Market Settlements - Advanced

Operating Reserve Module
• Operating Reserves

  – Credits and Charges
What are Operating Reserves?

- **“Operations”** Definition of Operating Reserves
  - “Extra” available generation that is scheduled on a day-ahead basis and maintained in real-time
  - Defined in
    - PJM Pre-Scheduling Manual (M-10)
    - PJM Emergency Ops Manual (M-13)

- **“Accounting”** Definition of Operating Reserves
  - “Make-whole” payments to pool-scheduled generation and transactions
  - Defined in Operating Agreement
    - Schedule 1-3.2.3 & 3.3.3

- Following presentation deals with the **Accounting** Definition
Operating Reserves

Accounting for Operating Reserve is performed on a daily basis. A pool-scheduled resource of a PJM Member is eligible to receive credits for providing Operating Reserve in the day-ahead market and, provided that the resource was available for the entire time specified in its offer data, in the balancing market. The total resource offer amount for generation, including startup and no-load costs as applicable, is compared to its total energy market value for specified operating period segments during the day.

If the total value is less than the offer amount, the difference is credited to the PJM Member.
Credits for Operating Reserve are calculated for each of the following situations:

- pool-scheduled generating resources (day-ahead and balancing markets)
- pool-scheduled transactions (day-ahead and balancing markets)
- canceled pool-scheduled resources (balancing market)
- resources providing quick start reserve (balancing market)
- resources reduced or suspended due to a transmission constraint or for other reliability purposes (balancing market)
- resources performing annual scheduled black start tests (balancing market)
- resources scheduled to provide Black Start service (day-ahead and balancing market)
- synchronous condensing for purposes other than providing synchronized reserve
- resources providing reactive services
- dispatchable economic load reduction resources that follow dispatch (day-ahead and balancing markets)
Day-Ahead Operating Reserves Credits

• For each eligible resource, daily credit is day-ahead offer amount in excess of day-ahead market revenue
  – calculation uses day-ahead scheduled MWh, offer data, and day-ahead LMPs

• Total offered price for start-up and no-load costs and energy determined on the resources scheduled output shall be compared to the value of the resource’s energy determined by the Day-ahead Energy Market
Balancing Operating Reserve Credits

- Credits are for any portion of their offer amount in excess of:
  - Any day-ahead operating reserve credits
  - Any day-ahead scheduling reserve market revenues in excess of offer
  - Any synchronized reserve market revenues in excess of offer plus opportunity, energy use and startup costs
  - Any non-synchronized reserve market revenues
  - Any reactive services revenues
  - Any applicable reactive services credits
Day-Ahead Operating Reserve Charges

The total cost of Day-ahead Operating Reserve for the Operating Day, excluding the total cost for resources scheduled to provide Black Start Service, Reactive Service, or transfer interface control is allocated and charged to PJM Members as follows:

1. in proportion to their total cleared day-ahead demand

2. cleared decrement bids plus their cleared day-ahead exports for that Operating Day
Day-Ahead Operating Reserve Charges

Day Ahead Operating Reserves for resources that are committed in Day Ahead for reliability will be allocated as follows:

- Reactive Control and Interface Control <=345kv are allocated to the zone(s) that benefit from the generation
- Black Start is allocated by ratio share of the monthly transmission use of each network customer or transmission customer serving load according to the PJM tariff schedule 6A
Balancing Operating Reserve Charges

The total cost of Balancing Operating Reserve, excluding the total cost associated with scheduling units for Black Start service or testing of Black Start units, for the Operating Day is allocated and charged to PJM Members as follows:

1. in proportion to their locational real-time deviations from day-ahead schedules
   - Generation
   - Load

2. generating resource deviations during that Operating Day

3. in proportion to their real-time load plus exports during that Operating day for generator credits provided for reliability
   - Load
   - Transactions
Balancing Operating Reserve Charges

• Total daily costs of balancing operating reserve related to resources identified as **Credits for Deviations** is allocated based on regional shares of real-time locational deviations from following the day-ahead scheduled quantities of:
  
  - Cleared generation offers not following PJM dispatch instructions
  - Cleared Demand Resources not following cleared Day Ahead offer
  - Cleared INC offers and purchase transactions
  - Cleared demand bids, DEC bids and sale transactions

• Total daily cost of operating reserve in the balancing market related to resources identified as **Credits for Reliability** is allocated based on regional shares of real-time load (without losses) plus exports
In order to determine the reason why the Operating Reserve credit has been earned so that the charges related can be properly allocated, PJM conducts a Balancing Operating Reserve Cost Analysis (BORCA).

