IBEW 1245 THE POWER IS IN OUR HANDS

high performance executive counsel

TECHNOLOGY AND THE NEXT GENERATION NETWORK

MARCH 9, 2016

Flow of Conversation

- Industry Landscape – changes and implications
- Leveraging Technology – some examples
- Path forward

Utility

Developer

Customer

Power Flow Control
- DFACTS
- Volt/VAr optimization
- Dynamic line rating

Enhanced Automation
- Self-healing switching and controls

New Capacity
- Order 1000

Distributed Resources
- Wind
- CHP – new and conventional
- Fuel cells
- Solar

Distributed Storage
- Battery
- Grid enabled water heaters and chillers
- EV and PHEV

Intelligent Loads
- Variable speed drives
- Smart appliances, homes, buildings
- Smart Cities

Energy Efficient Devices
- Appliances, lighting

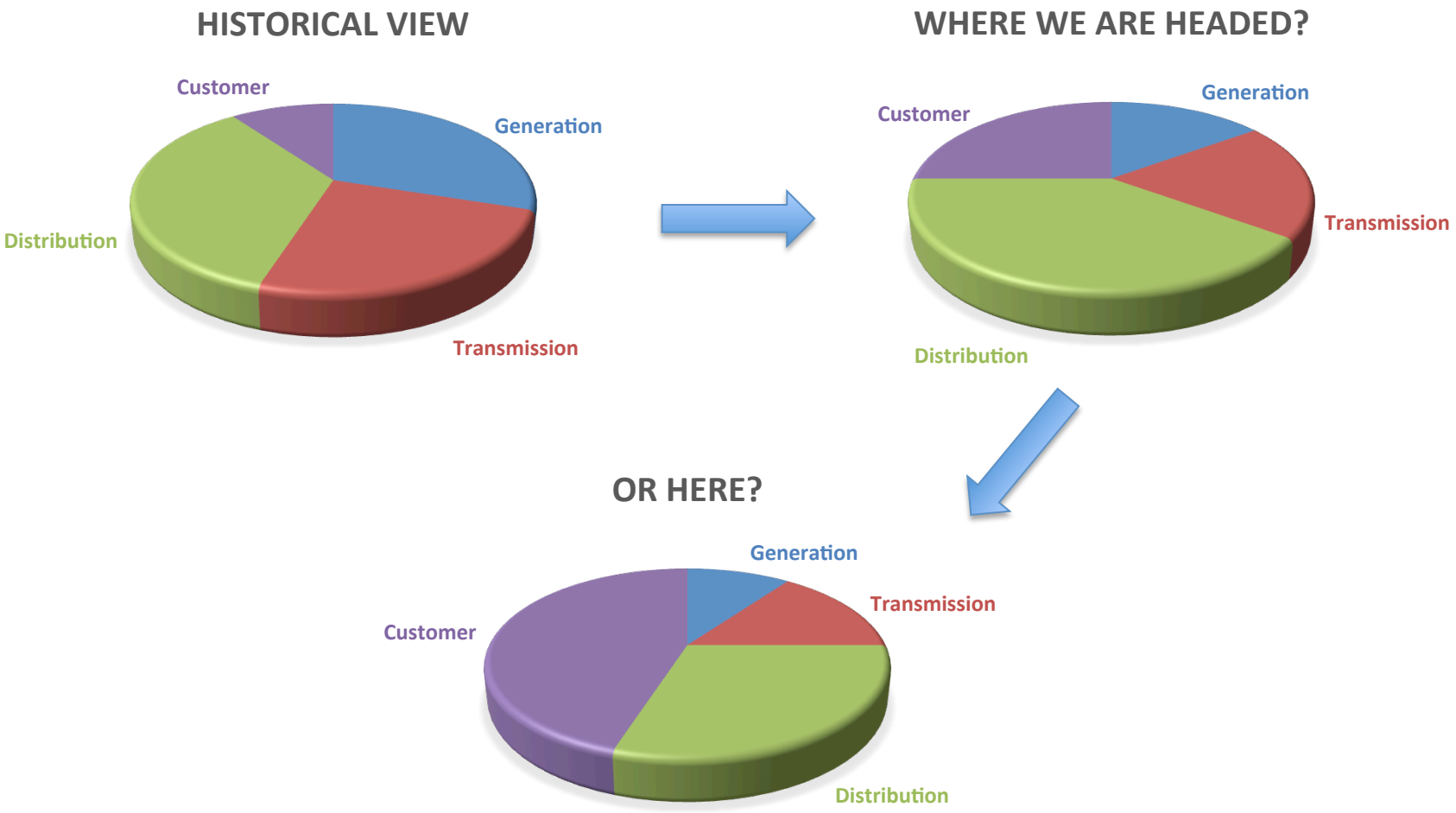
Micro Grids

Technologies, Policies and Regulation are Evolving Rapidly

- On both sides of the meter
- Adding complexity to the system
- Increasing the business and operational risks for utilities
- Increasing reputational risk for regulators
- Each technology can support a range of business models
- **Developer Deployments are focussed on capturing a share of the existing revenue stream**

