Regulation Mileage Ratio Calculation

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July 14, 2021

Mileage Ratio Calculation

The owner of each Regulation resource that actively follows the Office of the Interconnection's Regulation signals and instructions, will be credited for Regulation performance by multiplying the assigned MW(s) by the Regulation market performance-clearing price, by the ratio between the requested mileage for the Regulation dispatch signal assigned to the Regulation resource and the Regulation dispatch signal assigned to traditional resources, and by the Regulation resource's accuracy score calculated in accordance with subsection (k) of this section.

* traditional resources – RegA resources

$$\text{Mileage Ratio (RegA)} = \frac{RegA\ Hourly\ Mileage}{RegA\ Hourly\ Mileage}$$

$$\text{Mileage Ratio (RegD)} = \frac{RegD\ Hourly\ Mileage}{RegA\ Hourly\ Mileage}$$

Regulation Market Performance Clearing Price (RMPCP) Credit =

5-min integrated Regulation MW x 5-min Actual Performance Score x **Mileage Ratio** x 5-min RMPCP /12

Proposed Solution

- Floor RegA Mileage at 0.1 instead of zero
  - Would allow valid solution for Mileage Ratio while maintaining market design objectives
  - Would have impacted only 0.022% of hours since 2012 (17 hours)
  - No impact to Regulation signal design, Operations or Regulation Market Clearing
  - Highest expected mileage ratio based on signals movement is between 62 and 235
  - Consistent with 2018 change flooring Benefits Factor in market clearing to 0.1 instead of 0

Instances of When RegA Hourly Mileage is Less than 0.1

Local Hour	RMCCP	RMPCP	Hourly Mileage A	Hourly Mileage D	Hourly Mileage Ratio (settled)	Hourly Mileage Ratio (Proposed)	Difference in Mileage Ratio
3/4/2013 18:00	$37.67	$0.03	0.074304	0.257536	3.47	2.58	0.89
11/9/2013 18:00	$12.40	$0.97	0.072887	15.649591	214.71	156.5	58.21
5/31/2015 15:00	$187.06	$0.78	0.070406	14.128501	200.67	141.29	59.38
12/11/2015 16:00	$12.49	$0.01	0.078511	13.35094	170.05	133.51	36.54
12/31/2015 18:00	$0.27	$0.00	0.056789	12.54787	220.96	125.48	95.48
1/1/2016 2:00	$8.45	$0.00	0.013579	10.582214	779.31	105.82	673.49
6/28/2016 16:00	$3.08	$0.00	0.018116	11.818568	652.38	118.19	534.19
2/27/2018 9:00	$0.00	$0.00	0.040318	20.448624	507.18	204.49	302.69
1/21/2019 11:00	$313.49	$0.00	0.006478	27.402607	4230.10	274.03	3956.07
1/30/2019 14:00	$17.49	$0.01	0.046133	5.225629	113.27	52.26	61.01
6/22/2020 15:00	$0.01	$0.00	0.048004	19.204105	400.05	192.04	208.01
6/26/2020 0:00	$11.37	$0.00	0.096609	23.562192	243.89	235.62	8.27
8/12/2020 14:00	$15.09	$0.01	0.03332	22.412721	672.65	224.13	448.52
2/17/2021 9:00	$0.00	$0.00	0	19.159495	#N/A	191.59	191.59
4/2/2021 4:00	$8.59	$0.00	0.099567	6.182331	62.09	61.82	0.27
4/15/2021 9:00	$6.91	$0.00	0.052218	33.582262	643.12	335.82	307.30
5/8/2021 13:00	$13.77	$0.00	0.011427	31.296327	2738.81	312.96	2425.85

Difference in Proposals

Both the PJM and the IMM proposals will eliminate the undefined mileage ratio situation

$$Mileage\ Ratio = \frac{RegD\ Mileage}{RegA\ Mileage}$$

IMM Proposal:
- **Cap Mileage Ratio @ 5.5**
- Impacts 49.66% of hours since 2020

PJM Proposal:
- **Floor RegA Mileage @ 0.1**
- Impacts 0.022% of hours since 2012

Mileage Ratio affects payments to RegD resources (RMPCP($)*Mileage Ratio)

