Five Minute Dispatch and Pricing

MIC

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Siva Josyula

Monitoring Analytics

Background

- Problem Statement and Issue Charge
  - First read at May MIC
  - Approved at June MIC
- Key work activities:
  1. Review and provide education on current RT SCED execution process, including but not limited to the frequency of cases, the target interval of the cases, the number of cases, difference in inputs to cases, solution time frame, use of solution output.
  2. Review and provide education on the RT SCED case approval process, the criteria for approval, approval rates, reasons for not approving cases.

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Background

- PJM Real-Time five minute dispatch and pricing applications:

  - Real Time Security Constrained Economic Dispatch (RT SCED)

  - Locational Pricing Calculator (LPC)

- RT SCED is an optimization engine that uses inputs from the state estimator, generator offers, ASO output, load forecast, operator inputs such as load bias, and solves for a least cost solution.

- RT SCED executed as cases. Each case has a unique combination of inputs.

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Background

- A subset of solved RT SCED cases are approved to send dispatch signals to generators.

- A subset of approved RT SCED cases are selected to be used in LPC.

  - LPC produces real time five minute energy and ancillary service prices.

  - PJM can rerun LPC and recalculate five minute prices.

- All real time energy transactions are settled on five minute prices from LPC since April 1, 2018.

  - Settled on hourly average prices prior to April 1, 2018.

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Monitoring Dispatch and Pricing

- Five minute dispatch and pricing are an important feature of energy market price formation.

- The IMM reviews the output of RT SCED cases as part of its responsibility to monitor the efficiency of the market.

- The information provided in this presentation as education results from the IMM's monitoring.

- The State of the Market Report Section 3: Energy includes some of the same tables and discussion.

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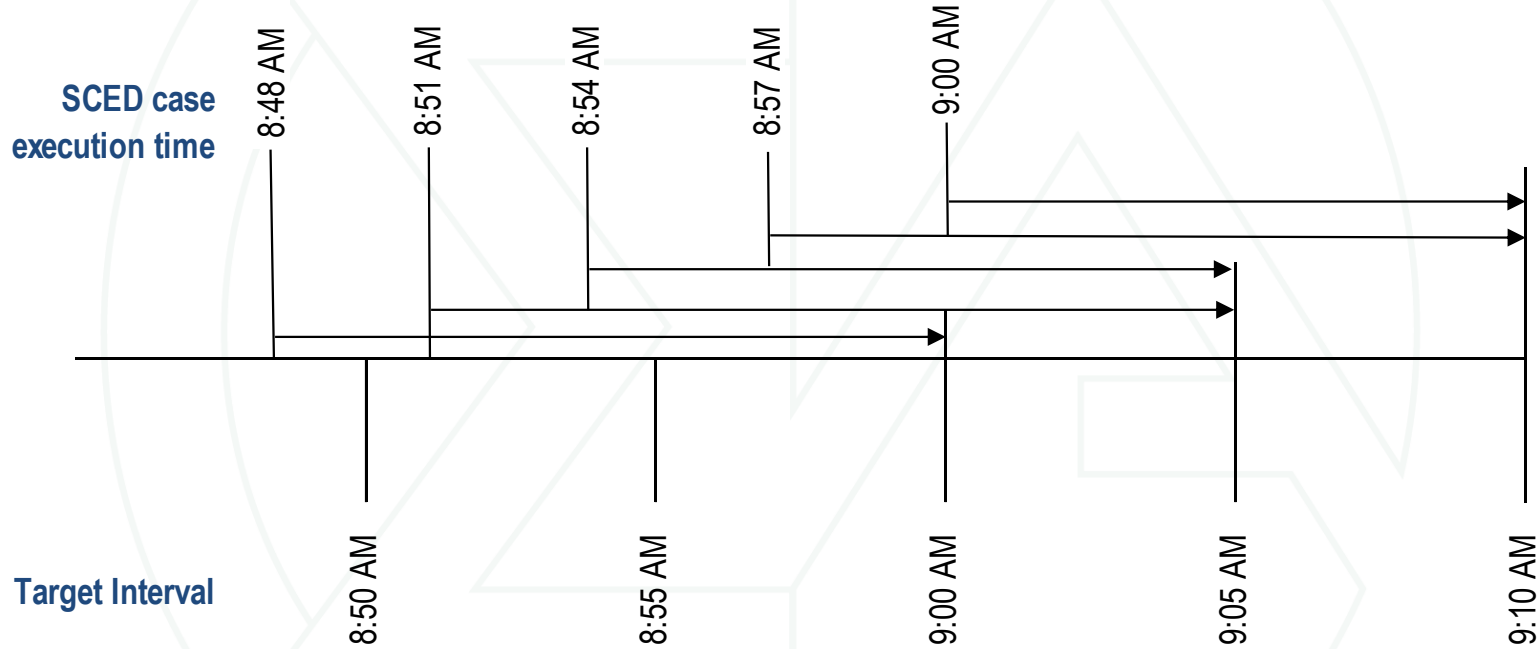# EDUCATION – RT SCED

