• The North American Electric Reliability Corporation is the Electric Reliability Organization (ERO)
  ▪ Develop and enforce reliability standards
  ▪ Annually assess seasonal and long-term reliability
  ▪ Monitor the transmission system
  ▪ Educate, train, and certify industry personnel

• Oversight from the Federal Energy Regulatory Commission (FERC) and Provincial authorities in Canada

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRCC</td>
<td>Florida Reliability Coordinating Council</td>
</tr>
<tr>
<td>MRO</td>
<td>Midwest Reliability Organization</td>
</tr>
<tr>
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<td>Northeast Power Coordinating Council</td>
</tr>
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<td>RFC</td>
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</tr>
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<td>SERC Reliability Corporation</td>
</tr>
<tr>
<td>SPP-RE</td>
<td>Southwest Power Pool Regional Entity</td>
</tr>
<tr>
<td>TRE</td>
<td>Texas Reliability Entity</td>
</tr>
<tr>
<td>WECC</td>
<td>Western Electric Coordinating Council</td>
</tr>
</tbody>
</table>
- Reliability “Building blocks”
- Accentuated by resource changes
- Partly covered through ancillary services
- Accommodate local/regional needs
Six Essential Reliability Services

- Operating Reserve
- Frequency Response
- Ramping Capability
- Active Power Control
- Reactive Power and Voltage Control
- Disturbance Performance
2013 LTRA Recommendation

- Develop primer on essential reliability services (ERS):
  - Develop a reference document on ERS
  - Operational requirements needed to ensure bulk electric system (BES) reliability
Important Take-Aways

• Physics of the BES remain constant
  ▪ Voltage, frequency and load/resource balance require ERS to be supported at all times

• Not all MWs are equal
  ▪ Having adequate resources does not equate to the right type of resources

• Changing resource mix impacts ERS
  ▪ “Reliability building blocks” are integral to a reliability BES and must be maintained

Figure 13: ERS are the building blocks of reliability and are impacted by resource mix changes
Objectives of ERS Tutorial

- Identify each of the **essential reliability services**
  - Simple tutorial
  - Functional, technology neutral, and performance-based

- Importance of ERS for reliability
  - How does the resource mix change ERS?
  - What happens when you don’t have ERS?

- **Target Audience**: regulators, policy makers, and industry leadership

Next Steps

• NERC staff report provides a foundation for task force
• Framework to address ERS expected in Q4 2014:
  ▪ Measures for planning and operations timeframes
  ▪ Identify parameters and performance needs
  ▪ Develop reference and guidance documents
  ▪ Coordinate initiatives, guidelines, and standards
• Final Assessment completed in 2015
Polar Vortex Report Update

Mark Lauby, Senior Vice President and Chief Reliability Officer
Annual Meeting of the National Conference of State Legislators
August 20, 2014
Polar Vortex Scope of Impact

FRCC  Florida Reliability Coordinating Council
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### New Winter Peak Loads

<table>
<thead>
<tr>
<th></th>
<th>MISO</th>
<th>ISO-NE</th>
<th>NYISO</th>
<th>PJM</th>
<th>SPP</th>
<th>TVA</th>
<th>VACAR</th>
<th>South-eastern RC</th>
<th>TRE</th>
<th>FRCC</th>
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<tbody>
<tr>
<td>Previous Winter peak (% of previous peak)</td>
<td>99,855</td>
<td>22,818</td>
<td>25,541</td>
<td>133,844</td>
<td>32,635</td>
<td>43,384</td>
<td>42,983</td>
<td>46,259</td>
<td>57,265</td>
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<tr>
<td>6-Jan-14</td>
<td>109,307</td>
<td>18,500</td>
<td>23,197</td>
<td>131,841</td>
<td>36,602</td>
<td>43,277</td>
<td>50,659</td>
<td>44,871</td>
<td>56,031</td>
<td>30,231</td>
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<tr>
<td></td>
<td>(109.5%)</td>
<td>(81.1%)</td>
<td>(90.8%)</td>
<td>(98.5%)</td>
<td>(112.2%)</td>
<td>(99.8%)</td>
<td>(117.9%)</td>
<td>(97.0%)</td>
<td>(97.8%)</td>
<td>(81.9%)</td>
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<tr>
<td>7-Jan-14</td>
<td>104,746</td>
<td>21,300</td>
<td>25,738</td>
<td>141,846</td>
<td>36,079</td>
<td>44,285</td>
<td>44,654</td>
<td>48,279</td>
<td>57,277</td>
<td>35,638</td>
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<tr>
<td></td>
<td>(104.9%)</td>
<td>(93.3%)</td>
<td>(100.8%)</td>
<td>(105.9%)</td>
<td>(110.6%)</td>
<td>(102.1%)</td>
<td>(103.9%)</td>
<td>(104.4%)</td>
<td>(100.0%)</td>
<td>(96.5%)</td>
</tr>
<tr>
<td>8-Jan-14</td>
<td>100,154</td>
<td>20,800</td>
<td>24,551</td>
<td>134,021</td>
<td>31,944</td>
<td>39,820</td>
<td>43,203</td>
<td>47,005</td>
<td>45,281</td>
<td>29,251</td>
</tr>
<tr>
<td></td>
<td>(100.3%)</td>
<td>(91.2%)</td>
<td>(96.1%)</td>
<td>(100.1%)</td>
<td>(97.9%)</td>
<td>(91.8%)</td>
<td>(100.5%)</td>
<td>(101.6%)</td>
<td>(79.1%)</td>
<td>(79.2%)</td>
</tr>
</tbody>
</table>

**New all-time winter peak**
Generator Performance: Common Trends

- **Fuel**
  - natural gas interruptions: supply injection, compressor outages, and one pipeline explosion
  - fuel oil delivery problems
  - inability to procure gas
  - fuel oil gelling

- **Cold weather effects**
  - wind turbine low temperature limits
  - hydro icing
  - failed auxiliary equipment
  - stress of extended run times

- **Frozen instrumentation**
  - drum level sensors
  - control valves
  - flow and pressure sensors
NERC: Eastern Interconnection
Generator Outages vs Temperature

NERC (No WECC): Cumulative Impact of Outage Type vs Temperature (F)
SERC: Outage vs Temperature

SERC: Cumulative Impact of Outage Type vs Temperature (F)
Observations and Recommendations

- Polar Vortex was an extreme event that tested resiliency
- Gas availability challenges highlighted in forced outage rates
- Sustain industry winter weather preparedness
- Share lessons learned in both operations and maintenance
Questions and Answers
Background
SPP: Cumulative Impact of Outage Type vs Temperature (°F)
RF: Cumulative Impact of Outage Type vs Temperature (F)

MWh

- Unrelated Outages
- Unknown Outages
- Misc Outages
- Cold Outages
- Fuel Outages
- RF Temp

Temperature in Fahrenheit
Outages by Fuel Type

- Gas: 5%
- Coal: 26%
- Waste Heat: 55%
- Distillate Oil: 5%
- Other - Solid (Tons): 5%
- Oils: 5%
- Nuclear: 5%
- Water: 5%
- Lignite: 5%
- Kerosene: 5%
- Other - Liquid (BBL): 5%
- Biomass: 5%
- JP4 or JP5: 5%
- Peat: 5%
- Petroleum Coke: 5%
- Wood: 5%