

EXECUTIVE SUMMARY OF PJM PROPOSAL

The following is an executive summary of the PJM proposal for the short term goals discussed at the Energy Price Formation Senior Task Force. The purpose of this document is to provide a high level summary of the proposal that PJM has put forth in the solution matrix as of the August 6, 2018 task force meeting and is not intended to cover all implementation details. The summary highlights changes to three main areas – Synchronized Reserves, Reserve sub-zone modeling and the Operating Demand Curve for Shortage Pricing. Synchronized Reserves focuses on the consolidation of Tier 1 and Tier 2 reserves as well as using energy market offer parameters when clearing the Synchronized Reserve Market. Reserve Sub-Zone modeling focuses on the short-term solution, following a sub-zone model similar to today, with the ability to change which sub-zone is effective on a day-ahead basis. Finally, the Shortage Pricing proposal focuses on changes to the Operating Reserve Demand Curve and making the second step of the demand curve a downward sloping segment.

SYNCHRONIZED RESERVE MARKET CHANGES:

Proposal Highlights

Consolidation of Tier 1 and Tier 2 reserves

- Unloaded capacity (currently referred to as Tier 1) will be treated similar to a Tier 2 product.
- All reserves will incur an obligation to perform and be compensated for assigned MW at the Synchronized Reserve Market Clearing Price.
- The Synchronized Reserve Must Offer requirement will be assessed for all applicable resources.
- All assigned synchronized reserve resources will be subject to non-compliance penalties.

Energy offer parameters will be used in place of synchronized reserve offer parameters

- Spin max will be set equal to or less than economic max
 - An exception request must be submitted to PJM in order to submit a spin max value that is less than economic max.
- Spin Ramp Rate will no longer be used
 - The energy ramp rate will be used in place of the spin ramp rate to calculate the reserve capability for resources that can reliably provide reserves.
- By default, a resource’s submitted energy offer will be used to determine its offer in the reserve market. However, any energy resource that cannot reliably provide reserves will not be considered in synchronized reserve market clearing. Such resources include but are not limited to: nuclear, wind, solar, and energy storage. Any resource in that subset that can reliably provide reserves would be required to opt in to participant in the reserve market and submit offers.
- Condensers are required to provide their condense to gen time, a new parameter, to the market.

Availability	Capability	Price
All capacity generation with an energy must offer requirement must adhere to the SR must offer requirement with no distinction between online and offline units. Resources available to provide energy will be considered available to provide reserves. The following subset of resources will be allowed to update their SR availability based on physical limitations: hydro units, DSR, solar, wind, nuclear, and energy storage.	The 10-minute capability (offer MW) will be automatically calculated for resources that are available for synchronized reserves based on the segmented energy ramp rate, limited by the economic max (or spin max if applicable). There are certain resources, such as hydro units, DSR, and energy storage that will be required to submit an offer MW to the market. Resources outside of this subset will not be able to specify an offer MW.	An offer price will be allowed to be submitted for all resources, up to \$7.50. The VOM costs will no longer be a component of the offer price. Any condenser-specific costs may be included in the offer price as it is today. The lost opportunity cost considered in the clearing and pricing will be calculated by PJM based on the submitted energy offer price.

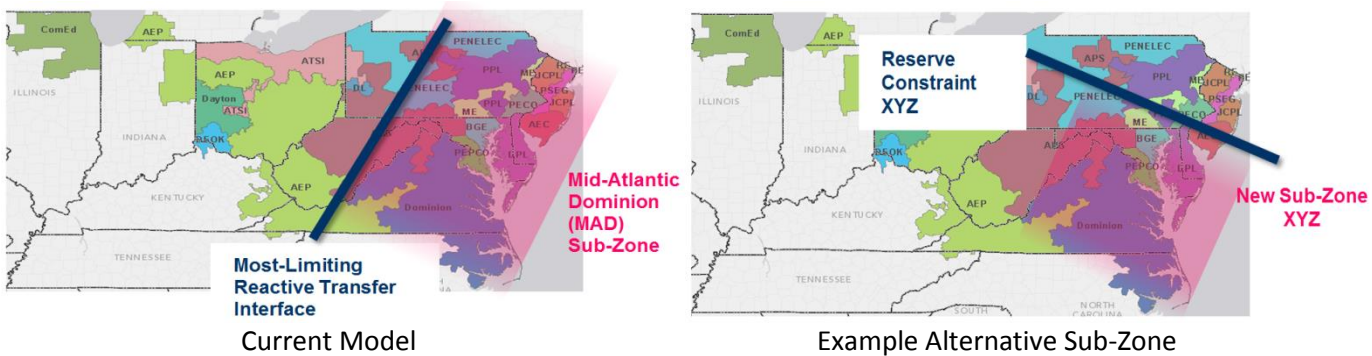
Additional Unit Parameter Flexibility

- Spin max will be allowed to be updated intra-hour to better reflect any changes to the reserve capability.
- Energy ramp rate will be allowed to be updated each hour of the operating day, up to 65 minutes before the operating hour, to better reflect any changes in the ramping capability of the resource.

