Abstract

Existing distribution network was designed to deliver unidirectional power flows to consumers. It was designed to require minimal control intervention, resulting in a largely passive infrastructure. The technical challenges to the connection of distributed generation (DG) lie in four main areas: voltage control, power flow management, fault current management and network security. In addition to these challenges are those associated the interactions between DG and the distribution system that require careful investigation. As more DG connects to distribution networks, the more 'active' controls of DG and/or network components are required. In this project, the impacts of DG on the distribution system voltage profile and fault detection are examined, and the remedial actions are investigated with an aim to increase the penetration of DG. The area based coordinated voltage control of On Load Tap Changing Transformers (OLTCs) and applications of voltage regulators will be studied. The low voltage ride through capability of wind turbine with various reinforcement techniques during fault situations is also investigated.

Microgrid architecture can be used to enhance distribution network reliability and manage various types of DG. With more measurements obtainable from distribution automations (DA), advanced metering infrastructure (AMI) and demand side management (DMS) systems, system states can be properly estimated and used in grid operations. Control strategies for distributed energy resource (DER) units within a microgrid are selected based on the required functions and possible operational scenarios. Controls of a DER unit are also determined by the nature of its interactions with the system and other DER units. The main control functions for a DER unit are voltage and frequency control and/or active/reactive power controls. In this project, dynamic simulations of microgrid using grid following and grid forming modes operations will be conducted and suitable controls schemes will be developed to stabilize the power frequency and voltage of a feeder based microgrid.

Key Words: Distributed Generation, Distribution System Operations, Microgrid