Distribution Management System for British Columbia Transmission Corporation

Bob Uluski, P.E.
Quanta Technology
As an independent electric transmission company, BCTC is responsible for the planning, management and operation of BCH’s transmission assets, which include 18,000 kilometres of high-voltage wires.

Currently, BCTC under contract from BC Hydro operates approximately 1,200 distribution feeders.
A distribution management system (DMS) is being proposed for implementation in phases starting in 2009.

Shift from the current practice of manually operating distribution assets to an automated electronic decision support system.

Provide centralized visibility and control of the distribution assets with enhanced decision support capability that will assist in the day to day operations of the distribution system.
DMS Value Drivers

- **Financial**: Provide financial benefits stemming from feeder deferrals, energy conservation, reducing fault locating and restoration times.

- **Environmental**: rapid expansion of **energy conservation** will result in an incremental reduction in electrical intensity.

- **Reliability/Customer**: will reduce system SAIDI.

- **Employees**: the employees will be empowered with enhanced decision support capability.

- **Safety**: provide a more secure and safe environment for field personnel.

- **Alignment with BC Energy Plan**: aligns with the **BC Energy Plan**, which calls for the use of innovation and technology.
Project Overview

- manage the operation of equipment located in
  - distribution substations;
  - on radial and “looped” distribution feeders (overhead and underground),
  - “spot” primary networks
  - underground networks (fully meshed primary and secondary network)
  - distributed generating resources located out on the distribution feeders

- optimize the performance and reliability of the distribution system and provide effective decision support tools for the distribution operators, including
  - On line power flow (OLPF)
  - Switch order management (SOM)
  - Volt-VAR optimization (VVO)
  - Fault Detection, Isolation Restoration (FDIR)

- Provide effective interfaces between DMS and other enterprise systems, including
  - Geographic Information System (GIS)
  - Energy Management System (EMS)
  - Outage Management System (OMS)
  - Smart Metering Infrastructure (SMI)
System Architecture (Preliminary)

Figure 2: DMS System Architecture
Switching Order Management (SOM)

- Software tool to assist the operators in creating switching orders

- Available modes of operation:
  - **Manual** – operator types in switch orders
  - **Computer aided** – operator creates switching steps by clicking on graphic displays, computer inserts specific detailed entry
  - **Computer generated** – operator selects components being worked on, computer generates complete switching sequence based on established safety rules.
  - **Study mode** – computer simulates execution of switch order using on line power flow to determine if adverse consequences will occur (low voltage, device overloads, etc.) when the switching actions are actually performed
On Line Power Flow (OLPF)

- **What is OLPF?**
  - A real-time version of the well known engineering power flow tool (“off line” power flow)

- **What does it do?**
  - Calculates electrical conditions (voltage, current, real/reactive power) at all points along the feeder.

- **OLPF objectives:**
  - Provide operators with nearly continuous “visibility” of all points along the feeder where no SCADA measurements exist ("state estimator" for distribution circuits)
  - Provide feeder electrical information needed by other DMS applications (FLISR, IVVC, Switch order management, etc)
Volt-VAR Optimization

- Determine optimal control actions to accomplish specified operating objectives:
  - Do not violate operating constraints:
  - Minimize energy consumption
  - Reduce demand
- VVO control actions include
  - LTC setting changes
  - Capacitor bank switching
  - Voltage regulator control.
- Optimal power flow-based solution
- Accurate modeling of load-voltage sensitivity
  - Customer load models
  - Transformer no load losses
- “Failsafe” design
Fault Detection Isolation Restoration (FDIR)

- **FDIR Objectives**
  - Improve System Average Interruption Duration Index (SAIDI)
  - Improve System Average Interruption Frequency Index (SAIFI)

- **FDIR functions:**
  - Automatically detect feeder faults,
  - Isolate the faulted section of the feeder (between two field switches),
  - Restore service to as many customers as possible
  - Do not overload backup sources

- **Fault Location - “Reverse short circuit” analysis**
  - Obtain fault magnitude and type (A, B, C, A-B, etc) from relay IED
  - Determine possible fault locations using DMS short circuit analysis tool and associated feeder model
External Interfaces

- Geographic Information System (GIS)
- Corporate data warehouse (PI)
- Outage Management System (OMS)
- Smart Metering Infrastructure (SMI)
- Control Room Operating Window (CROW)
- Spatial Asset Management (SAM)
- Others
Project Team

- Multi-disciplined core project team
  - BCTC Manager, Distribution Operations
  - BC Hydro Operations Planning Leader
  - Distribution system operators
  - Information Technology Experts
  - Distribution Engineering (application specialist)
- Consultants
  - Quanta Technology (SCADA/DMS functions)
  - Enspiria Solutions (IT architecture and external interfaces)
Project Status

- Planning and design phase
  - Information exchange meetings with DMS stakeholders (completed)
  - Functional requirements
  - Interface definitions
  - Conceptual architecture
  - Implementation strategy
  - Industry survey of best practices (reviewing results)

- Procurement phase
  - Request for qualifications (vendor prequalification) (reviewing results)
  - “Select” Request for Proposal (only those short listed)
  - Bid evaluation and contract negotiation

- Implementation phase
Questions?

Bob Uluski, PE.
Executive Advisor
Quanta Technology
Phone: 267 455-7634
E-mail: ruluski@quanta-technology.com