

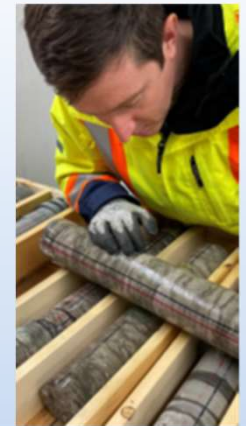
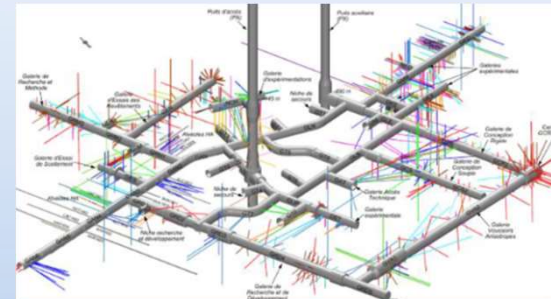
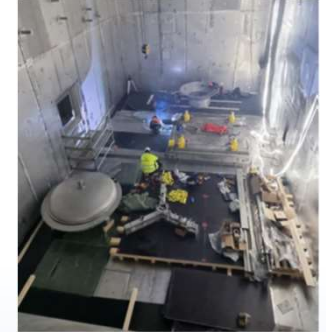
INTERNATIONAL PEER REVIEW

NUMO Pre-siting Site Descriptive Model Based Safety Case Report for Deep Geological Disposal

IRT chair, Director Jussi Heinonen

International background

- The scientific consensus today is that deep geological repositories (DGR) are a safe and effective approach to permanently dispose of high-level radioactive waste (NEA 2020)
- Geological disposal is widely accepted as final solution and a few countries have progressed to licensing, construction and operation of a DGR:
 - USA: DGR for trans-uranic waste has been in operation since 1999 (WIPP)
 - Finland: Operating license application was submitted at the end of 2021 (ONKALO)
 - Sweden: Government issued license in 2022
 - France: Construction license application was submitted January 2023 (Cigeo)



NEA, Management and disposal of high-level radioactive waste: Global progress and solutions, 2020

Pictures: Posiva, Andra and NWMO

Step-wise development of a Deep Geological Repository

Pre-operational phase

NUMO → Safety strategy
Disposal concept
Site selection
Design finalization
Safety assessments

Excavation and construction
Barrier fabrication
Preparations for operation

Operational phase

Waste packaging
Emplacement in DGR
Periodic safety evaluations
...
Closure of DGR

Post-closure phase

Safety is provided by
passively functioning
barriers

Institutional control and
monitoring

NEA International review team main findings

Feasibility of geological disposal and NUMO's approach (1/2)

- NUMO has done significant work to produce the SDM-based generic Safety Case.
 - NUMO's approach for step-wise development of safety case is in line with international good practices.
 - Current safety case is mature and sufficient for this phase.
- Areas potentially suitable for geological disposal in Japan have been identified
 - With the knowledge already available, NUMO has the capability for detailed site investigations and safety assessments
- The disposal design, conceptual at this phase, appears to be at an adequate stage of maturity
 - The studies and tests show that the technologies are available
 - Disposal design will be further developed as information of host rock increases

Feasibility of geological disposal and NUMO's approach (2/2)

- NUMO's approach to conduct safety assessments is consistent with international recommendations and practices
 - The numerous studies in support of the safety demonstration, and the resulting models, illustrate NUMO's ability to represent geological disposal, to describe its possible evolutions, and to analyze their consequences.
 - The SDM approach is an adequate, iterative way to describe and integrate geoscientific knowledge
- Based on review of NUMO's safety case, the IRT considers NUMO's approach to implement a DGR in Japan as feasible
 - Implementation of DGR still requires many studies and safety evaluations.
 - NUMO has demonstrated its ability to fulfill such a mission.

Overall programme key observations

For successful DGR implementation, the IRT strongly recommends that NUMO initiates or reinforces the dialogue with the major stakeholders. SDM-Based Safety Case forms a basis for dialogue.

Dialogue is suggested with:

- the regulator, with the aim to clarify regulatory expectations for coming steps.
- the waste producers, with the aim to have a more realistic understanding of RW inventory, characteristics and disposability.
- the institutions and teams involved in defining and carrying out R&D for the geological disposal, with the aim of focusing research on the needs expressed by NUMO.

The IRT also notes that international peer review (e.g. IAEA Artemis) focusing on overall Japanese DGR program and regulatory framework would be useful and would support successful DGR development.

Summary of main recommendations to NUMO

The IRT makes the following recommendations to be considered in the development of future safety cases:

- To continue efforts to further increase understanding of the disposal systems so that repository performance can be analyzed to an adequate level for each of the future decision-making steps.
- To develop a more global understanding of DGR robustness by carrying out sensitivity analyses that vary waste inventory, site properties, ranges of technical data, etc.
- To develop an R&D proposal based on the current safety case. Such proposal should clearly define and substantiate key R&D priorities needed in the next phase of siting and safety case development.
- To continue its investments in international activities, both with the international bodies NEA and IAEA, and with the organizations abroad working with similar geological disposal projects.

Summary of specific recommendations to NUMO (1/2)

The IRT makes following detailed recommendations to be considered in the development of future safety cases:

Disposal concept and design

- To define performance indicators for safety functions
- To consider in more detail the retention of radionuclide transport in the geosphere
- To continue design developments, particularly with a view to adapt design as information on site characteristics increases.
- Better integrate monitoring aspects of retrievability concept

Stepwise development and management system

- To keep design options open as much as possible in order to keep flexibility in DGR development phase.
- To implement a configuration management as part of NUMO's overall management system. Configuration management's objective is to record the various technical options studied as well as the sets of calculations associated with each of them.

Summary of specific recommendations to NUMO (2/2)

Safety assessments

- To supplement the operational safety assessment by including additional scenarios and all potential exposure pathways to workers and the public
- To explore phenomena not considered at this stage, since evaluated to be of secondary importance for repository evolution
- To continue developing storyboards and assessing further ways to increase their use
- To increase efforts to validate models and computing tools in the near future
- To strive for less conservatism, e.g. by developing sensitivity cases with alternative, reasonably expected, site properties

IRT conclusions

- NUMO's SDM-based safety case is in line with international standards and fulfils its role well in the current DGR development phase
- NUMO has demonstrated its capability to integrate multiple lines on scientific information and to carry out safety case development
- Preliminary results from the siting process and NUMO's safety case demonstrate that geological disposal is feasible in Japan
- For successful DGR implementation, it is of key importance that dialogue between main stakeholders is enhanced
- IRT has made observations and recommendations that NUMO should take into account in next steps of site selection and safety case development



Thank You!