

Dispatch and Pricing Issues

MIC Special Session
Five Minute Dispatch
and Pricing
October 2, 2019

IMM



Monitoring Analytics

Recap

- **PJM dispatches resources for a target interval that is 10 minutes into the future, but assigns the prices associated with that dispatch to the current interval.**
- **Under this approach, with five minute settlements, resources are compensated with LMPs and reserve prices that do not correspond to their dispatch instructions for a majority of intervals.**
- **For example, a resource that responds to a reserve shortage does not receive the shortage price for relief provided.**

LPC vs RT SCED Target Interval

- For 94.3 percent of the intervals in 2018, the five minute interval for which LPC calculates the prices is not the same as the target interval of the RT SCED case used to calculate the prices.

Difference between RT SCED and LPC Target Intervals (mins)	Percent of Five Minute Intervals	
	2018	2019 (Jan - Jun)
(10)	0.2%	0.1%
(5)	0.9%	0.5%
0	5.7%	4.0%
5	30.5%	27.7%
10	62.5%	67.6%

Locational Marginal Price

- **LMP is the marginal cost of serving the next increment of load at a location, given demand bids and supply offers and transmission constraints for a specific target time.**
- **In PJM, target times occur in five minute increments.**
- **RT SCED solves a linear optimization problem every three minutes with a 10 minute dispatch time for generation, using forecasts and input data for each load target time.**
- **Load target time and generation dispatch target time align only once every 15 minutes.**

Locational Marginal Price

- **SCED produces dispatch MW and prices (\$/MWh) using a linear optimization problem.**
- **This dispatch is the optimal outcome given the inputs, including the unit parameters and ramp rate.**
- **Deviating from the dispatch produces an inefficient (not a profit maximizing) outcome for a unit in a competitive market.**
- **Using any prices other than those produced in SCED sends a price signal that leads to an inefficient deviation from optimal outcome.**

Settlements

- **Settlement interval in PJM is currently five minutes.**
- **LPC assigns SCED prices to an interval that is 10 minutes prior to the dispatch target.**
- **Load and generation are settled for energy (MWh), not power (MW).**
- **The prices assigned to the beginning of each interval are applied to the energy produced during the subsequent five minutes.**
- **Energy (MWh) settled based on data submitted by generators (actual energy produced).**
- **Reserves settled based on MW calculated by PJM.**

Five Minute Settlements

- **Based on the principle that compensating resources at the price associated with their dispatch for each five minute interval provides the incentive to follow the dispatch signal.**
- **Order 825:**
- 4. “These settlement interval and shortage pricing requirements will help ensure that resources have price signals that provide incentives to conform their output to dispatch instructions, and that prices reflect operating needs at each dispatch interval.”**

Five Minute Settlements

- 68.** “...the compensation provided to resources must reflect the value of a resource providing given services to ensure appropriate economic incentives to meet system needs.”
- 70.** “...requiring settlement intervals of operating reserves transactions to match the intervals upon which those reserves are priced will reduce the need for payments made through uplift, make resource compensation more transparent and help ensure that there are adequate operating reserves to maintain reliability.”

Issue 1: Misalignment

- **Prices are recalculated in LPC using a SCED case and assigned to an interval different from the dispatch target time of that SCED case.**
- **As a result, energy and reserve prices are wrong since they do not correspond to the forecast system conditions (demand and supply) or dispatch for each interval.**
- **Five minute prices in PJM do not equal the marginal cost of serving load because they are misaligned.**

Issue 2: Dispatch not reflected in prices

- **RT SCED cases approved more frequently than one for every five minute target interval.**
- **All approved RT SCED cases are used to dispatch energy and reserves.**
- **Only one approved RT SCED case is selected for pricing each five minute interval.**
- **Only one approved RT SCED case is selected for reserve settlements.**
- **About 35 percent of approved SCED cases that send dispatch signals to generators are not used in pricing.**

Issue 3: Inefficient compensation

- **Compensation not consistent with dispatch instructions.**
- **Consistently incorrectly compensating resources, and consistently incorrectly charging load.**
- **Compensation does not reflect the value provided by resources.**
- **Erodes market confidence.**
- **Erodes incentive to follow dispatch.**

