



TrafoLoss project outputs, stakeholder uptake and outlook

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TrafoLoss final workshop

17 June 2021



**RI
SE**

VTT



PTB

UME

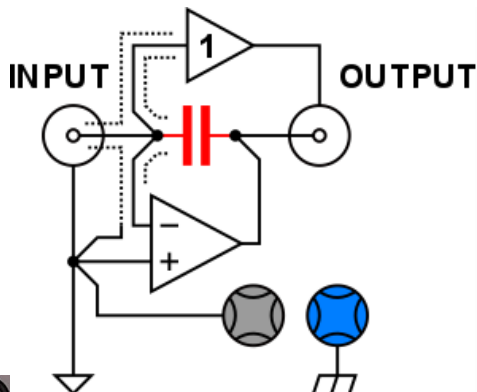




New LMS instrumentation

VTT

- Capacitive voltage divider, to be used with any HV capacitor, with phase compensation



Available for sale, first unit already sold

EPRO

- Improved voltage transformer, with passive and digital compensation



Part of improved transformer LMS



New on-site calibration services

VSL

- Fully automated high-end reference setup for on-site LMS calibration up to 230 kV, 2000 A, with 20-30 $\mu\text{W}/\text{VA}$ uncertainty



Already used in more than 10 on-site LMS calibrations



TUBITAK

- High-end reference setup for on-site LMS calibration up to 230 kV, 2000 / 4000 A with 50–100 $\mu\text{W}/\text{VA}$ uncertainty



Already used in more than 20 on-site LMS calibrations





Input to standardization and industry

- Extensive input to revision of the IEC 60076-19 standard



14/1064/CD

COMMITTEE DRAFT (CD)

TITLE:

Power transformers - Part 19: Rules for the determination of uncertainties in the measurement of the losses on power transformers

PROJECT NUMBER:

IEC 60076-19 ED1

DATE OF CIRCULATION:

2021-03-12

CLOSING DATE FOR COMMENTS:

2021-06-04

SUPERSEDES DOCUMENTS:

14/1049/CD, 14/1059A/CC

IEC TC 14 : POWER TRANSFORMERS

- Presently working on extension to reactor loss measurements (in preparation)

I and V scaling, power measurement

Phase corrections

Voltage dependence

$$P_{NLL} = k_{CN} \frac{1}{1 + \frac{\varepsilon_C}{100}} \cdot k_{VN} \frac{1}{1 + \frac{\varepsilon_V}{100}} \cdot P_W \frac{\cos(\phi)}{\cos(\phi + \Delta\phi_W + (\Delta\phi_V - \Delta\phi_C))} \left[\frac{U_N}{k_{VN} \frac{1}{1 + \frac{\varepsilon_V}{100}} \cdot U_{rms}} \right]^n$$



Good practice guides and new CMCs

Good Practice Guides under preparation, will be available in autumn

- Good practice guide on calibration of LMS
- Example on uncertainty evaluation of reactor loss tests (input to standardization)

New CMCs:

- Improved voltage scaling (VTT, TUBITAK, VSL)
- Improved On-site LMS calibration (VSL, TUBITAK)
- New CMC for HV measurement of DF of HV capacitors (RISE)

