Shortage Pricing ORDC - Order 825

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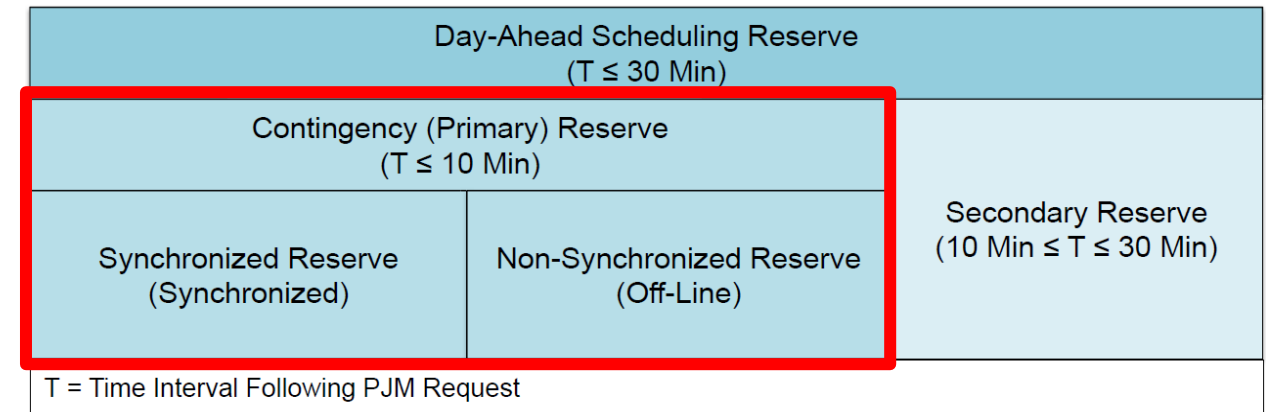
Market Implementation Committee – Special Session

October 26, 2016

|	Date	Committee	Agenda
✔	Jul. 28, 2016	MRC	Problem Statement/Issue Charge approval
✔	Aug. 10	MIC	Education
✔	Oct. 5	MIC	Education, Interest, Options
✔	Oct. 26	MIC	Education, Interest, Options
	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
- VACAR Reserve requirement
  - 485 MW

Day-Ahead Scheduling Reserve (T ≤ 30 Min)		
Contingency (Primary) Reserve (T ≤ 10 Min)		Secondary Reserve (10 Min ≤ T ≤ 30 Min)
Synchronized Reserve (Synchronized)	Non-Synchronized Reserve (Off-Line)	

T = Time Interval Following PJM Request

	RTO	Mid-Atlantic-Dominion (MAD)*
Primary Reserve Requirement	150% of largest single contingency (2,175 MW)	1,700 MW (VACAR RSG is 485 MW)
Primary Reserve Resources	Tier 1, Tier 2 and Non-Synch	
Synchronized Reserve Requirement	100% of largest single contingency (1,450 MW)	100% of largest single contingency (1,450 MW) (VACAR RSG is 485 MW)
Synchronized Reserve Resources	Tier 1 and Tier 2	
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

$/MWh

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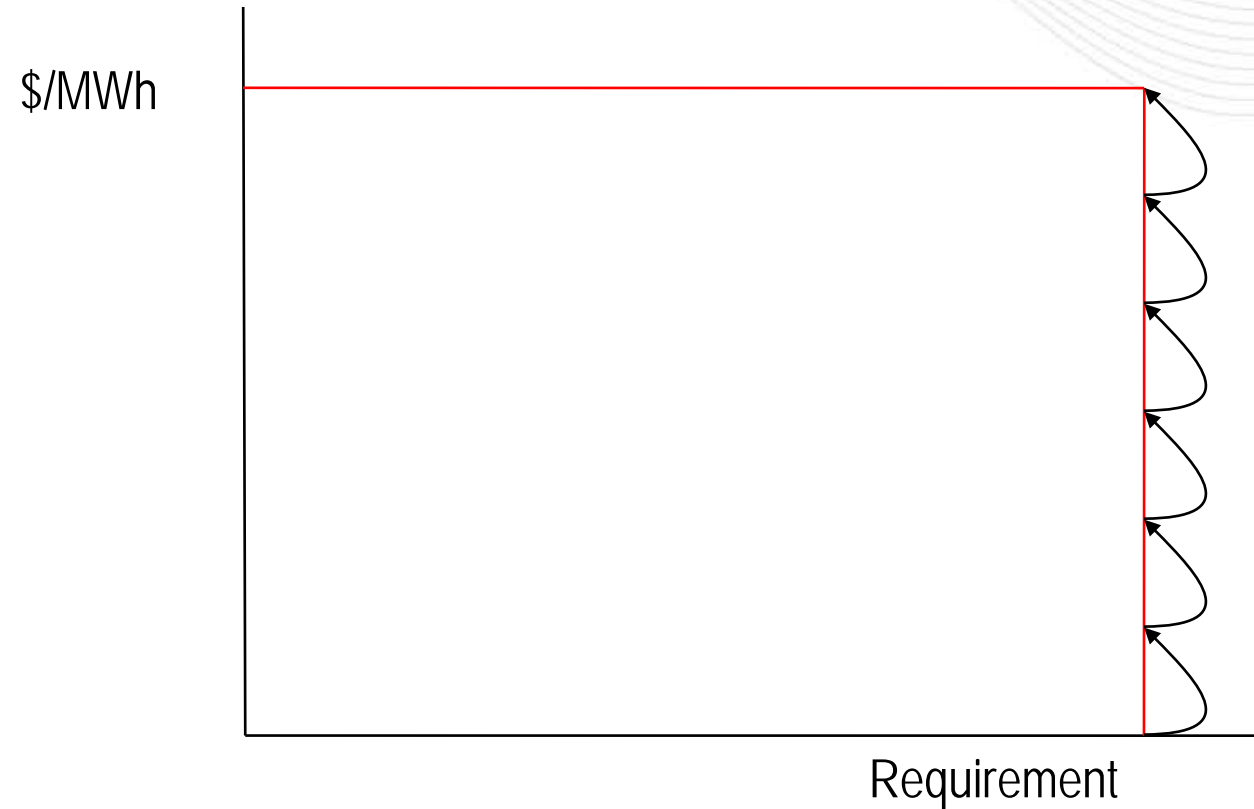
• This price represents the current cost of reserves given system conditions

