PJM Capacity Emergencies
Capacity Shortages
Objectives

Students will be able to:

• Identify the process and requirements for operating during capacity emergencies
A capacity emergency in PJM is defined as:

- Capacity deficiency condition (capacity shortage)
- Capacity excess condition (light load)
A capacity emergency in PJM is defined as:

- Capacity deficiency condition (capacity shortage)
  - Reserve Capability is often triggering event
- Capacity excess condition (light load)

### Synchronous Reserves

- MW

### Nonsynchronous Reserves

### Operating Reserves*

<table>
<thead>
<tr>
<th>Area</th>
<th>Ancillary Service Market Area</th>
<th>Day-ahead Scheduling (Operating)</th>
<th>Contingency (Primary)</th>
<th>Synchronized Reserve</th>
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<tbody>
<tr>
<td>RTO</td>
<td>RTO</td>
<td>Annual %</td>
<td>150% Largest Single Contingency</td>
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<td>Mid-Atlantic &amp; Dominion</td>
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<td>150% of the Largest Single Contingency</td>
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<tr>
<td>SERC</td>
<td>Dominion</td>
<td>VACAR ARS%</td>
<td>VACAR ARS%</td>
<td>VACAR ARS%</td>
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</table>
PJM Capacity Emergency Categories

**Capacity Shortage Actions**
- Issued real-time and requires PJM and/or Member response
- PJM actions are consistent with NERC EOP standards

**Capacity Shortage Warnings**
- Issued real-time, typically preceding, and with an estimated time/window for a potential future Action
- Same day of event but prior to Actions being declared

**Capacity Shortage / Excess Alerts**
- Alerts are issued in advance (Day-Ahead) of a scheduled load period
- Allows sufficient time to prepare for anticipated capacity shortages or excess
- The intent of the alert is to keep all affected system personnel aware of the forecast and/or actual status of the PJM RTO

**Capacity Excess Advisories**
- Issued one or more days in advance of the operating day
- General in nature and for elevated awareness only.
- No preparations required
- Advisory is not a capacity shortage type at this time, and is used in Light Load Procedures

PJM Manual 13, Emergency Operations

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.

All alerts, warnings, and actions are communicated to Transmission/Generation dispatchers via an ALL-CALL message (and/or, direct operator to operator communication for local events) and posted on selected PJM web-sites. Unless prior agreement is in place with PJM, Transmission Owner dispatchers are responsible for notifying Distribution Providers (DPs), assuring they receive the same information.
Alerts
Capacity Shortage Alerts

- Four capacity shortage alerts:
  - Unit Startup Notification Alert
  - Maximum Generation Emergency Alert
  - Primary Reserve Alert
  - Voltage Reduction Alert
Unit Start Up Notification Alert

• Purpose
  – To alert members to place generating units in a state of readiness so that they can be brought online within 48 hours in anticipation of a shortage of operating capacity, stability issues or constrained operations

• Trigger
  – When a reliability assessment determines that long lead time generation is needed for a future period
Unit Startup Notification Alert

**PJM Actions:**

- Notifications to PJM management and member companies
- Schedule an amount of long lead time generation anticipated to be needed for the operating day(s)
  - In economic order
  - Respecting operating parameters
  - Can be issued for the RTO, specific control zone(s) or individual units

- Alerted units must be in a “State of Readiness” in the lesser of:
  - Submitted notification time + startup time – 48 hours **OR**
  - 6 days – 48 hours
  - “State of readiness” = able to be online within 48 hours

- Evaluate conditions daily to determine when to release units from the state of readiness, or call the units to come online

**Member Actions:**

- Report Unit capabilities correctly
  - Markets Gateway “time to start” maximum is 6 days
- After reaching a “state of readiness”, if the unit fails to come online within 48 hours after being called by PJM, the unit will be considered on a forced outage until it comes online, or PJM cancels the alert
- Once a unit is scheduled, its offer price is locked for the operating day
Maximum Generation/Load Management Alert

• Purpose
  – To provide an early alert that system conditions may require the use of the PJM
    Emergency Procedures

• Trigger
  – When Maximum Generation Emergency
    is called into the operating capacity, or
    if Demand Response is projected to be
    implemented
    • Operating Reserve Requirement* is greater
      than scheduled Operating Reserve
    • Should be issued 1 or more days prior to the operating day in question
Max Generation / Load Management Alert

