Coordinated Control of STATCOM with Distribution Network Devices for Wind Farm Integration

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Abstract

The global warming and greenhouse effect have increased potential for renewable energy technologies. The wind power generation is proven as a prominent renewable energy source for producing electricity. The most wind potential is available in remote areas, where the distribution networks are constrained by the power quality and reliability issues. Usually the distribution network consists of several devices such as De-Energized Tap Changer (DETC) and On-Load Tap Changer (OLTC). Further, the STATCOM is also used to solve power quality and reliability problems. This study investigates a practical situation of a small and remote distribution network, connected with wind farm and STATCOM, using PSCAD simulation. A worst case analysis is studied using critical wind data. A coordinated control technique is proposed to operate DETC, OLTC and STATCOM to reduce voltage variations. Here, the STATCOM detailed model using IGBT switches and small scale distribution network were modelled. The DETC and OLTC control and STATCOM, converter control, AC terminal voltage drop control and DC link voltage regulatory control were designed to operate accordingly to solve the voltage variations. The above DETC and OLTC controls were based on to operate the distribution system at the middle set point of the stable limits. The STATCOM control used park transformation for locking phase angle for synchronization. Accordingly, STATCOM system control, its internal voltage was developed. The STATCOM converter control used the sine-triangular PWM to generate the gate pulses. This is to eliminate the voltage violations during the steady state as well as the transient operations. The proposed coordinated control technique with the DETC, OLTC and STATCOM has proven better performance of the small distribution network. This allows to increase the wind farm integration to the remotely operated distribution grid.