DynaLoad - Dynamic loading of transformer insulation

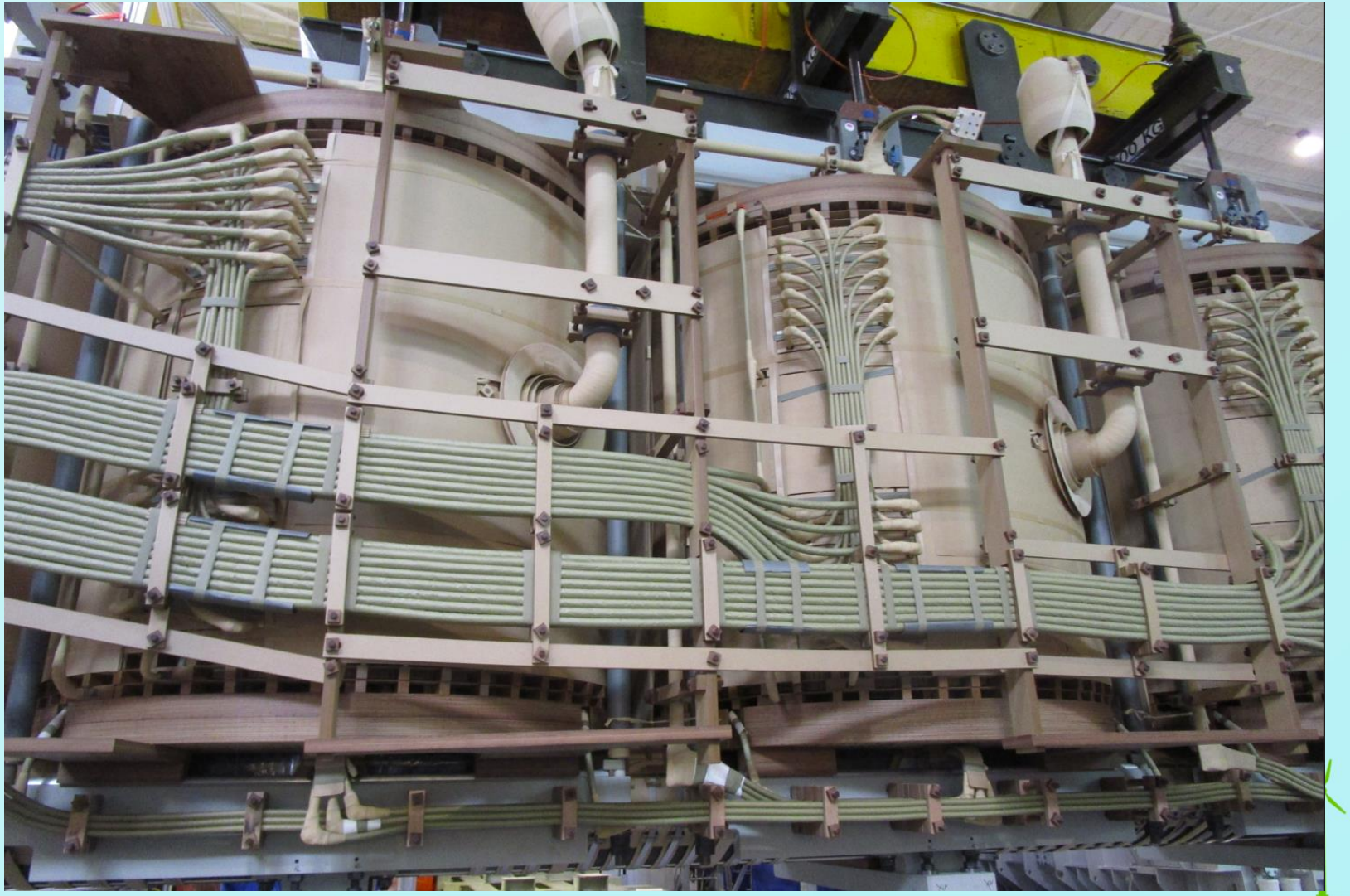
Background

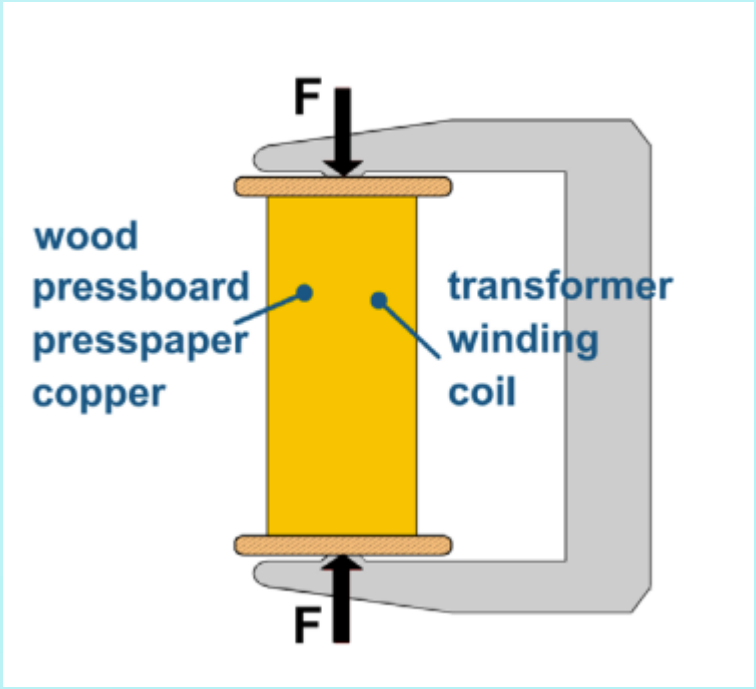
In power systems today we see an increasing amount of windpower and other renewable energy sources and in future power systems we expect a more dynamic operation with rapid load changes and dynamic loading of power transformers.

- More frequent start/stops in hydropower plants.
- Increased intermittent supply from renewable energy sources.
- Heavy load cycling from high-powered charging facilities.
- Rapid changes in energy export and import.
- More use of overload capacity.

How will this influence the old and new power transformers ?

Transformer active part – Mechanical strenght dependent on clamping pressure





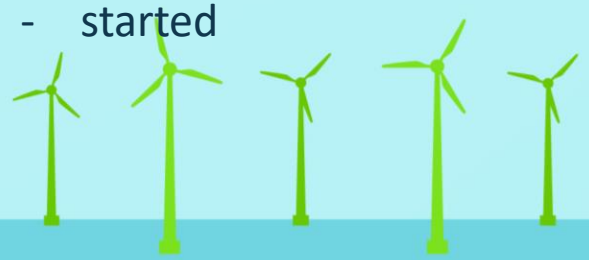
Objective of the project

To characterize the long-term mechanical endurance of transformer insulation under heavy dynamic loading conditions.

- Characterize the plastic deformation of winding insulation materials due to rapid thermal and mechanical stress cycles.
- Develop and validate a model that predicts the clamping pressure response due to rapid load and temperature cycling.
- Perform online monitoring of clamping pressure, and temperature in an in-service transformer.
- Initiate international collaboration for developing new and improved standard and guidelines for transformer materials

