



# Operating Reserve Demand Curve Education

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August 10, 2016

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# History

- FERC issued Order No. 719 on October 28, 2008 requiring RTO/ISO to reform their existing market rules to ensure that energy prices, during an operating reserve shortage, will appropriately reflect the value of energy
- PJM and Stakeholders discussed for almost 1.5 years to reform market rules to comply with Order No. 719
- PJM filed these reforms on June 18, 2010 in Docket ER09-1063, FERC issued an Order approving PJM's filing on April 19, 2012
- These reforms were effective on October 1, 2012
  - Additional resources eligible to set price
    - Emergency Demand Response
    - Emergency Import Transactions
    - Generation from emergency segments of units already on-line and operating in the real-time energy market
  - Penalty Factors introduced during times of shortage for Primary and Synchronized Reserves
    - \$400 (DY June 2013 - May 2014)
    - \$550 (DY June 2014 – May 2015)
    - \$850 (June 2015 – Future)
  - Co-optimization

- During some particular events occurring in July and September 2013, stakeholders requested better understanding of how PJM operator actions are incorporated into both the DA and RT market clearing solutions
- Energy Reserve Pricing and Interchange Volatility (ERPIV) sub-MIC group was created in November 2013
- PJM filed reforms on December 17, 2014 in Docket ER15-643, FERC issued an Order approving PJM's filing on April 10, 2015 with an effective date of March 1, 2015
  - Creation of secondary reserve requirement and adder
    - Effective during Hot/Cold Weather Alerts only
    - Requirement varies based on additional MWs called for reliability concerns
    - \$300 / MWh adder per Primary and Synchronized reserves

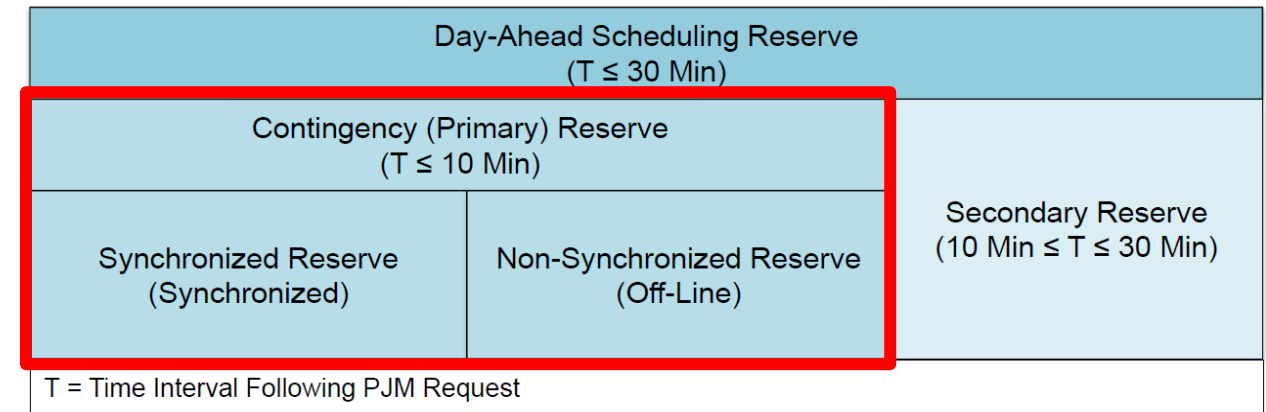
- FERC initiated Docket AD14-14 (“Price Formation”) on June 19, 2014
- Various workshops and filings have taken place over the last two years
- On June 16, 2016, FERC issued Order 825 from Docket RM15-24
- Order 825 focused on standardizing some of the market designs associated with market settlements 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

