The Distribution System of the Future...Today
An Intelligent Utility Reality Webcast

March 31, 2011

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The Distribution System of the Future...Today

Heather Cummins, PE
Director of Asset Management & Process Improvement
Avista Utilities

Becky Harrison
Director, Smart Grid Technology and Outreach
Progress Energy

Peter Kobzar
Senior Manager, Distribution Operations
BC Hydro

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![Cisco Logo]
The Distribution System of the Future...Today

Christopher Perdue
Vice President
Sierra Energy Group
Agenda

Introduction
• About Intelligent Utility

The discussion
• Heather Cummins, PE, Director of Asset Management & Process Improvement
  Avista Utilities
• Becky Harrison, Director, Smart Grid Technology and Outreach
  Progress Energy
• Peter Kobzar, Senior Manager, Distribution Operations
  BC Hydro

Q&A
• Audience questions welcome

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What Functional Areas Are Touched by Your Utility's Project Scope for Smart Grid?

- Load control & monitoring: 81.6%
- AMI: 80.6%
- Distribution automation: 76.0%

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Distribution System Challenges

• Integration of renewable generation resources
• Support of plug-in electric vehicle deployments
• Reduction of carbon emissions
• Integration of distributed energy resources
The Distribution System of the Future...Today

Heather Cummins, PE
Director of Asset Management & Process Improvement
Avista Utilities

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Avista’s Smart Grid Projects

The Distribution System of the Future… Today!

March 31st, 2011

Heather Cummins, PE
Director

Photo courtesy of Bill Owens, City of Pullman
Energy for a Smart Future
Transformation

2008

Distribution Reliability
- Distribution Automation
- O&M Driven Asset Replacement
- Pro-active Pole Management

Energy Efficiency
- Conductor "Right Sizing"
- Transformer Replacement
- Feeder Balancing
- Capacitor Placement
- Monitoring

Communications and Integration

American Recovery and Reinvestment Act – Smart Grid Grant Opportunity

July 2009

Smart Circuit

Distribution Reliability
- Distribution Automation
  - Conservation Voltage Reduction
  - Integrated Volt-Var Compensation
  - Optimal Load Transfer
  - Automated Fault Detection and Isolation
  - Adaptive Fuse Schemes

Energy Efficiency
- Conductor Replacement
- Feeder Balancing
- Monitoring

Communications and Integration
Avista Smart Grid Grants

Smart Grid Investment Grant

- Automated switching devices
- Larger wire
- Energy saving electronic devices

Smart Grid Demonstration Project

Smart Grid Workforce Training Grant
Spokane “Smart Circuit” Overview
Funding Overview

$3.4 Billion awarded in the following categories

- Advanced Metering Infrastructure
- Customer Systems
- Distribution
- Transmission
- Equipment Manufacturing
- Integrated Systems

Project Scope

- 59 Circuits
- 14 Substations
- 110,000 electric customers
Goals of the Spokane Project

• Enhanced Reliability

• Increased Energy Efficiency

• Integration of Distributed Energy Resources

• Extend Life of Assets
Enhanced Reliability - Outage Restoration Example
Increased Energy Efficiency

- Smaller Conductors
  - Larger Conductors

- Fixed Voltage Regulation
  - Dynamic Voltage Regulation

- Fixed Reactive Power Compensation
  - Dynamic Reactive Power Compensation
Distributed Resources & Asset Life

- System capable of handling a wide range of customer, and utility owned resources.

- System capable of handling a wide range of customer loads and system constraints.
Asset Life – Electric Vehicle Impact

Charging @ 6 pm
(240V, 12A)
Penetration 10%

Charging @ 9 pm
(240V, 12A)
Penetration 10%

July 27th 2007 24 hr: Total Loading for the Feeder Under Study

Hours

Total Loading at Substation (KW)

off-peak load
Charging

- **Level 1 Charging**
  - 120 Volt, 14-16 Amps
  - 1.5-2.0 kW

- **Level 2 Charging**
  - 240 Volt, 32-80 Amps
  - 7.5-19.2 kW
Charging Requirements

