At a glance
Successfully integrating increased levels of Distributed Energy Resources (DER) – including distributed generation (DG), energy storage systems (ESS), and demand response (DR) – into a distribution network is a complex process, impacting both transmission and distribution systems, and Planning and Operations departments. The identification of potential issues and designing of effective solutions relies heavily on effective planning and analysis.

Siemens Power Technologies International (Siemens PTI) can support your business throughout the DER integration process with:

- expert know-how and field experience to help develop an integrated transmission and distribution strategy to cost-effectively integrate DER
- state-of-the-art software tools (PSS®E and PSS®SINCAL) to explore the full potential of DER, including DG, ESS, and DR waveform.

The challenge
Integration of DG into a distribution network poses considerable challenges to existing Planning and Operation processes.

Challenges in Planning include identifying the following:
- how much DG a distribution feeder/circuit can host without system improvement
- mitigation measures and capital investment required to increase feeder/circuit hosting capacity
- locations in the system where DG would be optimal, or less than optimal

Challenges in Operations include voltage regulation, protection coordination, and power quality impacts; the integration of power electronic inverter-based generation into the traditional synchronous machine-based network can introduce harmonics components and challenges to the stability of the transmission network.

Integration of Distributed Energy Resources

- Distribution feeder/circuit hosting capacity analysis
- DG integration system impact assessment

Over the past 10 years, Siemens PTI has performed system impact studies of over 9.10 GW of wind and solar PV generation in the U.S. alone.
Our solution
Siemens PTI is a global provider of independent technical consulting services for the power generation, transmission and distribution sectors. Our consultants have built a strong reputation as leaders in power system modeling, simulation, and analysis, and have a comprehensive understanding of new and emerging technologies, concepts and methodologies.

Siemens PTI’s core expertise in power system analyses provides planning insights that enable our clients to make technical and economic business decisions regarding the performance, operation, and expansion of their systems. We offer high-quality engineering solutions for the challenges faced by both utilities and renewable generation developers, independently or in collaboration with both parties.

When DER integration is considered, we offer the following power system studies:

- steady-state (voltage, capacity constraint, contingency), islanding screening, losses
- system reliability assessment
- short-circuit changes and the resulting impact on equipment and adjacent feeders/circuits
- power quality measurement, impact assessment and filter design (harmonics, flicker, sag, swell)
- protection coordination
- transient stability analysis

The following power system studies we perform can further complement your DER integration planning and analysis:

- distribution feeder/circuit hosting capacity assessment
- DG integration system impact assessment

Distribution feeder/circuit hosting capacity analysis

When feeder hosting capacity is evaluated, the first critical step is to create a comprehensive network model. Siemens PTI can export data from existing power simulation software (e.g., CYMEDIST, Synergi Electric, SKM Power*Tools, ETAP®, etc.) into our PSS®SINCAL Software, and improve the system model, including modeling of MV/LV transformers, and incorporating different levels of DG integration in one simulation.

Siemens PTI models can incorporate load and generation profiles (seconds, minutes, or hourly resolution). If advanced metering infrastructure (AMI) data is available, we can incorporate it into the distribution feeder load and generation profile models (e.g., 8760 hour profiles).

Figure 1: Detailed distribution model created in our Distribution PSS®SINCAL Software.
Time domain steady state studies are an important component in the distribution feeder/circuit analysis. These studies highlight areas of voltage and capacity concerns for a specific time and load/generation condition. Results are clearly visualized using GIS-based heat maps.

The results of analysis using detailed system models, and the examination of system performance under varying load and generation conditions provide insight into feeder capacity concerns, aiding in investment decisions regarding feeder upgrades.
DG integration system impact assessment
Determining the impact of DG assets connected to the grid requires a comprehensive evaluation. Siemens PTI can provide a thorough DG integration system impact assessment, including evaluation of steady state, short circuit, anti-islanding screening, flicker, and protection coordination.

Harmonics analysis may also be required when levels of DG increase. Since DG assets are connected to the power grid via electronic inverters, cables and transformers, the generating units will contribute harmonics to the grid. If the harmonic distortions at the point of interconnection (POI) exceed limits, improvement measures will be required. Siemens PTI offers services to help achieve the required limits, including power quality measurements and filter design.

Application example
Siemens PTI performed a harmonic study on behalf of a solar developer to determine the harmonic impact of a 20 MW solar PV plant. The developer had interconnected the solar PV project to the network of a California utility, and the utility wanted to know the harmonic impact of the project at the POI. The harmonic current sources were modeled for each of the inverters. The frequency dependent characteristics of the network components were represented in the system model. Harmonic current injection and the harmonic voltage distortion at the POI were evaluated for different dispatch scenarios of the solar PV. The estimated distortion values were compared with the respective permissible distortion limits as per the IEEE Standard 519-2014.

For more information
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