Project 16-6:
Evaluation of Power Control Devices for Distribution Systems

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Project Summary:

High penetration of intermittent distributed resources such as photovoltaics (PV) creates several voltage and power quality issues including violation of voltage limits and excessive voltage variations. These issues impact the integration of PVs in the distribution systems and utility's operational control over the voltage and loading conditions in their service territory. Recently introduced var compensation-based Smart Devices claim to mitigate these issues thereby improving PV integration and providing other benefits. The relatively low cost and autonomous operation of such devices make them potentially attractive options, especially for long and weak circuits.

This project provides DSTAR utilities with a quantitative third-party performance evaluation of commercially available Smart Devices offered by three vendors:

1) Varentec's Edge of Network Grid Optimizer (ENGO);
2) GridBridge's Grid Energy Router (GER); and
3) American Superconductor's (AMSC) Dynamic Var Volt-var Optimizer (DVAR VVO).

The study approach involved three tasks – (1) developing an OpenDSS model of a real-world distribution system that is used as the test system, (2) developing Smart Device models that are suitable for time series analysis in OpenDSS, and (3) performing simulations on the test system.

Based on the analysis of the simulation results, the main findings can be summarized as:

- Each of the three evaluated Smart Devices improves circuit voltage profile and mitigates abnormal (under- and over-) voltages.
- Each of the three Smart Devices helps integrate PVs into distribution circuits.
- Varentec's ENGO high PV integration and abnormal voltage mitigation applications require decreasing feeder head voltage set-point and placing a number of these devices at low-voltage points on the secondary side of service transformers thereby boosting the voltage.
- Two deployment scenarios of GridBridge's GER can achieve high PV integration and circuit-wide abnormal voltage mitigation.
- AMSC's DVAR high PV integration and abnormal voltage mitigation applications require placing a device upstream of the circuit portion experiencing the voltage limit violations to provide VAr compensation thereby regulating the voltage.
- The cost of the solution varies with the scenario and circuit characteristics, but the cheaper solutions require adjustments in settings of other voltage regulation devices (e.g., regulators and substation transformer taps).

Who Should Use:

Distribution Planners, Standards Engineers, DER Interconnection, PQ/Reliability Engineers

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