

## TUTORIAL N°5

# Condition Assessment and Condition Monitoring of Power Transformers in Distribution Grids

### Background

Transformers are one of most the valuable and critical component in the electrical power grid. Therefore, it is crucial for the grid availability to evaluate the conditions of transformers and derive necessary actions for individual transformers and especially for the coordination of these actions in a complete transformer fleet. The tutorial is developed in co-operation with CIGRE A2, especially with A2.49, dealing with condition assessment of power transformers. The focus will be on transformers in the primary distribution grid up to 145 kV and up to 100 MVA.

### Aim of the tutorial

Based on the work of A2.49, the methodology of gaining information used to derive transformer indices and their consolidation towards structured decisions will be provided. The tutorial introduces a process that can be used to assess a transformer and develop transformer assessment indices to suit the needs of the user. In addition, the concept of a scoring matrix will be provided, which can be developed and used to ensure that scores are allocated to each transformer's failure mode or mechanism being assessed in a consistent way and the timing required for action. As a technical base the failure modes and mechanisms as well as the methods of detecting the failure modes and mechanisms for each subcomponent will be provided. The theoretical work will be complemented with a survey on technologies to test transformers on-site and a real live example of transformer assessments. Finally, the participants can discuss their questions and their experiences with the experts.

### Content

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| 1) Introduction                               | Uwe Kaltenborn                                 |
| 2) Health Index: Methods and Analysis         | Tara-Lee MacArthur<br>Brian Sparling           |
| 3) On-Site Transformer Testing                | Uwe Kaltenborn                                 |
| 4) Case Study                                 | Alexei Babizki / Petro Dalamaras<br>Marc Foata |
| 5) Utilization of Results at System Operators | Tara-Lee Mac Arthur<br>Marc Foata              |
| 6) Panel Discussion / Q and A                 | Michael Heinz                                  |

## **Expected benefits (Already discussed in the Objectives)**

- Overview of transformer asset management and condition assessment requirements
- Analysis of diverse types of indices, how they may be constructed and their limitations
- Guidance on dealing with missing or obsolete information, including working examples
- Detailed working examples on developing diverse types of indices, including replacement,
- refurbishment and repair indices
- Guidance on key transformer components that are considered necessary to build a transformer assessment index, along with suitable diagnostic techniques for the on-site testing and evaluation of transformers
- Case study and result utilization at System Operator

## **Who should attend**

Asset-Managers of DSOs, Field Service Engineers, Service Providers, Transformer Design Engineers, Maintenance Engineers, and Operations personnel ....

## **Support material**

A copy of all the presentation material used in the tutorial will be supplied to delegates (electronic version).

Upfront to the tutorial, questions and topics to be discussed will be collected to include them to the presentations or in the Q & A session.

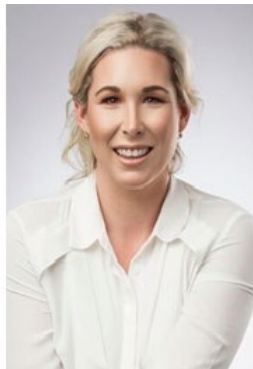
## About the presenter(s)

### Uwe Kaltenborn [[Kaltenborn@highvolt.de](mailto:Kaltenborn@highvolt.de)]



Uwe Kaltenborn is Chairman of the German National Committee CIREC, Member of CIREC SAG Session 1. With more than 20 year professional experience in the world of electric power equipment, he is working as Director Business Development at HIGHVOLT Prüftechnik Dresden GmbH, Germany. He holds a MSc EE and a PhD EE, published more than 60 technical papers, 1 monography and more than 30 patents. Actually he is focusing on automated test systems for distribution transformers, on-site testing of distribution transformers, especially for on- and off-shore windfarms.

### Tara-Lee MacArthur [[taralee.macarthur@gmail.com](mailto:taralee.macarthur@gmail.com)]



Tara-lee MacArthur is a Substation Design Standards Engineer at Ergon Energy. She is responsible for standardizing design strategies, standards, and equipment specifications for substation assets focusing on power transformers. She is an active member in Australian's CIGRE panels A2 and WG A2.49 Transformer Condition Assessment. She holds a BSc EE from the Queensland University of Technology and has experience working in the energy, mining and building services industries. Tara-Lee attained Chartered Professional status (CPEng) in 2017. Her expertise and achievements earned her the title of Engineers Australia's 'Graduate Electrical Power Engineer of the Year for 2018' and recipient of the E.S Cornwall Scholarship.

### Brian Sparling [[brian.sparling@dynamicratings.com](mailto:brian.sparling@dynamicratings.com)]



Brian Sparling, a Senior Member of IEEE, is a Senior Technical Advisor with Dynamic Ratings Inc. Brian has over twenty years of experience in the field of power and distribution transformers. For the last 25 years, he has been involved in all aspects of on-line monitoring and diagnostics and condition assessment of liquid-immersed transformers. He has authored and co-authored more than 30 technical papers on several topics dealing with the monitoring and diagnostics of transformers. He has worked on many guides and standards with the Canadian Electricity Association, IEEE Transformers Committee and, the CIGRÉ A2 Transformer committee.

**Mark Foata [m.foata@reinhausen.com]**



Marc Foata is Senior Technical Advisor on Asset Management Strategies at Reinhausen Group since 2016. His professional career was dedicated to power transformers and transformers health, spending 26 years with a major Canadian utility (Hydro-Quebec) before establishing and managing the Canadian subsidiary of Reinhausen in 2011. He is member of CIGRE, and IEEE Transformers Committee, currently participating in Working Groups A2.49 on Condition Assessment of Power Transformers, and A2.55 on Transformer Life Extension. He received the CIGRE Technical Award for his outstanding contribution to the Transformer A2 Study Committee in 2011 and IEEE Certificate of Appreciation for his outstanding contribution to the preparation of IEEE Standard C57.156 in 2016. He holds a Bachelor's Degree in Engineering from the Ecole Polytechnique de Montreal and a Master's Degree in Engineering Science from the University of California in San Diego (UCSD).

**Markus Zdrallek [zdrallek@uni-wuppertal.de]**



Markus Zdrallek is Chair of Session 3 of CIRED, Member of CIRED TC and Member of the German National Committee. He is Professor for Electrical Power Systems at the University of Wuppertal. He holds a MSc EE and PhD EE and was working many years in as Head of Network Operations, Planning and Assetmanagement at RWE. In the recent years one of his focus topics was the condition assessment of power equipment in the distribution grid. Together with several industrial partners and Grid Operators he has developed and implemented successfully condition assessment and monitoring systems.

**Petros Dalamaras [petros.dalamaras@uni-wuppertal.de]**



Petros Dalamaras holds a BSc EE from National Technical University of Athens, Greece and a MSc Business Administration and Engineering - Energy Management from University of Wuppertal, Germany. Actually he is working as Research Assistant at the Institute of Power System Engineering with focus on Condition Assessment and Asset Management.

**Michael Heinz [michael.heinz@siemens.com]**



Michael Heinz is Member of CIRED SAG Session 1 and Member of the CIGRE Study Committee A2. He has more 30 years of professional experience in the field of design, manufacturing and application of power transformers. Actually he is working as Senior Principal Expert Distribution Transformers at Siemens.