VTT has over 30 years of experience serving Finnish and Swedish nuclear waste management organisations, including support with high level waste management for Posiva Oy and Svensk Kärnbränslehantering AB (SKB) as well as Low and intermediate level (LLW) waste (TVO and Fortum Oy) and regulatory authorities in Finland and Sweden. We are active members of the European Technology Platform on Implementing Geological Disposal (IGD-TP) as well as OECD NEA committees on RWMC (Radioactive Waste Management Committee), IGSC (Integration Group for the Safety Case) and TDB (Thermochemical Data Base). We have participated in numerous EU and international projects, including many FP7 and H2020 Euratom projects.

The VTT offering

VTT has the expertise needed to assess the long-term safety of spent fuel and other nuclear waste disposal stages. The assessment of a disposal system's overall safety is based on understanding the coupled behaviour of its subsystems, gained through in-situ characterization, experimental studies, demonstrations and mathematical modelling. The following sections present some examples from our nuclear waste management research:

Modelling for post-closure safety assessment
Assessing the long-term safety of waste repositories means modelling the physical and chemical characteristics of radionuclides, the containers into which they are placed, and the surrounding environment.

Some of the parameters we look at include:
• The time-dependent inventories of radionuclides
• Volumes and flow rates of groundwater close to the repository
• Transport of radionuclides along groundwater in the fractures of bedrock
• Structural behaviour of disposal canisters and of protective materials like clay, concrete, and bedrock

VTT has performed several increasingly complex safety assessments and design of solutions of geological repositories for spent fuel. Such an assessment was done for the 2012 construction licence application of Posiva’s spent fuel repository in Finland. About 40% of Posiva Reports for support of Construction License Application of deep geological repository were written or co-authored by VTT. VTT also supports Posiva in Post-CL site investigations, modelling and analyses for Safety Case updates.

Non-destructive evaluation and testing
VTT has performed non-destructive evaluations (NDE) for over 50 years. Together with the customer organisation responsible for the safe disposal of spent nuclear fuel, we have developed a solid methodology for inspecting the disposal canisters and engineered barrier system (EBS) components, like buffer and backfill.

VTT is focused on developing more reliable, economical, and precise NDE methods for our customers’ specific needs. Our internationally competitive facilities include an accredited non-
destructive testing (NDT) laboratory with advanced mecha-
nised eddy current and phased array ultrasonic inspection
systems, as well as scanning acoustic microscopes and
state-of-the-art simulation programs. We have expertise in
wired and wireless transmissions systems, for real-time moni-
toring of site and EBS components. Monitoring programs are
developed with clients to demonstrate conformance to per-
formance targets.

Development of encapsulation and disposal
technologies

VTT has contributed to the development of disposal canister
Concepts. We have devoted together with the customer con-
siderable effort to the development of doublelayer, copper/ 
cast-iron canisters. These consist of a massive cylindrical
nodular graphite cast iron insert covered by a 50 mm-thick
alloy. We have worked closely with clients to optimize
the manufacturing of barrier materials, such as com-
pacted bentonite blocks, bentonite pellets and tunnel plugs
of concrete.

We have developed quality control systems for raw material
procurements and EBS component manufacturing. We have
developed techniques for installing compacted bentonite
blocks into disposal holes and deposition tunnels, and mois-
ture protection systems to prevent EBS early state deteriora-
tion during the construction phases.

Site characterisation and evaluation

VTT has been investigating and characterising Finnish nuclear
waste disposal sites for over 30 years. We begin by collecting
data on the disposal site, including fracture properties of the
bedrock, as well as groundwater chemistry and movement
in the repository area. This data is used to construct a three-
dimensional model of the site that displays the geophysical
and geochemical properties. We have significantly supported
the development of the safety case for an underground nuclear waste repository for Posiva.

We have also had a role with Finnish stakeholder
involvement, including studies in urban/municipality impacts
of repository site selection.

Operational safety of spent fuel management and
transportation

VTT evaluates the operational safety of interim storage
and encapsulation of spent nuclear fuel. We have made
risk analyses of the transportation of spent fuel from a
power plant to a disposal site. These covered various
modes of travel, be it road, rail, or ship. We contributed
to the probabilistic risk assessment (PRA) related to the
transportation and encapsulation operations.

Nuclear waste long-term safety research
in a nutshell

- Characterization of radioactive waste
- Operating waste and decommissioning
- Design of disposal concept (KBS-3)
- Operating waste and decommissioning
- Bedrock and groundwater characterization
- Long-term safety of materials, disposal facilities and
  safety case
- R&D supporting repository planning and construction
- Engineering barrier system component manufacturing
  and quality control
- Operational safety of disposal facilities, including PRA
- New and alternative waste management technologies
- Licensing support
- Low and Intermediate waste storage

Additional information

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