Shortage Pricing ORDC - Order 825

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Market Implementation Committee

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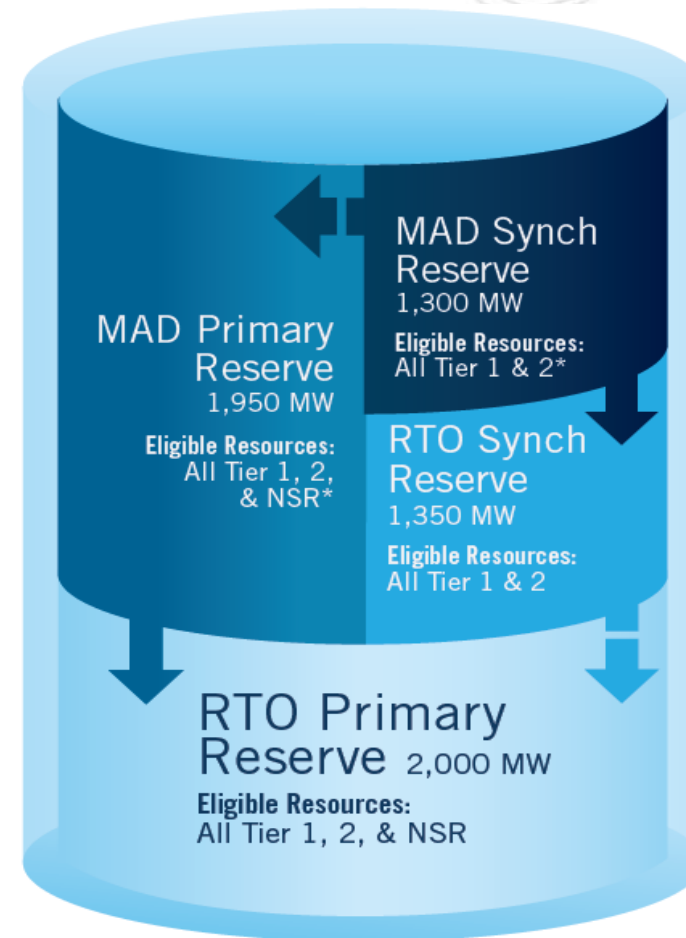
- FERC initiated Docket AD14-14 ("Price Formation") on June 19, 2014
- Various workshops and filings have taken place over the last two years
- On June 16, 2016, FERC issued Order 825 from Docket RM15-24
- Order 825 focused on standardizing some of the market designs associated with market settlements and shortage pricing
  - Settle RT energy transactions at the same interval it is dispatched
  - Settle RT operating reserve transactions at the same interval it is priced
  - Settle intertie transactions at the same interval it is scheduled
  - Trigger shortage pricing for any interval that a shortage of energy or operating reserves is indicated
- Changes to shortage demand curves must be filed in a separate docket

- PJM has two concerns with Order 825 Shortage Implementation

  1. Triggering shortage pricing on a 5-minute basis before settling on a 5-minute basis
     - Further exacerbates distortion for resources following the 5-minute pricing signal but getting paid the hourly average price
     - PJM will request a simultaneous implementation on Feb 1, 2018 in its compliance filing
  2. Use current ORDC to price shortage on a 5-minute basis
     - With the current demand curve
       – Will result in peak reserve prices during minimal/transient shortages
       – May result in overstating the severity of system conditions

	Date	Committee	Agenda
✔	Jul. 28, 2016	MRC	Problem Statement/Issue Charge approval
✔	Aug. 10	MIC	Education
✔	Oct. 5	MIC	Education, Interest, Options, Packages
	Nov. 2	MIC	Interest, Options, Packages
	Dec. 14	MIC	Interest, Options, Packages / 1st Read on Package(s)
	Dec. 22	MRC	Provide update on progress
	Jan. 11, 2017	MIC	Vote on Package(s)
	Jan. 26	MRC/MC	1st Read on Manual/Tariff changes at both MRC and MC
	Feb. 23	MRC/MC	Vote Manual/Tariff changes at both MRC and MC
	Mar. 1	---	Submit 205 filing at FERC