FLEXIBLE RESERVE SUB-ZONE MODELING:

Proposal Highlights

For Synchronized Reserves and Primary Reserves, the existing RTO reserve zone will remain in place. However, several possible sub-zones will be defined in advance and only one sub-zone will be effective on any given day. The likely reserve sub-zones to be defined will include the existing Mid-Atlantic Dominion sub-zone to capture West to East constraints, as well as at least one additional reserve sub-zones to capture North to South constraints.



DEFINING POTENTIAL SUB-ZONES

- New sub-zones may be defined for constraints in three categories:
 1. Reactive transfer interfaces
 2. 345kV or above actual overload constraint
 3. Contingency overload exceeding the load dump limit on a 345kV or above facility
- Only constraints that may potentially bind based on forward looking studies would be considered when modeling new sub-zones.
- New reserve sub-zones will be defined as far in advance as possible, but no later than one day prior to use.
- The sub-zone definitions will be re-evaluated and published quarterly coincident with network model builds.

COMMUNICATION OF EFFECTIVE SUB-ZONE

- Only one reserve sub-zone may be implemented at a time.
- The reserve sub-zone to be used for a given operating day will be defined on a day-ahead basis and will apply for the entire operating day.
- Participants will be notified day-ahead which sub-zone will be used for the following day.
- Changes to the reserve sub-zone in use can be made intra-day on an exception basis.
- Participants will be notified of all mid-day switches as soon as possible. The method of communication is TBD.

PJM is currently investigating adding requested spin event response MW to a resource's energy dispatch instructions so resources receive a single basepoint to follow and do not need to track a separate spin event signal to determine whether they need to respond to a synchronized reserve event in a given sub-zone or not. This enhancement is a pre-requisite to the implementation of flexible sub-zone modeling.

OPERATING RESERVE DEMAND CURVE (ORDC) FOR SHORTAGE PRICING:

Proposal Highlights

The fundamental element of PJM's Shortage Pricing proposal is the replacement of the second step of the current Operating Reserve Demand Curve (ORDC) for Synchronized Reserves (SR) and Primary Reserves (PR) with a downward sloping segment. The first step of the current Operating Reserve Demand Curves remains unchanged at the respective Minimum Reserve Requirement (MRR) valued at \$850/MWh. The downward sloping segment is determined based on the estimated reliability value that reserve levels beyond the respective MRR provide.

- The first step of the current ORDCs is maintained at the Minimum Reserve Requirement (MRR; dynamically established, based on real-time output of the largest online contingency) at its current value of \$850/MWh.
- The downward sloping segment of the ORDCs is determined based on the estimated reliability value that reserve levels beyond the MRR provide. The estimated reliability value is calculated by multiplying the Probability of Reserves Falling below the Minimum Reserve Requirement (PBMRR) times \$850/MWh.
- The PBMRR values are calculated based on the following uncertainties: load forecast, wind forecast, solar forecast and forced outages from thermal units. The uncertainties are quantified using a 30-minute time horizon.
- To recognize the varying uncertainty levels throughout the year, 24 ORDC downward sloping segments are calculated based on combinations of 6 time-of-day blocks and 4 seasons:
 - Time-of-day Blocks (based on hour-beginning): 1 (2300-0200), 2 (0300-0600), 3 (0700-1000), 4 (1100-1400), 5 (1500-1800), 6 (1900-2200).
 - Seasons: Winter (Dec-Feb), Spring (Mar-May), Summer (Jun-Aug), Fall (Sep-Nov)
- The ORDC downward sloping segments are updated annually based on historical data (for the uncertainties mentioned above) from the prior 3 calendar years.
- Regarding adjustments to the ORDCs in response to actions taken by PJM system operations to procure additional synchronized reserves for system reliability purposes:
 - If no specific resource is identified to provide the additional reserves, the amount of required additional reserves will be added to the MRR. The market clearing engines will then select the least cost set of resources to provide the additional reserves.
 - If PJM system operations identifies and calls on a resource outside of the market clearing engine specifically to create more reserves on the system, this additional MW reserve amount attempting to be procured will be added to the MRR.
 - In both cases above, the system operator will define the hour (s) the MRR is adjusted based on the operating condition driving the need for additional reserves.
 - Notification of these adjustments will be made using an informational message which is accessible in Markets Gateway and the PJM Tools/My Tools Home locations. The adjusted MRR will also be visible in real-time via Data Viewer. In addition, these adjustments will be reported on a monthly basis at the SOS and OC meetings.

The proposal does not suggest changes to the following:

- MRR for PR and SR, as mentioned above
- Energy and reserves (PR and SR) co-optimization
- Price cascading by product/location. The existing price caps for SR and PR will remain in place.