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

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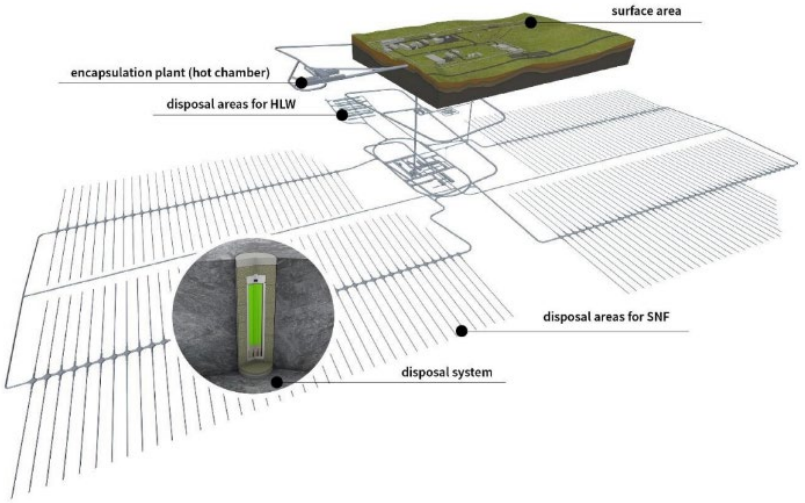
IGD-TP Exchange Forum 2025, Prague

Czech DGR Programme

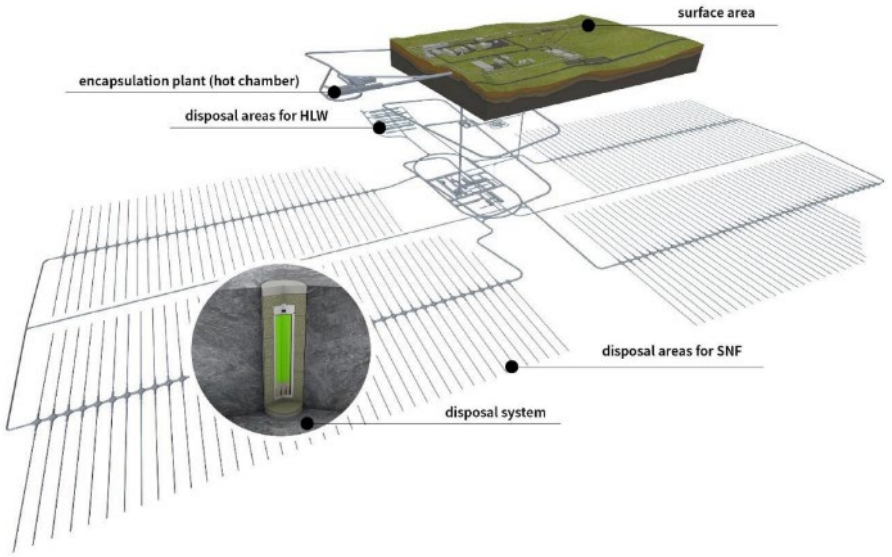
SÚRAO – Radioactive Waste Repository Authority of the Czech Republic

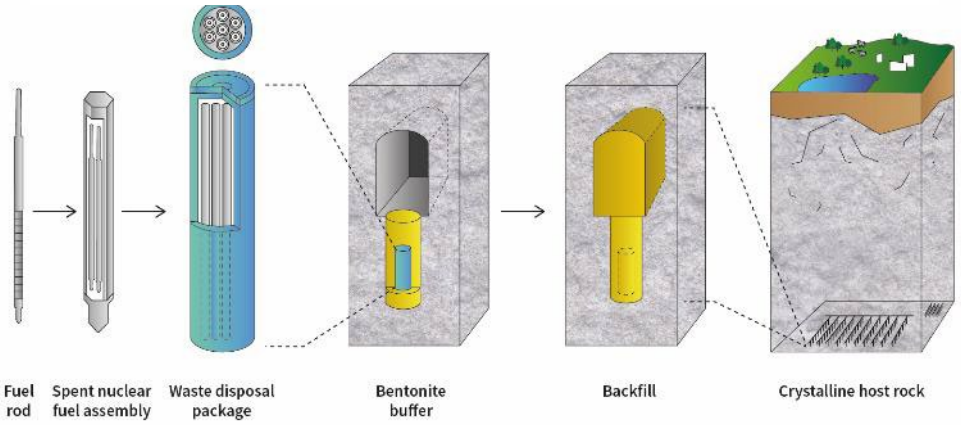
- Ongoing development of a **Deep Geological Repository (DGR)** with the aim of being in operation by **2050**, in line with EU Taxonomy.
- Current priority: **Site selection process** for the DGR, including feasibility studies across four shortlisted sites.
- Continuous development of the **technical design** of the repository, aligned with site-specific conditions.
- Strong focus on **research and development of EBS**, including long-term safety assessments and in-situ testing.
- **Preliminary safety assessment (Safety Case 1)** underway to evaluate the robustness of the Czech disposal concept.
- Operation of the **Bukov Underground Research Facility** supporting technical and scientific studies.



