

RCSTF Phase II: IMM Recommendations

RCSTF

April 9, 2025

IMM



Monitoring Analytics

IMM Overall View

- **The primary reserve products serve their purpose.**
 - **PJM recovers from losses of supply within the NERC required timeframe.**
- **The secondary reserve product does not have a defined purpose.**
 - **Ample 30 minute resources are available to be called on, including demand response and recallable exports.**

IMM Overall View

- **Why make any changes?**
 - **Defining a purpose for secondary reserves**
 - **Improving look ahead dispatch and scheduling software for market efficiency and improved operations**
 - **Defining algorithmic, verifiable, and systematic rules for market reserve requirements that can change with system conditions.**
 - **Planning for increased uncertainty due to intermittency**

Role of Market Reserve Requirements

- **The role of reserve requirements is to allow the market to economically allocate available supply between energy and reserves.**
- **The role of reserve requirements is not to increase prices to offset conservative operator actions, already taken, or to reduce uplift.**



Defining Market Reserve Requirements

- **The reserve requirements used in the market may have a significant effect on prices. For this reason, reserve requirements should be:**
 - **Clearly defined in the PJM tariff**
 - **Developed using an algorithmic, verifiable, and systematic approach**
 - **Not based on PJM discretion**
- **Synchronized and Primary reserve requirements should be tied to the largest contingency, according to PJM practice prior to 2023 and NERC rules.**

