Impacts of DERs on the Distribution System

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We are an electric delivery company

- 10,000-square-mile service area
- Approximately 1.4 million customers
- Tremendous increase in DER
Electric Power Industry is Transforming

**Distributed Energy Resources:** Economically competitive smaller, distributed power systems and storage are being installed in increasing numbers.

**Energy Efficiency:** Consumption of energy is being reshaped by technologies that drive efficiency and change demand patterns.

**Decarbonization:** Low-carbon technologies such as wind and solar are exceeding growth expectations.

**Digitization:** Asset, facility and fleet level, internet-enabled applications are proliferating.
Distributed power technologies have created the need for two-way power flows.

New technologies such as batteries are providing opportunities throughout the transmission and distribution network.

It is imperative that PPL begins testing the management of DER systems.
Growth of Customer DER

Solar PV Interconnections

- Solar PV Capacity (kW)
- Solar PV Systems


- Solar PV Systems:
  - 2013: 290 kW
  - 2014: 240 kW
  - 2015: 239 kW
  - 2016: 1518 kW
  - 2017: 17,340 kW
  - 2018: 26,491 kW

- Solar PV Capacity (kW):
  - 2013: 4,301 kW
  - 2014: 3,506 kW
  - 2015: 7,830 kW
  - 2016: 16,161 kW
  - 2017: 1301 kW
  - 2018: 200 kW
Changes Require Investments

Challenges

• Masked (Hidden) Load
  • Fault Location
  • Load Transfers
• Traditional Protection Methods
  • 69kv Substation Blown Fuse Detection
  • Inverter Fault Currents
• Cyber Security
  • Connected Systems
  • Aggregated Systems

Solutions

• Advanced Metering Infrastructure
  • Inverter Communication
• DERMS
• Microprocessor Relays
• 69kV Reclosers and Breakers
• DER Forecasting Tools

Opportunities

• Non-Wire Alternatives
• More discretely controllable Grid
  • Voltage
  • VARs
• Market Enablement
Keystone Solar Future Project

An innovative pilot that will allow PPL system operators to have remote monitoring and management capabilities of the DER systems:

- **Interconnection Web Portal**: Renewable Energy Connection

- **DERMS**: Central platform with Distributed Energy Resource-aware algorithms for management and optimization.

- **Proof of Scalability**: Customer enrollment, DERMS pilot, technology demonstration, Drexel simulation.