Since PJM will seek simultaneous implementation dates for Settlements and Shortage of February 1, 2018, then if FERC grants this request the above timeline may be relaxed

- Tier 1 (Economic)
  - Online units following economic dispatch that are only partially loaded
  - Increase output within 10 minutes
- Tier 2 (Non-Economic)
  - Online units that cleared in the Synch Reserve Market
  - Respond within 10 minutes
- Non-Synchronized Reserves
  - Offline units
  - Respond within 10 minutes

MAD Synch Reserve
1,300 MW
Eligible Resources: All Tier 1 & 2*

MAD Primary Reserve
1,950 MW
Eligible Resources: All Tier 1, 2, & NSR*

RTO Synch Reserve
1,350 MW
Eligible Resources: All Tier 1 & 2

RTO Primary Reserve 2,000 MW
Eligible Resources: All Tier 1, 2, & NSR

Reserve values are not current

Product Substitution   Locational Substitution   *Deliverable to MAD

- As the amount of reserves reduce because more MW are needed in the energy market to meet demand, then reserve clearing prices will increase

MW above Reserve Requirement	Reserve Clearing Price	Comments
1000	$0	Enough MW to meet both energy demand and reserve requirements
500	$50	As energy demand increases, more reserve MW are needed in energy market, the reserve clearing price is LOC+offer of that marginal resource
10	$800	
1	$848	
-1	$850	As energy demand continues to increase and there not enough MW to meet the reserve requirement; penalty factors are incorporated (penalty factor does not increase with increased shortage)
-500	$850	

For example purposes only, no real data used in table

$/MWh

Requirement
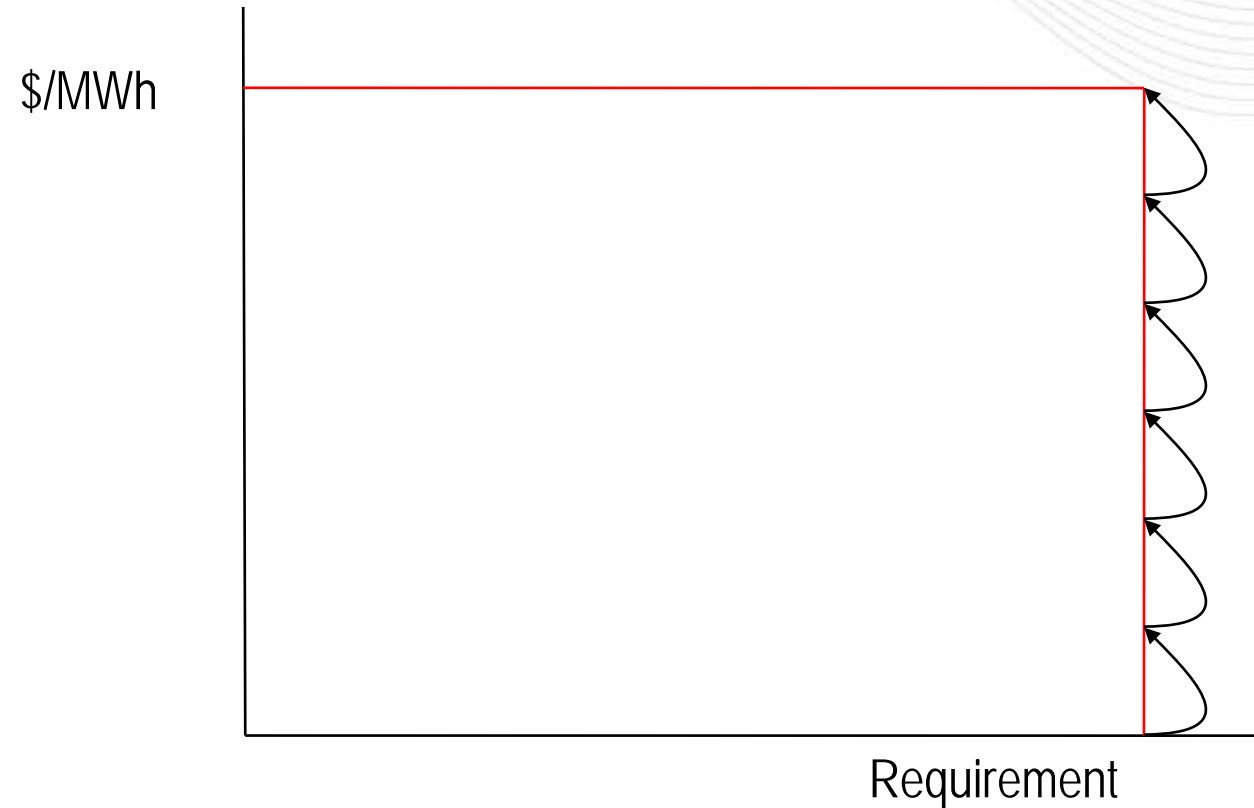
•This price represents the current cost of reserves given system conditions