- Specifically, we require each RTO/ISO to trigger shortage pricing for any interval in which a shortage of energy or operating reserves is indicated during the pricing of resources for that interval ... This rationale applies to any shortage “regardless of the duration or cause of [the] shortage.” It thus would apply to “transient shortages.” (para 162)
- PJM and SPP state that application of the shortage pricing reform to transient shortages would likely require the implementation of operating reserve demand curves that distinguish prices relative to varying degrees of shortage. In the NOPR, the Commission acknowledged that, as a result of the shortage pricing reform, “an RTO/ISO may need to calibrate administrative shortage prices to better reflect the value of the service.” Thus, if PJM or SPP believes that a modification of the applicable operating reserve demand curves is appropriate in light of the shortage pricing reform, the appropriate forum to make such a change is through an FPA section 205 filing. (para 173)
- With regard to shortage pricing, any revisions an RTO/ISO may propose to shortage pricing levels (which are not required by this Final Rule) must be filed under section 205 and could be submitted prior to the actual implementation of the shortage pricing provisions of this Final Rule, thereby permitting stakeholders and the RTO/ISO additional time to work through the implementation details. (para 204)

# Education



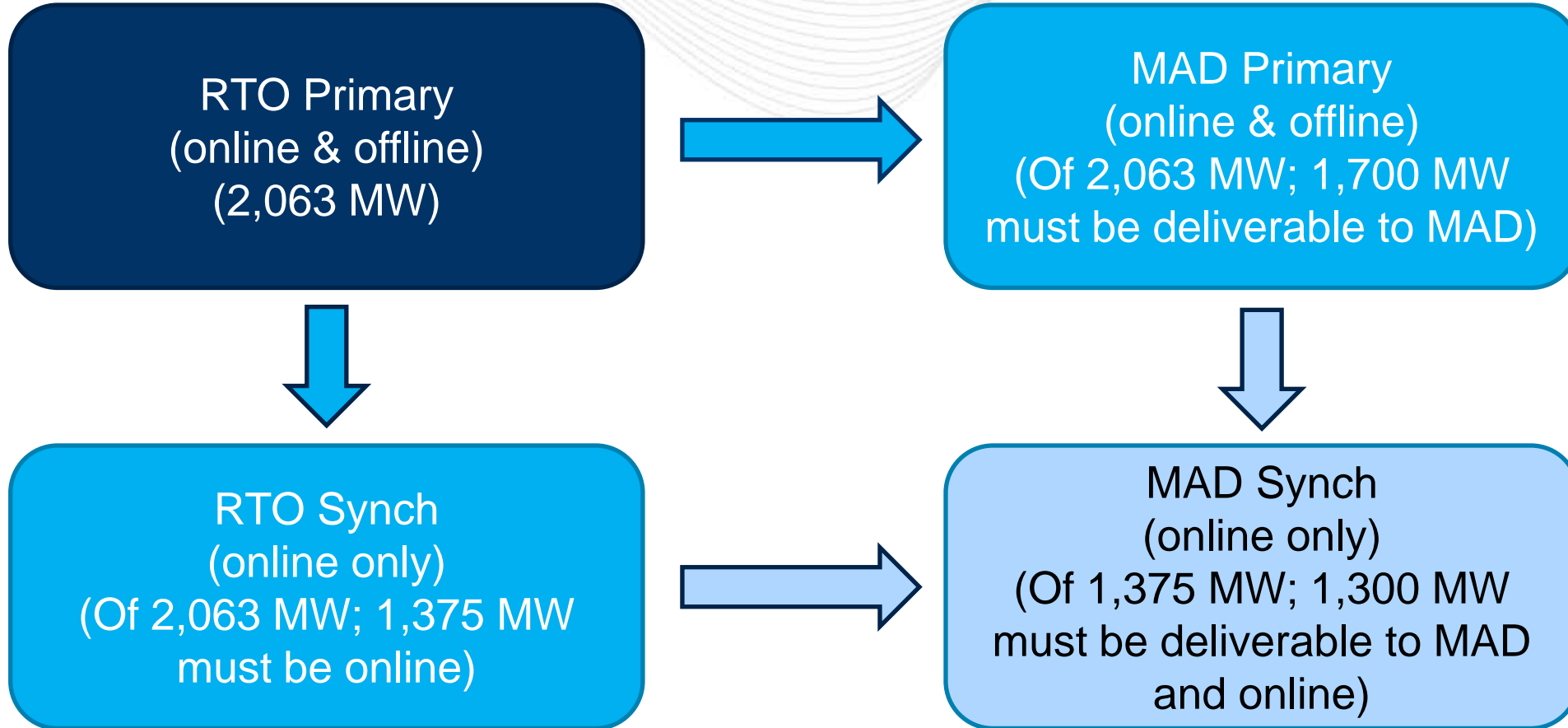
- Tier 1 (Economic)
  - Online units following economic dispatch that are only partially loaded
  - Increase output within 10 minutes
- Tier 2 (Non-Economic)
  - Online units that cleared in the Synch Reserve Market
  - Respond within 10 minutes
- Non-Synchronized Reserves
  - Offline units
  - Respond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



