

MTMP™ Transformer Condition Assessment

Manage your ageing transformer population

A large proportion of the worldwide transformer population is nearing the end of its lifetime, and means are urgently required to optimize transformer fleet performance for higher availability. This has to be achieved at the lowest possible cost and with minimum environmental impact.



The cost of failure

Power transformers are often situated at strategically critical locations in power supply systems, and as a result the financial consequences of their failure can easily exceed their actual asset value. The real challenge lies in implementing the right action at the right time. Here, a definite trend has emerged: Asset managers are moving from Time- Based Maintenance (TBM) to Condition- Based Maintenance (CBM) or even Reliability-Centered Maintenance (RCM), where decisions are no longer driven by an average timeframe defined by observations and past experience, but instead take into account the actual condition of the equipment and the level of reliability required to fulfill its function.

Given that the average age of power transformers and industrial transformers in most countries is around 25–30 and 15–20 years, respectively, and considering the increase of the typical failure probability with the transformer age, action clearly needs to be taken to ensure their continued reliability and functionality.

Ten years ago, ABB began to develop a methodology for evaluating, in the field, the status of single and also whole fleets of transformers, using non-invasive methods wherever possible.

The methodology integrates knowledge accumulated by ABB over the past hundred years and involves more than thirty different brands. This methodology, ABB Mature Transformer Management Program (MTMP™), has a modular structure, allowing the level of investigation to be adapted to a customer's specific needs and the respective budget. Evaluations can be carried out progressively, beginning with a condition assessment (step 1), then moving onto life assessment (step 2) and, finally, to a highly selective advanced evaluation or Risk Assessment (step 3).

ABB's MTMP™ solution provides valuable information to support:

- Assets managers to decide upon the best maintenance strategy and define the associated maintenance and replacement budget
- Maintenance managers to select the right units to be maintained and implement the needed maintenance actions in order to increase the reliability while optimizing their maintenance budget by addressing the units based on their condition.

Step 1 - Condition Assessment

Large fleets (100 units or more) are evaluated using data which is readily available, such as types of application, time in operation, gas in oil, power factor, maintenance history and major events, or experience with sister units. The aim here is to obtain a general ranking for the population, based on technical and economic criteria, and to identify clusters of units requiring further investigation (step 2) or some basic maintenance. This screening also provides key information for the estimation of a rough budget for future maintenance or unit replacement, and identifies the units which should be given priority. Budgeted investments in maintenance can be more effectively allocated and optimized as a result of this evaluation.

Step 2 - Life Assessment

A smaller number of units are selected from the step 1 process for this evaluation. Step 2 re-uses basic information from step 1 and brings in further information (eg, design reviews, site inspection reports, diagnostics data, input from monitoring systems), if available. Step 2 is much more structured to allow the key properties (general, mechanical, thermal, electrical and accessories) to be assessed separately and provides important information about the condition and suitability of the units with respect to each of these properties. The maintenance, repair or retrofit work necessary to ensure top reliability for the units in their respective operating modes can then be defined.

Step 3 - Risk Assessment (Expertise)

The number of units is further refined for step 3. Based this time on information from steps 1 and 2, it incorporates further advanced calculation, plus simulation or root failure analysis. ABB specialists are brought in to carry out a detailed study of the operating conditions and history, and to analyze the original design using state-of-the-art software. Basic and advanced diagnostics are also used to evaluate a whole range of properties, including:

- Oil, dissolved gas analysis and furan interpretation;
- Frequency response analysis;
- Dielectric response;
- Partial discharge.

Step 3 provides a solid understanding of each unit's condition, and yields reliable information which can be used for decision-making, e.g. whether to retrofit a unit or use it in another application. Step 3 is also useful for performing engineering surveys (overload capability, remaining life etc) or as an expert evaluation after a unit has failed.

Advanced evaluations of this kind provide accurate, reliable information, even in complex cases, allowing decisions to be made quickly and efficiently. For example, it allows owners to decide whether or not a unit already on site needs to be retrofitted, repaired or scrapped. Time and costs are saved as a result. The three-step evaluation described has proved to be cost efficient for determining the status of transformers based on different levels of information. With its status defined, the characteristics of each unit can be reviewed in terms of present-day or expected operating conditions to define the level of functionality and risk for every unit in a power system.



The solution

Once the status of a unit is known, recommendations for maintaining or improving its condition to meet the expected withstand level can be made. A priority list can then be drawn up, detailing what has to be done to specific transformers. This can range from maintenance (oil processing, drying, etc) through overhauls, remanufacturing, retrofitting or relocation, to scrapping and replacement.

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