Operating Reserves Educational Session (Updated)

Energy Market Uplift
Senior Task Force
June 11, 2014

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Monitoring Analytics
Operating Reserves

Operating reserves can be grouped into five categories:

- **Day-Ahead**
- **Balancing**
- **Reactive Services**
- **Black Start Services**
- **Synchronous Condensing**
Day-Ahead Charges

Millions (average per day)

Day-Ahead Operating Reserves
Unallocated Congestion

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Day-Ahead Charges

- Total Day-Ahead Operating Reserve Charges from Jan 2009 – Mar 2014:
  - $548 million

- From Day-Ahead Operating Reserve Credits (Not Black Start or Reactive):
  - $522 million (95% of all DA OR Charges)

- From Unallocated Congestion:
  - $27 million (5% of all DA OR Charges)
    - 75% or $20 million since Jan 2013.
Day-Ahead Credits Concentration

Top 10: 68%
Others: 32%
Day-Ahead Top 10 Units Distribution

Top 10 Distribution: 116 units.

Unit 1 was in top 10 in 62 months out of 63 months.
Top DA Operating Reserve Reasons

- Con Edison - PSEG wheel support and/or PS north thermal constraints relief.
- Long lead/run time coal units in three control zones committed to meet load and/or transfer interface relief.
Day-Ahead Allocation Recap

- Charges are paid by:
  - Day-Ahead Demand Bids (Load)
  - Day-Ahead Exports
  - Day-Ahead Decrement Bids (DECs)

- Charges are allocated across the entire RTO. Each transaction pays the same rate per day across the entire system.
Operating Reserves

Operating reserves can be grouped into five categories:

- Day-Ahead
- **Balancing**
- Reactive Services
- Black Start Services
- Synchronous Condensing
Balancing Charges

Balancing operating reserves:

• Balancing (make whole)
  • Reliability
    ◦ RTO, East or West
  • Deviations
    ◦ RTO, East or West
• Lost Opportunity Cost (LOC)
• Canceled Resources
Balancing Charges

- Balancing Operating Reserve (Make Whole)
- Lost Opportunity Cost
- Canceled Resources

Millions (average per day)
Balancing (BOR) Charges

- Total BOR Charges from Jan 2009 – Mar 2014:
  - $2,619 million

- From BOR Credits (make whole):
  - $1,901 million (73% of all BOR Charges)

- From LOC:
  - $698 million (27% of all BOR Charges)

- From Canceled Resources:
  - $20 million (<1% of all BOR Charges)
    - $0.5 million after Jun-2012 (wind LOC Rule): Before wind LOC rule, LOC paid to wind units was categorized as canceled resources.
Balancing (Make Whole) Credits Concentration

Top 10: 54%
Others: 46%
Balancing Top 10 Units Distribution

Top 10 Distribution: 136 units.
Unit 1 was in top 10 in 60 months out of 63 months.
Top Balancing Operating Reserve Reasons

- Con Edison - PSEG wheel support and/or PS north thermal constraints relief.
- Oil/Natural Gas steam turbines in two different control zones committed during peak periods to meet load.
DAOR and BOR Top 10 Units Distribution Comparison

Number of months in Top 10 (Day-Ahead and Balancing OR Credits)

Day-Ahead Balancing

Units 1 to 30 are listed on the x-axis, with corresponding bars indicating the number of months in the Top 10 for both Day-Ahead and Balancing OR Credits.
Balancing Charges

Reliability: 42%
Deviations: 58%
Balancing Charges

RTO Reliability
East Reliability
West Reliability

RTO Deviations
East Deviations
West Deviations
Balancing Charges Allocation

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Reliability Charges</td>
<td>$306</td>
<td>$488</td>
</tr>
<tr>
<td>RTO Share</td>
<td>39%</td>
<td>96%</td>
</tr>
<tr>
<td>East Share</td>
<td>22%</td>
<td>3%</td>
</tr>
<tr>
<td>West Share</td>
<td>39%</td>
<td>1%</td>
</tr>
<tr>
<td>Deviation Charges</td>
<td>$700</td>
<td>$406</td>
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<tr>
<td>RTO Share</td>
<td>82%</td>
<td>61%</td>
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<tr>
<td>East Share</td>
<td>13%</td>
<td>36%</td>
</tr>
<tr>
<td>West Share</td>
<td>4%</td>
<td>3%</td>
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</table>
Balancing Allocation Recap