• 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

- 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

- 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 Solution Intervals				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 in future				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

- PJM reviewed the 845 instances in MAD SR when deficit without pricing shortage

- In 2015, 638 of the 759 instances occurred between January and June (84%)
  - PJM implemented new procedures committing Inflexible CTs mid-Jun 2015

- PJM recommends using data between July 1, 2015 and September 30, 2016 for proposal
  - Better representation of current actions and practices
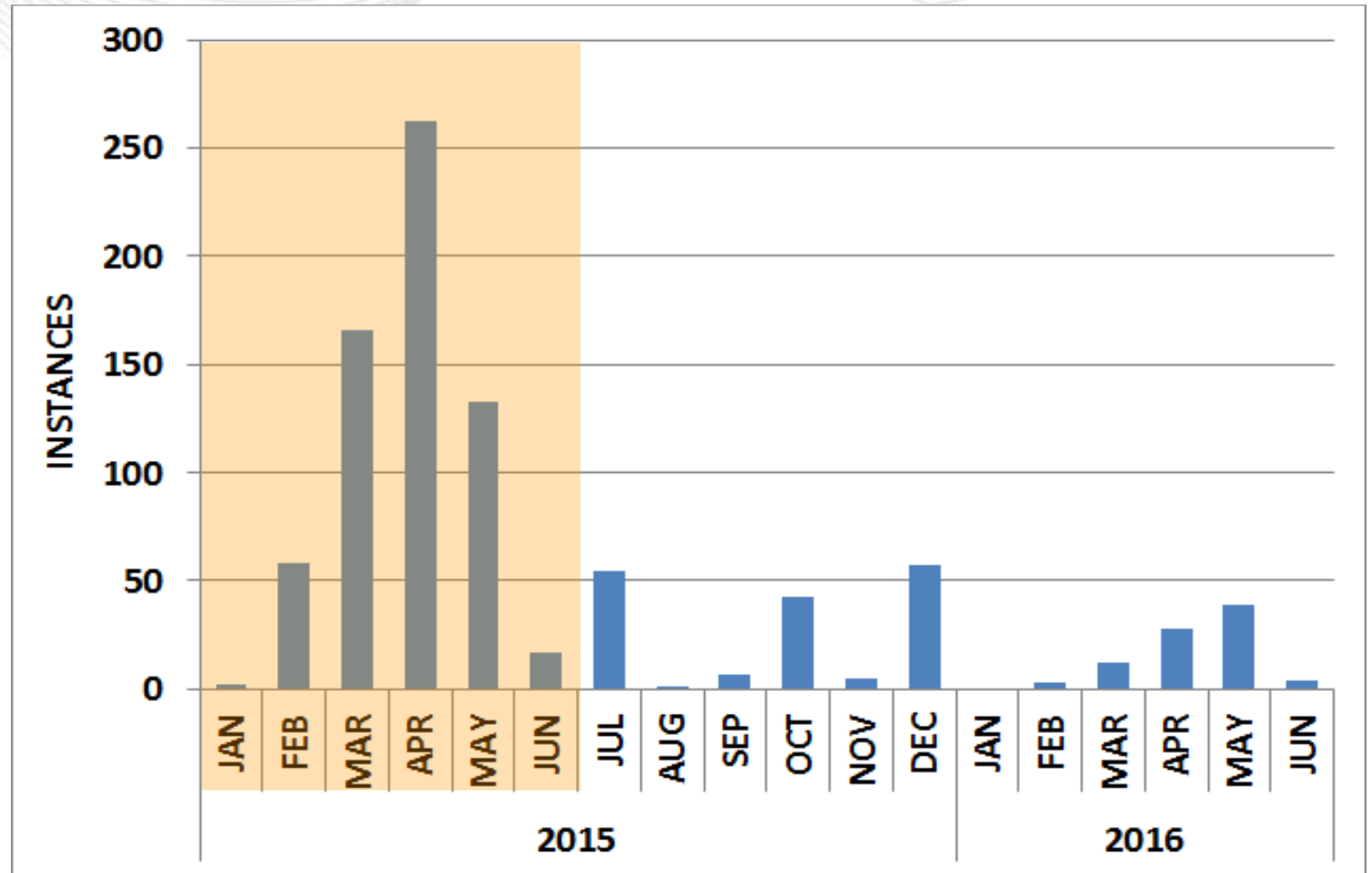
RTO Primary MW Deficits Without Pricing the Shortage

