Update on Winter Season Resource Adequacy Analysis

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Manager, Resource Adequacy Planning
Planning Committee
July 13, 2017
Winter Risk

Winter Season Resource Adequacy and Capacity Requirements
Issue Charge is posted at:

http://www.pjm.com/~/media/committees-groups/committees/mrc/20161117/20161117-item-09-winter-reliability-requirement-ps-ic-clean.ashx

The Issue Charge has three Key Work Activities

• Winter peak load forecasting
• Winter season resource adequacy
• Winter season reliability requirements
Areas of Investigation

- Winter Load Forecast Accuracy
  - Monthly load profile and forecast uncertainty
- Winter Generation Performance
  - Common mode failures
  - Correlation with load level
  - Maintenance scheduling
- Transmission System
  - Planned and forced outages
PJM - Forced and Planned Outages (Peak Winter Week)

![Graph of Generation Outages Density Functions - PJM](Image)

- **DensityType**
  - History
  - HistoryMod
  - PRISM

![Boxplot of Planned Outage Rates in Winter Weeks - PJM](Image)

- **Load Magnitude-Ordered Winter Week**
MAAC - Forced and Planned Outages (Peak Winter Week)
Scenario 1 – Current Model

- PRISM Forced Outages & PRISM Planned Outages
  - Regular PRISM runs
  - Individual unit EFORd’s are used by PRISM to develop Available Capacity cumulative distribution via convolution.
  - Planned Outages are scheduled by PRISM to levelize weekly reserves.
• Historical Forced Outages & PRISM Planned Outages
  – Forced Outages are observed values from the five weekdays of the peak load week of each of the winters over the 9-yr period (DY07-DY15). (45 data points.)
  – Available capacity cumulative distribution is developed by assuming that each of the 45 observations is equally likely to happen. Lumpiness of cumulative distribution is addressed by using linear interpolation. (Red curves on slides 5 and 6.)
  – Planned Outages are scheduled by PRISM.
Scenario 3

- **Historical Forced Outages & Mean Historical Planned Outages**
  - Forced outages and available capacity cumulative distribution are as per Scenario 2.
  - Planned Outages are observed values from the five weekdays of each week in each winter over the 9-yr period (DY07-DY15). (The winter weeks are combined based on load magnitude, not calendar order.)
  - The **mean** of each week is calculated and assumed to be the amount of Planned Outages in each winter week.
Scenario 4

- **Historical Forced Outages & Max Historical Planned Outages**
  - Forced outages and available capacity cumulative distribution are as per Scenarios 2 and 3.
  - Planned Outages are observed values from the five weekdays of each week in each winter over the 9-yr period (DY07-DY15). (The winter weeks are combined based on load magnitude, not calendar order.)
  - The **maximum** of each week is calculated and assumed to be the amount of Planned Outages in each winter week.
In addition,

- A variation of the Historical scenarios is also included. The variation removes Winter 14/15 peak week data (first polar vortex) and replaces it with Winter 15/16 peak week data (second polar vortex). (Green curves on slides 5 and 6.)
Winter LOLE Results (in days/year) - RTO

All columns (except the first one) in days/years

<table>
<thead>
<tr>
<th>Load-Magnitude Winter Week</th>
<th>PRISM Forced Outages &amp; PRISM Planned Outages</th>
<th>Historical Forced Outages &amp; PRISM Planned Outages</th>
<th>Historical Forced Outages &amp; Mean Historical Planned Outages</th>
<th>Historical Forced Outages &amp; Max Historical Planned Outages</th>
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<tbody>
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</table>

Removing Winter 14/15 peak week data and replacing it with Winter 15/16 peak week data

<table>
<thead>
<tr>
<th>Load-Magnitude Winter Week</th>
<th>Historical Forced Outages &amp; PRISM Planned Outages</th>
<th>Historical Forced Outages &amp; Mean Historical Planned Outages</th>
<th>Historical Forced Outages &amp; Max Historical Planned Outages</th>
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<tbody>
<tr>
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</table>
Winter LOLE Results (in days/year) - MAAC

All columns (except the first one) in days/years.

<table>
<thead>
<tr>
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</thead>
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Removing Winter 14/15 peak week data and replacing it with Winter 15/16 peak week data

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Winter LOLE Results (in days/year) - EMAAC

All columns (except the first one) in days/years.

<table>
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<th>Historical Forced Outages &amp; Max Historical Planned Outages</th>
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<td>0.00E+00</td>
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</table>
• LOLE presented in previous slides only considers impact of historical *generation* forced and planned outages.

• Need to also consider LOLE risk due to winter *transmission* outages that may affect deliverability of generation.
Transmission Outage Tickets

• Transmission Outage tickets in eDART can be flagged as market-sensitive.
  – Market-sensitive refers to tickets that have an impact on generation output.

• Over the last four winter seasons, a total of 28,964 transmission outage tickets were recorded. 1,871 (or about 7%) of these tickets were flagged as market-sensitive.

• 46 of the 1,871 market-sensitive tickets span one of the top 20 RTO winter peak load days in the examined period.
  – Load on those days ranges from 129,775 MW to 143,000 MW.
Next Steps

• Compute summer and winter reliability requirements for the RTO and for selected LDAs.
• Continue investigation of winter load forecast model.
• Upcoming RAAS conference calls:
  – Friday, Aug. 4 (9:30 AM – 11:30 AM)
  – Thursday, Sept. 7 (1:30 PM – 3:30 PM)