**PJM Actions:**
- Notifications to PJM management and members
  - States the amount of estimated operating reserve and the requirement
  - Issue NERC Energy Emergency Alert Level 1
- Performs a situation analysis and prepares projections for that day and future periods
  - Capacity
  - Interchange
  - Load
  - Reserve
- Reports any significant changes in the estimated operating reserve capacity
- Sets up Supplementary Status Report if required
  - May elect not to request until operating day for which alert is in effect
- Review the level of dependency on External Transactions to serve PJM load and to determine if the need to implement Capacity Benefit Margin is required

**Member Actions:**
- Notifications
  - Management, all stations, key personnel
- Review plans to determine if any maintenance or testing of equipment, scheduled or being performed, on any monitoring, control, transmission, or generating equipment can be deferred or cancelled
  - Suspend any high risk testing of generating or transmission equipment
- Report any and all fuel/environmental limited facilities as they occur

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Max Generation / Load Management Event

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![Load and Capacity Profile](load_capacity_profile.png)
Primary Reserve Alert

• Purpose
  – To alert member of the anticipated shortage of operating reserve capacity for a future critical period

• Trigger
  – When the estimated operating reserve is less than the forecasted primary reserve requirement

Load and Capacity Profile

150% Largest Single Contingency

Synchronous Reserves
Nonsynchronous Reserves
Operating Reserves*
Viewing Current Reserve Requirements on PJM.COM

Dispatched Reserves

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<thead>
<tr>
<th>Reserve Type</th>
<th>RTO (MW)</th>
<th>MidAtlantic / Dominion (MW)</th>
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Disclaimer: Data provided on this page is based on the real-time security constrained economic dispatch solution, which solves for a near-term look-ahead interval. Reserve pricing and declaration of shortage pricing is based upon the data displayed on this page.

Upcoming Meetings
- Liaison Committee Meeting 2.13.2018
- Subregional RTEP Committee - Western Meeting 2.14.2018
- Summer-Only Demand Response Senior Task Force Meeting 2.14.2018

Upcoming Training
- Operational Data Maps
  - Data Viewer Guest
  - Data Directory
- Emergency Procedures
- Center Highway
  - Manuals Filings
  - Careers Issue
  - Tracking
  - Agreements Communication
Primary Reserve Alert

**PJM Actions:**
- Notifications to PJM management and member companies
  - States the amount of estimated operating reserve capacity and the requirement
- Reports significant changes in estimated operating reserve capacity

**Member Actions:**
- Notifications
  - Management
  - All stations
  - Key Personnel
- Review plans to determine if any maintenance or testing, scheduled or being performed, on any generating equipment or critical monitoring, control, or bulk power transmission facility can be deferred or cancelled
- Inform PJM of any environmentally restricted units considering the need to obtain a temporary variance from environmental regulators for specific generators to assist in preventing load shed
Voltage Reduction Alert

• Purpose
  – To alert members that a voltage reduction action may be required in a future critical period

• Trigger
  – When the estimated operating reserve capacity is less than the forecasted synchronized reserve requirement
**Voltage Reduction Alert**

**PJM Actions:**
- Notifications to PJM management and member companies
  - Stating the amount of estimated operating reserve capacity and the requirement
  - Advise members that a possibility exists that a voltage reduction will be issued and the estimated hour of implementation

**Member Actions:**
- Notifications
  - Management
  - All stations
  - Key Personnel
- Take any necessary steps to expedite implementation of voltage reduction, should one become necessary (Transmission Owner Dispatch/LSEs)
- SOS members/PJM Management consider the issuing of Public Appeals
- PJM marketers proceed on heightened awareness regarding potential need for Emergency Energy purchases
• There are 3 Capacity Emergency Warnings:

1. Primary Reserve Warning

2. Voltage Reduction Warning & Reduction of Non-Critical Plant Load

3. Manual Load Dump Warning
During periods of reserve deficiencies, other measures must be taken to maintain system reliability including:

- Loading generation that is restricted for reasons other than cost
- Recalling non-capacity backed off-system sales
- Purchasing emergency energy from participants / surrounding pools
- Load relief measures

