VTT Technical Research Centre of Finland Ltd

Research and development as a success factor of the nuclear industry, radwaste management, and the entire energy system

Japan - Finland joint seminar on Energy Policy and Challenges of Nuclear Energy

Especially geological disposal of HLW

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About VTT

Research and technology organisation, one of the leading in Europe

Our vision

A brighter future is created through science-based innovations.

Our mission

Customers and society grow and renew through applied research.

Strategy

Impact through scientific and technological excellence.

269 M€
Net turnover
(VTT Group 2016)

33%
from abroad
(VTT Group 2016)

2,368
personnel
(VTT Group 2017)

Owned by
Ministry of Economic Affairs and Employment

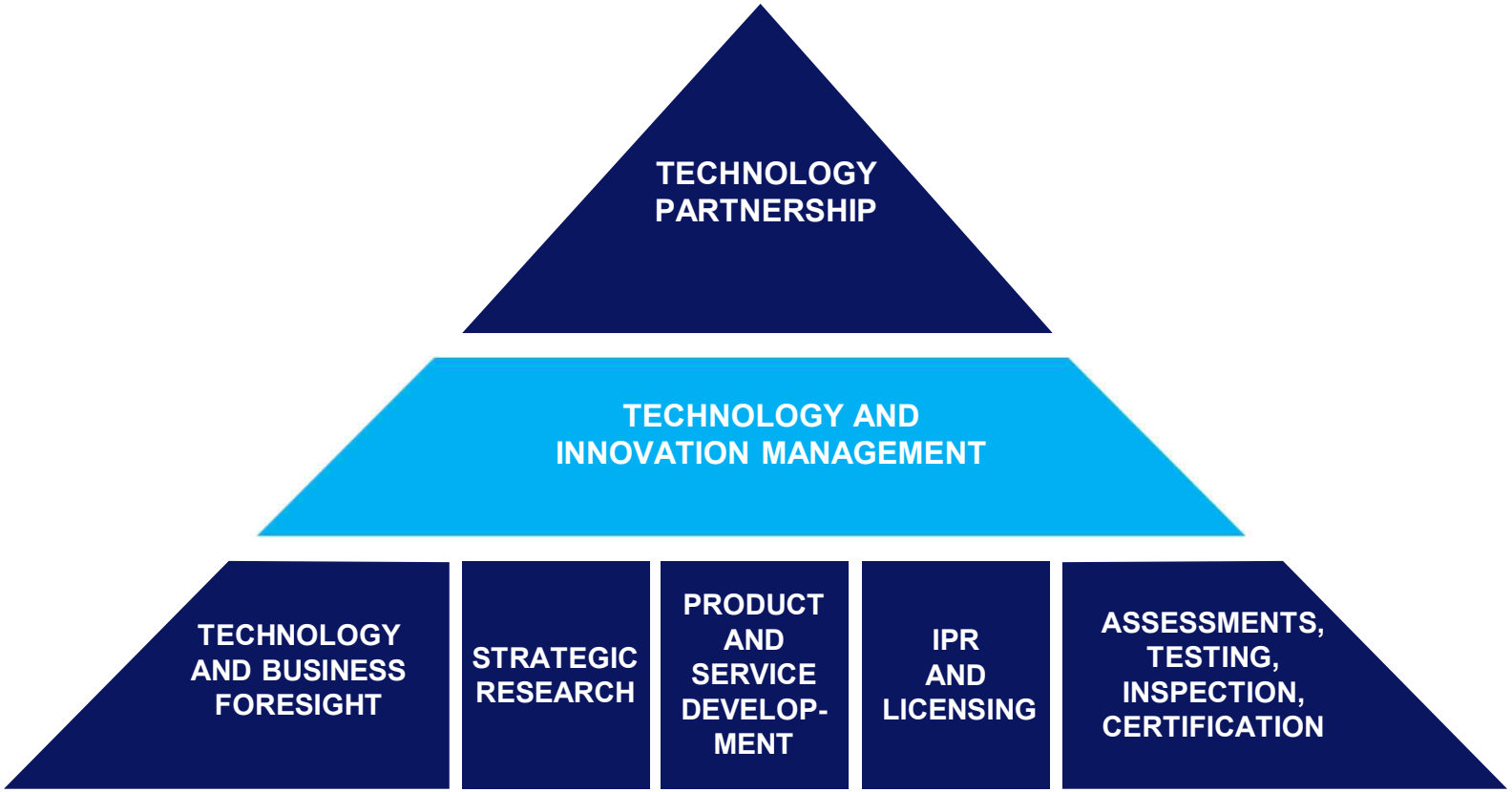
27%
Doctorates and Licentiates
(VTT Group 2017)

