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A comprehensive protection strategy for microgrids with high renewable energy penetration

A microgrid is a group of interconnected loads and distributed energy resources (DERs) with defined electrical boundaries forming a local electric power system at distribution voltage levels, that acts as a single controllable entity and is able to operate in either grid-connected or island mode. Deployment of DERs causes a microgrid or conventional distribution feeder to tackle several challenges, such as the bi-directional flow of power, changes in fault current magnitude, and continuous changes in operational configuration due to plug-and-play of DERs, fluctuation of load demands and intermittency of renewable generations. Hence, the traditional protection strategies will no longer be sufficient to protect microgrids against network faults, transient and dynamic disturbance conditions. This research study proposes a fast and reliable communication-assisted protection strategy for ensuring safe operation of microgrids with high penetration of renewable energy. The strategy is implementable by commercially accessible microprocessor-based digital relays. It also provides a backup protection to handle communication failures and malfunction of protection devices. The study also presents the detailed structure of the digital relay which enables the proposed strategy. A number of improvements are proposed to find an alternative way for conventional overcurrent relays to reliably detect small-magnitude fault currents and high impedance faults, commonly encountered in converter-interfaced renewable microgrids. Simple and economical bus protection method is also proposed. Several simulations and related product field tests are conducted on a comprehensive model of realistic operational industrial microgrids (such as Goldwind Smart Microgrid System, in Beijing, China, and many other microgrids in China) using PSCAD/EMTDC software environment and practical product field test setups, for different case studies and fault scenarios, to verify the effectiveness of the proposed protection strategy and its fault, transient and dynamic disturbances digital protection relays.

Biography

Dehua Zheng has completed his B.Sc. and M.Sc. degrees in Electrical Engineering from North China Electric Power University, Baoding, China in 1982 and 1987, respectively. He has also graduated another M.Sc. degree in Electrical Engineering from the University of Manitoba, Canada in 1995. His professional experience includes the Manitoba Hydropower Company, University of Manitoba, China National Wind Power Engineering Technology Research center, Goldwind Science and Technology, and many others. Dehua Zheng is an IEEE Senior Member, registered senior electrical engineer of North America, deputy director of China National Wind Power Engineering Technology Research Center and IEC project leader for IEC/TS 62898-3-1: Microgrids – Technical Requirements - Protection. Currently, as the Chief Scientist and Engineer of Goldwind Science & Technology, he is leading the Microgrid Platform R&D Institute and devotes himself to research and development of Chinese and world microgrid technology.

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