- From July 1, 2015 through September 30, 2016
- 23 instances where the $850/MWh penalty factor would have been included in the calculations of LMPs and reserve clearing prices
  - 2015: 23 instances (0.043% of total Jul-Dec 2015 instances) (All occurred in October)
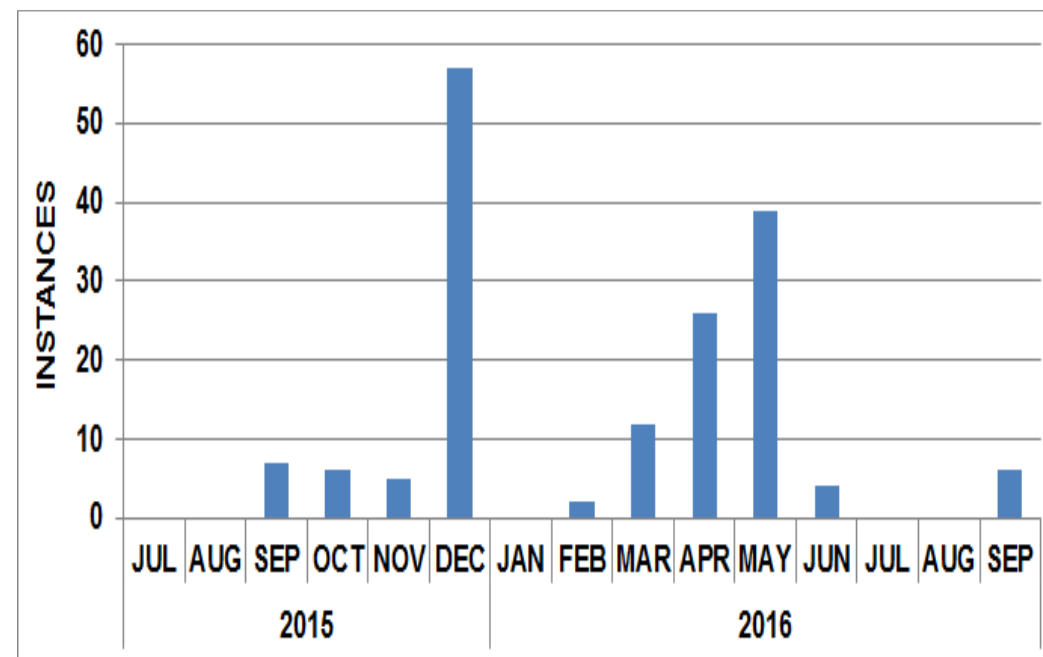 - 2016: 0 instances

Year	Shortage MW				
	Mean	Median	Min	Max	Standard Deviation
2015	104	111	10	228	60
2016	0	0	0	0	0
Combined	104	111	10	228	60

- From July 1, 2015 through September 30, 2016
- 166 instances where the $850/MWh penalty factor would have been included in the calculations of LMPs and reserve clearing prices
  - 2015: 75 instances (0.141% of total Jul-Dec 2015 instances)
  - 2016: 91 instances (0.115% of total Jan-Sep 2016 instances)

Year	Shortage MW				
	Mean	Median	Min	Max	Standard Deviation
2015	94	77	0	380	86
2016	92	61	3	463	102
Combined	93	70	0	463	95

- From July 1, 2015 through September 30, 2016
- 36 instances where the $850/MWh penalty factor would have been included in the calculations of LMPs and reserve clearing prices
  - 2015: 36 instances (0.068% of total Jul-Dec 2015 instances) (All occurred in October)
 - 2016: 0 instances

Year	Shortage MW				
	Mean	Median	Min	Max	Standard Deviation
2015	129	113	15	281	79
2016	0	0	0	0	0
Combined	129	113	15	281	79

- From July 1, 2015 through September 30, 2016
- 215 instances where the $850/MWh penalty factor would have been included in the calculations of LMPs and reserve clearing prices
  - 2015: 124 instances (0.234% of total Jul-Dec 2015 instances)
  - 2016: 91 instances (0.115% of total Jan-Sep 2016 instances)

