



Regulatory perspective about monitoring dedicated to geological disposal facilities for radioactive waste

Modern2020 2nd International Conference about Monitoring in Geological
Disposal of Radioactive Waste

Spent fuel management and disposal in Finland

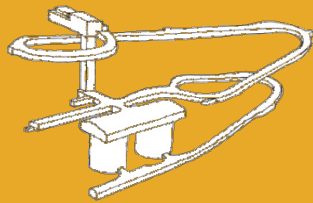
Olkiluoto NPP site



Olkiluoto power plant

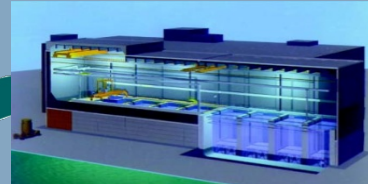


Interim storage of spent nuclear fuel



LILW waste repository

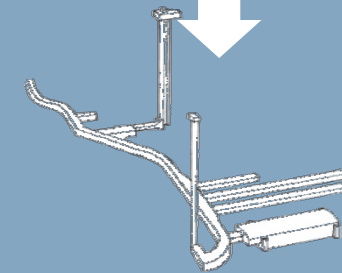
Loviisa NPP site



Interim storage of spent nuclear fuel



Loviisa power plant



LILW waste repository

Fennovoima Oy

In future

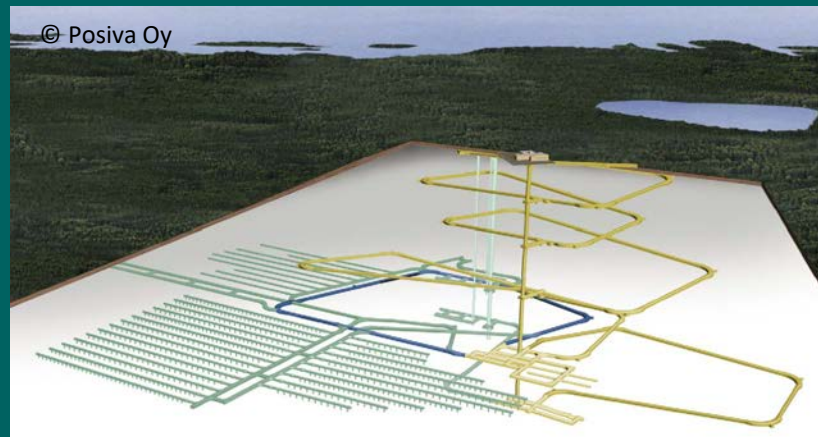


In NPP site:

- Interim storage of spent nuclear fuel
- LILW waste Repository
- HLW disposal plan in year 2016

In future

Posiva Oy



Final disposal of spent nuclear fuel

Steps in licensing of SNF repository

- 2000/2001 **Decision in Principle** was made. Political and societal acceptance of the Olkiluoto Repository
 - STUK's Preliminary Safety Appraisal followed by municipal acceptance, Government Approval and Parliament's ratification,
 - Authorization to construct URCF (Onkalo), planned to be part of the repository
- 2012-2015 **Construction License application**
 - Posiva submitted construction licence application 28th December 2012
 - Authorization to construct deposition tunnels, deposition holes and other underground facilities
 - Authorization to construct encapsulation facility
 - No nuclear waste to be introduced into repository
- 2020 -2022 **Operational License application**
 - Authorization to introduce nuclear waste into encapsulation and repository
 - Facility is expected to start operation around 2024
 - Fixed period with full safety review at 15 y intervals (or as specified in license)

Requirements for monitoring

- The Finnish regulation and regulatory decisions specify how monitoring shall be used to gather information and follow the nuclear facility safety and evolution of the site and near-field properties. For example
 - radiation protection of the workers
 - monitoring of radioactivity and dose rates
 - radiation monitoring in the environment of the nuclear facility
 - meteorological monitoring
 - Host rock properties during the construction and operation
 - monitoring of safety barrier performance
- The requirements are described in STUK Regulation (Y/4/2018) and STUK YVL regulations (YVL D.5 for disposal facilities)