	<b>RTO</b>	<b>Mid-Atlantic-Dominion (MAD)*</b>
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

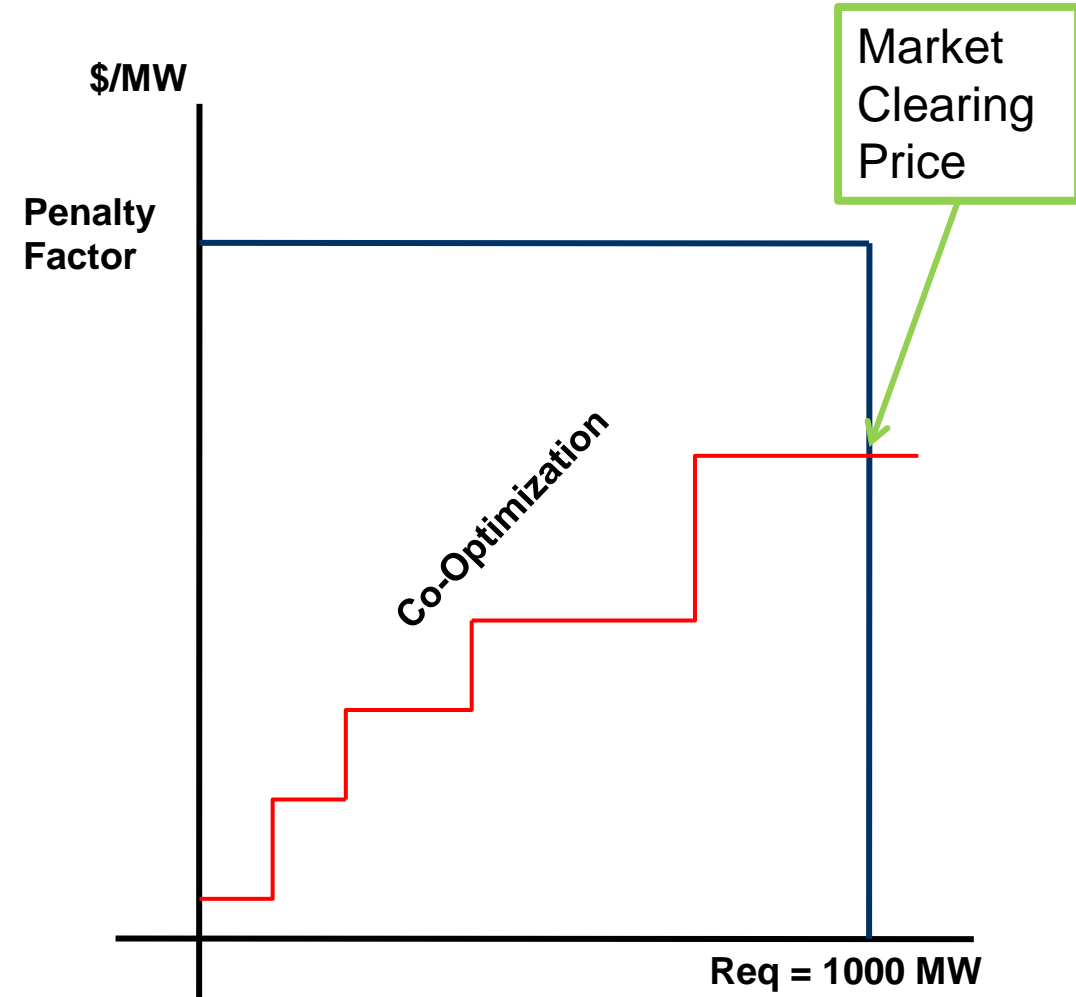
# Reserve Requirement Locational Nesting Example



Synchronized Reserve requirements are nested by location and within Primary Reserve Requirements

