



### **B.10.6. Diagnostic de l'isolation des câbles PR par système expert**

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#### **Résumé**

Ce document présente un système expert pour l'analyse de la dégradation de l'isolement des câbles "XLPE" (les câbles polythène connectés latéralement ("cross-linked")) qui sont utilisés comme des câbles électriques pour les lignes à haute tension. Ce système expert présente un grand avantage : il permet réaliser l'analyse de l'isolement dans toutes les circonstances où le câble est sous tension ("live-wire") et en état d'émission énergie. La base de données du système expert se construit sur un ensemble de données collectées et de diagnostics d'isolement grâce à des interviews avec des experts de ce domaine. Afin d'évaluer la qualité de ce système expert, ces diagnostics ont été comparés avec les autres diagnostics d'isolement. L'évaluation du système a montré que les résultats, obtenus par le système, sont très proches de ceux des experts. Ce résultat amène à la conclusion que le système expert peut réaliser l'analyse d'isolement des câbles "XLPE".

#### **1. Introduction**

Crosslinked-polyethylene-insulated-cable (XLPE cable) has been widely used on 3.3 to 6.6kV power cable since 1960. We can employ XLPE cables for higher voltage by great improvement of manufacturing technique. Today extra high voltage power cables with 500kV are available. However, it is known that breakdown accidents of old model XLPE cables is caused by water tree degradation because of some problems of structure, manufacturing technique and installation conditions of the XLPE cables. Insulation diagnosis technique has been studied and developed for preventing the breakdown accidents of cables by use of power outage tests employing d.c. high voltage leakage current method [1,2]. However, since it is not allowed to stop the power for a long time, the insulation diagnosis on live-wire state cables is very important.

Recently a facility failure diagnosis method using expert systems has been tried to diagnose the power equipments. A prototype expert system of insulation diagnosis for XLPE cables has been reported by Asari [3]. The authors have configured a knowledge data base in accordance with the degradation judgment standards established by the SID (Investigation Committee of Solid Insulation Diagnosis)[4] of IEEJ, and also structured an expert system for diagnosing the XLPE cables by employing fuzzy inference [5,6,7].

### **B.10.6. Insulation diagnosis of XLPE cables by expert system using fuzzy interference**

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#### **Abstract**

This paper presents an expert system for diagnosing insulation degradation of XLPE cables which are used as real power cables for the distribution lines. The expert system has a great advantage that the insulation diagnosis can be successfully carried out in any case of a live-wire state and a power outage state. A knowledge data base of the expert system is constructed with further specific information on a great number of insulation diagnosis data collected through interviews with experts in this field. In order to evaluate the expert system, they have compared the insulation diagnoses derived from their expert system with those from experts. It is shown from the system evaluation that the diagnosis results judged by the system are much the same as those by experts. This fact leads us to a conclusion that the expert system can serve sufficiently to carry out the insulation diagnosis on XLPE cables.

In this paper, the authors propose a further developed expert system for diagnosing the insulation degradation of XLPE cables with 6.6kV. The expert system has a great advantage that the insulation diagnosis can be successfully carried out in any case of a live-wire state and a power outage state. The insulation diagnosis at a live-wire state is realized by using a simple diagnosis module which enables us to catch degradation trends for preventing breakdown accidents by predicting residual breakdown voltage. The proper residual breakdown voltage is estimated by statistically analyzing insulation resistance data. In addition, the expert system makes use of a data base module storing the insulation diagnosis data for degradation trend control. A knowledge data base is constructed with further specific information on a great number of insulation diagnosis data collected through interviews with experts in this field.

#### **2. Configuration of the expert system**

The expert system for insulation diagnosis consists of three components, a simple diagnosis module in which the insulation characteristics are inspected by analyzing insulation resistance data and visual inspection data in a live-wire state, a precision diagnosis module to judge the insulation degradation by using several insulation characteristic data measured on a power outage state, and a