IEEE/PES Transformers Committee
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Interpretation of Dissolved Gas Analysis in Electrical Equipment with Duval Triangles and Pentagons

— Technical Presentation —
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by Dr. Michel Duval

1. Abstract

Dissolved gas analysis (DGA) is among the most widely used and cheapest techniques for detecting and identifying faults in electrical equipment, and for evaluating their condition in service.

Several methods are used for the interpretation of DGA in transformers and tap changers, including the popular Duval Triangles, and more recently the Duval Pentagons. Dr. Duval will explain the principles on which they are based, and the different types of faults and sub-faults which can be identified with them.

Also, how they can be used to detect multiple faults in transformers will be reviewed. Several practical examples of faults in transformers and tap changers will be presented, and guidelines provided as to when to use the different Duval Triangles and pentagons available for diagnosis.

2. Learning Objectives

The objective of this tutorial is to help engineers use the various diagnosis tools available for detecting faults in electrical equipment in order to avoid failures or damages.

3. Learning Outcomes

As a result of attending this tutorial session, members will get a better understanding of diagnosis methods, allowing them to evaluate the condition of their assets and extend their life in service.

4. Presenter's Biography

Dr. Michel Duval obtained a B.Sc. and Ph.D. in chemical engineering in 1966 and 1970, and has worked for IREQ (Hydro-Quebec) in Canada since 1970. He has made significant contributions in three (3) mains fields of R&D: dissolved gas-in-oil analysis (DGA), electrical insulating materials, and lithium-polymer batteries. In the field of DGA, Mr. Duval is well-known for his Triangle method of DGA interpretation, used worldwide. He has developed the use of gas-in-oil standards and participated to the development of an on-line monitor of hydrogen in oil. He has established the levels of gas formation observed in various types of electrical equipment. He has been a convener of numerous IEC and CIGRE working groups, and the principal author of several IEC international standards and CIGRE Technical Brochures on DGA. He is also very active on several IEEE working groups. He holds 16 patents and is the author of more than 100 scientific papers and standards. He is a Fellow of the Chemical Institute of Canada, an IEEE Life Fellow, and the recipient of IEC and CIGRE awards. In 2012, he was the recipient of the IEEE Herman Halperin Electric Transmission and Distribution Award.