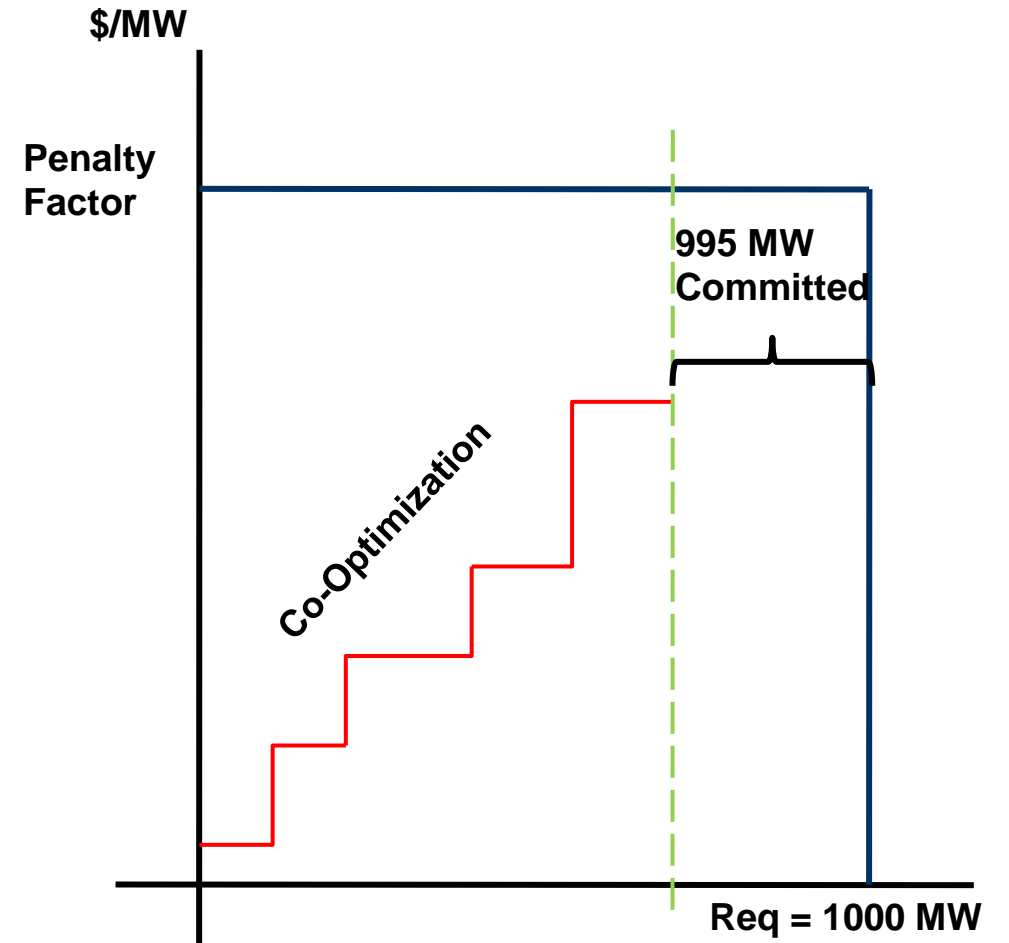
# Operating Reserve Demand Curve (ORDC)

- When the reserve requirement is met, the level of the Penalty Factor does not impact the clearing price
- Market Clearing Price is set by the intersection of the supply and demand curves



# Operating Reserve Demand Curve (ORDC)

- 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



- The ORDC has the potential of having two steps
  - Step 1: Manual 13, Section 2.2 describes requirements (as seen on slide 10)
    - \$850 / MWh for both Primary and Synchronized
  - Step 2:
    - Only occurs when HWA, CWA or greater emergency procedure is called
    - Requirement equals the sum of additional MW brought online for that hour by PJM dispatch to account for operational uncertainty after the RAC
    - \$300 / MWh for both Primary and Synchronized
    - Initiated from the Energy and Reserve Pricing and Interchange Volatility stakeholder group
    - Has never been used

