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Abstract Format

Accelerated Assessment of Operational Uncertainties Associated with High Penetrations of PV on the Distribution Grid

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Abstract

In order to efficiently integrate high penetration levels of PV into their system, planners can leverage modeling and analysis tools to understand the impact of the high penetration. However, there are several barriers to effectively using results from the modeling and analysis of high penetration PV for planning purposes. For example:

- How to model load variability and allocate load within a feeder model in a way that accurately preserves the impact of both load and PV variability on the circuit.

- A method for circuit simplification that enables faster execution of temporal circuit simulations but retains the desired accuracy of voltage calculations.

We present a technology approach for overcoming the aforementioned high penetration PV simulation barriers. The technology approach encompasses:

-Model reduction of the distribution network. For the distribution network, power flow computation time is approximately linearly proportional to the number of nodes in the system. A typical distribution feeder in the U.S. will have thousands of nodes in the network. This fact, along with the need to run a multitude of scenarios to capture the operational uncertainties in load and PV in the distribution feeder, makes the analysis infeasible for real-time operation. However, this limitation can be overcome by reducing the order of the distribution circuit. It is possible to reduce the order of the distribution feeder by more than 90%, while still retaining reasonable accuracy. In this method, the network equivalence is done separately from the load aggregation, which allows the load to be adjusted on the reduced network, making the scheme suitable for use in different operational conditions.

-Net load allocation and uncertainty assessment. The state of the art does provide methods and techniques to allocate load in the distribution system, and many utilities have been using these methods for their operational and planning needs. However, with the increased penetration of PV in the distribution network, the traditional method cannot be applied directly. In order to overcome this challenge, GE developed a probability based modeling technique that considered the uncertainties in load allocation and solar production prediction.

The expected outcome from the described technology will be increased PV penetration in distribution grids beyond the 15% rule without negative impact on the system.