| Year	Shortage MW				
	Mean	**Median**	**Min**	**Max**	**Standard Deviation**
2015	102	85	0	380	83
2016	92	61	3	463	102
Combined	98	73	0	463	92
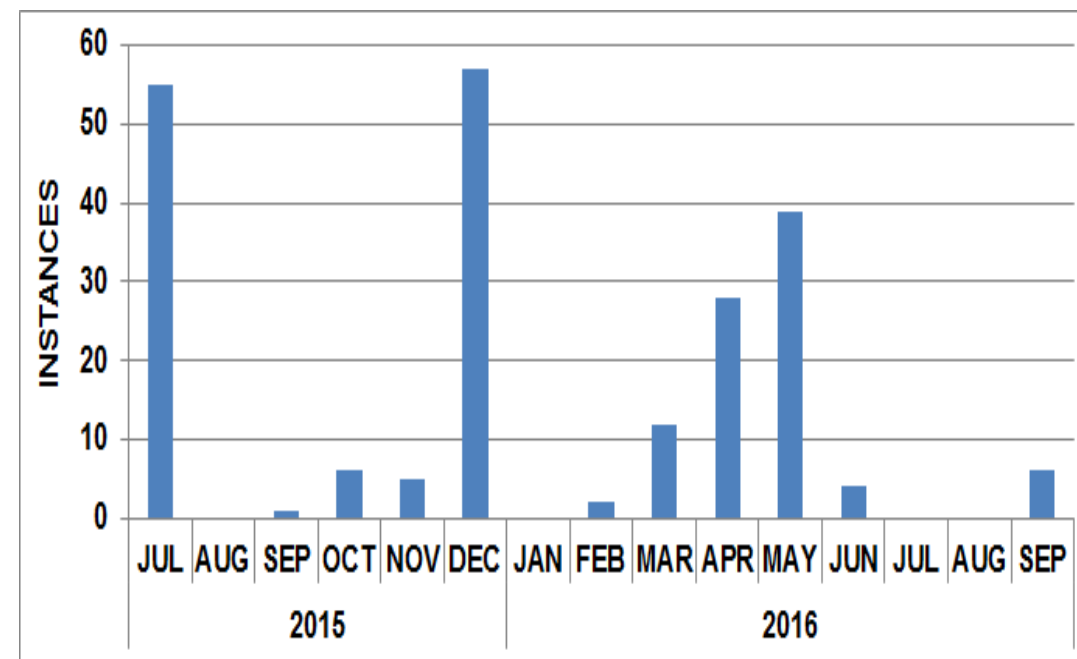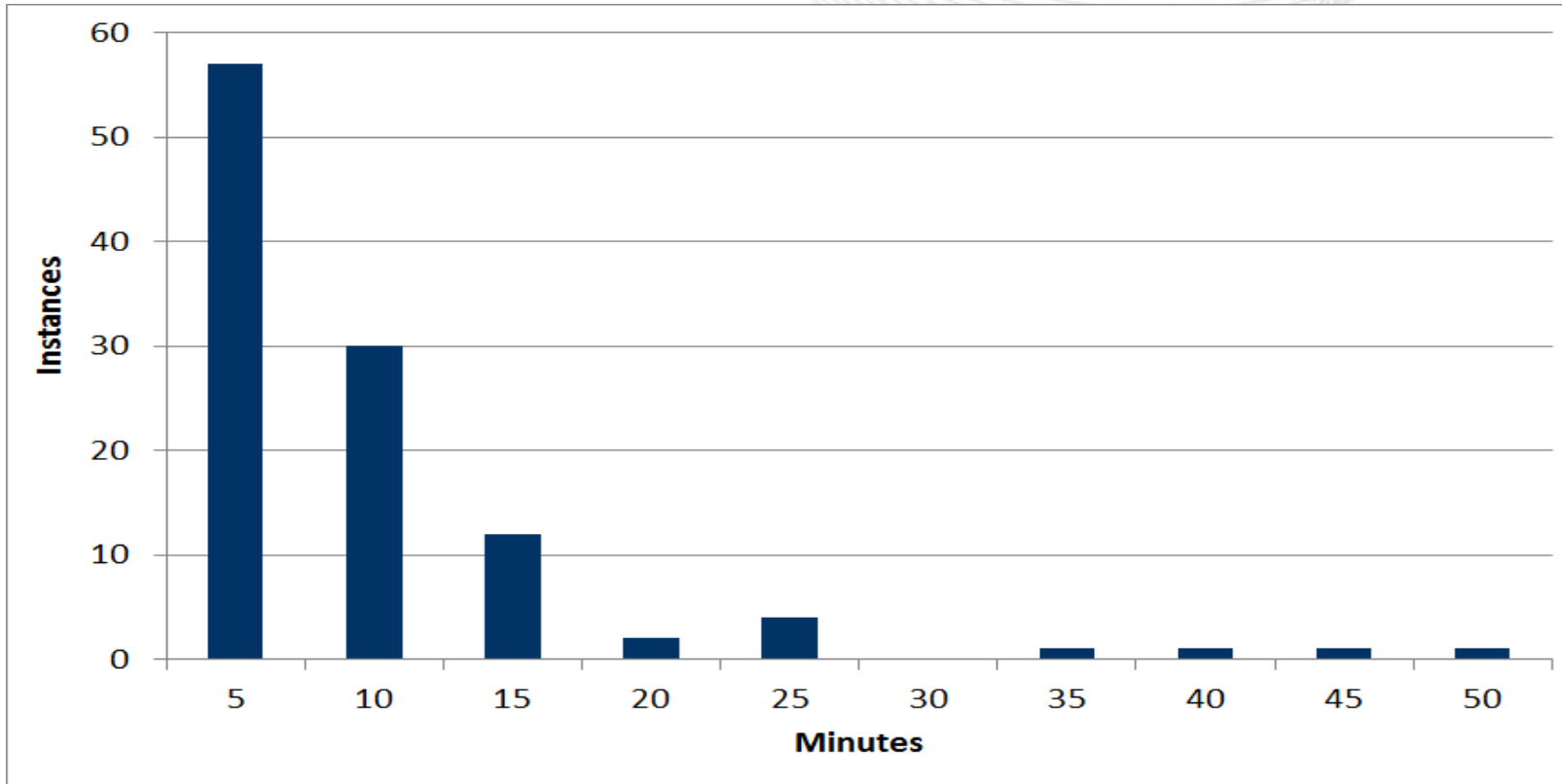
| Deficit Duration (minutes)	Number of Instances	Percentage of Total Deficity Duration Instances
5	57	26.5%
10	30	27.9%
15	12	16.7%
20	2	3.7%
25	4	9.3%
30	0	0.0%
35	1	3.3%
40	1	3.7%
45	1	4.2%
50	1	4.7%

- Graph shows the duration of minutes of the MAD SR 215 instances between July 1, 2015 and September 30, 2016
- Deficit duration minutes are bucketed every 5 minutes
- Over 70 percent of the MAD SR 215 instances lasted under 15 minutes (or 3 cases)