Established
1942

Key actor in innovation ecosystem of Finland

- VTT is innovation partner to companies
- VTT is Finland's biggest single actor in EU framework programmes
- VTT participates in ca. 30 national technology programmes (Business Finland, Academy of Finland)
- VTT has strategic partnerships with main universities
- VTT participates in four Centers of Excellence by Academy of Finland

Our services and support at all stages of innovation process

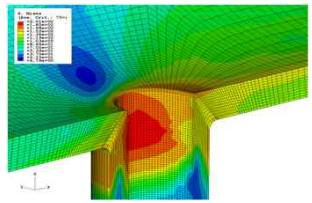


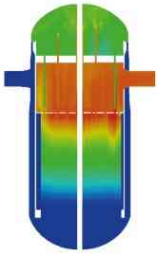
Why partner with VTT?

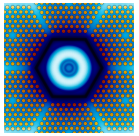
Three good reasons to choose VTT as your front-line research and innovation partner:

1. We provide comprehensive and profound expertise in technologies, cognitive sciences and business development.
2. We offer world-class research infrastructure and IPR assets.
3. We are impartial and independent from product suppliers.

VTT has an active role





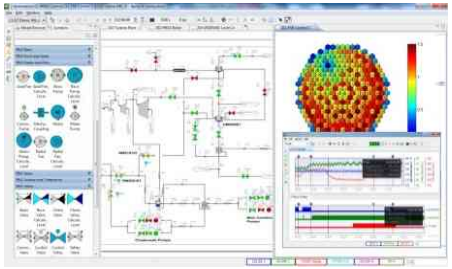


in policy development:

Multi-disciplinary studies to support
energy, climate and innovation policies
from national, European and global perspectives

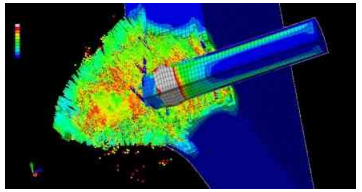
in nuclear investment projects:

Safety analyses – for the regulator
Licensing support – for the industry



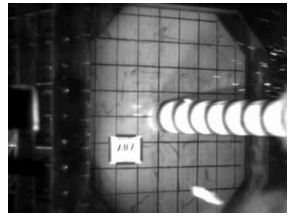
in NPP operation:

Material performance studies
Plant life and performance analysis



in NPP decommissioning:

Inventory calculations and measurements



in the future of nuclear energy:

SMR feasibility studies
GenIV and fusion technologies

in radioactive waste management:

See the next page

VTT services for implementation of Deep Geological Repositories (KBS-3 type)

Site

- Basis: safety concept, capacity needed
- Knowledge: minerals, geochemistry, groundwater flow
- Bedrock models
- Dominating processes in bedrock
- Long-term evolution: effects of construction
- Suitability analyses
- Target properties of bedrock
- Usability analysis

