



# Education on Reserve Practices across RTOs/ISOs

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# Primary Reserves Procured Quantities

	Primary Reserve Requirement	Synchronous (or Spinning) Requirement
<b>PJM</b>	150% of the Synchronous Reserve Requirement (inclusive of the synchronous reserves)	100% of the most severe single contingency (MSSC), currently increased to 130% to account for performance.
<b>ISO NE</b>	100% MSSC	25-100% of the primary reserve requirement must be met by spinning depending on historic ACE recovery performance.
<b>MISO</b>	100% MSSC	50% of the primary reserve requirement must be met by spinning
<b>NYISO</b>	100% MSSC	50% of the primary reserve requirement must be met by spinning
<b>SPP</b>	100% MSSC * performance factor. Current performance factor is 1.3.	50% of the primary reserve requirement must be met by spinning
<b>CAISO</b>	At least 100% MSSC, but can be increased by load levels and online photovoltaics	Minimal spinning reserve requirements are set for each ancillary service region.

<b>PJM</b>	All generation capacity resources must offer in their reserve capability.
<b>ISO NE</b>	Reserve capability on resources participating in the energy market is calculated by ISO NE and is assumed to be available for reserves.
<b>MISO</b>	Capacity resources not on a forced or maintenance outage must offer in their reserve capability if qualified.
<b>NYISO</b>	Any resource eligible to supply operating reserves and that is available to NYISO for dispatch must also make itself available to provide operating reserves.
<b>SPP</b>	With the exception of wind and solar, resources that are capable of providing reserves must offer into the reserve market.
<b>CAISO</b>	Resource adequacy resources subject to the ancillary service must offer obligation must offer into the reserve market.



# Primary Reserve Performance Requirements

<b>PJM</b>	Primary reserve resources must be able to respond within 10 minutes and sustain a response for 30 minutes.
<b>ISO NE</b>	Primary reserve resources must be able to respond within 10 minutes and sustain response for 60 minutes.
<b>MISO</b>	Primary reserve resources must be able to respond within 10 minutes and sustain a response for 60 minutes.
<b>NYISO</b>	Primary reserve resources must be able to respond within 10 minutes and sustain a response for 60 minutes.
<b>SPP</b>	Primary reserve resources must be able to respond within 10 minutes and sustain a response for 60 minutes.
<b>CAISO</b>	Primary reserve resources must be able to respond within 10 minutes and sustain a response for 120 minutes.

<b>PJM</b>	With the exception of resources using the energy storage resource participation model, hydro and demand response, PJM calculates resource reserve capability based on the submitted energy offer and reserve-specific parameters (e.g., spin max).
<b>ISO NE</b>	ISO NE calculates resource reserve capability based on the submitted energy offer.
<b>MISO</b>	MISO calculates resource reserve capability based on its active ramp rates and/or the clearing of other products on the resource.
<b>NYISO</b>	A resource's maximum operating reserve level is ten times its emergency response rate as provided by the supplier.
<b>SPP</b>	Resources offer in their reserve capability.
<b>CAISO</b>	Adequacy resources must offer in their reserve capability. If no reserve offer is provided, the resource's reserve capability is calculated by CAISO based on its energy offer.

<b>PJM</b>	There are no resource testing requirements for reserves.
<b>ISO NE</b>	ISO NE tests the ability of resources to provide reserves at regular intervals, when possible in coordination with the resource's normal testing practices.
<b>MISO</b>	MISO does qualification testing to provide offline supplemental reserve, but not for synchronized reserves.
<b>NYISO</b>	All resources requesting to become reserve suppliers and all resources that must re-qualify must complete a pre-qualification performance test.
<b>SPP</b>	SPP does random testing, and if a resource fails a random test, they are barred from clearing until they can pass a subsequent test.
<b>CAISO</b>	CAISO has the ability to conduct unannounced tests to verify resources' ability to meet reserve performance requirements.

<b>PJM</b>	PJM has the ability to set reserve requirements based on flexible reserve sub-zones to manage system constraints. Only one sub-zone can be in effect at a time.
<b>ISO NE</b>	ISO NE has four reserve zones.
<b>MISO</b>	Studies are conducted quarterly to establish the number and composition of MISO's reserve zones.
<b>NYISO</b>	NYISO has four reserve zones.
<b>SPP</b>	SPP has five reserve zones.
<b>CAISO</b>	CAISO has ancillary service regions, which have separate minimum spinning reserve requirements.



<b>PJM</b>	Resources may offer up to the expected penalty rate for providing synchronous reserves.
<b>ISO NE</b>	There are no distinct resource offers for reserve products in the real-time market, and so clearing prices are purely opportunity-cost based.
<b>MISO</b>	Resources may submit contingency reserve offers in \$/MW in the allowable range of \$0 to \$100 per MW. Offers default to \$0 per MW if not provided.
<b>NYISO</b>	Resources can provide reserve capability bids in the day ahead market in \$/MW. During real-time, all suppliers are automatically assigned an operating reserves availability bid of \$0 per MW.
<b>SPP</b>	Resources may submit spinning reserve offers in the allowable range of -\$100 to \$100 per MW.
<b>CAISO</b>	Resources' ancillary services bids must include a bid price of the capacity reservation for reserves in \$/MW, capped at the ancillary services bid price of \$250 per MW.