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Terminology

- **State Estimator Data Time (SE data time)**: when the EMS snapshot is taken for a RT SCED case

- **Execution Time**: when a SCED case starts to solve

- **Solution Time**: when a SCED case solution is complete

- **Approved Time**: when a solved case is approved by operators

- **Target Interval**: the future time for which SCED solves the economic dispatch problem

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RT SCED

- RT SCED cases are executed at instances that occur every three minutes.

  - Operators can execute cases more frequently if needed.

- RT SCED cases solve for target intervals that occur every five minutes, e.g., 09:00, 09:05, 09:10, 09:15 etc.

- The five minute target interval is approximately 10 to 14 minutes ahead of the execution time.

- Majority of RT SCED cases use snapshot data from EMS within two minutes of execution time.

- Majority of RT SCED cases solve in less than two minutes after execution (84 percent in 2018).

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RT SCED Timeline

SCED case execution time

8:48 AM 8:51 AM 8:54 AM 8:57 AM 9:00 AM

Target Interval

8:50 AM 8:55 AM 9:00 AM 9:05 AM 9:10 AM
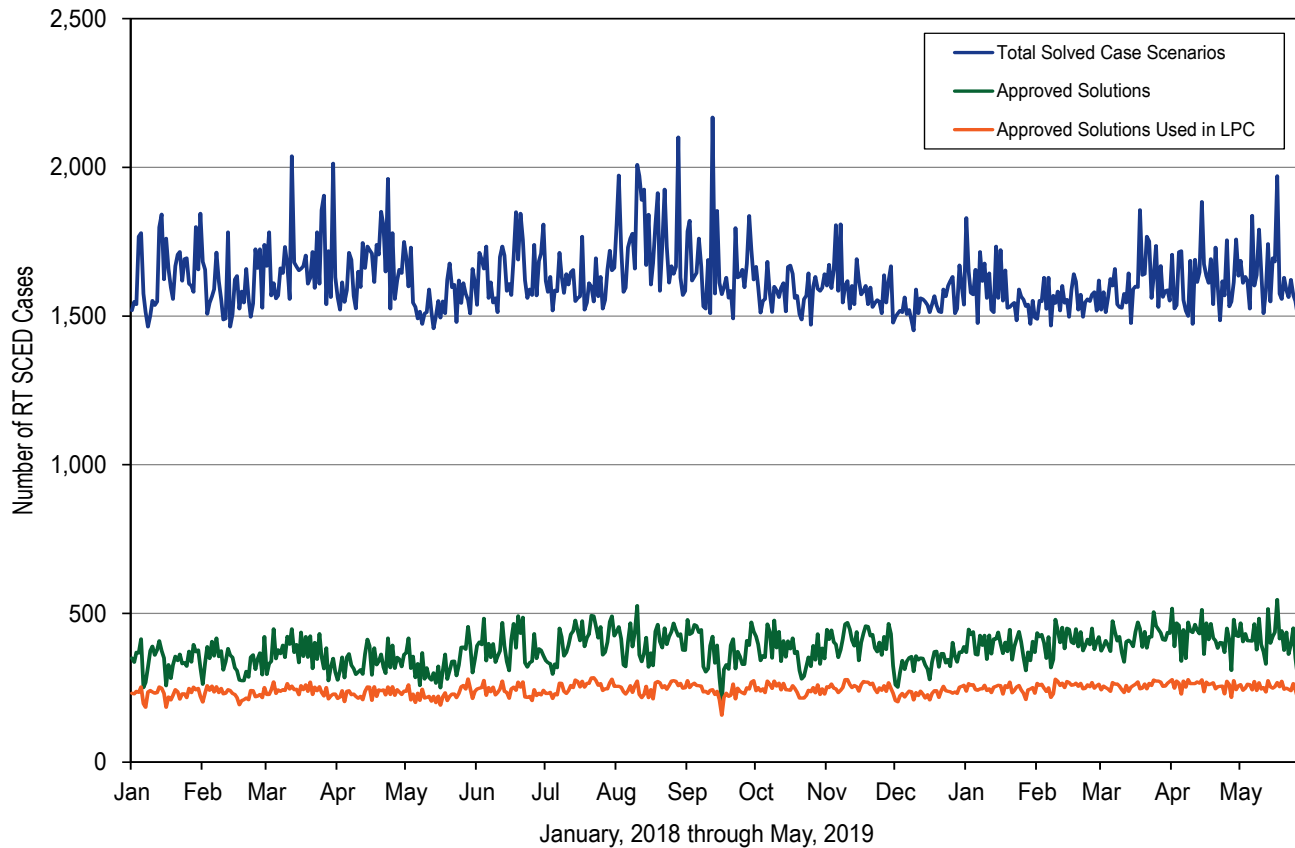
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RT SCED

