

Preface

Less than 10 years ago, a comprehensive book devoted to recent research on distribution systems would have been of limited interest. Indeed for decades the scientific community was only concerned with the development of distribution systems through their expansion and the development of protection equipment and the corresponding switchgears. Thus, the main innovations were primarily related to the equipment, because the structure and functioning of these networks, being simple, did not require special research and development.

In the 1980s, in the UK, and then the US, however, the opening of the energy markets to competition, often called “deregulation”, which was propagated thereafter in Europe and other countries across the world, introduced a new paradigm in the organization of electrical systems. This new paradigm has changed the organization of these systems, notably due to the entrance of new participants and the change in the structures and liabilities following it (the appearance of network operators, providers, producers, etc.).

In many countries, this change of paradigm has occurred simultaneously with the awakening of customers and governments to the worldwide environmental stakes. This has generated an unprecedented passion for renewable energies. The meeting of these two societal phenomena has led to the development of renewable energies: biomass and geothermy have come to supply the heating and electrical networks through cogeneration. At the same time, the fast development of wind and solar power gradually appeared in the form of small power installations, quickly developed, thanks to

government aid, into average power installations, described as “wind farms and solar parks”.

The appearance of these new means of production, usually installed on the distribution systems, led the network operators to be concerned with the impact on the latter due to the proliferation of decentralized means of production. Indeed these networks were not intended to host this type of production, whose localization is random and a big part is intermittent and thus not dispatchable.

It is in this context that IDEA (a French consortium for the invention of the electrical distribution of the future) was created between the industrial partners EDF, Schneider Electric Industries and the Polytechnic Institute of Grenoble. The vocation and culture of these partners are complementary. The objective of this group at the very beginning was to analyze the impact of intermittent and random decentralized production on distribution systems.

The culmination of nearly 10 years of innovation and research studies on the various facets of study of the interaction between distribution systems and renewable energy production devices have provided the framework for this book. Professor Nouredine Hadjsaïd, as Director of IDEA, was the most qualified person to ensure the coordination of its writing.

The need to introduce increasingly large quantities of renewable energies into distribution systems led engineers and researchers to imagine new concepts, such as the “virtual power station” or the decentralized voltage regulator, which give these networks the qualities of flexibility, robustness and self-healing. These qualities will enable them to host new generation means, while guaranteeing the security of energy transmission.

These concepts, based on the coordination of the energy structure with information infrastructures, were the premises of the “intelligent energy network”, known as the *smart grid*. Its repercussion on a worldwide scale shows the urgent need for a comprehensive work on distribution systems.

This book, by the quality and the originality of the contributions, will enable the reader to form a global and exhaustive vision of theoretical and practical tools relating to the concept of the smart grid.

We hope the book gets a particularly enthusiastic reception from the community of researchers and engineers, who in industry as well as in the research field will be involved in the design and erection of the distribution systems of the future.

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