Tracking Ramp Limit Desired Metric

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Primary Issue to Address: Following Dispatch

- PJM and the IMM are generally comfortable with how the current balancing operating reserve calculation treats resources that are not following dispatch.
  - Resources are only made whole to the lesser of actual or desired MW.
  - Resources are not made whole for DA buy back caused by their deviations.
- The main issue is with the calculation that determines whether a resource is following dispatch or not.
  - This determination is particularly an issue for large units with slow ramp rates.
- This leads to payment of uplift to generation units that may not be following dispatch well.
  - Rewards inflexible operation rather than flexible operation in some instances because inflexible units are paid more uplift

Review Current Desired Metrics

Currently PJM calculates how well a unit follows dispatch by comparing its RT MW to one of these three metrics:

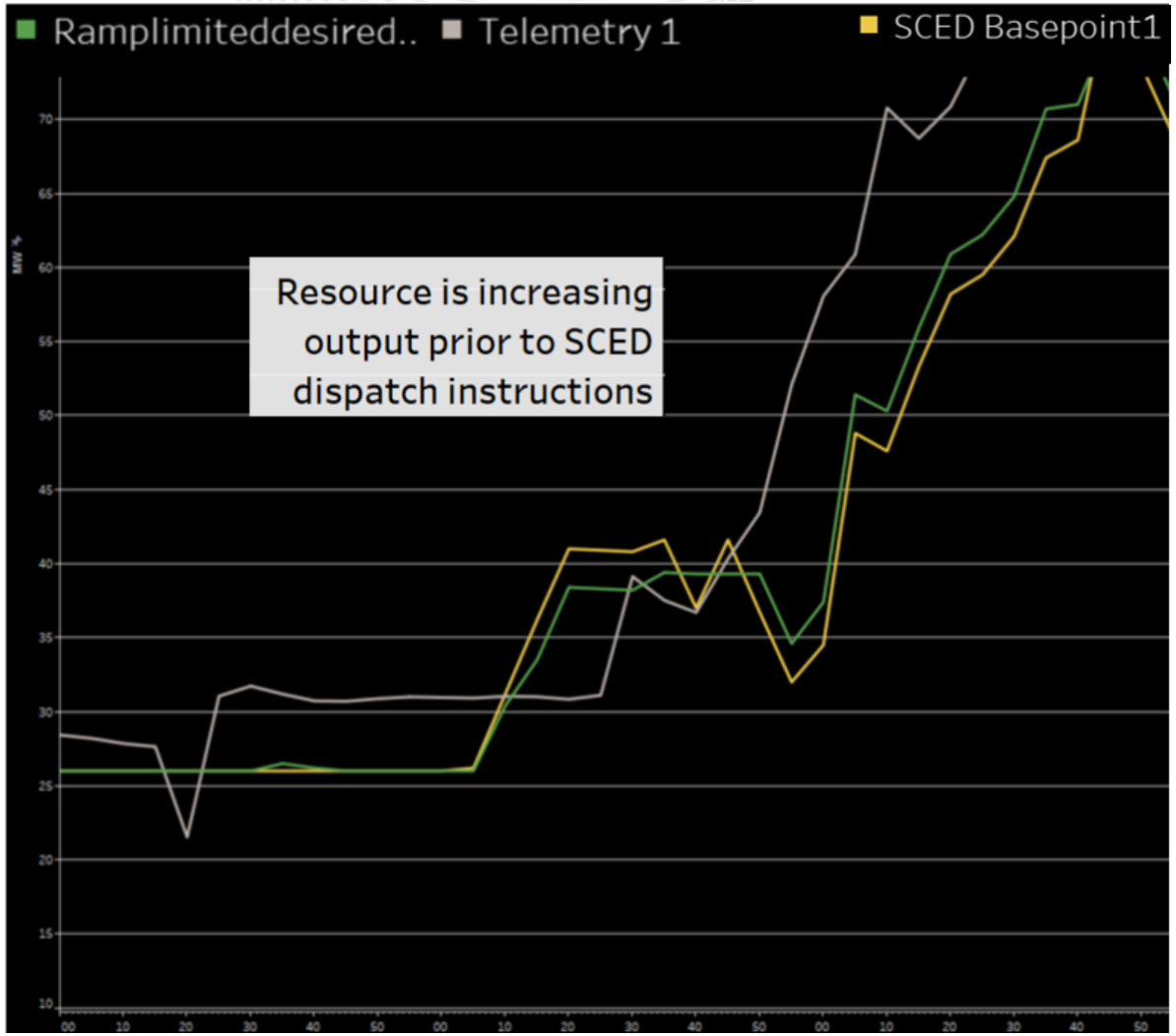
Methodology	Description	When Used as Desired MW
Dispatch Signal	Dispatch Signal calculated by RT SCED (Real-Time Security Constraint Economic Dispatch) and sent to generators.	• Dispatch Signal MW is less than or equal to the ramp-limited desired MW • Dispatch Signal MW is greater than the ramp-limited desired MW and the resource's Real-time MW is greater than the ramp-limited desired MW
Ramp Limited Desired (RLD) ***(used most frequently)***	The MW value that the unit should have achieved between Dispatch Signals or RT SCED case approvals.	Generally used when resource is "following dispatch" within +/- 20%
LMP Desired	The LMP Desired is the MW level on the incremental offer curve where the Dispatch Run LMP intersects the offer curve. Not a ramp-limited value.	• Percent off dispatch is greater than 20% or • Resource's Fixed Gen Flag is set in Real-time but not Day-ahead or • Resource clamps its economic limits from Day Ahead to Real-Time

