



PJM Capacity Emergencies

PJM State & Member Training Dept.



Objectives

Students will be able to:

- Identify the process and requirements for operating during capacity emergencies

Capacity Emergencies

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



Alerts

Capacity Shortage Alerts

- Alerts are issued in advance (Day-ahead) of a scheduled load period
 - Allows sufficient time to prepare for anticipated capacity shortages
- The intent of the alert is to keep all affected system personnel aware of the forecast and/or actual status of the PJM RTO
- Four capacity shortage alerts:
 - Unit Startup Notification Alert
 - Maximum Emergency Generation Alert
 - Primary Reserve Alert
 - Voltage Reduction Alert

Capacity Shortages - Alerts



Unit Startup 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

Capacity Shortages - Alerts

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 hoursOR
 - 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

Capacity Shortages - Alerts

Unit Startup Notification Alert

- **Member Actions**
 - Report Unit capabilities correctly
 - eMKT “time to start” maximum is 6 days
 - After reaching a “state of readiness”, if the unit fails to come online with 48 hours after being called by PJM, the unit will be considered on a forced outage unit it comes online, or PJM cancels the alert
 - Once a unit is scheduled, its offer price is locked for the operating day

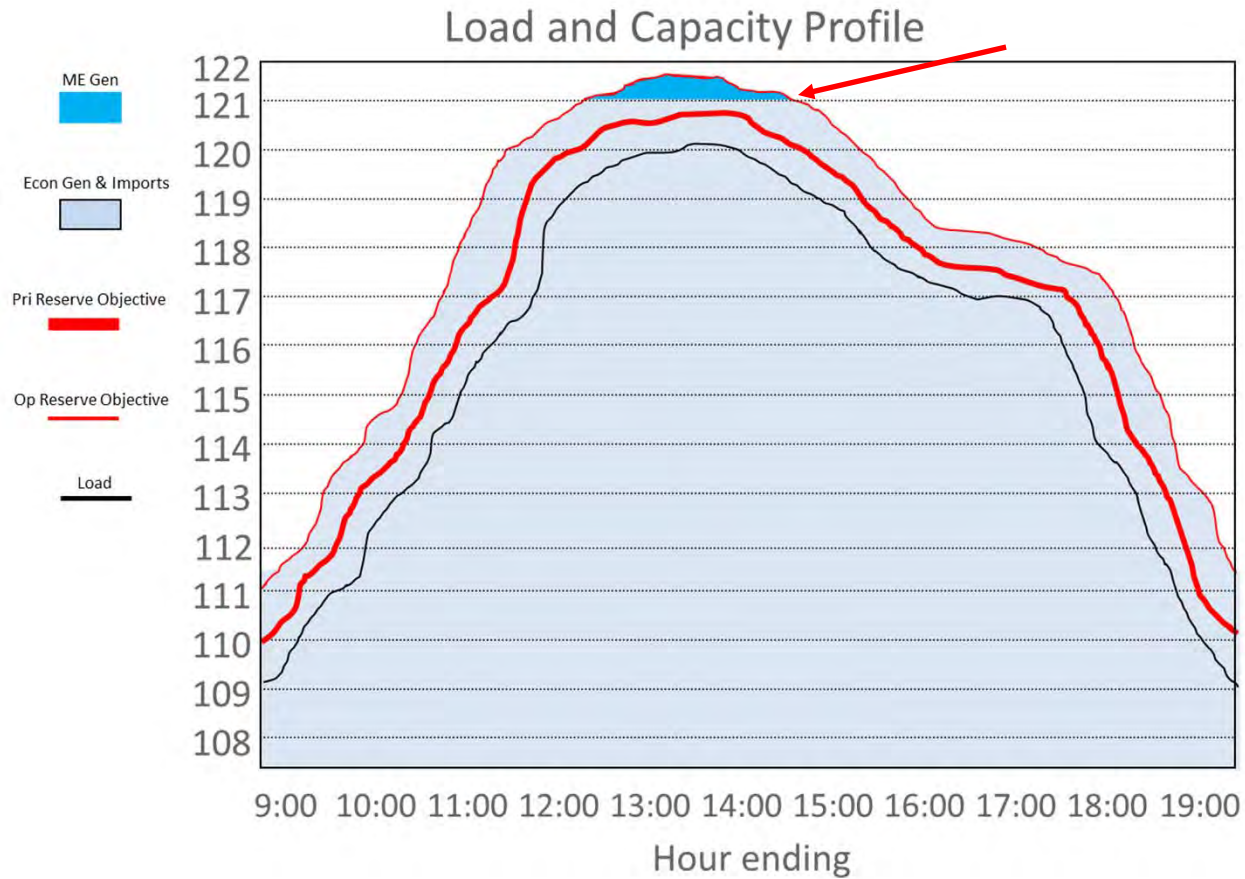
Capacity Shortages - Alerts



Maximum Emergency Generation Alert

- Purpose
 - To provide an early alert that PJM Emergency Procedures may be required
- Trigger
 - When Maximum Emergency Generation is called into the operating capacity
 - Operating Reserve Requirement is greater than scheduled Operating Reserve

