Renewable Energy and Power Quality Journal (RE&PQJ), ISSN 2172-038 X, No.9, 12th May 2011, Reference Paper: 218

European Association for the Development of Renewable Energies, Environment and Power Quality (EA4EPQ)	International Conference on Renewable Energies and Power Quality (ICREPQ'11) Las Palmas de Gran Canaria (Spain), 13th to 15th April, 2010

Digital Fault Locator for Double End Fed Transmission Lines

R. Micheletti

Department of Energy and Systems Engineering
University of Pisa
Largo L. Lazzarino, 1 56122 Pisa (Italy)
Tel. (+39 050) 2217349, Fax (+39 050) 2217333
E-mail: roberto.micheletti@dsea.unipi.it

Abstract

The paper presents a digital fault locator by dynamic system parameter estimation for a double end fed transmission line. The method uses about 1/6 cycle of recorded fault data and doesn't require filtering of dc offset and high-frequency components. The system differential equations are based on a lumped parameter line model, Thevenin equivalents at both ends of the line and an unknown fault resistance. The accuracy is demonstrated by a representative set of tests results obtained with computer simulation.

Key words

Fault location, Transmission lines, Parameter estimation.

1. Introduction

Transmission line faults must be located quickly and accurately in order to repair the faulted section, restore power delivery and reduce outage time as soon as possible. Therefore the development of fast and accurate fault location techniques has become a highly important research area. Several papers have been published in recent years on fault location methods. Most of them involve two main approaches. One is based on the travelling wave theory. When a line fault occurs a sudden change in voltage or in current at the fault point generates high frequency components. Fault generated travelling waves appear as disturbances superimposed on the power frequency signals; by processing these signals, recorded by the relays, it is possible to determine the fault distance. However this method depends on the travelling wave propagation, that is a complex phenomenon difficult to analyze perfectly; this is critical to the accuracy of the fault location [1]-[3].

The other approach relies on information supplied by the line currents and voltages at some observation points on an energized system within the first instants after fault inception [4]. In both cases the recordings of voltage and current constitutes the initial data for an estimation problem leading to fault location.

Most fault locating devices measure impedance, or more exactly reactance, between the short circuit and the end of the line where they are installed. The measured reactance provides an exact distance to the faulted point when the fault resistance is zero. This latter, unfortunately is not zero in actual faults, causing the impedance to deviate from its true value. This is because the current that flows through the fault resistance is slenderly shifted in phase with respect to the current measured at the end of the line, due to the effect of the prefault load current. As a result, the fault resistance is recognized as an apparent impedance with both resistive and reactive components, which is responsible for an error in the fault location. The error may be positive or negative, depending on the direction of the load current. Many algorithms that correct this error were presented [5]-[10]. Further publications on fault locacation can be found in [11]-[13]. In this paper another way of producing fast and accurate fault location is proposed. The line is represented as a lumped parameter circuit. The system model includes Thevenin equivalents with resistances and inductances at both ends of the line and an unknown fault resistance. A method of dynamic parameter estimation will be used in this paper to find fault distance. The fault location is quickly obtained by comparing the response of the actual system with that of the lumped parameter model. The model's parameters are varied until an adequate