- Reliability charges are paid by:
  - Real-time Load
  - Real-time Exports
- Reliability charges are allocated by region (RTO, East or West)

- Deviation charges are paid by:
  - Real-time deviations from day-ahead position
  - Deviations from desired output (units and DR)
- Deviation charges are allocated by region (RTO, East or West)
RTO Demand Deviations
12-month Rolling Totals

GWh
RTO Supply Deviations
12-month Rolling Totals

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## Balancing Rates

### Jan 2009 - Nov 2012

<table>
<thead>
<tr>
<th>Statistics</th>
<th>RTO</th>
<th>East</th>
<th>West</th>
<th>RTO</th>
<th>East</th>
<th>West</th>
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<tbody>
<tr>
<td>Average</td>
<td>0.04</td>
<td>0.04</td>
<td>0.09</td>
<td>0.79</td>
<td>0.22</td>
<td>0.10</td>
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<tr>
<td>Minimum</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td>Maximum</td>
<td>1.60</td>
<td>3.08</td>
<td>1.03</td>
<td>12.58</td>
<td>5.18</td>
<td>3.50</td>
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<tr>
<td>Standard Deviation</td>
<td>0.08</td>
<td>0.17</td>
<td>0.10</td>
<td>0.86</td>
<td>0.56</td>
<td>0.27</td>
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### Dec 2012 - Mar 2014

<table>
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<tr>
<th>Statistics</th>
<th>RTO</th>
<th>East</th>
<th>West</th>
<th>RTO</th>
<th>East</th>
<th>West</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>0.05</td>
<td>0.03</td>
<td>0.00</td>
<td>0.77</td>
<td>2.77</td>
<td>0.13</td>
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<tr>
<td>Minimum</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.01</td>
<td>0.00</td>
<td>0.00</td>
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<td>Maximum</td>
<td>0.80</td>
<td>2.89</td>
<td>0.13</td>
<td>10.17</td>
<td>32.88</td>
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<td>Standard Deviation</td>
<td>0.09</td>
<td>0.21</td>
<td>0.02</td>
<td>1.16</td>
<td>5.76</td>
<td>0.37</td>
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### Average Rates

<table>
<thead>
<tr>
<th>Average Rates</th>
<th>RTO</th>
<th>East</th>
<th>West</th>
<th>RTO</th>
<th>East</th>
<th>West</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan 2009 - Nov 2012</td>
<td>0.04</td>
<td>0.04</td>
<td>0.09</td>
<td>0.79</td>
<td>0.22</td>
<td>0.10</td>
</tr>
<tr>
<td>Dec 2012 - Mar 2014</td>
<td>0.05</td>
<td>0.03</td>
<td>0.00</td>
<td>0.77</td>
<td>2.77</td>
<td>0.13</td>
</tr>
<tr>
<td>Difference</td>
<td>0.01</td>
<td>(0.01)</td>
<td>(0.09)</td>
<td>(0.02)</td>
<td>2.55</td>
<td>0.03</td>
</tr>
<tr>
<td>Percentage</td>
<td>28%</td>
<td>(29%)</td>
<td>(96%)</td>
<td>(2%)</td>
<td>1,144%</td>
<td>28%</td>
</tr>
</tbody>
</table>
East Reliability Rate

$ per MWh

East Reliability Rate
Monthly Average East Reliability Rate
RTO Deviation Rate

Monthly Average RTO Deviation Rate

$ per MWh
East Deviation Rate

$ per MWh

East Deviation Rate
Monthly Average East Deviation Rate
West Deviation Rate

Monthly Average West Deviation Rate

$ per MWh
Lost Opportunity Cost Recap

- LOC is paid to units when:
  - Combustion turbine or diesel scheduled DA not called in RT. For purposes of this presentation, labeled as DA LOC.
  - Units reduced in real-time. For purposes of this presentation, labeled as RT LOC.

- LOC is paid by RTO deviations.

- Currently PJM posts one RTO Deviation Rate which combines the RTO Deviation Charges and the LOC Charges.
Lost Opportunity Cost

- LOC from Oct-2011 through Mar-2014: $397 million
  - Oct-2011: LOC calculations in settlement software were corrected to take into account “higher of price vs. cost offer” rule.
- DA LOC: $308 million (77%)
- RT LOC: $89 million (23%)
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