



VTT

# SMR Siting and Waste Management

SAFIR2022-KYT2022 Final Seminar 23-24.1.2022

VTT: [Paula Keto](#), Pauli Juutilainen, Timothy Schatz, Sami Naumer, Silja Häkkinen, Merja Airola, Nadezhda Gotcheva & Tuire Haavisto  
GTK: Jaakko Hietava, Heini Reijonen, Ismo Aaltonen & Taina Karvonen

08/02/2023 VTT – beyond the obvious

# Content

- Background & objectives
- Regulatory framework
- Effect of SMR spent nuclear fuel characteristics on the final disposal and applicability of the current management methods.
- Siting of SMR plants and repositories
- Societal acceptability

# Background & objectives

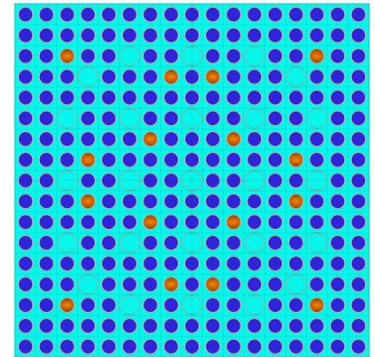
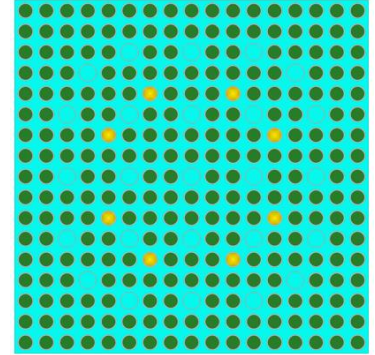
- Safe and efficient management of nuclear waste is a prerequisite for deployment of SMRs in Europe.
- Replacement of fossil fuel-based district heating systems is especially interesting for Finland → siting close to cities.
- SMRSiMa started in cooperation with the Geological Survey of Finland in a project “SMR Siting and Waste Management” in 2022. Work is limited to LWR-SMRs.
- Objectives of project are to study:
  - SMR spent nuclear fuel characteristics (KÄRÄHDE & SMRSiMa) and their effect on disposal.
  - SNF management options and regulatory framework in Finland.
  - SMR Plant and repository siting from geological perspective.
  - Societal acceptability of SMR plants and their siting.

# Regulatory framework

- Reform of Nuclear Energy Act ongoing. Some considerations potentially relevant for SMRs:
  - Enabling handling, storage and disposal of SMR SNF and other nuclear waste outside Finland (section 6a). Currently possible only for minor quantities for research purposes.
  - Is centralised waste management possible considering small SMR units (e.g. < 50 MWh) used for district heating?
    - “A licence holder whose operations generate or have generated nuclear waste (party with a waste management obligation = **jätehuoltovollinen**) shall be responsible for all nuclear waste management measures and their appropriate preparation, as well as for their costs (**huolehtimisvelvollisuus**).”
    - Transfer of waste management obligation (**huolehtimisvelvollisuus**) is already possible based on Nuclear Energy Act, section 30.
    - To be taken also into account organisation of financial provision obligation.

# Effect of SMR spent nuclear fuel characteristics on the final disposal

- Generally current management method applicable for LWR-SMRs with  $\text{UO}_2$  fuel, but there are some differences mainly due to smaller core size in SNF characteristics that may need to be considered in final disposal.
- Spent nuclear fuel characteristics were studied with Serpent 2D numerical modelling for two different LWR-SMRs:
  - The lower discharge burnup typical for the SMRs lead to (e.g.) lower decay heating power, photon emission rates (gamma radiation) and mobile nuclide concentrations → potential effect e.g. on canister spacing etc.
  - Increased post-irradiation reactivity (per initial U-235 enrichment) → potential criticality safety issue.
  - The smaller the core, the larger the neutron leakage fraction.
- Serpent-Ants sequence under construction for the purpose.



# SMR power plant, repository and DBD siting

- SMR power plant siting and SMR spent fuel repository siting from a geological suitability perspective.
- Review of IAEA documentation on nuclear facilities and previous repository research in Finland.
- Descriptions of site selection processes using ranking of investigation areas based on geological data from surveyed areas.
- Geological suitability criteria and data applied to SMR plant/repository siting concepts.
- Initial observations for deep borehole disposal concepts in Finnish bedrock conditions.

# Societal acceptability

- Social acceptability issues of SMR plants were studied via municipality interviews in Espoo, Vantaa, Tampere, Jyväskylä, Vaasa and Pyhäjoki.
- Lessons learned from other projects and insights of residents' opinions were collected.
- Results highlight the need for objective, transparent information and internal, regional co-ordination and communication and collaboration between the cities and the stakeholders.
- In addition, efficient and inclusive early phase information sharing and resident engagement methods are needed.