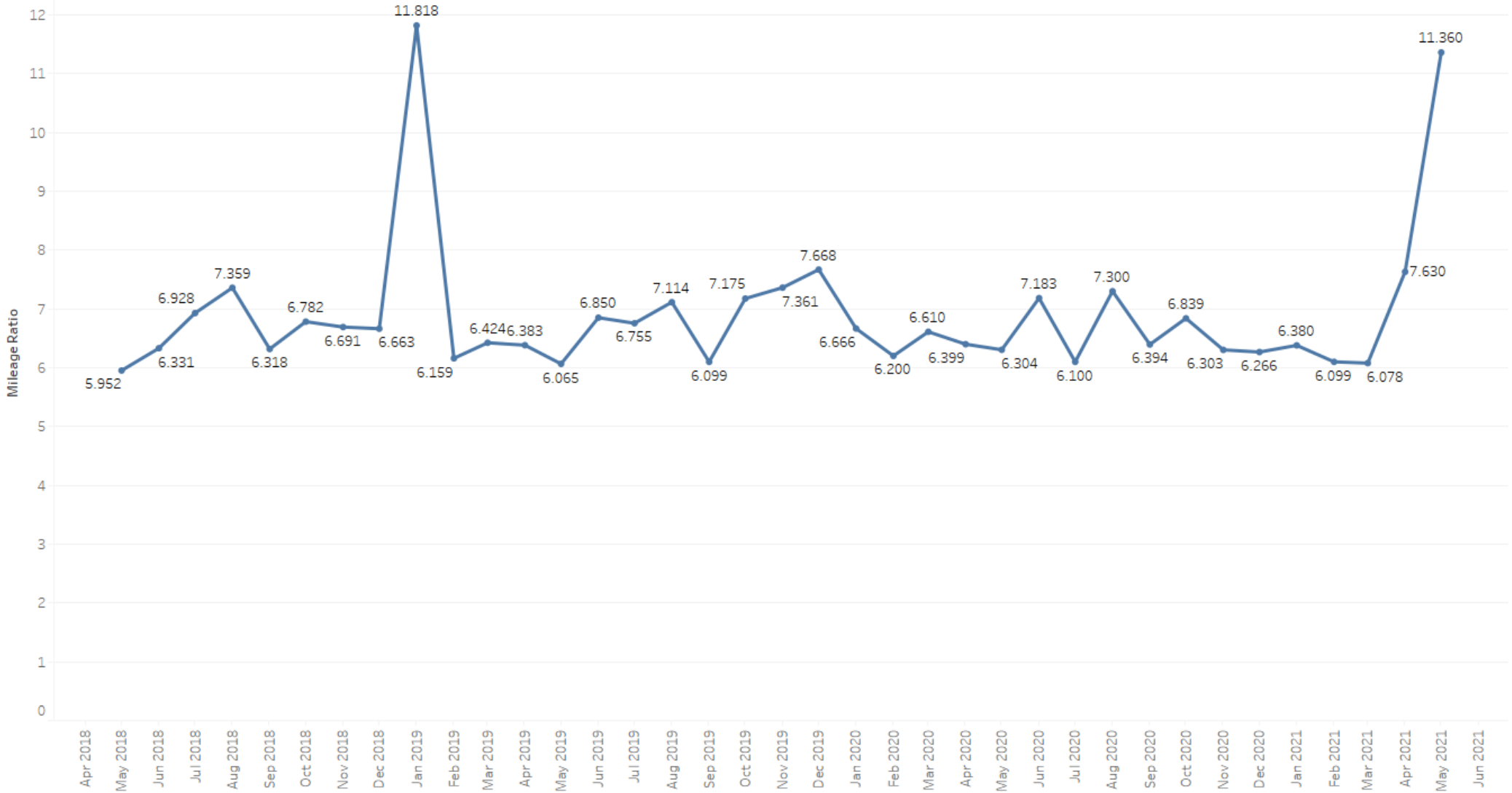
PJM vs. IMM Proposals Summary

- Both the PJM and the IMM proposals will eliminate the undefined mileage ratio situation

	PJM	IMM
Approach	Floor RegA hourly mileage at 0.1	Cap mileage ratio at 5.5
Impact	Minimal (0.022% of hours since 2012)	Almost 50% of hours since 2020
Mileage ratio range	For Jan 2020 to Mar 2021, 95 percentile hourly mileage ratio is 11.08	Up to 5.5
Reg D Compensation Impact	Overall reduces RegD credit only one time (on 8/12/2020 hour 14)	Overall reduces RegD credit approx. 50% of time where MR > 5.5 That is PCP*5.5

MR – Mileage Ratio
PCP – Performance Clearing Price

Average Mileage Ratio Per Month



Salient Stats

Data from January 2020 through March 2021

Metric	RegA Mileage	RegD Mileage	Mileage Ratio	RMPCP
Min	0.00	1.29	0.65	0.00
Max	14.29	59.71	672.65*	15.20
Median	5.29	29.13	5.47	0.17

* - Excluding 02/17/2021 Hour 9 where RegA Hourly Mileage was 0

Proposed Red Lines

- Section 3.2.2 (g) of the Operating Agreement and section 3.2.2 (g) of OATT Attachment K - Appendix

> The owner of each Regulation resource that actively follows the Office of the Interconnection's Regulation signals and instructions, will be credited for Regulation performance by multiplying the assigned MW(s) by the Regulation market performance-clearing price, by the ratio between the requested mileage for the Regulation dispatch signal assigned to the Regulation resource and the Regulation dispatch signal assigned to traditional resources, and by the Regulation resource's accuracy score calculated in accordance with subsection (k) of this section. In determining the ratio between the requested mileage for the Regulation dispatch signal assigned to the Regulation resource and the Regulation dispatch signal assigned to traditional resources, the hourly mileage applicable to traditional resources shall not be less than 0.1.