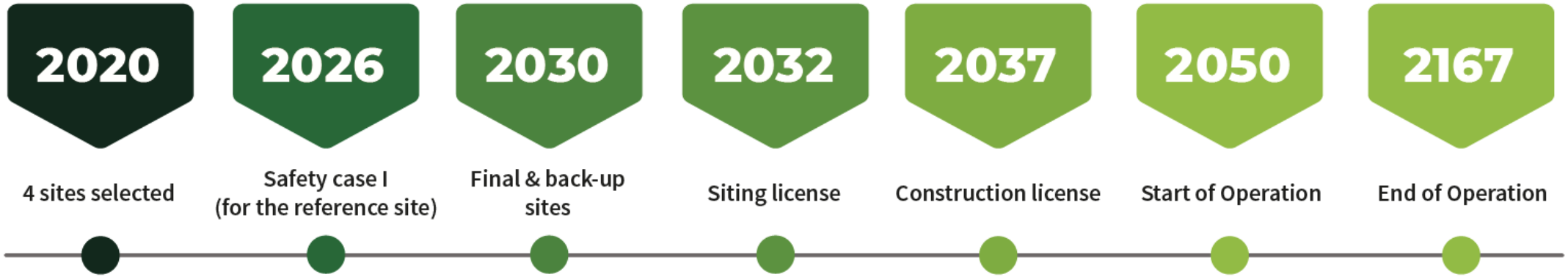
Czech deep geological repository project

- Estimated inventory 14 500 T of SNF, 23 500m^3 of HLW
- Underground part (approx. 3km^2), surface area (15 ha)
- Depth 500 m in crystalline host rock
- Multibarrier concept–bentonite barrier– steel-based waste disposal package
- Since 2020: 4 potential sites
- 2024-2025: update of inventory (Policy update, including new sources and SMR)





The 2050 Roadmap — Key Phases of the Czech DGR Programme



Czech DGR Candidate Sites

Role of R&D Within This Roadmap

R&D provides the evidence base for all key decisions.

- **Supports site characterisation and site selection process.**
- Reduces safety-relevant uncertainties
- Defines the design basis for the repository system
- Demonstrates long-term barrier performance (URF)
- Follows structured 5-year cycles linked to the programme roadmap

https://surao.gov.cz/wp-content/uploads/2024/10/TZ746_2024_ENG-1.pdf

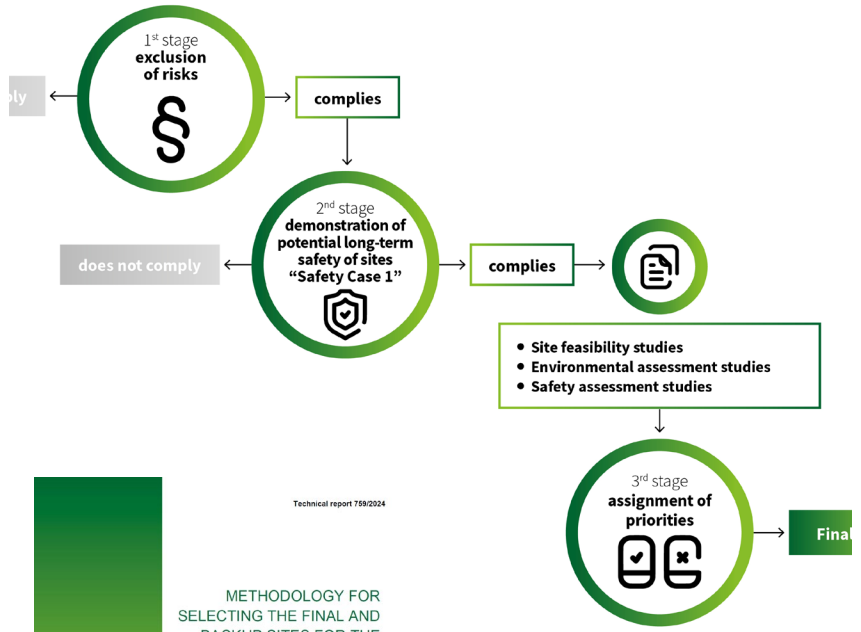
R&D Goals Supporting Site Selection in 2030