1. Change current reserve requirement from the economic maximum value of the single largest contingency to the highest actual output of a single unit

   a) Dynamically changes every 5-minutes

2. Create one additional step at a price lower then current $850/MWh penalty factor

3. Changes would apply to all demand curves (RTO PR, RTO SR, MAD PR and MAD SR)
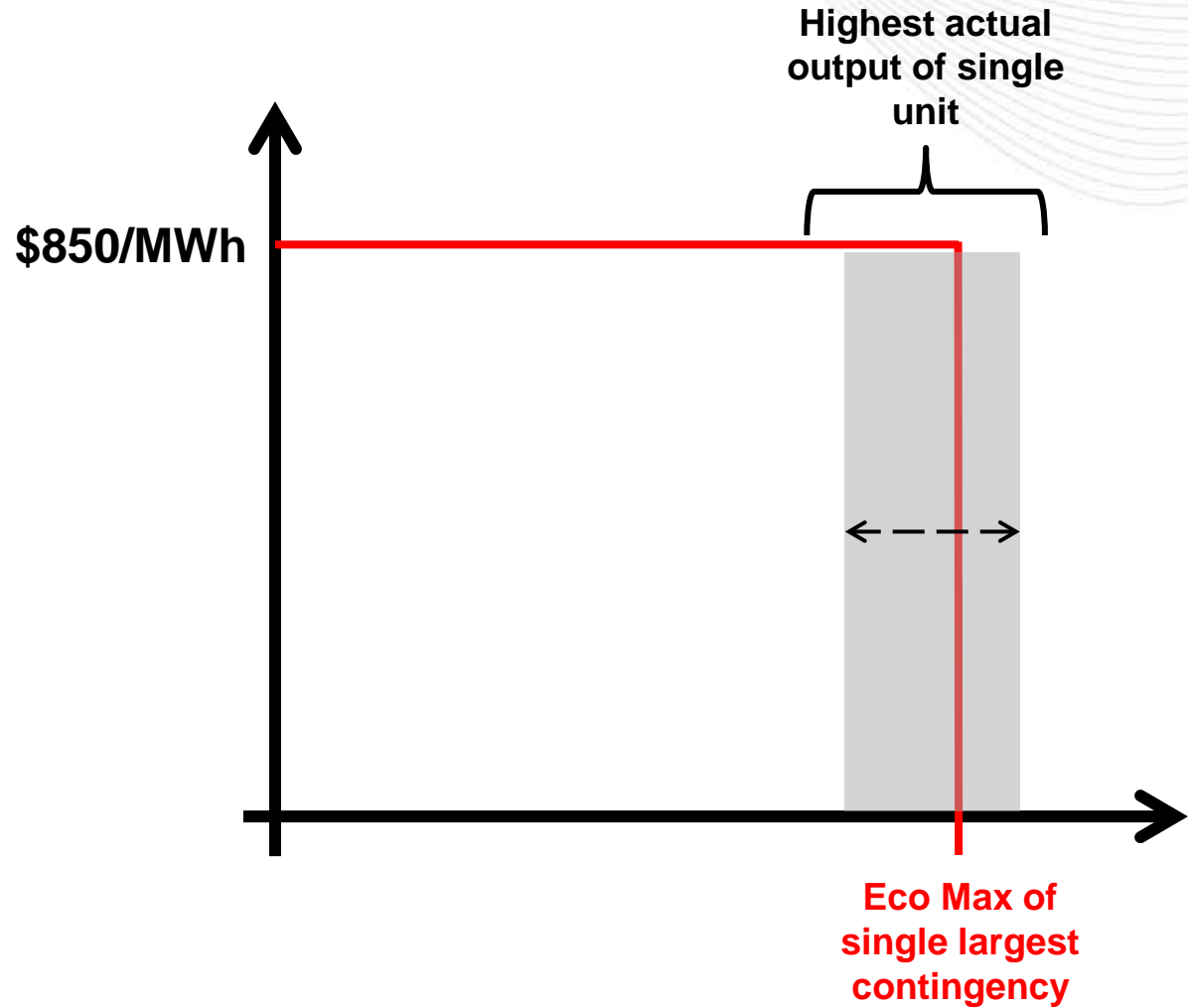
Highest actual output of single unit

$850/MWh

Eco Max of single largest contingency

- Change current reserve requirement from the economic maximum value of the single largest contingency to the highest actual output of a single unit