RCSTF Phase I Issues

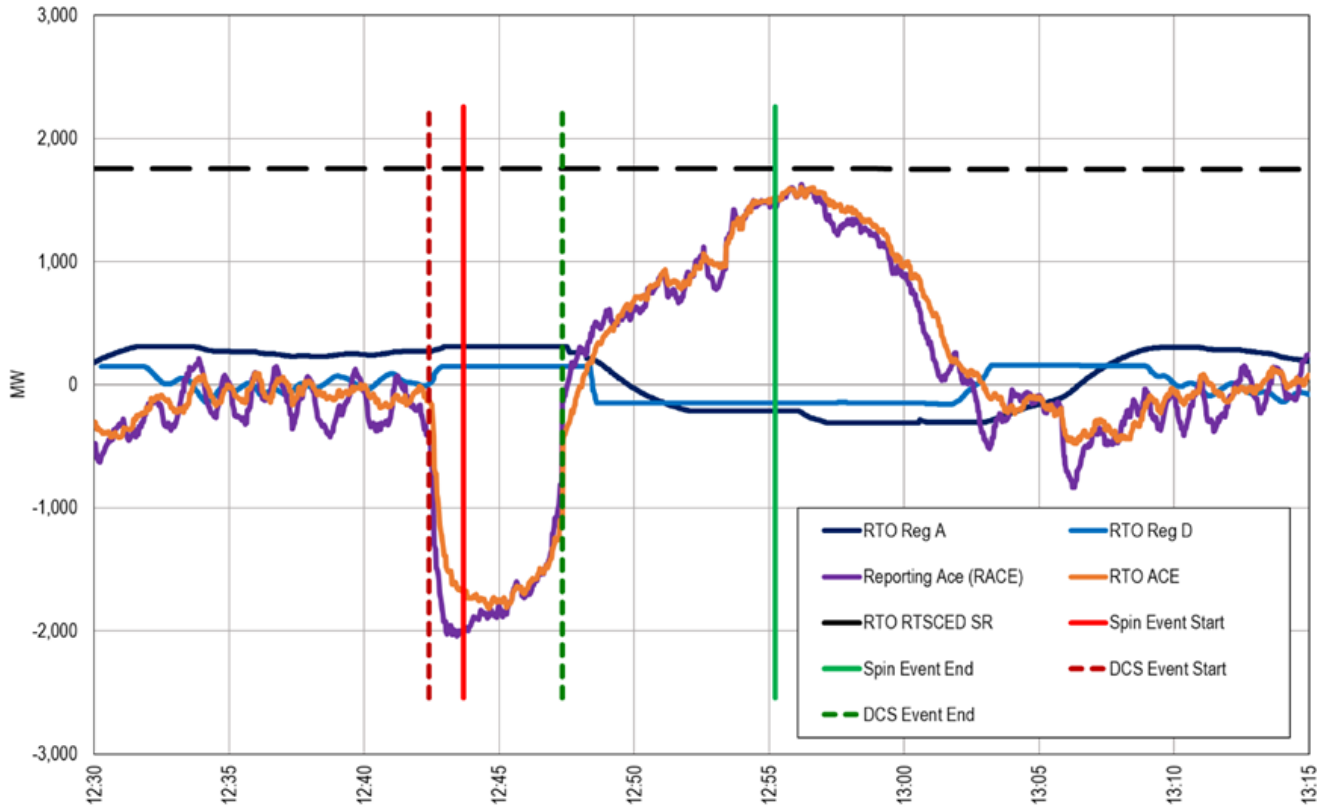
RESERVE EVENTS



Primary Reserves

- **ACE recovers in a timely manner.**
- **PJM measures synchronized reserve event (spin event) time based on when operators start and stop the call for reserves.**
- **NERC measures the Disturbance Control Standard (DCS) event based on ACE recovery.**
- **PJM defined spin events are longer than DCS events.**

Synchronized Reserve Event vs DCS Event



This event occurred on Jan. 5, 2023.

The shorter DCS event and high ACE recovery is the typical pattern.

