ISO/RTO Regulation Market Comparison

Regulation Market Issues Senior Task Force

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Similarities and Differences

- Similarities to most RTOs:
  - Settles on real-time values
  - Clears only 1 market for regulation (though some split Reg-up and Reg-down)
  - Performance taken into account in settlements
  - “Mileage” or worked performance is calculated
- Differences from most RTOs:
  - PJM currently has a fixed requirement
    - Other RTOs have varying regulation requirements based on operational parameters
  - PJM has a large amount of Storage and DR in the regulation market
    - Other RTOs have primarily conventional generation participating in the regulation market with smaller amounts of alternative resources (although some RTOs have ‘fast’ resources)
  - PJM has two discreet dispatch signals
    - Other RTOs have resource-specific signals
  - PJM evaluates the trade-off between RegA & RegD products based on the benefits factor curve
    - Other RTOs do not have a trade-off conversion factor between regulation products

Regulation Requirement and Resource Mix

Question:	PJM	ISO NE	MISO	ERCOT	SPP	CAISO	NYISO
What is the regulation requirement?	Fixed, 700 MW on-peak, 525 MW off-peak	Varies by hour, season, and day-type, averages 60 MW	Varies, About 400 MW	Varies by hour. Reg-up, average 459 MW; max/min 847 MW/ 297 MW. Reg-down, average 456 MW; max/min 956 MW/297 MW.	Varies, calculated hourly value for Reg-up and Reg-down, averages 350 MW	Varies, About 350 MW	Varies by hour and season, ranges from ~175-300 MW, Averages 220 MW
What is the resource mix in the Regulation Market?	Diverse mix of conventional generators, storage, and DR resources	Generators only	Mostly conventional generators. Very small percentage from one battery and one DR.	Conventional generators, mostly made up of CC for both Reg-up and Reg-down	Mostly conventional generation (gas and hydro for the most part).Dispatchable wind occasionally participates in providing Regulation Down.	Diverse mix of conventional generators, storage, and DR resources	Conventional generation, storage & DR

Regulation Market Clearing

Question:	PJM	ISO NE	MISO	ERCOT	SPP	CAISO	NYISO
Bi-directional market?	Yes	Yes	Yes	No, separate Reg-up and Reg-down	No, separate Reg-up and Reg-down	No, separate Reg-up and Reg-down	Yes
One market or different markets for different signal types (if applicable)?	One market. RegA and RegD are paid the same clearing price, current limit on RegD procurement	One market	One market	One market. Both conventional and Fast Responding Regulation Service (FRRS) are paid the same price. There are different requirements and different prices for Up and Down. There is a limit on how much regulation can come from FRRS.	One market. Separate regulation market clearing for Reg-up and Reg-down	One market. Separate regulation market clearing for Reg-up and Reg-down markets	One market.
Timeframe?	Cleared Hourly in Real-time Market	Real-time. Approximately hourly	Day-ahead and Real-time Markets	Cleared in Day-ahead Market	Day-ahead and Real-time markets. Reg-up and Reg-down are five minute products	Day-ahead Market. Reg-up and Reg-down are 15 minute products	Day-ahead and Real-time Markets
Is there a trade-off or conversion factor between regulation “products”?	Yes- Benefits Factor	Not at this time	No	Not at this time	No	No	No

Regulation Signals

Question:	PJM	ISO NE	MISO	ERCOT	SPP	CAISO	NYISO
How many regulation signals?	2	Up to 3*	1*	2	1*	1*	1*
If multiple, discreet signals, what are they?	RegA and RegD	Conventional, Energy Neutral, Continuous and Energy Neutral, Trinary	NA	Conventional Signal and Fast Responding Regulation Signal (FRRS).	NA	NA	NA
How are the signals created (eg. derivatization of ACE, inverse ACE, etc.)?	Derived from ACE with highpass/ lowpass filtering	Conventional signal is based on minimizing instantaneous ACE. Energy neutral signals have a highpass filtering	One traditional regulation signal derived from ACE	Conventional signal derived from ACE, FRRS is frequency dependent	Directly from ACE	Large ACE deadband, then derived from ACE	Derived from ACE with minimal filtering
Signal characteristics (neutrality, state-of-charge, ramp rate, etc.)?	Neutrality and ramp rate	Neutrality	State of charge for storage	FRRS has time-limited deployments	None identified	State of charge for storage	State of charge for storage

* Note – ISO-NE, MISO, SPP, CAISO, and NYISO send different (resource-specific) signals based on resource ramp rates

Pay for Performance

Question:	PJM	ISO NE	MISO	ERCOT	SPP	CAISO	NYISO
Is there a calculated mileage or 'work performed'?	Yes	Yes	Yes	No	Yes	Yes	Yes
Is there a performance score or evaluation on response accuracy?	Yes, performance score based on (ten-second sampling of) correlation, delay, and precision measurements	Yes, evaluated based on a Regulation Monitoring Program developed in-house that draws envelopes around the signal and compares to the response	Yes. Regulation performance is measured by signal mileage vs. response mileage	No, but monthly checks of performance and done to ensure resources are performing to a certain standard	Yes, the score is based on how well they follow and respond for regulation, using signal mileage vs. response mileage	Yes, regulation performance is measured, using signal mileage vs. response mileage, and poor performance is removed from market	Yes, Performance Tracking System (PTS) to monitor the performance using 30-second sampling of signal and response

Regulation Settlements

Question:	PJM	ISO NE	MISO	ERCOT	SPP	CAISO	NYISO
Is performance taken into account for compensation?	Yes	Yes	Yes	No	Yes	Yes	Yes
Do you use real-time, marginal price data or historical for settlements?	Real-time price and performance	Real-time price and performance	Real-time price and performance	Real-time price	Real-time price and performance	Real-time price and performance	Real-time price and performance