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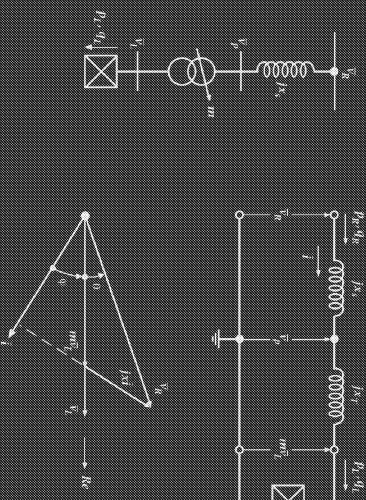
Roberto Marconato

ELECTRIC POWER SYSTEMS

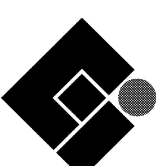
Second Edition

Background and Basic Components

Volume 1



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Within the collection of CEI publications, other than standards, but forming an appropriate supplement to them, CEI is publishing the following volume entitled

ELECTRIC POWER SYSTEMS

Second Edition

Volume 1

Background and Basic Components

by *Roberto Marconato*

This is the first Volume of the second edition of a treatise dealing with electrical power systems. It starts from the basic knowledge, the analysis and the modelling of fundamental components and then approaches the problems of their operation in "Steady-State Behaviour, Controls, Short-Circuits and Protection Systems" (second volume) e in "Dynamic Behaviour, Stability and Emergency Controls" (third volume).

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To pursue the basic goals of a power generation, transmission and distribution system, namely

- to meet the demand of consumers at any instant with good quality of electricity supply, i.e. to supply them with the demanded power, keeping voltage and frequency variations within narrow limits,
- to ensure the continuity of electricity supply, i.e. serving customers even in the event of major perturbations in the transmission system (or in power plants) or of abnormal load demand,
- to minimise the price of the electricity supply service,

the multiple aspects of the system behaviour should be investigated under both steady-state and dynamic conditions. In both cases, the analysis of the system, and the synthesis of the most appropriate protection and control actions, under normal and emergency conditions, are required.

As a result, the approach to this extensive subject matter is based on understanding the phenomena of the system, modelling them in terms of individual components and of the overall system, and dealing with analysis and control aspects.

In comparison with other classical books on the same subject, this Book is highly recommended especially for its in-depth analysis of the phenomena of the system and for its rigorous modelling of the various grid components, of the overall system and of related phenomena.

Therefore, although the Book does not cover structural and technological aspects, or the development of software for studying the various problem areas, it can be helpful for implementing the algorithms required for analysing modern interconnected power systems, whose geographic coverage is ever-increasing.

In fact, international interconnections are expanding constantly. Among the most significant projects, which are under way in Europe and in the Mediterranean Basin, it is worth mentioning the Baltic Ring in northern Europe (mainly DC interconnections) and the synchronous Mediterranean Ring, linking the power systems of three continents, i.e. the two South-European end points, Spain and Greece, via the countries of North Africa, the Near East and Turkey.

From the standpoint of CEI's standardisation activity, the book is particularly relevant for TC 11, which deals with HV Transmission and Distribution Systems, as well as for other Technical Committees: TC 2 on Rotating Machinery; TC 13 on Equipment for Electrical Energy Measurement and Load Control; TC 14 on Transformers; TC 17 on Switchgear and Controlgear; TC 20 on Electric Cables; TC 28 on Insulation Co-ordination; TC 36 on Insulators; TC 37 on Surge Arresters; TC 57 on Power System Control and Associated Communications; TC 65 on Industrial-Process Measurement and Control.

The Book is divided in 3 Volumes. The second and third will be published next years. Its contents is as follows:

Volume 1 - Background and Basic Components

- Introduction
- Review of Linear System Theory and Linear Circuit Theory
- Main Transformations of Variables Used in Power System Studies
- AC Transmission Lines
- Power Transformers
- HVDC Transmission
- Synchronous Machines
- Basic Load Representation

Volume 2 - Steady-State Behaviour, Controls, Short-Circuits and Protection Systems

- Power Flow
- Frequency and Real Power Controls
- Voltage and Reactive Power Controls
- Optimal Power Flow and Dispatching
- AC Transmission System Controls and FACTS Controllers

- Short-Circuit Analysis
- Protection Systems

Volume 3 - Dynamic Behaviour, Stability and Emergency Controls

- Dynamic Behaviour : An Overview
- Electrical Phenomena or Short-Term Dynamics
- Mid/Long-Term Dynamics and Stability : An Introduction
- Steady-State Angle Stability
- Angle Stability Following Large Perturbations
- Voltage Stability
- Contingency and Restoration Plans

All the above-mentioned topics were very important for vertically-integrated electricity companies (i.e. involved not only in electricity generation, transmission and distribution, but also in development and operation of the interconnected system). This all the more so given the liberalisation of the electricity market, where power system operation and security considerations may have less priority than return on the invested capital. The situation is compounded by the spin-off of large electric utilities into myriad small companies, each with very limited tasks with respect to the complexity of the overall system.

In view of the above, the Book was designed to train highly qualified professionals, proficient in the technical aspects of power systems so as to enhance their operation cost-effectiveness and security. The Book is addressed to both graduate and post-graduate students in Electrical Engineering and, more generally, to all electricity market players in the areas of power generation, transmission, distribution, as well as development and operation of the overall power system. Graduates in economics and business management, wishing to gain insight into the physical system characterising the context where they operate, could equally benefit from the Book.