

Regulation Market Proposal

RMDSTF

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IMM



Monitoring Analytics

Regulation Signal/Products

- **One signal, filtered inverse of ACE.**
 - **Resource agnostic signal aligned with system needs.**
 - **Allows a simpler implementation for dispatch to operate and track.**
 - **Eliminates RegA/RegD settlement interactions that cause issues with prices, incentives and market signals.**



Regulation Signal/Products

- **Retain bidirectional regulation market, with one clearing price.**
 - **Simple roll out, simple clearing.**
 - **Reduced cost for PJM to implement relative to reg up/reg down.**
 - **No complications associated with complex offers (reg up/reg down/reg both), iterative clearing**
 - **Allows batteries to maintain charge through reg set points**
 - **PJM has not presented a case where complex offers (up/down/both) can be cleared or what the resulting prices/regulation assignments would look like relative to bidirectional market.**
 - **PJM has stated it needs more time to sort out details of reg up/reg down markets.**

Regulation Signal/Products

- **Bidirectional market removes risk of internally inconsistent results between clearing and pricing in separate reg up/reg down markets**
 - **Inconsistencies between ASO LOC and within hour LOC can change optimal clearing for reg up/reg down/reg both.**
- **Reg up/Reg down will require buying more MW and/or paying more for the same MW of regulation, if there is an LOC and/or positive price for both Reg up/Reg down.**

Bidirectional

| Load | 500 | Reg needed up and down | | | | | | 25 MW | Biddirectional | | | | | |
|--|---------|----------------------------|----------------|--------------|---------|------------|------------------|---------------|----------------|---------------------|---------------------|--------------------|-----------|--|
| Reg requirement 25 MW (up and/or down) | | | | | | | | | | | | | | |
| MC | Eco Min | Reg MW offer bidirectional | Reg offer down | Reg Offer up | Eco Max | Reg Assign | Projected output | Projected LMP | Desired Output | Projected LOC \$/MW | Projected Reg Price | Projected Reg Cost | | |
| Unit 1 | \$5.00 | 10 | 10 | 10 | 10 | 200 | 5 | 195 | 0 | 200 | 10 | \$50.00 | | |
| Unit 2 | \$10.00 | 10 | 10 | 10 | 10 | 200 | 10 | 190 | 0 | 200 | 5 | \$100.00 | | |
| Unit 3 | \$15.00 | 10 | 10 | 10 | 10 | 200 | 10 | 115 | 15 | 115 | 0 | \$100.00 | | |
| Unit 4 | \$20.00 | 10 | 10 | 10 | 10 | 200 | 0 | 0 | 0 | 0 | 0 | \$0.00 | | |
| Unit 5 | \$25.00 | 10 | 10 | 10 | 10 | 200 | 0 | 0 | 0 | 0 | 0 | \$0.00 | | |
| | | | | | | 1000 | 25 | 500 | 15 | 515 | 10 | 10 | \$ 250.00 | |

Reg Up/Reg Down

| Load | 500 | Reg needed up and down | | | | | 25 MW | | |
|--------|---------|----------------------------|----------------|--------------|---------|----------|--------|-----------|----|
| MC | Eco Min | Reg MW offer bidirectional | Reg offer down | Reg Offer up | Eco Max | Reg Down | Reg Up | Reg Total | |
| Unit 1 | \$5.00 | 10 | 10 | 10 | 10 | 200 | 10 | | |
| Unit 2 | \$10.00 | 10 | 10 | 10 | 10 | 200 | 10 | | |
| Unit 3 | \$15.00 | 10 | 10 | 10 | 10 | 200 | 5 | 10 | |
| Unit 4 | \$20.00 | 10 | 10 | 10 | 10 | 200 | 0 | 10 | |
| Unit 5 | \$25.00 | 10 | 10 | 10 | 10 | 200 | 0 | 5 | |
| | | | | | | 1000 | 25 | 25 | 50 |

| Reg Down Cost | Reg Up Cost |
|---------------|-------------|
| \$ 375.00 | \$ 375.00 |