- Dynamically changes every 5-minutes

- Applies to all ORDCs
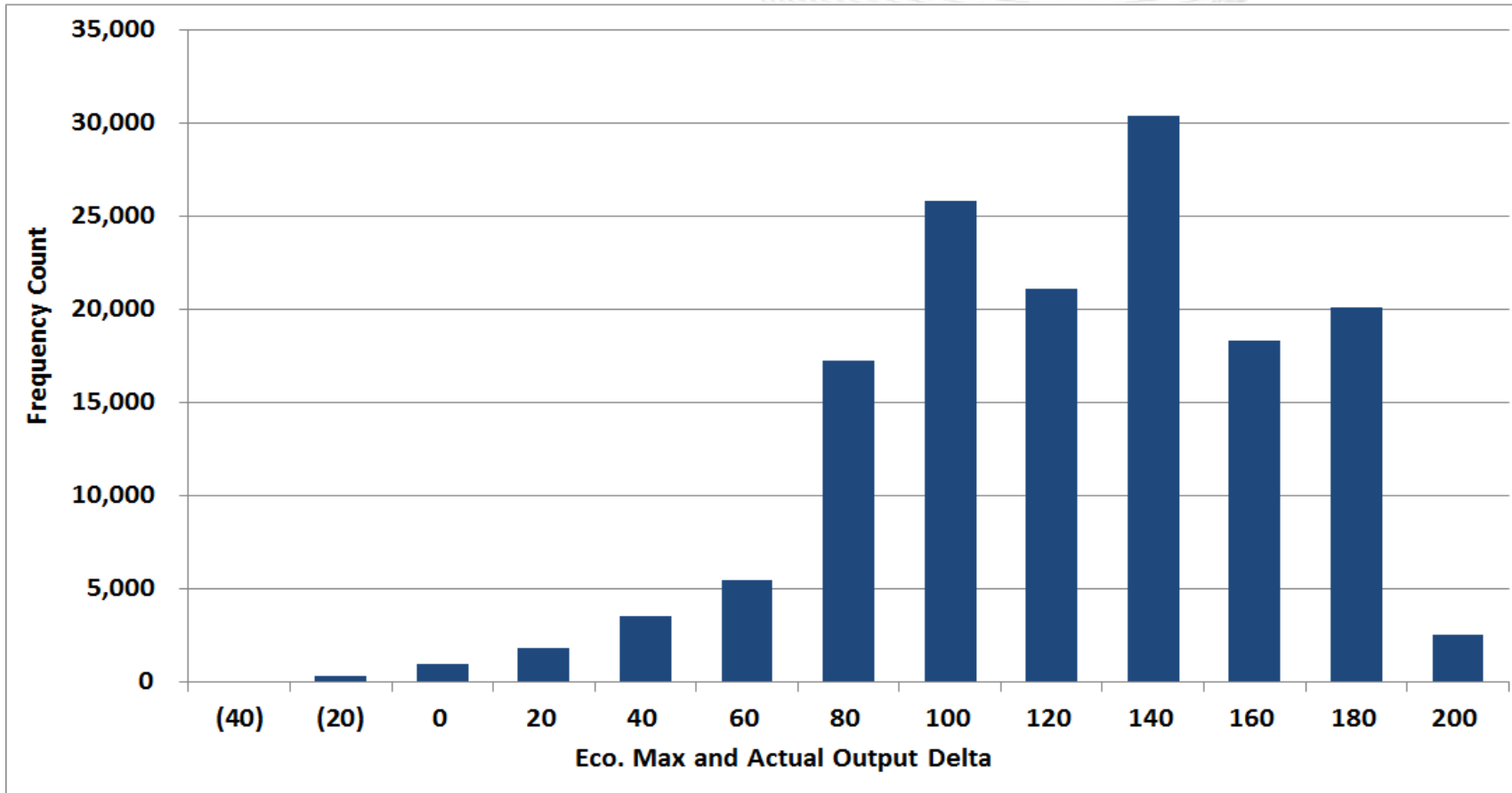
| Bin	Frequency	Precentage of Total Cases
(40)	47	0.03%
(20)	353	0.24%
0	953	0.64%
20	1,855	1.25%
40	3,511	2.38%
60	5,455	3.69%
80	17,254	11.67%
100	25,859	17.49%
120	21,138	14.30%
140	30,422	20.58%
160	18,314	12.39%
180	20,128	13.62%
200	2,525	1.71%

- Positive number represents that the Eco Max value (1,450 MW) was greater than the highest actual unit output
- Data pulled for July 1, 2015 through September 30, 2016 with a total of 147,814 cases

$850/MWh

$300/MWh

Highest actual
output of single
unit

Highest
Actual +
190 MW
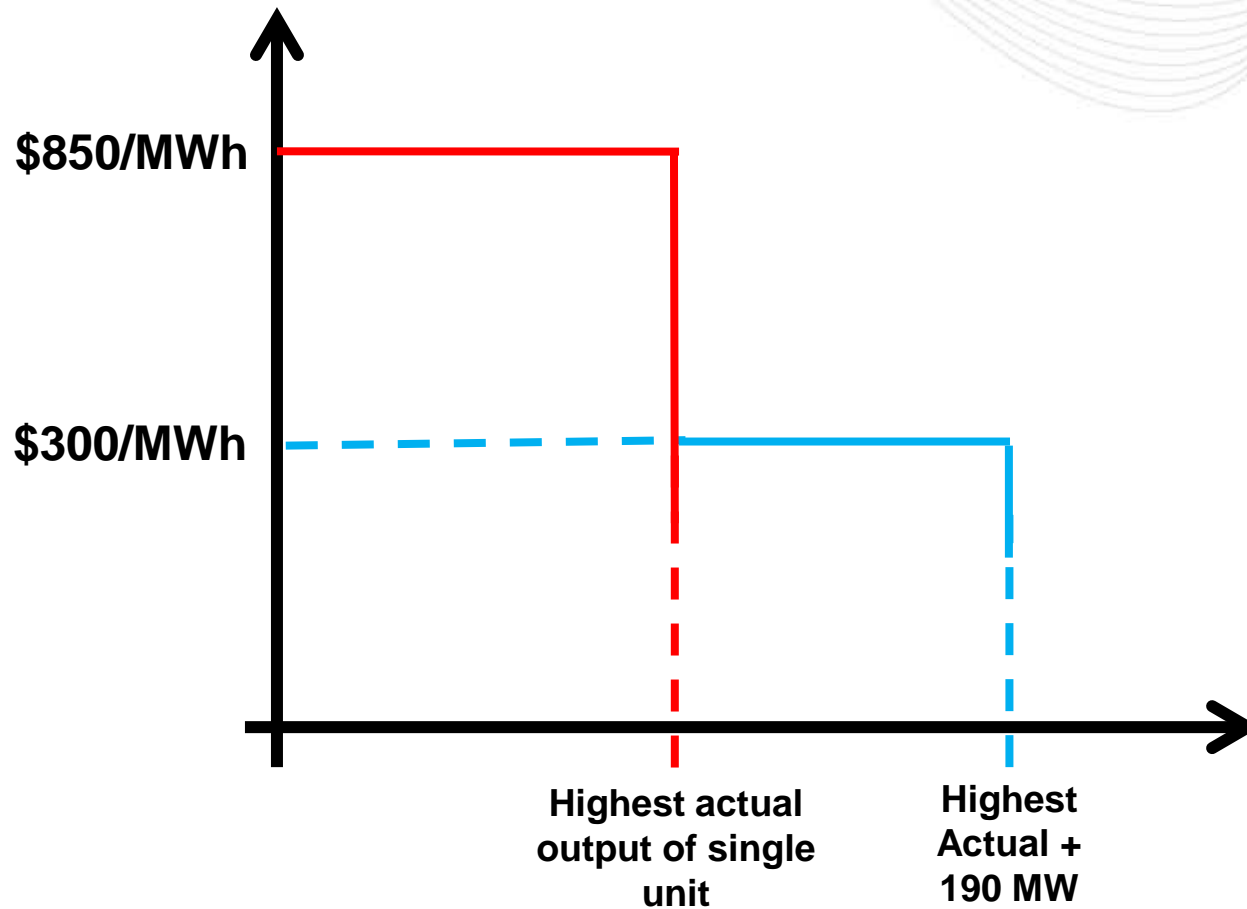
- Create one additional step at a price lower then current $850/MWh penalty factor

