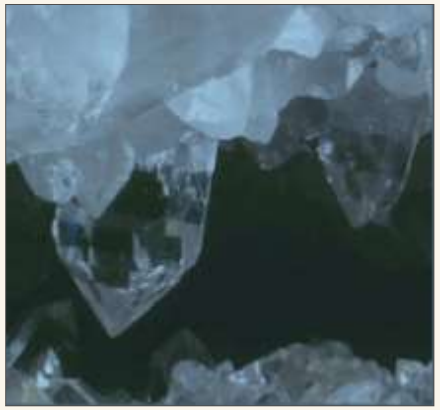
nagra.

**Nagra - National Cooperative for the Disposal of Radioactive Waste*

TWO GENERIC URLs WITH A BROAD SPECTRUM OF ACTIVITIES

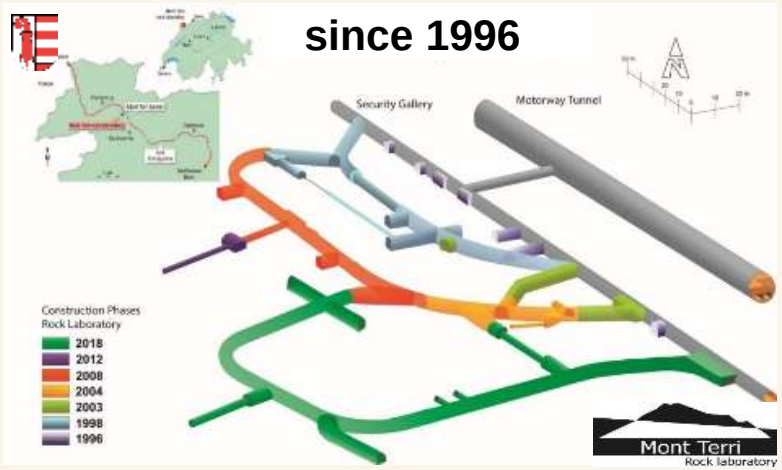




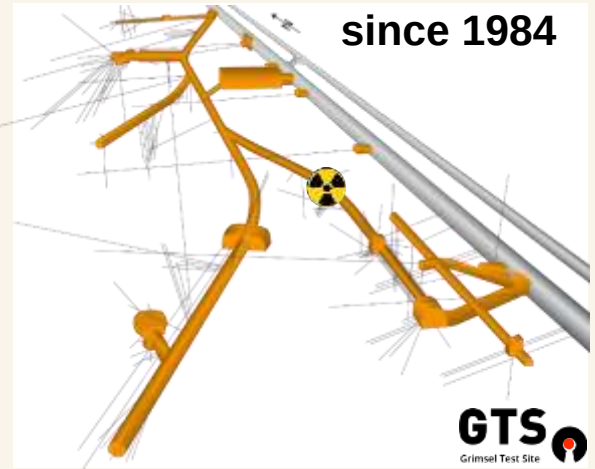



Mont Terri URL
(in **Opalinus Clay**)

- *Owned by République et Canton du Jura and operated by swisstopo*
- *1.2 km of reseach galleries*
- *Overburden: c. 300 m*



→ Study of processes related to host rock & EBS interactions and demonstration
www.mont-terri.ch



→ Investigation of EBS processes, demonstration, testing technology
www.grimsel.com

Grimsel Test Site
(in **crystalline bedrock**)

- *Owned & operated by Nagra*
- *1.1km length, 3.5m tunnels excavated with TBM and drill & blast*
- *Overburden: c. 450 - 500m*

swisstopo

nagra.

OVERALL PICTURE: SWISS HLW PROGRAMME → URLs

The white map approach!

1978 Concept report on nuclear waste management

1980 - 2000 Regional investigations in N. Switzerland (crystalline/sediments)

1984 **Start of operation of the Grimsel Test Site (crystalline URL)**

1985 Project Gewähr (crystalline) submitted

1988 Federal Council decision on Gewähr: investigations extended to clays / start of sediment programme

1996 **Start of operation of Mont Terri Project (Opalinus Clay URL)**

2002 Opalinus Clay project (feasibility study submitted to authorities)

2006 Feasibility study approved by Federal Council

2008 Start of Sectoral Plan process

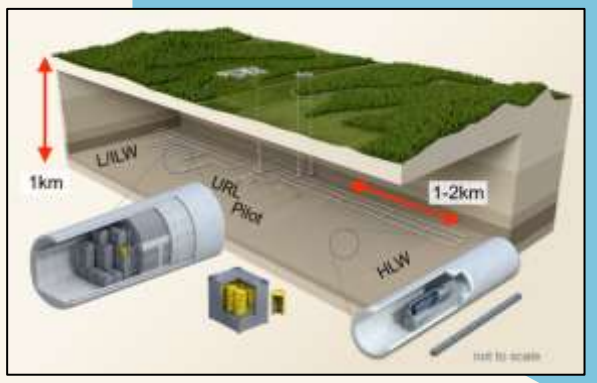
2024 **General licence application for the HLW repository**

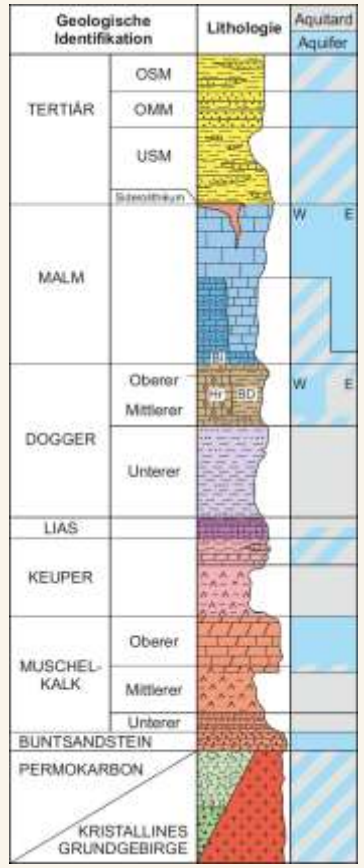
2029 Government decision

from 2035 Underground investigations / construction phase

from 2060 Start of repository operation

Swiss concept: combined DGR for L/ILW and SF/HLW





THE RD&D FOCUS FOR URLs EVOLVES OVER TIME,

….reflecting the progress made in DGR programmes and adapting to meet new expectations and needs.

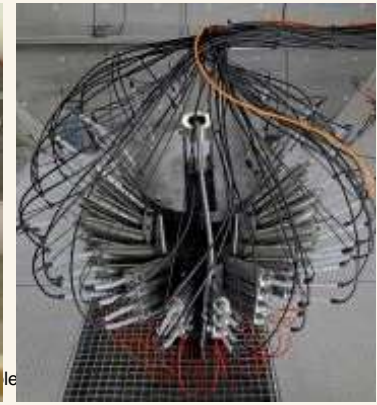
Start-up phase:
Exploration of intrinsic properties of the geological environment

Later phases:
Verification of characteristic parameters of processes expected in the lifetime of a repository

Past >20 years:
Additionally long-term demonstrators and experiments under more realistic conditions, more recently also optimisation of systems





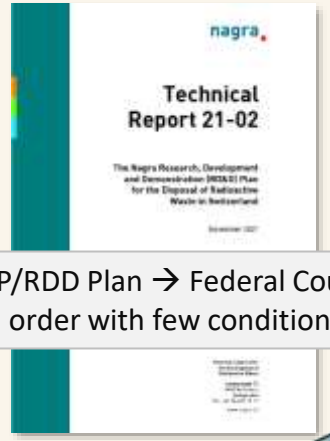



CONTEXT OF NAGRA'S UNDERGROUND RD&D

Basis is the Nagra disposal programme (repository for HLW and L/ILW)

Each step requires RD&D to ensure the safety and feasibility of repository design and its optimisation as it evolves