- Exact proposed language for the Tariff and the Operating Agreement will be included Manual 28, Sections 4.1 and 4.2

Proposed Implementation Schedule

June 2021	July 2021
MIC 2nd First Read	MIC Endorsement
MRC First Read	MRC Approval
	MC Approval

Target FERC Filing in July

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Regulation Mileage Ratio Calculation

Appendix

Regulation Mileage Overview

- *Regulation Mileage* is the measurement of the amount of movement requested by the regulation control signal a resource is following.
  - It is calculated for the duration of the operating hour for each regulation control signal: RegA and RegD
  - It is a proxy metric for the amount of movement requested while following the regulation signal to correct the RTO Area Control Error.

$$Mileage_{RegA} = \sum_{i=1}^{n} |RegA_i - RegA_{i-1}|$$

$$Mileage_{RegD} = \sum_{i=1}^{n} |RegD_i - RegD_{i-1}|$$

Regulation Pegging

- Describes times when PJM is deploying 95% or more of the available regulation (in either the positive or negative direction)

- The controller is designed to allow RegA to peg more frequently to help manage the neutrality of the RegD signal.
  - This design was put into place in 2017 with the introduction of the 30-minute conditional neutrality signal.

Effect of Regulation Pegging

- If a signal is “pegged” high or low for an entire operating hour, the corresponding mileage would be zero for that hour
- PJM has seen increased frequency of RegA signal pegging
  - Increased amount of RegD participation
    - RegA supporting conditional neutrality of RegD
- Increased visibility to dispatchers on RegA signal pegging
- No reliability issues as total regulation typically not pegged for long durations

How long the signal is automatically pegged

- RegD

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
20-30 min. duration	0	1	3	2	2	3	2	2	5	10	4	3	4	2	4	1	5	1	4	8
>30 min. duration	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0

- RegA

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
20-30 min. duration	44	40	46	44	45	88	66	85	71	101	93	71	80	79	55	80	74	93	104	85
>30 min. duration	19	10	21	12	22	56	35	30	45	67	65	36	57	48	40	32	57	50	64	63

