

Evolution of PJM Reserve Market Design

MMUAC

December 1, 2023

IMM



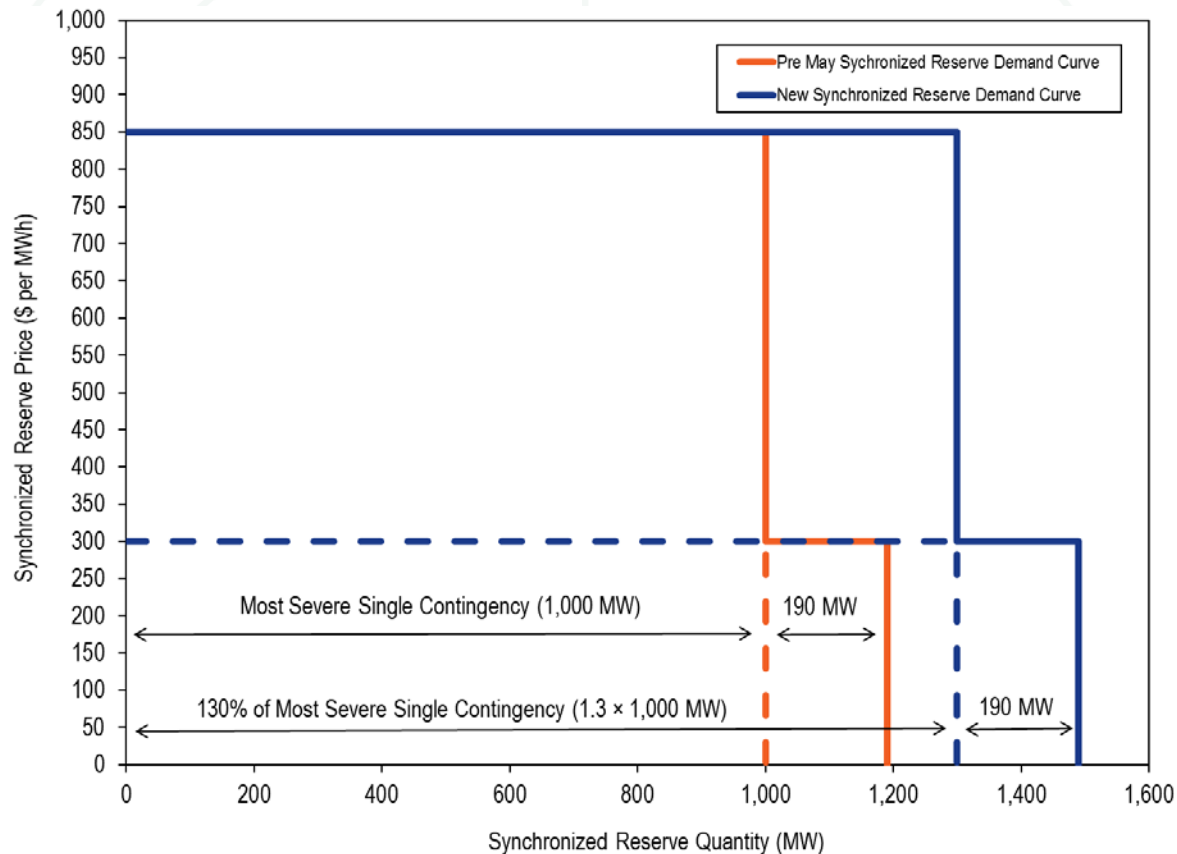
Monitoring Analytics

Reserve Products

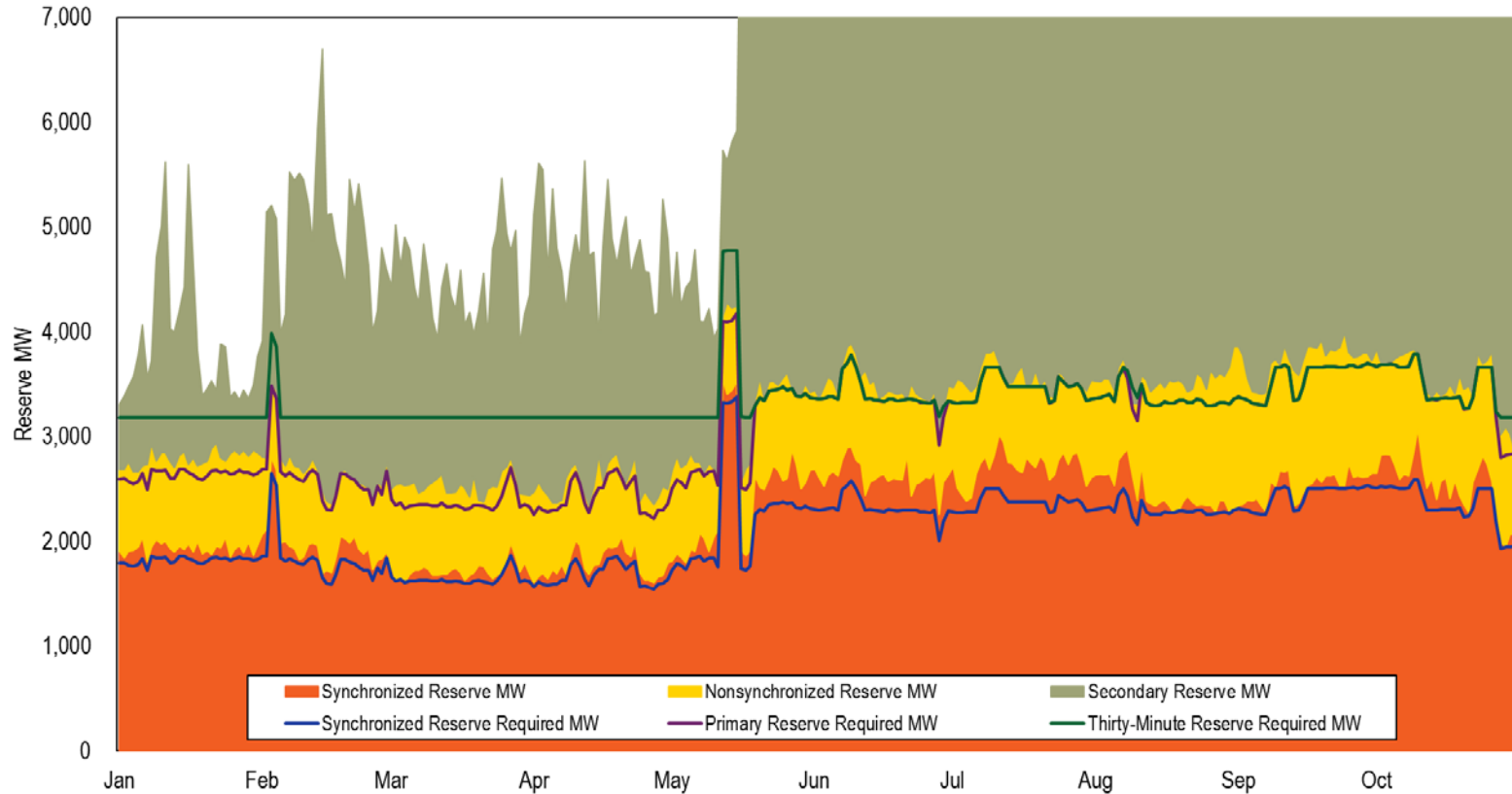
Service	Response Requirement (minutes)	Provided by Online Resources	Provided by Offline Resources
Synchronized Reserve	10 or less	Yes	No
Primary Reserve	10 or less	Yes	Yes
30-Minute Reserve	30 or less	Yes	Yes

Service	Service Reliability Requirement	Service Extended Requirement
Synchronized Reserve	Most Severe Single Contingency	SR Reliability Requirement + Extended Reserve Requirement
Primary Reserve	$1.5 \times$ SR Reliability Requirement	PR Reliability Requirement + Extended Reserve Requirement
30-Minute Reserve	max(Largest Active Gas Contingency, PR Reliability Requirement, 3,000 MW)	TMR Reliability Requirement + Extended Reserve Requirement

PJM Extended the Reserve Requirement



Real-Time Reserves and Requirements



Failure of Reserves to Respond

- **Focus on the demand for reserves.**
 - The demand for reserves is correctly defined.
 - Difference between PJM and NERC definitions.
- **Supply side not addressed.**
 - Resources did not provide the reserves that were offered and paid for.
- **Solutions:**
 - Accurately recognize the actual supply of reserves.
 - Buy the correct amount of reserves, accounting for the actual performance of supply.
 - Address technological and communication issues.