Another way to look at this is the shift in investment

- There is a strong push for decentralization – even to the point of elimination of G & T



Loss of customers/ sales threatens the business model

Reduced throughput

Reduced revenues

Infrastructure costs fixed or escalating

Costs per unit delivered rise rapidly accelerating the predation

The infrastructure risks becoming a liability

Erosion of earnings is inevitable

Continuation of the Social Inequity – affluent benefit at the cost of the rest

- Commercial, Industrial and Residential
- customers are being drawn toward the
- "Technology Promise"
  - "Lower Costs"
  - "Higher Reliability"
  - "Greener", more "Socially Responsible"
  - "Anti Big Power"
  - "Off Grid"

- Shrinking the value of the infrastructure and undermining the value of the business

What do we do about it? Leverage your Skills, leverage Technology and take the lead. Focus on ways that you and the grid will be:

- More Efficient
- More Cost Effective
- More Intelligent
- More Reliable
- More Secure
- Safer

Win this race.

Efficient – Use of Drones?

- The application and use of drones continues to grow. Unmanned beyond line of sight is already happening. What else will we do and how do we leverage them?

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Feb. 3, 2016

Xcel Energy raises bar with unmanned aircraft surveys

Texas drone flight to be first beyond operator's line of sight for utility survey

AMARILLO, Texas – **Xcel Energy**, a leader in the use of unmanned aircraft systems to inspect energy infrastructure, will be the first utility in the nation to fly a research and development mission that is beyond the operator's line of sight when it surveys a transmission line near Amarillo, Texas, today.

Xcel Energy inspects more than 320,000 miles of electricity and natural gas infrastructure to ensure the safety and reliability of its energy system, and helicopters have been the primary means of accessing lines in rugged terrain. In 2015, Xcel Energy began a program of visually inspecting substations in Texas with unmanned aircraft, commonly known as drones, which are operated within the line of sight of the operator. Today, **the company is using contractors, Environmental Consultants Inc. & FLōT Systems**, to fly an unmanned inspection using a system that allows the aircraft to fly beyond the line of sight of the operator, a first for U.S. electric utility companies.

Xcel Energy has more than 7,000 miles of high-voltage transmission lines in its Texas-New Mexico service area alone. This first beyond-line-of-sight unmanned aircraft mission will be flown in an area known as the Canadian River Breaks north of Amarillo in the Texas Panhandle.

"Xcel Energy is committed to embracing new technologies that allow us to work safer, more efficiently and at lower costs than before, and the unmanned aircraft systems are a great example of boosting our productivity through technology," said Teresa Mogensen, Xcel Energy's senior vice president for transmission. "Employees will also use drones to observe environmentally sensitive areas without the use of trucks, helicopters or other utility equipment, minimizing the environmental impact," she added.

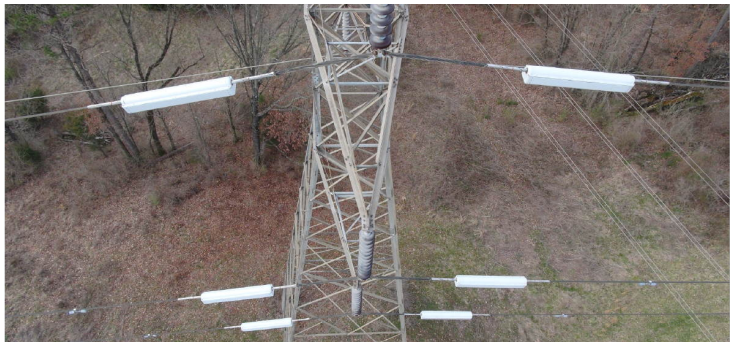
Xcel Energy (NYSE: XEL) is a major U.S. electricity and natural gas company with regulated operations in eight Western and Midwestern states. Xcel Energy provides a comprehensive portfolio of energy-related products and services to 3.5 million electricity customers and 2 million natural gas customers through its regulated operating companies. Company headquarters are located in Minneapolis. More information is available at www.xcelenergy.com.