***See Appendix September MIC Special session slide 22/23 for additional detail*

Challenges of Status Quo Desired Metrics

- The weakness of these above calculations is the difficulty in determining if the unit is actually following dispatch over a period of time
- The Dispatch Signal and the Ramp Limited Desired use actual generation as the starting point for their calculation. When a unit does not follow dispatch, the Dispatch Signal and the Ramp Limited Desired do not reflect where the unit should have been over time.
  - May result in a unit being made whole for more MW than PJM really desired from the unit
  - Resources with limited intention to follow the basepoint may receive significant uplift payments
- LMP Desired does not consider ramp limits and therefore it does not consider whether resources could have realistically achieved that MW level based on ramping capability.
  - May be overly punitive when determining MWs to be made whole

Status Quo Example 1 – Is the resource following the Dispatch Signal?



Example 1: Comparison of Ramp Limit Desired and LMP Desired

Interval ID	SETTLEMENTGENMW	BASEPOINT	SCEDLMPDESIRED	% off SCEDLMPDESIRED	RAMPLIMITEDDESIRED	% off RLD
1	30	41	82	64%	38	23%
2	30	41	82	64%	38	22%
3	38	41	82	54%	38	2%
4	36	42	82	56%	39	9%
5	35	37	82	57%	39	10%
6	39	42	82	53%	39	2%
7	42	37	26	60%	39	6%
8	50	32	26	92%	35	44%
9	57	35	26	118%	37	51%
10	59	49	26	128%	51	15%
11	69	48	26	165%	50	37%
12	67	53	26	158%	56	20%
13	69	58	26	166%	61	13%
14	73	60	26	182%	62	18%
15	76	62	26	192%	65	17%
16	77	67	26	195%	71	8%
17	77	69	26	196%	71	8%
18	77	79	82	6%	76	1%
19	77	74	26	196%	76	1%
20	77	69	26	195%	72	7%
21	77	69	26	196%	72	7%
22	77	69	26	195%	72	7%
23	77	69	26	196%	72	8%
24	77	69	26	196%	71	8%
25	77	69	26	196%	72	7%
26	77	69	26	196%	72	7%
27	77	69	26	196%	72	7%
28	77	69	26	196%	72	7%
29	77	69	26	197%	72	8%