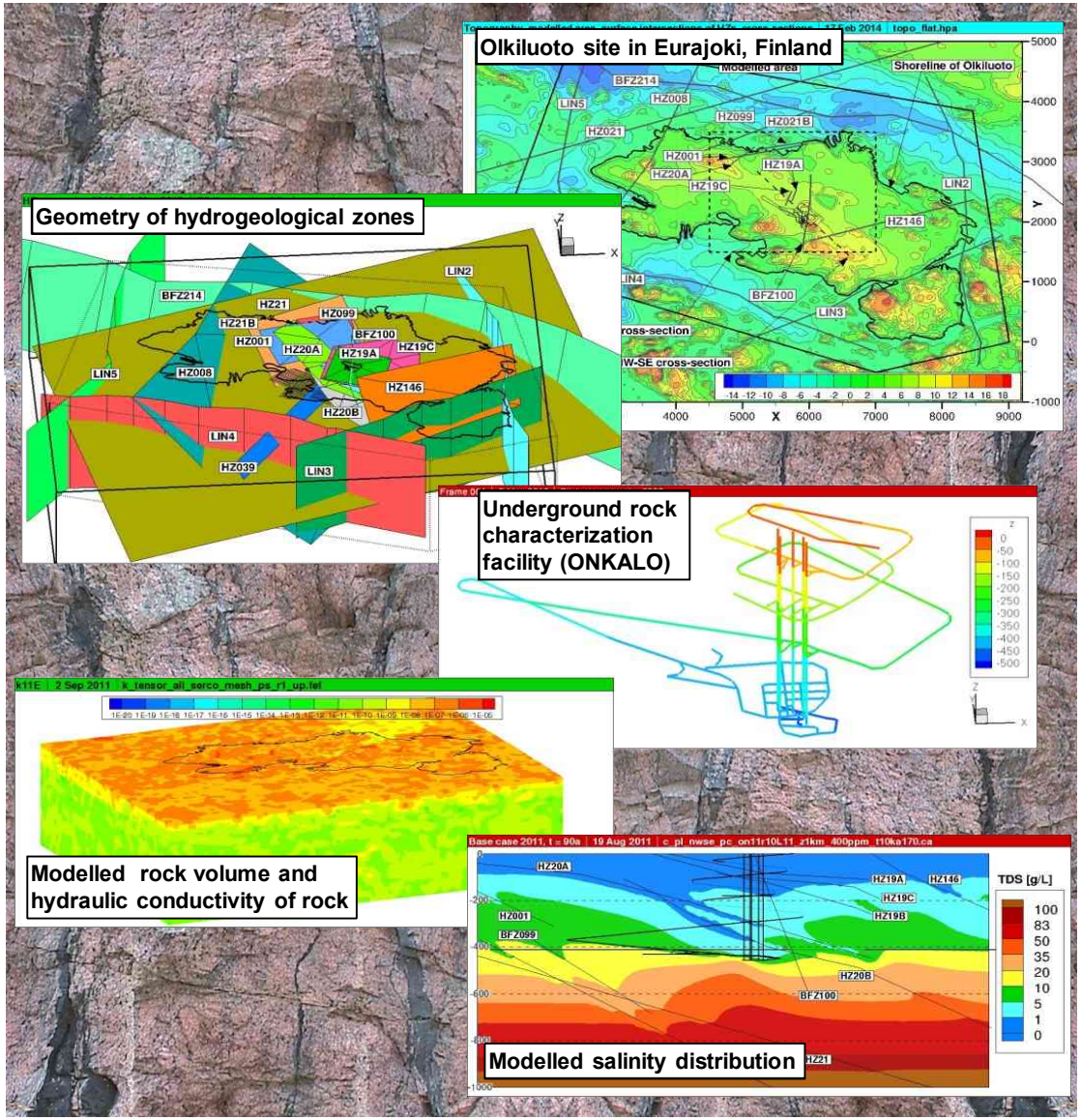
Disposal System

- Knowledge: materials and bedrock
- Expected conditions and evolution
- Safety functions: engineered barrier systems (EBS) and bedrock
- Technical design
- Scenarios
- Safety demonstration
- Performance and optimization

Facilities: underground and encapsulation

- Dimensioning and timing
- Safety principles and functions
- Knowledge: site and materials
- Technical solutions
- Operation
- Validation of design
- Operation scenarios
- Assessment of operational safety
- Performance and life cycle

