



Decommissioning status, challenges
and solutions in Finland

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Nuclear Energy Act 7 g § sets the basic safety principles for the decommissioning of a nuclear facility

- Decommissioning of the nuclear facility shall be taken into account in the design of the nuclear facility and also during operation
- Decommissioning plan is required in connection with construction and operation license applications and shall be updated every 6 years, if not otherwise required in license conditions. The final decommissioning plan is required for the decommissioning license application.
- Decommissioning of a nuclear facility shall be performed in accordance with the safety requirements and with a decommissioning plan approved by the Radiation and Nuclear Safety Authority (STUK)
- Dismantling the nuclear facility and other measures taken for the decommissioning of the facility may not be postponed without due cause
- Funding is secured for waste management including decommissioning

Decommissioning License is added into the Nuclear Energy Act 20 a §

- When the operation of a nuclear facility is ended, the licensee shall apply for the Decommissioning License. The license application shall be submitted to the authorities in time to ensure that they are able to review the application while the Operating License is still in force
- The Decommissioning License application shall contain two parts: 1) Decommissioning License Application to the Government (33 a § and 34 a §) and 2) Documentation to STUK for approval (36 a §)
- The Ministry of Employment and Economy asks for a statement from STUK about the decommissioning license application

The documentation provided to STUK for approval (Nuclear energy degree 33 a §)

- 1) the final decommissioning plan;
- 2) risk assessment for the decommissioning;
- 3) the final safety analysis report;
- 4) a classification document, which shows the classification of structures, systems and components important to the safety of the nuclear facility, on the basis of their significance with respect to safety;
- 5) a quality management programme ;
- 6) the Technical Specifications;
- 7) a summary programme for periodic inspections for the structures, systems and components important for safety during decommissioning;
- 8) plans for the security and emergency arrangements;
- 9) a description on how to arrange the safeguards that are necessary to prevent the proliferation of nuclear weapons;
- 10) administrative rules for the nuclear facility;
- 11) a programme for radiation monitoring in the environment of the nuclear facility;
- 12) a description of how safety requirements are met; and
- 13) a programme for the management of ageing.
- 14) In addition to documents 1-13 any other document required by regulatory authority

Decommissioning plan

- Nuclear facility shall have a decommissioning plan, which should be detailed enough and respond to the design and current state of the nuclear facility. At the minimum the decommissioning plan shall contain:
 - 1) Selected decommissioning strategy and justification for it
 - 2) Planned decommissioning phases and the project time schedule
 - 3) General description of the decommissioning and nuclear waste management methods;
 - 4) Cost estimation for the decommissioning and nuclear waste management
 - 5) Planned end-state
- The Ministry of Employment and Economy shall ensure that the plan is technically possible, follows the safety principles and cost estimates are reliable. STUK is asked to give statement about the decommissioning plan.

The Decommissioning License may be granted according to 20 a §, if

1. The nuclear facility and its decommissioning plan meet the safety requirements laid down in Nuclear Energy Act and appropriate account has been taken of the safety of workers and the population, and environmental protection;
2. The methods available for the decommissioning and to the nuclear waste management are sufficient and appropriate;
3. The applicant has sufficient expertise available and, in particular, the competence of the staff and the organisation of the nuclear facility are appropriate for the decommissioning;
4. The applicant is considered to have the financial and other prerequisites to engage in operations safely and in accordance with Finland's international contractual obligations; and
5. The planned decommissioning activities fulfil the general safety principles laid down in Nuclear Energy Act.

The end of the decommissioning

- Nuclear facility is decommissioned, when the Licencee has proven to STUK that the buildings and environment are clear from radioactive materials.
- When the decommissioning of a nuclear facility has been brought to completion and all waste has been removed from the site, the licensee shall submit to STUK for approval an application for the clearance of the site and any buildings therein.
- When STUK has noted that the building and environment are clear, Licensee can apply for an order on the expiry of his waste management obligation with the Ministry of Employment and the Economy

Nuclear power plants in Finland



Hanhikivi Site - Fennovoima

- Construction License application for VVER (AES2006)

Olkiluoto NPP - TVO

- 2 operating units - ABB BWRs
- OL3 (EPR) under commission
- Interim Spent Fuel Storage
- L/ILLW repository