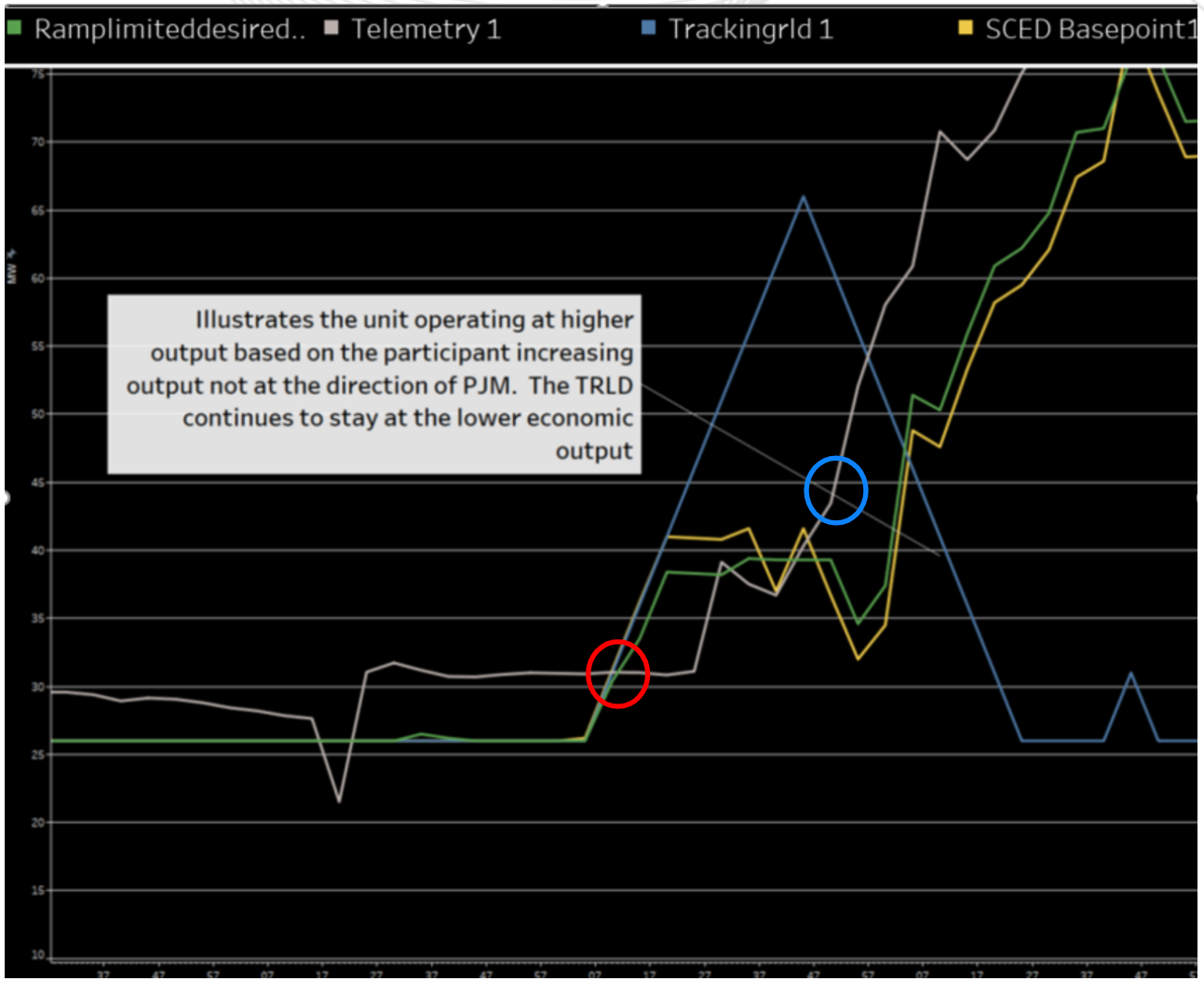
Foundation Solution Option

- PJM and the IMM jointly propose implementing a new Tracking Ramp Limit Desired (TRLD) MW
- TLRD MW proposed solution would replace ***all*** desired mw values in the calculation of operating reserve credits
  - Simplifies the calculation
  - More accurately measures how closely a resource is following dispatch over a period of time than the Status Quo
  - Acknowledges ramping limitations better than the LMP Desired MW value that is currently used when resources are significantly deviating