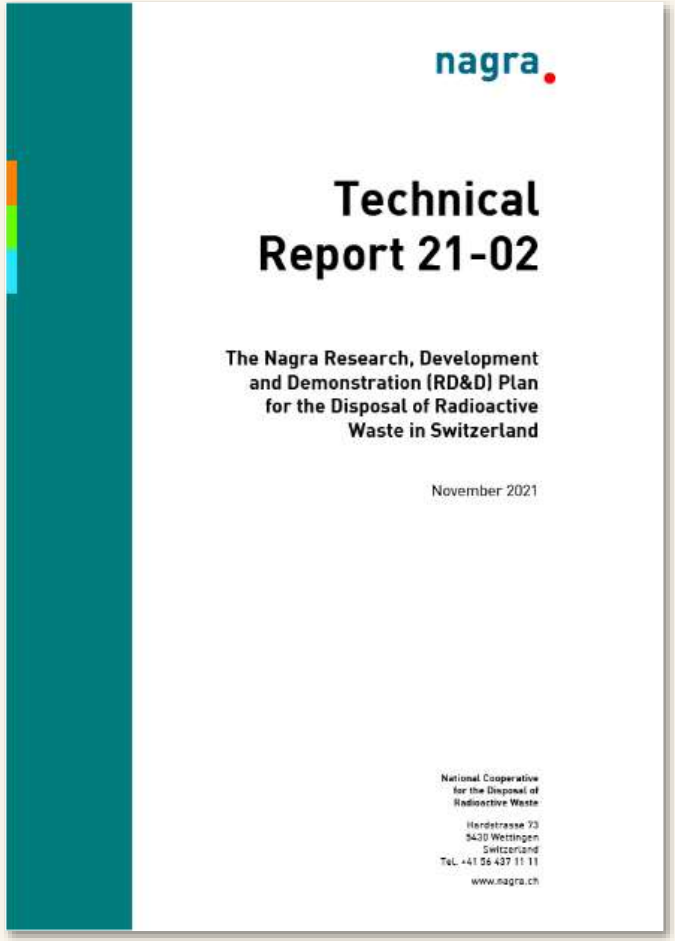
Nagra Research Development and Demonstration Plan for the Disposal of radioactive Waste in Switzerland (NTB 21-02)



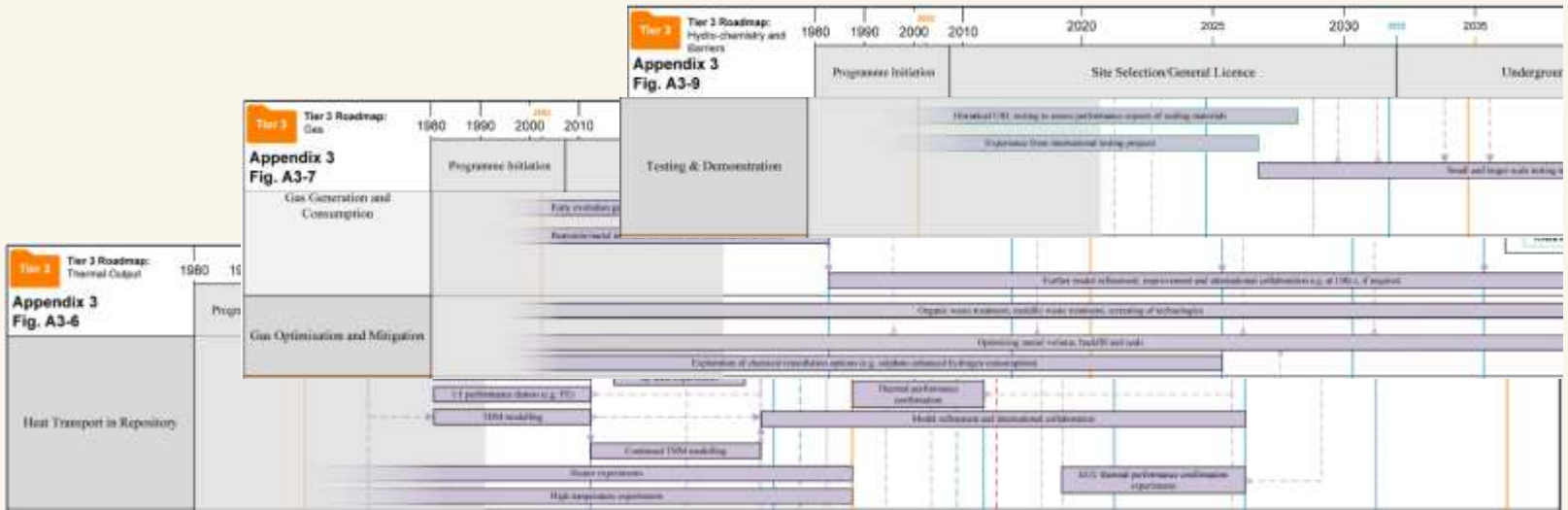
*EP/RDD Plan → Federal Council order with few conditions

URL - NEEDS AS IDENTIFIED IN NAGRA'S RD&D PLAN / ROADMAP

Consequently, ongoing projects at MT and GTS will support the identified topics, focusing on Near Field Evolution and specific process understanding.



- Specific process understanding, e.g.:
  - → Gas
  - → Monitoring
  - → Thermal Output - Heat Transport in Repositor
  - → Barriers - Testing of EBS/canister material
- Demonstration
- Development of new technologies and testing



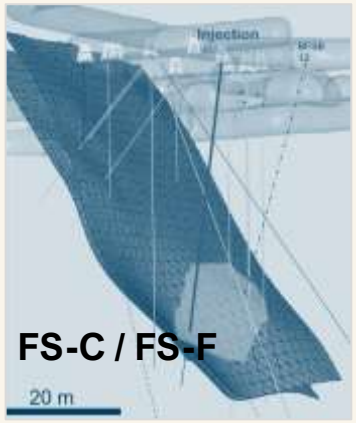
NAGRA IS CURRENTLY INVOLVED

→ in about 30 projects in **GTS** and **MT** focusing on:

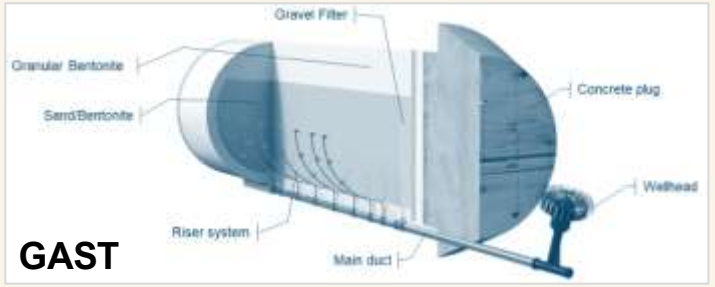
- **Heater experiments** focusing on thermal output and optimization
- **Diffusion & migration** processes in rock and cement/rock interaction
- **Corrosion**
- **Gas** related processes and Gas migration
- **Microbial** characterisation
- **Monitoring** → monitoring technologies and geological models
- **Geomechanics** and fault reactivation in Opalinus Clay
- **Construction**
- **Geochemical** characterization of the Opalinus Clay

