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Equipment for Predictive Maintenance in Hydrogenerators

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Abstract

This paper presents an equipment for predictive maintenance in large hydrogenerators. This equipment uses techniques of digital signal processing of the information contained in the electrical variables involved in the operation of the generator. Basically, the current and voltage signals of the generator are monitored and applied the techniques of electric signature analysis. The central idea is to unite the techniques of current signature analysis (CSA), voltage signature analysis (VSA) and Enhanced Park's Vector Approach (EPVA), to separate the spectra of signals and detect frequencies related to electrical and mechanical defects of generator-turbine set. This is possible because the generator is basically a device handling magnetic fields, so it's believable to infer that any operating conditions of all, somehow, influences the behavior of the magnetic field, reflecting noticeably in variations in signs of tensions and currents provided by its. The problem is to detect these variations, because some of them are under existing noise signs, and relate them to defects which they represent. This paper presents a real implementation in a hydrogenerator at Itapebi Power Plant, Brazil.

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Keywords: Predictive maintenance, measurements, signal Processing, hydrogenerators, DSP

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1. Introduction

The condition monitoring of electrical machines is understood as the ongoing process of assessing the health of the equipment throughout its useful life. The primary function of a predictive monitoring system is to recognize the development of faults in an initial state. The more premature for failure detection is made easier for the maintenance department to schedule a shutdown for the correction of the problem. The process of continuous monitoring of the condition of electrical machines is vital for the production process and it brings significant benefits to the company [1]. The main benefits are: increased efficiency of the productive process, reduction of losses due to non-scheduled shutdowns, increasing the useful life of the equipment, and the creation of a history of failures.

In the case of hydrogenerators, insulation condition represents an important point of failure and concern. Other important points to strengthen the diagnosis on predictive analytics that can also be listed would be: bearings, unwanted vibrations, partial discharges, alignment, balancing etc. Thus, equipment for monitoring condition needs to have a system for extracting features that can through data mining techniques relate to possible elements that contribute to premature deterioration of the equipment.

This paper presents equipment for supervision and predictive diagnosis of operating conditions of hydrogenerators based on digital processing of the information contained in the electrical variables. Based on information obtained specifically by the currents and tensions, it is expected to be able to infer about the operating conditions of the generator, because the pattern involving the behavior of variables monitored presents some degree of correlation with the deterioration of the operating conditions of the same. Through the information contained in the collected signals, extracted after an adequate digital signal processing, it is possible to obtain an assessment of the operational state of the observed generator and turbine set.

The equipment consists basically of current, voltage, vibration and temperature transducers with adequate pass band, a signal conditioning circuit to adjust the signal measured data acquisition circuit, a high speed and resolution circuit for converting analog/digital signals, a DSP type microprocessor for processing and storage of electrical variables and measures of an intelligent program data consolidation, evaluation and diagnosis of operational condition of the generator.

Initially, this paper presents a brief overview of the electric signature analysis techniques, and then the proposed equipment is presented. Following that, some aspects of the real implementation is made and some results are carried out.

2. Electric Signature Analysis Techniques

Electrical Signature Analysis (ESA) is the term used for the evaluation of voltage and current signals of electric machines [2]. In the most common case, the voltage and current signals are transformed to the frequency domain where are analyzed. Fig. 1 presents pictographic form the signal processing occurred, between its acquisitions until the fault detection.

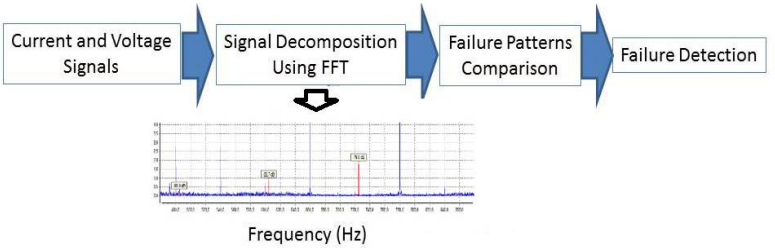

Fig. 1. Simplified block diagram of the application of ESA.