Case: Groundwater Flow Modelling in Fractured Rock

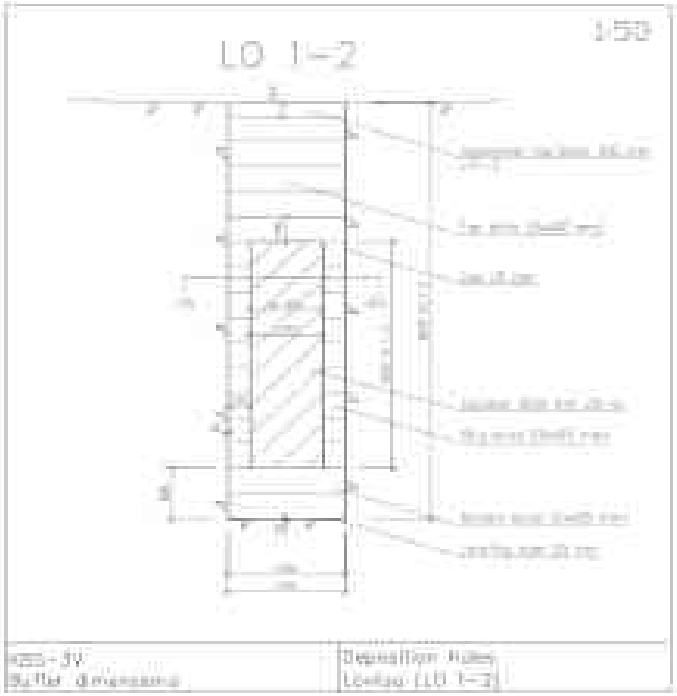


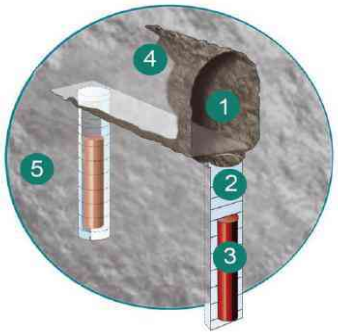
- **Challenge**:
  The hydrogeological conditions of fractured rock at the Olkiluoto site constitute a significant factor with regard to the performance of the spent nuclear fuel repository in Finland.
- **Solution**:
  The FEFTRA finite element program package developed at VTT for simulation of coupled fluid flow, heat transfer, solute transport in fractured, heterogeneous media. The software includes an advanced mesh generator and a calibration technique (EnKF).
- **Key benefits**:
  Support for Posiva's site characterization and safety assessment projects for the disposal of nuclear waste in Finland.

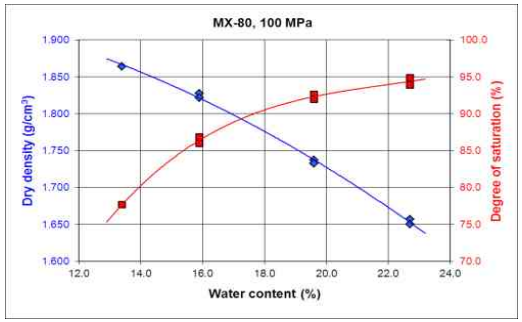
***Contact & Reference(s)**: Suvi Karvonen, Kari Rasilainen*

FEFTRA™ – Verification – Update 2013: http://www.posiva.fi/files/3455/WR_2013-60.pdf,
Simulations of Hydrogeological Evolution at Olkiluoto: http://www.posiva.fi/files/3074/WR_2012-35_2.5.pdf