Due to system conditions and the time required to obtain results, PJM dispatchers may find it necessary to vary the order of application to achieve the best overall system reliability.
Capacity Shortages – Warnings

• Actions taken prior to entering into capacity related
  Emergency Procedures:
  – Review weather projections, load forecasts, reserve projections and generation performance
  – Ensure LMPs are reflective of system conditions
  – Curtail all non-Firm exports (issue EEA1 if not already done)
  – Dispatch may elect to implement an interchange cap to stabilize the amount of interchange during peak hours to protect against volatility
Primary Reserve Warning

- **Purpose**
  - Warning that available Primary reserves are less than required Primary Reserve Requirement and present operations are becoming critical.

- **Trigger**
  - Primary Reserve is less than Primary Reserve Requirement but greater than Synchronized Reserve Requirement.

Diagram:
- Synchronous Reserves
- Nonsynchronous Reserves
- Operating Reserves

- 0 – 10 Min
- 10 – 30 Min

- Primary
- Secondary

- MW

- 150% of largest single contingency
- 100% of largest single contingency
**Primary Reserve Warning**

**PJM Actions:**
- State amount of adjusted primary reserve capacity and the requirement
- Assure all available equipment is scheduled and requested secondary reserve brought to primary reserve status
- Ensures applicable deferrable maintenance has been halted
- Notifies PJM public information personnel

**Member Actions:**
- Notifications
  - Management
  - All stations
  - Key Personnel
- Ensure all deferrable maintenance or testing affecting capacity or critical transmission is halted
- Prepare to load primary reserve, if required
- Inform PJM of any environmentally restricted units
  - If needed, obtain temporary variance to run those generators
- PJM Marketers remain aware regarding the potential need for Emergency Energy Purchases

One of the procedures that triggers a Performance Assessment Interval
A Capacity Performance Assessment occurs when one of eleven specific emergency procedures are initiated by PJM system operators. PJM calculates (after-the-fact) the actual performance of capacity resources evaluating real-time production versus their UCAP position, results in bonus payments or penalty charges.

“How well you’re doing versus what you’re committed to do?”

The interval means this assessment occurs every 5 minutes during the assessment period.
Voltage Reduction Warning

Purpose

Warning that available Synchronized Reserves are less than required and present operations may require a voltage reduction. All secondary and primary reserve* is brought to a Synchronized Reserve status and emergency operating capacity is scheduled from adjacent systems.

*Excludes Max Emerg Capacity

Trigger

- Synchronized Reserves are less than the Synchronized Reserve Requirement and present operations may require a voltage reduction.

100% of largest single contingency

Primary

Secondary

MW

Synchronous Reserves

Nonsynchronous Reserves

Operating Reserves*

0 - 10 Min

10 - 30 Min
Voltage Reduction Warning

**PJM Actions:**

- State amount of adjusted synchronized reserve capacity and the requirement
- Notification to Department of Energy (DOE)
- Notifies PJM public information personnel
- All secondary and primary reserve* is brought to a synchronized reserve status and emergency operating capacity is scheduled from adjacent systems

* Excludes restricted Max Emergency Capacity

**Member Actions:**

- Notifications
  - Management
  - All stations
  - Key Personnel
  - Applicable Government Agencies
- Prepare for implementation of Voltage Reduction Action
- Order all generating stations to curtail non-essential station light & power
  - Non-Critical Plant Load is considered anything that is not needed to produce MWs and MVARs on the system
- PJM Marketers remain on a heightened awareness of the potential need for emergency energy purchases
- CSPs – Possible Load Management Action
Curtailment of Non-Essential Building Load

Purpose:
Provide additional relief, to be expedited prior to, or at the same time as the Voltage Reduction Action

Trigger:
In anticipation or activation of Voltage Reduction Action
Requirements

Curtailment of Non-Essential Building Load

**PJM Actions:**
- Notification to PJM Management, PJM public information personnel, and member companies
- Advise members to utilize public appeals to conserve energy
- Issue the request to curtail non-essential building load
- Notify outside systems through the RCIS

**Member Actions:**
- Notification to member company management
- Notification of government agencies (TO’s)
- Consider the use of public appeals to conserve energy
- Switch off all non-essential light and power in company-owned commercial, operations, and administration offices (Transmission and Generation)

