Hydro Québec Distribution
Automation Program
- Regulatory Approach

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Presentation Summary

1. Analysis of Hydro-Québec's Distribution Network Performance
2. Documentation and Argumentative Case
3. Commitments of the Distributor
4. Presentation of the Hydro-Québec's Case to the Regulator
5. Conclusion
Analysis of Hydro-Québec's Distribution Network Performance

- Reliability index (SAIDI) reached a stable point but remains unequal among customers
  - Since 1999, the SAIDI index has reached a stable value at 2 hrs per customer, per year
  - But 15% of our customers have a reliability index higher than 4 hrs
- Outages remain a major concern to customers
  - Customers are addressing these concerns to the Regulator
Hydro-Québec Customer Satisfaction

Evolution of customer satisfaction with respect to the service reliability

- Customer satisfaction is fragile and unpredictable versus power outages

Reliability of service

- Residential
- Commercial & agricultural
- Industrial (M up to 2002)
Current Performance of Hydro-Québec Distribution Network

- Investments in maintenance having reached its limits
Benchmarking: Hydro-Québec's Position Among Utilities in Canada

Hydro-Québec's Position
Average Reliability Index for the past 5 years (1999-2003) – exclusive of sources

Selected Canadian Utilities
In order to improve its network performance, Hydro-Québec Distribution aims at the following objectives:

- Improvement of the equity among HQ's customers
  - Equivalent reliability for the same rates
  - Reduction of outage duration in selected sectors

- Reduction of the SAIDI

- Improvement of the position of Hydro-Québec in the North American market
To achieve these goals, a major study was undertaken in order to:

- Identify and survey the various and potential schemes
- Optimize schemes with added value only (economic or performance)
- Take advantage of current technologies and equipment available on the market
- Provide the Distributor with a long-term vision of the evolution of the distribution network
Various Schemes Analysed

Based on case study of a representative distribution feeder, with a reliability index of 2.3 hrs

<table>
<thead>
<tr>
<th>Analysed Alternatives</th>
<th>Costs (per feeder)</th>
<th>Reliability Index (hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scheme A: Increasing network robustness</td>
<td>1 030 k$</td>
<td>0.20</td>
</tr>
<tr>
<td>Scheme B: Division of line to reduce the number of customers per section</td>
<td>600 - 1 500 k$</td>
<td>0.67 - 1.11</td>
</tr>
<tr>
<td>Scheme C: Automated distribution line</td>
<td>126 k$</td>
<td>1.33</td>
</tr>
</tbody>
</table>
The rationale of Hydro-Québec's program is mainly based on reliability improvements

- Hydro-Québec has developed and used a reliability software application (FIORD) to evaluate the impact of its distribution automation project based on data from 2 years of real outages.

- Hydro-Québec has evaluated 9 different scenarios, from fault detectors information only to fully automated network reconfiguration schemes.
## Analysis of Reliability Scenarios in Automation

- Sample of the scenarios to validate Hydro-Québec's Distribution Automation Program

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>SAIDI</th>
<th>SAIDI improvement</th>
<th>SAIFI improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – Remote fault indication only</td>
<td>1.96</td>
<td>4.6%</td>
<td>0.00%</td>
</tr>
<tr>
<td>2 – Optimized recloser installation (1 per feeder) without remote control</td>
<td>1.98</td>
<td>3.6%</td>
<td>3.55%</td>
</tr>
<tr>
<td>3 – Remote control of actual switches and breakers</td>
<td>1.61</td>
<td>21.6%</td>
<td>0.00%</td>
</tr>
<tr>
<td>4 – Remote control of actual switches and breakers and addition of breakers when needed</td>
<td>1.60</td>
<td>22.1%</td>
<td>3.55%</td>
</tr>
<tr>
<td>5 – Remote control of actual switches and breakers, addition of breakers when needed and automatic reconfiguration</td>
<td>1.56</td>
<td>24.0%</td>
<td>3.55%</td>
</tr>
</tbody>
</table>
Hydro-Québec's Choice: Automation of its Distribution Network

Hydro-Québec Distribution studies confirmed that the chosen solution (*Scheme C: Automated distribution line*) is in accordance with the current industry trend, especially

- **Recent Industry Roadmaps**
  - CEATI Distribution Roadmap (January 2004)
  - EPRI Advanced Distribution (June 2004)
Direct Benefits of Distribution Automation (DA)