Estimated Operating Reserve Less than Operating Reserve Objective



Capacity Shortages - Alerts

Maximum Emergency Generation Alert

- **PJM Actions**
 - Notifications to PJM management and member companies
 - States the amount of estimated operating reserve and the requirement
 - Issue NERC EA Level 1
 - Performs a situation analysis and prepares projections for that day and future periods
 - Capacity
 - Load
 - Interchange
 - Reserve

Capacity Shortages - Alerts

Maximum Emergency Generation Alert

- **PJM Actions**
 - 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

Capacity Shortages - Alerts

Maximum Emergency Generation Alert

- **Member Actions**
 - Notifications
 - Management, generating stations, key personnel
 - Review plans to determine if any maintenance or testing of equipment can be deferred or halted
 - Suspend any high risk testing of generating or transmission equipment
 - Report any fuel/environmental limitations

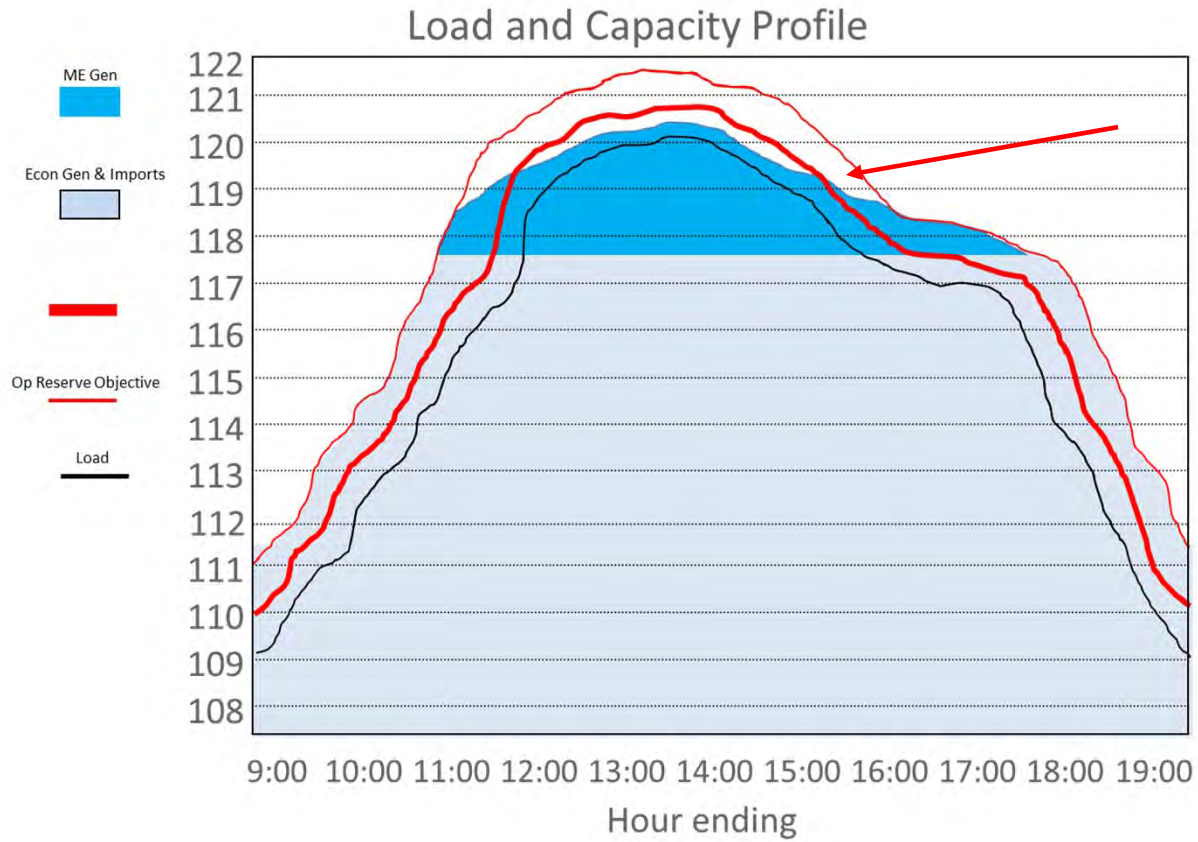
Capacity Shortages - Alerts



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

Estimated Operating Reserve Less than Primary Reserve Requirement



Capacity Shortages - Alerts

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
 - Considers the need to obtain a temporary variance from environmental regulators for specific generators to assist in preventing load shed

Capacity Shortages - Alerts

Primary Reserve Alert

- Member Actions
 - Notifications
 - Management, generating stations, key personnel
 - Review plans to determine if any maintenance or testing can be deferred or halted

Capacity Shortages - Alerts



Voltage Reduction Alert

- Purpose
 - To alert members that a voltage reduction may be required in a future critical period
- Trigger
 - When the estimated operating reserve capacity is less than the forecasted synchronized reserve requirement