# # #

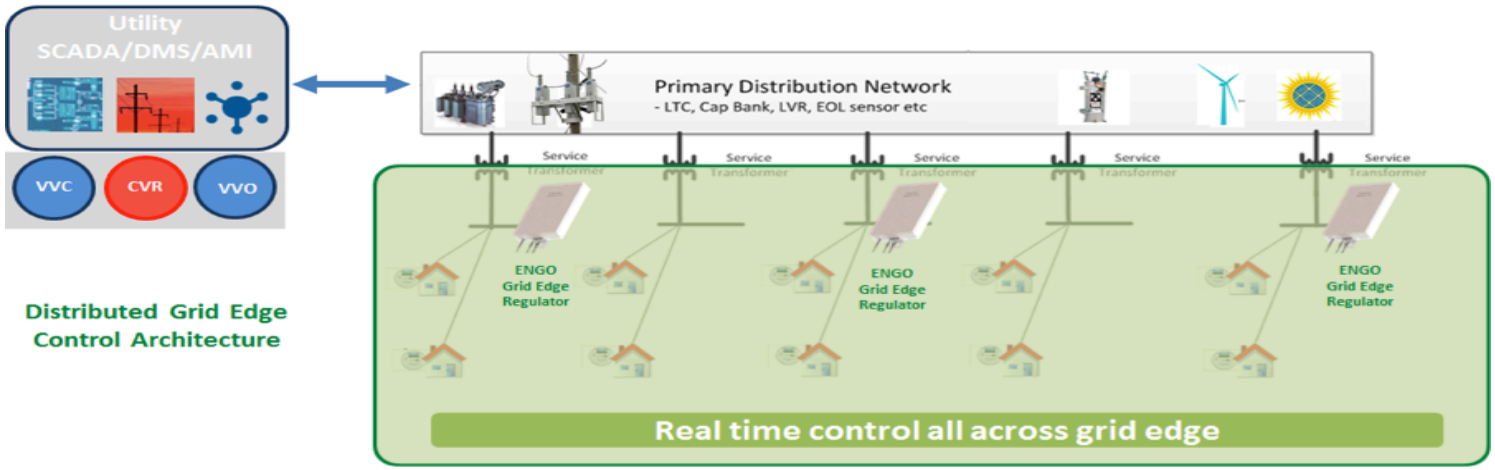
Cost Effective – Power Flow Control

- Transmission – Smart Wires enables dynamic control of power flow, line by line. Better utilization of existing transmission assets





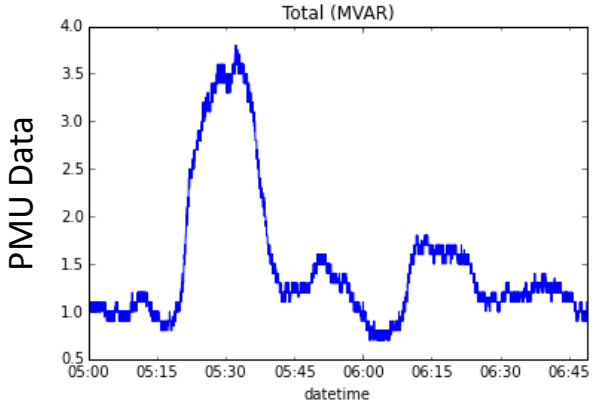
- Distribution – Volt/VAr systems like Varentec reduce losses and improve reliability/utilization on the distribution system

