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Diagnosis of defects on Medium Voltage Electric Energy Distribution Networks

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ABSTRACT

An analysis of the Medium Voltage (MV) electricity power distribution network in the operated by Cameroon's AES-SONEL company shows that losses are very high due to energy which is produced but not distributed and that the duration of power interruptions as a result of these defects is long due to the time used in searching for the defects. Given that quick detection of defects is a sure means of improving availability and productivity in any company, we hereby propose a system of real-time diagnosis of the defects on AES-SONEL's electric power distribution network. After an inventory of typical defects on electric power networks and the proposal of a tool for their identification, we propose a system for the detection and localization of these various failures. The implementation of the system on a Programmable Logic Controller (PLC) enables the performance of the system to be assessed.

1. Introduction

Electricity supply networks are subject to various disturbances because of the means of production, alongside atmospheric conditions and industrial usage which affect them during transportation and the distribution of the energy produced. The control and management of these shortcomings are of primary importance for reasons of reliability, availability, maintainability and effectiveness of the network, as well as for the safety of persons and property. The transfer of electricity supply in most parts of the developing countries is manual. This system of transferring energy has a high annual rate of energy interruption (more than 10%) as compared to the rate of energy interruption of in developed countries (less than 5%) [1] who use an artificial intelligence based network.

Studies made on the Medium Voltage Electric Power Distribution Networks at the Downstream Network of the AES-SONEL Ngousso Sub-Station [13], show that the company recorded 131,544 kWh of undistributed energy, furthermore it was noticed that the D113 head station at Ngousso recorded for this period 20 activations of its circuit breaker, giving a total duration of 120 h of power cuts, that is to say an average of 6 h per power cut [2]. According to the data experimentally collected by the Network Load-dispatching Centre (NLC), there is typically a time lapse of between 50 min and 2 h from the detection of the defect to the beginning of the search for a solution. In the case of loss of phase, it is usually customers who inform the NLC of the cut [3]. As for the duration of the search for a defect, this depends on the distance from the sub-station to the location of the defect, since the search is done manually. It also depends on the time of day when the fault occurs. To ensure power availability throughout the network and at all times, AES-SONEL should have a reliable system for the control and management of these defects. This availability requires a reliable system of diagnosis which is an important first step to detection and localisation of defects. Such a system will be of paramount importance in contributing to early and rapid detection, improving availability and productivity of the network equipment as well as the profitability of capital invested [4].

The purpose of this research is to design an automatic system for the diagnosis of failures on AES-SONEL's electric power distribution network, using the results of the studies made on the Medium Voltage Electric Power Distribution Networks at the Downstream Network of the AES-SONEL Ngousso Sub-Station. After listing the various potential defects in the electric power network, a tool is proposed for their identification. This is followed by a proposal of an automatic system for the detection and localization of defects as well as the results obtained during system implementation.

2. Types of defects, the characteristic values of the network and identification of defects on electric power network

The various types of defects of the electric power networks are listed and the algorithms for identifying characteristic values have been elaborated.

2.1. Various types of defects

A defect is the difference between the reference characteristics of a device and the characteristics observed on the said device

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