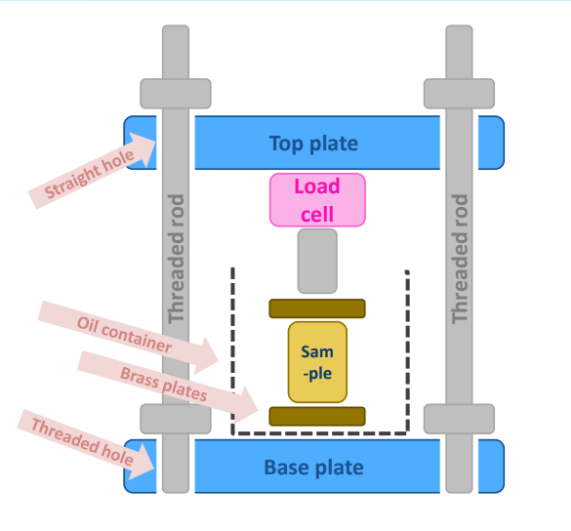
Work packages

		Status activity
WP1	Insulation material testing and modelling	
	Literature survey	- Draft report circulated
	Small scale experiments	- Preparation of test rig started
	Testing with electromagnetic screw	- Preparation of test rig started
	Climate cell	- Not started
	Heat cabinet/climate chambers	- Not started
WP2	Winding model measurements and modelling	
	PhD - Mock-up model design and Mock-up model production	- Sketch of simple model suggested
	Thermal modelling	- Started
WP3	Online measurements of clamping pressure	
	Råde transformer, sensor qualification and measurements	- Measurements started
	Conference paper	- Submitted and accepted
WP4	Communication and exploitation	
	Bimonthly meetings with stakeholder group	- Started
	Workshops with stakeholder group	- started

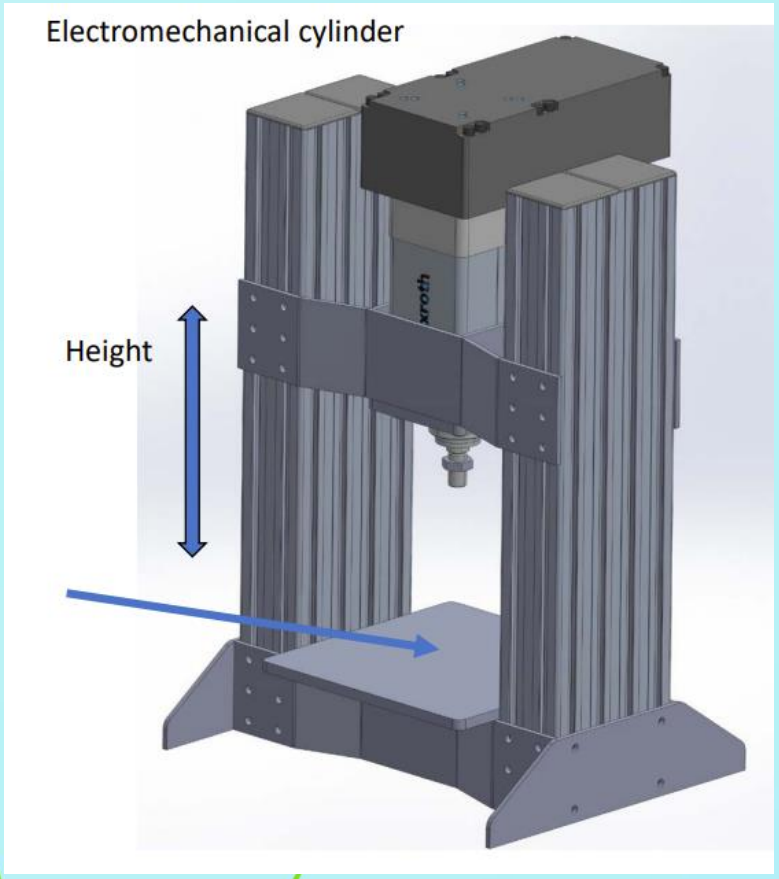


Test rigs for small scale experiments.