Tracking Ramp Limited Desired MW Equation

- Generically, the new metric is calculated as:
  - $D_t = D_{t-1}$ +/- $Ramp_t$
- Where:
  - D = New Desired MW
  - t = Calculation interval. When t-1 = 0, D = Actual Output.
  - *Ramp = Increase/decrease in output based on market conditions. The ramp will be calculated using the dispatch LMPs solved in every RTSCED case and the ramp rates submitted by the units.*

Example 1 with TRLD: Shows the Unit is Not Following Dispatch



Example 1 with TRLD:

Interval ID	SETTLEMENTGENMW/ ACTUAL	BASEPOINT	SCEDLMPDESIRED /LMPDESIRED	% off SCEDLMPDESIRED	RAMPLIMITEDDESIRED	% off RLD	TRACKINGRLD	% off TRLD
1	30	41	82	64%	38	23%	41	28%
2	30	41	82	64%	38	22%	46	35%
3	38	41	82	54%	38	2%	51	26%
4	36	42	82	56%	39	9%	56	36%
5	35	37	82	57%	39	10%	61	42%
6	39	42	82	53%	39	2%	66	41%
7	42	37	26	60%	39	6%	61	32%
8	50	32	26	92%	35	44%	56	11%
9	57	35	26	118%	37	51%	51	11%
10	59	49	26	128%	51	15%	46	29%
11	69	48	26	165%	50	37%	41	68%
12	67	53	26	158%	56	20%	36	86%
13	69	58	26	166%	61	13%	31	123%
14	73	60	26	182%	62	18%	26	182%
15	76	62	26	192%	65	17%	26	192%
16	77	67	26	195%	71	8%	26	195%
17	77	69	26	196%	71	8%	26	196%
18	77	79	82	6%	76	1%	31	148%
19	77	74	26	196%	76	1%	26	196%
20	77	69	26	195%	72	7%	26	195%
21	77	69	26	196%	72	7%	26	196%
22	77	69	26	195%	72	7%	26	195%
23	77	69	26	196%	72	8%	26	196%
24	77	69	26	196%	71	8%	26	196%
25	77	69	26	196%	72	7%	26	196%
26	77	69	26	196%	72	7%	26	196%
27	77	69	26	196%	72	7%	26	196%
28	77	69	26	196%	72	7%	26	196%
29	77	69	26	197%	72	8%	26	197%

Example 1 with TRLD Continued:

Interval ID	SETTLEMENTGENMW/ ACTUAL	BASEPOINT	SCEDLMPDESIRED /LMPDESIRED	% off SCEDLMPDESIRED	RAMPLIMITEDDESIRED	% off RLD	TRACKINGRLD	% off TRLD
1	30	41	82	64%	38	23%	41	28%
2	30	41	82	64%	38	22%	46	35%
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4	36	42	82	56%	39	9%	56	36%
5	35	37	82	57%	39	10%	61	42%
6	39	42	82	53%	39	2%	66	41%
7	42	37	26	60%	39	6%	61	32%
8	50	32	26	92%	35	44%	56	11%
9	57	35	26	118%	37	51%	51	11%
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26	77	69	26	196%	72	7%	26	196%
27	77	69	26	196%	72	7%	26	196%
28	77	69	26	196%	72	7%	26	196%
29	77	69	26	197%	72	8%	26	197%

Key Take Away from Example 1

- When the unit is deviating by **less** than +/- 20% of ramp limited desired, the unit is currently made whole to the lesser of ramp limited desired MW and Actual MW
  - When the unit is deviating for sustained periods, using Tracking RLD MW will make the unit whole for fewer MW, better recognizing the unit is not following dispatch
- When the unit is deviating by **more** than +/- 20% of RLD, the unit is currently made whole to the lesser of LMP Desired MW and Actual MW.
  - Using Tracking RLD MW will make the unit whole for more MW in many of these instances since it respects ramp limits.