- Three RT SCED case scenarios are executed at each instance, with different levels of load bias in each.

- A minimum of three RT SCED solutions are calculated for each target interval.

No of RT SCED Solutions for Target Interval	Percent of Intervals (2018)	Percent of Intervals (Jan through May, 2019)
3	26.2%	26.3%
6	58.2%	58.7%
9	12.4%	12.5%
12	2.7%	2.2%
15	0.5%	0.3%

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RT SCED Approval

- There is a short render time for presenting the solved RT SCED cases to operators (~ 20 seconds).

- A subset RT SCED cases are approved to send dispatch signals to generators.

Month (2019)	Number of Solved RT SCED Cases	Number of Approved RT SCED Cases	Number of Approved RT SCED Cases Used in LPC	Approved RT SCED Cases as Percent of Solved Cases	RT SCED Cases Used in LPC as Percent of Solved Cases	RT SCED Cases Used in LPC as Percent of Approved Cases
Jan	49,158	12,177	7,656	24.8%	15.6%	62.9%
Feb	43,628	11,484	7,186	26.3%	16.5%	62.6%
Mar	49,753	12,942	7,966	26.0%	16.0%	61.6%
Apr	48,765	12,759	7,768	26.2%	15.9%	60.9%
May	50,772	12,890	7,808	25.4%	15.4%	60.6%

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Note: The total solved case scenarios count all three load bias scenarios solved at each execution of RT SCED as a unique solution.

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RT SCED Load Bias

- Operator bias of forecast load is one of the inputs to RT SCED.

- The three SCED scenarios that are executed at each instance (every three minutes) use different levels of load bias.

Distribution of Load Bias (MW) in All Executed RT SCED Cases								
Year	Average	5th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	95th Percentile
2018	-582	-1,750	-1,500	-1,000	-500	0	250	500
2019	-551	-1,600	-1,500	-1,000	-500	0	250	500

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RT SCED Load Bias

	2018		2019 (Jan through May)	
Load Bias	Average Bias (MW)	Percentage of Executed Cases	Average Bias (MW)	Percentage of Executed Cases
Negative	-874	74.2%	-843	73.2%
Positive	462	14.5%	456	14.6%
Unbiased	0	11.3%	0	12.2%

