

# Reserve Price Formation

## Manual 11 & Manual 27,28,29 Revisions

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- Effective October 1, 2022 several aspects of the PJM Reserve markets will change
  - As a result of Reserve Price Formation efforts, 2018 to-date
    - Consolidation of Tier 1 and Tier 2 Synchronized Reserve products
    - Alignment of reserve products in Day-Ahead and Real-Time
    - Flexible modeling of Reserve subzones
- All revisions to M-11 v122 are meant to be conforming to FERC Orders: EL19-58-000 and ER19-1486-000
  - FERC’s response to the PJM February 22, 2022 Compliance Filing is pending
  - PJM will not implement changes until a ruling from FERC



# Revisions to Manual 27

- Section 8.1

Non-Dispatched Charging Energy must pay applicable transmission charges as a Network Service User. By contrast, Dispatched Charging Energy does not pay such charges. Charging energy qualifies as Dispatched Charging Energy when the Energy Storage Resource follows PJM dispatch within 10% of the desired output and meets one of the following conditions:

- Provides Energy Imbalance Service under Schedule 4 of the PJM Tariff. Energy Storage Resource Model Participants shall be considered to be providing Energy Imbalance Service when they are dispatchable by PJM in real time. An Energy Storage Resource shall be considered dispatchable when the fixed generation flag is set to “no” and the dispatchable range exceeds 10% of the absolute value of the relevant economic limit.
- Assigned to Regulation, ~~Tier II~~ Synchronous Reserves, or Reactive Service;
- Being manually dispatched for reliability

- Note: No redline or clean copy of Manual 27 was posted for today’s meeting



# Revisions to Manual 28

- Section 19.2.2
  - Reworded Secondary Reserve Shortfall MW definition
  - Added into Calculation
- Section 19.2.3
  - Removed Secondary Reserve Shortfall Charge from calculation because of change in 19.2.2

- Section 1
  - Updated service accounting definitions
- Section 20
  - Updated Billing Line Item names

- Section 5 name remains Operating Reserves
- Section 5.1
  - Added inclusion of Secondary Reserve and Market Revenue Neutrality Offset into different Operating Reserve calculations
  - Added language regarding Nuclear Units eligibility for Operating Reserve credits from Manual 11
- Section 5.2
  - Added inclusion of Secondary Reserve and Market Revenue Neutrality Offset into different Operating Reserve calculations
- Section 5.3
  - Clarify generator deviation calculation with the inclusion of Secondary Reserves



- Section 6 name remains Synchronized Reserves
- All references to Tier I and Tier II have been removed
- Section 6.1 (Overview)
  - Overall clean-up for Tier I and Tier II language
  - Clarification of how the Obligation is calculated between RTO zone and Sub-Zone
- Section 6.2 (Credits)
  - 6.2.1: Renamed and reworded for Day-ahead Synchronized Reserve Market Clearing Price Credit description and calculation
  - 6.2.2: Renamed and reworded for Balancing Synchronized Reserve Market Clearing Price Credit description and calculation
  - 6.2.3: Added for Synchronized Reserve Lost Opportunity Cost Credit to describe and show different calculation components

- Section 6.3 (Charges)
  - New charge calculations for both the Clearing Price and LOC
  - Added more details for the Clearing Price and LOC charge calculations
  - Re-word Retroactive Penalty Charge section for organization
- Section 6.4 (Recon)
  - Clarification regarding the billing determinants per Reserve and Sub-zone

- Section 7 remains for Non-Synchronized Reserves
- Section 7.1 (Overview)
  - Clarification of how the Obligation is calculated between RTO zone and Sub-Zone
- Section 7.2 (Credits)
  - 7.2.1: Renamed and reworded for Day-ahead Non-Synchronized Reserve Market Clearing Price Credit description and calculation
  - 7.2.2: Renamed and reworded for Balancing Non-Synchronized Reserve Market Clearing Price Credit description and calculation
  - 7.2.3: Added for Non-Synchronized Reserve Lost Opportunity Cost Credit to describe and show different calculation components

- Section 7.3 (Charges)
  - New charge calculations for both the Clearing Price and LOC
  - Added more details for the Clearing Price and LOC charge calculations
- Section 7.4 (Recon)
  - Clarification regarding the billing determinants per Reserve and Sub-zone

# Section 15: Ramapo (old), Market Revenue Neutrality Offset (new)

- Section 15 was for Ramapo PAR Facilities, however, calculation for these PARs are within the Market-Market calculation
- Re-use section 15 for new Market Revenue Neutrality Offset Accounting
- Section 15.1 (Overview)
  - Provides an overview of the interaction between Lost Opportunity Cost Credit, Market Revenue Neutrality Offset and Opportunity Cost Credit Owed
- Section 15.2 (Market Revenue Neutrality Offset)
  - New section
  - Provides eligibility criteria
  - Description of the calculation and how it applies to the Lost Opportunity Cost Credit calculation
- Section 15.3 (Opportunity Cost Credit Owed)
  - New section
  - Describes when the calculation applies
  - Description of the calculation and how it applies to the Lost Opportunity Cost Credit calculation