Capacity Shortages - Alerts

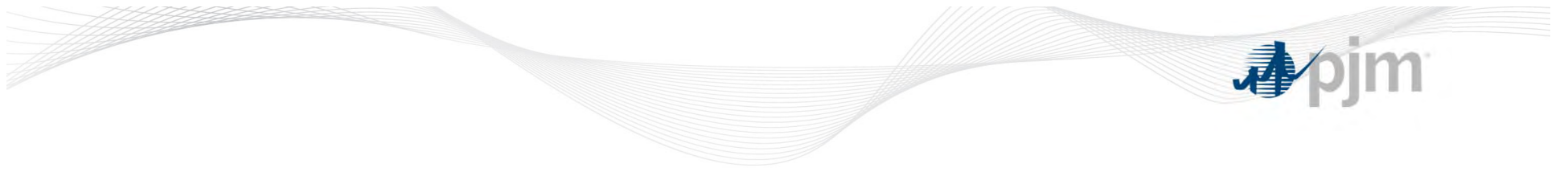
Voltage Reduction Alert

- **PJM Actions**
 - Notifications to PJM management and member companies
 - Advise members the estimated hour of implementation

Capacity Shortages - Alerts

Voltage Reduction Alert

- Member Actions
 - Notifications
 - Management, generating stations, key personnel
 - Take any necessary steps to expedite implementation of voltage reduction, should one become necessary (Transmission Owner Dispatch/LSEs)
 - SOS members consider issuance of Public Appeals
 - PJM marketers proceed on heightened awareness regarding potential need for Emergency Energy purchases

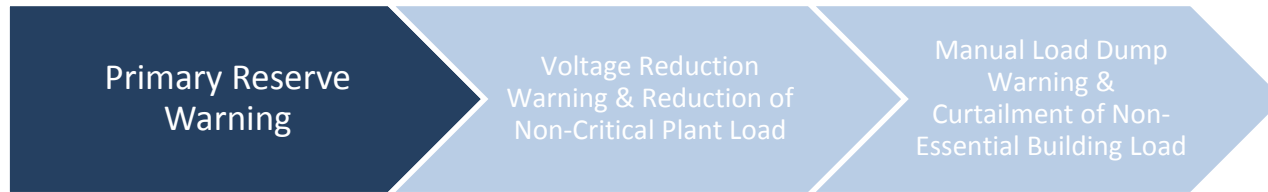


Warnings

Capacity Shortages - Warnings

- There are three Capacity Emergency Warnings:
 - Primary Reserve Warning
 - Voltage Reduction Warning & Reduction of Non-Critical Plant Load
 - Manual Load Dump Warning

Capacity Shortages - Warnings



Primary Reserve Warning

- Purpose
 - Warns members that available primary reserve is less than the required amount
- Trigger
 - Issued when the Primary Reserve is less than the Primary Reserve requirement but greater than the Synchronized Reserve requirement
 - All supplemental reserve (except MW's in Max Emergency) is first moved to primary reserve status

Capacity Shortages - Warnings

Primary Reserve Warning

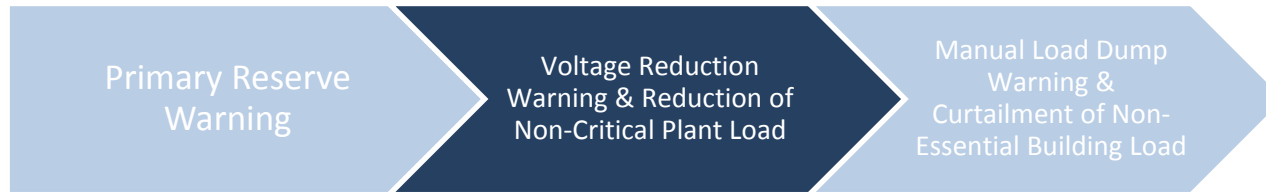
- **PJM Actions:**
 - Issues a warning to members and PJM management stating the amount of adjusted primary reserve capacity and the requirement
 - Notifies PJM public information personnel
 - Assure that all available equipment is scheduled and requested supplemental reserve has been brought into the primary reserve
 - Ensures all deferrable maintenance or testing on the communications and control systems has halted
 - Obtain a temporary variance from environmental regulators for specific generators to assist in preventing load shedding
 - Cancel warning when appropriate

Capacity Shortages - Warnings

Primary Reserve Warning

- PJM Member Actions:
 - Notify management
 - Advise all stations and key personnel
 - Prepare to load primary reserve, if required
 - Ensure all deferrable maintenance or testing affecting capacity or critical transmission is halted
 - PJM Marketers remain on a heightened awareness regarding PJM conditions and the potential need for Emergency Energy Purchases

Capacity Shortages - Warnings



Voltage Reduction Warning/Reduction of Non-Critical Plant load

- Purpose
 - To inform the Member Companies that Synchronized Reserve is less than required and present operations may require a voltage reduction
- Trigger
 - When actual Synchronized Reserve is less than the Synchronized Reserve Requirement
 - All secondary and primary reserve (except MW's in Max Emergency) are first moved to Synchronized Reserve status

