9:00 a.m. to 11:00 a.m. today
Terry Oliver, Chief Technology Innovation Officer, Bonneville Power Administration
What are the Top 3 Technology or Policy Drivers to Achieve (Near) Zero Outage?
Terry Oliver's Panel

Tom Dunn
CEO, Vermont Electric Company

Gary Gauthier
Director, Information Office, DTE Energy

Hagen Haentsch
Director, Ops. & Asset Investment, Oncor

Frank Doherty
R&D Project Manager, Con Edison

Tarun Kumar
STSM & Sr. Mgr., Smarter Energy, IBM Research
Poll Question

What is the most important resiliency detractor for your organization or geography?

- Severe weather
- Other acts of God (e.g., natural disasters)
- Human activity (cars, construction, etc.)
- Wildlife (rodents, birds, etc.)
- Cyber attacks
- Intermittent generation
- Voltage imbalances
- Other
You Want to do WHAT?!?

JUNE 18, 2015

TERRY OLIVER
Chief Technology Innovation Officer
Bonneville Power Administration
Getting to (zero?) Outages

UNPLANNED, SAIDI - all interruptions
Average annual time of interruption (minutes)
First in World Using EPS, Inc. Triple Friction Pendulum (TFP) Base Isolation Technology

First in United States
This Transformer Will Move How Far?!?
Switch to Frank Doherty’s PDF

Con Edison
VELCO’s Work on Reliability and Resiliency

Tom Dunn
President and CEO
VELCO asset growth 2000-2014

![Graph showing asset growth from 2000 to 2014. The y-axis represents millions of dollars, and the x-axis represents the years from 2000 to 2014. The values range from 83.8 million dollars in 2000 to 1018.4 million dollars in 2014.](image-url)
Extreme weather impacts

Weather-Related Power Outages Increased Dramatically in the 2000s

Source: “Blackout: Extreme Weather, Climate Change and Power Outages” (Climate Central)
Increase of solar generation “behind the meter” is offsetting VELCO demand curve
EE Affects New England’s Electricity Consumption

*Peak demand growth is lower; energy use is flat*

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**Summer Peak (MW)**

- The gross forecast of energy use for the region
- The forecast minus the impact of EE resources participating in Forward Capacity Market auctions to date

**Annual Energy (GWh)**

- The forecast minus anticipated EE growth

Communications critical

Statewide Infrastructure

- eEnergy VT smart grid
- Fiber optic network
- Radio system
VELCO-IBM
Vermont Weather Analytics Center
Strategic Initiatives

Champion
- Champion an energy future aligned with Vermont values

Deliver
- Deliver value to owners, Vermont, the region and each other

Transform
- Transform VELCO’s culture to live Trusted Partner

FOR THE SAKE OF THRIVING

FOR THE SAKE OF PERFORMANCE

FOR THE SAKE OF A STRONG FOUNDATION
And now as we embrace change:

“Our great new adventure.”
Grid Resiliency Panel Discussion
Opening Statement – June 2015

Gary Gauthier
IT Manager – Electric Reliability Strategy & Research
• Dual Sources of Negative Impact
  – Weather Related Damage
  – Asset Health Implications

• Dual Areas of Focus for Improvement
  – System Hardening
  – System Operability
Profile of DTE Electric & Impact of Storms

- Twelfth largest US electric utility with 2.1 million customers
- ~$5 billion in revenue, $17 billion in assets
- ~12,000 MW Electric Generation
- 9 Fossil Fuel Plants; 1 Nuclear Power Plant; >10% Renewables

### Distribution Assets
- 7,600 square-mile service area
- 12 Service Centers
- 678 distribution substations
- 2,800 Distribution Circuits
- 450,000 Distribution Transformers
- 46,000 miles of power lines
- 1,000,000 Wooden Poles

- On average DTE has 12 – 15 storm related disruptions impacting >10k customers per year
- There were 19 such storms in 2014
- 7 impacting more than 110,000 customers each

<table>
<thead>
<tr>
<th>Customer</th>
<th>Count</th>
<th>Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>1,920k</td>
<td>34%</td>
</tr>
<tr>
<td>Commercial</td>
<td>197k</td>
<td>44%</td>
</tr>
<tr>
<td>Industrial</td>
<td>1k</td>
<td>22%</td>
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</table>
Circuit Health Disproportionately Impacts SAIDI

