Regulation Signal Analysis

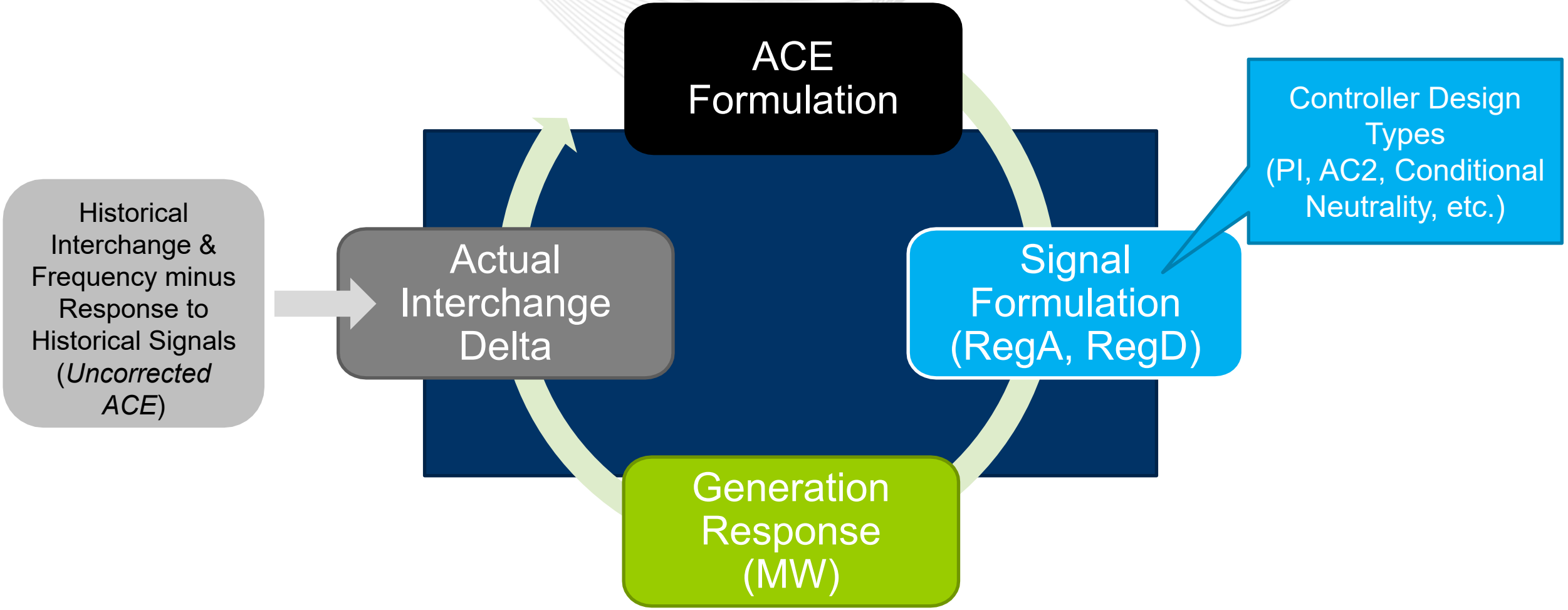
Single-Signal Approach

Danial Nazemi
Advanced Analytics, Market Design & Economics
Regulation Market Design Senior Task Force
October 19, 2022

Agenda

- Review of the PJM's Regulation Simulation Tool
- Output Metric
- Testing Approach
- Simulation Parameters and Assumptions
- Simulation Results
- Next Steps

PJM Regulation Signal Simulation Tool



What is CPS1 Metric?

- CPS1 is the 12-month rolling average control performance metric that compares the RTO ACE against measured frequency deviation over periods of time.
- It is expressed as follows:

$$CPS1 = (2 - CF1) * 100\%$$

$$CF1 = \frac{\left(CF_{1_{min}}\right)_{12month}}{(\varepsilon_1)^2}$$

$$CF_{1_{min}} = \frac{ACE_{1_{min}}}{-10B} * \Delta f_{1_{min}}$$

- B is the control area frequency bias, $\Delta f_{1_{min}}$ is the 1 minute average of frequency deviation. $ACE_{1_{min}}$ is the 1 minute average of ACE. ε_1 is the specified steady state frequency bound for each interconnection (for the Eastern Interconnection, it is equal to 0.018 Hz.)
- If the CPS1 is greater than 100%, the control area is helping the interconnection frequency response

Testing Approach

- We assume to have one generic response for all the resources.
- We used Traditional PI Controller (controller that was used prior to 2017) to send the response to RegA resources.
- The response sent to RegD signal resources has been set to 0.
- The simulation parameters were tuned based on the numbers from RTO Regulation Control.