HIGH TEMPERATURE BENTONITE PROJECT

FAULT SLIP EXPERIMENT

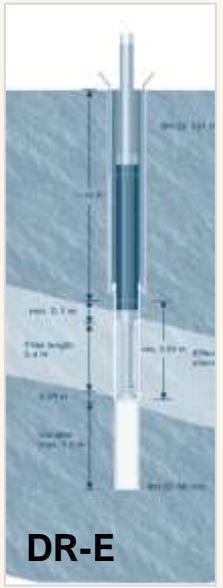


GAS PERMEABLE SEAL TEST



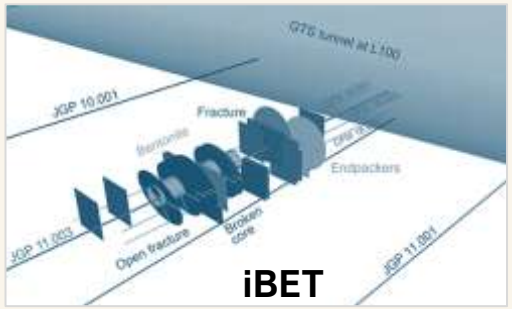
Examples from GTS & MT

DIFFUSION & RETENTION



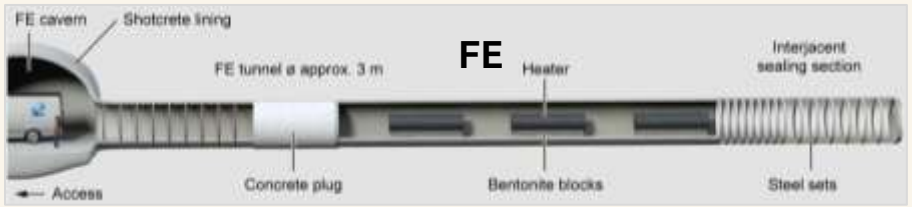
COLLOID FORMATION & MIGRATION

IN-SITU BENTONITE EROSION TEST



MATERIAL CORROSION

FULL-SCALE EMPLACEMENT EXPERIMENT

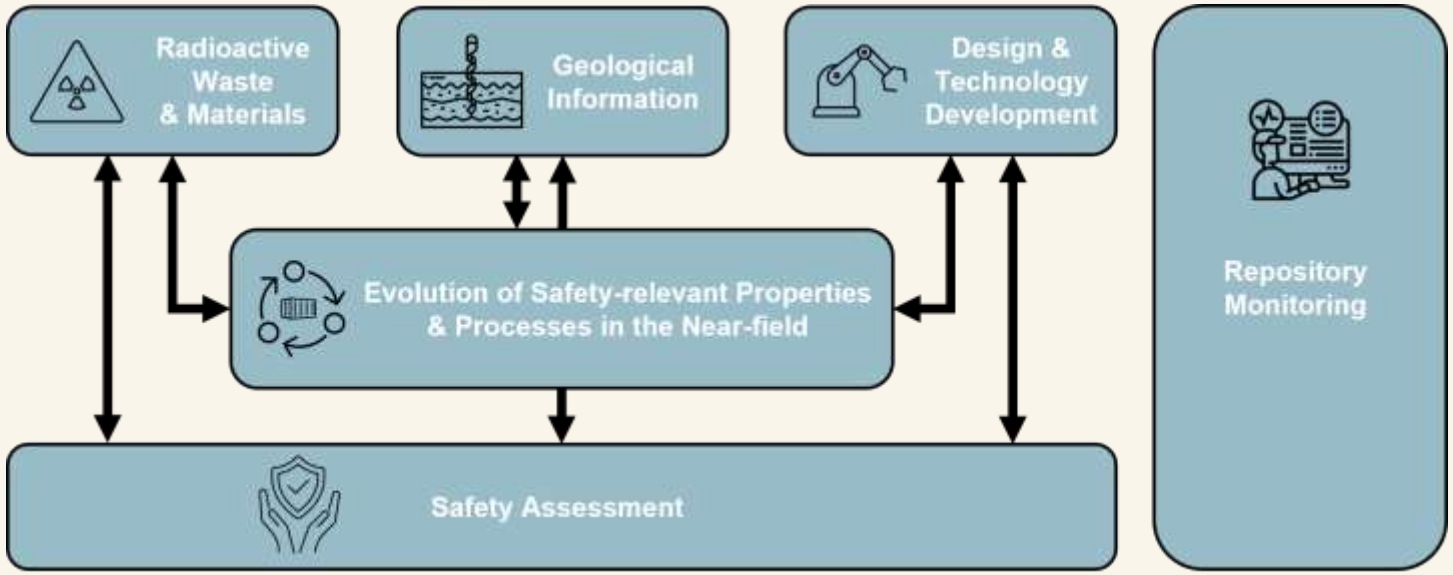


LOOKING AHEAD

(5 to 10 years)

→ **GTS** & **MT** will support these topics in line with requirements that cannot currently be addressed in Nördlich Lägern *(proposed DGR site)*

Nagra RD&D programme is divided into six main topics



Focus of URL activities:

- Design & Technology Development → Demonstrating the feasibility & optimisation of repository construction, operation and closure (conceptual level) / introduction of digital ways of working (digital workflow)
- Evolution of the Near-field → Performance requirements for engineered and natural barriers - Underpinning our SAFETY CASE (validate our existing and emerging modelling results)
- Repository Monitoring → Proving monitoring concepts and applications

FURTHERMORE

- Both URLs provide flexibility and full international context (22 partner organisations from 13 countries)
  - → Shared knowhow and resources amongst WMOs
  - → Joint research with world-renowned research facilities ensure state-of-the-art
  - → A combination of focussed experiments as well as broad shared interest – competence building experiments
- Knowledge transfer, training and stakeholder interactions
- and URLs make our work visible and help build confidence and acceptance by playing a crucial role in communication and public outreach (e.g., visits, media).

GTC Grimsel Training Centre

GTS Grimsel Test Site

Mont Terri Rock laboratory

…LET’S GO UNDERGROUND

nagra.

SESSION 5 A- ROLE OF UNDERGROUND RESEARCH LABORATORIES (URL) IN DGR ADVANCEMENT AND STRATEGIES FOR PROMOTING KNOWLEDGE SHARING

Jacques Delay

Busan, Korea 30/05/2024

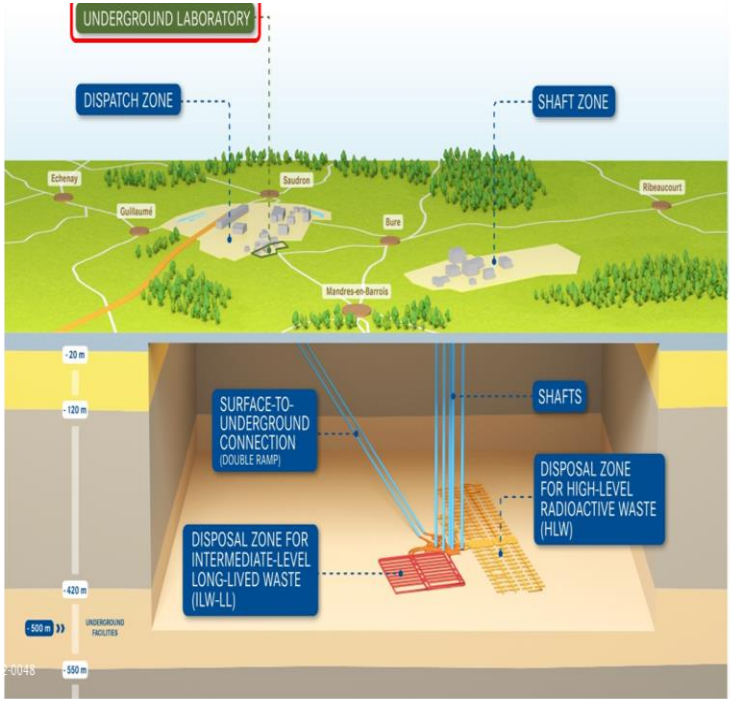
French URL : Scientific and Technical support for Cigéo

URL built in the vicinity of the French Deep Geological Repository (DGR) project “Cigéo” (Centre Industriel de stockage GEOlogique)

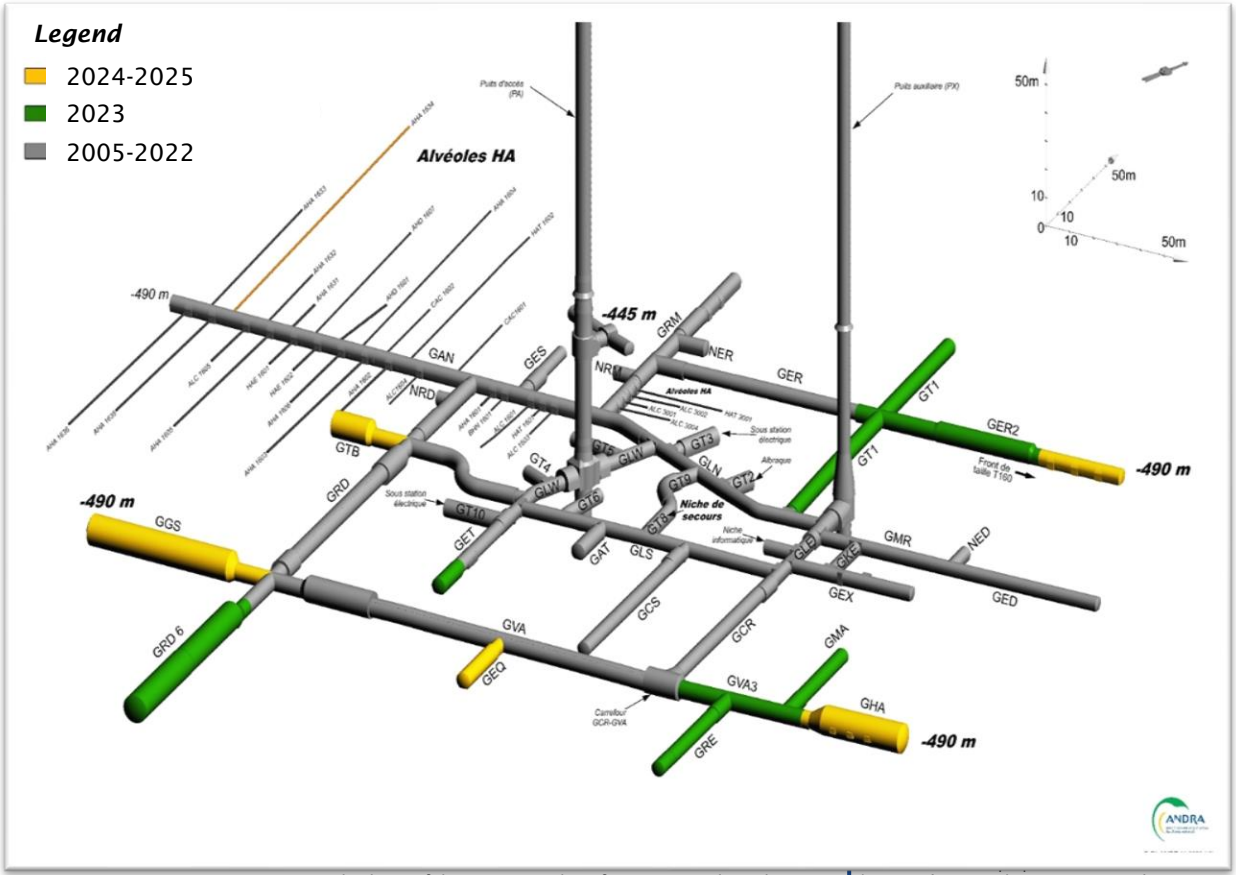
The main scientific and technical objectives for the URL are:

