2025 IERE-TPC Taipei Net-Zero Workshop
May 26–29, 2025

Application and Study of Virtual Synchronous Generator in Microgrid and International Standards

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Keywords: *Microgrid, Inverter, Virtual Synchronous Generator, Virtual Inertia*

Abstract

With the penetration rate of renewable energy continues to increase, the inverter-based-resources (IBRs) will continuously dominate the power systems. According to the report "Taiwan 2050 Net-Zero Emission Pathway, "the proportion of renewable energy will reach 60~70% in Taiwan. The traditional power systems are mainly composed of synchronous generators, which can contribute the rotating mechanical inertia. Therefore, when the power system suffers a disturbance, the mechanical inertia can suppress the frequency of severe changes. However, the inverters do not have rotating mechanical inertia and damping, resulting in the power system becoming relatively unstable and the frequency susceptible to disturbance. To overcome the above problems, the novel control method called virtual synchronous generator (VSG) has been presented. VSG is a type of grid-forming inverter that has the dynamics characteristics of synchronous generator, including droop control, damping, and inertia. Therefore, VSG control is the key technology in the high renewable energy penetration of power system.

Taiwan Power Research Institute (TPRI) has made significant efforts in research and development of VSG in microgrid and large power system, aiming to assist in use of VSG in Taiwan Power System and improve resilience. This study mainly simulates and analyzes the performance of virtual synchronous generators and examines the effect of suppressing the rate of change of frequency (RoCoF). Furthermore, TPRI is actively studying VSG international standards and its testing procedures including IEEE 2988-2024, GB GC0137, UNIFI Consortium, NERC, etc. The goal is to improve Taiwan Power System resilience using VSG technology and develop VSG standards in the future.