| | | | Reg Down Price | | Reg Up Price | | |
|------------------|---------------|----------------|---------------------|---------------------|---------------|---------------------|-----------|
| Projected output | Projected LMP | Desired Output | Projected LOC \$/MW | Projected Reg Price | Projected LOC | Projected Reg Price | Payments |
| 200 | 0 | 200 | \$ - | | \$ - | | \$150.00 |
| 190 | 0 | 200 | \$ 15.00 | | \$ 15.00 | | \$150.00 |
| 90 | 0 | 200 | \$ 10.00 | | \$ 10.00 | | \$225.00 |
| 10 | 0 | 200 | \$ 5.00 | | \$ 5.00 | | \$150.00 |
| 10 | 25 | 10 | \$ - | | \$ - | | \$75.00 |
| 500 | 25 | | \$ 15.00 | \$ 15.00 | \$ 15.00 | \$ 15.00 | \$ 750.00 |

Regulation Requirement

- **Requirement (total regulation) based on expected system conditions (Same proposal as PJM)**
 - **Defined, verifiable, systematic and algorithmic calculation of requirement**
 - **Transparent rules and definitions**
 - **Requirements based on seasonal and hourly moving average of historic ACE and CPS data.**

LOC

- **LOC based on dispatched energy offer.**
- **LOC based on unit specific hourly differences between regulation set point and desired/achievable MW, calculated every five minutes.**
- **Physical ramp limited MW within the hour.**
- **LOC calculation reset at start of each commitment period.**

LOC

- **LMP based energy desired MW for LOC calculation within the hour based on cumulative movement over the commitment period based on physical ramp limit relative to regulation set point at the beginning of each commitment period.**
- **Shoulder ramp period reduced to 10 minutes from 15 (assuming a move to 30 minute commitments).**
- **Portions of the energy offer where physical limitations prevent measurable energy ramping within the commitment period are not eligible to contribute LMP desired MW for LOC calculations.**

Offer Structure

- **Performance and Capability (Status Quo)**
- **Remove VOM from regulation cost offers**
- **Eliminate \$12 adder**

Commitment Period

- **ASO: Clear the market every 30 minutes, with a 30 minute look ahead.**



Clearing Price/Settlement

- **Clearing price determined every 5 minutes within the commitment period based on the true (ex post) marginal offer in each interval (\$/MW).**
 - **Total offers = LOC + components**
 - **Clearing price reflects actual mileage (ex post) and performance score (ex post) of marginal offer.**
 - **Resources paid based on their (ex post) performance adjusted MW for the commitment period.**

Testing

- **Status Quo and PJM determined test times.**
- **Status quo testing requirements:**
 - **"New unit tests -Meet or exceed 75% on 3 consecutive test (limited to one test per calendar day.) Up-rate tests- Meet or exceed 75% on 1 test (limited to one test per calendar day.) Signal change tests- Meet or exceed 75% on 1 test (limited to one test per calendar day.)"**

Performance Score

- The performance score is defined as the precision score (replace the current method of three components).
- Precision calculation based on status quo formula for precision.

$$\text{Error} = \text{Avg of Abs} \left| \frac{\text{Response} - \text{Regulation Signal}}{\text{Hourly Average Regulation Signal}} \right|$$

$$\text{Precision Score} = 1 - \frac{1}{n} \sum \text{Abs}(\text{Error})$$

Performance Score

- **Market participation requirement of a 40 percent performance score, based on rolling 100 hour average (status quo).**
- **Minimum performance score required for compensation or to set price is 25 percent.**



Performance Score

- **Self deselection results in zero score in the cleared commitment period.**
- **PJM dispatcher deselection does not affect performance score.**



Regulation Set Point and Range

- **Regulation range (Regulation Min and Regulation Max) should match economic dispatch range (limited by ramp rates and by economic min and economic max), unless explained by physical limitations (not fuel limit).**
- **Portions of the energy offer where physical limitations prevent measurable energy ramping within the commitment period are not eligible to contribute LMP desired MW for LOC calculations.**

Regulation is a Real Time Only Product

- **Regulation depends on unpredictable real time conditions.**
- **No must offer obligation creates gaming opportunities between DA and RT applications**
- **DA market would add modeling/market result differences between DA and RT market**
- **DA market would add unneeded deviation/settlement/uplift complications**

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