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Fault Protection and Dynamic Control Strategy for Microgrids with High Renewable Energy Penetration

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Abstract
Microgrid is a group of interconnected loads and distributed energy resources (including microturbines, diesel generators, energy storage, renewable resources, and all other kinds of distributed energy resources) at distribution level with defined electrical boundaries that has black start capacity and can operate in island mode and/or grid-connected mode.

Because of the uncertainty, intermittent, and discontinuity of the renewable resources, transient disturbance and dynamic disturbance exist in the microgrid. For the fault current is small in the system and the microgrid has very little inertia, the disturbance control and fault protection of microgrids are more difficult than the ones of traditional grids.

The most challenging part of protection and dynamic control of microgrids is figuring out whether a fault or disturbance is occurring in the system. In the microgrid, there may appear transient characteristics similar to the transient and dynamic disturbance at the initial faults. If there is a fault, the transient disturbance control should be used to prevent the system from collapsing and make sure the right breakers should be tripped. But if there are transient and dynamic disturbances, even the initial characteristics of the transient and dynamic are very similar to the fault ones, the breakers should not be tripped.

So that Mr. Zheng has been leading his team to propose and develop the dynamic disturbance control, transient disturbance control and fault protection technologies, and they all have been well applied in practical projects. The main innovations are as follows:

(1) Relying on the dynamic disturbance control technology of the energy storage system, it can achieve safe and stable operation under the condition of high permeability of renewable energy, and can support 100% consumption of renewable energy generation in microgrid system.

(2) Through real-time load and power generation monitoring, analysis and control technology, relying on power and energy storage energy to effectively suppress transient disturbances and dynamic disturbances, respectively, to achieve unplanned seamless switching from grid connected mode to island mode or vice versa (time less than 10 milliseconds), Improve the safe and stable operation level of the system.

(3) Based on the Park transformation and the fault identification technology of branch current and voltage harmonic rapid changing rate, the precise positioning and fast isolation of the fault components of the microgrid are realized.

(4) Based on the power and load side comprehensive treatment technology, the total harmonic distortion rate (THD) of voltage and current is less than 3% when operating on an island.

The microgrid dynamic disturbance control technology, transient disturbance control technology and fault protection technology have been evaluated by domestic and foreign experts as reaching the international leading level.

Biography:
Dehua Zheng has completed his B.Sc. and M.Sc. degrees in Electrical Engineering from North China Electric Power University, Beijing, China in 1982 and 1987, respectively. He has also graduated another M.Sc. degree in Computer Engineering from the University of Manitoba, Canada in 1995. His profesional experience includes the Manitoba Hydropower Company, University of Manitoba MB Canada (he involved in the PSCAD & RTDS development teams), Saskachewan Polytech Institute SK Canada, China Goldwind Science and Technology Co., Ltd., and others. Dehua Zheng is currently a Deputy Director of China Smart Distribution System & Decentralized Generation Committee, Deputy Director of China National Wind Power Engineering Technology Research Center, Chief Scientist of Goldwind Science and Technology Co., Ltd., IEC project leader for IEC/TS 62898-3-1: Microgrids – Technical Requirements – Protection and Dynamic Control, IEEE Senior Member, and registered senior electrical engineer, PhD. professor in many universities. He is also leading the Microgrid and Energy Internet Technology and Business in

China, and devotes himself to research and development of Chinese and world microgrid and energy internet technology.

Speaker Publications:

1. Dehua Zheng , Min Shi,Yifeng Wang, et al., Day-Ahead Wind Power Forecasting Using a Two-Stage Hybrid Modeling Approach Based on SCADA and Meteorological Information, and Evaluating the Impact of Input-Data Dependency on Forecasting Accuracy. MDPI, 2017; 10(12): 1988.

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