Photovoltaic Array on a Distribution Feeder

Sponsor: Energy Systems Innovation Center
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Abstract
Team Moquette worked in conjunction with Energy Systems Innovation Center and the SmartCity testbed at WSU to model the local Turner 117 distribution feeder and the newly installed 72 kW Photovoltaic Array. Utilizing GE’s e-tesseract, Distribution Management System (DMS), and a python based programming interface the team studied the affect of several voltage control strategies to help mitigate problems associated with increased PV penetration at the distribution level and to determine the maximum solar kW for the Turner 117 feeder.

Effects of PV Integration

The use of DG resources like solar can cause voltage rise on a feeder instead of a voltage drop.

Effect of VAR control

By using a dynamic power factor on the PV inverter the voltage rise can be minimized while simultaneously minimizing the inductive load used at non-necessary times.

Turner 117 Modeling Results

At the maximum possible solar generation of 1 MW peak, there was no voltage issues on the Turner 117 distribution feeder.

Algorithm Flowchart

The VAR control algorithm dynamically changes the power factor of the solar inverter to maximize real power generation while minimizing voltage rise due to Solar integration.

Results

• 1 MW of Solar Generation on Turner 117 before the GE DMS fails to converge on Power Flow

• No voltage issues found on Turner 117 that can be solved by the VAR algorithm

• The VAR algorithm successfully keeps voltage within ±5% at all times during the day on IEEE 37 Node model

Recommendations

This Project:
• Solve power flow convergence issues
• Automate VAR control
• Incorporate 1 MW battery to voltage regulation analysis

Future Projects:
• Analyze line capacities, harmonics pollution and protection for bidirectional power flow
• Analyze various feeder structures

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Team Moquette