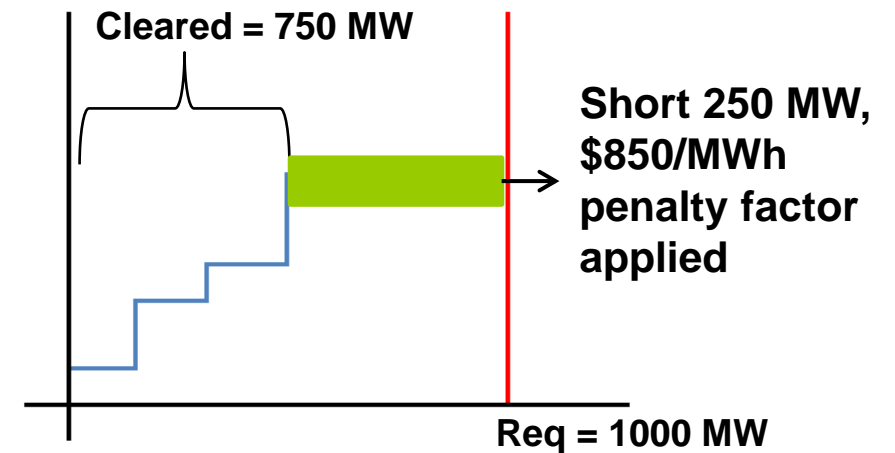
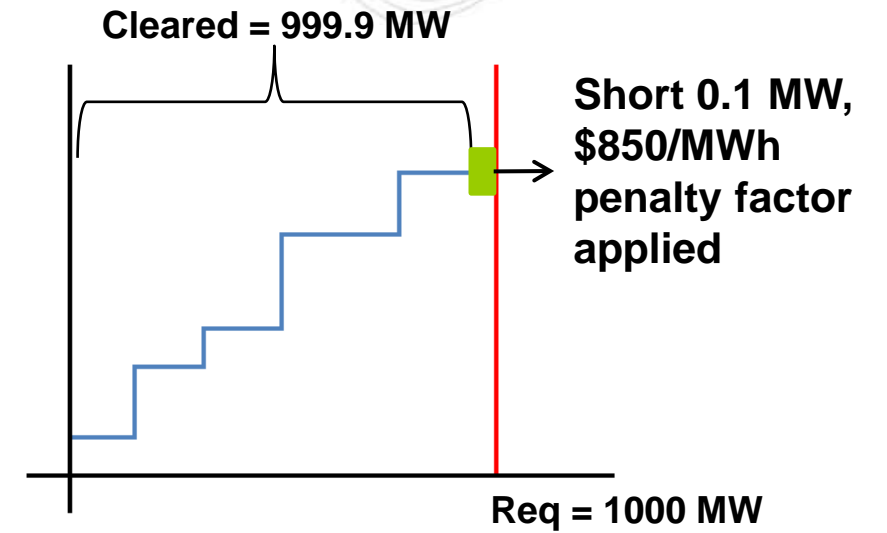
# Concerns

- 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
  2. Use current ORDC to price shortage on a 5-minute basis
    - Will result in peak reserve prices during minimal/transient shortages
    - May result in overstating the severity of the reserve shortage



## Current curve structure:

- PJM will trigger the \$850/MWh penalty factor for even a 0.1 MW shortage
- The penalty factor does not change with an increase in reserve shortage quantity



“Moreover, if the Commission elects to establish a general, universal shortage pricing rule that requires related pricing even for transient circumstances that do not warrant such pricing, the Filing Parties note that such a rule would likely require the implementation of demand curves that distinguish prices relative to varying degrees of shortage. For example, if PJM were to implement the proposed rules related to shortage pricing, it will require review and adjustment to its operating reserve demand curves (“ORDC”). The ORDCs PJM currently utilizes were designed under the assumption that shortage pricing would only occur during emergency operating conditions and therefore the curves are a step function. Under the proposal in the NOPR, PJM would be required to price instances of transient shortages that may only be for few megawatts, and therefore do not pose the same reliability threat as the sustained reserve shortages PJM prices for today. **Under the Proposed Rule in the NOPR, an adjustment would be needed to PJM’s ORDCs to incorporate how the level of reserve shortage corresponds to system reliability to ensure that market clearing prices do not overstate the current operating state of the system.**”

(Jointly filed with SPP on November 30, 2015; pages 7 and 8)