• When the reserve clearing price is non-zero (for Synchronized, Primary, or OR), it means that PJM had to re-dispatch units in order to maintain adequate reserves

• The opportunity cost of the marginal unit for reserves will be what sets that reserve clearing price

• As the system grows tighter on reserves, the cost of re-dispatching the system to maintain the reserve requirement will become greater and greater

- When the reserve requirement cannot be met, the reserve shortage will be priced using an Operating Reserve Demand Curve (ORDC)

  - Sets a price that serves as a "penalty factor" for being unable to meet the reserve requirement

  - Sends an indicator that as the reserve market clearing price reaches the penalty factor, the system's ability to maintain reserves is becoming increasingly tenuous and reserve shortage may or has occurred

$/MW

Penalty Factor

995 MW Committed

Co-Optimization

Req = 1000 MW
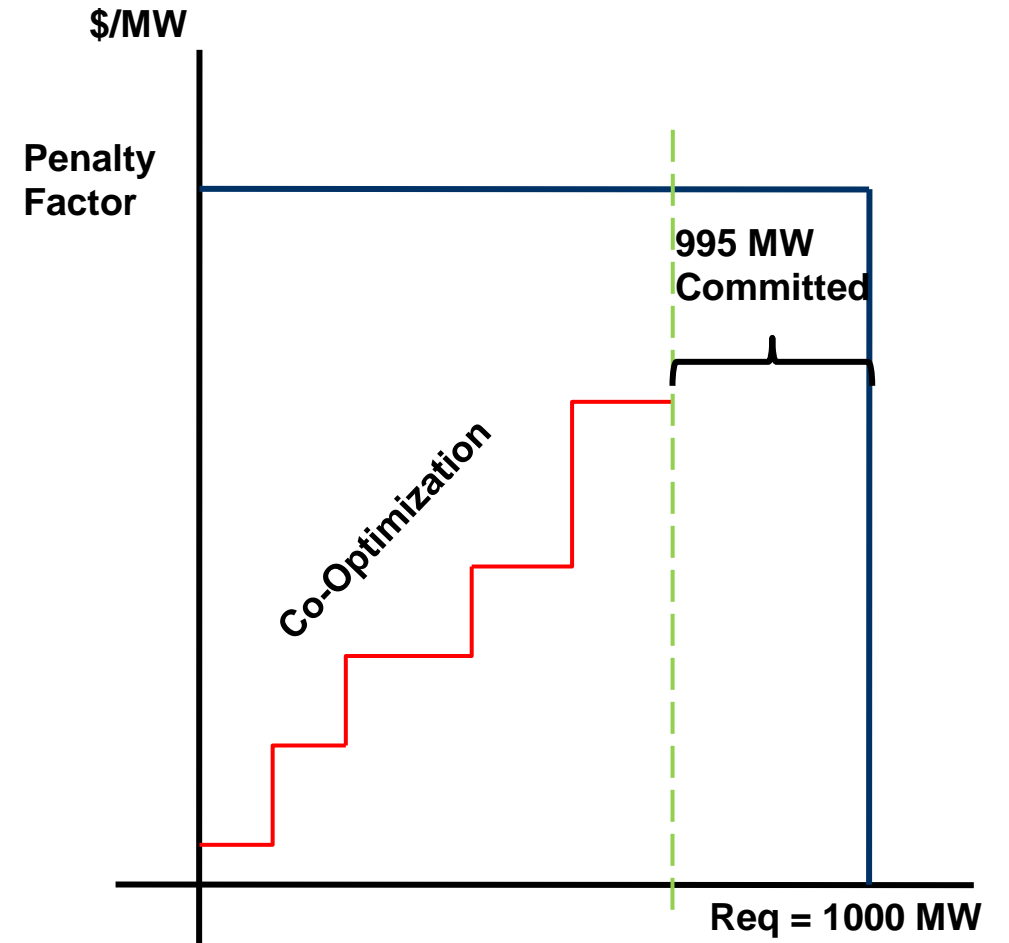
- PJM's current rules say that <u>both</u> IT SCED and RT SCED must produce a solution that forecast a shortage in order to price a reserve penalty factor

