Locating Faults in Parallel Transmission Lines under Lack of Measurements from the Healthy Line Circuit

Rafal Kawecki Jan Izykowski

Wroclaw University of Technology, Institute of Electrical Engineering (I-8)
Wyspianskiego 27, 50-370 Wroclaw, Poland

Abstract

One-end fault location technique is still a subject of great interest and is used in many applications. This is the case when the means of communication between the line terminals are unavailable.

The standard practice for one-end fault location algorithm intended for application to parallel transmission lines relies on using the following measurements as the input signals: – phase voltages of the faulted line, – phase currents from the faulted line, – zero sequence current from the healthy line. Providing the zero sequence current from the healthy line circuit enables to compensate for the mutual coupling between parallel lines, what is required for single phase to ground faults.

The standard fault location algorithms with the input signals as listed above requires knowing impedance data for equivalent sources behind the line terminals and using pre-fault measurements of currents from the faulted line. The local source impedance can be on-line measured while the remote source impedance is not measurable with one-end measurements and thus it's representative value is usually provided for the algorithm. The other drawback of the standard fault location algorithms is that pre-fault measurements of the currents can be in some cases unreliable or even unavailable. Modifications of the standard location algorithms for overcoming these drawbacks are presented in some approaches published in the last two-three years. These modifications require increasing the fault locator input signals, namely, instead of the zero sequence current from the healthy line the complete phase currents from this line have to be supplied to the locator. Such the possibility is available in some applications.

Yet another modification of the standard fault location algorithms is presented in this paper. Adaptation to the case of complete lack of measurements from the healthy line circuit is considered. The delivered fault location algorithm takes into account the following two cases: – the healthy line is in operation, – the healthy line is switched-off and earthed at both ends. The considered fault loop equation in terms of phasors contains four unknowns: – distance to fault, – fault resistance, – real part of the zero sequence current from the healthy line, – imaginary part of the zero sequence current from the healthy line. The first two unknowns are as in the standard location algorithm while the latter two – resulting from lack of measurements from the healthy line, have to be estimated. For this purpose the relations between the sequence components of currents at fault are utilised. As a result, the non-linear equation for the sought distance to fault is obtained. The solution of this equation is achieved with use of the Newton-Raphson iterative procedure.

Results of broad ATP-EMTP testing and evaluation of accuracy of the developed fault location algorithm are provided and discussed in the paper. They illustrate effectiveness of the proposed algorithm.

Contact Author:
Rafal Kawecki
email: kawecki@elektryk.ie.pwr.wroc.pl