Smart Grid at BC Hydro: Current Status

Summer - 2009

Tom Gutwin
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Agenda

• Who is BChydro?

• What is a Smart Grid?
  – BChydro's definition
  – Drivers & Benefits

• Smart Grid Application Building Blocks
  – Building Blocks
  – Application Current Status

• BChydro’s Smart Grid Program

• BChydro’s Smart Grid Experience

• Questions
Who is BChydro?

• Gov't Owned Crown Corp.
• 1.7 Million Customers
• 51,000 GWh Domestic Load
• Serve 94% of British Columbia
• Triple Bottom Line Performance
  – Reliable, Low Cost for Generations
• Distribution Assets: $5.7B
• 2,200 Field Employees
• F09 Normalized SAIFI=1.7  F09 Normalized CAIDI=2.5hrs
• CEMI-4=9%  CELID-6=12%
What is a Smart Grid?

The BCydro Definition of Smart Grid:

“A modern, intelligent electricity transmission and distribution system that incorporates elements of traditional and advanced power engineering, sophisticated sensing and monitoring technology, information technology, and communications to provide better grid performance and to support a wide array of additional services to customers and the economy.”

In other words:

Modernization and automation of the current power delivery system
BChydro’s Smart Grid Program

There are numerous reasons to pursue a Smart Grid:

- **Internal factors**: BC Energy Plan, Legislation for Smart Meters by 2012, Green energy, Ageing assets, Limited labour resources, Employee safety

- **External factors**: Impending energy shortages, Advanced technology, Reliability of service, Customer service, Public safety, Green energy


- **Considered to be the lowest cost option to meet long term system operation requirements**
Smart Grid Benefits

- Reliability and Power Quality
  - SAIDI improvement of 40% anticipated
- Safety
  - Public and Worker
- Conservation and energy efficiency
  - Behaviour (Peak use and consumption)
  - Energy diversion detection
  - Voltage optimization
- Enhanced Customer Service
  - Two way information flow in real time including outage notification
  - Customer Choice (Reliability, Rates, Generation)
- Operational Efficiencies
  - Asset Optimization
  - Utility Efficiency
Smart Grid Benefits (cont’d)

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Smart Grid Building Blocks

Utility-Side Application
- Demand Response
- Microgrid
- Operational Efficiency
- Volt-Var Optimization Application
- Substation Automation
- Distribution Management System
- Distribution Automation
- Meter Data Management System
- Smart Meters
- Home Area Network
- Plug-in Electric Vehicles
- Energy Storage
- Distributed Generation
- Enabled Applications
- Future

Customer-Side Application
- Asset Management Framework
- IT Infrastructure (Enterprise Service Bus, Geographic Information System, Customer Relationship Management)
- Telecommunication Infrastructure (Wide Area Network, Local Area Network, Backhaul)
- Circuit Topology (Feeder/Substation Design)

*includes Energy Management System
Smart Grid Applications - SMI

Smart Metering & Infrastructure
Four Integrated Projects

- Theft Detection
- Grid Modernization
- In-Home Displays
- Smart Meters
Smart Grid Applications - SMI

SMI as a Smart Grid foundation

Smart Metering & Infrastructure as a Foundation

BCHydro's Smart Grid

Metro Reliability

Volt Var Optimization

DMS

Load Tap Changers

Reclosures

Distributed Generation

Plug In Hybrid E-Vehicles
BChydro has tangible Smart Grid progress in the following areas:

– Distribution Management System
– Smart Metering and Infrastructure (SMI) Program
– Distribution Automation
– Substation Automation/VVO
– PEV/Microgrids/Distributed Generation
– Other - Industry Forum Participation
Distribution Management System (DMS)

• A Decision Support System to assist the control room and field operating personnel with the monitoring and control of the electric distribution system

• Centralized DMS control with provision for peer-to-peer automation
Smart Grid Applications - DMS

DMS (Cont’d)

Past

Present

Future

Wall Board Mimic

Electronic Mimic

New Energy Management System by Areva

Little or No Decision Support Capability within the Control Room Environment

The Transformation
Current State → Future Vision
Smart Grid Applications – SMI Status

Smart Metering & Infrastructure Status

• Legislated to install ALL customer meters by 2012

• The “I” in SMI is for Infrastructure
  – Communication systems
  – Feeder and various feeder device meters
  – IT systems

• Request For Proposals - Summer/Fall 2008
  – 3 Vendors Shortlisted
  – Decision Was Scheduled For December 2008
  – Decision Currently Pending

• Expect system to be operational by 2012.

• Currently staffed with 150-200 employees
D-Automation Strategy - Status

• Circuit Topology
  – Feeder open-loop configuration

• Equipment Standards
  – Supervisory Control and Data Acquisition (SCADA) enabled
  – Secure and IP based communications

• Substation Automation
  – Protection Control and Monitoring (PCM) and Volt-VAR Optimization (VVO) Upgrades

• Distribution Automation
  – Guidelines for Enabling SCADA for Reclosers & Switches
Distribution Automation/Circuit Topology

- Enabling SCADA (Supervisory Control and Data Acquisition) and other automation technologies to make the distribution network more intelligent.

- Some automation in place currently
  - DV2010 partnered - Park Royal Closed Loop system
  - Recloser project initiated on Vancouver Island this year
  - Vista switches with SCADA being used for 2010 Winter Games

- Metro Vancouver DA/Topology Redevelopment
  - Planning and Justification
  - Open Loop with sub loops as necessary
Metro Vancouver Topology - Open Loop with Sub Loops
Maple Ridge automation project

- Step 1 (F2009 March), is installation of reclosers and switchgear at strategic locations.