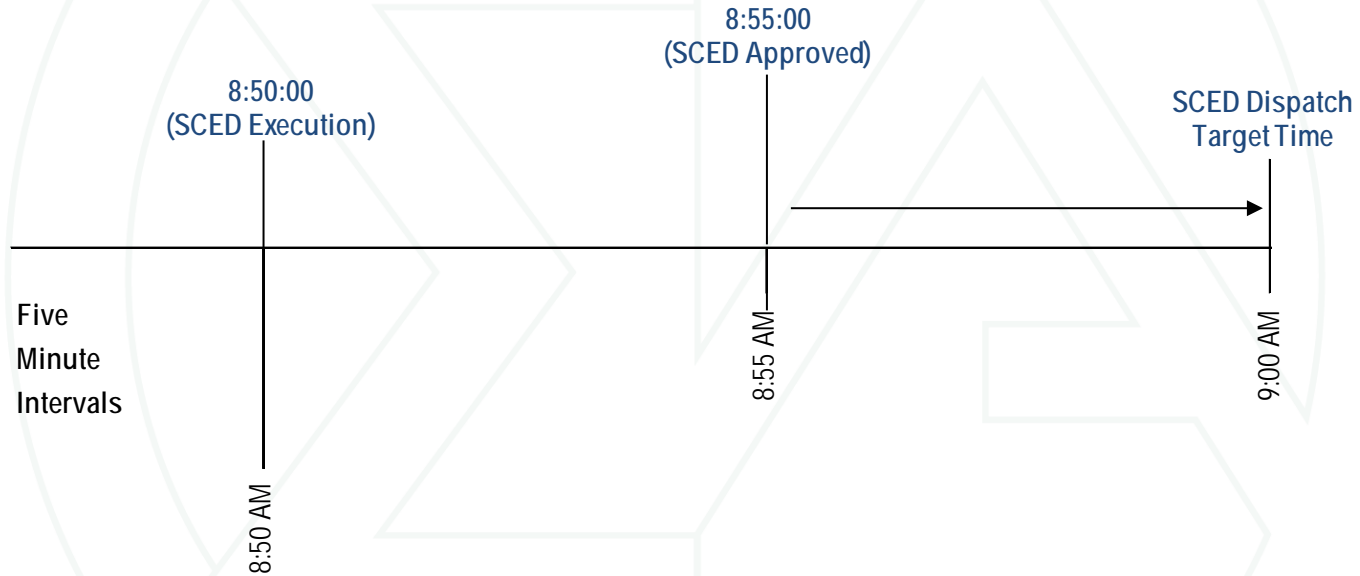
Issue 4: Lack of transparency

- **No documentation of:**
 - **Timing of SCED and LPC execution.**
 - **SCED case approval process.**
 - **SCED and LPC target intervals.**
- **Lack of documentation of the details of the inputs to SCED and LPC.**
- **Lack of documentation of manual operator inputs to SCED and LPC.**
- **No documentation of the use of SCED and LPC in settlements.**