IT SCED SolutionIntervals				RT SCED Solution	Shortage Pricing
1	2	3	4		No
1	2	3	4		No
1	2	3	4		Yes
1	2	3	4		Yes
1	2	3	4		Yes

Shortage Pricing only occurs when IT SCED and RT SCED agree there is a shortage.
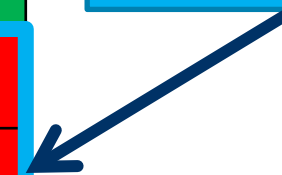
- IT SCED reviews four different time intervals from the execution time in groups of 15 minute segments (+30 mins, +45 mins, +90 mins and +135 Mins)
- RT SCED reviews one intervals that is 15 minutes in front of the execution time

- IT SCED will no longer be used to grant permission to RT SCED to price a shortage
- All shortages will be determined solely by RT SCED regardless of severity or duration. Any time the requirement cannot be met, shortage pricing will be invoked.

IT SCED Solution				RT SCED Solution	Shortage Pricing
1		3			No
1	2	3			Yes
1	2	3			No
1	2				Yes
1	2	3	4		Yes

Only RT SCED needs to detect a shortage for shortage pricing to occur.

- IT SCED reviews ... the execution time in groups of 15 minute segments (+30 mins, +45 mins, +90 mins and +135 Mins)
- RT SCED reviews one inter... minutes in front of the execution time

- From Jan 1, 2015 through Sept 1, 2016
  - 845 instances where the $850/MWh penalty factor would have been included in the calculation of LMPs and reserve clearing prices
    - 2015: 759 instances
    - 2016: 86 instances

Shortage MW (Raw Data)

Year	Mean	Median	Min	Max	Standard Deviation
2015	149	93	0	1059	158
2016	89	57	3	463	100
Combined	143	88	0	1059	154

Shortage MW (Cleaned Data – 61 outliers removed)