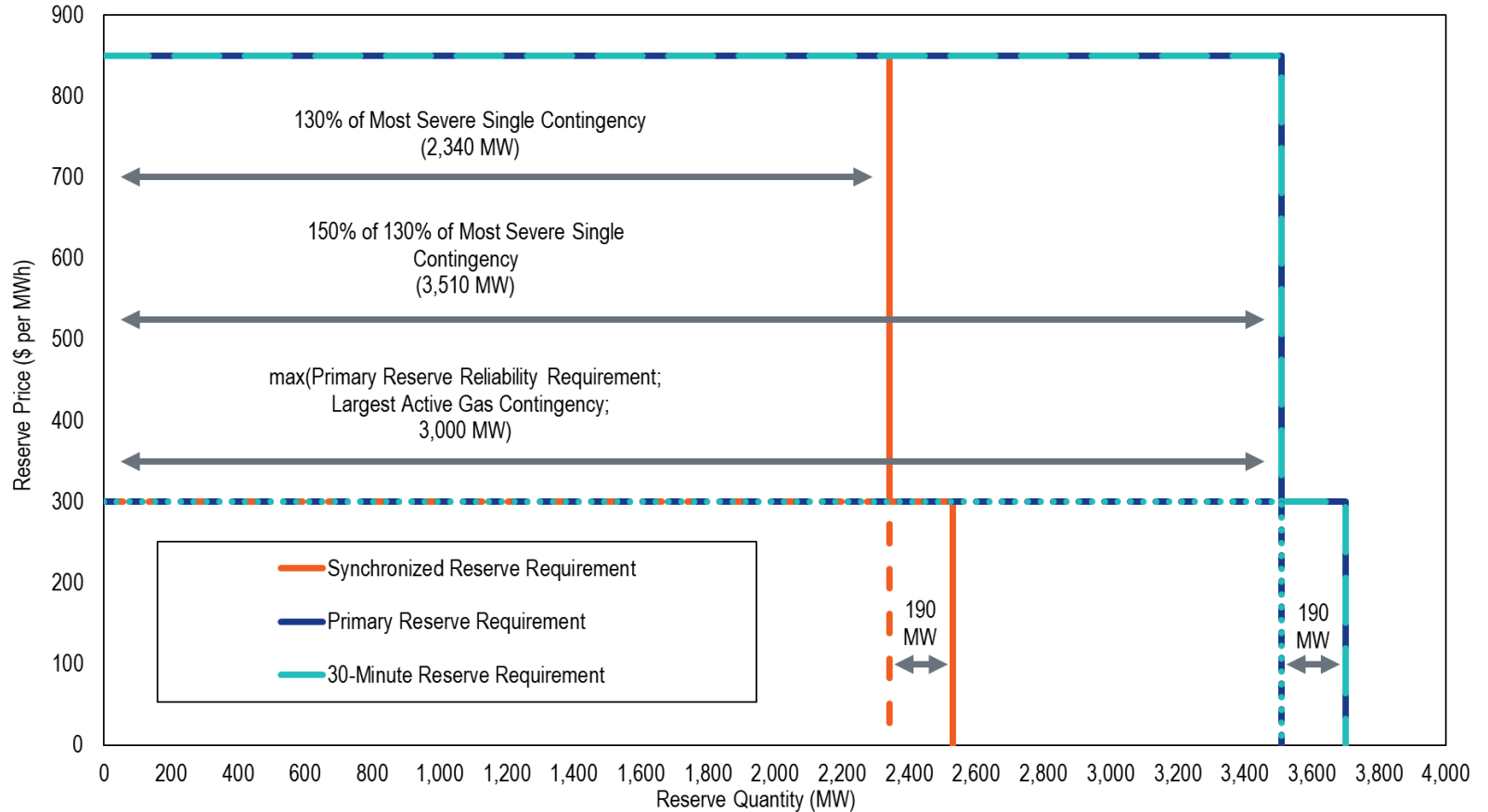
Primary Reserves

- **PJM should be able to rely on cleared reserves.**
 - **PJM's communication enhancement is a good first step.**
 - **All generators should be required to have the capability to receive the automatic signal and follow it.**
- **Some nonsynchronized reserves resources are also used in events and should have performance requirements.**
- **The reserve requirement should be defined based on the largest contingency**
- **PJM's 30 percent increase in the reserve requirement should be removed immediately.**

Primary Reserves (30 percent increase)

- **In May 2023, PJM increased the synchronized and primary reserve requirements.**
 - **Stakeholders did not endorse**
 - **Not filed with FERC**
- **The stated purpose was to compensate for poor performance by assigned reserve resources.**
- **There had not been NERC violations or problems with ACE recovery. The increase was not needed.**
- **In RCSTF Phase I, PJM made changes to improve performance. The 30 percent should be removed.**
- **This reserve increase is costly to the market.**

30 Percent Increase in ORDCs



Secondary Reserves

- **PJM has ample 30 minute reserves, including mostly offline and some online generators.**
- **All 30 minute demand response and recallable exports are 30 minute reserves and should be included in the market supply definition.**
- **The purpose of secondary reserves should be defined in the tariff.**
- **The 30 minute reserves cover uncertainties that PJM cannot account for in longer planning time frames, like day ahead.**