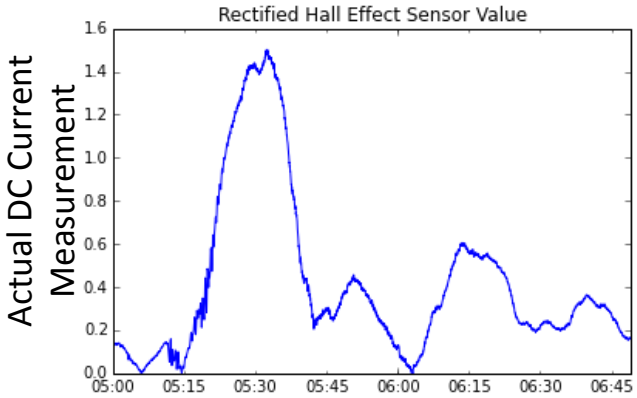


Distributed Grid Edge Control Architecture

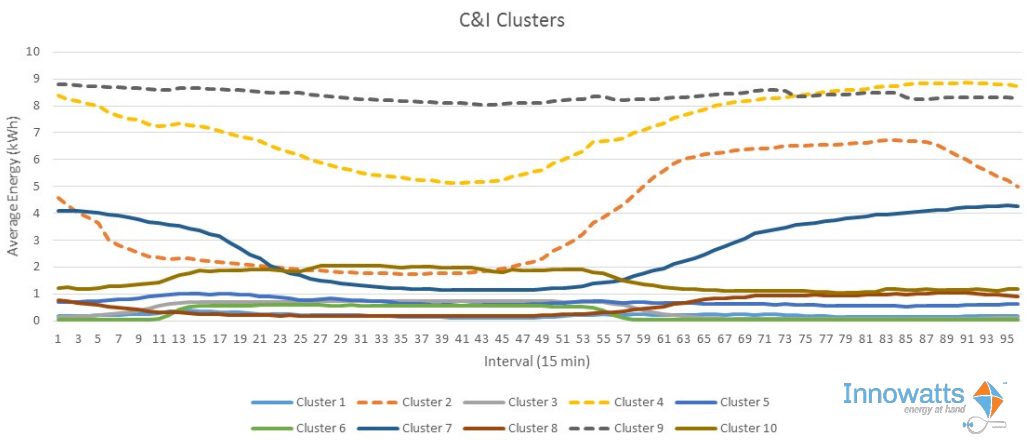
More Intelligent – IoT and Analytics

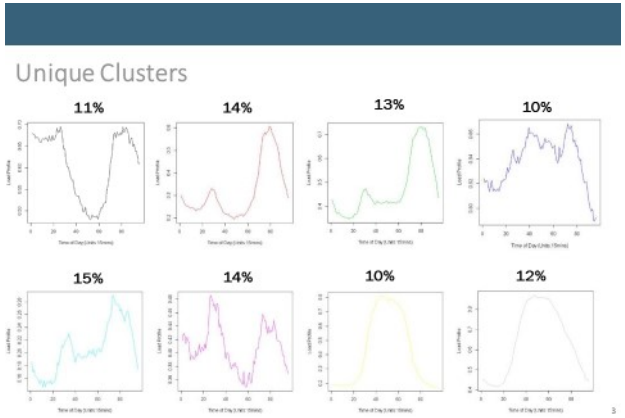
- Transmission – Synchrophasor Data provides enhanced visibility and decision making. Geomagnetic Induced Current example:





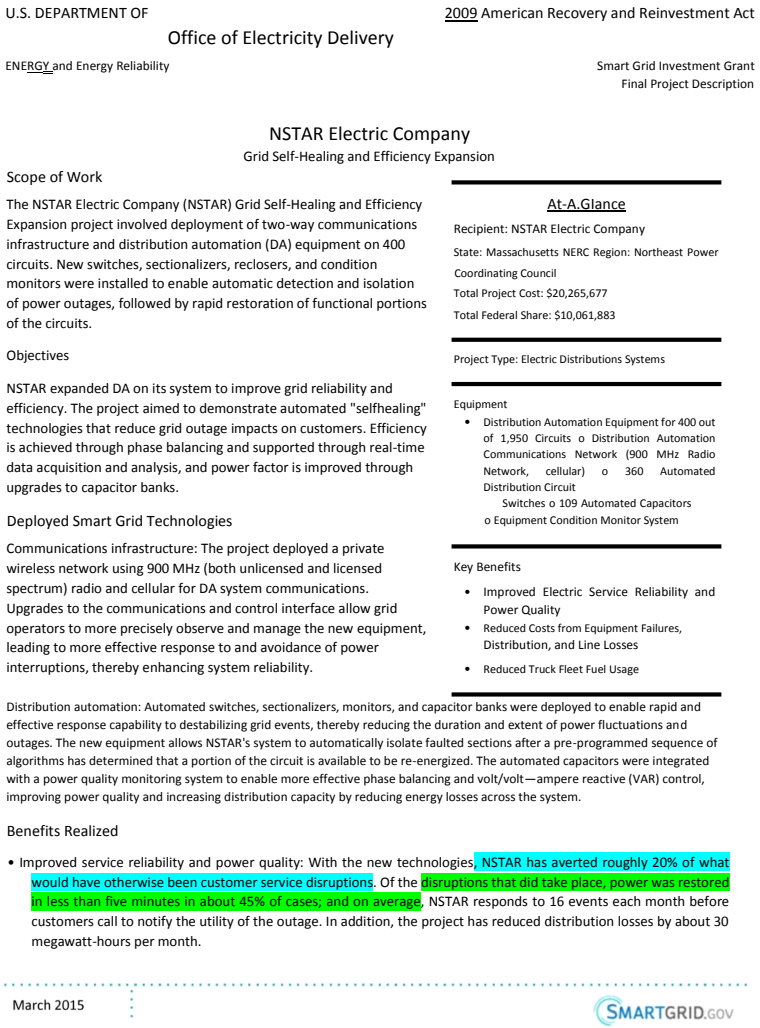
- What else could we see in PMU data?
- Distribution – Meter Data Analytics can reveal a lot about customers, their needs and how we can bring value to them and support the system at the same time.





