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Condition assessment of medium voltage power cables in industrial environments by means of VLF techniques

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Résumé

Le réseau de câbles constitue un gros investissement économique; de ce fait, la possibilité d'étendre la vie utile d'un câble dans le contexte d'une réduction des coûts de gestion et de maintenance, s'avère attrayante. L'utilisation systématique de contrôles et de diagnostics peut constituer un moyen efficace pour l'identification de tronçons dont les propriétés diélectriques se détériorent, et pour programmer des interventions spécifiques, afin d'éviter des interruptions accidentelles en service. Des informations utiles sur l'état de vieillissement de l'isolation peuvent être obtenus avec la mesure de la tgo à très basse fréquence (0.1 Hz). Il est de ce fait possible d'évaluer si une connection peut être maintenue en service, si d'autres contrôles sont nécessaires ou si un remplacement du tronçon critique s'avère indispensable.

Abstract

In economic terms, the cable network is a large investment; therefore, the possibility of extending the useful service life of a cable line, within the framework of limiting operating and maintenance costs, is a major advantage.

The systematic application of diagnostic methods may thus be an efficient means of identifying elements whose dielectric properties deteriorate and, through a program of interventions, to avoid interruptions in service due to faults.

Within the framework of the measurement of the loss angle at 0.1 Hz (or VLF, Very Low Frequency), useful information concerning the insulation ageing condition can be obtained. Thus, it is possible to evaluate whether the line can be maintained in service, if instead further research is required or if it is necessary to replace the critical section.

Introduction

Industrial plants are characterized by the presence of distributed loads having very complex shut-down procedures. Faults in the cable network, skeleton of the power supply grid, can be very critical. Periodical assessment of the conditions of the main electrical components carried out in the frame of predictive maintence schemes can contribute to the enhancement of the level of reliability keeping operational and maintenance costs under strict control. In the particular case of electric cables, apart from faults due to external causes (i.e. digging), dielectric degradation phenomena are slow enough to be detected by means of periodical check carried out measuring efficient diagnostic indicators. This paper summarizes the available techniques for the condition assessment of power cables, focusing the attention on intergral methods based on very low frequency supplies. A case study, relevant to a major petrochemical plant in Northern Italy is also presented.

Condition assessment of power cables

The decision to run, refurbish or replace a power cable requires the identification of a sound technical-economical compromise between the opportunity to keep it in service, thus avoiding the necessary investment for its replacement, and the enhanced maintenance necessary to ensure an acceptable level of reliability.

The method use by CESI is based on a well-established three levels integrated survey scheme articulated according to figure n. 1.

The first and second evaluation levels proceed following the items of a specific technical checklist considering data collection aspect and visual inspection. The following main points are addressed:

- Basic and detailed constructive characteristics of the cables, of their accessories and of the mechanical supporting structure
- Evaluatation of the adequacy of the type of cable connections for the specific application and of its present conditions at the light of an accurate visual inspection, considering :