Big Data: Using Smart Grid to Improve Operations and Reliability

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Power Delivery Grid Automation Manager – FPL
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NextEra Energy is a premier U.S. power company comprised of three strong businesses

- U.S. leader in renewable generation
- Assets primarily in 24 states and Canada
- 18,303 MW in operation

- One of the largest U.S. electric utilities
- 4.7 MM customer accounts
- 24,273 MW in operation
- $36 B in operating revenues

- $39.6 B market capitalization
- 42,576 MW in operation
- $69 B in total assets

(1) Market capitalization as of February 25, 2013; source: FactSet
Note: All other data as of December 31, 2013
FPL Facts*

- 4.7 million customer accounts
- 589 substations
- 6,700 miles of transmission lines
- 67,600 miles of distribution lines
- 1.1 million distribution poles
- 878,900 transformers
- 90 percent of our customers live within 20 miles of the coast
- 35 counties covering 27,000 square miles

FPL’s service territory covers more than half of Florida

* As of December 31, 2013
FPL announced its Energy Smart Florida (ESF) program in April 2009 and was one of the six utilities nationwide to receive a $200 million grant from the U.S. Department of Energy.

Energy Smart Florida

- 4.6 million residential and business smart meters
- More than 11,500 intelligent devices
- Digital technology at 600 power substations
- Cutting-edge enhancements to performance-monitoring centers
- Provide customers with more information than ever before to better manage energy usage and monthly bills
- Help FPL continue to deliver strong service reliability over the long term – reducing outages, improving restoration and enhancing customer service
- Help FPL achieve operational efficiencies that will keep customers’ bill among the lowest in Florida

In March 2013, FPL completed its $800 ESF program – nine months ahead of schedule.
Smart grid investments will improve the grid from the power plant to the customer’s meter

End-to-End Improvements

Smart grid technologies will benefit all customers and lay the foundation for future service improvements
Current and future deployment of Smart Grid devices is producing mountains of data, enabling benefits through analytics that were never before possible.

**Data Analytics**

**Improving FPL’s value proposition through analytics**

- **Increased customer satisfaction**
  - Improve through touch point management
  - Field insight to customer experience
  - Complaints

- **Better capital spend**
  - Size equipment based on better load profiles
  - Optimize asset life cycle
  - Capital

- **Improved efficiency**
  - Match work with workers more efficiently
  - Reduce maintenance visits
  - O&M

- **Improved reliability**
  - Predict and prevent equipment failure
  - Better manage operating parameters
  - SAIDI/SAIFI/MAIFI

- **Improve cost position**
  - Improve economic dispatch based on grid conditions
  - Condition-based maintenance
  - O&M

**Incremental and step change opportunities exist in all business elements**
Operations and Reliability Improvements

- Distribution Smart Islanding
- Transformer Replacements
- Restoration Spatial View
IEEE 1547.2 Recommendations for Unintentional Islanding

- Detect and cease to energize islanded system within 2 seconds
- Protect equipment, employees, and customers
- Meet power quality specifications under all operating conditions
- DG Trips Three Cycles Prior to Reclose
Typical System Interconnection
Proposed Solution Detects Islanding for All Power Exchange Conditions

- Marries Conventional elements (27, 59, 81O, 81U) with:
  
  **Local-area measurement-based (IDS_LA)**
  - Requires no data communication
  - Detects islanding only when power exchange is significant

  **Wide-area measurement-based (IDS_WA)**
  - Synchrophasors from DG and remote source
  - Calculates slip frequency and acceleration between two systems, asserts trip if operating point is in islanding region
  - Trips if angle difference exceeds 20 degrees
Smart Islanding Highlights

- **Enablers**
  - Phasor Measurement and Control Units at Remote Source and DG end
  - Communications channel
  - Support: Scada indication and remote operation

- Improves personnel safety & power quality, avoids out-of-phase reclosing
- Local-area schemes require significant power exchange to detect islanding
- Wide-area schemes detect islanding for all power exchange conditions
- Use adaptive load shedding for efficient islanding

Smart Islanding Team: John Mulhausen and Joe Schaefer (Florida Power & Light Co.)
Mangapathirao Mynam, Armando Guzman, Marcos Donolo (Schweitzer Engineering Laboratories, Inc.)
Operations and Reliability Improvements

• Distribution Synchrophasors for Smart Islanding
• Transformer Replacements
• Restoration Spatial View
Transformer Project Background

- In 2012, FPL began a pilot program based on smart meter data to identify and proactively address or replace transformers.
- Target – transformers with minor coil damage, but still energized.
- Objectives – make operational improvements to:
  - Shorten outage times
  - Reduce restoration costs
  - Improve the customer experience
  - Reduce customer claims

In 2013, the company integrated the proactive transformer replacement program into its distribution operations.
FPL is analyzing the history of each high-voltage transformer to identify the root cause.

High-voltage Transformer Example

Event Summary: 2114607 | View All

<table>
<thead>
<tr>
<th>Time</th>
<th>Event Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/7/13 4:14:37</td>
<td>Power Restored</td>
</tr>
<tr>
<td>2/17/13 22:05:40</td>
<td>Power Restored</td>
</tr>
<tr>
<td>2/17/13 22:02:55</td>
<td>Power Down</td>
</tr>
<tr>
<td>2/17/13 2:03:42</td>
<td>Power Restored</td>
</tr>
<tr>
<td>2/17/13 2:03:38</td>
<td>Power Down</td>
</tr>
<tr>
<td>2/14/13 22:13:28</td>
<td>Power Restored</td>
</tr>
<tr>
<td>2/14/13 22:13:24</td>
<td>Power Down</td>
</tr>
</tbody>
</table>

Smart meter voltage data can proactively identify transformers that need to be replaced.
Using voltage information, FPL can proactively identify and replace transformers before they cause an outage

