Five Minute Dispatch

RCSTF

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Energy Certainty

- **Reserve certainty is energy certainty.**
- **PJM calculates and sends five minute dispatch instructions to generation resources.**
- **The assumption is that resources can follow five minute dispatch.**
- **Reality is different.**
- **Experience from reserve deployment has shown that PJM's expectations differ from Market Sellers' actions.**

Five Minute Dispatch

- PJM produces five minute dispatch signals.
- Not all units follow the five minute dispatch equally.
- Not all units follow five minute dispatch at all.
- Some units are on AGC and follow the signal automatically.
- Some units are ramped manually by operators.

Five Minute Dispatch

- Some units cannot follow a five minute dispatch, instead they follow dispatch in different ways:
  - Some follow their DA award.
  - Some wait for sequential signals to ramp.
  - Some confirm actions with PJM operators.
- Operational discontinuities (e.g. duct burners, CC multiconfiguration, coal mills, peak firing) are represented today using ramp rates.
  - This is an approximation, but without guidelines, they can be useless and counterproductive.
- Some units are not dispatchable (i.e. fixed gen).

Dispatch Signals Rules

- **PJM calculates and sends dispatch signals to resources.**
- **Resources are responsible for receiving and following dispatch signals.**

Dispatch Signal Rules

- **OA Schedule 1 - 1.11 Real-time Dispatch**

  The Office of the Interconnection shall determine the least cost security constrained economic dispatch and **send dispatch targets** for each resource to Market Participants. The least cost security constrained economic dispatch is the least costly means of serving load and meeting reserve requirements at different locations in the PJM Region based on forecasted operating conditions on the power grid (including transmission constraints on external coordinated flowgates to the extent provided by Operating Agreement, Schedule 1, section 1.7.6) as described in the PJM Manuals and on the offers for energy and ancillary services at which Market Sellers have entered as described by Operating Agreement, Schedule 1, section 1.10 and Operating Agreement, Schedule 1, section 2.4 and on offers by Economic Load Response Participants to reduce demand that qualify to set Locational Marginal Prices in the PJM Interchange Energy Market.

Dispatch Signal Rules

- **OA Schedule 1 - 1.11.3 Pool-dispatched Resources.**

  (a) The Office of the Interconnection shall implement the dispatch of energy from pool-scheduled resources with limited energy **by direct request**, by following the Day-ahead Market clearing, or by following the direct request of the Market Seller, subject to the Office of the Interconnection's determination of actions necessary to maintain reliability.

  (b) The Office of the Interconnection shall implement the dispatch of energy from other pool-dispatched resource increments, including generation increments from Capacity Resources the remaining increments of which are self-scheduled, by sending appropriate signals and instructions to the entity controlling such resources, in accordance with the PJM Manuals. Each Market Seller shall ensure that the pool-dispatched resource offered or made available by that Market Seller **complies with the energy dispatch signals and instructions transmitted by the Office of the Interconnection upon receipt**.

Dispatch Signal Rules

- **OA Schedule 1 - 1.7.20 Communication and Operating Requirements.**

(a) Market Participants. Each Market Participant shall have, or shall arrange to have, its transactions in the PJM Interchange Energy Market subject to control by a Market Operations Center, with staffing and communications systems capable of real-time communication with the Office of the Interconnection during normal and Emergency conditions and of control of the Market Participant's relevant load or facilities sufficient to meet the requirements of the Market Participant's transactions with the PJM Interchange Energy Market, including but not limited to the following requirements as applicable, and as may be further described in the PJM Manuals.

(b) Market Sellers selling from generation resources and/or Economic Load Response Participant resources within the PJM Region shall: report to the Office of the Interconnection sources of energy and Economic Load Response Participant resources available for operation; supply to the Office of the Interconnection all applicable Offer Data; report to the Office of the Interconnection generation resources and Economic Load Response Participant resources that are self-scheduled; with respect to generation resources, report to the Office of the Interconnection bilateral sales transactions to buyers not within the PJM Region; confirm to the Office of the Interconnection bilateral sales to Market Buyers within the PJM Region; **respond to the Office of the Interconnection's directives to start, shutdown or change output levels of generation units**, or change scheduled voltages or reactive output levels of generation units, or reduce load from Economic Load Response Participant resources; continuously maintain all Offer Data concurrent with on-line operating information; and ensure that, where so equipped, generating equipment and Economic Load Response Participant resources are operated with control equipment functioning as specified in the PJM Manuals.

