

Very High Resistance Fault on a 525 kV Transmission Line – Case Study

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Abstract

This paper presents a rare occurrence of phase-to-ground short circuits with very high fault resistances—more than 300 primary ohms—on a 525 kV transmission line in southeastern Brazil. This report emphasizes the analysis techniques. Due to the lack of experience in faults of this type, one of the paper's objectives is to provide a specific example as well as to stimulate research on this topic.

DFR oscillogram analysis techniques are presented with the use of symmetrical components and simulation by short-circuit calculation. These simulations achieved a close approximation to the fault parameters observed. The performance of the line protection is evaluated for the specific conditions of the short circuit, with calculation of the viewed impedances and currents. Laboratory testing of protective relays is also described. The importance of the ground overcurrent directional protection on a pilot directional comparison scheme is shown, and the paper speculates on the widespread use of differential protection for transmission lines.

The specific criteria for resistive reach setting of the quadrilateral ground distance characteristic is presented, with the objective to show an evolution of those criteria and to discuss the settings limits. The impacts of load flow, remote infeed, and other system conditions related to the quadrilateral element are discussed.

The conclusions show the importance of the present techniques of oscillogram analysis using computer simulations. They also show the need of appropriate settings criteria for resistive lateral bands of the distance function for ground faults. Finally, it demonstrates the importance of ground overcurrent directional protection with a pilot scheme for HV and EHV transmission line protection. A comparison of differential and distance functions is included with experience-based recommendations for very long lines.

Short Paragraph

This paper analyzes a rare case of a ground fault with very high fault resistance, more than 300 primary ohms on a 525 kV transmission line in southeastern Brazil.

Considering the values of fault impedance larger than those usually observed in single-phase fault on extra high voltage (EHV) lines, the probable cause of the fault is discussed, and a subsequent analysis is mentioned for evaluation. Objective of this paper are to stimulate research and contribute to the collection of very high resistance fault information.

The analysis techniques are presented, using symmetrical components and fault calculations arrive at values of fault parameters that are very close to the ones provided by protective relays. The performance of the line protection is also evaluated. The importance of the ground over current