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Load Bias Example Snapshot

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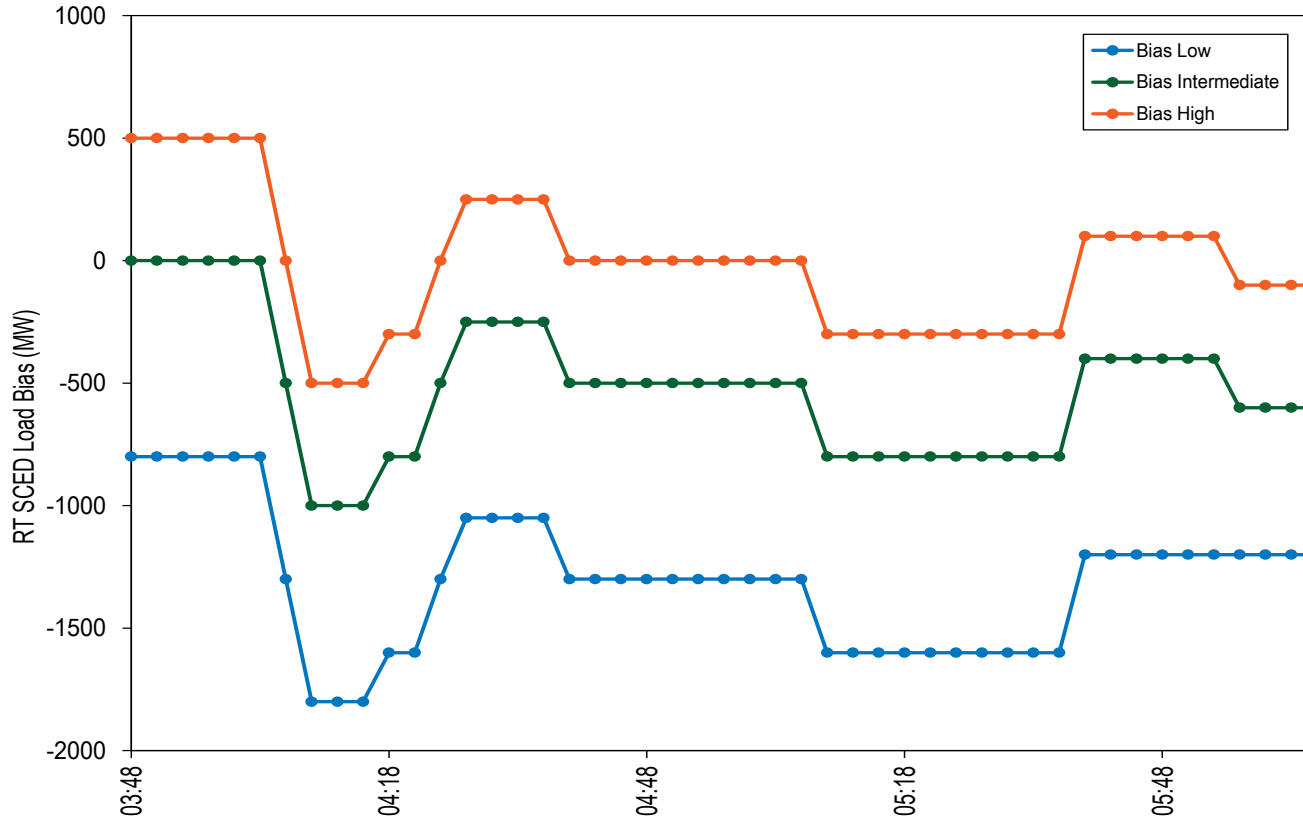
Shortage in RT SCED

Month (2019)	Number of Solved RT SCED Cases	Number of Solved RT SCED Cases With Reserve Shortage	Number of Approved RT SCED Cases With Reserve Shortage	Number of Approved RT SCED Cases With Reserve Shortage Used in LPC	Cases With Reserve Shortage as Percent of Solved RT SCED Cases	Approved RT SCED Cases With Reserve Shortage as Percent of Solved RT SCED Cases With Shortage	RT SCED Cases With Shortage Used in LPC as Percent of Solved RT SCED Cases With Shortage
Jan	49,158	151	3	3	0.3%	2.0%	2.0%
Feb	43,628	317	0	0	0.7%	0.0%	0.0%
Mar	49,753	713	16	10	1.4%	2.2%	1.4%
Apr	48,765	796	9	7	1.6%	1.1%	0.9%
May	50,772	364	0	0	0.7%	0.0%	0.0%
Total	242,076	2,341	28	20	1.0%	1.2%	0.9%

Note 1: Shortage determined based on the extended reserve requirement, defined as the Minimum Reserve Requirement plus 190 MW.
Note 2: Shortage based on any of the reserve requirements not being met: Primary or Synchronized reserves for RTO or MAD.

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Monitoring Analytics, LLC

2621 Van Buren Avenue

Suite 160

Eagleville, PA

19403

(610) 271-8050

MA@monitoringanalytics.com

www.MonitoringAnalytics.com

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