Early stage

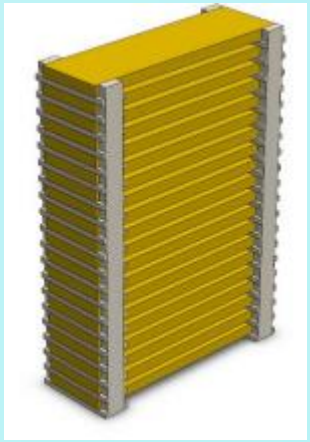


Dynamic stress test rig

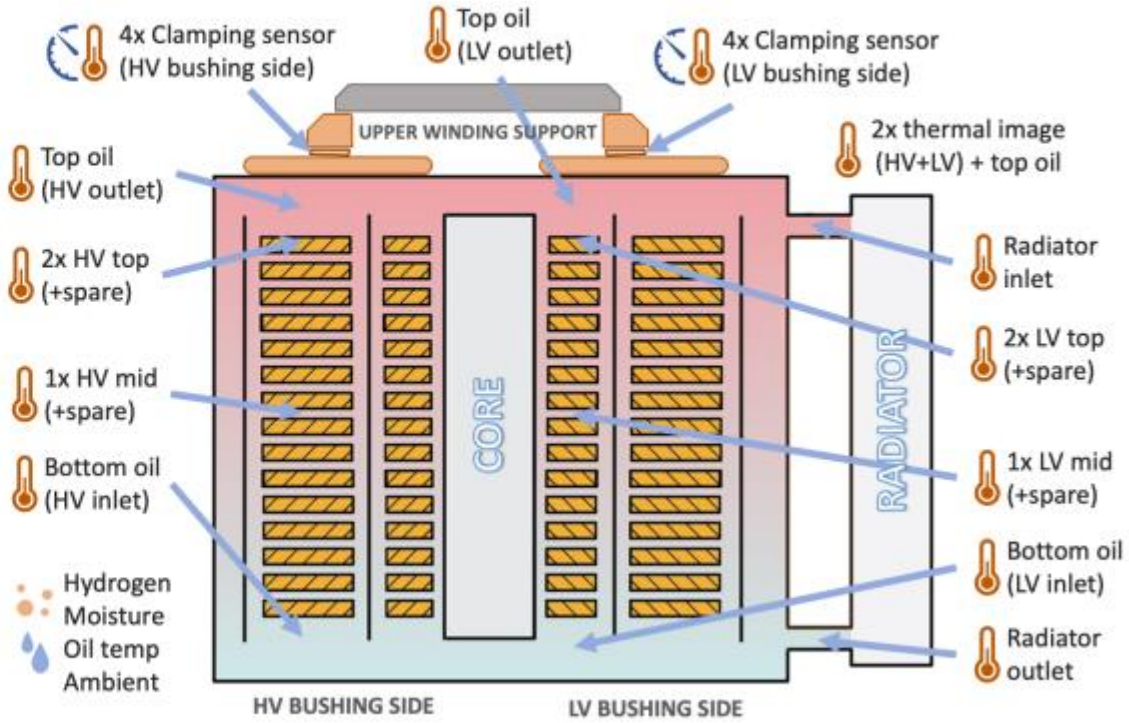


What is a mock-up winding model ?

A downsized representative model of a winding.



Elvia Råde transformer equipped with sensors for clamping pressure monitoring



Project – DynaLoad "Dynamic loading of transformer insulation"
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Sintef Energy - Project owner

Participants:

Electricity de France EDF
Weidmann Electrical Technology AG
Siemens Energy Global GmbH
Kolektor Etra
Scottish Power Energy Networks
Statkraft Energi AS
Elvia AS
Norges Teknisk-Naturvitenskapelige Universitet NTNU
Kungliga Tekniske Högskolan KTH
Statnett SF

Expected outcome.

Dynaload will through experiments and modelling contribute essential knowledge regarding the performance of transformer winding insulation materials and the design of transformers operating under new dynamic load patterns in the future flexible power grid.

Results will pave the way for increased sensor-based condition monitoring of transformers.

Contribute in development of new and better insulation materials and design for transformers.

Increased knowledge of how the transformers are stressed during dynamic loading may prevent costly failures.

Increased knowledge of ageing of insulation materials will give more precise estimates of transformer life expectancy and optimised reinvestment plans.