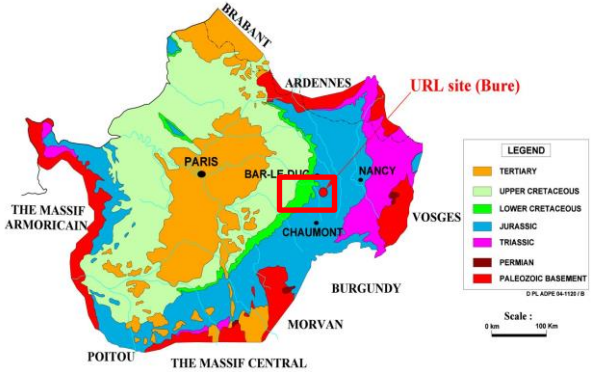
- to confirm the suitability of the selected clay rock for a deep geological repository
- to guide the specific design and architecture of the disposal facility
- to validate key technological options in the conditions that are particular to the site

The URL is granted license for operation until 2030



URL Geological Context and Architecture





Callovo-Oxfordian Clay Rock

Age : **160 My**

Depth : **~500 m**

Thickness : **~140 m**

2,35 km of drifts

1900 scientific boreholes

URL as Tool and Object of Experiments

Surface investigation (boreholes and seismic data core and water/gas sampling) provided good knowledge of the geological formation and structures

However, URL offered unique environment for studying

- Development of fractures around the openings (Excavation Damaged Zone)
  - It strongly depends on the stress path induced by the timing of the excavation, the means and timing of support, and to a lesser extent the excavation technique
    - Experiments are aiming at the design of the rock support and the modeling of the EDZ generation and evolution
- Thermo-Hydro-Mechanical behaviour of the host rock is studied in URL through in-situ experiments in various conditions at large scale
- Transport conditions which take into account hydrogeological disturbances created by the excavations and hydrochemistry allow for assessment and observation of:
  - Chemical reaction paths induced by the presence of a reservoir of elements such as oxygen in construction drifts or CO2 or sulphate from material
  - Phenomena such as oxidation and its induced effect on corrosion, biological and microbiological reactions, and interaction of natural rock/fluid with disposal materials

URL as National and International Exchange Platform

Before the construction of the URL, Andra developed strong links with other URLs through European and bi-lateral collaborative projects

- In Clay (Hades Archimedes Argile) … but also in granite (Grimsel/ Aspö)
- Strong involvement in the Mont Terri project since its inception
  - Almost all the experiments carried out at the level 445 of the laboratory in 2004-2005 have been developed in the Mont Terri Tunnel niches and galleries

National and International collaboration in the URL consisted in

- Specific experiments carried out by French University consortium (FORPRO - Rock mechanics) and French Atomic Agency (Diffusion Experiment)
- Specific Experiments carried out through European Projects
  - Coordinated by IGDTP (MODEXREP, DOPAS…then EURAD)
- Experts visits and workshops in Bure or Nancy, France
- Long term participation to other Key projects in generic URLs
- Staff training for long period of time (four months to two years) with CEA, CNRS and Nagra, BGR, Enresa
  - Directly participating in Andra's experiments

URL as Knowledge Sharing and Communication Tool

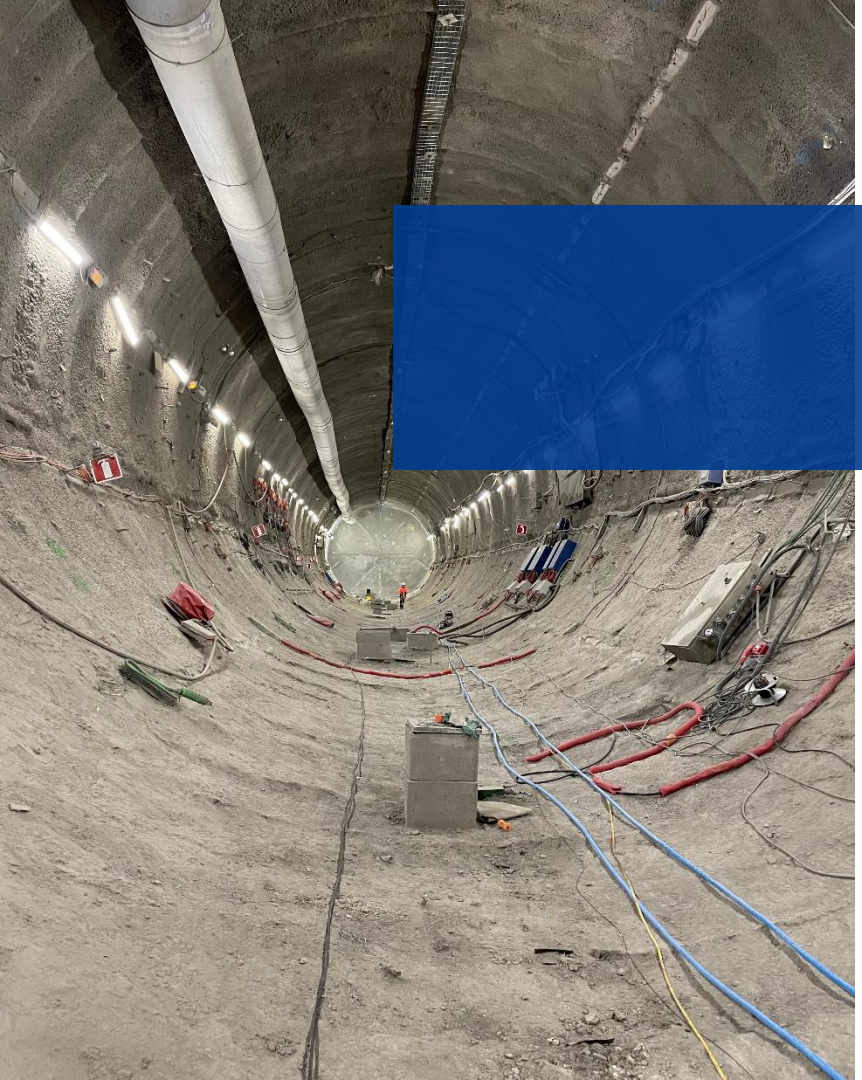
Andra support strongly initiatives in knowledge sharing

- In the framework of EURAD project (Knowledge Management – Domaine Insights)
- Collaboration with NEA and IAEA for production of technical documents capitalizing experience gained in siting and URL experiments

Bure URL is a platform for training professional in Underground construction through the PoCES

- The Underground Environment Competence Center (PoCES) offers companies operating in underground environments adapted and tailor-made training for the construction of underground structures (civil engineering, tunnels)
  - Supported by the University of Lorraine and AFTES (French Association of Tunnels and Underground Space)

With about 7000 visitors per year (3000 visiting underground installation), the URL is providing relevant information on the whole project and its environment



THANK YOU!