- Benchmarking of existing DA experiences among other utilities resulted in identifying where DA improvement is effective
  - **Reliability**: disparity among SAIDI of customers having to pay the same price
  - **Reduction in Labor Costs**: restoration crews locate promptly the outage site with remote control information
  - **Energy Efficiency**: voltage and Vars control
  - **Claim reduction**: advance knowledge of network product quality provided with DA
The Regulator showed some interest in the following topics, of which only rough estimates of the costs were analyzed:

- **Carry-forward Investment**: installation of transmission equipment deferred because automation allows transfer of loads on the distribution network
- **Social Costs**: reduction of the outage duration for industrial and commercial customers as productivity impact
- **Information Management, Predictive Maintenance and Power Quality**: additional information from the network will lead to additional performance improvements and cost reduction
Indirect Benefits of Distribution Automation (continued)

Example of social costs

- External benchmark of social cost evaluation methods (EnerNex)
- Application to Québec's situation
- Results available on the "Régie de l'Énergie" website:

<table>
<thead>
<tr>
<th>Total (M$)</th>
<th>EDF</th>
<th>IEEE</th>
<th>HQ</th>
<th>PRS</th>
<th>UofS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic costs</td>
<td>208</td>
<td>205</td>
<td>341</td>
<td>586</td>
<td>714</td>
</tr>
<tr>
<td>Automation</td>
<td>138</td>
<td>136</td>
<td>261</td>
<td>454</td>
<td>543</td>
</tr>
<tr>
<td>Avoided costs</td>
<td>70</td>
<td>68</td>
<td>79</td>
<td>132</td>
<td>170</td>
</tr>
<tr>
<td>%</td>
<td>34%</td>
<td>33%</td>
<td>23%</td>
<td>23%</td>
<td>24%</td>
</tr>
</tbody>
</table>

http://www.regie-energie.qc.ca/audiences/3565-2005/
RencPrep3565/Engagements3565/HQD-02-02_Engag2_30juin05.pdf
# Key Points of the Distribution Automation Argumentative Case

<table>
<thead>
<tr>
<th>KEY POINTS</th>
<th>INTERNAL ACTIONS</th>
<th>EXTERNAL ACTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>◗ Define the development strategy to be given to the distribution network evolution</td>
<td>◆ Strategy developed within the utility</td>
<td>◆ Strategy confirmed by the industry trend and practices</td>
</tr>
</tbody>
</table>
| ◗ Determine and estimate gains anticipated and earned from the program | ◆ Direct gains of reliability index identified and estimated within the utility  
◆ Indirect gains analyzed by the utility | ◆ Estimated and confirmed by the industry, via benchmarking |
| ◗ Choose optimized technologies with respect to their acquisition costs | ◆ Technologies selection done by the technical resources of the utility  
|   ◗ Start DA program with the equipment already on the network  
|   ◗ Simplify the choice of telecommunication technologies to be implemented | ◆ Technological watch performed on a continuous basis  
|   ◗ Optional equipment offered on the market  
|   ◗ Existing telecommunication technologies | ◆ Technological watch performed with regard to lesser costs |
A pilot project in automation on the distribution network was carried out on a small-scale. Components were:

- To operate by remote control equipment already on the distribution network, of which
  - 14 overhead line switches
  - 2 circuit breakers
- To install a telecommunication network (conventional dial-up telephone lines)

After a period of nine months, a gain of one (1) hour in service reliability (i.e. 22 %) has been measured on the remote control feeders of the pilot project.
Documentation Related to the Automation Program

◆ Internal Reports*

- Orientations for the Automation of the Distribution Network, Perspective 2002-2012, Department of Strategic Planning, Hydro-Québec Distribution, June 2002
- Summary Report of the Pilot Project, Distribution Network Automation Project, Department of Strategic Planning, November 2004
- Report on Customers' Expectations, Survey "Table des Tables", Hydro-Québec Distribution, Summary 2004
- Additional Reports:
  - Saturation point of the reliability of the distribution network, Department of Strategic Planning, HQD, September 2004
  - Means for improving the reliability of the distribution network, Network Automation Alternatives, Department of Strategic Planning, December 2004
  - Improvement value of the reliability from the distribution automation, Quebec Electric Research Institute in Electricity, IREQ, Hydro-Québec, June 2004
  - Description of analyzed scenarios in the framework of the distribution network automation and relevance of the schemes to a representative feeder, Department of Strategic Planning, June 2005