Capacity Shortages - Warnings

Voltage Reduction Warning/Reduction of Non-Critical Plant load

- **PJM Actions:**
 - Issues the warning to members and PJM management stating the amount of adjusted synchronized reserve capacity and the requirement
 - Notification of PJM public information personnel
 - Notification of the Department of Energy
 - Cancels the warning, when appropriate

Capacity Shortages - Warnings

Voltage Reduction Warning/Reduction of Non-Critical Plant load

- **PJM Member Actions:**
 - Notification to member company management
 - Notification to government agencies
 - Advise all stations and key personnel
 - Order all generating stations to curtail non-essential station light and power
 - Prepare for implementation of a Voltage Reduction Action
 - Be aware of the potential to implement load management programs
 - Awareness of need for Emergency Energy Purchases

Non-Critical Plant Load

What is Non-Critical Plant Load?

- Non-Critical Plant Load is load that is not required to operate the generator and its essential equipment (relays, pumps, etc.)
- Non-Critical Plant Load is considered anything that is not needed to produce MWs and MVARs on the system

Non-Critical Plant Load

Examples

<i>Non-Critical Plant Load</i>	<i>Critical Plant Load</i>
Lighting	Feed Water Heaters
Heating	Feed Water Pumps
Air Conditioner	Induction Fans

Capacity Shortages - Warnings

Curtailment of Non-Essential Building Load

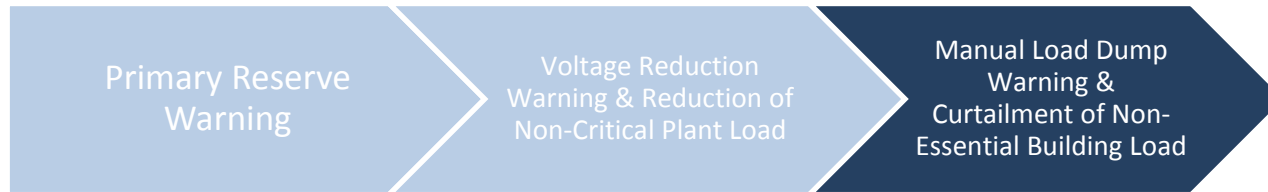
- Purpose:
 - The purpose is to provide additional relief, to be expedited the same time as the Manual Load Dump Warning
- **PJM Actions:**
 - Notification to PJM Management, PJM public information personnel, and member companies
 - Advise members to utilize public appeals to conserve energy
 - Issue the request to curtail non-essential building load
 - Cancel the request, when appropriate

Capacity Shortages - Warnings

Curtailement of Non-Essential Bldg Load

- **Member Actions:**
 - Notification of member company management
 - Notification of government agencies
 - 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

Capacity Shortages - Warnings



Manual Load Dump Warning

- Purpose
 - To warn Member Companies of increasingly critical system conditions that may require manually dumping load
- Trigger
 - When the Primary Reserve is less than the largest generating unit or the loss of a transmission facility jeopardizes reliability after all possible measures have been taken to increase reserves

Capacity Shortages - Warnings

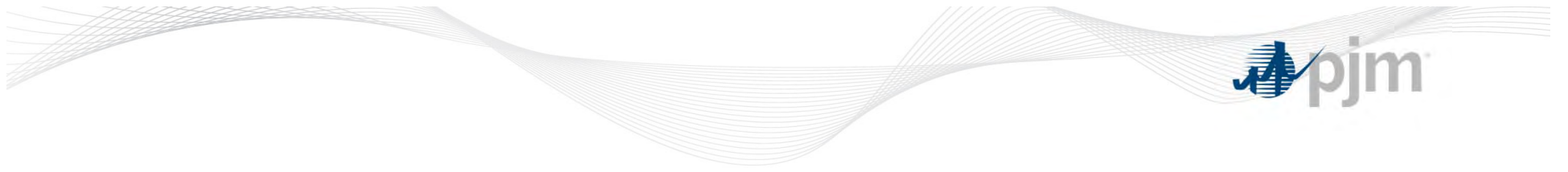
Manual Load Dump Warning

- **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 Transmission Operators of the need for action with minimum delay
 - Examine EHV bus voltages

