Preface

This book presents a method of adapting the traditional probabilistic safety analysis (PSA) to the security analysis of a power system. The book proposes a reliability model for a power system, where the possible failures of substation operations after grid faults are analysed and their impact on the power system dynamics and security is taken into account. The book presents the method in such a way that the reader is guided and equipped to build up a similar model. This reliability approach is suitable and applicable to real transmission grids, which can have hundreds of substations and lines.

In the reliability analysis of transmission systems, the basic phenomena and reliability problems are at the system level. The analysis of the local perspective, for example the outages of single components, is not adequate to capture the whole picture. So far, there have not been systematic methods that would combine local and system level issues in a similar way as this book presents. The method adapts the traditional probabilistic safety analysis (PSA) to the security analysis of a power system and includes the simulation of grid dynamics after grid faults and component failures in the modelling. This combination of different (traditional) tools enables a systematic security analysis where the connection of the failures of single devices and the system level consequences, for example a system breakdown, is possible.

The approach and methods presented in the book are based on the dissertation of one of the authors, Professor Liisa Haarla (formerly Pottonen). Her background is in the system planning, reliability and protection of power systems. Usually, only a few readers have deep enough knowledge to understand the insights of dissertations and few people actually read the dissertation. This book presents the basic ideas of the dissertation, but in addition to that, it provides a lot of background information and in doing so, presents the idea in a larger context. This helps the readers to understand the applied methods better.

The book also gives theoretical knowledge about reliability engineering and power systems. Chapter 3 presents the basic concepts of transmission grid planning. The main author of this chapter is Senior Specialist Mikko Koskinen, who has worked for over 20 years in that field. The reader is given a deeper
appreciation of the dynamics and reliability aspects of a meshed transmission grid. The book also presents the basic concepts of reliability theory, written by Professor Pierre-Etienne Labeau, whose expertise is in reliability engineering and PSA methodology for nuclear applications. This chapter helps the reader to understand the essential features of the proposed method. Doctor Ritva Hirvonen introduces the electricity market design, renewable generation, and emerging technologies that affect transmission system and its reliability. Her background is in operational and system planning of the network and in electricity markets. The book provides references to the literature that the interested reader can use for deepening his/her knowledge in the various domains combined in this work.

The book is practical minded, it concentrates on issues encountered when an analysis of this kind has to be completed for an existing transmission grid. This perspective is quite rare in books, because experts making practical security analyses for a real power system are seldom interested or have time to write books.
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