Loviisa NPP Low Pressure Turbine Renewal

Energiforsk/Vibrations, Yearly seminar 6.11.2024

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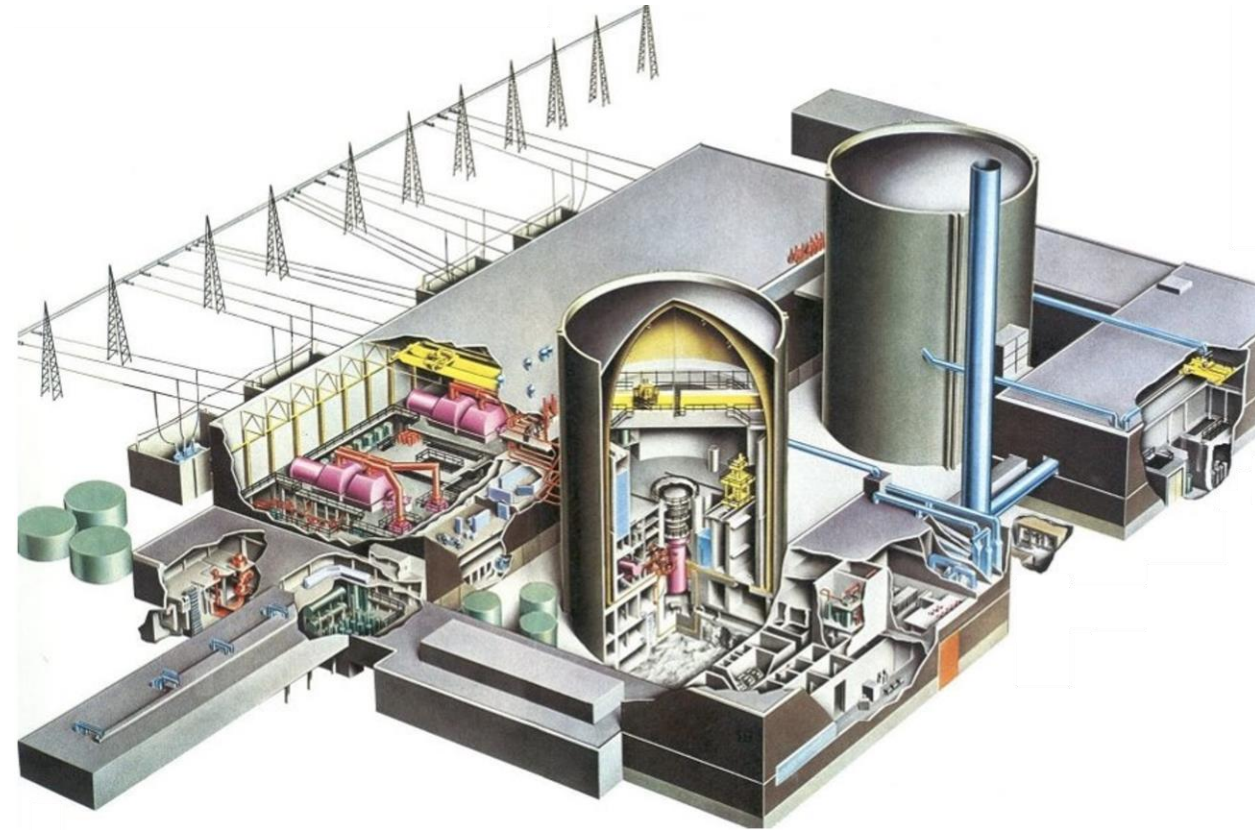**fortum**
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Agenda

- Introduction
- Low-Pressure turbine modernization project
- Development of Loviisa NPP turbine-generator shaft train rotordynamics models
- Rotordynamic models and vibration monitoring
- On-site monitoring of turbine train vibrations
- Summary of analyses conducted for RETU preparations
- Vibration risk management plan for LP-turbine renewal project

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Introduction (1/2)

- LO1 & LO2, PWR, VVER 440, Commissioned in 1977, 1980, Currently electricity net output 2 x 507 MWe

- In March 2022 lifetime extension application for operation until 2050 (LO1 73 years, LO2 70 years).
  - STUK's review ready with green light on 26.1.2023.
  - The Finnish Government granted a new operating license for both Loviisa NPP units until the end of 2050 on 16.2.2023

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Introduction (2/2)

- Fortum's Loviisa nuclear power plant's low-pressure turbines and turbine protection and control systems will be modernised.

- Fortum has signed an agreement for the turbine modernisation with Doosan Škoda Power in May 2024.
  - In the turbine project, eight low-pressure turbine housings and their internal parts will be renewed.

- Fortum has signed an agreement with Valmet to upgrade the turbine automation in September 2024.
  - Valmet will supply the turbine protection and control systems for both Loviisa power plant units as well as for training and development simulators.

- The modernisations, starting in 2026, are part of the lifetime extension-related investments consisting of continuous improvements to ensure reliable electricity production until the end of the plant's lifetime.

- The modernisation of the turbines will also increase the total capacity of the plant by approximately 38 megawatts, increasing the output of the power plant during its lifetime by approximately 7 terawatt-hours.

Press release

Fortum's Loviisa nuclear power plant low-pressure turbines to be modernised, increasing capacity by approximately 38 MW

29 May 2024, 13:00 EEST

Press release

Fortum's Loviisa nuclear power plant turbine automation to be upgraded

11 September 2024, 10:00 EEST

Low-Pressure turbine modernization project

Objectives

- Eliminate malfunction risks to the power plant caused by rotor aging

- Increase power output by approximately +38 MW

- New support from the equipment supplier for changes, as the OEM supplier is from Ukraine

Implementation Schedule

- 2026 – LO2 TG3
- 2027 – LO1 TG1
- 2028 – LO1 TG2 , LO2 TG 4

Scope

- Modernization of internal parts of all LP-turbines:
  - Bladed rotors, stator blades, intermediate shaft, inner casings
  - Changes to diffuser structures
  - Outer casing of turbine structure stays original
- Bearings
- Turbine turning gear, Motor and frequency converter
- Changes to the SC oil system as needed (lifting oil for turbine)
- Oil circulation pumps from main oil tanks to upper oil tanks

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Continuous development of Loviisa NPP turbine-generator shaft train rotordynamics models

1   1997...2000 Rotordynamic 1-D model creation and on site test verifications

2   2012 LO2 TG4 foundation ODS measurement, laser scannings

3   2013 Running through rotordynamic reference calculations with 1-D for new HP turbine set up, bearing stiffness and damping values calculated

4   2014…2016 Ansys 3-D model created

5   2019 Updating 1-D and 3-D models both corresponding to existing configuration, and model comparison

6   2023 Validating 3-D model with onsite vibration measurements and RfP LP-data reference calculations

7   2024→ Onsite third party independent vibration measurements with shaker and actions for upcoming rotordynamic configuration together with new LP-turbine supplier

As a result new LP-turbine set compatible with existing renewed HP-turbines, generator rotors and foundation guaranteeing safe and reliable operation up to 2050.

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On-site monitoring of turbine train vibrations

- Loviisa NPP turbine train vibration measurements implemented with realtime data acquisition and vibration monitoring system

- Each turbine train TG1-TG4 is equipped with

  – Accelerometers measuring bearing vibrations

  – Proximity probes measuring shaft vibrations, rotational speed and shaft axial position

- Vibration alarm levels adjusted for each turbine and sensor separately

- Vibration levels and trends are monitored daily by power plant Condition monitoring team and Operating unit

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Thank You!