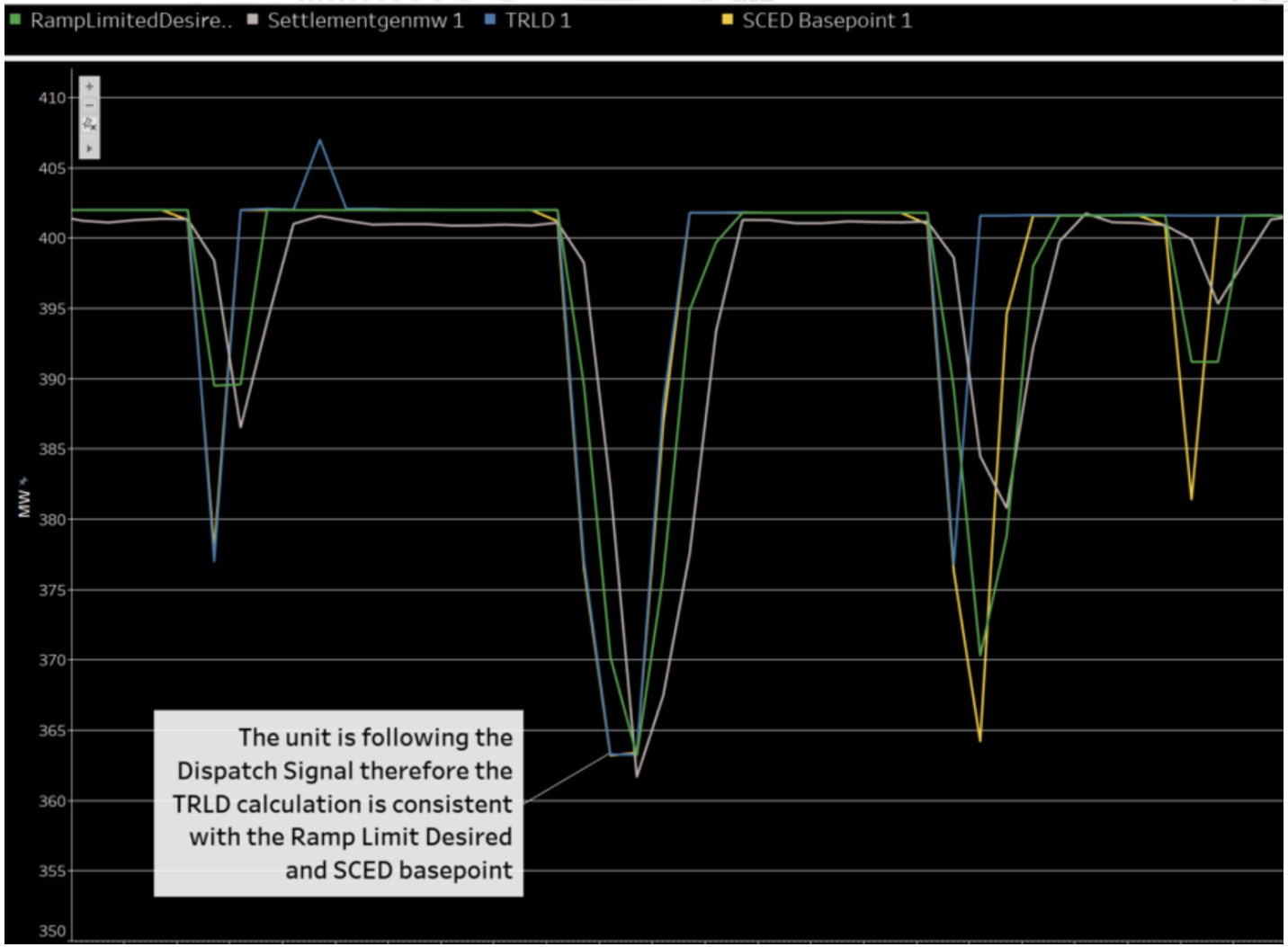
Example 1- TRLD Sample Uplift Payment Adjustment

- Replacement of existing desired mw options and replace with TRLD desired

- Approximate result of this change

Balancing Operating Reserve Credit	New Balancing Operating Reserve Credit (TRLD)	Delta Operating Reserve Net Credit	Delta Operating Reserve Net Credit %
26,000	12,000	14,000	54%

