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An Innovative Platform for DER Simulation, Testing, and Grid Integration

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Abstract

The high penetration of distributed energy resources (DERs) presents new challenges to power grids, particularly distribution networks. DERs such as photovoltaics (PV), energy storage systems (ESS), and electric vehicles (EV) are characterized by dispersion and diversity. To accommodate the rapid growth of DERs, effective monitoring and integration of DER information have become essential.

To address this, an innovative IEC 61850 Extensible Messaging and Presence Protocol (XMPP) platform has been developed at the Taiwan Power Research Institute (TPRI) of Taiwan Power Company (TPC). Additionally, a robust testing facility is crucial to ensure the performance of DER monitoring and control. This platform also supports DER simulation and testing.

The proposed platform integrates the IEC 61850 XMPP protocol, with DER sites implemented in distribution networks alongside enhanced cybersecurity measures. To validate its robustness, performance analysis and stress tests are conducted.

Furthermore, a DER simulation and testing facility has been developed. A PV simulation system has been constructed, using a DC power supply to simulate the output V-I characteristics of a PV array. A PV inverter, which converts DC power into AC power, acts as the main controllable device in this system. Additionally, a three-phase AC power supply is used to emulate grid connection. A three-phase power data acquisition system is also established for power measurement, along with a local control system for system management.

The testing focuses on the XMPP gateway and XMPP cloud platform. Test procedures and scenarios are designed to simulate grid-connected PV system and ensure compliance with distribution operation requirements.