Case: Engineered Barrier Systems Geotechnical & Structural Design







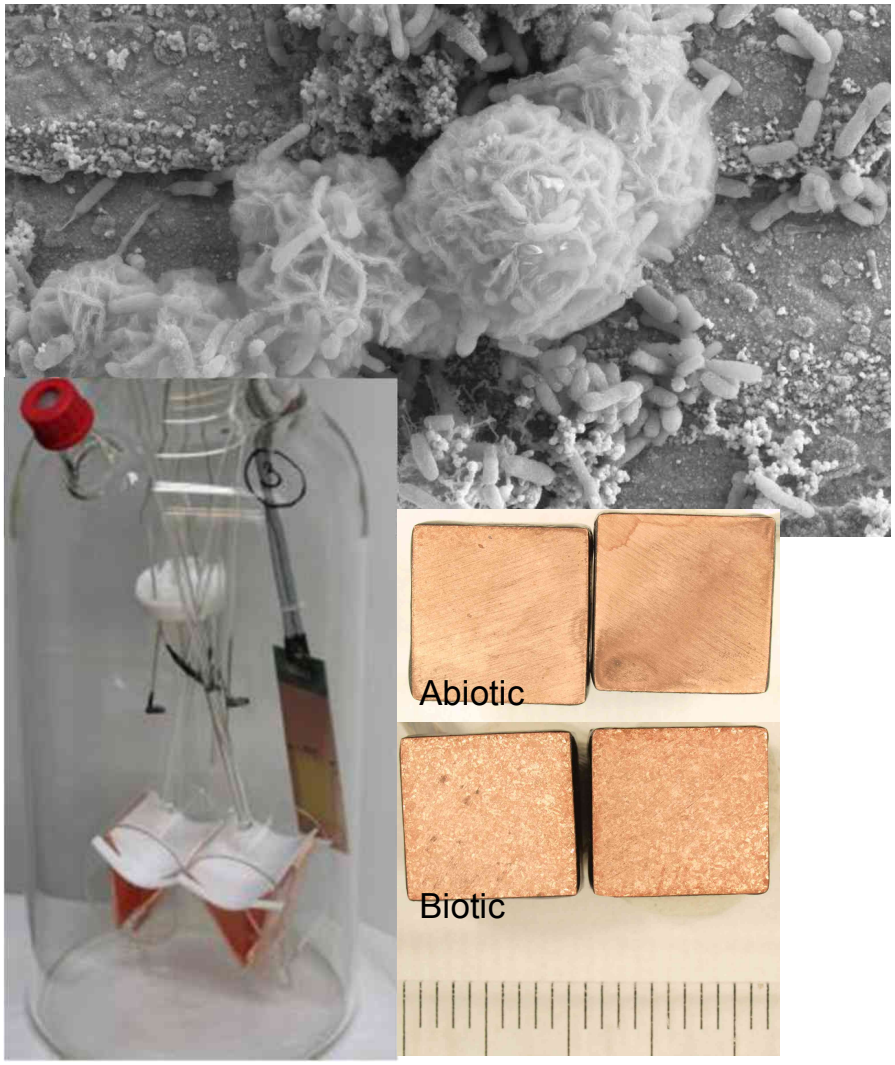
- **Challenge**:
  Structural and geotechnical design of deposition components, including buffer, backfill and tunnel plugs to ensure initial state performance for long term safety.
- **Solution**:
  Buffer and backfill components are designed so that after saturation and swelling they fulfil the long term safety requirements. The saturated density of the components shall lie in an interval in which they are dense enough to fill all the space with defined properties but still elastic to protect the canister for example in case of rock movements.
- **Key benefits**:
  Proper design of the components establish mechanical, geochemical and hydrogeological conditions that are predictable and favourable to the canister, and protect canisters from external processes that could compromise the safety function of complete containment of the spent nuclear fuel and associated radionuclides, and limit and retard radionuclide releases in the event of canister failure.

Contact & Reference(s): *Markku Juvankoski, Ville Rinta-Hiiro, Erika Holt*

Buffer Production Line 2012 – Design, production and initial State of the buffer. POSIVA 2012-17. Posiva Oy, Eurajoki.

Buffer Design 2012. POSIVA 2012-14. Posiva Oy, Eurajoki.

Case: Corrosion and Microbially induced corrosion of copper canisters



- **Challenge:**
  Microbial activity may effect the integrity and long term performance of copper canister in repository environment.
- **Solution:**
  Corrosion research and monitoring of biofilm formation with sophisticated electrochemical and molecular biological methods simulating the repository scenarios. Evaluating influence of the aggressive substances that microbes can produce on copper. Characterization of surface processes of copper in natural environment.
- **Key benefits:**
  Improved understanding of corrosion of copper in repository conditions.
  Safety evaluation of long-term corrosion resistance.

Contact & Reference(s): *Leena Carpén, Pauliina Rajala*


A brighter future is created
through science-based innovations.
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