## Section 19: DASR (old), Secondary Reserve (new)

- Section 19 was for Day-ahead Scheduling Reserves (DASR), however, this product has been removed with Reserve Price Formation
- Re-use section 19 for new Secondary Reserve Accounting
- Consider all sections new, even if same numbers as DASR
- Follows the pattern and style of Synchronized Reserve and Non-Synchronized Reserve
- Section 19.1 (Overview)
- Section 19.2 (Credits)
  - 19.2.1: Day-ahead Secondary Reserve Market Clearing Price Credit
  - 19.2.2: Balancing Secondary Reserve Market Clearing Price Credit (change from 8-10-22 MIC)
  - 19.2.3: Secondary Reserve Lost Opportunity Cost Credit (change from 8-10-22 MIC)
- Section 19.3 (Charges)
  - 19.3.1: Secondary Reserve Market Clearing Price Charge
  - 19.3.2: Secondary Reserve Lost Opportunity Cost Charge
- Section 19.4 (Recon)



# Revisions to Manual 29

- Section 2.2.1 (Monthly Charges)
  - Removed Day-ahead Scheduling Reserve charges
  - Added Secondary Reserve charges
  - Updated Load Reconciliation charges
- Section 2.3.1 (Monthly Credits)
  - Removed Day-ahead Scheduling Reserve credits
  - Added Secondary Reserve credits
  - Updated Synchronized Reserve credits and Non-Synchronized Reserve credits



# Revisions to Manual 11

- Section 2.14
  - Added back an introductory sentence for flow
- Section 4.2.12
  - Removed references to Tier 1 and Tier 2 SR
- Section 4.8
  - Removed references to Tier 1 and Tier 2 SR
  - Removed redundancies with Manual 28 in Section 4.8
- Section 10
  - Updated redline for consist formatting - included all language, not just paragraphs that had changes

- All Reserve rules will be covered in one overarching section and will merge existing sections:
  - Current section 4: Overview of the PJM Synchronized Reserve Market
  - Current section 4b: Overview of the PJM Non-Synchronized Reserve Market
  - Current section 11: Overview of the Day-ahead Scheduling Reserve Market

- Section 4: PJM Reserve Markets
  - 4.1 Overview of the PJM Reserve Markets
    - Description of Synchronized, Primary, and 30-Minute Reserve Services and the Synchronized, Non-Synchronized, and Secondary Reserve Products that can meet the Service requirements in both DA and RT
  - 4.2 PJM Reserve Markets Offer Business Rules
    - 4.2.1 Reserve Markets Resource Eligibility
      - 4.2.1.1 Requests for Eligibility for Nuclear, Wind, Solar Resources
        - » These resource types are ineligible by default but may request an exemption with documentation to support the resource's ability to follow PJM's dispatch
      - 4.2.1.2 Economic Load Response Reserve Eligibility
    - 4.2.2 Reserve Resource Offer Requirements
      - Capacity generation resources must offer their 10-min and 30-min reserve capability. Reserve capability is calculated based on Energy offers with the exception of Hydro, Economic Load Response, and Energy Storage resources which must submit specific reserve offers.
      - 4.2.2.1 Communication for Reserve Capability Limitation
        - » Exception process to be able to submit Synchronized Reserve Max or Secondary Reserve Max less than EcoMax

- 4.2 PJM Reserve Markets Offer Business Rules (cont.)
  - 4.2.3 Reserve Markets Resource Offer Structure
    - Availability, Offer MW, Offer Price
  - 4.2.4 Offer Period Timing
    - For both DA and RT Reserve Markets
  - 4.2.5 Reserve Markets Resource Capability
    - 4.2.5.1 Reserve Markets Capability for Online Generation Resources
      - » Based on initial energy output, ramp rate, Eco Min, and the lesser of Eco Max and Synch/Secondary Max
    - 4.2.5.2 Reserve Markets Capability for Offline Generation Resources
      - » Based on startup/notification times, ramp rate, Eco Min, and the lesser of Eco Max and Synch/Secondary Max
    - 4.2.5.3 Reserve Markets Capability for Synchronous Condensers
      - » Based on ramp rate, condense to generate time, Eco Min, and the lesser of Eco Max and Synch/Secondary Max

## – 4.3 Reserve Requirement Determination

- Reserve requirements in DA and RT for Synchronized Reserve, Primary Reserve, and 30-Min Reserve are determined based on the greatest MW loss of all the potential Largest Single Contingencies on the system
- 4.3.1 Locational Aspect of Reserves
  - Multiple subzones may be modeled but only one will be active at a time. Active subzones will be communicated via Markets Gateway.
- 4.3.2 Creation of New Reserve Subzones
  - New reserve subzones will be defined as far in advance as possible.
- 4.3.3 Reserve Demand Curves and Penalty Factors
  - Demand curves for each reserve product and location. First step of the curve is at \$850/MWh and second step is at \$300/MWh.