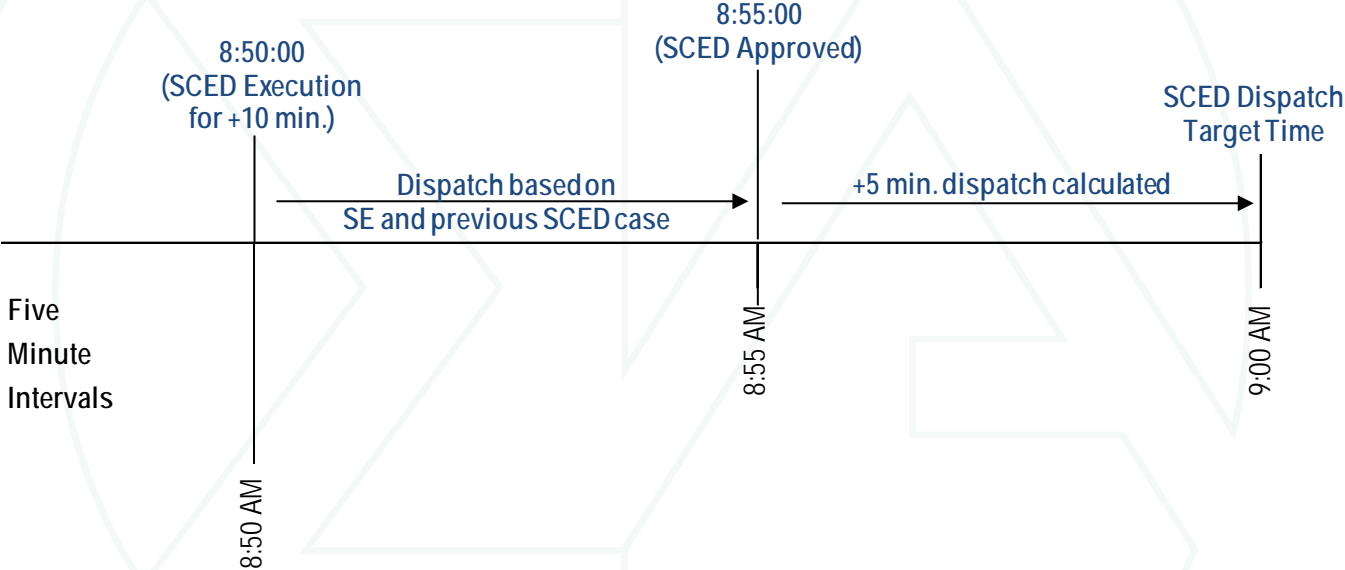
Example from MISO

- Documented in MISO Business Practice Manual 2, especially Attachment D, and Tariff Module C, Section 40.2.
- SCED case approved (dispatch signals sent) every five minutes.
- SCED optimizes for a target time that is 10 minutes ahead.
- However, for the first five minutes (first half of the 10 minute look ahead), SCED uses the previous SCED solution combined with the state estimator data to determine output.
- SCED calculates optimal dispatch for the next five minutes (the second half of the 10 minute look ahead).
- Prices apply to the interval ending at the dispatch target time.

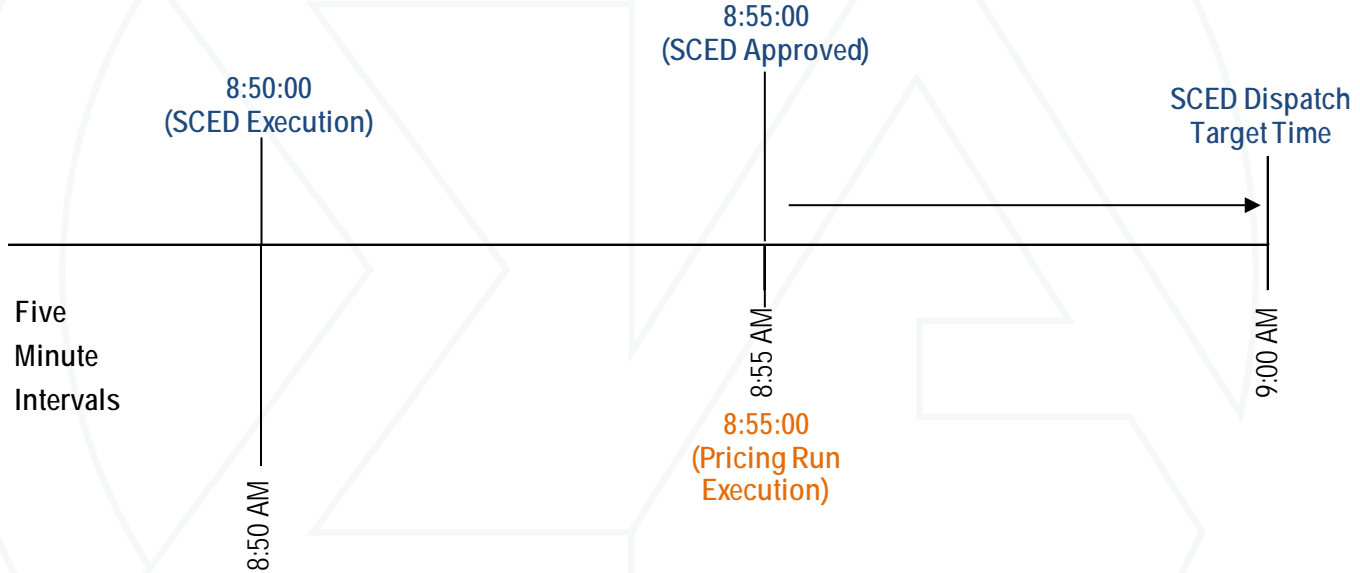
MISO



MISO



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MISO



MISO



RTO Comparison of Dispatch and Pricing

RTO/ISO	Pricing Interval Aligned with Dispatch Interval	SCED execution periodicity	SCED Future Target Intervals	Pricing Execution Periodicity (Intervals)	Automated Approval of RT SCED Cases	Settlement Intervals	Dispatch and Pricing Applications separate
NEISO	Yes	10 minutes	15 Minutes	5 minutes	No	5 Minutes	Yes
MISO	Yes	5 minutes	10 Minutes	5 minutes	No	5 Minutes	Yes
NYISO	Yes	5 minutes	10 Minutes	5 minutes	Yes	5 Minutes	No
SPP	Yes	5 minutes	10 Minutes	5 minutes	No	5 Minutes	No
PJM	No	3 Minutes	10 Minutes	5 minutes	No	5 Minutes	Yes
ERCOT	Yes	5 Minutes	5 Minutes	5 minutes	Yes	15 Minute (Time Weighted Avg)	Yes
CAISO	Yes	5 Minutes	10 Minutes	5 minutes	No	5 Minute	No

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