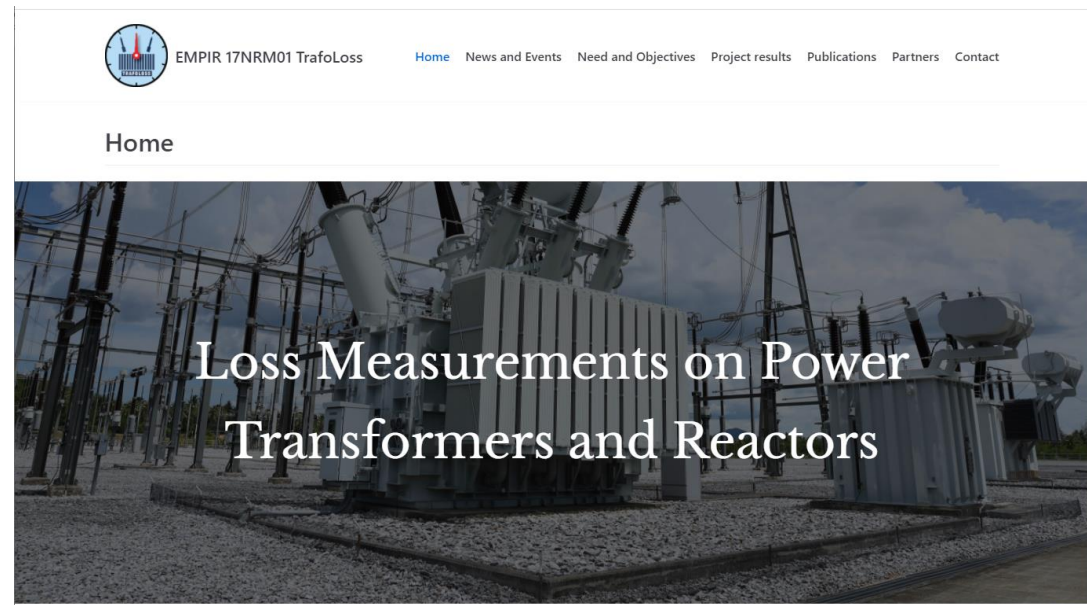


Stakeholder interaction

- TrafoLoss website ([see link](#))
- Euramet TrafoLoss site ([see link](#))
- [Publishable summary](#)
- Regular stakeholder update mails
- News updates via Euramet

Workshops:

- September 2019, Aachen: AMPS 2019, September: 2 overview presentations, 4+7 posters
- June 2021, Teams (today!): 10 presentations
- September 2021: possible short additional workshop





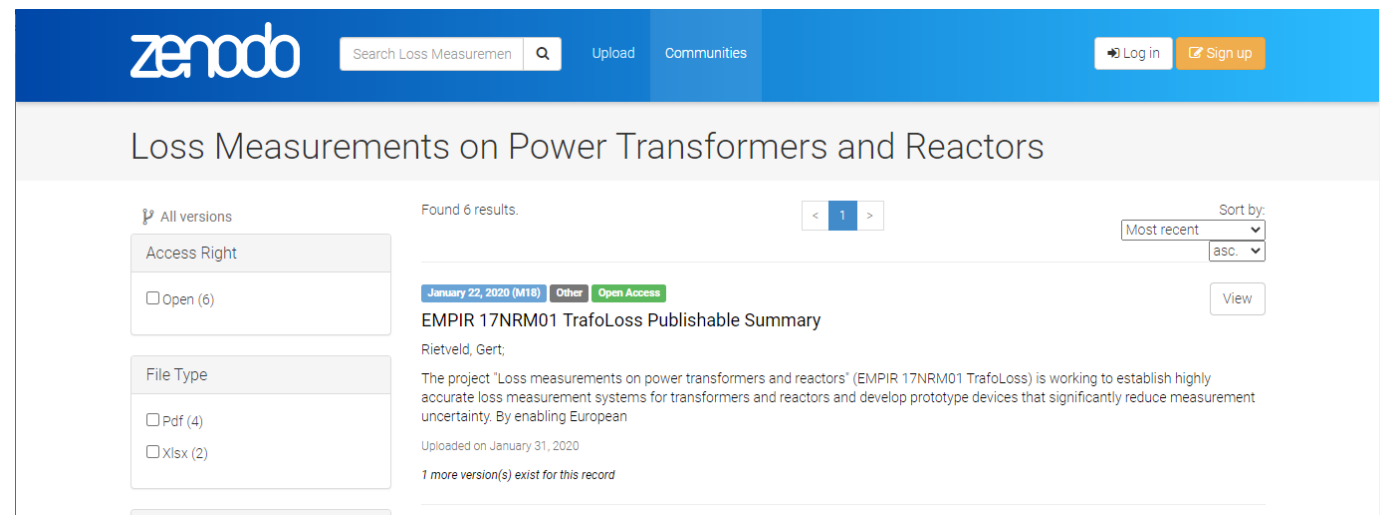
Scientific output

Journal and conference papers:

- Peer-reviewed Papers ([see link](#))
- Open access on Zenodo ([see link](#))

Contributions to conferences:

- CPEM 2018, 2020, 2022
- AMPS 2019
- ISH 2019
- ICTRAM 2019





Need expressed by CLC TC14



CLC TC14 “Power Transformer” industry needs:

- ✓ ■ Accurate industrial loss measurement systems for transformer & reactor losses
- ✓ ■ System calibration of industrial loss measurement systems (TLMS)
- ✓ ■ Guidance in complex uncertainty evaluation

Normative issues

- ✓ ■ Effects non-sinusoidal waveforms (NLL)
- ✓ ■ EU Guidance on TLMS calibration
- ✓ ■ Reactor loss tests accuracy evaluation (IEC and CLC 60076-19)

Project response

Key result: new instrumentation for loss measurements
up to 230 kV, 2000 A with 20 μ W/VA uncertainty





Outlook

- Possible additional workshop in September
 - Results of the PTB measurement campaign on the voltage channels
 - Results of experiments on voltage dependence of HV capacitor dissipation factor
 - Uncertainty analysis for reactor measurements
- Application of the new voltage channels in industrial LMS
- More on-site calibrations using the new reference setups (accuracy, ease of operation)
- Use of the reference setups by Market Surveillance Authorities?
- Future R&D required? Any needs from your side?
 - Further study of the effect of harmonics?
 - ...



EMPIR



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THANK YOU!

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