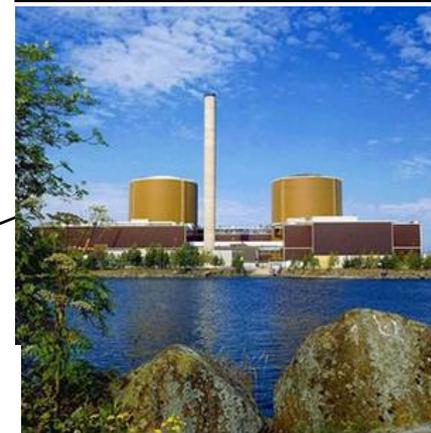
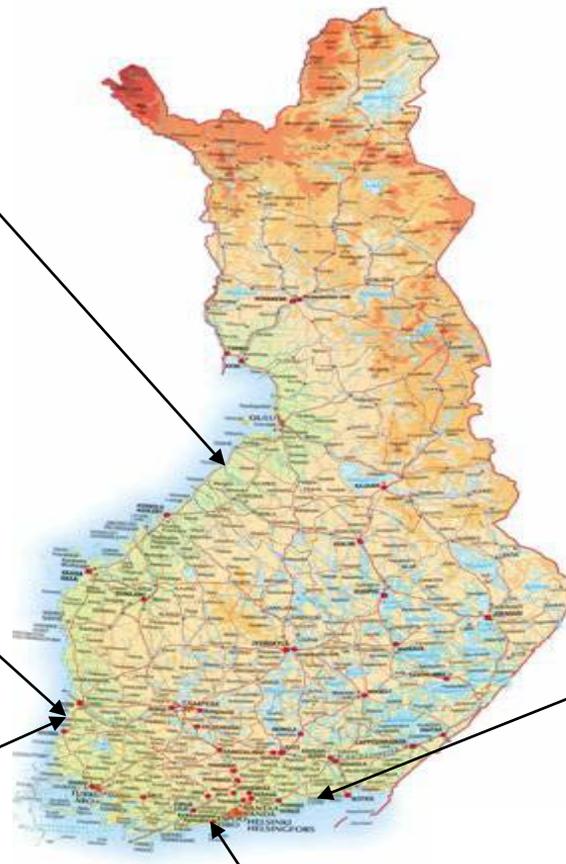
Loviisa NPP - Fortum

