Lessons from the Real World Webinar Series

Next Generation
Asset Management

Broadcast on December 8, 2010
Next Generation Asset Management

1. Next generation asset management capabilities

2. Asset analytics vision at Hydro One Networks

3. Grid modernization tools at Toronto Hydro

4. Utility decision environment of the future
## Today’s Presenters

<table>
<thead>
<tr>
<th>Name</th>
<th>Background</th>
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</table>
| **Thor Hjartarson** | • Manager, System Reliability Planning, Toronto Hydro  
                     • 20+ years in electric distribution, including Iceland State Electricity, Acres International, and Kinectrics. Current responsibilities include planning, grid modernization, reliability analysis and system studies. Co-founder Health Index methodology for asset condition assessment |
| **Bruno Jesus**    | • Manager, Asset Strategies and Standards, Hydro One  
                     • 20+ years in asset planning, process, and strategy development. Currently responsible for long-term asset strategies and improving asset management analytic capabilities for asset lifecycle investment decisions. |
| **Paul Yarka**     | • Accenture Utilities Industry Partner and leads the Accenture Smart Grid Services Asset Management Practice  
                     • 29+ years of experience. Involved with client projects regarding impacts of smart grids on T&D operations; Smart Grid, DMS, OMS, GIS, and EAM integration; asset investment management and how to pay for a smarter grid; asset analytics, CBM, and T&D transformation. |
### Today’s moderator

<table>
<thead>
<tr>
<th>Name</th>
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</table>
| Jesse Berst  | • Managing Director, Global Smart Energy  
• Publishers of SmartGridNews.com, the Internet’s oldest, largest and highest-ranked smart grid site.  
• Advisory Council, Pacific Northwest National Laboratory  
• Keynote and participant, DOE’s original National Grid Vision Planning Committee (2003)  
• Co-founder, Smart Grid Consumer Collaborative, SmartGridCC.org |

- You will receive a copy of the slides  
  - To the email you used to register  

- You can ask questions at any time as we go along  

- You will receive a FAQ with answers  
  - If we are unable to get to all the questions during the Webinar
To ask a question:

- Use the question box to type questions at any time
- We will pause periodically to answer questions
- If we run out of time, we’ll answer by email as a FAQ
- Yes, you will receive a copy of the slides
1. Next generation asset management capabilities

2. Asset analytics vision at Hydro One Networks

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4. Utility decision environment of the future
Next Generation Asset Management Capabilities

Asset Performance Management

• Asset Performance & Condition Reporting
• Failure Mode Event Analysis
• Load Profiling and Trending
• Asset Performance Simulation
• Asset Health Metrics
• Integrated Load and Health Analysis

Risks, Projects, & Programs
• Asset Risk Modeling and Analysis
• Asset Life Cycle Costing & Analysis

Direction, Standards, & Performance

Asset Strategy

Asset Investment Planning

High

Low

Data Latency

Systems and Data

EAM  CBM  DGA

Temperature Sensing

Utilization Sensing

SCADA
Next Generation Asset Management

1. Next generation asset management capabilities

2. Asset analytics vision at Hydro One Networks

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Hydro One Vision

Performance Management

Reporting

Asset Modeling & Analytics

Asset Life Cycle Planning

Business Planning

Work Execution

Information Technology/Information Management Initiatives

T&D Rate Filings

Compliance
Implement a **Cascading Information Delivery Framework** to guide information consumers towards areas requiring attention or action based on quantitative triggers.

**Business Benefits**
- Improve decision-making
- Establish consistency
- Reduce data gathering effort
- Create vertical transparency as to how data is being used
- Align business processes to strategic objectives
Asset Analytics - Back to Green

