

**Talk on “ 4 pillars of Transformer Condition Monitoring”**

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On 21<sup>st</sup> November 2016, the IEM Electrical Engineering Technical Division had the privilege of inviting Mr. Max Philipp to give a talk on transformer condition monitoring. Mr. Max Philipp shared his more than 28 years' experience on transformers and On Load Tap Changers (OLTC), addressing actual issues and doubts from the participants.

Transformer, a critical equipment in the efficient transfer of electrical power through long distances, is a matured technology having been around for more than 125 years. While a transformer life time expectancy is 40 years, operational and maintenance factors are common causes of accelerated aging or damage to the transformer.

The 4 pillars of transformer condition monitoring, namely visual inspection, Dissolved Gas Analysis (DGA), Offline maintenance and Record keeping, provide the root input for a transformer asset management system.

Visual inspection on a regular basis is critical to discover important information about the transformer's condition. Inspection should be performed on the operating parameters such as the temperature and conservator oil level, the conservator and OLTC breathers, the cooling equipment, the protection devices such as the pressure relief devices, Buchholz relays, OLTC surge relays and bladder failure relay, and the control cubicles and motor drive unit (MDU).

DGA provides the first indication of potential insulation or oil deterioration, hot spots, partial discharge or arcing. Oil samples are sent to the laboratory for testing of individual and total combustible gas (TCG) generation rates based on IEC 60599 and IEEE C 57104<sup>TM</sup> standards. The types of TCG detected indicates the type of potential fault, and the concentration levels provide a recommended action to be taken. DGA sampling procedure is critical as it affects the TCG level result and therefore the interpretation of the transformer health. While oil samples are typically taken from the bottom levels of the transformer, there are now practices of obtaining oil samples from the middle levels of the transformer where the oil is less affected by the bottom level sediments or water content.

Periodic Maintenance of OLTC and Bushings can be carried out based on the operating time or number of operations, depending on the type of plant and frequency of operation. Contact wear depends on the wear characteristics of the contact material, number of operations and operating current of the transformer. Between the maintenance intervals, oil values, silica gel breather and drive housing should be checked, and OLTC should be operated across 25 times to avoid formation of varnishing film layer.

Accurate record keeping of all visual inspection, operational and protection data, DGA results and input from off-line maintenance allows for evaluation of the data and conclusion of the transformer condition. Spare parts and replacements can be organized and scheduled, further extending the life of the transformer.