More Reliable

- Utilities are already highly reliable – and we can enhance that further. In addition to technologies discussed earlier many utilities have moved toward automation and self healing systems.



U.S. DEPARTMENT OF ENERGY and Energy Reliability

Office of Electricity Delivery

2009 American Recovery and Reinvestment Act

Smart Grid Investment Grant
Final Project Description

NSTAR Electric Company

Grid Self-Healing and Efficiency Expansion

Scope of Work

The NSTAR Electric Company (NSTAR) Grid Self-Healing and Efficiency Expansion project involved deployment of two-way communications infrastructure and distribution automation (DA) equipment on 400 circuits. New switches, sectionalizers, reclosers, and condition monitors were installed to enable automatic detection and isolation of power outages, followed by rapid restoration of functional portions of the circuits.

Objectives

NSTAR expanded DA on its system to improve grid reliability and efficiency. The project aimed to demonstrate automated "selfhealing" technologies that reduce grid outage impacts on customers. Efficiency is achieved through phase balancing and supported through real-time data acquisition and analysis, and power factor is improved through upgrades to capacitor banks.

Deployed Smart Grid Technologies

Communications infrastructure: The project deployed a private wireless network using 900 MHz (both unlicensed and licensed spectrum) radio and cellular for DA system communications. Upgrades to the communications and control interface allow grid operators to more precisely observe and manage the new equipment, leading to more effective response to and avoidance of power interruptions, thereby enhancing system reliability.

At-A.Glance

Recipient: NSTAR Electric Company

State: Massachusetts NERC Region: Northeast Power Coordinating Council

Total Project Cost: $20,265,677

Total Federal Share: $10,061,883

Project Type: Electric Distributions Systems

Equipment

- Distribution Automation Equipment for 400 out of 1,950 Circuits o Distribution Automation Communications Network (900 MHz Radio Network, cellular) o 360 Automated Distribution Circuit Switches o 109 Automated Capacitors o Equipment Condition Monitor System

Key Benefits

- Improved Electric Service Reliability and Power Quality
- Reduced Costs from Equipment Failures, Distribution, and Line Losses
- Reduced Truck Fleet Fuel Usage

Distribution automation: Automated switches, sectionalizers, monitors, and capacitor banks were deployed to enable rapid and effective response capability to destabilizing grid events, thereby reducing the duration and extent of power fluctuations and outages. The new equipment allows NSTAR's system to automatically isolate faulted sections after a pre-programmed sequence of algorithms has determined that a portion of the circuit is available to be re-energized. The automated capacitors were integrated with a power quality monitoring system to enable more effective phase balancing and volt/volt—ampere reactive (VAR) control, improving power quality and increasing distribution capacity by reducing energy losses across the system.

Benefits Realized

- Improved service reliability and power quality: With the new technologies, NSTAR has averted roughly 20% of what would have otherwise been customer service disruptions. Of the disruptions that did take place, power was restored in less than five minutes in about 45% of cases; and on average, NSTAR responds to 16 events each month before customers call to notify the utility of the outage. In addition, the project has reduced distribution losses by about 30 megawatt-hours per month.

March 2015

SMARTGRID.GOV

More Secure and Safer

- Secure - Utilities are subject to:
  - FERC/NERC rules relating to Critical Infrastructure Protection (CIP)
    - Physical security
    - Cyber security
    - Confidentiality and use of data
  - Regulations that protect customer information
  - When will these requirements apply to third party providers of DER?

- Safer
  - How do we address the matter of DER and customer ability to operate and maintain the systems?

Path Forward – Policy and Technology will continue to evolve rapidly

- Embrace Technology and make it work for you
- Engage in Policy, find the common ground
- See the bigger picture and do what makes sense for the customers