Preface

Electric power systems, which are growing in size and complexity, will be always exposed to failures of their components. In the case of a failure, the faulty element should be disconnected from the rest of the sound system in order to minimize the damage of the faulty element and to remove the emergency situation for the entire system. This action should be taken fast and accurately and is accomplished by a set of automatic protective relaying devices. At the same time, when a fault occurs on a line (distribution or transmission), it is very important for the utility to identify the fault location as quickly as possible for improving the service reliability. If a fault location cannot be identified quickly and this produces prolonged line outage during a period of peak load, severe economic losses may occur and reliability of service may be questioned. All these circumstances have raised the great importance of fault-location research studies and thus the problem has attracted widespread attention among researchers in power-system technology in recent years.

Basic algorithms used in fault locators are intended to make distance to fault calculation as accurate as possible. The fault locator is mainly associated with protection relays. Distance relays for transmission-line protection provide some indication of the general area where a fault occurred, but they are not designed to pinpoint the location. Moreover, both the tasks: line protection and fault location are fulfilled by processing the same current and voltage signals that are obtained from the instrument transformers and recorded at the substation. Fault-location estimation is a desirable feature in any protection scheme. Locating the fault on the transmission line accelerates line restoration and maintains system stability. That is why these two subjects are closely related to each other. There are, however, different demands formulated for protection and fault location. The last function should be made most precisely and with great accuracy. Distance to fault is estimated off-line from the recorded data. On the other hand – the relaying function is made on-line as fast as possible.

Different algorithms were developed in order to get a better estimation of fault distance depending on the extracted data from one or both ends of the transmission line. Most of the research done to date, has been aimed at finding the locations of transmission-line faults. This is mainly because of the impact of transmission-line faults on the power systems and the time required to physically check the lines is much larger than the faults in the sub-transmission and distribution systems. Of late, the location of faults on sub-transmission and distribution systems has started receiving some attention as many utilities are operating in a deregulated environment and are competing with each other to increase the availability of power supply to the customers. A fault location in the distribution system is not an easy job due to its high complexity and difficulty caused by non-homogeneity of line, fault resistance, load uncertainty, and phase unbalance.

The material is organized in 9 chapters. It starts with the introduction of basic concept and characteristic of methods of fault location in Chap. 1, which is followed by a general presentation of network configurations and models in Chap. 2. A separate chapter, 3, is dedicated to the nature of power-line faults, models and analyses. The algorithms for fault detection, fault-direction discrimination and determination of a type of fault are mentioned in the same Chap. 3 as well. Since a fault locator is a microprocessor device, its performance is determined primarily by an algorithm running on adequate hardware. From this perspective, the signal-processing methods for fault location are presented in detail in Chap. 4. A separate chapter, 5, is included that describes the measurement chains of fault locators. The main part of this book covers description of fault-location methods based on different approaches. In Chap. 6, it describes one-end impedance-based fault-location algorithms. It continues in Chap. 7 with two-end and multi-end fault-location algorithms. A separate chapter, 8, is dedicated to describe in brief different fault-location methods in distribution networks. Finally, Chap. 9 describes intelligence-methods application with respect to fault location.

Intended to link the design and application perspectives, written by authors from both university and relay manufacturer domains, this book is aimed at the audience of application, design and R&D engineers in protective relaying and automation as well as at university graduate and continuous-education students.

Distinctive Feature of the Book

The underlying assumption of this work is that fault location cannot be truly understood, applied, set, tested and analyzed without a deep and detailed knowledge of their interiors. Consequently, the design perspective organizes the included material. Unlike many other books, this one does not direct the reader to manufacturers' documentation, but instead, it tends to gather detailed information for both better understanding and comparison. It is intended to provide information enabling one to reproduce complete algorithms of a fault locator at least in their basic forms. The authors believe that this will help the reader to understand all aspects of fault location.

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