Example 2 with TRLD: Unit is Following Dispatch



Example 2 Approximate Uplift Calculation – Unit is Following Dispatch

Balancing Operating Reserve Credit	New Balancing Operating Reserve Credit (TRLD)	Delta Operating Reserve Net Credit	Delta Operating Reserve Net Credit %
0	0	0	0%

Additional Considerations for TRLD or Operating Reserve Calculations

PJM Instructions

- Manual Dispatch/Ancillary Services
  - PJM Provides directives to a resource at specific Dispatch point or Dispatch Range
  - Reserves/Regulation services must to be compensated equitably
  - PJM directives and instructions must not be penalized

Market participant adjustments via Markets Gateway that reduce resource flexibility

- Restricting economic limits from day-ahead to real-time
  - Economic min clamping
  - Economic max clamping
- Use of fixed gen flag
  - Resource intends to not follow PJM dispatch

Real-time Visibility into Deviations and Unit Performance

Markets Gateway (Dispatch Lambda)	Telemetry(ICCP/Internet SCADA)
Generator Name	Desired Dispatch MW Basepoint
Schedule ID/Type the unit is currently running on	Reg Assignment (A/D-Reg)/Flexible Reserve Assignment
Lambda – Dispatch Rate (marginal cost) for the Unit ($/MWh)	Log Reason or GenRunner Code
Gen. MW – Desired Dispatch MW Basepoint	Economic Limits (values used in latest approved SCED case sent to the resource)
Non-Ramp MW – Non-Ramp restricted MW value at the Dispatch rate/marginal cost of the unit	Spin Event Notification
Reg MW – Current Regulation assignment	Gross Resource output (member sends this to PJM)
Deviation – Delta between current generation output and Desired Dispatch MW Basepoint	Automatic CT Notification
The Data provided between Markets Gateway and Telemetry provides the ability to determine how well a resource is following Dispatch	
*See full list in reference slide **Markets Gateway** User Guide*	*See full list in reference slide **Telemetry Points** for PJM to Member and Member to PJM data transfers*

Real-time Visibility into Deviations and Unit Performance Markets Gateway

pjm | Markets Gateway

- Bilaterals
- Demand
- Demand Response
- Generator
  - Unit
  - Schedules
  - Dispatch Lambda
  - Market Results
  - Regulation Market
  - Synchronized Reserve Ma
  - Non-Synchronized Reserv
  - Secondary Reserve Marke
  - Unit Limitations
- Interface Pricing
- Opportunity Cost Calculator
- Parameter Limits
- Price Responsive Demand
- Pseudo Tie Transaction
- Public
- System Utilities
- Up-To-Transaction
- Virtual
- Weather Forecast

>> 2023-11-02 >> Last Queried: 11/2/2023 11:01:06 Total Steam: Total Regulation MW: 0

Location	Schedule	Schedule Type	Lambda	Gen. MW	Non-Ramp MW	Reg. MW	Deviation MW	Econ. Min.	Econ. Max.	Capacity Max.

Unit name and detailed schedule information

Unit cost, dispatch signal, regulation assignment and deviation MW

Economic limits

SR Assignment	NSR Assignment	SecR Assignment	On Time	Off Time	Status

Reserve assignments

Unit logging information

Contact

Operating Reserve Clarifications

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Operating Reserve Clarifications

Potential Solution Options – Desired MW Calculations

Member Hotline

(610) 666 – 8980

(866) 400 – 8980

custsvc@pjm.com

Reference Materials

- MIC July 2022

  https://www.pjm.com/-/media/committees-groups/committees/mic/2022/20220713/item-11b---new-desired-mw-metric.ashx
- MIC Special Session September 2023

  https://www.pjm.com/-/media/committees-groups/committees/mic/2023/20230911-special/item-02---operating-reserve-clarification-issue-charge-education.ashx
- MIC Special Session October 2023

  https://www.pjm.com/-/media/committees-groups/committees/mic/2023/20231016-special/item-02a---imm-following-dispatch-metrics-education.ashx
- Markets Gateway user guide, Section 4.4

  https://www.pjm.com/-/media/etools/markets-gateway/markets-gateway-user-guide.ashx
- Telemetry Points

  https://www.pjm.com/-/media/planning/services-requests/generator-telemetry-list.ashx