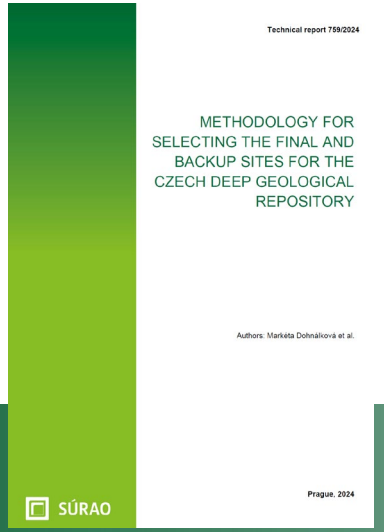
Key programme goals:

- Select the final and backup site by 2030 through a transparent, scientifically robust process.
- Demonstrate long-term safety of the Czech disposal concept.
- Develop the repository and engineered barrier design for site-specific conditions.
- Ensure technical, geological, regulatory and operational feasibility of repository construction.
- Provide transparent evidence for all key decisions — for the regulator, the government, and local communities.
- Follow the programme roadmap towards operation in 2050, in full compliance with EU Taxonomy requirements.

Methodology for site selection by 2030

- Developed specifically for the DGR programme to ensure a **structured, transparent and evidence-based approach**.
- Defines clear **rules, procedures and evaluation criteria** for assessing and comparing the four candidate sites.
- Implements a **three-stage evaluation process**:
  1) legal exclusionary criteria →
  2) safety-based feasibility →
  3) multi-criteria comparison of sites.
- **Reviewed by national and international experts**
- **Discussed and endorsed by the Director's Advisory Panel of Experts II**, an independent external expert body supporting the scientific robustness of the process.





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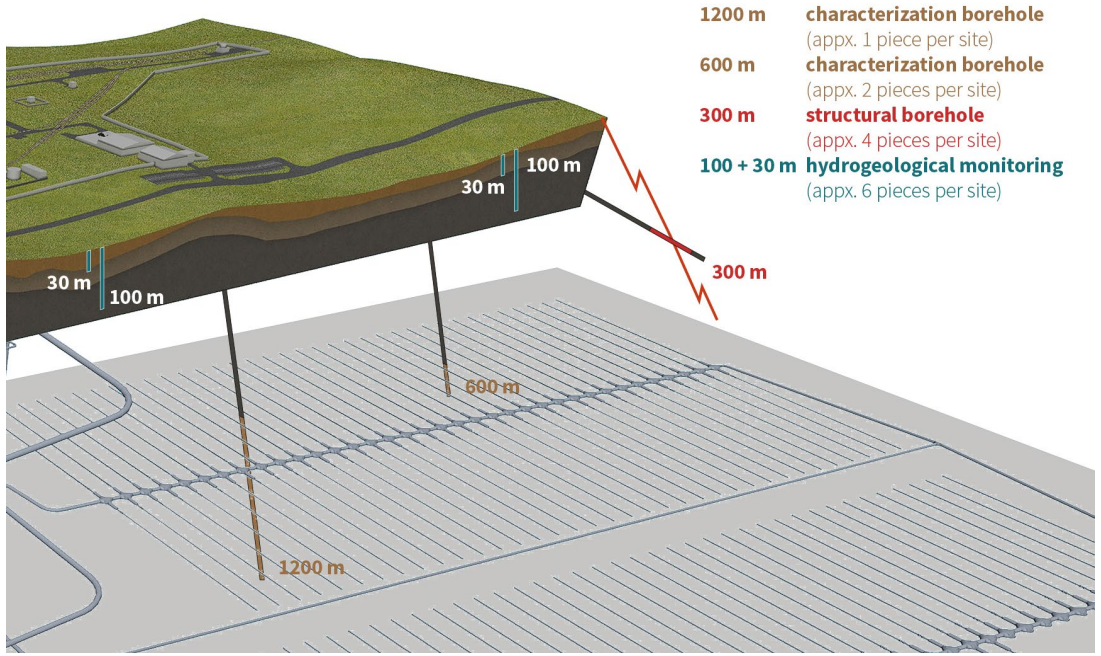
Geological Investigation Programme (2024–2028)

Key ongoing and planned activities:

