



*Working to Perfect the Flow of Energy*

# PJM Manual 13 Emergency Operations

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## Section 2: Capacity Emergencies

Welcome to the *Capacity Emergencies* section of the ***PJM Manual for Emergency Operations***. In this section, you will find the following information:

- A general description of the system alert and emergency actions (see “*Overview*”).
- A general overview of Reserve Requirements by Control Zone (see “*Reserve Requirements*”).
- How PJM and the PJM Members respond to capacity shortage situations (see “*Capacity Shortages*”).
- How PJM and the PJM Members respond to capacity excess situations (see “*Light Load Procedures*”).

### 2.1 Overview

PJM is responsible for determining and declaring that an Emergency is expected to exist, exists, or has ceased to exist in any part of the PJM RTO or in any other Control Area that is interconnected directly or indirectly with the PJM RTO. PJM directs the operations of the PJM Members as necessary to manage, allocate, or alleviate an emergency.

- *PJM RTO Reserve Deficiencies* — If PJM determines that PJM-scheduled resources available for an Operating Day in combination with Capacity Resources operating on a self-scheduled basis are not sufficient to maintain appropriate reserve levels for the PJM RTO, PJM performs the following actions:
  - Recalls energy from Capacity Resources that otherwise deliver to loads outside the Control Area and dispatches that energy to serve load in the Control Area.
  - Purchases capacity or energy from resources outside the Control Area. PJM uses its best efforts to purchase capacity or energy at the lowest prices available at the time such capacity or energy is needed. The price of any such capacity or energy is eligible to determine Locational Marginal Prices in the PJM Energy Market. The cost of capacity or energy is allocated among the Market Buyers as described in the PJM Manual for Operating Agreement Accounting (M28)
- *Light Load Procedures* — If PJM determines that the forecasted load in the PJM RTO falls below a margin of 2,500 megawatts above the sum of the output of the self-scheduled resources and the total Normal Minimum Generation of all PJM-scheduled resources, PJM implements the alert and possibly Minimum Generation Emergency procedures as described later in this section. To the extent it deems appropriate in order to avoid or reduce the cost of a Minimum Generation Emergency, PJM sells energy to other Control Areas. Any costs or revenues resulting from such sales are allocated as described in the [PJM Manual for Operating Agreement Accounting \(M28\)](#).

If PJM is requested to purchase energy from another Control Area in order to alleviate an actual or threatened Minimum Generation Emergency in the other control area, PJM may purchase energy if PJM determines that the purchases can be made without adversely affecting the safe or reliable operation of generators within the PJM RTO and without unduly

increasing the cost of energy of the PJM Members. Any energy purchased and associated costs or revenues are allocated as described in the PJM Manual for Operating Agreement Accounting (M28)

**Note:** Emergency power purchases by PJM to assist in alleviating external Minimum Emergency Conditions should be accepted at a quote below the PJM system cost (unconstrained conditions) or interface locational marginal price.

## 2.2 Reserve Requirements

PJM schedules reserves on a day-ahead basis in order to ensure that differences in forecasted loads and forced generator outages does not negatively impact the reliable operation of the PJM Transmission System. PJM operates in real-time to ensure Contingency/Primary (10 minute) and Synchronized/Spinning reserve requirements are always maintained. Day Ahead Scheduling Reserves (Operating), Contingency (Primary) and Synchronized/Spinning Reserve Requirements are as follows:

Area	Ancillary Service Market Area	Day-ahead Scheduling (Operating)	Contingency (Primary)	Synchronized Reserve
RTO		Annual %	150% Largest Single Contingency	Largest Single Contingency
	Mid-Atlantic & Dominion	N/A	1700 MW	Largest Single Contingency
SERC	Dominion	VACAR ARS%	VACAR ARS%	VACAR ARS%

- As system conditions dictate, PJM Dispatch will load Synchronized and Primary Reserves. Members are expected to take actions as indicated in [PJM Manual M-12: Section 4.1.2 “Loading Reserves”](#).
- PJM periodically evaluates the Synchronized and Primary reserve estimates in real time via the Instantaneous Reserve Check (IRC) process documented in [PJM Manual M-12: Section 4.1.1 “Monitoring Reserves”](#).

The Day-ahead Scheduling Reserves for RFC are calculated on an annual basis. This calculation considers variables that adversely impact system reliability, specifically, Underforecasted Load Forecast Error (LFE) and Generator Forced Outage Rates (FOR).

$$\text{Day-ahead Scheduling Reserves} = \text{Underforecasted LFE} + \text{FOR}$$

### Load Forecast Error Component

The LFE component is based on a 3 year average of Underforecasted LFE. PJM focuses on only underforecasted Load Forecast errors because underforecasted loads result can result in a capacity deficiency. PJM computes the Underforecasted LFE based on the 80<sup>th</sup> percentile of a rolling three year underforecast average.