Executive Dashboard

Spatial View

Operational Dashboard

Management Report

Transactional Report

Source System

ALERT

ROOT CAUSE ANALYSIS

ACTION
Circuit Operational Risk Assessment

<table>
<thead>
<tr>
<th>Circuit Name</th>
<th>Voltage</th>
<th>Line Section Name</th>
<th>Section In-Service</th>
<th>Age</th>
<th>No. of Structures</th>
<th>Section km</th>
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<tbody>
<tr>
<td>A6P</td>
<td>115</td>
<td>ALEXANDER SS X RESERVE JCT</td>
<td>1920.12.20</td>
<td>90</td>
<td>156</td>
<td>15.8</td>
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<tr>
<td>A6P</td>
<td>115</td>
<td>RESERVE JCT X PORT ARTHUR TS #1</td>
<td>1920.12.20</td>
<td>90</td>
<td>563</td>
<td>91.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Circuit Name</th>
<th>Line Section Name</th>
<th>Criticality</th>
<th>Conductor ACA (Torsion Test)</th>
<th>Structure Health Index</th>
<th>Confidence</th>
<th>Freq. - Mom</th>
<th>Freq. - Sust</th>
<th>Freq. - Total</th>
<th>Unavailability (Hr/Yr)</th>
<th>Perf Index - Freq Tot</th>
<th>Unavail Index</th>
<th>Loading / Circuit Rating (%)</th>
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</thead>
<tbody>
<tr>
<td>A6P</td>
<td>ALEXANDER SS X RESERVE JCT</td>
<td>2</td>
<td>Under Review</td>
<td>83.71%</td>
<td>78.72%</td>
<td>0.60</td>
<td>2.20</td>
<td>2.80</td>
<td>28.74</td>
<td>1.28</td>
<td>1.26</td>
<td>66.7%</td>
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<tr>
<td>A6P</td>
<td>RESERVE JCT X PORT ARTHUR TS #1</td>
<td>2</td>
<td>6.4</td>
<td>92.83%</td>
<td>30.44%</td>
<td>0.60</td>
<td>2.20</td>
<td>2.80</td>
<td>28.74</td>
<td>1.28</td>
<td>1.26</td>
<td>115.3%</td>
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</tbody>
</table>

Note: Plan calls for refurbishing A6P from STR 156 x STR 720 for 73.7 km.
STR 720 x Port Arthur TS #1 (17.3 km) was refurbished in 1995.
Asset Risk Index – Transformers & Breakers

Circuit Breakers Asset Risk Index (Transmission)

Transformers Asset Risk Index (Transmission)

Circuit Breakers Asset Risk Index (Transmission)

Transformers Asset Risk Index

13
<table>
<thead>
<tr>
<th>Station</th>
<th>Functional Location</th>
<th>Asset Type</th>
<th># of Outages</th>
<th>Outage in Min</th>
<th>Annual Outage Freq. (Oct)</th>
<th>5 Yr Benchmark Out. Freq.</th>
<th>Perf.</th>
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<tbody>
<tr>
<td>T2 - 230-44</td>
<td>TF</td>
<td></td>
<td>1</td>
<td>36</td>
<td>0.6002</td>
<td>0.2076</td>
<td>289</td>
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<tr>
<td>T2 - 230-44</td>
<td>TF</td>
<td></td>
<td>1</td>
<td>1414</td>
<td>0.6002</td>
<td>0.2076</td>
<td>289</td>
</tr>
</tbody>
</table>
## Value Realization Report

**Station Name:** N-TS-PARRYSNDTS  
**Calendar Year/Month From:** JAN 2009  
**Calendar Year/Month To:** DEC 2010  
**Benchmark Year:** 2009  
**Zone:** N/A  
**TS:**

### Project Summary

<table>
<thead>
<tr>
<th>Zone</th>
<th>Station Name</th>
<th>Value Proposition</th>
<th>Project Cost</th>
<th>Investment Driver</th>
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</thead>
<tbody>
<tr>
<td>N/A</td>
<td>N-TS-PARRYSNDTS</td>
<td>Investment in Service</td>
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</table>

### Savings & Improvements

<table>
<thead>
<tr>
<th>Financial (SM)</th>
<th>Integration Savings (SM)</th>
<th>Maintenance Savings (SM)</th>
<th>Project NPV (SM)</th>
<th>Project ROI (%)</th>
<th>Project ROI (%)</th>
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</thead>
<tbody>
<tr>
<td>Customer/Reliability</td>
<td>Contact Savings (SM)</td>
<td>Customer Satisfaction (%)</td>
<td>SAIFI</td>
<td>Unit Cost (SM)</td>
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<tr>
<td>Productivity &amp; Efficiency</td>
<td>Outage Management Savings</td>
<td>Time/Schedule (Mo)</td>
<td>Eng./PSC/Const (Hz)</td>
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<tr>
<td>Safety &amp; Environment</td>
<td>Lost/Congestion Savings (SM)</td>
<td>Losses (kW / Energy (kWh))</td>
<td>Oil Spills (L)</td>
<td>Total Value (SM)</td>
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</tr>
<tr>
<td>EOM &amp; DG Connections</td>
<td>Incremental DG Connections</td>
<td>Incremental DG Capacity (MW)</td>
<td>Carbon Footprint / SHP Gas (kg)</td>
<td></td>
<td></td>
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</table>