Role of the Bukov URF in the DGR programme in the Czech Republic -

Markéta Dohnálková

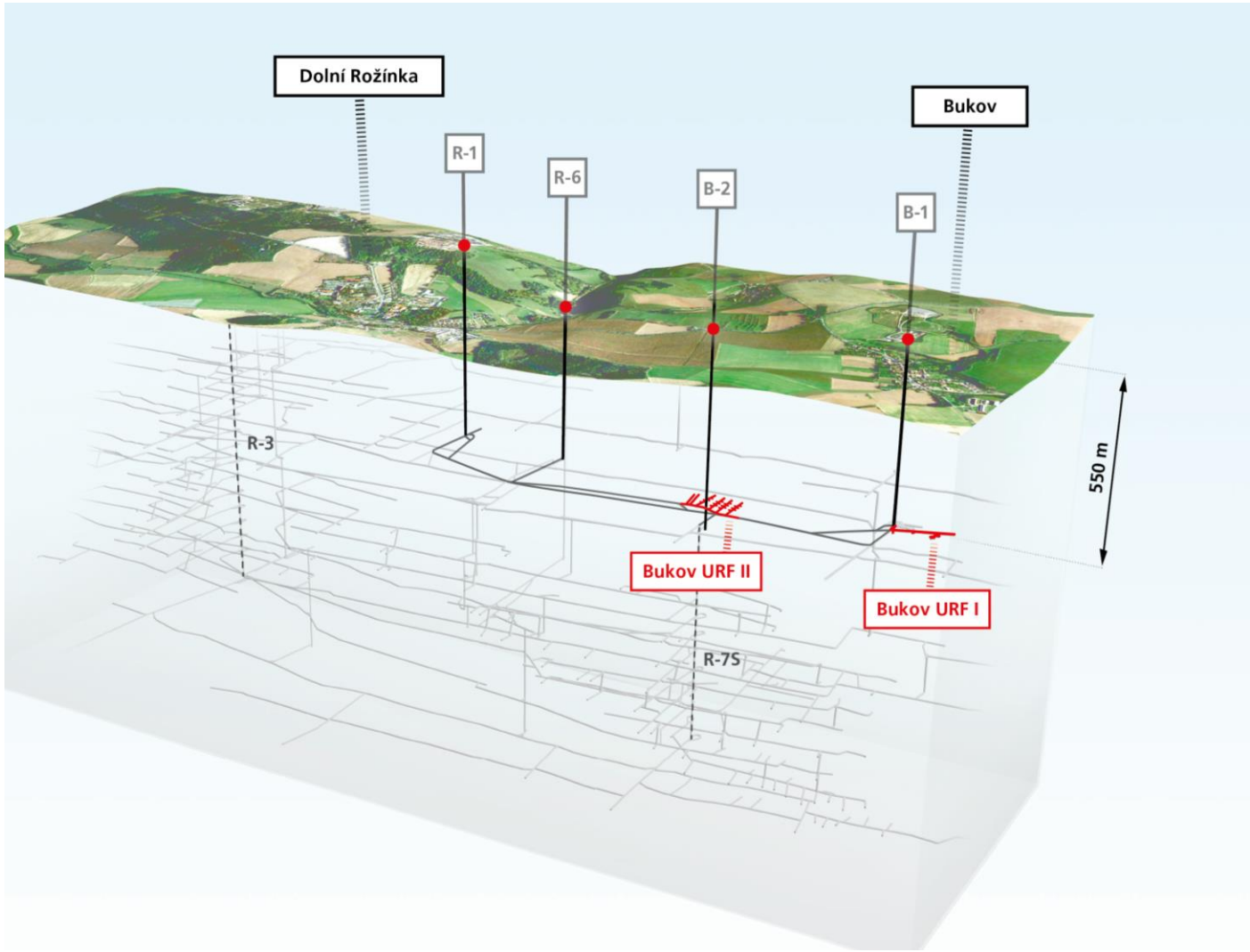
Head of the Deep Geological Repository Department, SÚRAO

SNF disposal programme in the Czech Republic

- SÚRAO is responsible for the deep geological repository (DGR) project in the Czech Republic
- DGR is planned to be in operation in 2050
- The site selection process is still ongoing.
- Four suitable sites in crystalline host rocks have been selected.
- SÚRAO has its own scientific research program for the development of DGR.
- This programme includes The BUKOV Underground research facility (URF).

The Bukov URF

- The Bukov URF is a unique research facility in the Czech Republic
- Using the original infrastructure of a former uranium mine
- The laboratory is located in highly metamorphosed rocks - migmatites, amphibolite, paragneiss.
- The Bukov URF is located in a new excavated section 550 m below the surface
- The first stage- Bukov URF I - a systém of gallerieswith test chambers was prepared in 2017
- The second stage Bukov URF II is currently being completed for new experiments



Use of Bukov URF data for the needs of the deep geological repository programme

- To demonstrate the final site for DGR from a long-term safety perspective, it will be necessary to develop a model predicting the behaviour of the proposed disposal system
- This model will be used to demonstrate the long-term safety of the deep geological repository The set of models includes geological, tectonic, hydrogeological, geomechanical, geochemical and THMC models.
- The development of modelling tools and the validation of their functionality requires the use of available and most relevant data, preferably from in-situ measurements.
- A comprehensive system of modelling tools, currently under development, must be available during the period of work at the final site.
- The validity and the robustness of these tools for long-term prediction of the evolution of the DGR must be verified in advance.
- The use of generic laboratories is the only way to obtain relevant data at this stage of the programme for these models.
- The Bukov URF provides a comprehensive set of data necessary to build and validate models to demonstrate long-term safety and to verify the feasibility of the technical concept of a deep geological repository.

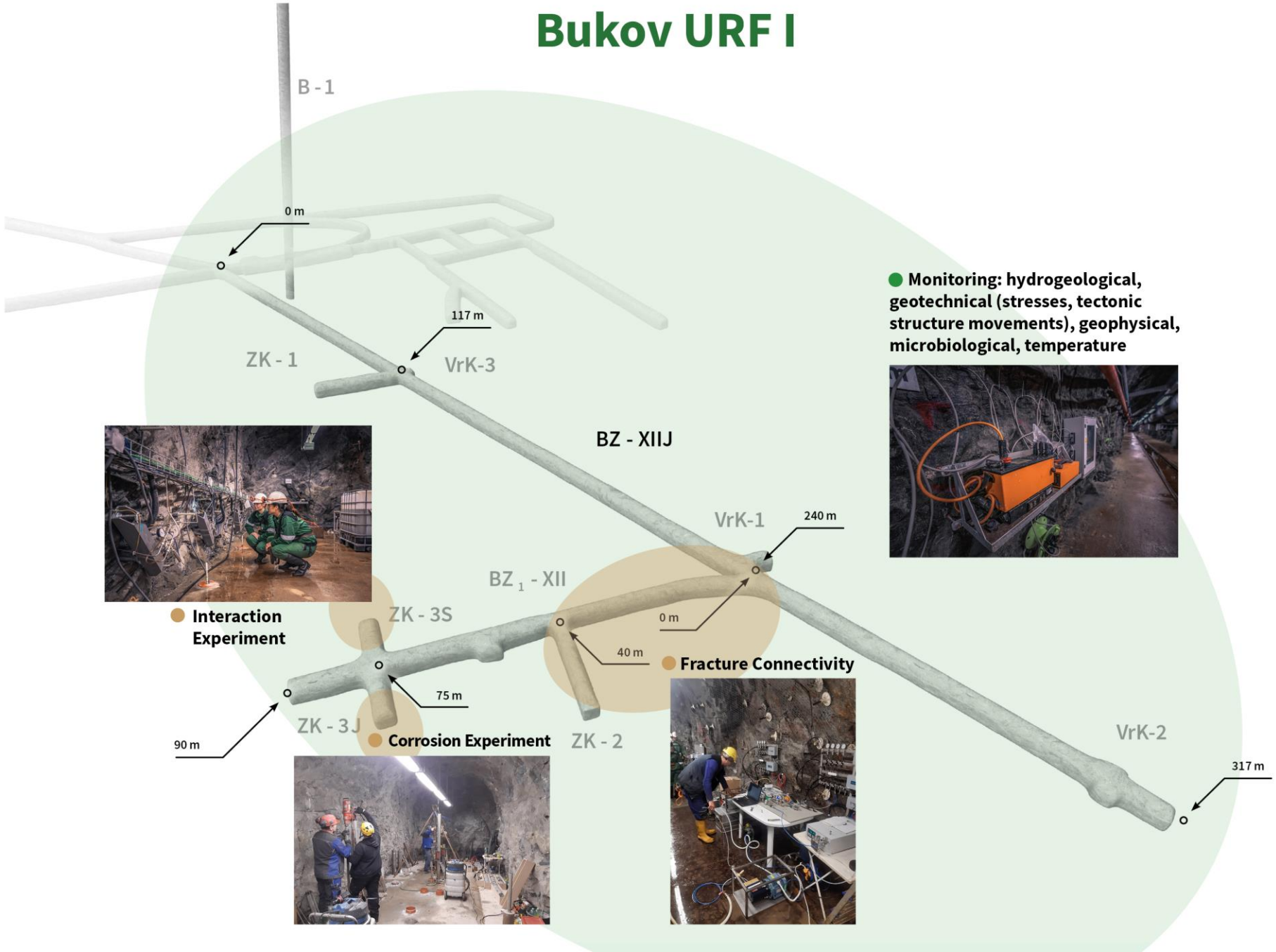
Objectives of the programme in the Bukov URF

- The testing and demonstration of the various technical solutions under consideration
- The determination of research approaches for the study and detailed description of the host rock
- To obtain know-how on the construction and characterisation of underground complexes
- To obtain the data required for the validation and verification of models
- **In-time preparation and verification of SÚRAO's own technical approaches**