<b>PJM</b>	During a synchronized event, PJM deploys all synchronized reserves via an All-Call and asks them to ramp up to their maximum capability.
<b>ISO NE</b>	Operators run a Contingency Scheduling Pricing and Dispatch economic dispatch engine, which sends out a special emergency dispatch instruction, which resources must acknowledge within 60 seconds.
<b>MISO</b>	Operators deploy reserve MWs depending on the resource loss or other system conditions. Deployment is proportional across generation resources with a reserve assignment and based on merit order for demand response. MISO may switch early to a SCED solution that reflects the applicable systems conditions if available and may re-execute RTSCED if the event occurs early in the dispatch interval.
<b>NYISO</b>	Operators initiate a reserve pickup, and units with or without a reserve award are expected to respond with their emergency response rate as bid. Units are paid for any over-generation during the reserve pick-up and for a grace period of three intervals (15 minutes) following.
<b>SPP</b>	Operators decide how many MWs of reserves to deploy and enter that into a reserve deployment tool. Reserves are deployed pro rata across resources with a reserve assignment, beginning with spinning reserves. Reserve assignments are added automatically to the dispatch basepoint.
<b>CAISO</b>	A real-time contingency dispatch tool is activated when a SE solution is available post contingency to produce dispatch instructions for a 10 minute interval using Energy Bid prices. If 300MW or more are needed, a real-time disturbance dispatch is done that dispatches resources based on merit order without a network model, starting with resources that have a reserve assignment.



# Performance Evaluation

<b>PJM</b>	A resource's reserve performance is measured based the difference in its output at the beginning and end of the deployment event respectively.
<b>ISO NE</b>	For non-spinning reserves (cleared in the Forward Reserve Market), the actual amount of energy delivered is measured at the 10 minute point following deployment. If the resource becomes unavailable within 60 minutes, its response is reduced to zero. For contingency dispatch events, resources are evaluated on whether they acknowledge the emergency dispatch notification within 60 seconds and then follow dispatch instructions.
<b>MISO</b>	Resources can pass the reserve performance test by meeting any of four conditions: 1) meeting or exceeding the deployment instruction, 2) meeting or exceeding its expected output based on a linear ramp, 3) exceeding the change in output in the deployment instruction, or 4) exceeding its expected change in output.
<b>NYISO</b>	NYISO measures actual resource output or demand reduction against its expected performance and may disqualify resources that consistently fail to perform from providing reserves in the future.
<b>SPP</b>	Resources can pass the reserve performance test by meeting at least 75% of its obligation as measured by any of four tests, two based on its MW output delta, and two based on its calculated ramp capability. If the resource fails, its highest performance measure is used to de-rate its assignments for the remainder of the operating day.
<b>CAISO</b>	Ten minutes after deployment, resources must provide at least 90% of the amount of energy requested, measured using resource telemetry.

<b>PJM</b>	Resource non-performance results in an obligation to repay all or a portion of the reserve credits it received.
<b>ISO NE</b>	Reserves with an obligation in the Forward Reserve Market (non-spinning and 30-minute reserves) that fail to perform must pay back the greater of a failure to activate rate or the real-time LMP.
<b>MISO</b>	Resource that do not perform when called upon must buy back their MW deficiency at the real-time LMP. Any additional cleared reserves that were not deployed do not receive reserve payment for that hour.
<b>NYISO</b>	Resource must buy out of its day-ahead reserve commitment at the real-time reserve market clearing price. Repeated failure may disqualify resources from providing reserves in the future.
<b>SPP</b>	Buy-back portion of the reserves at the real-time reserve clearing price. Resources that don't pass their performance test are de-rated based on actual performance for the remainder of the operating day.
<b>CAISO</b>	If a resource fails to provide reserves when called upon to do so, its reserve capacity payments are rescinded.

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Acronym	Term & Definition
LMP	<p><b>Locational Marginal Price</b> is defined as the marginal price for energy at the location where the energy is delivered or received. For accounting purposes, LMP is expressed in dollars per megawatt-hour (\$/MWh). LMP is a pricing approach that addresses Transmission System congestion and loss costs, as well as energy costs.</p>
MSSC	<p>The <b>Most Severe Single Contingency</b>, as defined by the North American Electric Reliability Corporation (NERC), is the Balancing Contingency Event, due to a single contingency, that would result in the greatest loss (measured in MW) of resource output used by the Reserve Sharing Group (RSG) or a Balancing Authority that is not participating as a member of a RSG at the time of the event to meet firm system load and export obligation (excluding export obligation for which Contingency Reserve obligations are being met by the sink Balancing Authority).</p>
ACE	<p><b>Area Control Error</b> is a signal generated by the PJM Control Center and sent to the plants, stations and/or PJM members scheduled to provide regulation to change generation quickly to keep PJM's area control error within allowable limits. It is used to control for small fluctuations in load.</p>
MW	<p>A <b>Megawatt</b> is a unit of power equaling one million watts (1 MW = 1,000,000 watts) or one thousand kilowatts (1 MW = 1,000 KW). To put it in perspective, under non-severe weather conditions, one MW could power roughly 800 to 1,000 average-sized American homes.</p>

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