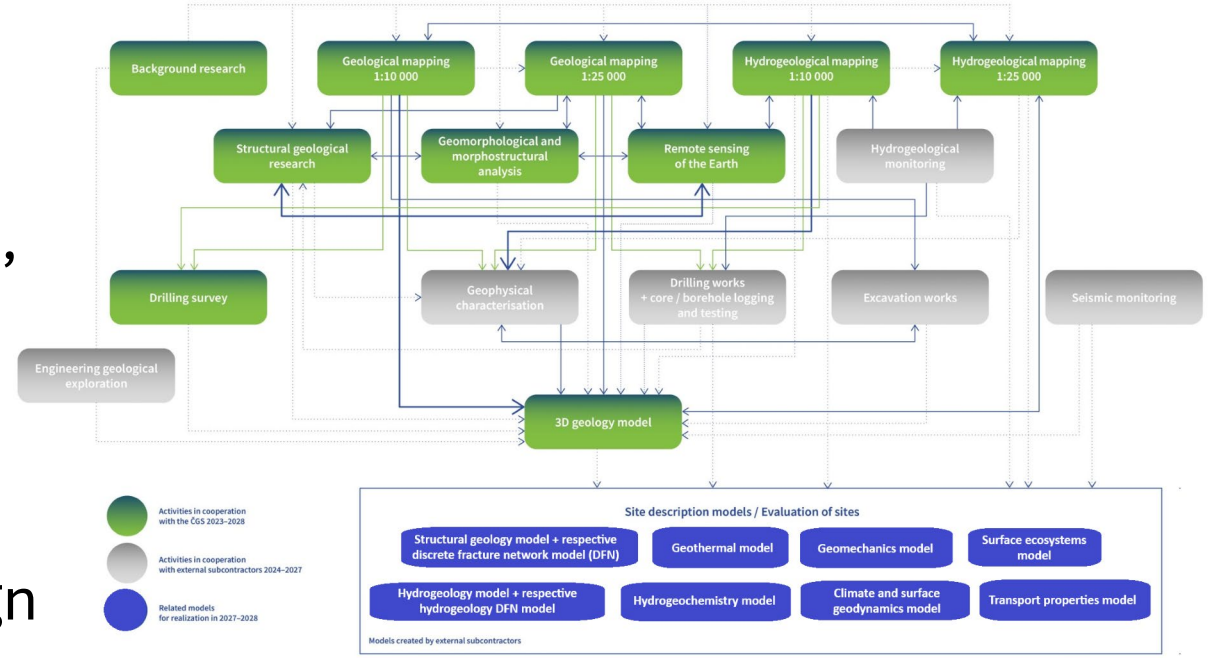
- Hydrological & hydrogeological monitoring
  Groundwater levels, flows, pressures, hydrochemistry.
- Geophysical & seismic surveys
  Mapping major and minor fault zones; defining structural blocks.
- Exploratory deep boreholes
  Core drilling, fracture logging, hydraulic tests, lab analyses.
- Structural geology & block characterisation



Site Descriptive Models (SDM) – 2026–2028

We expect that the following will be available to support the site comparison:

- Integrated models of the key geological, hydrogeological and geomechanical systems
- Comparable datasets across all four candidate sites
- Indicators for safety assessment, design requirements and feasibility
- Evaluated uncertainties relevant for decision making



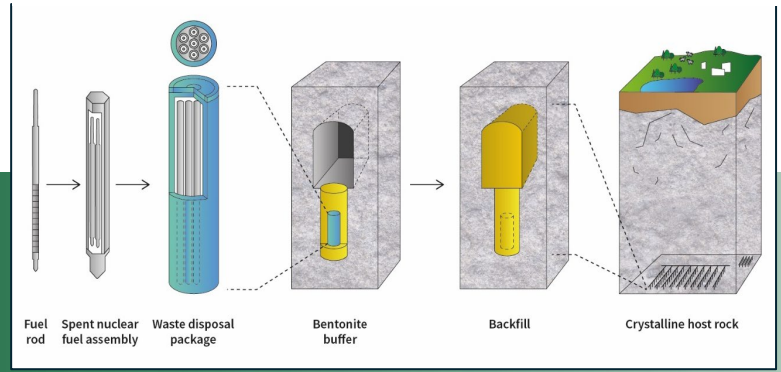
Engineered barrier system development and Testing in the Bukov URF

- Continuous development of the engineered barrier system, focusing on bentonite, waste disposal package integrity and their THM behaviour.
- Laboratory and numerical studies supporting the EBS design
- In-situ experiments in the Bukov URF provide real-scale evidence of behaviour
  Experimental results feed into safety assessments, models and repository design.