25 KVA

- **Level 1** – 16 Amps: 7%
- **Level 2** – 30 Amps: 25%
- **Level 2** – 80 Amps: 67%
Benefits for Spokane Smart Circuit

Savings (MegaWattHour)

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Savings (MegaWattHour)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacitors</td>
<td>2,827</td>
</tr>
<tr>
<td>Voltage Optimization</td>
<td>4,385</td>
</tr>
<tr>
<td>Reconductor</td>
<td>34,839</td>
</tr>
</tbody>
</table>

Carbon Reduction: 14,360 Tons a year.
- $50/Ton to Sequester
- $718,000/year.
Smart Grid Demonstration Project
ARRA Smart Grid Demonstrations

Smart Grid Demonstration Project Locations

16 Awards Support Projects in 21 States
Pacific Northwest Demonstration Project

**What:**
- $178M, ARRA-funded, 5-year demonstration
- 60,000 metered customers in 5 states

**Why:**
- Quantify costs and benefits
- Develop communications protocol
- Develop standards
- Facilitate integration of wind and other renewables

**Who:**
Led by Battelle and partners including BPA, 11 utilities, 2 universities, and 5 vendors
NW Smart Grid Demonstration

Project Impacts

- 3 Substations
- 13 Circuits
- 13000 Electric Customers
- 5000 Gas Customers
Pullman Smart Grid Demonstration Project

- Upgrade facilities and automate distribution system
- Install technologies and tools for customers to actively monitor and manage their energy usage
Lessons Learned

- Value of Hard Deadlines
- Importance of Change Management
- Need for Cross-functional Governance
- Required Level of Process and Documentation Rigor
- View Changes from a Customer’s Perspective
The Distribution System of the Future...Today

Becky Harrison
Director, Smart Grid Technology and Outreach
Progress Energy

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Overview

• Who we are
• Our approach for Distribution Optimization
• Where we are going
• Key observations
Progress Energy

- Fully integrated IOU
- 3.1 million customers with more than 21,000 megawatts of generation
  - Progress Energy Carolinas
    - 1.5 million customers
  - Progress Energy Florida
    - 1.6 million customers

Progress Energy service territory in red
Distribution System Demand Response
The Foundation

DSDR Substation

Distribution Feeder

PGN/Carrier Network Communications

PGN Network Communications

Carrier Network Communications

EMS
DSCADA
VMS
FMS
DSM/AMI
DMS

Progress Energy
EnergyWise
SMART GRID INITIATIVES
Distribution System Demand Response

How Does it Work?

Flattened profile allows greater Voltage Reduction

Upper Regulatory Limit

Lower Regulatory Limit

Existing

Flattened Profile

Lower Voltage to Reduce MWs
Smart Grid Program
Strategic Roadmap

Wave 4
- HAN
- Advanced Energy Storage

Wave 3
- PEF DSDR Phase II
- CBM Phase II
- PEF Feeder Segmentation
- Residential Offerings

Wave 2
- DOE Funded SGIG Projects

Wave 1
- PGN Funded SGIG Projects

FOUNDATION
- Reliability and Customer Satisfaction
- Skilled Workforce

- FMS
- ITR/ETR
- DSCADA
- VAR Management
- OMS
- DLC

1997 - present
2008 to 2013
2013 and beyond

DOE Funded SGIG Projects
Key Observations

• Don’t underestimate the people change
• Remember you are building the foundation
• Don’t underestimate the complexity, scale and pace
Acknowledgment: This material is based upon work supported by the Department of Energy under Award Number OE0000213.

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The Distribution System of the Future...Today

Peter Kobzar
Senior Manager, Distribution Operations
BC Hydro

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Strategy for Operating the Distribution System of the Future

Energy Central Webinar

March 30, 2011
BC Hydro Quick Facts

- Operating Area is 68,200 km² (26,300 sq. miles)
- 1.83 million customers
- ~6000 employees
- 11.3 GW total generating capacity
- 90% renewable hydroelectric, 10% thermal/diesel
- 52,440 GWhr of annual domestic consumption
- 18,200 km transmission (500kV to 60kV)
- 57,000 km distribution lines
- 900,000 poles, 300,000 transformers
- 7,600 km of which is underground (14%)
- ~500 km of submarine cable
- 212 distribution substations
- 75 transmission substations
- ~1280 feeders (split between 12 and 25 kV)
- Residential rates ~7.13 cents per kWhr
Discussion Points