Effective January 1, [2016-2017](#) the LFE error component of the Day-ahead Scheduling Reserve is [2.0916%](#).

## Forced Outage Rate Component

The FOR component is based on a rolling three year average of forced outages that occur from 18:00 the scheduling day (day – 1) through the operating day at 20:00. This duration covers the timeframe after the Reserve Adequacy Run through the evening peak period for which the system is scheduled. Forced outages that occur prior to 18:00 of the scheduling day are accounted for in the commitment plan. PJM dispatch still has the ability to schedule additional reserves if a Hot Weather / Cold Weather Alert is issued since FOR are typically higher during such timeframes.

Effective January 1, [2016-2017](#) the FOR error component of the Day-ahead Scheduling Reserve is [3.6436%](#).

PJM Performance Staff performs Day-ahead Scheduling Reserve Requirement calculations every year during the month of November. The calculations cover the 3 year window from November 1<sup>st</sup> (year – 3) through October 31<sup>st</sup> (current year). The results are communicated to the Market Implementation Committee, Operating Committee and System Operations Subcommittees. The revised reserve calculations are implemented annually on January 1<sup>st</sup>.

Effective January 1, [2016-2017](#) the Day-ahead Scheduling Reserve for RFC and EKPC regions of PJM is [5.7951%](#) times Peak Load Forecast for RFC plus EKPC.

Dominion Day-ahead Scheduling Reserve is based on their share of the VACAR Reserve Sharing agreement and is set annually.

The RFC, EKPC and Dominion Day-ahead Scheduling Reserve Requirements are added together to form a RTO Day-ahead Scheduling Reserve Requirement.

**Note 1:** PJM must schedule sufficient Regulating Reserves to satisfy control standards. Regulating reserves shall be made up of not less than 75% spinning reserves, and resources allocated to regulating reserves shall not be included as part of Contingency Reserves.

**Note 2:** PJM must schedule sufficient Contingency Reserves to satisfy the Reliability *First* (RFC) requirements. Contingency Reserves shall not be less than the largest contingency. Contingency Reserves must be made up of at least 50% Spinning Reserves. No more than 25% of Contingency Reserves should be interruptible load. (Standard BAL-002-1, BAL-002-RFC-02)

**Note 3:** PJM triggers the Contingency (Primary) Reserve Emergency Procedures on the Mid-Atlantic Control Zone based on a Contingency/Primary Reserve Requirement of 1700 MW due to potential deliverability issues. Contingency (Primary) Reserve Requirements for the RFC portion of the PJM footprint is 150% of the largest generators.

**Note 4:** The Regulation Requirement for the PJM RTO is defined in section 4 of Manual 12, Balancing Operations.

**Note 5:** RFC and VACAR Contingency and Synchronized Reserve requirements are set on an annual basis.

**Note 6:** For Dominion Control Zone, SERC Reserve Requirements, as outlined in the SERC Contingency Reserve Policy, are maintained. Dominion-VP load is subject to the SERC requirements based on the VACAR Reserve Sharing Agreement which is set annually. For non Dominion-VP load in the Dominion Control Zone, SERC reserve requirements (non-reserve sharing group) are applicable to the Balancing Authority (PJM). There are sufficient reserves in the RTO to surpass these SERC requirements through the existing reserve methodology.

PJM schedules Day-ahead Scheduling reserves on a day-ahead basis as a single market in the RTO. Primary and Synchronized Reserves are maintained in real-time based on the locational requirements identified above, recognizing transmission constraints while scheduling sufficient localized reserves on a control zone basis to satisfy reserve sharing agreements. The cost of capacity or energy is allocated among the Market Buyers as described in the PJM Manual for [Operating Agreement Accounting \(M-28\)](#).

PJM commits generation real-time on an economic basis, considering resource characteristics (start-up, min run, starts per day) and anticipated system changes (load curve, interchange, must-run generation) while honoring system constraints.

PJM issues capacity emergencies across the entire PJM RTO except for PJM Load Dump Warnings/Actions, which are solely issued on a Control Zone basis. However, transmission constraints may force Emergency Procedure warnings/actions to be issued on a Control Zone or a subset of a Control Zone. For example, if known transmission constraints would prohibit delivery of Maximum Emergency generation capacity from one Control Zone to another, a Maximum Generation Alert would not be issued for the Control Zone with undeliverable energy.