Secondary Reserves

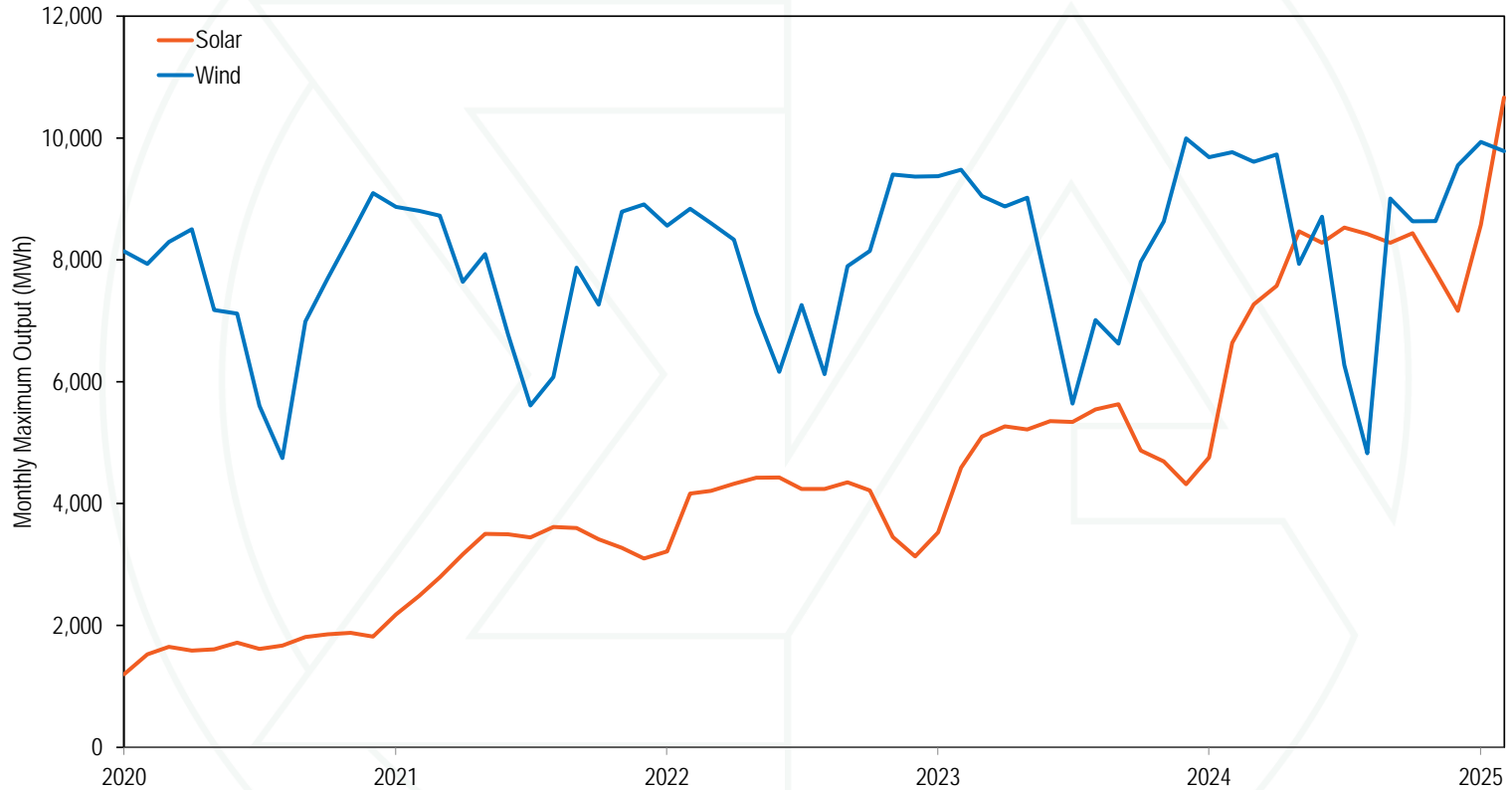
- **Operationally, there is a need for secondary reserves. In the rare case when the constraint would bind, a market requirement would facilitate economic commitment of the needed capacity.**
- **There should be no PJM discretionary increases in the market reserve requirements.**
- **Premarket commitments are not market reserves.**

RCSTF PHASE II ISSUES

Uncertainty

- **Uncertainty should be the basis for secondary reserves.**
- **The primary source of uncertainty is net load forecast error.**
- **Net load forecast error increases with the amount of intermittent resources both in the wholesale market and behind the meter.**
- **Intermittent output is increasing in PJM but remains a relatively small share of total energy.**

Monthly Maximum Solar and Wind Hourly Output



Annual Hourly Solar and Wind Output

Year	Solar Maximum Hourly Output				Wind Maximum Hourly Output			
	Maximum Hourly MWh	Change	Percent Change	Solar Percent of All Generation For The Year	Maximum Hourly MWh	Change	Percent Change	Wind Percent of All Generation For The Year
2020	1,879			0.4%	9,095			3.3%
2021	3,617	1,739	92.5%	0.9%	8,911	(184)	(2.0%)	3.3%
2022	4,429	812	22.4%	1.1%	9,402	491	5.5%	3.8%
2023	5,630	1,201	27.1%	1.4%	9,993	592	6.3%	3.5%
2024	8,532	2,901	51.5%	2.1%	9,768	(226)	(2.3%)	3.7%
2025	10,665	2,134	25.0%	1.6%	9,929	161	1.7%	4.5%