Simulation Parameters and Assumptions

- The results are for a week in June 2022 (6/1/2022 to 6/7/2022). The summer ramping hours are from 6 to 14 and from 19 to 24.

- In this analysis, we ran multiple simulation with Traditional PI Controller and RegD signal was zeroed out to get the results for a similar condition to when we have a single regulation signal.

- The results were compared to Actual CPS1 scores (which we got from performance compliance) for the same days.

- In this analyses, RegD value was 0 and the variables were RegA MW and RegA Response Times.

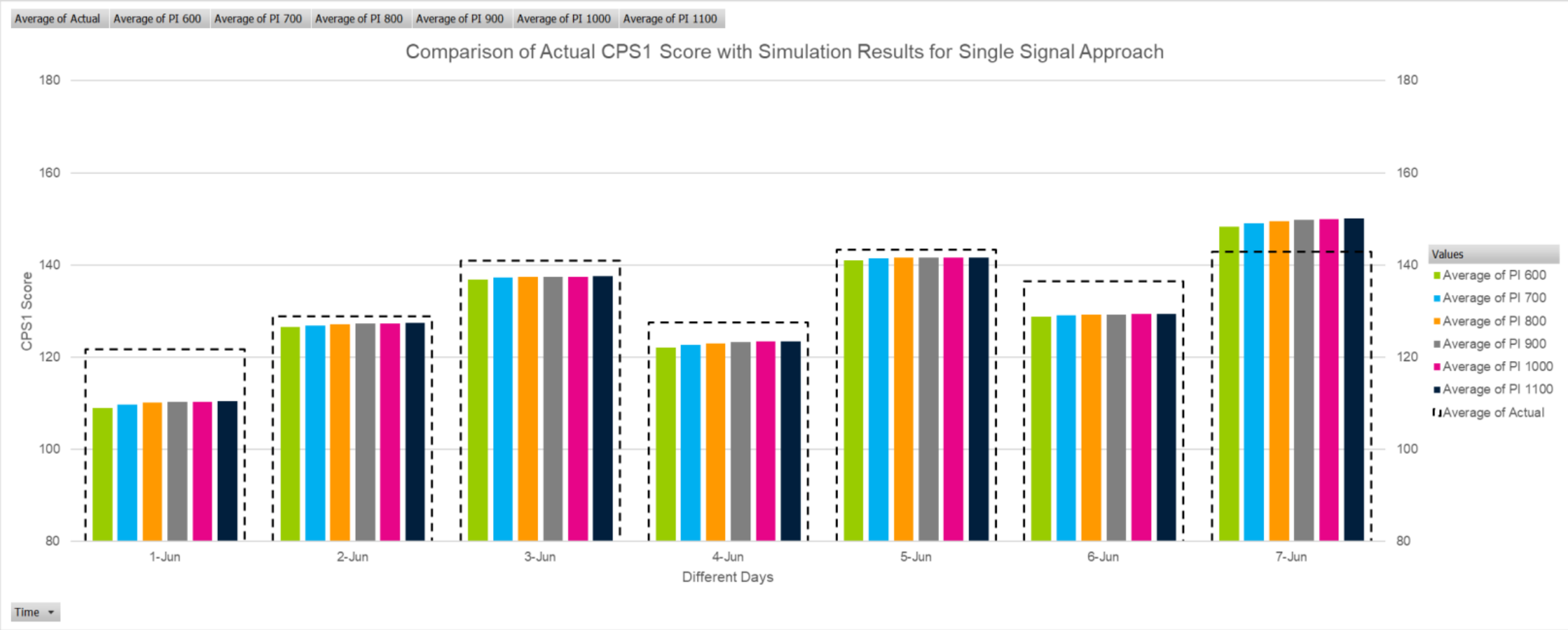
Sample Results: CPS1 Comparison for Different RegA MW

- Descriptive Statistical Analysis on CPS1 Scores (for 7-day time span)