**Non-Critical Plant Load**
- Lighting
- Heating
- Air Conditioner
- Boom Box

**Critical Plant Load**
- Feed Water Heaters
- Feed Water Pumps
- Induction fans
Manual Load Dump Warning & Curtailment of non-essential building load

**Manual Load Dump Warning**

**Purpose:**

Warn Member Companies of increasingly critical system conditions that may require manually dumping load

**Trigger:**

When the Primary Reserve is less than the largest operating generating unit, or the loss of a transmission facility jeopardizes reliability after all possible measures have been taken to increase reserves
Manual Load Dump Warning

**PJM Actions:**
- Issue the warning to members and PJM Management, stating the estimated amount of load relief needed
- Notification to PJM public information personnel
- Notification to include the FERC Division of Reliability
- Establish an awareness with the appropriate Transmission Operators of the need for action with minimum delay
- Examine EHV bus voltages

**Member Actions:**
- Notification to member management
- Notification to government agencies
- Advise all station and key personnel
- Review local procedures and prepare to dump load in the amount requested
- Reinforce internal communications so that load dumping can occur with a minimum delay
- Marketers remain on a heightened awareness of the potential need for Emergency Energy Purchases
Actions
Pre-Emergency Load Management Reduction Action

Purpose:

To provide additional load relief by using PJM controllable load management programs (Relief is expected to be required after initiating Maximum Emergency Generation)

- Applies to any site registered in the PJM Demand Response Program as a Demand Resource (a.k.a. DR) type that needs 30, 60 or 120 minute lead time to make its reductions

- Reductions are mandatory when dispatched during the product availability window

- Minimum dispatch duration is 1 hour
Pre-Emergency Load Management Reductions

**PJM Actions:**

- Notifications to PJM management, public information personnel, and member companies.
- Advises Members to use public appeals for conserving electricity usage.
- PJM dispatch notifies other Control Areas through the RCIS system.
- Via DR Hub and Emergency Procedures website, PJM will post detailed instructions to the Curtailment Service Providers (CSP) to implement:
  - Dispatch 30, 60, and/or 120 minute Pre-Emergency Load Management Reductions (Long Lead Time).
- Via the RCIS, PJM issues a NERC Energy Emergency Alert Level 2.

**Member Actions:**

- Member Curtailment Service Providers implement load reductions as requested by PJM.
Emergency Load Management Reduction Action

Purpose:

To provide additional load relief by using PJM controllable load management programs (Relief is expected to be required after initiating Maximum Emergency Generation)

- Applies to any site registered in the PJM Demand Response Program as a Demand Resource (a.k.a. DR) type that needs 30, 60 or 120 minute lead time to make its reductions
- Reductions are mandatory when dispatched during the product availability window
- Minimum dispatch duration is 1 hour
Emergency Load Management Reductions

**PJM Actions:**
- Notifications to PJM management, public information personnel, and member companies
- Advises Members to use public appeals for conserving electricity usage
- PJM dispatch notifies other Control Areas through the RCIS system
- Via DR Hub and Emergency Procedures website, PJM will post detailed instructions to the Curtailment Service Providers (CSP) to implement dispatch 30, 60 or 120 minute Emergency Load Management Reductions
- Via the RCIS, PJM issues a NERC Energy Emergency Alert Level 2

**Member Actions:**
- Member Curtailment Service Providers implement load reductions as requested by PJM
- Member dispatchers notify management of the emergency procedure and that they should consider the use of public appeals to conserve electricity usage
- Member dispatchers notify governmental agencies, as applicable
Maximum Generation Emergency Action

Purpose:
To increase generation above the maximum economic level

Trigger:
Real-time Generation is needed to meet the load demand that is greater than the highest incremental cost level
Maximum Generation Emergency Action

**PJM Actions:**

- Issue the Maximum Emergency Generation Action
- Notify PJM management, PJM public information personnel, and member dispatchers
- Implements the Emergency Bid Process, requesting bids by posting messages to selected PJM websites, RCIS, and contacting neighboring Control Areas
- Suspend regulation on all resources except for hydroelectric