Uncertainty Reserves

- **30 minute reserve product, secondary reserves**
- **Net load forecast error varies by hour of the operating day, so should any related reserves.**
- **Locational element necessary for deliverability**
 - **Net load forecast error should be calculated by location.**
 - **Uncertainty reserves should be maintained based on those locations.**

Measuring Uncertainty

- **Net load forecast error can be estimated using various statistical methods that account for actual historic net load forecast error and specific current market conditions.**
- **Quantitative analysis is required to evaluate any proposed measurement process.**
- **Objectives for measuring uncertainty for inclusion in reserve requirements:**
 - **Transparency, accuracy, informed by historic forecast error, informed by current market conditions**

Forced Outage Risk

- **Primary reserves cover forced outage risk.**
- **Uncertainty reserves should not include forced outage risk unless it is quantified as larger than the primary reserve requirement.**
- **Forced outage risk can be defined in an algorithmic manner and included in the daily reserve requirement.**
 - **Forced outage risk changes with system conditions.**
 - **Does not include risks already eliminated by premarket commitments, including during conservative operations.**
 - **Requires a defined list of risks, MW subject to that risk, and a probability calculation of loss of supply.**

Day Ahead vs Real Time Uncertainty

- **Forecast error, and therefore uncertainty, decreases as the operating hour gets closer.**
- **Uncertainty about real time is greater from the day ahead perspective than in real time.**
- **Any larger amount of day ahead reserves due to greater uncertainty should not be carried forward to the real time reserve requirements.**

DASR Requirement

- **PJM proposes to use its historic annual day ahead reserve calculation.**
- ***DASR = PJM Load Forecast at Peak x (Avg. Load Underforecast + Avg. Gen. Forced Outage Rate)***
- **This proposal requires reserves for all hours of the day based on what is needed for the daily peak.**
- **An hourly requirement would be more accurate and less costly.**

Energy Gap Proposal

- **PJM's assertion that there is an Energy Gap is based on an incorrect analysis, e.g., PJM compares DA PJM Forecast to DA Bid in Load.**
- **PJM's Energy Gap proposal aims to match day ahead physical generation plus reserves to real time physical generation plus reserves.**
- **PJM proposes to create a requirement that:**
DA Physical Gen + Reserves \geq DA PJM Forecast + Net DA Exports

Energy Gap Proposal

- **How it works**
 - **A constraint in the market model would require DA physical generation plus reserves to equal the PJM hourly forecast.**
 - **The energy gap constraint would have an ORDC. Per ISO-NE design, the penalty factor would need to exceed the sum of all other reserve penalty factors (\$4,250 per MWh for PJM).**
 - **The clearing price would directly affect LMP, because all DA cleared physical energy satisfies the requirement.**
 - **The settlements for this product are complicated. The ISO-NE call option and strike price proposal does not make sense for PJM, because it assumes little to no congestion. PJM has not proposed an alternative.**

Energy Gap Proposal

- **The IMM opposes the Energy Gap proposal.**
 - **Based on incorrect analysis**
 - **Creates a DA must buy obligation**
 - **Locational issues: DA/RT differences are locational. The energy gap appears to be a system wide calculation.**
 - **No definition of allowable reserve costs for generators**
 - **The market design and settlements are complicated, and PJM does not have the details sorted out. It may not be workable at all.**
 - **If PJM wants the DA market to have a physical only requirement, the clean solution would be to eliminate virtuals and load bids, a physical only market.**

Ramp Product

- **A ramp product creates reserves that are usually based on a shorter time frame, like 10 to 30 min, using the near term net load forecast.**
- **There are alternatives for scheduling and dispatch on that time frame using PJM's current software by enhancing RT SCED and/or using IT SCED.**
- **Other RTOs have had problems with the performance of ramp products, especially deliverability.**
- **Pricing and procurement are sensitive to load biasing.**
- **With no demonstrated need in the next few years, it does not make sense for PJM to pursue a ramp product when better options are available.**