Failure of Reserves to Respond

- Recent changes in the reserve market revealed technology issues.
- Communications with synchronized reserve units
 - All Call includes significant time lags
- Other issues
 - Lack of knowledge about obligations
 - Lack of knowledge about relevant dispatch signals
 - Lack of knowledge about All Call process
 - Discontinuities in offer curves

Certainty



- **Known with certainty**
 - Sunrise/sunset by location of solar resources
 - Mean wind, solar, and load forecasts with margin of error
- **Problem: net load ramping**
 - The energy market has always solved a commitment and dispatch problem.
 - The pattern and timing will change.
- **Solution**
 - Adapt current market processes and tools
 - Develop new tools for commitment and dispatch
- **Market Considerations**
 - The market needs are locational. Resources must be committed, decommitted, dispatched to deal with locational net load changes.
 - New ancillary service products (like ramp products) are not required for this purpose.

Uncertainty



- **Causes of uncertainty**
 - Unpredictable weather, deviations from forecasts
 - New load patterns with rooftop solar, electrification, etc.
- **Problem: net load variability**
 - There will be more fluctuations in net load that may lead to shortages or surpluses of energy and reserves.
- **Solution**
 - Targeted amounts of deliverable reserves are needed to cover unexpected net load fluctuations.
 - Targeted by location and based on current intermittent use
 - Dispatchable resources must perform flexibly
- **Market Considerations**
 - The timeframe with the most uncertainty needs to be determined. Little uncertainty in five to ten minutes, more in 30 minutes to a few hours.
 - How many MW can be lost or gained, in what time frame? How does this vary by location?
 - Which types of resources will fill the gap?
 - Requirements should be dynamic and locational based on real-time information.

ORDCs

- **Is there a problem?**

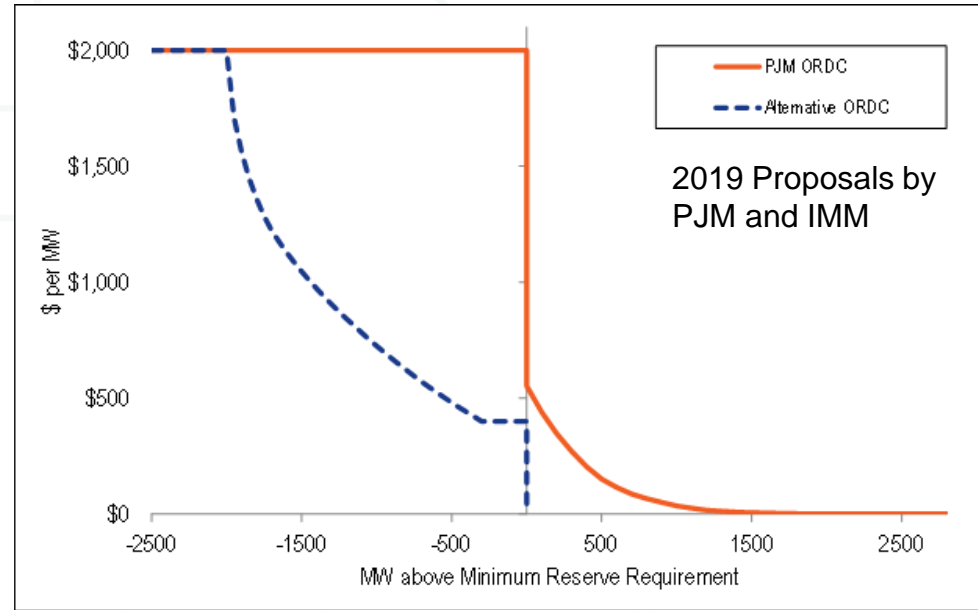
- The ORDCs do not have to change to adapt to the increased level of intermittents.
- Shifting the ORDC should not be used to solve issues that need to be addressed directly, like reserve response rates.

- **ORDC Alternatives**

- Different reserve products may have different ORDC prices to reflect their different values.
- The demand curve can slope at quantities below the minimum requirement.
- Value of Lost Load (VOLL) has questionable role in practice

- **Opportunities**

- Is the PJM market getting the most reliability possible given the current cost of reserves?
- If there are opportunities to improve reliability and price formation without increasing costs, those are the first opportunities to explore.



It is possible to improve price formation to reflect a varying value of reserves, without ORDCs that require carrying more reserves all, or most of, the time.

Up and out is not the only reasonable direction for the ORDCs to go.

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