*Only French version is available
Documentation Related to the Automation Program (continued)

◆ **Internal Reports***: (continued)
  - Economic analysis: Tariff impact of investment required for the network automation
  - Approved Recommendation by the Board of Directors of Hydro-Québec, February 2005
  - Argumentative Case submitted to the Quebec Regulatory Agency, March 2005

◆ **Benchmarking and External Reports (in English)**
  - Costs of Outages, performed for Hydro-Québec by EnerNex Corporation, October 2004
  - Distribution Automation Benchmarking Performed for Hydro-Québec by, EnerNex Corporation, July 2004
  - Technical and System Requirements for Advanced Distribution Automation (ADA), EPRI Project Manager, June 2004
  - Electric Distribution Utility Roadmap, Distribution Asset Life Cycle Management Interest Group (DALCIG), January 2004

*Only French version is available*
Link to the Distribution Automation Project on the Québec's *Régie de l'énergie* Website

**Hydro-Québec's Commitments**

- Commitments undertaken by Hydro-Québec with respect to the improvement provided by the Automation Program are:
  - The ratio of customers with a reliability index above 4 hrs, is about 15 % (500 000 customers) and it shall drop at 8 %
  - SAIDI shall be reduced by 15 min per customer, per year, in average
  - Labor costs shall be reduced significantly
  - Total amount of customer claims shall be cut down by about 20 %
Hydro-Québec's Distribution Automation: Project Description

- Hydro-Québec's Distribution Automation Program includes
  - Remote control of 3750 MV switches and breakers on 1100 feeders (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
Regulatory Approach

Some key elements of the case submitted to the Regulator

- The spokesperson of the case must be in total control of the contents during the hearings
  - Some experts should be available in order to respond promptly to all enquiries related to specific aspects of the program

- All justification or statement must be supported by financial and technical analyses, facts and/or experimental data
  - Main documents should be at hand and on the premises
  - Documentation submitted to the Regulator remains in the public domain

- Representatives must be transparent on all aspects of the program
  - Criteria for selecting technologies, direct and indirect costs, etc.

- The Distributor shall commit to produce to the Regulator a report on the program outputs
Some key elements of the case submitted to the Regulator (continued)

- The arguments shall be presented and challenged, but should not be restricted to the main objectives.
- Demonstrate that all studies have been carried out to the limit of the existing knowledge.
- For example:
  - Estimate of subsequent effects of the implementation of automation
    - Energy efficiency, decentralized production, carrying forward investments…
  - Positioning the strategic evolution of the distribution network in a long-term perspective
  - Evaluation of social costs of power outages on Hydro-Québec's customers
Implementation of the Automation Program on the Distribution System

◆ Undertaking the implementation of automation requires the following:
  ■ Setting up a new specialized unit in automation
    • This unit will gather about 40 engineers and technicians
  ■ Relying on a Project Team dedicated only to the program
    • Project Matrix Organization and Project Team Management are performed
    • All relevant departments and units are fully involved
    • Reporting to high management is achieved on a regular basis
  ■ Targeted objectives of the Automation Program must be included in the contracts of the relevant management executives
Conclusion

From the beginning of the project development, it is important to focus on the right elements in order to:

1. Keep in mind the final goal of the program:
   - **Short-term: Reliability gain** is the main focus of the rationale of the project, as technology is only the means required to achieve the estimated gain
   - **Long-term: Intelligent network** - Project rationale should also be considered in a long-term plan and should focus on the real objectives

*Hydro-Québec has a Distribution Automation Roadmap available (presented at Distributech and IEEE T&D)*
Conclusion

2. Retain and apply the appropriate tools to succeed:
   - A strong commitment from Management at all time
   - Team work and multidisciplinary teams play an essential role in the success of the project, together with a centralized coordination
   - A rigorous approach and a timely planning
   - Several support committees (technical and managerial) to challenge and review all documents
   - The justification report should be explained in simple terms as in most cases, it will be examined by a non technical public

3. Establish a realistic timeframe for the project preparation:
   - From HQ's perspective, it took 3 years to develop all components, which includes the gathering of data and studies, the planning and the final period of approval