Software Tools for Market Efficiency

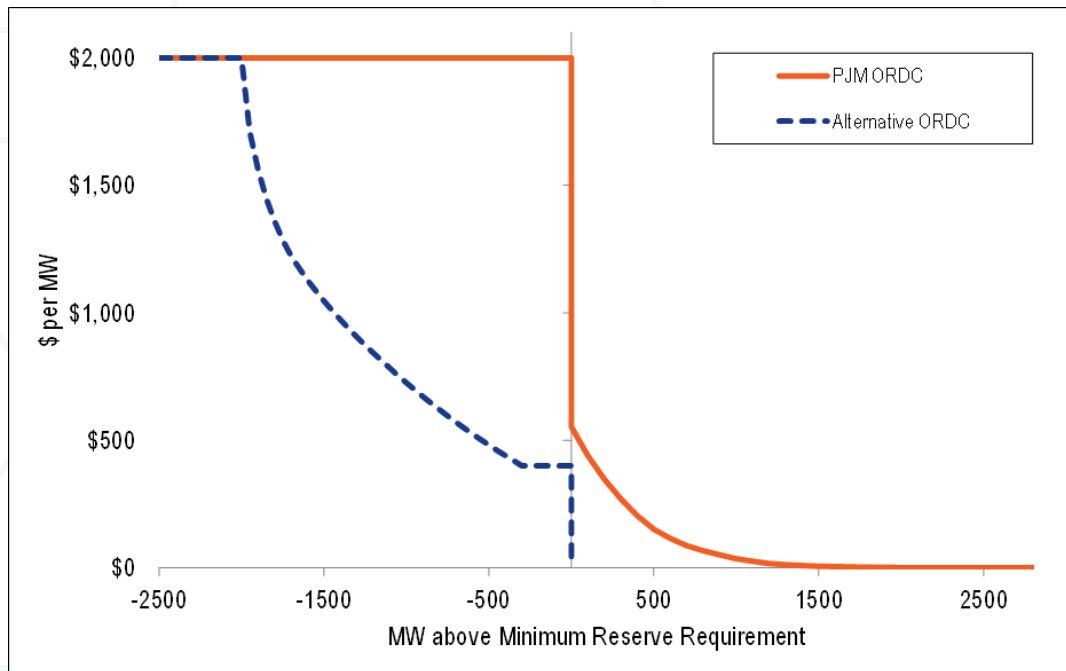
- **IT SCED**
 - **Look ahead software**
 - **Covers 15 min to two hours ahead, but can be configured for a longer look ahead**
 - **Currently used for commitment, but could be used for look ahead dispatch**
 - **The IMM recommends evaluating changes.**
- **Multi interval dispatch**
 - **Extension to RT SCED that solves an optimization over multiple upcoming five minute intervals, instead of only one**
 - **The IMM supports pursuing this software upgrade.**

ORDC

- **The Operating Reserve Demand Curves (ORDCs) do not require a change for any market efficiency or reliability reason.**
- **PJM has not demonstrated that the \$850 per MWh demand curve price has ever been insufficient to prevent shortages.**
- **VOLL is not relevant to market pricing. Any ORDC price is administrative and not based on actual customer preferences.**

ORDC IMM Proposal 2019

- **Higher penalty factor for very severe shortages**
- **Lower penalty factor for less severe shortages**



- **Increase penalty factor if fuel prices indicate a widespread need for generator cost-based offers exceeding \$1,000 per MWh.**

Summary Topics

- **DA Imbalance Reserves**
- **Ramp Product**
- **Uncertainty Reserves**
- **Look ahead software**
- **ORDC Changes**
- **Reserve performance**
- **Fuel costs in reserve offers**
- **IMM does not support.**
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- **IMM proposal**
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- **IMM does not support.**
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- **IMM does not support.**



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