Dispatch Signals Rules

- **Manual 11 - 2.5.3.4 Real-time Security Constrained Economic Dispatch Timeline and Instruction Set**
  - A RT SCED dispatch case is executed automatically every five (5) minutes or when manually executed by the operator at least eight (8) to ten (10) minutes prior to a target time. **All generators are expected to follow the dispatch signals upon approval** of the RT SCED dispatch solution every five (5) minutes.

Dispatch Signals Rules

- **Manual 11 - 2.5.3.5 Real-time Security Constrained Economic Dispatch Inputs**
  - Multiple RT SCED solutions are produced, with each solution solving the security constrained economic dispatch problem.
  - A subset of the solved RT SCED solutions are approved to send Dispatch Signals to online resources. **Each resource owner or Market Operations Center (MOC) is expected to comply with the energy dispatch signals sent by each RT SCED** solution in accordance with the PJM Tariff and Operating Agreement.

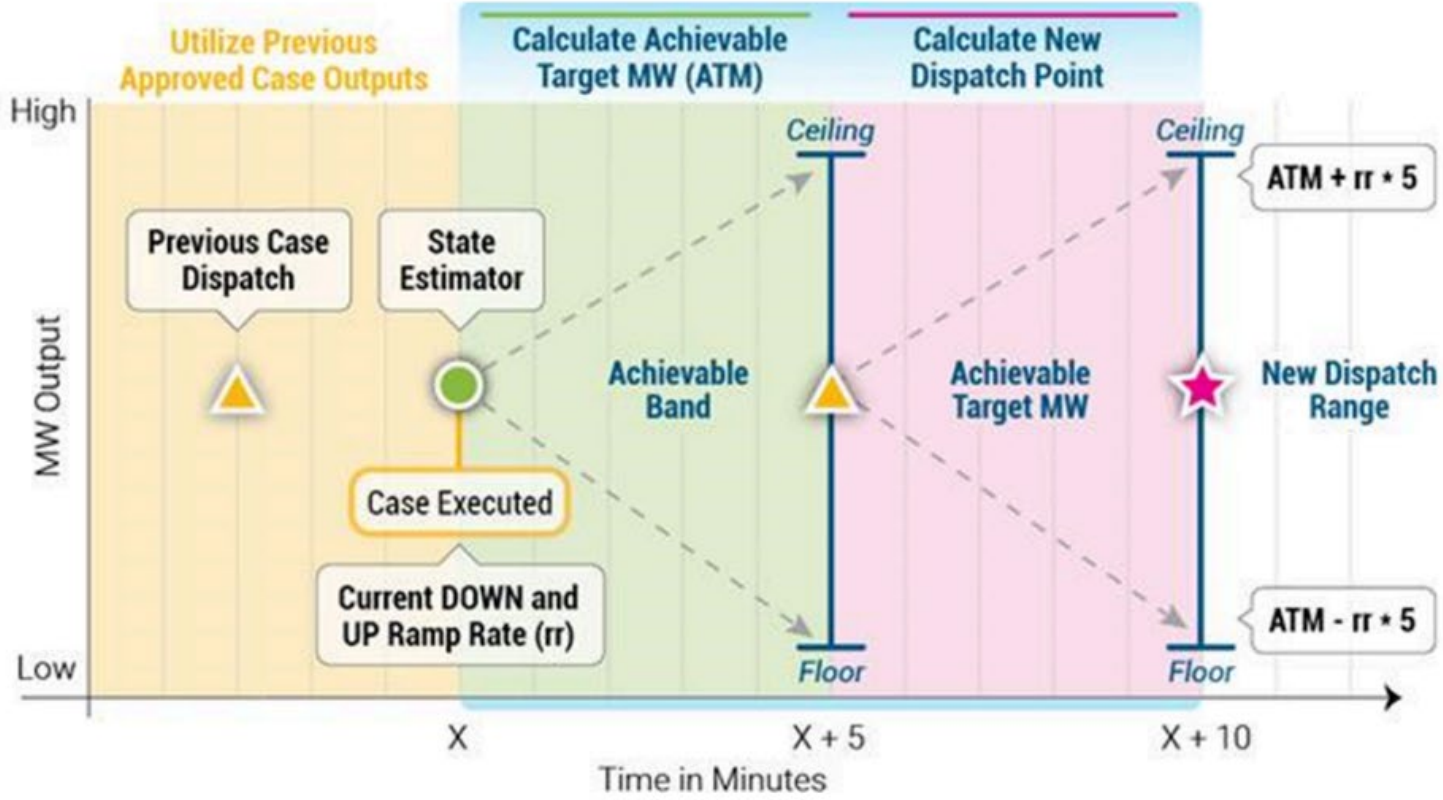
Dispatch Signal Rules

- **Manual 12 - 3.1.3 PJM Member Control Implementation**
  - The PJM Member's Generation Owner converts the total dispatch signal and the Regulation signal to individual unit control signals. PJM Member resources that are dispatchable **are expected to respond to the dispatch and regulation signals received from PJM**. PJM Members are expected to operate their generating resources as close to desired output levels, as practical, consistent with Good Utility Practice.

RT SCED

- **RTSCED is a look ahead dispatch software that jointly optimizes energy and reserves to meet load and reserve requirements subject to generation and transmission constraints for a specific target time that occurs within approximately 8-10 minutes.**
- **RTSCED runs at least every five minutes.**
- **The dispatch results from approved RTSCED cases are sent as energy dispatch signals and reserve assignments to resources**

