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IEEE Guide for Application for Monitoring Equipment to Liquid-Immersed Transformers and Components

IEEE Power and Energy Society

Sponsored by the
Transformers Committee

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IEEE Guide for Application for Monitoring Equipment to Liquid-Immersed Transformers and Components

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Abstract: Identification of the key parameters that can be monitored for obtaining an indication of the condition of liquid-immersed transformers is covered by this guide. It also covers risk/benefit analysis, sensor application, and monitoring systems application. This guide does not cover interpretation of monitoring results.
Keywords: IEEE C57.143, liquid-immersed transformers, transformer monitoring

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Introduction

This introduction is not part of IEEE Std C57.143-2012, IEEE Guide for Application for Monitoring Equipment to Liquid-Immersed Transformers and Components.

For many decades, transformer users have sought ways to assess the general condition of electrical power apparatus and identify specific problems. Over the years, diagnostic tests have been developed, based on available technology. In the last few years, a sophisticated means has evolved for collecting a great deal of diagnostic information while the equipment is in service.

Periodic off-line diagnostic tests still play an important role in industry. However, "continuous" or "on-line" monitoring can overcome some of the fundamental limitations of off-line tests, in that it can increase the performance and reliability of substation power apparatus, it can reduce maintenance costs, and it can aid in the optimization of apparatus operations and maintenance procedures and help manage the growing risk of an aging population of transformers and components.

Starting in the 1980s, industry and electric utilities shifted their strategies and resources from construction and expansion, to maintenance and diagnostics for the plants that were built in the development boom of the 1960s and 1970s. Maintenance records were retrieved, tabulated, and analyzed, databases were created. Maintenance technology evolved through the following four levels:

- Corrective: Ensuring that equipment is operating and functional
- Preventive: Optimizing the performance of the equipment
- Predictive: Diagnosing impending downtime for maintenance
- Strategic/optimization: Operational controls and corporate wide asset management

Today, plant optimization systems have become fairly common, and the leading edge of technology is now focused on predictive maintenance systems. However, the monitoring of transformers and other electrical apparatus has several challenges: the reliability of the electronic equipment, cost of the monitors, continuing development of the sensors and monitoring systems, performance under harsh field conditions, lack of availability of field expertise, data collection, and interpretation.

This guide describes most of the commonly used on-line monitoring and diagnostic methods that are in common practice at the time this guide was written, and provides additional information in the case of developing techniques. This guide addresses transformer operational parameters that can be monitored and the risks and benefits of the monitoring. It also provides specification considerations for monitoring hardware, software, and communication systems. For the purposes of this guide, the term *transformer* refers, but is not limited to: generator step-up transformers; autotransformers; phase-shifting transformers; regulating transformers; intertie transmission transformers; DC converter transformers; instrument transformers; retail, customer, or industrial service transformers;, and shunt, series, and saturable reactors.

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IEEE Guide for Application for Monitoring Equipment to Liquid-Immersed Transformers and Components

1. Overview

On-line monitoring of power transformers and associated accessories is becoming an essential feature of electric utility systems. The justification for on-line monitoring is driven by the need to increase the availability of power transformers, re-direction of time and/or operational-based maintenance to condition-based maintenance, asset and life management and failure cause analysis.

1.1 Scope

This guide covers identification of the key parameters that can be monitored for obtaining an indication of the condition of liquid-immersed transformers. It also covers risk/benefit analysis, sensor application, and monitoring systems application. This guide does not cover interpretation of monitoring results.

1.2 Purpose

The purpose of this document is to provide guidance to those who specify, apply, install and use on-line monitoring equipment on liquid-immersed power transformers and their components.