Capacity Shortages - Warnings

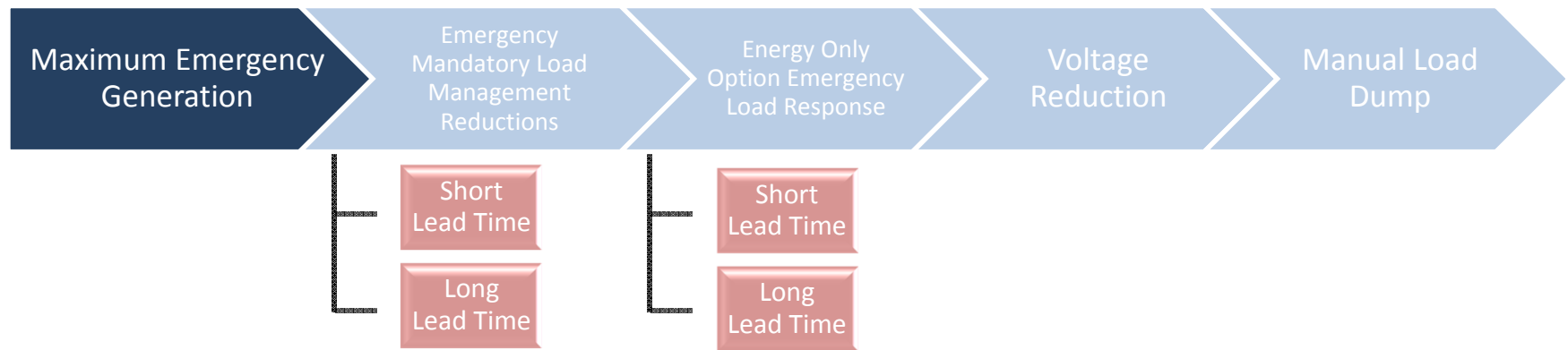
Manual Load Dump Warning

- PJM 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

Capacity Shortages - Actions

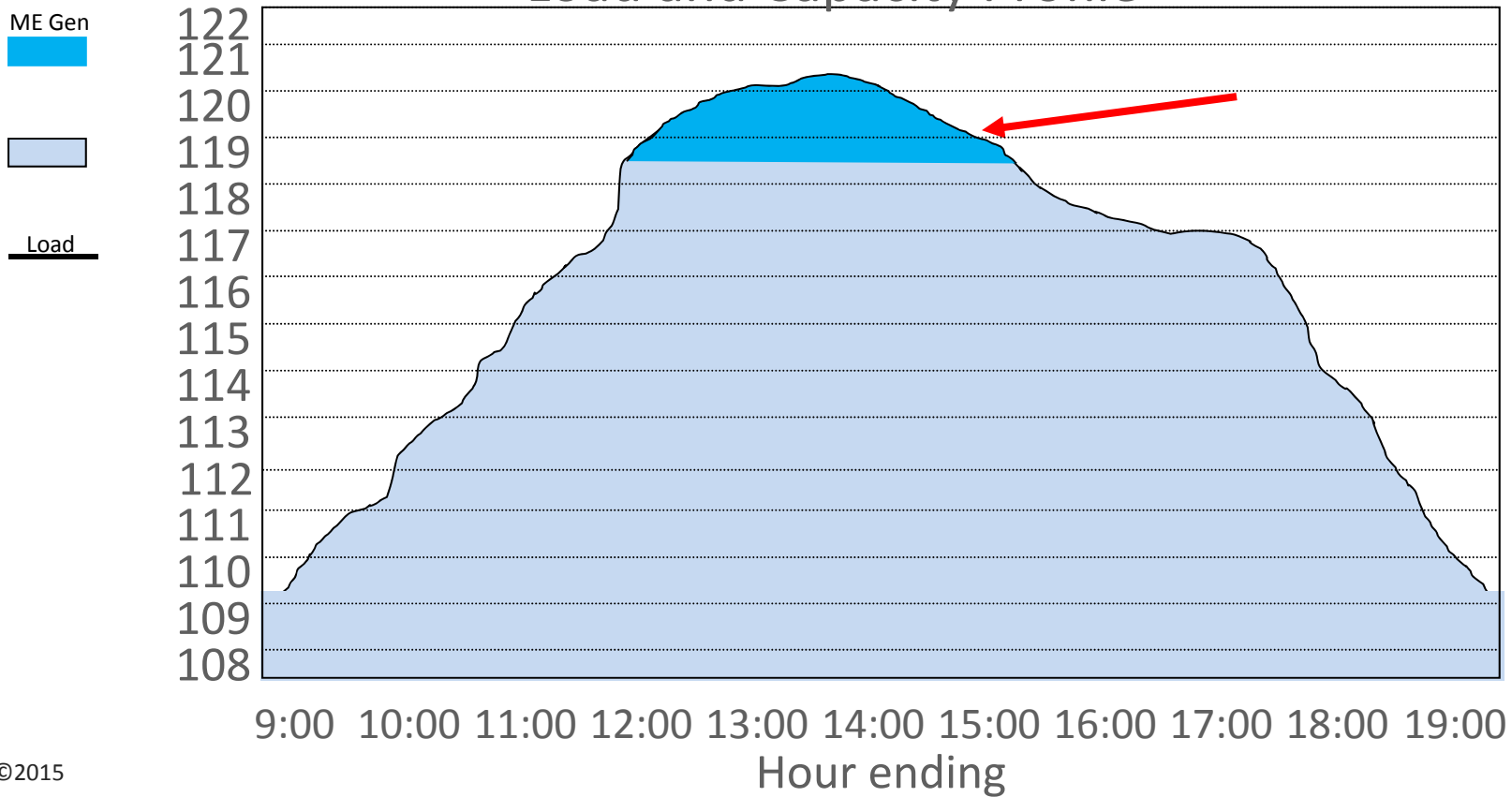


Maximum Emergency Generation

- 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

Load Exceeds Maximum Economic Generation Levels

Load and Capacity Profile



Capacity Shortages - Actions

Maximum Emergency Generation

- **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 web-sites, RCIS, and contacting neighboring Control Areas
 - Suspend regulation on all resources except for hydroelectric
 - Recalls off-system capacity sales from network resources

