



Tutorial on Guide for Dielectric Frequency Response

— Technical Presentation —
Thursday, March 28, 2019

By Ali Naderian, Poorvi Patel and Peter Werelius

1. Abstract

The tutorial will cover four topics:

- Background and history of dielectric frequency response (DFR)
- Overview of test purposes and objectives (moisture assessment)
- Summary of IEEE C57.161-2018
- Application of DFR and case studies

In the first part, Peter Werelius from Megger will present a brief review of the background and history of DFR test as a non-intrusive, non-destructive, off-line testing technique developed as an advanced diagnostic tool. He will explain the basics of a test that can be performed in the frequency domain to determine moisture content of a transformer's solid insulation.

Secondly, Poorvi Patel from EPRI will provide a review of the newly published IEEE C57.161: IEEE Guide for Dielectric Frequency Response Test. This guide is a summary of four years of hard work by active working group members. Poorvi's presentation includes the difference between 50/60Hz PF and capacitance vs. DFR, general DFR measurement test practices, test records and reports, measurement considerations and interpretation of test results.

Finally, Ali Naderian from METSCO Energy will provide participants with case studies, including moisture assessment for new and service aged power transformers, influence of carbon contamination, influence of electrostatic shield and un-shorted core-to-ground resistance.

2. Learning Objectives

This presentation will familiarize attendees with the DFR test technique for factory or field testing while providing practical application examples and case studies to use the test, perform the test and analyze the results as an optional FAT and maintenance test.

3. Learning Outcomes

By attending this tutorial, attendees will gain an understanding of the following:

- History and background of DFR for transformer moisture assessment
- Overview of IEEE C57.161: IEEE Guide for Dielectric Frequency Response Test
- Application of DFR

4. Presenters' Biographies

Ali Naderian is a professional engineer with experience in high voltage testing and condition assessment, including power transformers, switchgear and underground cables. He has international experience working in four high voltage labs in the past 15 years, with strong hands-on experience in performing high voltage testing, condition assessments and equipment root cause failure analysis. He compared commercially available RTV coatings in his PhD research at the University of Waterloo.

Ali was the chair of IEEE C57.161 DFR WG and is the chair of IEEE C57.113 Partial Discharge Measurement. He has published more than 40 papers with IEEE, CIGRE and other conferences and journals. He is a senior member of the IEEE and Chair of IEEE Dielectric and Electrical Insulation, Ontario since 2014. Ali is a recognized reviewer in the IEEE Power & Energy Society since 2009 and has been invited to talk at IEEE EIC, IEEE PES, IEEE DEIS, Doble, CEATI and Electricity Forum.

Dr. Poorvi Patel is a principal technical leader in transmission and technical expert in substation power delivery and utilization programs. Her current research area focuses on monitoring and diagnostics of transformers and transformer accessories. She is also focusing on a reliability study of transformer bushings as well as transformer and substation inspection robot development.

Poorvi joined EPRI in August 2018. Prior to that, she worked for 20 years at ABB TRES. During that time, she led R&D for transformer on-line monitoring solutions such as gas monitor development and asset management development. She also performed R&D in the area of transformer advanced diagnostic tools and analytical methods, such as dielectric frequency response (DFR) and sweep frequency response analysis (SFRA) technologies. She received her PhD from Lund University in Sweden in 1999 and her MSc degrees in Mechanical Engineering from the University of Luleå, Sweden in 1992.

Poorvi has been a member of the Power Engineering Society of the IEEE since 2007 and is actively involved in the work of the IEEE PES Transformers Committee. She is a key contributor to the C57.161 DFR guide and Secretary of the IEEE Dielectric Subcommittee. She is also task force leader for the revision of IEEE monitoring guide, Vice Chair for IEEE SFRA guide and CIGRE TF leader of the new A2.53 SFRA guide.

Peter Werelius received his PhD in Electrical Engineering from Kungl Tekniska Högskolan (KTH Royal Institute of Technology) in Stockholm, Sweden, developing the dielectric frequency response (DFR) technique for diagnosis of medium voltage XLPE cables.

Peter began his professional career starting up a spin-off company, WaBtech, in 1996, manufacturing the first field DFR test equipment. He was responsible for improving and further developing DFR technology and its applications under WaBtech, Programma, GE, Pax Diagnostics and Megger. Peter currently works for Megger Sweden as a senior application specialist with responsibilities related to research, product development, product sustainability and training for the Megger global organization.

Peter is a member of SEK TC14, IEEE and CIGRE and actively participates in working groups and task forces, especially those related to FDS/DFR and SFRA. Throughout his career, he has participated in relevant technical conferences, authored technical papers and patents.