IEEE PES Transformers Committee
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Tutorial on CIGRÉ WG A2.49

— Technical Presentation —
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1. Abstract

The focus of CIGRÉ Working Group A2.49 was to investigate information used to derive transformer assessment indices, their consolidation and how the output should be utilized. Many asset managers currently use a 'health index' for this purpose; however, in many cases, the index does not provide any indication of how quickly the worst transformers on the list need to be actioned, nor does it provide any indication of the type of action needed, i.e. replace, repair or refurbish. Many indices also fail to provide any indication of the confidence the asset manager should have in the indexed assessments.

Furthermore, many asset managers use their 'health index' to help determine which transformers in their fleet to replace. However, some "unhealthy" transformers can be relatively easily repaired, and, therefore, do not need to be replaced. In these cases, a 'health' index may not be the ideal tool to determine transformer replacement.

Chapters 1 through 7 of this tutorial introduce a process that can be used to assess a transformer and develop transformer assessment indices to suit the needs of the user. These chapters also introduce the concept of a scoring matrix, 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.

Chapters 8 through 12 and Annex A deal with the subcomponents of a transformer and discuss:

- Failure modes and mechanisms
- Methods of diagnosing failure modes and mechanisms for each subcomponent

This section is mostly existing knowledge. Annex A provides tables of diagnostic information that are formatted to allow assessment using the methods described in the technical brochure. The information is from IEC and IEEE guides, CIGRE experts and other industry experts. Users can apply these values as a starting point when assessing a transformer but should consider if the values are suitable for their fleet of transformers, operating conditions, maintenance practices and the time scales used in the scoring matrix.

Annex B provides several examples illustrating how to generate different types of transformer assessment indices and how to use the different scoring methods.

2. Learning Objectives

This tutorial provides the following learning opportunities:

- Overview of transformer asset management and condition assessment requirements
- Analysis of different 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

3. Learning Outcomes

By attending this tutorial, attendees will gain an understanding of the following five key steps to develop a TAI, which are as follows:

- Determine the purpose of the transformer assessment score and index
- Identify the failure modes to be included in the TAI
- Determine how each failure mode will be assessed
- Design a calibrated system for categorizing failure modes (scoring matrix)
- Calculate a TAI score for each transformer

4. Presenters' Biographies

Brian Sparling (IEEE Senior Member) is a Senior Technical Advisor with Dynamic Ratings, Inc. Brian has over 20 years of experience in the field of power and distribution transformers. For the last 26 years, he has been involved in all aspects of on-line monitoring and diagnostics and condition assessment of power transformers. He has authored and co-authored more than 27 technical papers on several topics dealing with monitoring and diagnostics of transformers and has worked on many guides and standards with the Canadian Electricity Association, IEEE Transformers Committee and the CIGRÉ A2 Transformer Committee.

Ed teNyenhuis is currently working for ABB Transformer Service as Operations & Technical Manager in Brampton, Canada. Ed has worked in past positions as a transformer design engineer, research engineer, engineering manager and quality manager at ABB locations in Sweden, U.S. and Canada. Ed is Secretary of the IEEE Transformers Committee, Canadian Chairman of the IEC TC 14 and member of the CIGRÉ A2.49 and A2.59 working groups. He has published more than 10 technical papers and is licensed as a Professional Engineer in the province of Ontario.

Joe Watson (IEEE member) is an independent consultant, specializing in all aspects of power transformers and related equipment. He holds two patents for transformer monitoring and testing devices and has authored or co-authored several papers on transformer and bushing monitoring. He is a licensed Professional Engineer in Power and Controls in California and has worked on the Transformers Committee since 1990. He is also a CIGRÉ member and served on the CIGRÉ A.49 WG that developed the Condition Assessment Guide. He has held engineering and/or management positions at the Los Angeles Department of Water and Power, Florida Power and Light/NextEra, Smit, ZTR USA and Pennsylvania Transformer Technology, Inc.

Tom Prevost (IEEE member) is Vice President of Innovation for Transformer Insulation Products in the Americas region at Weidmann Electrical Technology and has worked at Weidmann for 27 years. He was Chairman of the Transformers Committee from 2008 to 2009 and is the current chair of several IEEE working groups, including PC57.162 (developing a guide for moisture in insulating systems), PC57.166 (developing a guide for acceptance and maintenance of insulating fluids) and PC57.124 (revising a guide for partial discharge measurement in dry-type transformers). Tom is also active in ASTM Committee D27 on Insulating Fluids and is a member of the U.S. National Committee of CIGRÉ. He has written many technical papers on the subject of electrical insulation materials, transformer diagnostics and condition monitoring.