Requirements for disposal monitoring

- STUK Regulation (Y/4/2018)
 - *In order to ensure the performance of the barriers, a research and monitoring programme shall be established and implemented for the operating stage of the disposal facility.*
- STUK YVL Guide D.5
 - *510. During the construction and operation of the disposal facility, a research and monitoring programme shall be executed to ensure that the site and the rock to be excavated are suitable for disposal and to collect supplementary information about the safety-relevant characteristics of the host rock and the performance of the barriers. This programme shall at least include*
 - *characterization of the rock volumes intended to be excavated*
 - *monitoring of rock stresses, movements and deformations in rock surrounding the emplacement rooms*
 - *hydrogeological monitoring of rock surrounding the waste emplacement rooms*
 - *monitoring of groundwater chemistry*
 - *monitoring of the performance of engineered barriers; and*
 - *monitoring of the surface environment.*

Lifecycle of disposal facility

- The monitoring has different tasks/goals during the different phases of disposal facility lifecycle, for example
 - Monitoring before the site selection (for the Environmental Impact Assessment, EIA)
 - Baseline of site properties (bedrock, environment, several areas of monitoring) during the detailed site investigation
 - Monitoring the effect of construction (URCF or disposal facility)
 - Monitoring or compilation of nuclear facility operational baseline
 - Monitoring related to demonstrations for technical feasibility of the concept and performance confirmation of barriers
 - Monitoring the effect of operation and continued construction
 - Monitoring the performance of closure structures
 - Post-closure monitoring (institutional control)
- For all phases or activities it is important to identify *the safety relevant functions* that should be confirmed and the *parameters* that can be monitored reliable

Monitoring before construction

- Site characterization and baseline monitoring
 - Favourable site properties
 - Undisturbed conditions
- Monitoring program during construction
 - Disturbances in the bedrock, surface water, groundwater and in surface environment
 - Monitoring program based on assessment of post-closure safety relevant site properties and possible disturbances affected by construction
 - Focus on maintaining of favourable site properties
- Integration of safety and safeguards relevant monitoring activities

Monitoring during construction

- Baseline monitoring program before construction starts and identification of safety relevant properties to be monitored
- Similar and extended monitoring programme later during the construction and operating periods of the disposal facility
 - Focus on changes in characteristics that may have implications for post-closure safety
 - Verification of models that describe the evolution of the site
 - EBS
- STUK's regulatory approach is to review monitoring plans, yearly reporting of monitoring results and assess monitoring as part of inspections focusing on construction disturbances
 - Regulatory control of disposal facility construction is primarily to ensure that the design, adaption and construction are carried out in such a manner that the geological environment maintains its favourable characteristics and conditions needed for the safety functions.

EBS Monitoring

- STUK requires implementer to monitor site properties evolution and also the behaviour of engineered barriers
- No explicit requirements identifying specifically the concept of performance confirmation of the EBS
 - Emphasis on connecting test to the safety related properties of individual barriers
- For example some of the following options might be used
 - Monitor EBS relevant near field properties
 - Monitor inactive EBS demonstrations
 - Planned retrieval of active waste packages during operational period
 - Monitor defined active waste packages (possibly needs retrieval)
 - Use wireless monitoring for all waste packages (future?)
- Monitoring activity shall be balanced in a way that it has no negative effects on safety

Summary and some open issues

- In Finland power companies, Posiva and STUK has experience in implementing and regulating the monitoring of disposal facilities and also first phases of SNF repository lifecycle based on experiences of licensing and construction.
- The Finnish regulatory requirement defines main items for monitoring
- For the next phases there are items that should be further addressed
 - Long-term monitoring of disposal system performance
 - Identification of key properties of engineered barriers system and near-field
 - Strategy and goal of performance confirmation and monitoring, what can be achieved in reality?
 - Role of post-closure monitoring - why, for who and how long?