Research is performed in 7 individual scientific areas

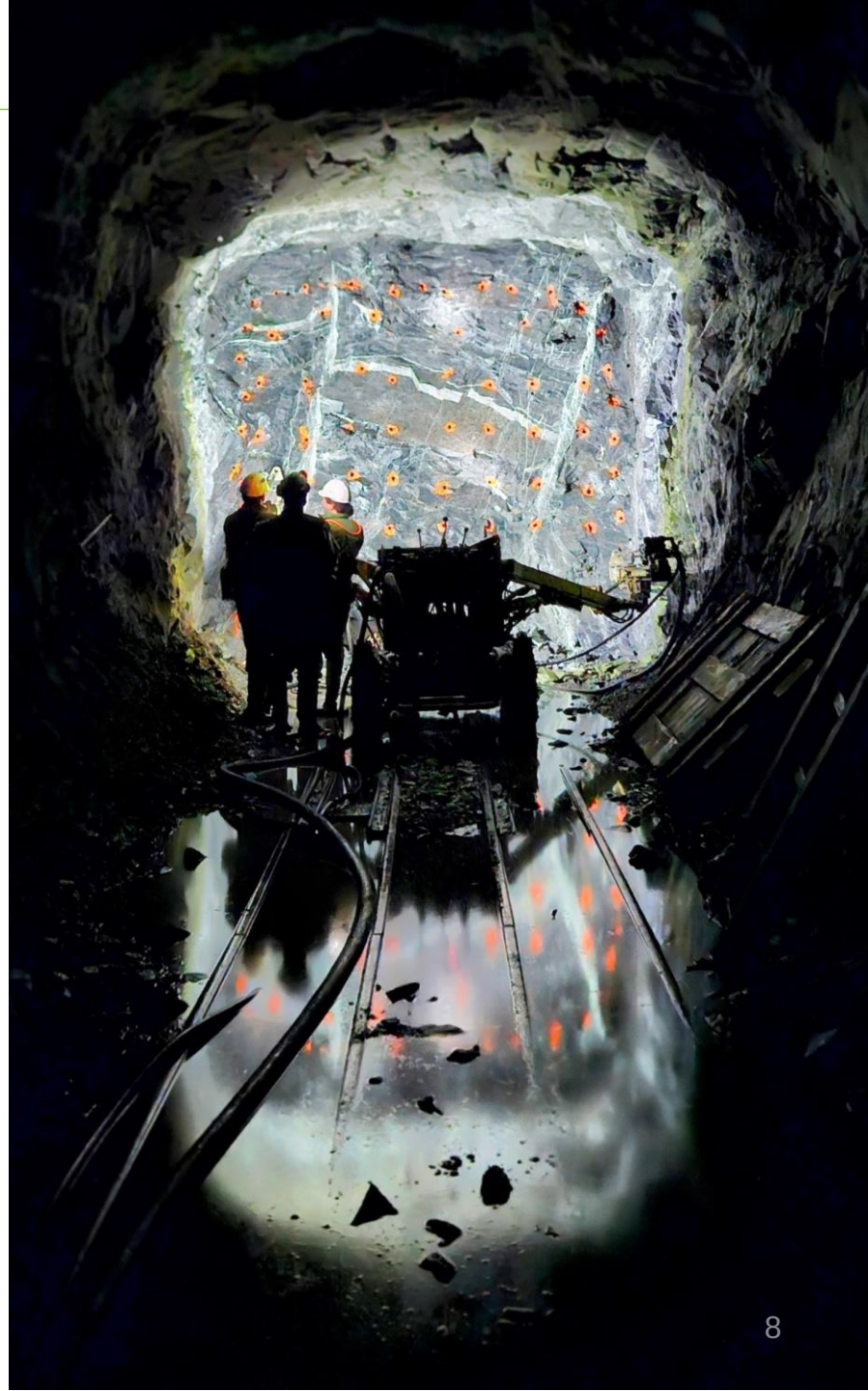
Programme area SÚRAO	Short name	Objectives
VEP1	Geological characterization	Development of methodologies for the description of the rock environment. Collection of descriptive geological data, their storage in databases and interpretation in the form of 3D models.
VEP2	Monitoring	Testing and development of methods for long-term monitoring of rock mass processes (hydrogeology, tectonics, microbiology, seismicity, etc.). Development of non-destructive geophysical methods.
VEP3	Transport	Investigation of groundwater flow and radionuclide transport in the rock environment. In-situ tests in boreholes. Development and testing of modelling tools.
VEP4	Engineering barriers system THMC processes	Development and research of engineering barrier materials. Research on corrosion properties of materials for WDP. Research on interactions between engineering barrier materials (bentonite, concrete) and rock. Verification and validation of THMC models.
VEP5	EDZ	Development and testing of methods to characterize the damaged (EDZ) and disturbed/impacted (EdZ, EIZ) area of rocks in the vicinity of underground facilities.
VEP6	Technological procedures	Development of new construction procedures for underground works (drilling and excavating, grouting, injection of fault zones).
VEP7	Demonstration experiments	Comprehensive experiments testing the behaviour of disposal system elements in real scale and conditions in the geological environment. Testing of handling technologies, design of experimental models and process monitoring.

Bukov URF I


B - 1
0 m
117 m
ZK - 1
VrK-3
BZ - XIIJ
VrK-1
240 m
BZ 1 - XII
ZK - 3S
0 m
40 m
75 m
ZK - 3J
90 m
ZK - 2
VrK-2
317 m
Interaction Experiment
Corrosion Experiment
Fracture Connectivity
Monitoring: hydrogeological, geotechnical (stresses, tectonic structure movements), geophysical, microbiological, temperature

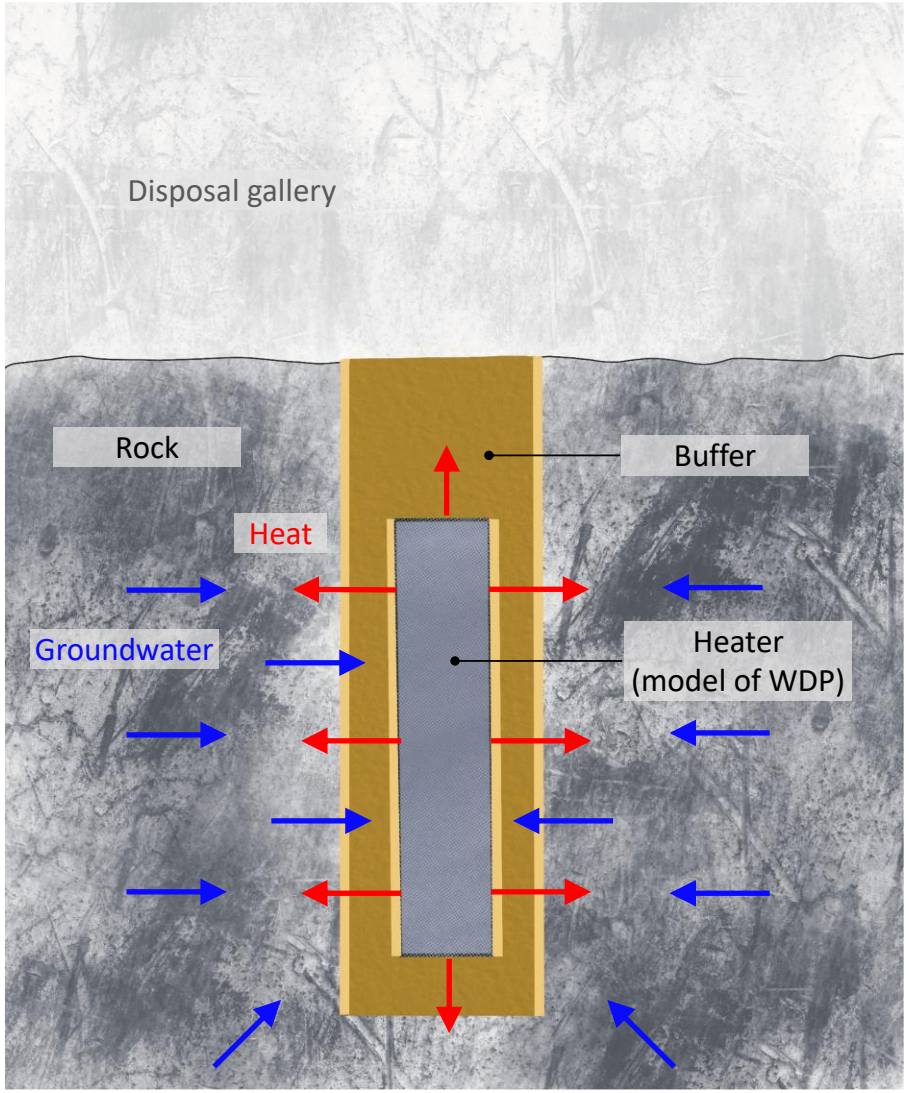
Bukov URF II

- Bukov URF II is being completed.
- New experiments are currently in preparation.
- The experiments are designed to test the long-term interactions of materials and the effects of the environment on these materials.
- A priority topic is the verification of heat distribution from the WDP through the bentonite material into the rock.
- It is planned to continue the study of the mechanisms of transport of materials through fracture systems and through engineered barriers.



