ENSURE

ELECTRIC ENERGY AND SUPPLY RELIABILITY (ENSURE)

SCIENTIFIC OBJECTIVES

1

On-site CT calibration

Optical current sensors for on-site calibration in substations reducing downtime and even live connection

2

Harmonics-induced loss in power transformers

New reference instrumentation for determination of the impact of grid harmonics on power transformer losses

3

Harmonics-induced losses in HVAC cables

New traceable metrology for the determination of the skin effect of HVAC cables using both calorimetric and electrical methods up to 3 kA

4

PD monitoring in HVDC grids

New PD monitoring and fault detection capabilities in DC cables at 100 kV and above for use in monitoring systems

We welcome you to the 1st newsletter in a series for the ENSURE EU-funded joint research project, which will provide you a first introduction into the project which started 1 June 2024 and will run for three years until 31 May 2027.

The background for the ENSURE project lies in the fact that the amount of electricity generated from renewable sources needs to increase to meet the EU's aim of becoming carbon neutral by 2050. However, the connection of these renewable sources to the power grid causes harmonics which lower network power quality and increase electricity losses in e.g., power transformers and high voltage alternating current (HVAC) cables.

The ENSURE joint research project aims to tackle this problem by performing the metrology research necessary to support standardisation and the development of traceable tools for HV condition monitoring and fault detection as well as the means to ensure the reliable determination of losses in HV transformers and HV cables.

We hope you enjoy reading this first newsletter! Future newsletters will update you on the project progress and will present selected results from the research carried out. Please contact us if you want more information on a certain subject or are willing to cooperate with us in the research.

Best regards,
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Webpage of the project

EUROPEAN PARTNERSHIP

Co-funded by the European Union

METROLOGY PARTNERSHIP

EURAMET

Novel metrology solutions to support HV manufacturing industry and grid operators

ENSURE

1st newsletter

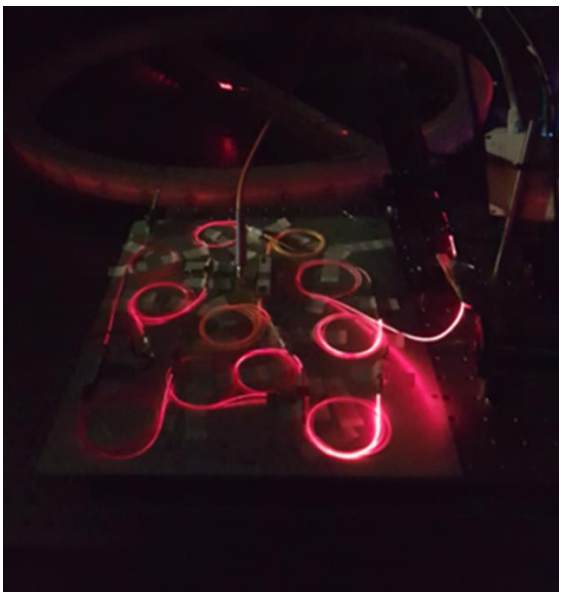
Need

In the ongoing expansion of HV power grids, new power sources from renewables, wind, solar and battery power have been introduced. These sources use converters/inverters for interfacing to the grid, which pollutes it with harmonics. Harmonics will inevitably lead to increased losses in power transformers, especially in the older types, as well as in both overhead power lines and underground cables in the HV grid. HV grid operation needs new reference instrumentation both for the calibration of instrumentation in substations and for the monitoring of harmonics, to ensure stability and reliability. HV grid condition monitoring is crucial to ensure the reliability of the electricity grid. There is a strong industrial need for applying new partial discharge (PD) detection and is in particular relevant for monitoring HVDC systems.

Progress beyond the state of the art

On-site CT calibration

Starting from the proof-of-concept fibre optics current sensor (FOCS) developed in EMRP JRP ENG61 Future Grid (Technology Readiness Level (TRL) 3), this project will progress beyond the state of the art by setting up a non-invasive optimised FOCS sensor as a new wideband reference. The sensors' non-invasive design, and on-site live connection and measurement procedures, will be made available for use during the calibration phase. This will enable the positioning and measurement time to be minimised, and on-site live calibrations will be made possible with target uncertainties of 0.05 % of the fundamental current at up to 1 kA, thus reaching TRL 6.

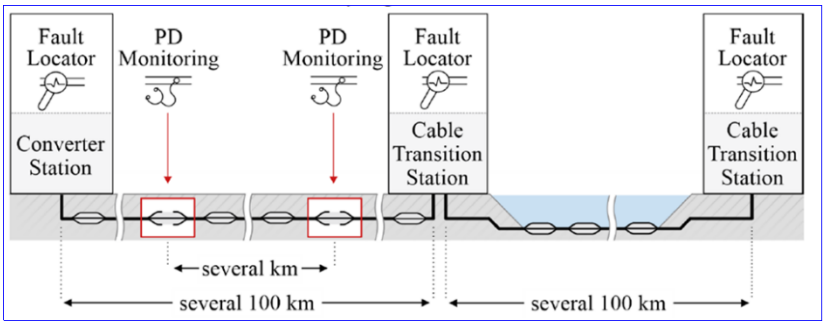


Harmonics-induced loss in power transformers

The verification of power transformer losses, in the presence of harmonics, requires systematic research with a traceable measurement system. To get a systematic scientific inspection of the influence of harmonics on power transformer efficiency, the existing reference loss measurement systems need to be extended in frequency beyond the present power line frequencies (50 Hz – 60 Hz) to at least 2 kHz.

Harmonics-induced losses in HVAC cables

The techniques for measuring the ratio between the AC and DC resistance of a low loss cable have been established using both electrical and calorimetric measurement systems. This project will go beyond the state of the art for both electrical, and especially calorimetric, methods for skin effect loss determination in HVAC cables, not only in the presence of the fundamental, but also in presence of harmonics.



PD monitoring in HVDC grids

This project aims to progress beyond the state of the art by developing innovative techniques for detecting online PD signals within HV cable systems that are subjected to sudden voltage changes like transients (e.g., lightning impulses, pole to ground faults at converter stations), and harmonics. It seeks to establish a reliable method for online PD monitoring (for the detection, classification and localisation of defects or damage before breakdown) in HVDC grids at 100 kV and above, which will be able to distinguish PD from transient noise.

Consortium

VSL, RISE, TÜBİTAK UME, IMBIH, VTT, circe, RSE Ricerca Sistema Energetico, TU Delft, Universidad Politécnica Madrid, F²I², INRiM Istituto Nazionale di Ricerca Metrologica, LNE, Universitat Politècnica València, University of Twente., METAS