Maximum Generation Emergency Action

**PJM Actions:**

- Recalls off-system capacity sales from network resources,
  
  PJM dispatch will:
  
  - Determine any limiting transmission constraints internal to PJM that would impact the ability to cut transactions to a specific interface
  - Identify off-system capacity sales associated with the identified interfaces
  - Contact the sink Balancing Authority to determine the impact of transaction curtailment
Maximum Generation Emergency

**PJM Actions:**

- Recalls off-system capacity sales from network resources, if the net result of cutting off-system capacity sales would:
  - Put the sink Balancing Authority into load shed then PJM will not curtail the transactions unless it would prevent load shedding within PJM
  - Put PJM in a more severe capacity emergency than it is in currently in
    - Due to reciprocal transaction curtailments from the sink Balancing Authority
    - PJM will not initiate curtailing the transactions

Maximum Generation Emergency

**PJM Actions:**

- Declare Maximum Emergency Generation and begins to load Maximum Emergency or start purchases of Emergency Energy bids, based on economics and availability
  - The PJM Member is responsible for delivering (i.e., securing all transmission service) of the energy to one of PJM’s borders with a neighboring control area
  - Loads Maximum Emergency Generation incrementally as required
  - Max Emergency CT’s are loaded prior to Max Emergency Steam in order to preserve synchronized reserve
Maximum Generation Emergency

**Member Actions:**

- Notify member company management
- Recall off-system capacity sales that are recallable
- Suspend regulation, as requested, and load all units to the Maximum Emergency Generation level, as assigned
- Notify PJM of any Maximum Emergency Generation that was loaded prior to PJM requesting Maximum Emergency Generation be loaded
Purpose:

Request end-use customers who participate in the Emergency Voluntary Energy Only Demand Response program to reduce load during emergency conditions.

Trigger:

Additional load relief is still needed.

Program criteria:

Any site registered in the PJM Demand Response Program as an emergency energy only resource. Reductions are strictly voluntary.
Emergency Voluntary Energy Only Demand Response Reductions

PJM Actions:
- Issues action via the ALL-CALL and posts message on website
- Notifies PJM management, PJM public information personnel, and PJM Markets personnel
- Have Curtailment Service Providers with Demand Resources reduce load

Member Actions:
- Notify management of the emergency procedure
Deploy All Resources Action

Purpose:

To instruct members that all generation resources are needed online and at full output, and All demand resources are to be reduced immediately upon receipt of dispatch instruction

Trigger:

When unplanned events such as the loss of a transmission or generating facility have resulted in reliable operations being jeopardized
Deploy All Resources

**PJM Actions:**

- Suspend all reserve assignments and regulation assignments
- Dispatch Load Management via DR Hub
- Recall any external capacity
- Issue a NERC Energy Emergency Alert Level 2 via the RCIS
- Notify PJM Management, PJM public information personnel, and Member Companies

**Member TO Actions:**

- Notify management of emergency procedures and consider use of public appeals for energy conservation
- Notify applicable government agencies
- Member CSPs with load management reduce load immediately when dispatched
Deploy All Resources

**PJM Actions:**
- Suspend all reserve assignments and regulation assignments
- Dispatch Load Management via DR Hub
- Recall any external capacity
- Issue a NERC Energy Emergency Alert Level 2 via the RCIS
- Notify PJM Management, PJM public information personnel, and Member Companies

**Member GO Actions:**
- Unless PJM instructs otherwise
  - Raise ALL available on-line generation and ramp to full output
  - Start off-line generation and ramp to full output
  - Notify management of emergency procedures and consider use of public appeals for energy conservation
  - Notify applicable government agencies
Voltage Reduction Action

Purpose:
To reduce voltage on the distribution system in order to reduce demand
Provide a sufficient amount of reserve to maintain tie flow schedules and preserve limited energy sources

Trigger:
Load relief still needed to maintain ties

Voltage Reduction:
Voltage is reduced at distribution levels by 2.5% to 5% of nominal values depending on the area
Produces a 2-3% decrease in system load increasing transmission voltages
Generally not being noticed by customers (lights dimmer, slower heating)
**Voltage Reduction Action**

