Analysis of Light Load Historical Data and Light Load Reliability Criterion

PJM Planning Committee
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• “Light Load Period”
  – November 1st – April 30th, Hours Ending 01:00 – 05:00
  – High wind capacity factors

• Recently re-evaluated 3 years of historical nuclear, oil, coal, natural gas, and wind generation during the light load period to benchmark the test procedure to real time data

• Reviewed the data to determine how well the current study parameters correlate to the observed data
  – Load
  – Generation
  – Interchange
Light Load - Background

- Light Load Reliability Analysis is conducted in order to ensure that the PJM transmission system can reliably deliver the system generating capacity during light load conditions.

- During the light load period, PJM Operations experiences constraints due to over generation in the West and low loads seen in the Michigan and MAAC areas
• **Analytical Procedure Review**
  – In the Light Load Reliability Analysis, the entire wind fleet (or any other fuel type available to ramp per the test) is not ramped simultaneously
  – Units are ramped on a flowgate by flowgate basis and only the electrically closest generation is ramped
    • E.g. The test method will not ramp generation in PJM West for an electrically distant transmission flowgate in MAAC
  – Typically, only a handful of units that are electrically close to a single flowgate are ramped in the Light Load Reliability Analysis

• **Historical average capacity factors are used for initial target dispatch**
  – Recent historical data demonstrates that natural gas is no longer offline during light load period
• The Light Load Reliability Criteria (and other deliverability tests that ramp generation limit the amount of generation that is ramped to:
  – The electrically closest generation to the specific flowgate under study
    • 5% DFAX or 10% DFAX depending on the voltage of the facility
  – A statistically probable group
    • per the 80/20 or 50/50 procedure
Max and Average Wind Capacity Factors During Light Load Periods in the PJM RTO

- **Max CF**
- **Average CF**
- **80%**
Max and Average Wind Capacity Factors During Light Load Periods in ComEd

![Chart showing maximum and average wind capacity factors during light load periods in ComEd. The chart includes dates and corresponding capacity factors, with a red line at 80%.](chart.png)
Max and Average Wind Capacity Factor During Light Load Periods in MAAC

- Max CF
- Average CF
- 80%
Generation Sensitivity Study
• For the Light Load sensitivity analysis, units were initially dispatched to the following parameters, unless required to be ramped up beyond the initial target dispatch in order to meet the required load + interchange.

Table 1: Current vs. Sensitivity Study Light Load Base Case Initial Target Dispatch

<table>
<thead>
<tr>
<th>Generation Type</th>
<th>Current Initial Target Dispatch (% of Pmax)</th>
<th>Sensitivity Study Initial Target Dispatch (% of Pmax)</th>
<th>Total Available MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear</td>
<td>100%</td>
<td>100%</td>
<td>34,571</td>
</tr>
<tr>
<td>Oil</td>
<td>0%</td>
<td>0%</td>
<td>N/A</td>
</tr>
<tr>
<td>Coal &gt;= 500 MW</td>
<td>60%</td>
<td>55%</td>
<td>45,212</td>
</tr>
<tr>
<td>Coal &lt; 500 MW</td>
<td>45%</td>
<td>25%</td>
<td>16,031</td>
</tr>
<tr>
<td>Natural Gas: Combined Cycle &amp; &gt;=400MW</td>
<td>0%</td>
<td>45%</td>
<td>36,287</td>
</tr>
<tr>
<td>Natural Gas: &lt;400MW</td>
<td>0%</td>
<td>0%</td>
<td>N/A</td>
</tr>
<tr>
<td>Wind</td>
<td>40%</td>
<td>40%</td>
<td>8,748</td>
</tr>
</tbody>
</table>
In the Light Load sensitivity analysis (which is similar to the Generator Deliverability and Common Mode Outage test), generation was ramped to the following parameters:

Table 2: Current vs. Sensitivity Study Light Load Study Generation Ramping Limits

<table>
<thead>
<tr>
<th>Generation Type</th>
<th>Current Ramping Limits (% of Pmax)</th>
<th>Sensitivity Study Ramping Limits (% of Pmax)</th>
<th>Total Available MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear</td>
<td>100%</td>
<td>100%</td>
<td>950</td>
</tr>
<tr>
<td>Oil</td>
<td>0%</td>
<td>0%</td>
<td>N/A</td>
</tr>
<tr>
<td>Coal &gt;= 500 MW</td>
<td>60%</td>
<td>55%</td>
<td>3490</td>
</tr>
<tr>
<td>Coal &lt; 500 MW</td>
<td>45%</td>
<td>25%</td>
<td>9068</td>
</tr>
<tr>
<td>Natural Gas: Combined Cycle &amp; &gt;=400MW</td>
<td>0%</td>
<td>45%</td>
<td>13751</td>
</tr>
<tr>
<td>Natural Gas: &lt;400MW</td>
<td>0%</td>
<td>0%</td>
<td>N/A</td>
</tr>
<tr>
<td>Wind</td>
<td>80%</td>
<td>100%</td>
<td>20751</td>
</tr>
</tbody>
</table>
Sensitivity study:
- enforce updated generation parameters but not the updated lower demand level

Total of 34 unique thermal violations in AEP, AP, PENELEC, ATSI, DPL, and ComEd
- kV level ranging from 69kV – 345kV
- Currently investigating conductor limits

Table 3: Summary of Potential Thermal Violations

<table>
<thead>
<tr>
<th></th>
<th>AEP</th>
<th>AP</th>
<th>PENELEC</th>
<th>AP / PENELEC</th>
<th>ATSI</th>
<th>DPL</th>
<th>ComEd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Potential Violations</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>kV Level</td>
<td>345</td>
<td>138</td>
<td>115/345</td>
<td>115/138</td>
<td>115</td>
<td>345</td>
<td>69</td>
</tr>
<tr>
<td>Contingency Type</td>
<td>Single</td>
<td>Single</td>
<td>Basecase</td>
<td>Single</td>
<td>Single</td>
<td>Breaker</td>
<td>Single</td>
</tr>
<tr>
<td>Possible Conductor Limits</td>
<td>5</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>TBD</td>
<td>1</td>
<td>None</td>
</tr>
</tbody>
</table>

*All violations are potential violations, currently working to validate the results with the PJM TOs*
• One unique AP 115kV bus experiencing high voltage for several single contingencies

• One PENELEC 345kV bus experiencing high voltage for a single contingency

• One unique METED 115kV buses experiencing high voltage for several single contingencies

*All violations are potential violations, currently working to validate the results with the PJM TOs*
• Next Steps
  – Sensitivity Analysis:
    • PJM to test the sensitivity of the updated assumptions for the Light Load Reliability test and report back to the PC
      – Generation initial dispatch and ramping limits
        » Initial study complete, results validation underway
      – Lower load level
        » case creation underway
  – First Read at the MRC (only after PC review of sensitivity results)
  – Draft Manual 14B Language for PC review