• BC Hydro’s definition of a Smart Grid
• British Columbia Clean Energy Act
• What we expect in the Future
• Key Success Factors
• Key DGOS recommendations
Purpose of the DGOS project is to prepare for this, from an Operational perspective.
Purpose of DGOS

- In 2009/2010, BC Hydro launched a Distribution Grid Operations Strategy (DGOS) to prepare for the System of the Future, from an operational perspective.
- The System of the Future will transform many systems, processes and competencies in the design, operation, and maintenance the power grid.
- DGOS is intended to start the thinking on operational impacts for this transformation.
What makes a smart grid smart?

<table>
<thead>
<tr>
<th>20th Century Grid</th>
<th>21st Century Smart Grid</th>
</tr>
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<tbody>
<tr>
<td>No communications capability</td>
<td>Integrated two-way communications between the customer and utility</td>
</tr>
<tr>
<td>Customer cost/consumption feedback provided through bills only</td>
<td>Customer cost/consumption feedback provided near real-time and via multiple choices</td>
</tr>
<tr>
<td>No outage detection (customer must call in)</td>
<td>Automated outage detection and notification</td>
</tr>
<tr>
<td>Limited ability to support conservation rates and then, only simple rate structures</td>
<td>Full ability to support multiple types and complex conservation rates</td>
</tr>
<tr>
<td>No tamper detection capability</td>
<td>Automated meter tamper alarms, support for theft detection strategies</td>
</tr>
<tr>
<td>Built for centralized generation</td>
<td>Accommodates distributed generation</td>
</tr>
<tr>
<td>Few sensors to provide information on system status</td>
<td>Self-monitoring with sensors throughout</td>
</tr>
<tr>
<td>Manual restoration</td>
<td>Semi-automated restoration and eventually self-healing</td>
</tr>
<tr>
<td>Few consumer choices</td>
<td>Many consumer choices</td>
</tr>
</tbody>
</table>
Clean Energy Act Key Highlights  (April 2010)

- Identifies the development of clean energy as a key economic priority
- Allows for the creation of significant renewable independent power production
- Creates opportunities for expansion of Standing Offer Program, Feed in Tariff and Net Metering
- Legislates the introduction of smart meters by 2012
- Allows for the creation of telecommunications infrastructure to allow for the modernization and control of the utility grid.
- Requires 66% of incremental electricity needs to be met through efficiency and conservation by 2020 (up from 50%)
What We Expect in the Future

- Interconnection of much more Distributed Generation
- Game-changers such as Plug-in Electric Vehicles (v2g)
- Urban densification resulting in capacity constraints
- More energy generation being owned and operated by our customers
- Much more customer based Demand Response
- Significant momentum behind Volt VAR Optimization
- Net Zero communities, micro-grids and energy storage capability
- Implementation of DMS centralized intelligence
- More Intelligent electronic devices in Distribution
- New business models with the possible introduction of energy aggregators
System operations will go from passive to more active, dynamic, and adaptive.
Immediate access to real-time system telemetries at any point on the grid.
Understanding of advanced DMS algorithms
Intelligent and complex event processing
Much more reliance on an accurate electronic system mimic
Protection and control schemes must adapt to changing operating conditions and more dynamic distribution network configuration changes.
Management and control of intermittent renewable energy resources
Distributed Energy Value Chain:
  ➢ Visibility
  ➢ Predictability
  ➢ Operability
Key DGOS Recommendations

1. Create an Advanced Distribution Operations Capability
2. Re-examine and improve distribution GIS network model and asset data base
3. Accelerate deployment of adaptive and dynamic protection capabilities
4. Integrate Distribution Management System and Outage Management System
5. Implement functionality to enable greater level of DG/DER/EV connections and DR benefits in T&D, and manage the dispatch of renewable resources.
Q&A

To submit a question . . .
Use the interface question box
to the right of your screen.

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• April 14 - New Mobile Workforce Management: Insights to Increase Your ROI

• April 21 – The Future of Coal Generation

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