- Additional step will be based on MAD SR historical data using the Mean plus 1 Standard Deviation (190 MWs)

- Static number applies to all ORDCs and is effective all the time

Is there a correlation between LMPs and Interchange?
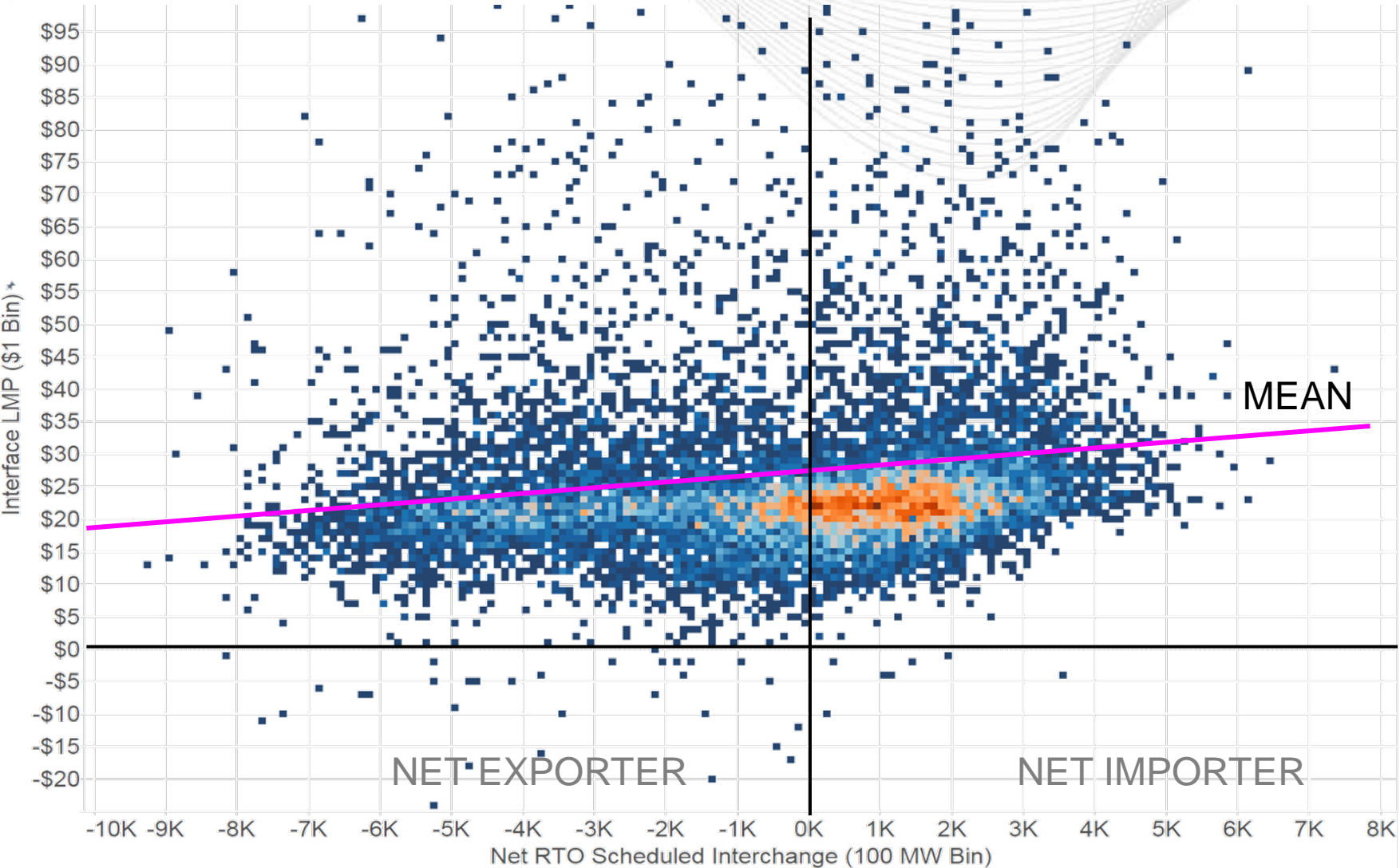
- Real-time price sensitivity of RTO Interchange between July 2015 and September 2016