PJM also calculates a Regional Balancing Operating Reserve rate for the costs of Operating Reserves that result from actions to control transmission constraints that are solely within pre-defined regions in the RTO.

Additional costs of Operating Reserves that result from actions to control transmission constraints that benefit the entire RTO will continue to be allocated equally to deviations across the entire RTO.
Balancing Operating Reserve Cost Allocation (BORCA)

**Reliability Analysis (RA) BOR Cost Allocation**

**RA BOR Credits for Reliability**
Units committed due to extenuating conditions that warrant conservative actions to ensure the maintenance of system reliability (i.e. – to provide reserves over and above the quantity determined by the real time load forecast)

**RA BOR Credits for Deviations**
Units committed to operate in real time in order to augment the physical units committed in the Day-Ahead Market to meet the forecasted real time load plus the operating reserve requirement

**Real- Time (RT) BOR Cost Allocation**

**RT BOR Credits for Reliability**
Units called on by PJM to operate during the operating day for which the LMP at the unit’s bus does not meet or exceed the unit’s applicable offer (cost or price) for at least four, 5-minute intervals of at least one clock hour during which the unit was running at PJM’s direction

**RT BOR Credits for Deviations**
All other units operated at PJM’s direction in real time
• Allocate OR charges that were accrued for local constraints to the regions, creating “regional” rates for Balancing Operating Reserve charges
  • will be collected for the RTO and/or each Region based on whether units were committed for transmission constraints and if so, for which constraints they were committed
  • BORs that are associated with a constraint of $\leq 345$ kV will be allocated regionally
Reliability Analysis (RA) BOR Cost Allocation

RA BOR Credits for Reliability
- Regional Credits for Reliability
- RTO Credits for Reliability

RA BOR Credits for Deviations
- Regional Credits for Deviations
- RTO Credits for Deviations

Real-Time (RT) BOR Cost Allocation

RT BOR Credits for Reliability
- Regional Credits for Reliability
- RTO Credits for Reliability

RT BOR Credits for Deviations
- Regional Credits for Deviations
- RTO Credits for Deviations

Load Ratio Share plus exports By Region
Real-Time Deviations from Day-Ahead Schedules By Region
Balancing Operating Reserve Cost Allocation

This BORCA process separates the TOTAL COST (credits) of BORs into eight (8) buckets.
Allocation for Reliability

BORs for Reliability are allocated by Load Ratio Share plus Exports:

\[
\text{RTO or Regional Rate for BORs for Reliability} = \frac{\text{Total BORs for Reliability (by RTO or Region)}}{\text{Total PJM MWh of energy delivered to load + exports (by RTO or Region)}}
\]

\[
\text{Participant’s Reliability Allocation (by RTO or Region)} = \frac{\text{RTO or Regional Rate for BORs for Reliability}}{\text{Customer total MWh of energy delivered to load + exports (by RTO or Region)}}
\]

PJM©2017

05/24/2017
Allocation for Deviations

BORs for Deviations are allocated by participants based on deviations from Day-Ahead scheduled quantities:

\[
\text{Participants Deviation Allocation} = \frac{\text{Total MW Deviations Across RTO or Region (after netting by zone, hub, interface)}}{\text{RTO or Regional Rate for BORs for Deviations}}
\]

\[
\text{RTO or Regional Rate for BORs for Deviations} = \frac{\text{Total $ Cost of BORs in RTO or Region for Deviations}}{\text{Total MW Deviations of Participant (by RTO or Region)}}
\]
**Allocation Methodology**