Capacity Shortages - Actions

Maximum Emergency Generation

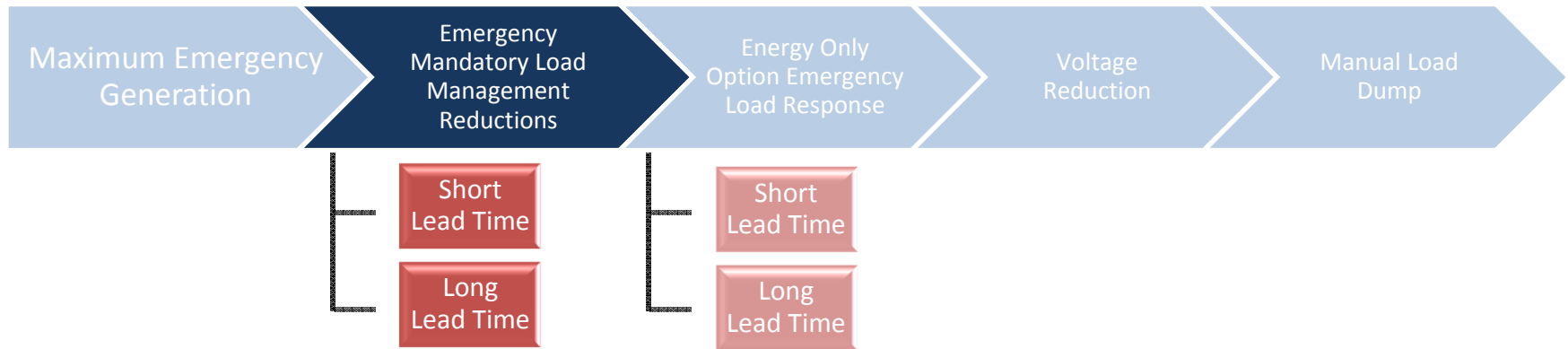
- **PJM Actions:**
 - Declares Maximum Emergency Generation and begins to load Maximum Emergency or start purchases of Emergency Energy bids based on economics and availability
 - Loads Maximum Emergency Generation incrementally as required (Max Emergency CT's are loaded prior to Max Emergency Steam in order to preserve synchronized reserve)

Capacity Shortages - Actions

Maximum Emergency Generation

- **Member Actions:**
 - Notify 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

Capacity Shortages - Actions



Emergency Mandatory Load Management Reductions

- Applies to any site registered in the PJM Demand Response Program as a:
 - Capacity resource of interruptible load for reliability
 - Demand resource of interruptible load for reliability
- Issued to provide additional load relief using controllable load management programs (Load relief is expected to be issued after initiating Maximum Emergency Generation)
- Participating customers receive capacity credits and/or reduced retail rates for reducing load during emergencies
- PJM and/or Transmission Operator controlled and directed

Capacity Shortages - Actions

Emergency Mandatory Load Management Reductions

- PJM recognizes three types of Load Management:
 - Direct Load Control (DLC) – Load management which is initiated directly by the LSE’s market operations center, employing a communication signal to cycle equipment
 - Firm Service Level (FSL) – Load management achieved by a customer reducing its load to a pre-determined level (the Firm Service Level), upon notification from the LSE’s market operations center
 - Guaranteed Load Drop (GLD) - Load management achieved by a customer reducing its load by a pre-determined amount (the guaranteed load drop), upon notification from the LSE’s market operations center