- 2 operating units – VVERs
- Interim Spent Fuel Storage
- L/ILLW repository



Olkiluoto - Posiva

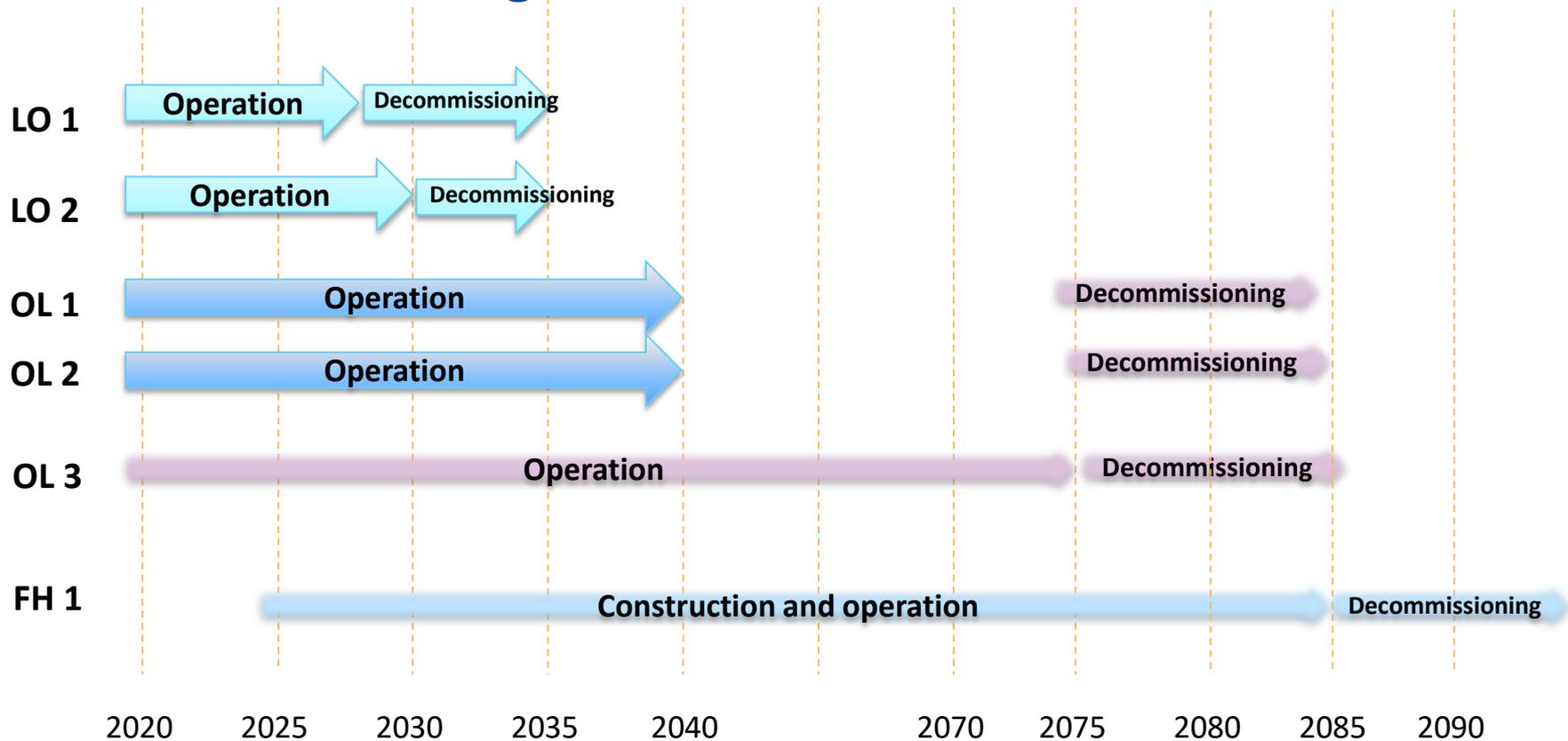
- SF repository



Design basis for the decommissioning planning

- Legislation and YVL Guide D.4
- The length of the expected operating lifetime
- Interim storage arrangements for spent nuclear fuel
- Decommissioning strategy
- Organization and suppliers
- Extension of the Dismantling and planned end state
- Available dismantling methods
- ALARA –principle
- Final disposal options of nuclear wastes

Decommissioning of NPP's in Finland



Decommissioning plans for operating NPP units

- Loviisa 1 and 2
 - Decommissioning plan: 2012, update required by the end of 2018
 - Strategy: immediate dismantling
 - End state: brown field
 - Spent fuel management: interim storage at the plant site and final disposal in Olkiluoto
 - Nuclear waste management: repository for LILW at the plant site
- Olkiluoto 1 and 2
 - Decommissioning plan: 2014, updated required by the end of 2020
 - Strategy: deferred dismantling
 - End state: brown field
 - Spent fuel management: interim storage at the plant site and final disposal in Olkiluoto
 - Nuclear waste management: repository for LILW at plant site



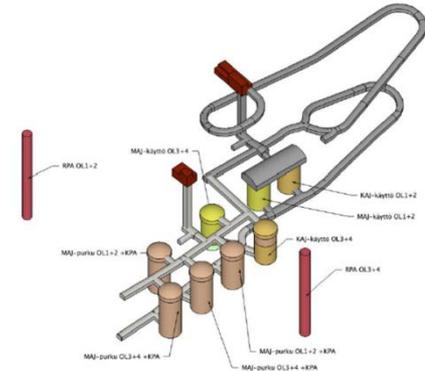
Preliminary decommissioning plans for new-build NPP projects

- Olkiluoto 3

- Decommissioning plan: 2018 (approved as part of the operating licence application)
- Strategy: immediate dismantling
- End state: brown field
- Spent fuel management: interim storage at the plant site, final disposal in Olkiluoto
- Nuclear waste management: repository for LILW at the plant site