Statistic	*Actual Score*	*RegA-like= 600 MW*	*RegA-like= 700 MW*	*RegA-like= 800 MW*	*RegA-like= 900 MW*	*RegA-like= 1000 MW*	*RegA-like= 1100 MW*
Mean	134.52	130.34	130.87	131.13	131.26	131.34	131.40
Change in Overall Mean*	-	-3.11%	-2.71%	-2.52%	-2.42%	-2.36%	-2.32%
Standard Deviation	39.87	55.71	54.91	54.53	54.37	54.29	54.25
Range	193.84	303.86	299.86	299.33	299.11	298.89	298.67
Confidence Level (95.0%)	6.07	8.49	8.36	8.31	8.28	8.27	8.26

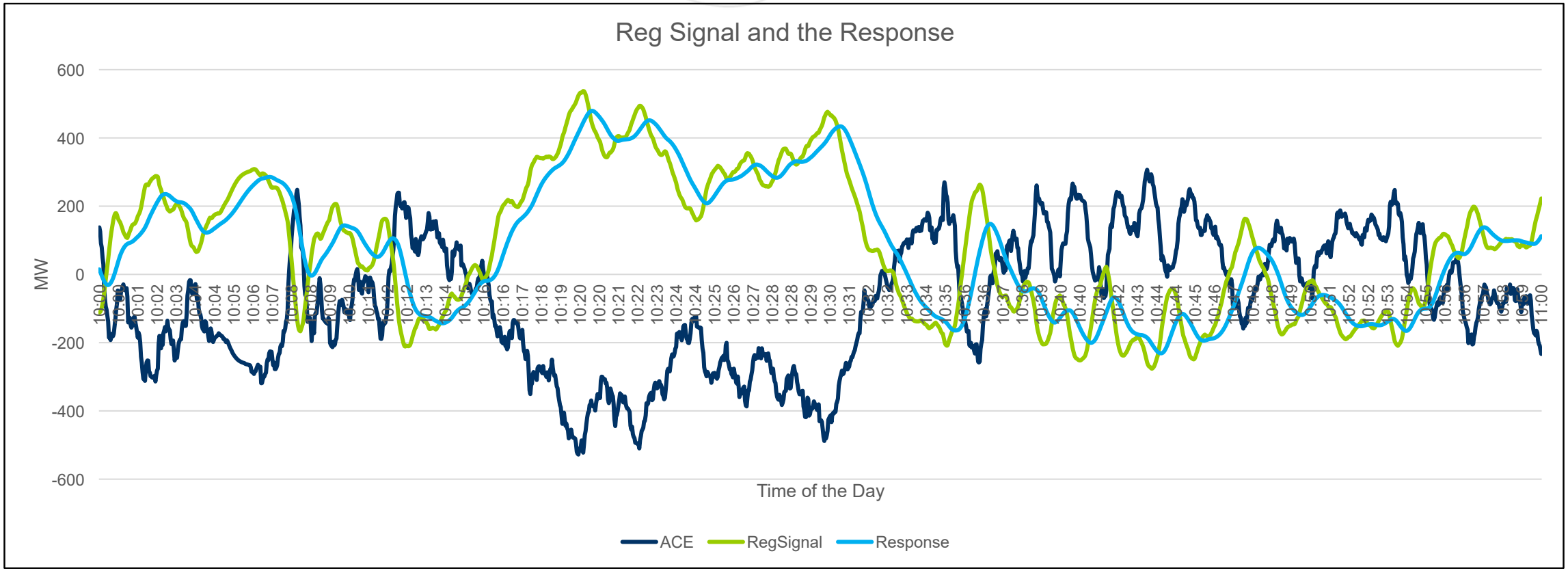
* It shows the difference between each case with the actual CPS1 score over the one-week analysis time-span.