- Step 2 (F2010) for the full automation project will involve replacement of all station feeder protection relays from electromechanical to SEL electronics relays (part of VVO project).

- As a final step, we will add communication to the equipment and implement the automation scheme with a target date of June 2010.

- Currently considering piloting Distributed Intelligence approach
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<th>Functionality</th>
<th>Restoration Success</th>
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<td>Any alternate feed; Limited visibility</td>
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<td>X</td>
<td>Avoid nuisance trips; Devices report in</td>
<td>System reconfiguration</td>
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U/G Switchgear Specifications

- S&C Electric Vista Switchgear (25 kV)
- SEL 351 relays for automation of 600 A fault interrupters on the feeder main
  - allows for zone protection scheme versus always fault clearing with the substation feeder breaker
  - allows for S&C IntelliTEAM II interface module
- 200 A fault interrupters on the load tap positions
- Prefer below ground control enclosures
- Proceed with fibre optic cables for communications to enable centralized SCADA
- Wireless communication for centralized SCADA is being considered, but is not a valid option until a final recommendation is available
Automation Projects & Guides

- Protection, Control & Monitoring (PCM) and Volt VAR Optimization (VVO) Upgrades
- Proceeding on automating 200 sets of reclosers based on Life-Cycle Analysis
- Automation Guide For Switches
  - Feeder open-loop configuration with sufficient switchgear on each circuit to allow for the historical two-thirds rule and the increasing circuit utilization
  - Installed on feeder main to connect to an alternate supply, or where an isolation point is required when a portion of the circuit is connected to alternate supplies
  - Sub loop for loads as necessary
  - Currently Being Implemented in Metro Vancouver
- U/G Switchgear Specifications
Protection, Control & Monitoring (PCM) and Volt VAR Optimization (VVO) Upgrades

- VVO is an effective conservation tool to reduce energy consumption, and has been in operation at one substation since the mid 1990’s, and there is a program operational since 2007 to upgrade individual substations.

- Substations that do not have VVO savings also benefit from PCM Upgrades as total Life-Cycle Cost of sustaining legacy electro-mechanical feeder-bus and feeder relays is equivalent to replacement with digital relays (or IEDs – Intelligent Electronic Devices).

- Other benefits of providing SCADA to distribution substations include safe & reliable operation of the power system, employee & contractor safety, and operational efficiencies.
• Proceeding on automating 200 sets of reclosers based on Life-Cycle Analysis

• Application of Three-Phase Reclosers
  – At least 300 customers connected downstream
  – Eliminate 3 or more annual sustained outages
  – Reduce annual duration of sustained outages by at least 30 min

• Application of Single-Phase Reclosers
  – At least 100 customers connected downstream
  – Eliminate 2 or more annual sustained outages
  – Reduce annual duration of sustained outages by at least 20 min
• Installed on feeder main where there is an ability to connect to an alternate supply, or where an isolation point is required when a portion of the circuit is connected to alternate supplies

• Feeder open-loop configuration with sufficient switchgear on each circuit to allow for the historical two-thirds rule and the increasing circuit utilization

• Sub loop for loads as necessary
Enabled Applications (PEV, DG, Microgrids)

- **Plug In Electric vehicles (PEV)**
  - By end of 2009, BCHydro expects to have largest fleet of plug in vehicles in North America (at 10)

- **Distributed Generation (DG)**
  - Existing large penetration of IPPs
  - Existing customer Net metering program (<10kW)
  - Strategy under development for customer based DG
  - Smart Grid is ensuring system will be prepared to accommodate.

- **Microgrids**
  - In partnership with BCIT we are working to develop a demonstration project of a true Microgrid.
  - BCHydro is preparing a Microgrid Use Case that defines the term and lays out various scenarios.
• Gridwise Alliance
  – Membership and Board Seat
• Grid-Interop
  – Participating in various working groups
• DV2010
• Utility AMI / Open AMI, IEEE, EPRI, CEATI, UTC
• Benefits – Driving open standards, sharing information, common voice, coordinated approaches
BChydro’s Smart Grid Program
Current Status

- Authorized to form Smart Grid Program team in February 2008
  - Currently Reporting to the Chief Technology Office
  - Currently about 10 people in the Smart Grid group

- Key deliverables:
  - five year strategic vision and roadmap (both imminent)
  - as well as a cost/benefit analysis of Smart Grid and a 20 year vision (proposed)

- Strategic Group intended to align all programs and applications that reside under the Smart Grid governance umbrella
  - Provide a cross-application coordination (for example – DG needs work with SMI needs)
An organization is in place

Our Purpose:

To advance the deployment of Smart Grid applications
What does this all mean?

• Clarify the inconsistent understanding of what a Smart Grid is (hence the need for the Pyramid diagram) and therefore how it will be achieved.

• BChydro is relatively mature in the Strategic space of Smart Grid (Strategy, Dedicated Team, Interest Group Participation).

• Also a risk averse organization so measurable progress has been slow.
Smart Grid Building Blocks

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Circuit Topology (Feeder/Substation Design)

Asset Management Framework

*includes Energy Management System
Thank You

Tom Gutwin
Reliability Specialist
BCHydro Distribution Planning