NEA Horonobe International Project

Developing Advanced Technologies and Human Resources for Geological Disposal of Radioactive Wastes

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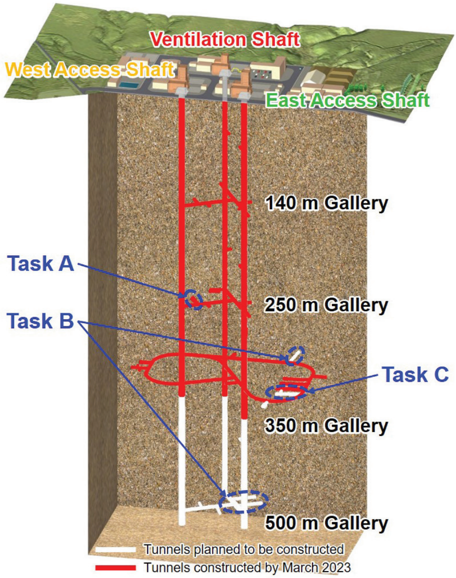
The Nuclear Energy Agency (NEA) Horonobe International Project (HIP) offers through the Horonobe Underground Research Laboratory (URL) an opportunity to enhance the understanding of sub-surface environment and testing models and techniques under realistic conditions. The Horonobe URL, located in Hokkaido, Japan, is a platform for international collaboration, hands-on training and tailor-made courses. It is a great opportunity for the current generation of nuclear specialists to share and transfer knowledge and experience, and for the next generation to put skills into practice and gain confidence.

The first HIP Management Board meeting was held in April 2023 with the participation of 11 organisations from Australia, Bulgaria, Germany, Japan, Korea, Romania, Chinese Taipei and the United Kingdom. The Management Board has decided to structure the project in two phases: from 2023 to 2025 and from 2025 to 2029.



Horonobe URL (JAEA)

The main objectives of the HIP are to:

- develop and demonstrate advanced technologies to be used in repository design, operation and closure, and a realistic safety assessment in deep geological disposal; and
- 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 organisations worldwide.

Project timeline

The three HIP project tasks will span seven years from the beginning of Phase 1 to the end of Phase 2, in parallel. The project's first phase takes place from 31 March 2023 to 31 March 2025. The second phase, associated with experiments at the new excavated gallery (500 m underground) will officially run from 1 April 2025 to 31 March 2029.

During the project development phase, additional participants can still be accommodated. Interested parties are invited to contact the NEA for further information on the joining process (Soufiane.Mekki@oecd-nea.org).

Task descriptions

Task A – Solute transport experiment with model testing

Attempts have been made to enhance the technical reliability of solute transport models for repository safety assessments by tracer tests at in situ conditions. In general, the results of tracer tests are modelled to produce a set of "best fit" values for the transport parameters by comparing calibrated model curves with the experimental breakthrough curves but the modelled values are not always a unique solution. This could be due to the fact that the actual structures and processes of relevance to solute transport are unknown and hence these are represented in the solute transport models with effective parameters in a relatively simple manner. It is thus suggested that detailed and realistic information on the relevant structures and processes be obtained through a series of tracer tests and the subsequent rock characterisation at the in situ conditions. This would allow the models and model assumptions to be rigorously tested and, as a result, the technical reliability of the models to potentially be enhanced.

Boring survey for in-situ tracer test (JAEA)

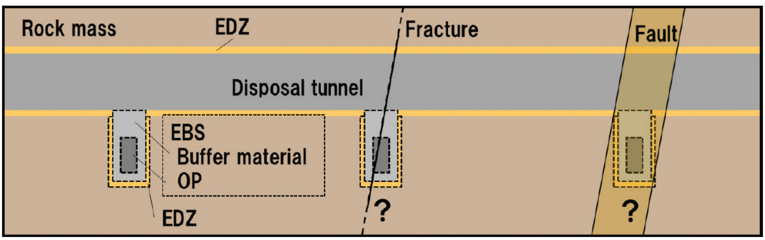
The principal aim of this task is to develop more realistic 3D solute transport models that can be applied to repository safety assessments for fractured porous sedimentary rocks.