- Data shows no correlation between LMPs and RTO Interchange

- Energy prices generally remained the same even when PJM was an exporter or importer

- What was the reserve margin, per ORDC, between July 2015 and September 2016?
- Looked to see when PJM met its reserve requirement and determined how much additional reserves remained

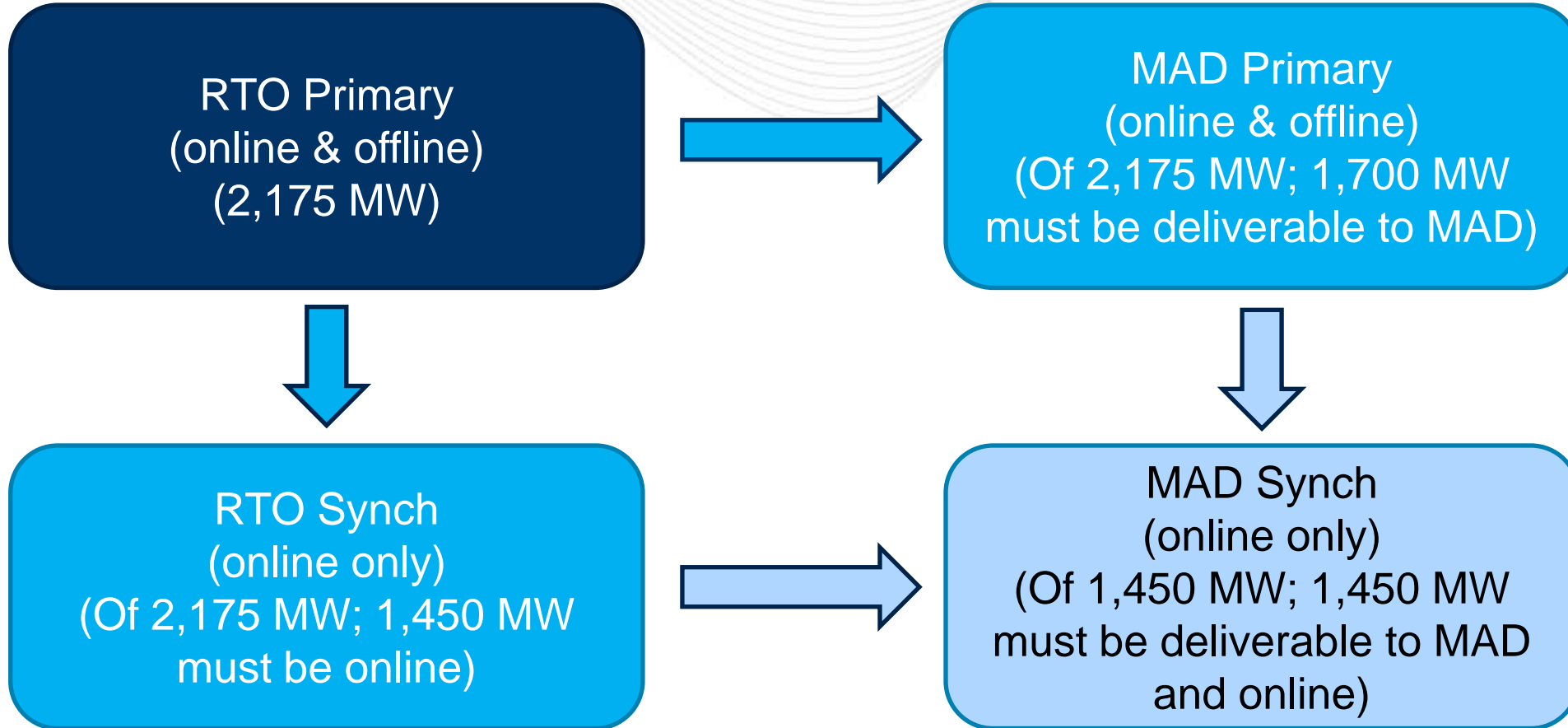| Margin (MW)	PR		SR	
	RTO	MAD	RTO	MAD
0 to 50	0.02%	0.00%	0.97%	0.01%
50 to 150	0.05%	0.00%	3.36%	0.03%
150 to 300	0.15%	0.00%	8.01%	0.11%
300 and Above	99.78%	100.00%	87.66%	99.85%

- Based on the historical data shown, PJM recommends that each ORDC:
  - Change Step 1 MW from Economic Maximum of the single largest contingency to the highest actual output of a single unit
  - Retain Step 1 Penalty Factor of $850/MWh
  - Replace current dynamic Step 2 with a permanent step
    - Use a static number of 190 MWs (MAD SR Mean + 1STDEV)
  - Retain current dynamic Step 2 Penalty Factor of $300/MWh

Appendix

- 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

	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 Primary
(online & offline)
(2,175 MW)

MAD Primary
(online & offline)
(Of 2,175 MW; 1,700 MW must be deliverable to MAD)

RTO Synch
(online only)
(Of 2,175 MW; 1,450 MW must be online)

MAD Synch
(online only)
(Of 1,450 MW; 1,450 MW must be deliverable to MAD and online)

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