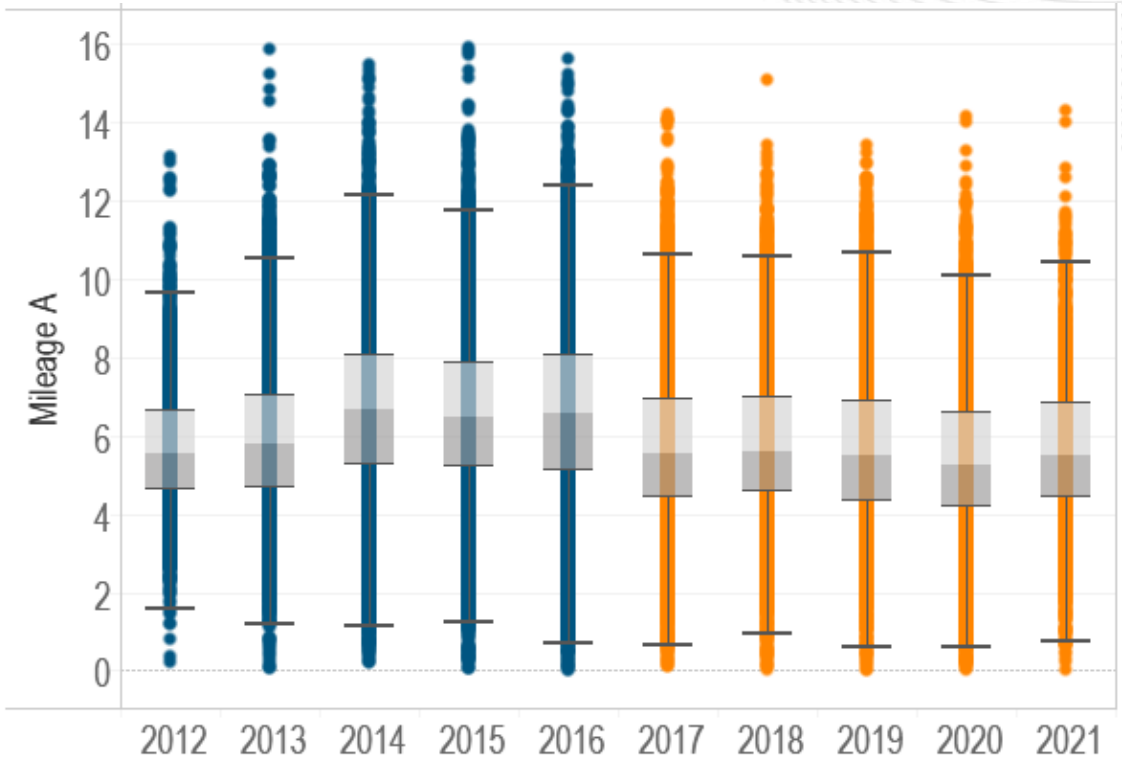
*Data through 5/26/21

Regulation D Performance

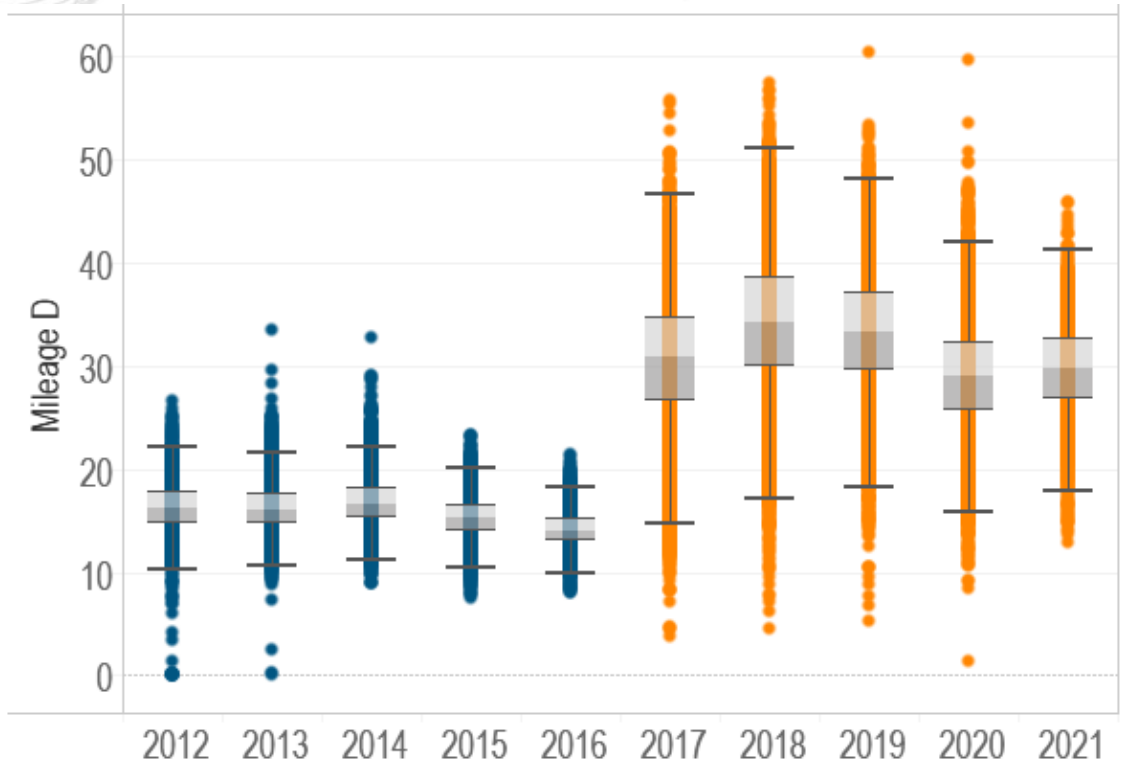
MW	Hydro	CT	Energy Storage	DSR
Regulation D				
Avg. Performance Score (1/2017)	77%	90%	96%	85%
Avg. Performance Score (1/2018)	77%	92%	92%	84%
Avg. Performance Score (1/2019)	80%	85%	93%	85%
Avg. Performance Score (1/2020)	80%	85%	91%	87%
Avg. Performance Score (6/2021)	80%	85%	90%	85%
Regulation D Qualified MW (6/21)	334	132.4	251.5	19.5

Historical Hourly Mileage by Signal Type

Mileage of Regulation Signal A



Mileage of Regulation Signal D



Conditional Neutrality logic implemented Jan 2017 resulted in an increase in the movement of the REGD resources

Hourly Mileage Ratio, by Year by Signal Methodology