Implementation of a Power Line Carrier solution to support anti-islanding protection and reduce interconnection costs for Distributed Generation

Jorge Valenzuela
Cleveland, Oct 2017
NG Solar Phase II – Up to 20 MW of Company-owned solar,

- Company or third party-owned property (NG owns solar)
- Size of the solar site between 60 kW and 1,000 kW (except for National Grid owned facilities)
- Introduce the concept of deployment for system improvement
- Includes R&D activities
- Estimated Capital Cost U$85M (mid-point) - $4.2 / W

**Benefits**

<table>
<thead>
<tr>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity relief</td>
</tr>
<tr>
<td>Improvement of operational conditions</td>
</tr>
<tr>
<td>Advanced functionality analysis under special conditions</td>
</tr>
</tbody>
</table>
Direct Transfer Trip scheme:
• Used for DG sites where risk of islanding is present (large)
• Minimizes safety concerns for workers and equipment
• Designed to trip PCC recloser on loss of utility

Existing National Grid scheme:
• 1 to 1 solution – Dedicated equipment at the station and individual receiver at customer site
• Based on a leased communication line through local provider

Characteristics of operation:
• Guarantees high speed trip of DG in event of substation feeder breaker open
• Uses guard signal – Activates trip signal on loss of communication or opening of feeder breaker at the station
Anti Islanding Protection

Medium Voltage Distribution Line

Distribution Substation

Individual transmitter

Individual communication line

Solar Facility

Recloser

Recloser

Recloser

TRIP!
Challenges with existing DTT

For the utility:

- Requires substation modifications per each individual customer (time consuming and costly)
- Reliance on communication provider for activation and maintenance (protection scheme dependent on a separate company)
- Feeder modifications require coordination with communication company

For the customer:

- Recurring leased line costs
- Troubleshooting requires contacting a third party (communication provider)
- Long wait times for interconnection
GridEdge DG-TTP - Characteristics

- Single Transmitter
- Receiver
- Medium Voltage Distribution Line
- Recloser
- Recloser
- Recloser

The GridEdge protection signal rides on top of existing wire

- No need for a separate communications network
- Reduced capital and operational costs
- Accelerates deployment time
GridEdge DG-TTP - Characteristics

Characteristics:

- Uses primary conductors as a communication medium to support Transfer Trip Protection
- Operates with signals in the 50KHz to 500KHz range, minimizing interference at 60Hz
- 1 to many – Multiple customers can be “integrated” without station changes (requires installation of individual receiver)
- Provides high speed and safe guard characteristics

Architecture
GridEdge DG-TTP - Characteristics

**Substation**
- Transmit Modem
  - Sends protective Guard Signal

**Line Recloser Closed**
- Coupler
- **Coupler**
  - Receiver Modem
  - Receives Guard signal
  - DG Site
  - **CLOSE**

**Line Recloser Open**
- Coupler
- **Coupler**
  - Receiver Modem
  - No signal is received
  - DG Site
  - **TRIP**

Sends a PLCP guard signal from the TX in the substation to the RX at the DG interconnection point. Loss of guard signal at the RX indicates an islanding condition and causes tripping of the DG site.
GridEdge DG-TTP - Pilot

Testing of Solution through National Grid’s managed Solar Phase II sites for a period of 2 years

1 Station, 2 OH 13.8kV feeder, 3 solar sites (1 MW each)
Substation work

Installation of 2 Transmitters (station) – Transmitters needed to be installed downstream regulators (acting as low pass filters)

One transmitter per feeder with breaker status integrated. If breaker is open, the transmitter stop pumping the signal to the circuit
D-Line work

Installation of 7 Regenerators (distribution line) and 2 receivers

Required:
• Suitable locations for installation of regenerators
• Issuing standard drawings
• Training of OH crews on non-standard equipment
GridEdge DG-TTP - Pilot

- D-Line work

Install RG units to extend signal reach for longer distances

Couplers
GridEdge DG-TTP - Benefits

### Single installation
- Shared infrastructure

+ $80k labor

Cost estimate per additional customer < $20k (with labor)

Single installation
- Shared infrastructure
  + $80k labor

Break-even point
- Including O&M

$1.5M in savings over 20 year life cycle of typical PPA
Internal Challenges:
- Buy-in from the departments involved (negotiation)
- Non-Standard equipment installation (drawings, training, etc.)
- Design iteration looking for the optimal solution for everybody
- Setting up the priority
- Resource allocation (O&M and D-Line crews)

External Challenges:
- Quasi development product (lack of proper documentation for design)
- Lead time for design modifications (ground kits, etc.)

Opportunities:
- Further development (active power curtailment, etc.)
- Additional services through PLC in distribution systems
For the utility:

- Control of the communication portion of the protection scheme (self reliance)
- Reduction on station work and space required for Transfer Trip protection of multiple DG customers
- Aligned with National Grid’s commitment to remove or reduce barriers for integration of Distributed Energy resources

For the customer:

- Elimination of the monthly leased cost (the total cost of installation can be recovered in 3-4 years)
- Reduction of overall interconnection costs (requires the installation of an additional receiver if the feeder is DG-TTP “ready”)
- Reduction on interconnection time (no wait time for leased line activation)
- Troubleshooting simplified (solution through just 1 party)
Thank you,

Questions?

jorge.valenzuela@nationalgrid.com