Sample Results: Daily CPS1 Score Comparison



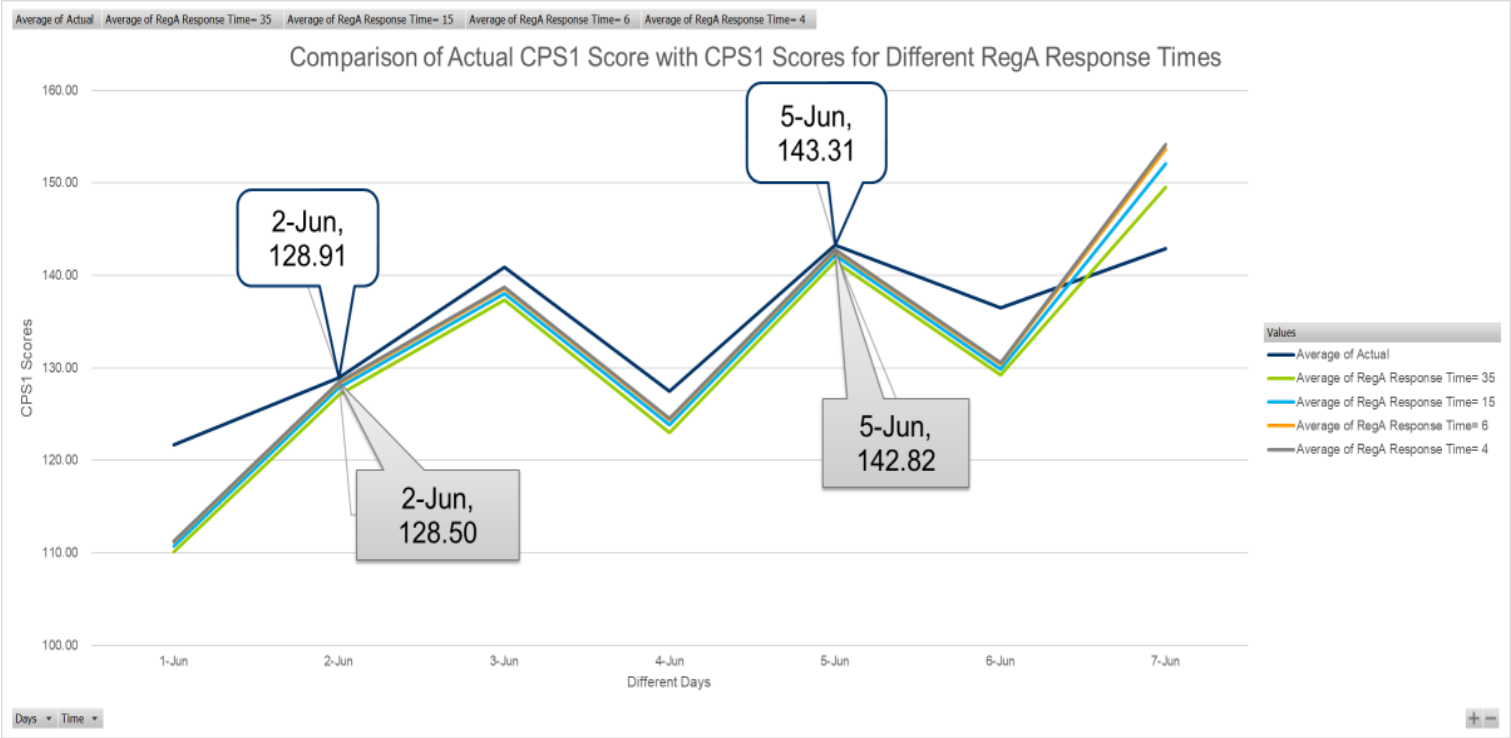
Sample Results: Regulation Signal and the Response

- RegA requirement is 800 MW for this simulation. This graph shows the results between 10 AM to 11 AM on June 3rd of 2022.



CPS1 Score Comparison for Different RegA Response Times

- RegA requirement is 800 MW and RegD is 0 for this simulation.



Statistic	*Actual Score*	*RT = 35 s*	*RT = 15 s*	*RT = 6 s*	*RT = 4 s*
Mean	134.52	131.13	132.10	132.76	132.95
Change in Overall Mean	-	-2.52%	-1.80%	-1.30%	-1.17%

Next Steps

- Conducting more simulations to compare the current construct to a single-signal approach.
- Researching on additional details and parameters for a single-signal design proposal.
- Researching on the other performance metrics and comparing the results with the same metrics from status quo.

Contact

Presenter:
Danial Nazemi

danial.nazemi@pjm.com

Facilitator:
Michael Herman

michael.herman@pjm.com

Regulation Signal Analysis

Member Hotline

(610) 666 – 8980

(866) 400 – 8980

custsvc@pjm.com

PROTECT THE POWER GRID

THINK BEFORE YOU CLICK!

Be alert to malicious phishing emails.

Report suspicious email activity to PJM.

(610) 666-2244 / it_ops_ctr_shift@pjm.com