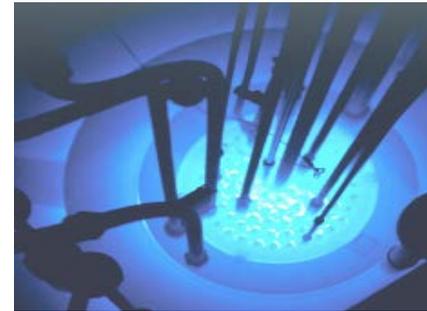
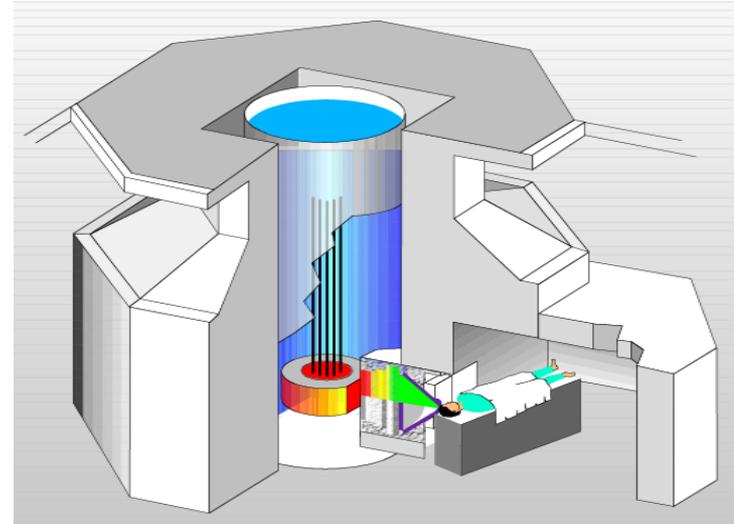
- Hanhikivi 1

- Preliminary decommissioning plan: 2018 (approved as part of construction licence application)
- Strategy: immediate dismantling
- End state: brown field
- Spent fuel management: interim storage at the plant site, final disposal not fixed yet
- Nuclear waste management: repository for LILW at the plant site, near surface repository for VLLW



First nuclear reactor in Finland - Research reactor FiR 1

- TRIGA Mark II reactor 250 kW was in operation from 1962 to 2015
- Operation contained e.g. intensive neutron beam research, activation analysis, in-core irradiations for isotope production, irradiation testing and Neutron Capture Therapy treatments
- The fuel type is uranium (8-12 w%) – zirkonium (91%)-hydrid (1%) fuel
 - The core contained 15 kg of Uranium, the enrichment < 20%
 - In total 103 spent fuel assemblies are located in Otaniemi, 67 is still in the reactor core.



Decommissioning of research reactor FiR 1

- VTT Technical Research Centre of Finland decided in July 2012 to decommission the FiR 1 TRIGA research reactor
- Environmental Impact Assessment (EIA) was conducted in 2014 –2015
- The research reactor was shutdown at the end of June 2015
- Operation license application for decommissioning was send to state council at the end of June 2017
- The first batch of the licensing documentation required by STUK was delivered at the end of June 2017. The last licensing document was delivered at the September 2018
- STUK's safety evaluation and statement to the Ministry of Economic Affairs and Employment is planned to be ready in March 2019

Final decommissioning plan

- The Final Decommissioning plan for FiR 1 reactor was sent to STUK for approval at the end of June 2017
- Main decommissioning principles:
 - Final decommissioning plan: 2017 (approved as part of operating licence application)
 - Strategy: immediate dismantling
 - End state: brown field
 - Spent fuel management: 1) the first option is to return the fuel back to USA by spring 2019. 2) The second option is interim store the spent fuel in Finland and return it back to USA later. 3) The third option is final disposal in Finland
 - Nuclear waste management: storage and final disposal in Loviisa NPP site (estimated amount for disposal is about 100 m³ packed waste), contract negotiations are on-going

Challenges in the decommissioning in Finland

- Spent fuel and waste management solutions for research reactor are still open – will cause delays in the FiR 1 decommissioning project
- Updated Nuclear energy act and decree contains basic requirements for the decommissioning planning, but the detailed requirements are not yet updated (e.g. it is not very clearly defined in the safety guides, what should be presented in the decommissioning plan and what in FSAR, more clear requirements are probably needed to define what activities related to decommissioning can be done under operating license and for what activities the decommissioning license is required)
- Detailed technical requirements concerning decommissioning are missing from the guidance (not very clear yet, if these are even needed)
- No experience on regulatory oversight of the decommissioning project

