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Fault Causes Analysis in Feeders of Power Distribution Networks

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Abstract. In this paper, a basic statistical analysis about principal causes of faults in power distribution networks is presented. Principal failure causes are identified through basic statistical and PCA (Principal Component Analysis) is used to find combinations of causes or other factors that describe major trends in the data set in terms of data variability.

The idea is to exploit information available related with the causes of faults occurred over an important period of time in a real power network. Common causes, trends as well as relations between causes and feeders types (overhead and underground) are found. Relevant information to know the behaviour of faults in a network is extracted.

Key words

Failure causes, fault, incidence, voltage sag, PCA.

1. Introduction

The failure of components in power networks can cause problems related with power quality and reliability [1]. The solutions of such problems are of interest both for the utilities and customers.

Factors such as environmental conditions, external agents or component status are involved in the occurrence of faults and failures. While faults are short circuits caused by dielectric breakdown of the insulation system, the failures are the termination of the ability of the components to perform its required functions [2]. The components failures normally induce faults and these faults are reflected as defects in the supply voltage. Utilities also use the term *incidence* to refer the actions implemented to return the systems to normal operation when faults and failures have occurred. Voltage sags are the main defect caused by faults in power networks.

Maintenance policies (preventive, based on condition monitoring, etc) are implemented to reduce the impact of the faults on the network. Also, fault prediction based on the early identification of symptoms, or incipient faults, leading to the appearance of faults is a topic of interest in power systems and several frameworks are available. Moreover, several methods have been developed to estimate the number and severity of faults in the network, based on the study of the voltage sags in a stochastic sense. However, methods must be developed to improve the systematic analysis of events caused by faults and their propagation along the network in order to discover fault patterns associated with frequent causes and their origin or to maintain accurate fault diagnoses and predictions.

The huge number and variety of components (overhead lines, cables, circuit breakers, transformers, fuses, insulators, etc.) that can be affected by failures makes difficult to deploy monitoring strategies that individually supervise all of these elements. So, new paradigms are needed to develop low cost solutions to maintenance policy difficulties. They have to be oriented to extract and exploit useful information from historical data and on-line events generated in both normal and abnormal conditions.

This work focuses on faults and failures generated in power systems and recorded in substations, and related information whit these faults (normally collected by the utility) such as cause, failed component, location, etc., with the aim of knowing the main causes of faults and their contribution on the global generation of incidences on the distribution network. Since not all the faults or incidences are produced by failures and these have different natures and causes, the goal is to recognize statistical information that shows the behaviour of the causes and the relation whit the lines topology.

The main idea is to exploit the information available related with the causes of faults occurred over an important period of time. Common causes, correlations between causes and feeders types (overhead and underground) can be found. According to [6] the information about the failure cause is of special importance since the consequences of failures can be prophesied and the appropriate measures of maintenance may be devised by evaluating it.