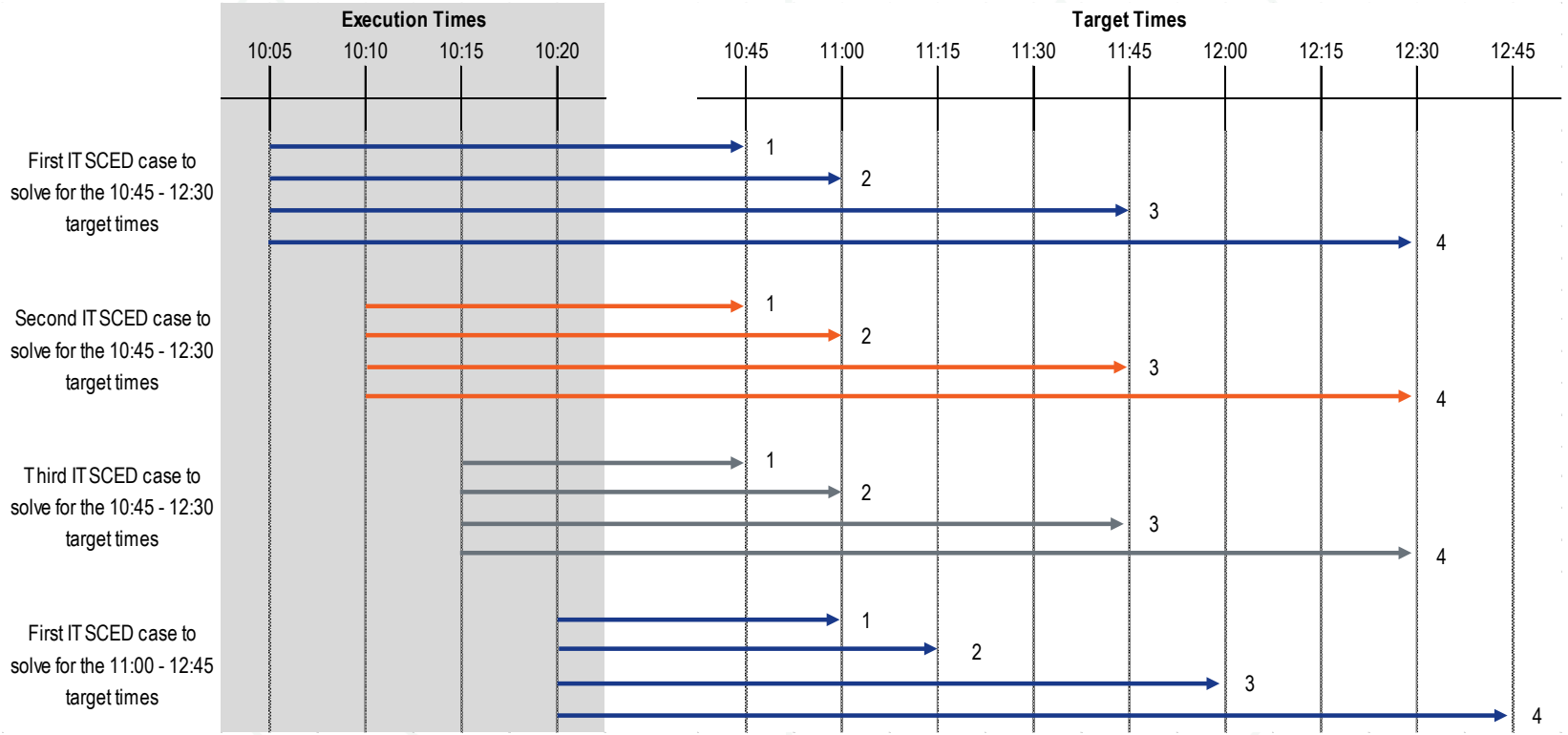
RT SCED


Utilize Previous Approved Case Outputs
Calculate Achievable Target MW (ATM)
Calculate New Dispatch Point
High
Low
MW Output
Previous Case Dispatch
State Estimator
Case Executed
Current DOWN and UP Ramp Rate (rr)
Achievable Band
Achievable Target MW
New Dispatch Range
Ceiling
Floor
Ceiling
Floor
ATM + rr * 5
ATM - rr * 5
X
X + 5
X + 10
Time in Minutes

IT SCED

- **ITSCED is a look ahead commitment and dispatch software that jointly optimizes energy and reserves to meet load and reserve requirements subject to generation and transmission constraints for four time coupled target times that occur between 30 and 145 minutes ahead.**
- **ITSCED runs every five minutes.**
- **The dispatch results from approved ITSCED cases are not used.**
- **The commitment results from approved ITSCED cases provide recommendations to PJM operators.**

IT SCED


Execution Times
10:05
10:10
10:15
10:20
Target Times
10:45
11:00
11:15
11:30
11:45
12:00
12:15
12:30
12:45
First IT SCED case to solve for the 10:45 - 12:30 target times
Second IT SCED case to solve for the 10:45 - 12:30 target times
Third IT SCED case to solve for the 10:45 - 12:30 target times
First IT SCED case to solve for the 11:00 - 12:45 target times
1
2
3
4

SCED

- RTSCED
  - Produces dispatch signals for the target time.
  - Latest approved RTSCED is used for pricing.
  - Does not produce unit commitment.
- ITSCED
  - Produces dispatch signals for the four target times. This is not communicated.
  - Produces unit commitment recommendations. Final commitment is made by dispatchers.

Clear Requirements and Expectations

- Suppliers need clear requirements.
- The market needs clear expectations.
- The default should be that generators follow a five minute dispatch signal.
  - If they cannot, what is the guideline?
  - If they cannot, can PJM provide dispatch signals targeted to their capability?
- In the absence of the nGEM multiconfiguration model, how should discontinuities be deployed?
- These questions need answers before making any changes to the reserve markets.

Modeling Example Issue