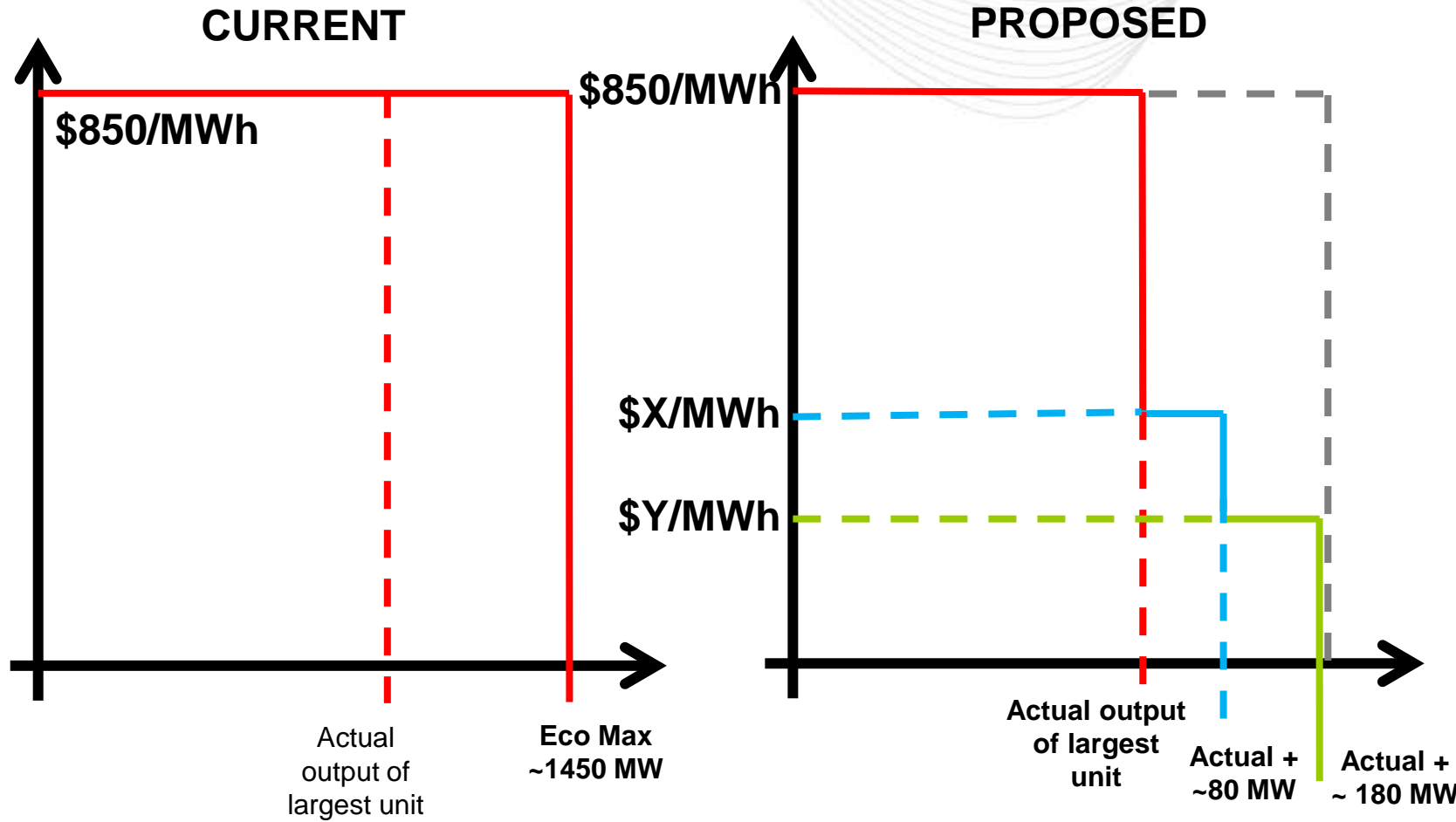| Year	Mean	Median	Min	Max	Standard Deviation
2015	115	82	0	411	100
2016	71	55	3	236	59
Combined	110	79	0	411	98

1. Do Nothing
   – All future transient shortages will be priced at the $850/MWh penalty factor for each reserve product in each location
     - All 845 instances over the past 2 years
   – PJM is concerned this will result in operational volatility if participants respond to transient events

2. Change Demand Curves to Moderate Potential Price Spikes
   – Add smaller steps(s) to the demand curve to better reflect the lower reliability concern of small reserve deficiencies

	Status Quo (Current)	Proposed
Reserve Products	1. Online; within 10 minutes (Tier 1 and Tier 2) 2. Offline; within 10 minutes (Non-Synch)	Status Quo
Demand Curve	$850/MWh at EcoMax of largest unit*	1. $850/MWh at actual output of largest unit 2. Add one or two additional steps at lower prices based on history

* Additional second step can be added during emergencies when extra reserves are carried.