High-voltage Transformer Replacement Program

- 372 high-voltage transformers identified in November of 2012
- 46 high-voltage transformers currently in the system
- 452 replaced since January
- Targeting replacement of units with voltage above 252
- Majority of the units identified are more than 15 years old

Damage to primary winding of high-voltage transformer identified through smart meters

Scheduled replacements reduce outage times by more than 93 minutes
Smart meters help FPL reduce replacement costs and improve the customer experience

Benefits of Proactive High-voltage Transformer Replacement

- Average outage time is 93 minutes shorter than an unplanned transformer replacement
- Costs are 25% lower than unplanned replacements
- Can improve customer perceptions
- Reduces potential for customer claims

Smart meter data has driven results to date, but continued efforts in big analytics will redefine the way FPL does business
Operations and Reliability Improvements

- Distribution Synchrophasors for Smart Islanding
- Transformer Replacements
- Restoration Spatial View
RSV 2.0 – State of the art mobile application placing the smart grid in the hands of our crews

Restoration Spatial View Overview

- Customer Information
- Trouble Tickets
- Truck Locations
  - FPL, Vegetation and External Crews during Storm (pilot)
- Weather
  - Radar
  - Real-time lightning within 100-mile radius
  - Weather Station
  - Storm information (Tracks/Development Areas)
  - Customized weather alerts based on location
- Street View & Driving Directions
- Restoration Confirmation
- Fault Location (DMS/SynerGEE)
- Device detail, including drawings
- Real-time AMI outage activity
- Fully customizable by user

The goal is to have a single application giving our crews everything they need to restore power safely and efficiently
Mobile empowerment starts with a solid mobile infrastructure that delivers information quickly & securely

Mobile Toolkit

802.11 Wireless Hotspot

In all 850 Trucks

Vehicle Area Network (VAN) Project
760 Trucks in Production

<table>
<thead>
<tr>
<th>Technology/Change</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moved GPS from SaaS to FPL</td>
<td>$800K Annual O&amp;M</td>
</tr>
<tr>
<td>Consolidated cellular plans</td>
<td>$100K Annual O&amp;M</td>
</tr>
<tr>
<td>Collecting more truck telemetry</td>
<td>Usage based to time based maint.</td>
</tr>
<tr>
<td>Verizon 3G to 4G (LTE)</td>
<td>10x increase in speed</td>
</tr>
<tr>
<td>Add wireless 802.11 hotspot</td>
<td>Add connections @ no additional $</td>
</tr>
<tr>
<td>Piloting new wireless tablets</td>
<td>Lower TCOO, more frequent upgrades</td>
</tr>
</tbody>
</table>

Improving speed & reliability & enabling future technology growth all while improving our cost position
Mobile applications combined with AMI data: empowering employees, improving service

Digital Troubleshooting

GPS Finds Nearby Meters

Ping Meter & Retrieve Voltage

Usage & Voltage History

Meter Event History

Users can view customer information from Smart Meters
Within RSV Users can view the trouble ticket details for further information regarding the outage.

Trouble Ticket Information in Real-Time

Use **Repeat Tickets** to display the number of times a device has been out.

Repeat Tickets can be used to better understand our customers’ experience.
RSV provides custom weather information

**Weather Information**

Customer weather based on specific user location provides accurate situation awareness during restoration activity.
RSV allows users to search for a trouble ticket, obtain information about it, and direct service to the location.

View ticket summary and route to location

User can view…
• Ticket type
• Number of customers out
• Color coded ITR/ETR
• Repeat device
• Route to location
• Weather updates

Important details like the ticket type, AMI information, and ITR/ETR can be helpful in restoring our customers’ power quickly.
Restoration Confirmation can be a great tool to ensure there are no embedded outages prior to leaving a site.
RSs use technology to confirm all customers are restored to prevent repeat calls and added truck rolls.

**Reduced Repeat Ticket Call Backs**

**Restoration Confirmation**

<table>
<thead>
<tr>
<th></th>
<th>With AMI</th>
</tr>
</thead>
<tbody>
<tr>
<td># Total Tickets</td>
<td></td>
</tr>
<tr>
<td>(Lat &amp; Tx)</td>
<td>2010: 37,143</td>
</tr>
<tr>
<td></td>
<td>Change: 12%</td>
</tr>
<tr>
<td># Repeat Tickets</td>
<td></td>
</tr>
<tr>
<td>(Lat &amp; Tx)</td>
<td>2010: 1,053</td>
</tr>
<tr>
<td></td>
<td>Change: -31%</td>
</tr>
<tr>
<td># Repeat Calls</td>
<td></td>
</tr>
<tr>
<td>(Lat &amp; Tx)</td>
<td>2010: 9,373</td>
</tr>
<tr>
<td></td>
<td>Change: -51%</td>
</tr>
</tbody>
</table>

“During Tropical Storm Isaac, the restoration confirmation tool performed flawlessly.”

– Richard Britt, Sr Line Specialist, Distribution Operations North Dade

Use of Restoration Confirmation improves customer satisfaction and increases operational efficiency.
RSV uses the latest technology to further enable web applications.

Fault Location

Integrating fault information directly into application makes identifying and isolating issues easier.
RSV is using the latest technology to further enable web applications.

We currently developing the deployment plan for pictures in RSV while understanding the various use-cases.
RSV – Also works on the iPhone
Smart Grid is to Distribution as SCADA was to Transmission 40 years ago

The Paradigm Change

Power Generation  Transmission & Substation  Distribution  Customer Service

Telemetry Yesterday:

1: Distribution Automation
2: AMI Meters

Telemetry Today/Tomorrow:

Active involvement by subject matter experts coupled with enabling technology sets the stage for data analytics that can change all aspects of our business