Real-time Monitoring of Power Transformers in EDP Distribuição Substations using New Diagnostic Techniques

The growing need for the reduction of maintenance costs in the electric energy sector has boosted a shift to condition-based maintenance programs of some components, with special emphasis on power transformers due to their critical role in the power system. In this context, this project aims the development of a non-invasive real-time diagnostic system for power transformers of EDP Distribuição.

GENERAL MOTIVATION AND OBJECTIVES

Power transformers are the most critical and expensive components in any production, transportation and distribution network. All electric energy produced and consumed by the end-user flows by power transformers. Thus, it is easily recognized that a fault in this equipment may lead to interruptions of the electrical service and have serious direct and indirect costs to the energy system operator.

Traditionally, power transformers are subjected to a periodic maintenance plan, which usually consists in annual inspections to perform a dissolved gas analysis to the oil, physicochemical tests, search for furanic compounds, etc. for screening and detection of anomalies. These tests are expensive, require physical access to the power transformer and are not very reliable. In addition, the transformer may eventually develop an incipient fault between each inspection, later on progressing unnoticed until finally culminating into a more serious and eventually catastrophic fault. This is leading utilities to seek for more advanced diagnostic solutions that may give an early warning about any fault at an incipient stage, thus avoiding an unscheduled shutdown of the power transformer and reducing maintenance costs.

In this context, the main objective of this project is the development and validation, in the laboratory and in the field using two real power transformers, of two diagnostic techniques able to detect and discriminate three different types of transformer faults: (i) inter-turn short-circuits in the windings; (ii) hot spots in the magnetic circuit; (iii) increase of the contact resistance of the OLTC.

The diagnostic algorithms can be applied to any oil-immersed or dry-type power transformer used in the production, transportation and distribution energy systems as well as in industry.

The tasks carried out and the obtained results can be grouped into three different categories: algorithms, hardware and software.

Work Description and achievements

- Development and validation, in the laboratory and in the field, of two real power transformers, of two diagnostic techniques able to detect and discriminate three different types of transformer faults: (i) inter-turn short-circuits in the windings; (ii) hot spots in the magnetic circuit; (iii) increase of the contact resistance of the OLTC.

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- An application with an intuitive and user-friendly interface was developed, which allows the operator to monitor in real-time the actual condition of each component of the power transformers located in the substation. The software allows to visualize different variables related to the operation of the power transformers and issues a final report about the condition of each power transformer.

- The tool developed automatically issues warnings, alerts and operator recommendations in case a fault is detected and some action is required.

PROJECT WEBPAGE URL
https://www.it.pt/Projects/index/1838