CURRENT

PROPOSED

$850/MWh

$850/MWh

$X/MWh

$Y/MWh

Actual output of largest unit

Eco Max ~1450 MW

Actual output of largest unit

Actual + ~80 MW

Actual + ~ 180 MW

1. Propose to make Step 1 value using the largest single resource's actual output. Dynamically change every 5-minutes

2. Create Step 2 and Step 3 using the Median and one Standard deviation from the 2015/2016 deficit MW

3. Similar changes would also be made to the other demand curves

- Dynamic reserve requirement will more flexibly procure reserves
  - Sometimes more than the current requirement, sometimes less
- More rational linkage between market clearing prices and the level of reserve shortage
  - Very small MW shortage will not result in very large price swings
- Better transitions into tight/shortage conditions.
  - Less volatility as conditions worsen due to additional steps
- Better price signals prior to when synchronized reserves are less than the largest contingency
  - At will resources and interchange are incentivized earlier

- Request stakeholder's feedback
  - Thoughts on options
  - Conceptual proposal
  - Additional analysis
    - Currently only reviewed MAD SR deficiencies that were not priced. Need to evaluate all requirements and causes.

- PJM plans to create curves for all ORDC and provide details and analysis at the November MIC

Appendix

	PJM	MISO	ERCOT	ISONE	NYISO
Penalty Factors	1. $850/MWh 2. $300/MWh (only during HWA and specific conditions)	1. $3,500/MWh (0%-4% cleared Reserves) 2. $1,100/MWh (4%-95% cleared Reserves) 3. $200/MWh (96%-100% cleared Reserves)	1. Created RT Price added to reflect the Value of Lost Load (VOLL) based on Loss of Load Probability. VOLL is set to $9,000/MWh	1. $1,500/MWh (system-wide 10-min) 2. $1,000/MWh (system-wide 30-min) 3. $250/MWh (system-wide replacement 10-min) 4. $250/MWh (reserve zone specific) 5. $50/MWh (system-wide 10-min spinning)	There are 12 different ORDC that have Penalty Factors between $775/MWh and $25/MWh Manual 2 (Ancillary Service); Section 6.8 (Operating Reserve Demand Curves) provides details
Regions	1. RTO 2. Mid-Atlantic+Dominion	1. Zone 1 5. Zone 5 2. Zone 2 6. Zone 6 3. Zone 3 7. Zone 7 4. Zone 4	1. System wide	1. Rest of System 2. Rest of CT Zone 3. SWCT Zone 4. NEMA/Boston Zone	1. West 2. East 3. Southeastern 4. Long Island
Products	1. Online; within 10 min 2. Offline; within 10 min	1. Online; within 10 min 2. Online or Offline; within 10 min	1. Online; within 10 min 2. Offline; within 10 min 3. Offline; within 30 min	1. Online; within 10 min 2. Offline; within 10 min 3. Online or Offline; within 30 min	1. Online; within 10 min 2. Offline; within 10 min 3. Online; within 30 min 4. Offline; within 30 min

	RTO	Mid-Atlantic-Dominion (MAD)*
Primary Reserve Requirement	150% of largest single contingency (~2,063 MW)	1700 MW (VACAR RSG is 485 MW)
Primary Reserve Resources	Tier 1, Tier 2 and Non-Synch	
Synchronized Reserve Requirement	100% of largest single contingency (~1,375 MW)	100% of largest single contingency (~1,300 MW) (VACAR RSG is 485 MW)
Synchronized Reserve Resources	Tier 1 and Tier2	
Response Time	10 minutes	

* Dominion-specific requirement is from the VACAR Reserve Sharing Group. This requirement is not cleared in the PJM reserve markets.
Manual 13, Section 2.2 (Reserve Requirements) describes the requirements per type and area