IEEE PES Transformers Committee
Fall 2025 Meeting
Bonita Springs, FL

IEEE C57.143 Guide for the Application of Monitoring Equipment to Liquid-Immersed Transformers and Components

— Technical Presentation —

Thursday, October 23, 2025

By Elizabeth Bray, Donald Lamontagne, Kyle Stechschulte, and Mike Spurlock

1. Abstract

The purpose of the Guide for the Application of Monitoring Equipment to Liquid-Immersed Transformers and Components is to provide guidance to those who specify, apply, install, and use online monitoring equipment on liquid-immersed power transformers and their components. Online monitoring of power transformers and their associated accessories have become essential features of electric utility systems. Justification for online monitoring systems includes the need to increase the availability of power transformers, improve strategies for time and/or operational-based maintenance to condition-based maintenance, asset and life management, catastrophic failure prevention, and failure cause analysis.

This guide describes most of the continuous online monitoring and diagnostic methods that are in common practice at this time, addressing various transformer operational parameters that can be monitored as well as describing the different technologies available for that purpose. It also provides specification considerations for monitoring hardware, software, and communication systems.

This guide identifies key parameters that can be monitored for obtaining an indication of the condition of liquid-immersed transformers and their components, as well as risks/benefits, sensor application, and monitoring systems application. This guide does not cover interpretation of monitoring results.

Chapter 4 addresses preliminary planning for monitoring equipment and what should be considered at a high level.

Chapter 5 goes into detail about which parameters can be monitored and the various technologies available for monitoring those parameters. This chapter is organized into the following main topics:

- Online monitoring introduction
- Transformer and winding temperature
- Transformer cooling control
- Transformer loading
- Load tap changer (LTC)
- Main tank sensors
- Conservator tank membrane
- Main tank dissolved gas-in-oil analysis
- Moisture in insulation systems
- Bushing monitoring
- Partial discharge
- Geomagnetic-induced current (GIC)
- Online transient frequency response
- Online impedance measurement

A summary table is provided in Chapter 5, as well.

Chapter 6 covers communication hardware and protocol.

Chapter 7 covers cost benefits and analysis. Several annexes are also provided to provide further insight into monitoring systems:

Annex B (informative) Specifications

Annex C (informative) Partial discharge (PD)

Annex D (informative) Direct winding temperature

Annex E (informative) Data analysis methods for DGA online monitoring

2. Learning Objectives

This tutorial provides the following learning opportunities:

- An overview of the new Guide for the Application of Monitoring Equipment to Liquid-Immersed Transformers and Components
- Case history and user experience provided by Southern Company, Arizona Public Service, and American Electric Power

3. Learning Outcomes

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

- What is covered in the new Guide for the Application of Monitoring Equipment to Liquid-Immersed Transformers and Components.
- Where in the guide to find detailed information on various monitoring technologies and their application as well as methods for cost benefit analysis.

In addition, an array of monitoring equipment applications, lessons learned, and benefits realized by three separate utilities will provide valuable insights for endusers that are either contemplating deployment of monitoring systems or already have monitoring equipment in place.

4. Presenters' Biographies

Elizabeth Bray, SMIEEE, is the equipment services manager within Technical Shared Services Engineering at Southern Company. She leads a team of subject matter experts in transformers, circuit breakers, regulators, and FACTs technology who are responsible for all generation and power delivery projects across Southern Company. Prior to this role, she built the condition-based maintenance program for the Power Delivery segment of Southern Company. Elizabeth has published papers on condition-based maintenance and supports monitoring and analytics initiatives within Southern Company, EPRI, NATF, Doble, and IEEE. She holds a Bachelor of Science Degree in Electrical Engineering from the University of Alabama and a Master of Engineering Degree from Mississippi State University. She is a licensed professional engineer in the state of Alabama.

Donald Lamontagne, SMIEEE, is an engineering supervisor at Arizona Public Service (APS) in Phoenix, Arizona. He is the inventor of APS' Transformer Oil Analysis and Notification (TOAN) system, winner of the Edison Electric Institute's 2008 Edison Award, which is given annually for outstanding contributions to the advancement of the power industry. He is currently responsible for the Electrical Engineering department for APS' non-nuclear generation fleet. Donald is the author of three patents for the TOAN system: one for its exception-based notification system, one for the development of piecewise linear approximation and harmonic regression algorithms to accurately calculate gassing rates from online dissolved gas monitors, and one for estimation of the degree of polymerization of transformer insulation using on-line DGA monitor data. He earned his Bachelor of Science Degree in Electrical Engineering from Rensselaer Polytechnic Institute in Troy, New York.

Kyle Stechschulte, IEEE M ’12, is a staff engineer for American Electric Power, Inc. (AEP), with 15 years of experience as a substation equipment standards engineer. Kyle oversees technical activities for all major substation equipment with core and coil windings, from voltage regulators to power transformers. He is the subject matter expert for extra high voltage power transformers with ownership of the entire lifecycle from specification writing to retirement decisions. He holds a Bachelor of Science Degree in Electrical and Computer Engineering from Ohio State University and is licensed as a Professional Engineer in the state of Ohio.

Mike Spurlock, LSMIEEE, retired from American Electric Power, Inc., as staff engineer in 2020 and currently works as a consultant. He joined Public Service Company of Oklahoma (PSO) as an intern in 1976 and, after his graduation from college in 1977, served in a variety of positions within PSO, Central and Southwest Services, and AEP (Central and Southwest Corp. merged with AEP in 2000). His career work experience includes downtown distribution network engineering, underground substation, commercial, and industrial distribution systems, substation design engineering, FACTS project engineering, large power transformer subject matter expert, and gas-insulated substation project engineering. He holds a Bachelor of Science Degree in Electrical Engineering from the University of Tulsa and is a licensed Professional Engineer in the state of Oklahoma.