### Composite Health Index

<table>
<thead>
<tr>
<th>Asset</th>
<th>Inventory</th>
<th>Average Age</th>
<th>Outstanding PPA</th>
<th>Total # of PPA</th>
<th>3 Spent on Prev</th>
<th>Prev 3 Spent per year</th>
<th>2 YR PR Mtd Cost Benchmark</th>
<th>Ratio of 3 Spent to Total</th>
<th>3 Spent on Cont/Emerg - PM</th>
<th>Total # of DR &amp; TO</th>
<th>Outstanding Diffs</th>
<th>3 Spent on Cont/Emerg</th>
<th>Cont/Pct Spent per Unit</th>
<th>Curr/Pct Spent per Unit</th>
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<td>AC Station Service</td>
<td>1</td>
<td>5.0</td>
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<td>450</td>
<td>270</td>
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<td>0.13</td>
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<td>Breaker - Oil LV</td>
<td>6</td>
<td>-</td>
<td>28</td>
<td>557</td>
<td>1,057</td>
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<td>Breaker - SF6 LV</td>
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<td>3.0</td>
<td>4</td>
<td>5,000</td>
<td>4,000</td>
<td>1,273</td>
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<tr>
<td>Buses LV</td>
<td>2</td>
<td>-</td>
<td>6</td>
<td>97</td>
<td></td>
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<td></td>
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<td>Control</td>
<td>6</td>
<td>-</td>
<td>0</td>
<td>17</td>
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<td>DC Station Service</td>
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<td>14.3</td>
<td>22</td>
<td>2,256</td>
<td>4,411</td>
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<td>HV Instrument Transformers</td>
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<td>-</td>
<td>-</td>
<td>-</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Protection</td>
<td>24</td>
<td>-</td>
<td>60</td>
<td>12,500</td>
<td>222</td>
<td>420</td>
<td>27.0</td>
<td>2</td>
<td>4.65</td>
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<td>Site</td>
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<td>-</td>
<td>111</td>
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<td>Switches 1LV</td>
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<td>-</td>
<td>14</td>
<td>14</td>
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<td>Switches LV</td>
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<td>71</td>
<td>52</td>
<td>109</td>
<td>109</td>
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<td>105.5</td>
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<td>Telecom</td>
<td>17</td>
<td>40.0</td>
<td>14</td>
<td>9,223</td>
<td>348</td>
<td>26</td>
<td>55.0</td>
<td>8</td>
<td>11,291</td>
<td>564</td>
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<tr>
<td>Transformer - Power 230</td>
<td>2</td>
<td>40.0</td>
<td>53</td>
<td>29,740</td>
<td>8,922</td>
<td>2,025</td>
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<td>7.45</td>
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<tr>
<td>Transformer - Station Service</td>
<td>2</td>
<td>40.0</td>
<td>6</td>
<td>118</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Others</td>
<td>10</td>
<td>8.8</td>
<td>9</td>
<td>58</td>
<td>58</td>
<td>58</td>
<td>71.6</td>
<td>4</td>
<td>18,976</td>
<td>1,483</td>
<td></td>
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Note: SAP Cont/Emerg Costs information is only available from mid 2009 onwards.

