Hydro-Québec's Distribution Automation Vision and Roadmap

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Summary

1. Hydro-Québec's Distribution Automation: Project Description
2. Distribution Automation Roadmap: Vision and guiding Principles
3. Distribution Automation Roadmap: from 2005 to 2015 in 4 steps
4. Distribution Automation Standards Evolution
5. Conclusion
Hydro-Québec's Distribution Automation: Project Description

- Hydro-Québec's Distribution Automation Program includes
  - Remote control of 3750 MV switches and breakers (188 M $ - CDN over 6 years)

- "Distribution Automation" is much more than remote controlling of switching equipment on the MV feeders
  - Hydro-Québec's roadmap expresses a vision how the actual distribution network evolves toward an intelligent distribution network, which includes:
    - Network monitoring
    - Equipment monitoring, and
    - Product monitoring
Hydro-Québec's Distribution Automation Vision

◆ Vision
  ■ The distribution network must become more intelligent
  ■ Choosing to retain today’s design standards and equipment, opting for small incremental changes in the way that business is done today, will result in an un-profitable future for a distribution utility.

◆ Vision confirmed by
  ■ CEATI's Technology Roadmap (May 2004)
  ■ EPRI's ADA Report (June 2004)
Distribution Automation Flow of Information

Technologies

DATA
(Using what?)

Voltage
Fault Currents
Load Currents
Temperature
Number of Operations
Alarms
...

Applications
(How?)

Voltage Control
Optimised Load Flow
Fault Location
Faulty Equipment
Power Quality Evaluation
...

Business needs
(Why?)

Energy Efficiency
Reliability
Distributed Resources
Power Quality
Customer Satisfaction
**Distribution Automation Flow of Decision**

**DATA**
(Using what?)
- Voltage
- Fault Currents
- Load Currents
- Temperature
- Number of Operations
- Alarms
  ...

**Applications**
(How?)
- Voltage Control
- Optimised Load Flow
- Fault Location
- Faulty Equipment
- Power Quality Evaluation
  ...

**Business needs**
(Why?)
- Energy Efficiency
- Reliability
- Distributed Resources
- Power Quality
- Customer Satisfaction

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6 Distribution Strategic Planning

May 2006
**Distribution Automation Roadmap: Guiding Principles**

- The distribution network evolution must start from the actual network and gradually moves toward an intelligent grid.

- The remote control infrastructure shall be used to gather network information:
  - This information is needed to add intelligence to the network in order to increase its performance.

- The multiple task possibilities of modern digital equipment (i.e. smart meters, digital relays, ...) should be integrated to reduce cost.

- Distribution network evolution shall consider the growing interconnection of DER.
**Distribution Automation Roadmap: Guiding Principles**

- Use transmission grid experience with automation to transpose on distribution networks (i.e. equipment, standards, ...)

- The telecommunication structure of the distribution network should evolve toward a compatible network with the transmission level
  - The ultimate goal is to develop standards (utilities with the manufacturers) defining a "Plug and Play" concept

- Distribution feeders should be seen as an extension of the substation busbar

- *Distribution Automation Roadmap* is influencing Hydro-Québec's R&D program
Distribution Network 2006 - 2007

Present Network
Remote control of substation MV breakers
Remote control of MV DER breakers

Existing remote control
New remote control

Operation Center
SCADA
Distribution Network 2006 - 2007

TECHNOLOGIES IMPLEMENTATION
- Beginning of the installation of remote control of feeder load break switches and breakers

INTERNAL DEVELOPMENT
- Voltage control
- Fault location

STUDIES
- Telecommunication architecture
- Network information acquisition and management
- Distribution capacitors optimisation
**Distribution Network 2007 - 2010**

**TECHNOLOGIES IMPLEMENTATION**
- Addition of sensors for voltage control and fault location
- Gathering of information from remote control cabinet
- Addition of DER LV net metering
- Power Quality qualification
- Intelligent underground equipment

**INTERNAL DEVELOPMENT**
- Telecommunication architecture
- Intelligent maintenance system

**STUDIES**
- Automatic network reconfiguration
- Data structure

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Distribution Automation Program undergoing
**Distribution Network 2010 - 2015**

**TECHNOLOGIES IMPLEMENTATION**
- More DER on the distribution grid
- Automatic reconfiguration
- Voltage regulator control
- Capacitors control

**INTERNAL DEVELOPMENT**
- Telecommunication architecture
- Intelligent system of predictive maintenance

**STUDIES**
- Automatic reconfiguration with DER (micro islanding)
- Demand side management

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Distribution Automation Program completed

Real Time
Delayed Time
Distribution Network 2015 and beyond

TECHNOLOGIES IMPLEMENTATION
- Beginning of installation of Plug and Play equipment
- Implementation of integrated data and telecommunication architecture
- Demand side management

INTERNAL DEVELOPMENT
- Automatic reconfiguration with DER
- Energy exchange network

STUDIES
- Energy portal for consumers

Architecture IEC 61850

Real time

Delayed Time
Distribution Automation Standards - Past situation

TECHNOLOGIES

- Equipment suppliers
  - Protection
  - Power Quality
  - Metering

APPLICATIONS

- Suppliers' softwares and applications

BUSINESS NEEDS

- Distribution utility
  - Internal needs
    - Costs
    - Planning
    - Maintenance
    - Grid management

Industry Standards

National standards
Distribution Automation Standards - Present situation

TECHNOLOGIES
- Equipment suppliers
- Protection
- Power Quality
- Metering

APPLICATIONS
- Suppliers' softwares and applications

BUSINESS NEEDS
- Distribution utility
- EXTERNAL NEEDS
  - For customers and regulators
- INTERNAL NEEDS
  - Energy efficiency
  - Power reliability
  - Asset management
  - Distributed resources
  - Power quality

Industry Standards

National standards

EXTERNAL NEEDS
- Information

INTERNAL NEEDS
- Energy efficiency
- Power reliability
- Asset management
- Distributed resources
- Power quality

PRESENT SITUATION

Suppliers' softwares and applications

Distribution utility
Hydro-Québec's activities in DA/DER

- Hydro-Québec has a 2006 project to evaluate data integration software with existing sensors on its distribution test line.
- Hydro-Québec is participating to EPRI'S ADA #124.005 "First generation Integrated sensor and Monitoring system for ADA"
- Hydro-Québec is participating and influencing forums on Distribution Automation and DER
  - IEEE DA Group
  - EPRI's ADA
  - IEC TC 57 / 61850 Standard
  - CEATI's DALCM and PQIG who established a list of DA/DER projects
  - CEA Regulatory Innovation Task Group
  - Exchange with other utilities on DA/DER projects (BCHydro, Manitoba Hydro, EDF and others…)
  - Participation with CANMET (Canada Natural Resources) on DER
  - …
Conclusion

- Hydro-Québec distribution network roadmap is adaptable and takes into account key elements such as:
  - Business needs of Hydro-Québec Distribution (HQB)
  - Available technologies and their evolution
  - Local context (i.e. Province of Quebec)
- The HQD roadmap is compatible with other industry roadmaps (CEATI and EPRI)
- Distribution Automation is the backbone of the future intelligent distribution network
- IEEE/IEC working groups must develop integrated Distribution Automation and DER standards to prepare the industry to the future intelligent Distribution Network
Distribution Strategic Planning
Asset management
Hydro-Québec Distribution Network