## – 4.4 Reserve Markets Clearing

- Reserves and Energy will be co-optimized the same way in the DA and RT markets.
- **4.4.1 Product and Locational Substitution**
  - Synchronized Reserve can also meet the Primary and 30-Min Reserve requirements. Non-Synchronized Reserve can also meet the 30-Min Reserve requirement. Reserves procured in a subzone can also meet the requirement of the RTO.
- **4.4.2 Day-Ahead Reserve Market Clearing**
  - DA Reserve clearing prices and assignments are posted simultaneously with DA Energy.
- **4.4.3 Real-Time Reserve Market Clearing**
  - Inflexible reserves cleared DA will have their assignments carried to RT. Inflexible reserves are committed hourly and assignments are posted to Markets Gateway thirty minutes prior to the operating hour. Flexible reserve commitments come from the RT SCED application and are communicated via ICCP.
- **4.4.4 Opportunity Costs for Condensers**
  - LOC is based on the forecasted hourly LMP, price of the unit at its set point, and the amount of reserve provided
- **4.4.5 Determination of Reserve Clearing Prices**
  - Clearing Prices for Synchronized Reserves, Non-Synchronized Reserves, and Secondary Reserves are the marginal cost to serve an additional MW of applicable reserve product in the RTO Reserve Zone and applicable active Reserve Sub-Zone.

## – 4.5 Event Performance

- 4.5.1 Performance Verification

- Measurement of a resource's magnitude of response when PJM requests reserves to be dispatched to Energy.

- 4.5.2 Non-Performance

- Consequences for failure to respond to PJM's request for reserves to be dispatched to Energy

## – 4.6 Reserve Obligations

- LSE's incur a reserve obligation based on their RT load ratio share and the total assigned MW to meet each applicable requirement.

## – 4.7 Bilateral Transactions

- Bilateral transactions for Synchronized Reserves, Non-Synchronized Reserves, and Secondary Reserves may be reported to PJM via Markets Gateway

## – 4.8 Settlements

- PJM Reserve settlements are a zero-sum calculation based on the Reserves provided to the market by Market Sellers and purchased from the market by Market Buyers. More details in Manual 28



- 1 – Overview
- 1.1 – PJM Responsibilities
- 2.3.3.2 – Generation Schedules
- 2.3.7 - Mechanical/Technical Rules
- 2.7 – Locational Pricing Calculator (LPC)
- 2.8 – The Calculation of Locational Marginal Prices (LMPs) During Emergency Procedures
- 2.9 – Shortage Pricing

- 2.14 – Balancing Operating Reserve Cost Analysis
- 3.1 – Overview of the PJM Regulation Market
- 3.2.1 – Regulation Market Eligibility
- 3.2.7 – Regulation Market Clearing
- 3.2.7.5 – Total Offer
- 5.2.4 – Markets Database System

- 10.1 – Overview of Demand Resource Participation
  - 10.2 – Demand Resource Registration Requirements
    - 10.2.1 – Registration Combinations
    - 10.2.2 – Curtailment Service Providers
  - 10.4.1 – Metered Data
  - 10.5 – Aggregation for Economic, Pre-Emergency and Emergency Demand Resources
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- Updated DA Market Ops owner from Mike Ward to Joe Ciabattoni

- Section 2.5.3.3 - Real-time Security Constrained Economic Dispatch Methodology
  - Updated Achievable Target MW calculation
  - Updated definition of up/down ramp rate used
  - Updated diagram to reflect these changes

This enhancement was deployed to production on June 28, 2022

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**Reserve Price Formation M-11 & M-27, 28, 29  
Revisions**



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# Appendix: Manual Revision Schedule

- Several manuals require updates to account for the Reserve Price Formation implementation:
  - Operations Related Manuals:
    - Manual 10: Pre-Scheduling Operations
    - Manual 12: Balancing Operations
    - Manual 13: Emergency Operations
  - Markets and Settlements Related Manuals:
    - Manual 11: Energy & Ancillary Services Market Operations
    - Manual 15: Cost Development Guidelines
    - Manual 27: Open Access Transmission Tariff Accounting
    - Manual 28: Operating Agreement Accounting
    - Manual 29: Billing



# Reserve Price Formation Manual Revision Schedule

	Committee	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Manuals 10, 12, 13	SOS				8/3 ●	★ 9/1			
	OC				8/11 ●	★ 9/8			
	MRC				8/24 ●	★ 9/21			
Manuals 11, 27, 28, 29	MIC				8/10 ●	★ 9/7			
	MRC				8/24 ●	★ 9/21			
Manual 15	CDS			7/6 ○					
	MIC			7/13 ●	★ 8/10				
	MRC				8/24 ●	★ 9/21			
	MC				8/24 ●	★ 9/21			

- *First Read*
- ★ *Endorsement*
- *Info Only*

Go-live for Reserve Price Formation changes is **October 1, pending FERC action**



**PROTECT THE  
POWER GRID  
THINK BEFORE  
YOU CLICK!**



Be alert to  
malicious  
phishing emails.

**Report suspicious email activity to PJM.**  
(610) 666-2244 / [it\\_ops\\_ctr\\_shift@pjm.com](mailto:it_ops_ctr_shift@pjm.com)