### Condition / Health

### Performance Index

<table>
<thead>
<tr>
<th>Performance Asset</th>
<th>Inventory</th>
<th>PFA</th>
<th>Protection</th>
<th># Of Direct Sustained Forced Outages</th>
<th>Outage Freq (Cicy/yr)</th>
<th>Benchmark HIn (6 Year)</th>
<th>Outage Minutes</th>
<th>Avg Min (hrs/mo)</th>
<th>Unavailability (hrs/Yr)</th>
<th>Benchmark HIn</th>
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<tr>
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<td>-</td>
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<td>-</td>
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<td>0.0019</td>
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<td>-</td>
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<td>-</td>
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<td>0.0003</td>
<td>1.450</td>
<td>12.68</td>
<td>73.73</td>
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</tbody>
</table>

### Performance by Asset Type

<table>
<thead>
<tr>
<th>Performance Asset</th>
<th>Inventory</th>
<th>PFA</th>
<th>Protection</th>
<th># Of Direct Sustained Forced Outages</th>
<th>Outage Freq (Cicy/yr)</th>
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<th>Outage Minutes</th>
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<th>Unavailability (hrs/Yr)</th>
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<td>-</td>
<td>-</td>
<td>0.0030</td>
<td>0.0030</td>
<td>0.025</td>
<td>13.14</td>
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<tr>
<td>Transformer 230</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>0.0002</td>
<td>0.0003</td>
<td>1.450</td>
<td>12.68</td>
<td>73.73</td>
<td></td>
</tr>
</tbody>
</table>

### Frequency of Forced Direct Sustained Outages

- Frequency of Forced Direct Sustained Outages
- Duration of Forced Direct Sustained Outages

### Benchmark HIn

- Benchmark HIn: 254.1
Top 20 Stations by Actual Dollars Spent
DEMO BI-AM-RPT-1.3.3 - Asset Type and Age View

Calendar Year: All
Calendar Month: All
Asset Type: All

Zone/District: All
Station/Circuit: All
Nominal Voltage: All
WO Type: All

Report Date: 6/6/10

Asset Cost by Age

Actual Amount

Age Number
Hydro One Roadmap
Questions?
Next Generation Asset Management

1. Next generation asset management capabilities

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Toronto Hydro Roadmap

RCM – Reliability Centered Maintenance
ACA – Asset Condition Assessment
FIM – Feeder Investment Model
AIS – Asset Investment Strategy
PAS 55 and Condition Assessment (ACA)

Total Business

Human Assets

Physical Assets

Intangible Assets

PAS 55

SCOPE OF

Financial Assets

Information Assets

Subject Matter Experts

Asset Age

RCM Processes

Feeder Patrols

Health Index

Weighted Degradation Factors

Inspection Data
Quantifying Cost Of Risk

From Information to Decision Power

Asset Data

ACA
Asset Register
Reliability Metrics

Probability of Asset Failure
Impact of Asset Failure

Quantifying Cost Of Risk

Optimal Intervention Time
With the optimal timing of intervention produced for each individual asset, high-risk “hotspots” can be easily identified and displayed.

Toronto Hydro can deploy a series of proactive actions to mitigate the identified risks within these identified hot-spot locations.
This approach allows Toronto Hydro to take the Right Actions, on the Right Assets, at the Right Time.
Loading and Demand

Factors

• Provide insight into how demand and load is distributed among monitored transformers
• Provide a snapshot of under- or over-utilized transformers, resulting in better planning and utilization of existing and future equipment

Analytics and Reporting

• **Use Factor** – Relationship between the peak demand on a transformer, and the rating of that transformer.
• **Demand Factor** – Relative portion of load on a circuit compared to load on a particular transformer.
• **Coincidence Factor** – Relationship between the system peak and the individual peaks of the transformers.
• **Load Factor** – Indicates the variation in demand.
• **Voltage Profile** – Implementation delivered enables an understanding of how voltage decreases over transformers on a circuit.
Distribution Transformer Monitoring (cont.)

Reliability Analysis
• Reliability metrics indicate both the frequency and duration of outages
• Metrics provided can help detect patterns in recurring outage areas and allow operators to better identify the root cause of events

Analytics and Reporting
• Geospatial Distribution of Outages
  – Color coded contour regions are overlaid on the map based on outage time, red being the longest duration
• Distressed Assets
  – A heat map provides a visual representation of outage duration and frequency
Questions?
Next Generation Asset Management

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Utility Decision Environment of the Future

Emerging best practices for providing real-time analytics and business intelligence to operate the “data-driven” utility of the future will impact all levels of T&D utility organizations.
Additional Questions?
Just type them in
Thank you and more information

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http://www.accenture.com/Global/Services/By_Industry/Utilities/Services/Accenture-Grid-Solutions.htm