Flexible Ramping Product Refinements Initiative
Appendix A – Other ISO/RTO Demand Curve Summaries

Below are summaries of how other ISO/RTOs employ demand curves to relax reserve constraints and produce stepped price signals during scarcity conditions.

Midcontinent Independent System Operator (MISO):

The MISO utilizes demand curves to relax reserve constraints and ensure the market produces scarcity price signals. The three market-wide demand curves the MISO employs are for operative reserves, the sum of regulating and spinning reserves, and regulating reserves. Each of these demand curves are designed to communicate shortages in capacity, regulating, and spinning reserves and the prices produced from these reflect deficiencies in each product in the entire market. These demand curves and rationale behind their designs are detailed in the Energy and Operating Reserve Markets Business Practices Manual Section 5.2.1.[1]

The MISO fully co-optimizes energy, regulating reserve and contingency reserve requirements in both their day-ahead and real-time energy markets. This differs from the CAISO's design in which energy and ancillary services are only fully co-optimized in the day-ahead market. In the real-time market the CAISO only procures additional ancillary services if needed.

ISO-New England (ISO-NE):

ISO-NE relaxes real-time reserve constraints depending on the specific reserve requirement. The following reserve constraint penalty factors (RCPFs) are the prices beyond which ISO-NE's real-time dispatch software will no longer re-dispatch the system to maintain reserve requirements[2]:

Constraint	RCPF ($/MWh)
Ten Minute Spinning Reserves	$50
Total Ten Minute Reserves	$1,500
Total Thirty Minute Reserves	$1,000

During 5-minute scarcity conditions in which the Total Ten Minute Reserve or Total Thirty Minute Reserve requirements are deficient, the RCPFs will set the real-time reserve price and serve as an adder to the real-time LMP. Assuming all reserve requirements are deficient, the maximum LMP adder that could be applied would equal:

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[1] See pages 172 – 182 for information on MISO's demand curves from the Energy and Operating Reserve Markets Business Practices Manual available at https://cdn.misoenergy.org//BPM%20002%20-%20Energy%20and%20Operating%20Reserve%20Markets49546.zip

[2] See Section III.2.7A for information on ISO-NE Calculation of Real-Time Reserve Clearing Prices available at https://www.iso-ne.com/static-assets/documents/2014/12/mr1_sec_1_12.pdf

$2,550/MWh (all RCPFs) + $1,000/MWh (energy offer cap) = $3,500/MWh

Additionally, ISO-NE fully co-optimizes reserve requirements in their real-time market for every interval.

New York ISO (NYISO):

The NYISO relaxes reserve constraints using 15 Operating Reserve Demand Curves based on reserve regions. The following table outlines the various demand curves that apply to both the Day-Ahead Market and Real-Time Market[3]:

New York Region	Operating Reserve Demand Curve Type	Demand Curve Amount (MW)	Demand Curve ($)
NYCA	Spinning Reserves	All	$775
NYCA	10-Minute Reserves	All	$750
NYCA	30-Minute Reserves	300 655 955 Remainder	$25 $100 $200 $750
Eastern New York (EAST)	Spinning Reserve	All	$25
	10-Minute Reserves	All	$775
	30-Minute Reserves	All	$25
Southeastern New York (SENY)	Spinning Reserve	All	$25
	10-Minute Reserves	All	$25
	30-Minute Reserves	All	$500
New York City (N.Y.C.)	Spinning Reserve	All	$25
	10-Minute Reserves	All	$25
	30-Minute Reserves	All	$25
Long Island (LI)	Spinning Reserve	All	$25
	10-Minute Reserves	All	$25
	30-Minute Reserves	All	$25

The NYISO fully co-optimizes energy, reserve, and regulation requirements in their real-time market.

PJM:

[3] See Section 6.8 for information on NYISO's Operating Reserve Demand Curves available at https://www.nyiso.com/documents/20142/2923301/ancserv.pdf/df83ac75-c616-8c89-c664-99dfea06fe2f

PJM utilizes a two-step Operative Reserve Demand Curve (ORDC) to relax reserve constraints in which the first step is set at the Reserve Penalty Factor of $850/MWh and the second is at $300/MWh for 190MW of added reserves.[4] The first step at the Reserve Penalty Factor was designed to prevent the reserve market clearing price from reflecting the incremental costs of resources needed to meet reserve requirements in the shortage or near-shortage conditions. The second step provides protection against price swings associated with scarcity conditions by signaling to market participants if the market is approaching scarcity/shortage conditions.

PJM fully co-optimizes energy and reserves in their day-ahead and real-time markets. When constraints are relaxed and the ORDC is used, the determined penalty factor is included in the calculation of the energy price. This increases the energy price to reflect scarcity/shortage conditions.

Southwest Power Pool (SPP):

SPP uses three demand curves, Contingency Reserve, Regulation-Up Service, and Regulation-Down Service, to set LMPs and market clearing prices during scarcity conditions on either a Reserve Zone or system-wide basis. The prices determined from these demand curves are calculated based on the MW amounts of shortages per product and are outlined in detail within the Market Protocols for SPP Integrated Marketplace Section 4.1.5.[5]

SPP fully co-optimizes energy and reserves in their day-ahead and real-time markets.

[4] See Section 4.2.2.1 for information on PJM's Reserve Demand Curves and Penalty Factors in the Energy & Ancillary Services Market Operations Manual available at https://www.pjm.com/-/media/documents/manuals/m11.ashx?la=en

[5] See Section 4.1.5 for information on SPP's demand curves available at https://spp.org/Documents/61445/Integrated%20Marketplace%20Protocols%2075.zip