Task B – Systematic integration of repository technology options

In order to arrange and construct disposal tunnels and pits or holes in suitable rock volumes, it is crucial to design their layout in detail, taking into consideration the distribution, spatial scale and hydraulic properties of faults and fractures and their potential impacts on likely radionuclide migration and the long-term stability of an engineered barrier system (EBS). Methods must be established for locating the disposal tunnels and pits or holes. The adequacy of these methods should then be ensured through the in situ demonstrations at all stages, from the initial geological characterisation to the design and final construction of a tunnel and pits or holes. As a range of technology options have been developed for each process, it is suggested that such options be evolved using the most advanced technology possible and that the systematic integration of available options then be demonstrated.

The principal aims of this task are to:

- develop technology options that could contribute to the operation of disposal sites;
- establish the concepts and criteria for locating disposal pits or holes in suitable rock domains around the disposal tunnels; and
- demonstrate the systematic integration of available technology options to arrange and construct the disposal pits or holes.



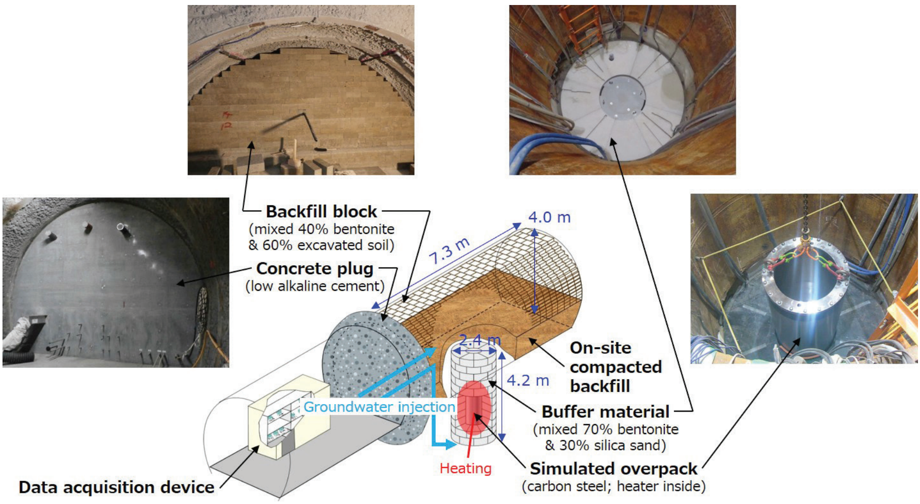
Schematic illustration of pit layout criteria (JAEA)

Notes: OP - Overpack; EDZ - Excavation damaged zone.

Task C – Full-scale EBS dismantling experiment

It is important to evaluate the evolution of near-field thermal-hydrological-mechanical-chemical (T-H-M-C) conditions during the transition period following the emplacement of waste forms. This would allow the near-field initial conditions to be defined for safety assessments and the overpack lifetime to be predicted. To this end, a full-scale EBS performance experiment for vertical EBS emplacement has been carried out at the -350 metres gallery since 2014, with the aim of understanding the T-H-M-C coupled processes and testing the T-H-M-C coupled simulation code during backfilling of the EBS and tunnel and its subsequent dismantling. The relevant data have been obtained through previously installed sensors. However, as data collected only from the sensors would not allow the conditions and processes occurring at the interfaces of the different EBS materials to be understood in detail, the experimental setup will be dismantled to acquire more detailed information.

The principal aim of this task is to test the T-H-M-C coupled simulation code in a rigorous manner by understanding the near-field T-H-M-C coupled processes in more detail.



Schematic image of the full-scale in-situ EBS experiment (JAEA)

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