- Currently, CCs can either be modeled as one aggregated unit or as multiple units (pseudo model). PJM does not restrict CC modeling.
- PJM does not dictate how aggregated units operate. PJM clears MW and provides dispatch signals. The generators decide how to meet such instructions.
- CCs with multiple CTs can meet MW levels with a combination of operating modes.
- But when operating in a mode in which one or more CTs are offline, DA clearing engine and SCED does not see those MW offline.

Modeling Example Issue

- This creates a discrepancy between reality and the modeling assumptions.
- In the energy market, CCs deal with this discrepancy using slow ramp rates.
- In the reserve market, CCs deal with this discrepancy using synchronized reserve max exceptions.
- In the absence of nGEM, there must be clear guidelines.
  - For example, CCs that want to operate in different configurations must use the pseudo model.
  - If not, how should offline MW be committed/dispatch?

Communication

- **PJM needs to know, in real time, which units can follow five minute dispatch instructions.**
  - **Which ones can follow automatically and which ones can follow manually.**
- **PJM needs to know, in real time, which units cannot follow five minute dispatch instructions.**

Problem

- **Failure to address this issue (i.e. how units follow dispatch or cannot follow dispatch) will lead to the discovery that some units cannot provide ramping/uncertainty reserves.**
- **For example, PJM/IMM identified that some units cannot provide 10 minute reserves as part of the IMM/PJM reserve deployment inquiries. The solution was not to increase the requirement. The solution is to identify the supply that can meet the requirement.**
  - **This was not a product of the ORDC order or its remand. We would have had the same problem of clearing reserves that would have not performed.**

Next Steps

- **Addressing how units follow dispatch today must precede any discussion about reserves.**
- **The IMM will provide a matrix / design components to address dispatch instruction requirements.**

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