Circuits by System Health Decile

Contribution to system SAIDI in 2014

<table>
<thead>
<tr>
<th>Score</th>
<th>Count</th>
<th>Circuit SAIDI</th>
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<tbody>
<tr>
<td>1.0</td>
<td>6</td>
<td>1,032</td>
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<tr>
<td>2.0</td>
<td>29</td>
<td>769</td>
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<td>166</td>
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<tr>
<td>10.0</td>
<td>244</td>
<td>44</td>
</tr>
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## Four Plus One Investment Categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Programs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary Focus Programs Included</strong></td>
<td>Preventive, predictive and corrective maintenance programs</td>
</tr>
<tr>
<td></td>
<td>Pole top maintenance and vegetation management programs</td>
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<tr>
<td></td>
<td>Capital replacement programs</td>
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<tr>
<td></td>
<td><strong>System Hardening</strong></td>
</tr>
<tr>
<td></td>
<td>Maintain “baseline” reliability performance (once backlogs have been addressed)</td>
</tr>
<tr>
<td></td>
<td>Ensure sustainability of operating cost in long run</td>
</tr>
<tr>
<td></td>
<td><strong>System Operability</strong></td>
</tr>
<tr>
<td></td>
<td>Invest in design health to gradually improve system reliability performance</td>
</tr>
<tr>
<td></td>
<td><strong>System Technology</strong></td>
</tr>
<tr>
<td></td>
<td>Invest in technology to enhance monitoring and automation across the system</td>
</tr>
<tr>
<td></td>
<td><strong>Infrastructure Renewal</strong></td>
</tr>
<tr>
<td></td>
<td>Invest in structural changes that drive significant performance improvements</td>
</tr>
<tr>
<td></td>
<td><strong>Reactive Programs</strong></td>
</tr>
<tr>
<td></td>
<td>Address specific, local reliability issues that have a significant, negative impact on customer satisfaction and/or trigger MPSC complaints</td>
</tr>
<tr>
<td></td>
<td>These will decline over time</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category</th>
<th>Programs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Secondary Improvement Programs</strong></td>
</tr>
<tr>
<td></td>
<td>Supported by update of engineering standards and overhaul of engineering organization</td>
</tr>
<tr>
<td></td>
<td><strong>Load Planning Program</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Circuit Modernization and System Hardening Programs</strong>²</td>
</tr>
<tr>
<td></td>
<td><strong>SCADA Program</strong></td>
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<td><strong>IT/OT System Integration Program</strong></td>
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<td></td>
<td><strong>SOC Renovation</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Programs Covering Strategies for Aging Infrastructure (4.8 KV and 24 KV Systems)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>CEMI4 Program (&quot;Bad Pocket&quot;)</strong></td>
</tr>
<tr>
<td></td>
<td>Other programs (e.g., worst performing feeder, CELID, Power Quality, System Improvement Program)</td>
</tr>
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Driven By Pursuit of Corporate Priorities

<table>
<thead>
<tr>
<th>Top Decile Customer Satisfaction</th>
<th>Sup. &amp; Sus. Financial Performance</th>
<th>Highly Engaged Employees</th>
<th>Growth &amp; Value Creation</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAIFI / SAIDI</td>
<td>Power Quality (ind./res.)¹</td>
<td>O&amp;M</td>
<td>System Modernization²</td>
</tr>
<tr>
<td>CAIDI</td>
<td></td>
<td>Safety</td>
<td></td>
</tr>
</tbody>
</table>

**Primary Focus**

- **System Hardening**: Maintain "baseline" reliability performance. Ensure sustainability of operating cost in long run.
- **System Operability**: Invest in design health to gradually improve system reliability performance.
- **System Technology**: Invest in technology to enhance monitoring and automation across the system.
- **Infrastructure Renewal**: Invest in structural changes that drive significant performance improvements.
- **Reactive Programs**: Address specific, local reliability issues that have a significant, negative impact on customer satisfaction.

1. Exact definition/metric yet to be determined
2. Ability of the distribution system to handle changes triggered by disruptive technologies (e.g., increase in distributed generation/net metering)
What are the Top 3 Technology or Policy Drivers to Achieve (Near) Zero Outage?

Hagen Haentsch
Director, Distribution Operations Center - West
Driver #1: The Customer

The customer drives technology and policy developments

Technology:

1. Changing customer expectations across various industries are driven by user experiences shaped by Apple, Google, the Internet and mobile communication services
2. Distributed generation increases equipment diversity and network volatility
3. Cost consciousness drives energy efficiency and improved asset utilization
4. Sustainability and environmental concerns increase cost of energy

Changing and conflicting customer demands are resulting in an increased diversification of services and technologies.
Driver #1: The Customer

The customer drives technology and policy developments

Policy:

1. Policy frameworks lag behind customer demands and technology developments
2. Changing policy agendas constrain viability of long-term investments
3. Security requirements represents gatekeeper to technological innovation
4. Competing business models: fully integrated vs. open grid/unbundle

Changing technologies and policies increase risk of stranded investments.
How does increased customer and technology diversity impact reliability?

**Minimizing Duration:**
- D-SCADA, automation
- AMS/OMS integration
- Data model accuracy and analytics
- Fault identification

**Avoidance:**
- Load management, dynamic grid mgmt.
- Better planning tools
- Resource diversity

**Negative:**
- Increased complexity, lack of standards
- Low maturity, shorter product lifecycles
- Regulatory gaps/lag (i.e. storage)
- Investment & maintenance uncertainty
- Lagging workforce skill sets and tools
- Unintended consequences of government subsidies
- Regulatory uncertainty
Poll Question

Which grid level has the most promising potential for improving power service resiliency?

- Improved generation availability
- Transmission reliability
- Distribution reliability
- Microgrids
- Customer premise backup
Terry Oliver's Panel

Tom Dunn  
CEO, Vermont Electric Company

Gary Gauthier  
Director, Information Office, DTE Energy

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Director, Ops. & Asset Investment, Oncor

Frank Doherty  
R&D Project Manager, Con Edison

Tarun Kumar  
STSM & Sr. Mgr., Smarter Energy, IBM Research
Poll Question

Which is the top investment or change that will help improve resilience?

- Maintenance of existing infrastructure
- Distribution automation
- Tree trimming
- Advanced analytics and data
- Grid capacity and redundancy increases
- Automated metering systems (AMS/AMI)
- Put facilities underground