**PJM Actions:**

- Notification to PJM Management, PJM public information personnel, and member companies
- Advise members to use public appeals for conservation of energy
- Notification to the Department of Energy
- Investigates loading of shared reserves with neighboring systems prior to a voltage reduction action
- PJM dispatch issues a NERC Energy Emergency Alert Level 2
- Issues the order for a 2.5% to 5% voltage reduction
- Initiates Shortage Pricing if the region where the voltage reduction action has been initiated corresponds with an entire Synchronized Reserve Zone or Sub-Zone

**Member Actions:**

- Notification of member company management
- Notification of government agencies
- Consider the use of public appeals to conserve energy
- Take steps to implement a voltage reduction (TO’s/LSE’s)
- Unless PJM requests a manual adjustment, the Generator must maintain the facility's automatic voltage regulator(s) in service during an Emergency
Purpose:

The Manual Load Dump Action is an Operating Instruction from PJM Issued to shed firm load - providing relief when all other possible means of supplying internal load have been exhausted to prevent a catastrophe within PJM or to maintain tie schedules so as not to jeopardize the reliability of other interconnected regions.

Trigger:

When the PJM RTO cannot provide adequate capacity

Meet the PJM RTO’s load and tie schedules, or

Critically overloaded transmission lines or equipment cannot be relieved in any other way.
Manual Load Dump Action

**PJM Actions:**

- Verify that separations have not occurred and that load dumping is desirable on the system being controlled
- Instruct members to suspend all remaining regulation
- Determine which Control Zone(s) are capacity deficient and the relative proportion of deficiency
- Estimate the total amount of load to be dumped and order appropriate members to dump load according to EMS calculations
- Notification to PJM Management, PJM public information personnel, and member companies
- Advise members to consider the use of public appeals to conserve energy
- Notification to other Control Areas through the RCIS

**Note:**

- If a partial restoration of the load dumped is requested by PJM, confirmation of restored load by each member must be made prior to any further load restoration
- If UFLS is insufficient to return frequency to acceptable ranges, PJM will dump sufficient load to restore system frequency
Manual Load Dump Action

**Member Actions:**

- Suspend regulation, as required, prior to load dump
- Notification member company management of the procedure
- Notification of government agencies
- Consider the use of public appeals to conserve energy
- Promptly dump load equal to or in excess of the company’s allotment of load dump
- Maintain the requested amount of load relief until the load dump order is cancelled by PJM
- Load dump plan should consider/recognize priority/critical load
- Report amount of load curtailed/restored upon implementation

Manual Load Dump Action

**The Process:**

- Process described here pertains only to capacity deficient situations
- For transmission constraints or voltage problems, load dump will be ordered in areas where it is most effective
- If Mid-Atlantic region is deemed deficient, total load shed must be further broken down by Manual Load Dump Allocation Tables
  - Manual M-13, Attachment E
- Manual Load Dump last utilized in PJM on January 19, 1994
## Attachment E: Manual Load Dump Allocation Tables

### Winter/Summer Required Manual Load Dump PJM Mid-Atlantic Region

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<th>MW</th>
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<td>724</td>
<td>601</td>
<td>16</td>
<td>599</td>
<td>1011</td>
<td>70</td>
<td>212</td>
<td>13</td>
<td>249</td>
<td>59</td>
<td>21</td>
<td>13</td>
<td>5</td>
<td>3</td>
<td>35</td>
</tr>
</tbody>
</table>

### Manual Load Dump Allocation - PJM Mid-Atlantic Region

When issuing a manual Load Dump via All Call, the PJM Dispatcher will include the following information in the message:

1. Area (PJM Mid-Atlantic Region or a zone / company)
2. Total megawatts (refer to appropriate tables for allocation)
3. Allocation table to be used
4. Transmission Zone allocations will be handled separately based on PJM EMS capacity calculations

Allocation percentages are based on 2016 summer but applicable to both 2016 summer and 2016/2017 Winter Load conditions

### Exhibit 9: Manual Load Dump Allocation Tables

PJM Manual Load Dump Capability by company is located in [Manual 13: Attachment E](#).
Questions?

PJM Client Management & Services
Telephone: (610) 666-8980
Toll Free Telephone: (866) 400-8980
Website: www.pjm.com

The Member Community is PJM’s self-service portal for members to search for answers to their questions or to track and/or open cases with Client Management & Services.
Resources & References