Tests of disposal solutions

- In-situ physical models of disposal place
- Technical solution based on the SÚRAO‘s „EBS project“ (ongoing project)
- Validation of mathematical models concerned with the thermal dimensioning of the DGR and THM processes
- 1. Large-diameter boreholes for heater tests (creation and characterisation)
- 2. Waste Disposal Package (WDP) model (heater) development
- 3. Fabrication of bentonite material (blocks and granular mixture - pellets)



The Bukov URF research, development and demonstration activities programme 2023

Name of the area	Programme area SÚRAO
Rock classification systems	VEP1
Characterisation of EDZ and EIZ	VEP5
Advection-dispersion transport processes	VEP3
Diffusion processes	VEP3
Model concepts in groundwater flow	VEP3
Uncertainties in in-situ transport parameters	VEP3
Flow in EDZ and EIZ	VEP5
Testing the implementation and characterisation of disposal bore holes	VEP6
Concrete with lowered pH	VEP4
Long-term laboratory	VEP4
Experimental study of THM(C) processes - HEAT experiment	VEP4
Bentonite erosion and colloid transport (ERO)	VEP4
Buffer expansion to backfilled and WDP load (EXP)	VEP4
Prototype repository demonstration experiment (DEMO)	VEP7

Technical report no. 683/2023

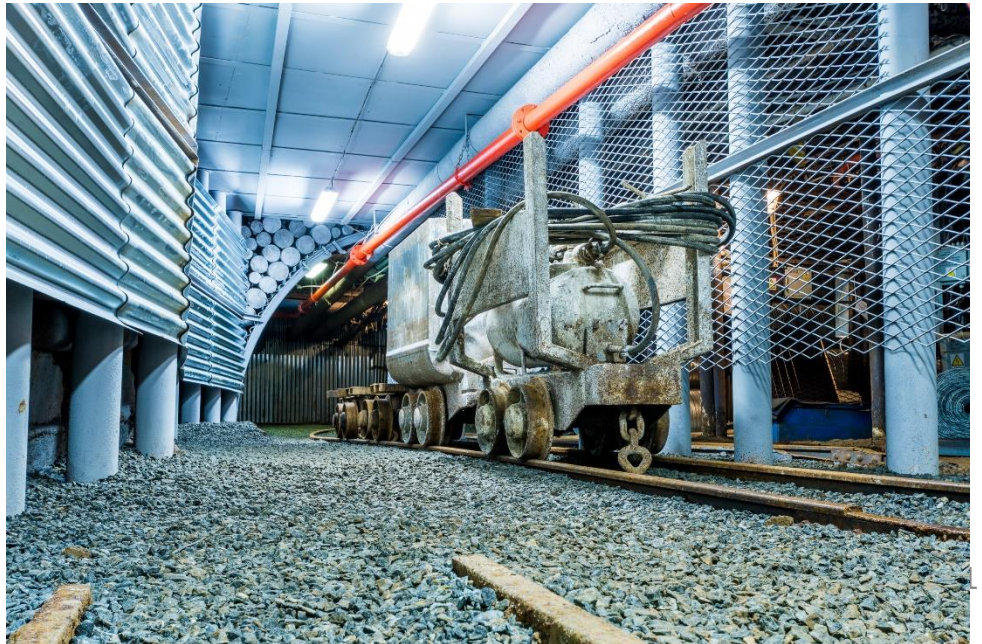
THE BUKOV URF RESEARCH, DEVELOPMENT AND DEMONSTRATION ACTIVITIES PROGRAMME 2023

Authors: Jan Smutek et al.

Prague, 2023

Conclusions

- An important objective of the Bukov URF is to obtain the experience and data necessary to demonstrate the safety and feasibility of a future deep geological repository at the final site.
- Since the start of the construction work in 2013, ten research projects have been successfully implemented here.
- Eight projects are now underway.
- New projects and experiments are in preparation.
- Use of the Bukov URF is planned until 2035, when the programme in the generic laboratory will be followed by work at the final site within the underground facilities of the DGR.



Thank you for your attention!

Role of ONKALO®
in Posiva's DGR project

Tiina Jalonen

Main tests and demonstrations done in ONKALO®

Posiva

Access tunnel, vehicle connections and shafts

Rock characterisation and development of investigation methods

Pilot holes (ONK-PH1-29)

Drill holes for monitoring and research (ONK-KR1-17)

Groundwater stations (ONK-PVA1-13)

Inflow measurements and measurement weirs

Grouting development and testing

Microseismic network

Convergence measurements and extensometers

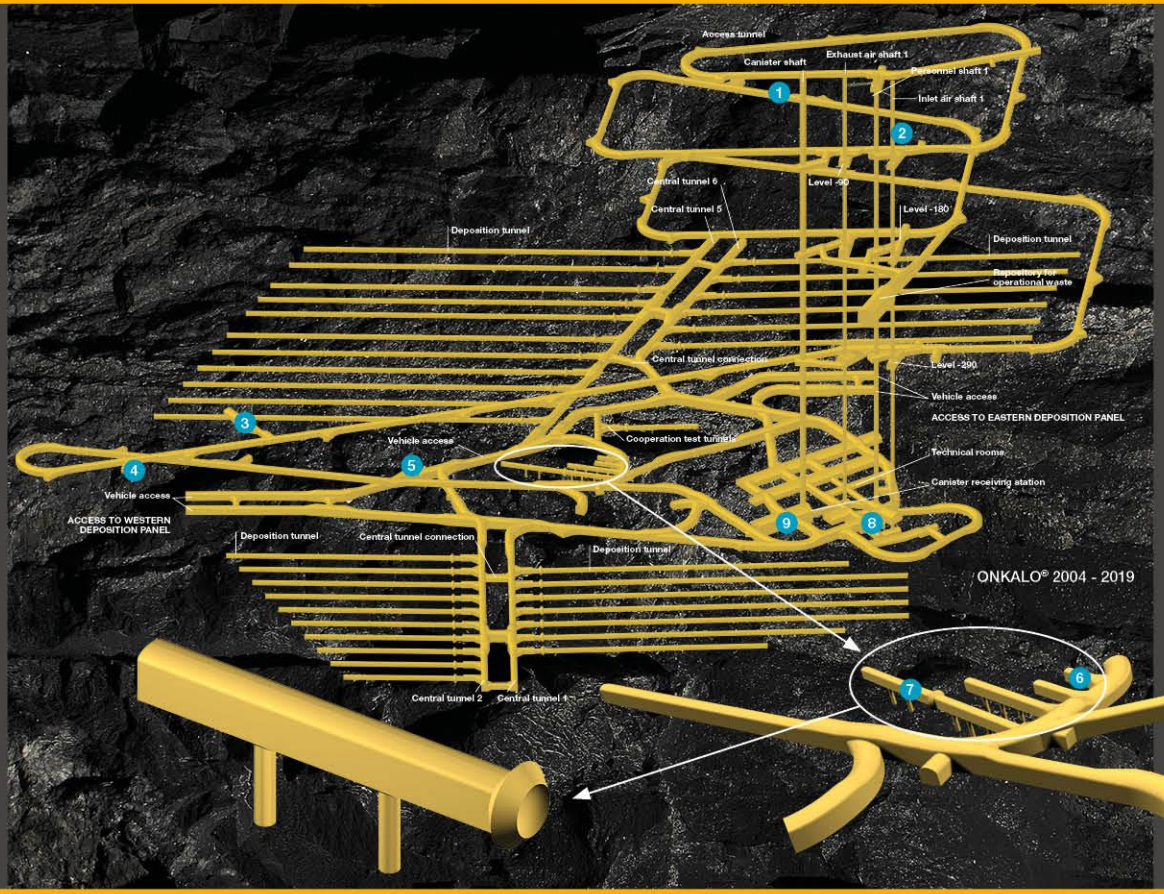
Geophysical investigations
- Ground penetrating radar
- Tunnels seismics

KBS-3H Steering hole drilling test for disposal tunnel (ONK-PH28)

SURE Sulphate reduction experiment (ONK-KR15)

Research niches

1. Research niche 1:
   - Buffer test in 40% scale
2. Research niche 2:
   - EDZ studies
   - Tunnel floor grinding
   - Stress measurements
   - Groundwater station (PVA)
3. Research niche 3:
   - POSE Posiva's Olkiluoto Spalling Experiment
   - Excavation damage zone (EDZ) studies
4. Research niche 4:
   - HYDCO Hydrogeological characterization and interference test
5. Research niche 5:
   - REPRO The in situ retention properties of rock matrix



