QUANTA TECHNOLOGY

Distribution & Asset Management

Distributed Energy Resources (DER) Interconnection

Our Services

Our Distribution team is comprised of industry experts with extensive utility experience. We have a strong customer focus to ensure that our clients' objectives are fully and effectively met. Our service offerings are flexible so that they can be tailored to meet specific client objectives.

Quanta Technology helped pioneer the development of what is commonly considered impact studies related to DER interconnection. Our experts worked with the early adopters in the utility industry who have been interconnecting thousands of PV and wind plants since 2009. We have participated on standards committees, led industry working groups and published many articles and papers on the subject. DER interconnection requires a thorough understanding and analysis of the steady-state and dynamic impacts as a result of introducing a distributed generator (DG) to the utility grid

The most common impacts associated with DG interconnection in distribution systems include:

Voltage increase: DG interconnection may change feeder voltage profiles, and lead to voltage increase and potential voltage violations, particularly at the DG point of interconnection

Voltage fluctuation: variable DG output (PV and wind) can change significantly due to clouding and wind speed variations, this can modify feeder power flows and voltage drops and eventually lead to voltage fluctuation that may affect quality of service and generate complaints from customers

Reverse power flow: when the amount of DG interconnected to a distribution feeder or substation exceeds the respective load, then power may change direction and flow from to the substation and sub-transmission/transmission system. This can represent a challenge for voltage regulation and control equipment and protection systems.

Voltage regulation: interaction with voltage regulation and control equipment such as Load Tap Changers (LTC), voltage-controlled capacitor banks, and line voltage regulators: voltage fluctuations caused by DG variability can lead to frequent operation of voltage regulation and control equipment, the incremental wear and tear associated to these additional operations may imply more frequent maintenance needs and costs for utilities, and eventually impact equipment life cycle.

DER is defined as renewable distributed generation, energy storage, electric vehicles, energy efficiency, and demand response technologies. Together, these technologies when combined with local loads and an independent control system can comprise a microgrid.

Reactive power fluctuation: DG interactions with voltage-controlled capacitor banks may lead to frequent switching on/off operations that can create sudden changes in reactive power flows. If such changes are systemic and affect numerous capacitor banks over a large distribution system footprint then they may end up impacting sub-transmission/transmission systems as well.

Power factor modification: the majority of DG plants operate at unity power factor to maximize the amount of active energy (MWh) delivered to the system, since this is the variable used for DG revenue calculation. Therefore, as DG penetration levels increase the active power delivered by the feeder and substation decreases, while the respective reactive power remains constant, this effectively decreases the feeder and substation power factor, which can lead to economic penalties for utilities and customers that are required to maintain system power factors above a predefined threshold.

Voltage and current imbalance: most residential utility customers have single-phase service (120/240 V), which means that proliferation of residential DG (particularly rooftop PV), which is also largely single-phase, can increase current and voltage imbalance beyond acceptable limits set by applicable standards.

Equipment loading increase: if the magnitude of the reverse power flow through a distribution asset cause by DG proliferation exceeds that of the original forward power flow before DG interconnection, then that asset's loading has increased because of DG integration. If the increase is large enough then it can lead to equipment rating violations and potential equipment life-cycle reduction, deterioration or damage.

Short-circuit duty increase: fault current contribution from DG units may increase short-circuit duties (total fault current expected at a specific distribution system location) beyond acceptable limits, which can lead to distribution equipment damage and reliability issues.

Losses increase: if the magnitude of the reverse power flow through a distribution asset (e.g., line, transformer) caused by DG proliferation exceeds that of the original forward power flow before DG interconnection, then power and energy losses associated to that asset will increase with respect to the base scenario, and impact overall distribution system efficiency.

Overcurrent and overvoltage protection: overcurrent and overvoltage protection equipment and practices are necessary to prevent or minimize potential damage to distribution and customer assets associated to distribution system faults. However, most of these practices have been designed for radial distribution feeders and may not be fully applicable to non-radial feeders with DG. Potential issues include temporary over voltages (TOV) caused by islanding (disconnection) of sections of the distribution system with large enough penetration of DG, sympathetic tripping, overcurrent protection miscoordination, reach modification, etc.

Power quality issues: voltage fluctuations caused by variable renewable DG, such as PV and wind, may be severe and frequent enough to create visible variations on lighting systems, which are known as flicker. Furthermore, high penetration levels of inverter-based DG, can increase Total Harmonic Distortion (THD), which measures the quality of the voltage supply. If flicker or THD exceed acceptable limits set by applicable standards, then they can either create visual discomfort on end-users or affect the operation of sensitive loads, respectively.

About Quanta Technology

Quanta Technology is an independent technology, consulting, and testing company providing business and technical expertise, along with advanced methodologies and processes, to utilities and others in the power and energy industries. Our mission is to provide unparalleled value to our clients in every engagement across the value chain by using advanced software and hardware, laboratories, and custom tools for a holistic approach to practical service and the most insightful thought leadership in the industry.

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Practical Results

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