1. “Reliability” allocated to real-time load plus exports across RTO
2. “Deviations” allocated to deviations across RTO

These are RTO rates

1. “Reliability” allocated to real-time load plus exports in region
2. “Deviations” allocated to deviations in region

These Regional rates are added to the RTO rates

---

**Regional costs allocated regionally**

---

**RTO costs are allocated globally**

---

Separate buckets:

- The costs of Regional BORs are not contained in the costs of the RTO BORs

No “Double Dipping” of costs
Operating Reserves Rates

• There is one (1) Day-Ahead Operating Reserve rate and six (6) Balancing Operating Reserve rates

• Posted on PJM website at:


– Preliminary operating reserve charges are typically posted about one week after the operating day

– Operating Reserve Summary reports available in MSRS are updated daily

– Rates not final until the 5th business day of the following month!

<table>
<thead>
<tr>
<th>day</th>
<th>day_ahead_rate</th>
<th>balancing_rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/1/2007</td>
<td>0.0183</td>
<td>0.5516</td>
</tr>
<tr>
<td>2/2/2007</td>
<td>0.0675</td>
<td>0.5644</td>
</tr>
<tr>
<td>2/3/2007</td>
<td>0.1333</td>
<td>7.6307</td>
</tr>
<tr>
<td>2/4/2007</td>
<td>0.1228</td>
<td>2.6514</td>
</tr>
<tr>
<td>2/5/2007</td>
<td>0.0752</td>
<td>4.4426</td>
</tr>
</tbody>
</table>
**Balancing Operating Reserve Quick Reference**

<table>
<thead>
<tr>
<th>Day Ahead Operation Reserve Rate</th>
<th>RTO Balancing Operating Reserve Rates</th>
<th>East Balancing Operating Reserve Rates</th>
<th>West Balancing Operating Reserve Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>DA Operating Reserve Rate</td>
<td>RTO Bal Operating Reserve for Reliability Rate</td>
<td>East Balancing Reserve for Reliability Rate</td>
<td>West Balancing Reserve for Reliability Rate</td>
</tr>
<tr>
<td>$/MWh of cleared DA Demand, Decrements, Load Response, and Exports</td>
<td>$/MWh of RT Load plus Exports</td>
<td>$/MWh of RT Deviations</td>
<td>$/MWh of RT Deviations</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Zones</th>
<th>Interfaces</th>
<th>Zones</th>
<th>Interfaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEC</td>
<td>CPLEEXP</td>
<td>AEP</td>
<td>IMO</td>
</tr>
<tr>
<td>BGE</td>
<td>CPLEIMP</td>
<td>APS</td>
<td>MISO</td>
</tr>
<tr>
<td>Dominion</td>
<td>DUKEXP</td>
<td>ATSI</td>
<td>NIPSCO</td>
</tr>
<tr>
<td>PENELEC</td>
<td>DUKIMP</td>
<td>ComEd</td>
<td>NORTHWEST</td>
</tr>
<tr>
<td>PEPCO</td>
<td>HUDSONTP</td>
<td>Duquesne</td>
<td>OVEC</td>
</tr>
<tr>
<td>ME</td>
<td>LINDENVFT</td>
<td>Dayton</td>
<td></td>
</tr>
<tr>
<td>PPL</td>
<td>NCMPAEXP</td>
<td>DEOK</td>
<td></td>
</tr>
<tr>
<td>ICU</td>
<td>NCMPAIMP</td>
<td>EKPC</td>
<td></td>
</tr>
<tr>
<td>PECO</td>
<td>NEPTUNE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DPL</td>
<td>NYIS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSEG</td>
<td>SOUTHEXP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RE</td>
<td>SOUTHIMP</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- BORs that are associated with a constraint of <345kV will be allocated regionally.
Questions?

PJM Client Management & Services
Telephone: (610) 666-8980
Toll Free Telephone: (866) 400-8980
Website: www.pjm.com

The Member Community is PJM’s self-service portal for members to search for answers to their questions or to track and/or open cases with Client Management & Services