Demonstration area

Development and testing of Rock Suitability Classification (RSC) method

Excavation of demonstration tunnels (DT1-4)

Demonstration tunnel sealing and reinforcement

Tunnel floor grinding test

Test deposition hole boring

Measurements of test deposition holes

6. POPLU Construction and pressurisation of wedge plug

Buffer and canister emplacement tests

7. FISST Full scale in situ system test

In situ stress measurement

Mise-à-la-masse measurements

ONKALO® monitoring programme

Hydrogeological sampling and measurements

Hydrogeochemical sampling and measurements

Rock mechanical measurements

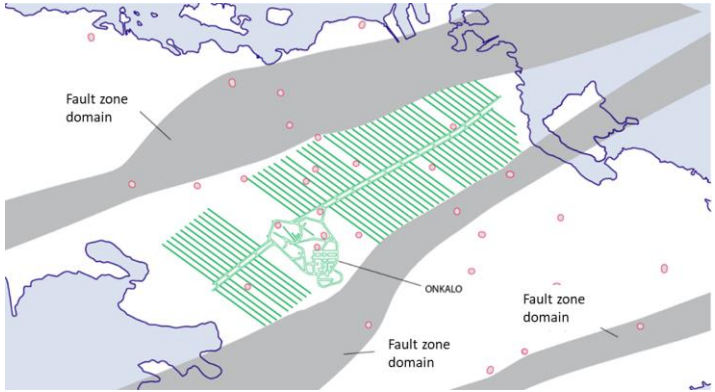
Other tests

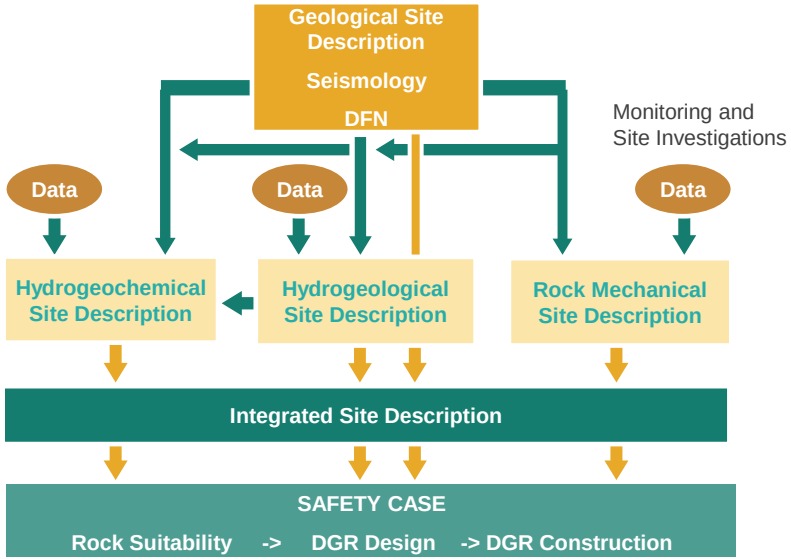
8. Borehole plugging test (OL-KR24)
9. Pellet wetting test

Site Investigations

Data from monitoring and site investigations is used for the integrated Site Description and further to the Safety Case for Operating License Application

Host rock properties affect and steer repository layout design and rock suitability assessment





Development of Rock Construction Methods

Rock construction methods in parallel of site investigations have been developed during the construction of ONKALO ramp, shafts and tunnels.

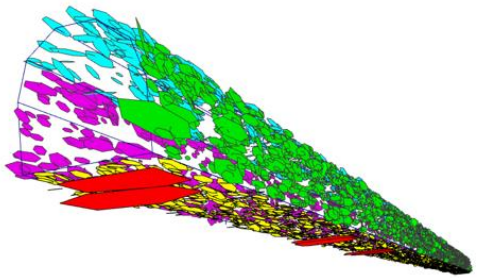
Boring of deposition holes have been tested and demonstrated in ONKALO

Results have been used for further design and construction of the DGR.

How to construct a deposition tunnel without disturbing the rock properties?

How to bore a deposition hole that meets the tolerance requirements?

If we can't meet the tolerances, can we change other requirements or designs?

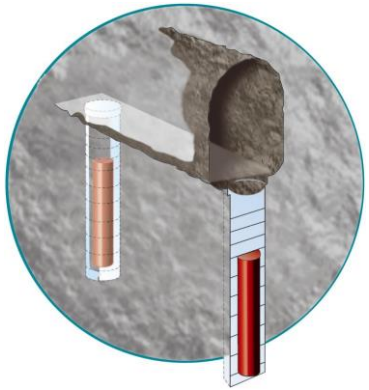


Installation Tests of the Engineered Barrier System

Engineered barrier system (EBS) installation tests have been made to get feedback to the design of installation machinery and the detailed design of the EBS and the DGR and to the construction of the DGR.

How to fit the machinery to the tunnels that are minimized in size to avoid “extra” excavations and backfill?

Can the tolerances of the EBS be met in the installation?



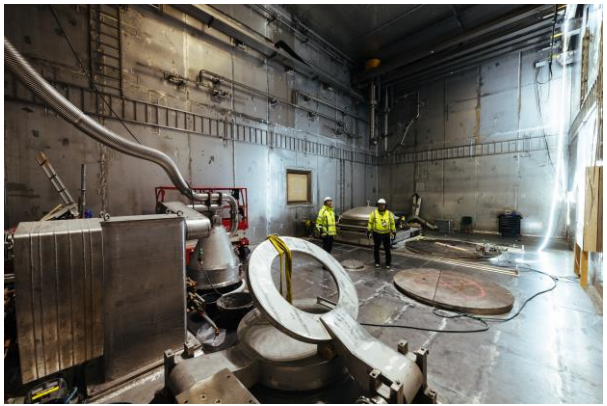
Full-Scale In-Situ System Test in ONKALO

Installation of the Engineered Barrier System (EBS) components was done with prototype machinery. The system is monitored to get feedback on the early phase performance of the EBS.

Benefits of the Full-Scale In-Situ System Test

Feedback to the Safety Case, Olkiluoto Monitoring Programme, and to the TH- and THM models of the EBS.

Feedback in preparing for the The Trial Run of Final Disposal

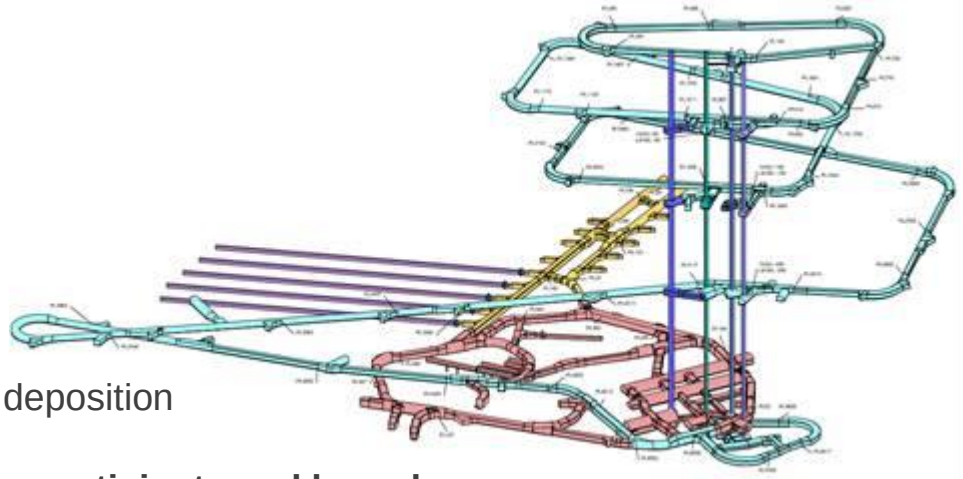


Trial Run of Final Disposal in 2024

See the video!

The Trial Run is the final phase of Posiva's preparing for the operation of the DGR. It will be carried out In ONKALO with the methods, procedures, equipment and personnel to be used in the operation phase. It includes:

- fuel transports
- encapsulation
- final disposal
- retrieval of a "damaged" canister back to the encapsulation plant



It consists of 4 canisters and about 70 m of deposition tunnel as well as the plug for the tunnel.

There is also an opportunity for WMO´s to participate and learn how the entire disposal process functions. Discuss with Posiva´s experts and gain insights to benefit own national program.

Participation of Posiva in International URL Projects

Äspö HRL

Engineered Barrier Performance and Installation

LOT – Long-Term Stability of Clay Material

Dismantling of Prototype Repository – Performance of the EBS

DOMPLU – Plug Installation Test

Grimsel

Posiva has been a participant in an international research consortium


Posiva
Global leader
in final disposal