Canister
double walled, consisting of a 65 mm thick carbon steel outer casing and a 36/40 mm thick stainless-steel inner casing/s

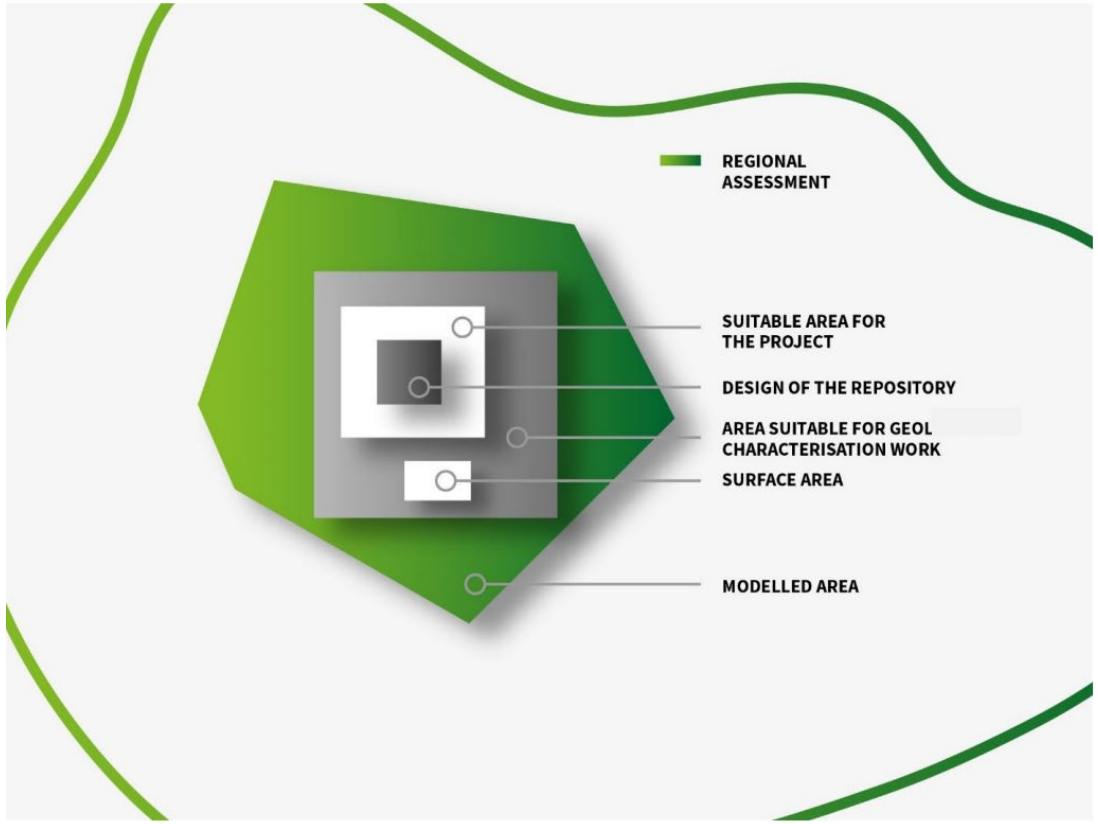
Buffer
Czech Ca-Mg bentonite, bentonite blocks + granulated bentonite mixture, average dry density of 1600 kg/m^3

Backfill
Czech Ca-Mg bentonite, granulated bentonite mixture, average dry density of 1400 kg/m^3



Technical Feasibility and Repository Design

- The repository have to be technically feasible in all four candidate sites.
- A detailed technical design of the repository system has been developed for all sites.
- Technical feasibility includes:
  – layout and construction concept
  – access routes and logistics
- We are now focusing on the final localisation of the surface facilities, guided by a dedicated siting methodology.
- Repository design is fully integrated into the site selection process.



Preliminary safety assessment of the Czech disposal concept (Safety Case 1)

Role in the site selection process:

- Provides the first complete safety evaluation of the Czech disposal concept.
- Helps determine whether the concept is inherently safe under realistic geological and hydrogeological conditions.
- Defines the safety functions, key processes and performance expectations of the repository system.
- Conducted on a reference site to assess concept robustness
- Defines key safety parameters and transferability ranges for comparing the four sites

From Site Comparison to Licensing (2030 → 2032)

- All data collected by 2029 will be integrated and compared to select the final and backup site in 2030.
- The same data will form the basis for the 2032 siting licence application.
- Therefore, all datasets must already meet strict quality and regulatory requirements.

Thank you for your attention!