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Autore	Zhong Qing-Chang
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Nota di contenuto	Theoretical Framework. Synchronized and Democratized (SYNDEM) Smart Grid -- Ghost Power Theory -- 1G VSM: Synchronverters. Synchronverter Based Generation -- Synchronverter Based Loads -- Control of Permanent Magnet Synchronous Generator (PMSG) Based Wind Turbines -- Synchronverter Based AC Ward Leonard Drive Systems -- Synchronverter without a Dedicated Synchronization Unit -- Synchronverter Based Loads without a Dedicated Synchronisation Unit -- Control of a DFIG Based Wind Turbine as a VSG (DFIG-VSG) -- Synchronverter Based Transformerless Photovoltaic Systems -- Synchronverter Based STATCOM without an Dedicated Synchronization Unit -- Synchronverters with Bounded Frequency and Voltage -- Virtual Inertia, Virtual Damping, and Fault Ride-through -- VSM: Robust Droop Controller. Synchronization Mechanism of Droop Control -- Robust Droop Control -- Universal Droop Control -- Self-synchronized Universal Droop Controller -- Droop-Controlled Loads for Continuous Demand Response -- Current-limiting Universal Droop Controller -- 3G VSM: Cybersync Machines. Cybersync Machines -- Case Studies. A Single-node System -- A 100% Power Electronics Based SYNDEM Smart Grid Testbed -- A Home Grid -- Texas Panhandle Wind Power System.

Sommario/riassunto

"Today, the generation in power systems is dominated by synchronous generators, of which the inherent synchronisation mechanism is the underlying principle that holds a power system together. This book considerably facilitates engineers in the integration of renewable energy sources, electric vehicles, energy storage systems etc., and the operation of power systems from the fundamental level. In this book, this mechanism is adopted to develop the framework and a technical route for the next generation smart grid: Completely Autonomous Power Systems (CAPS). After giving some general introduction, the basics of power systems, synchronous machines and power electronics will be presented to pave the way for the introduction of the architecture of the next-generation smart grid. The book will show how to make inverters into power systems, to mimic conventional synchronous generators to possess the same synchronisation mechanism. These inverters are called synchronverters and this technology, developed by the author and his collaborator, was awarded Highly Commended at 2009 IET Innovation Awards. It has attracted a lot of interest from academia and industry as now many leading research centres in renewable energy, power electronics and smart grid integration are doing research in this area. The book demonstrates how the majority of generators and loads in a power system can be governed by the same synchronisation mechanism and will be able to work together autonomously as equal partners to maintain system stability. It will also show how to remove the dedicated synchronisation unit in a synchronverter, without losing the vital synchronisation mechanism. The theoretical justification why the dedicated synchronisation unit that has been believed to be a must-have can be removed will then be provided, via showing that the widely-adopted phase-locked loops for grid connection of inverters are intrinsically the same as the droop control strategy. Brief TOC: Introduction; Part One Architecture;Basics of Power Systems; Basics of Synchronous Machines; Basics of Power Electronic Systems; Next-Generation Smart Grid; Part Two Technical Route; Synchronverter-based Generation; Synchronverter-based Rectifier; Synchronverter without a Dedicated Synchronisation Unit; Synchronverter-based Rectifier without a Dedicated Synchronisation Unit; Synchronverter-based STATCOM without a Dedicated Synchronisation Unit; Droop Control v.s. Phase-Locked Loops; Part Three Demonstration System; Demonstration System. Power systems are going through a paradigm change from centralised generation, to distributed generation, and further to smart grid. A large number of renewable energy sources, electric vehicles, energy storage systems etc. are being connected to power systems. Moreover, various loads/consumers are being required to take part in the regulation of power systems and to improve energy efficiency. These make it impossible to manage power systems in the way that has been (is being) done, simply because of the huge number of players in the system. A power system will eventually need to be operated completely autonomously, with minimum human interaction. A significant advantage of this is that the communication and information layer of smart grid can be released from the low-level control, which improves system reliability and performance. Because of the technological advancements in control and power electronics, this is now becoming possible"--