Capacity Shortages - Actions

Emergency Mandatory Load Management Reductions

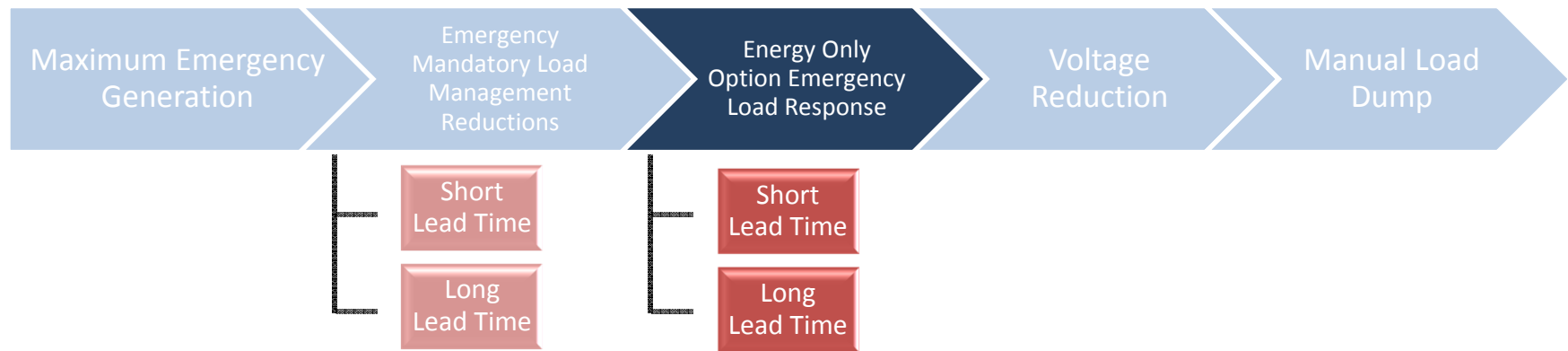
- **PJM Actions:**
 - Notifications to PJM management, public information personnel, and member companies
 - Use of public appeals to conserve electricity usage
 - Via the PJM All-Call, PJM requests Curtailment Service Providers to implement curtailment procedures
 - Via the RCIS, PJM issues a NERC Energy Emergency Alert Level 2

Capacity Shortages - Actions

Emergency Mandatory Load Management Reductions

- **PJM Actions:**
 - Member Curtailment Service Providers implement load reductions as requested by PJM
 - Notify member company management and consider the use of public appeals
 - Notify government agencies
 - Long Lead Time: curtailment achieved in 1-2 hours
 - Short Lead Time: curtailment achieved in 1 hour or less

Capacity Shortages - Actions



Energy Only Option – Emergency Load Response

- Purpose
 - To request end-use customers who participate in the Energy Only Option Emergency Load Response reduce load during emergency conditions
- Trigger
 - Additional load relief is still needed

Capacity Shortages - Actions

Energy Only Option – Emergency Load Response

- Program criteria:
 - Any site registered in the PJM Demand Response Program as an emergency energy only resource
 - Reductions are strictly **voluntary**

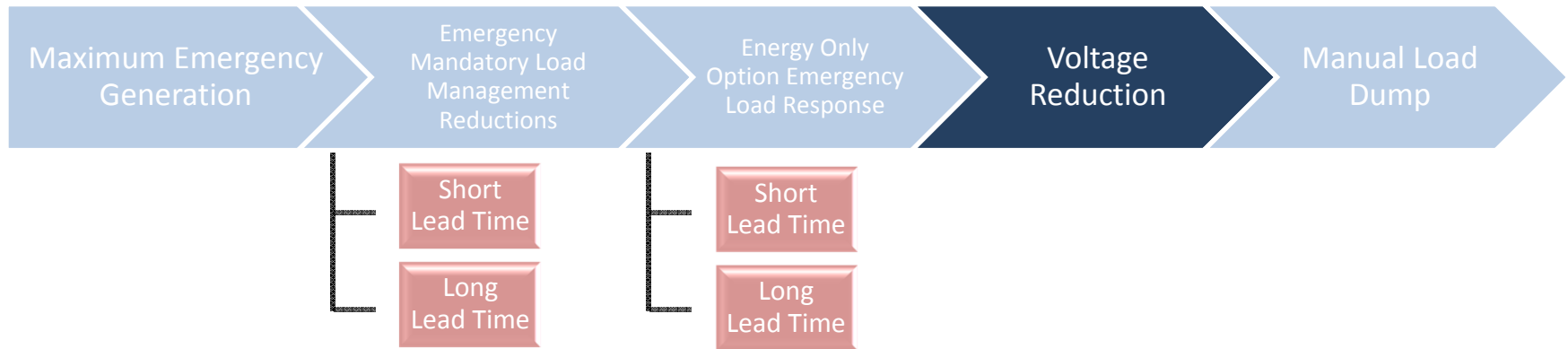
PJM Actions:

- 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

PJM Member Actions:

- Notify management of the emergency procedure

Capacity Shortages - Actions



Voltage Reduction

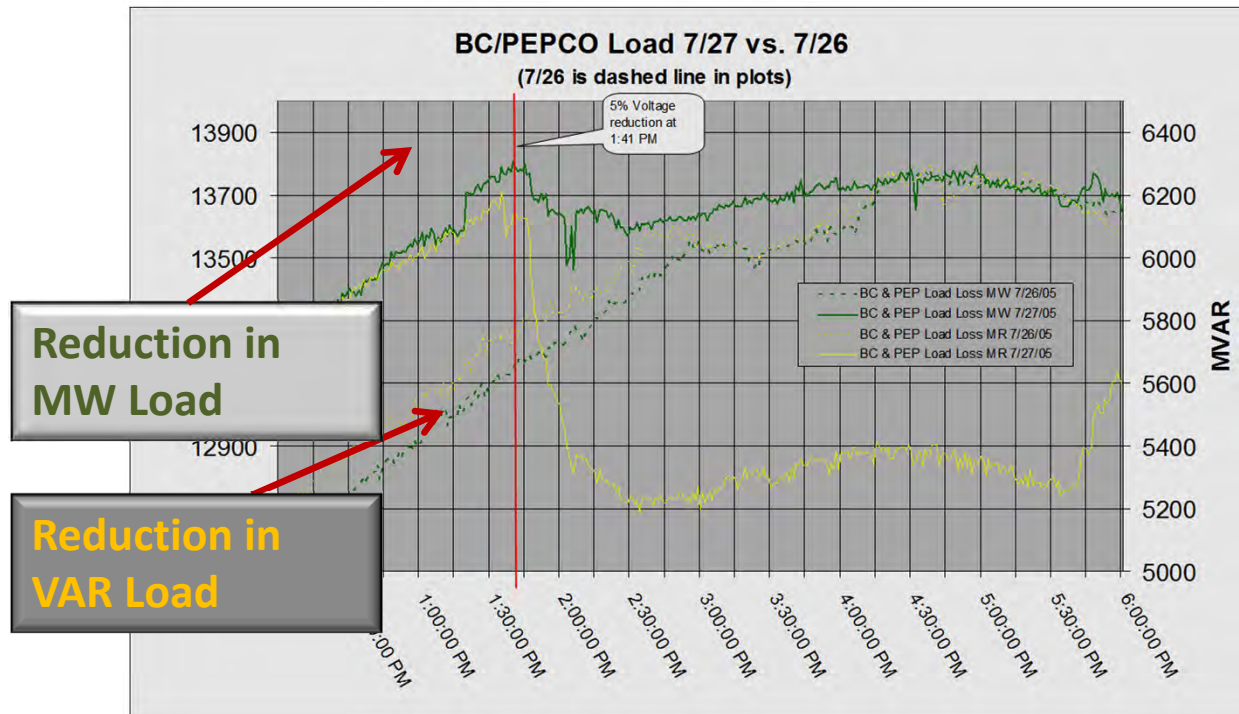
- Purpose
 - To reduce load to provide a sufficient amount of reserve to maintain tie flow schedules and preserve limited energy resources OR to increase transmission system voltages
- Trigger
 - Load relief still needed to maintain ties

Capacity Shortages - Actions

Voltage Reduction

- Voltage is reduced at distribution levels by 2.5% to 5% of nominal values depending on the area
 - **Increases** transmission voltages
- Produces a 2-3% decrease in system load
- Generally not noticed by customers
 - Lights dimmer, slower heating
 - City of Chicago limited to 2.5% voltage reduction

Effects of Voltage Reduction in BC/PEPCO in 2005



Capacity Shortages - Actions

Voltage Reduction

- **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
 - Issue a system-wide or Control Zone-specific Public Media Message H-3
 - Investigates loading of shared reserves with neighboring systems prior to a voltage reduction

Capacity Shortages - Actions

Voltage Reduction

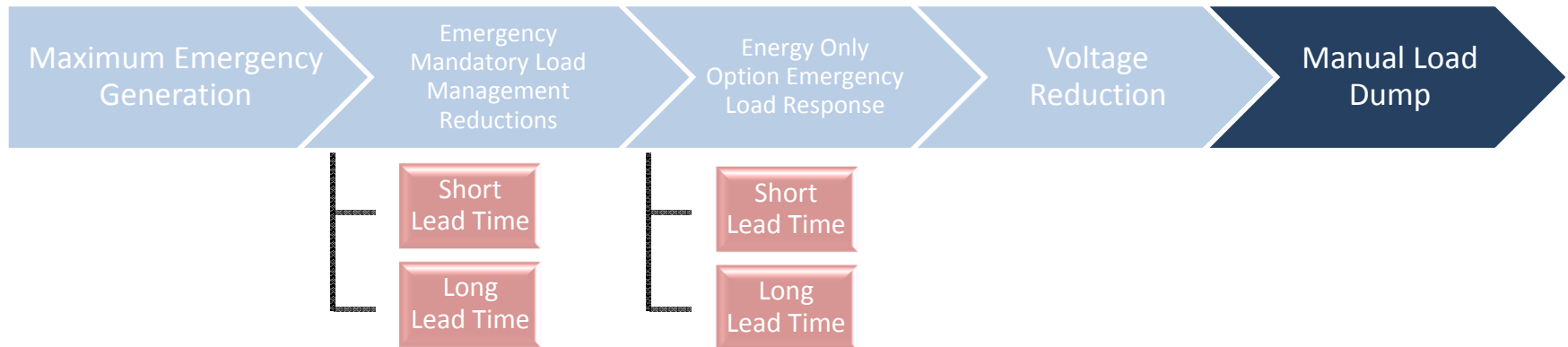
- **PJM Actions:**
 - Issues the order for a 2.5% to 5% voltage reduction
 - Issues a NERC Energy Emergency Alert Level 2 via the RCIS
 - Initiates Shortage Pricing if the region where the voltage reduction action has been initiated corresponds with an entire Synchronized Reserve Zone or Sub-Zone
 - Cancels the reduction, when appropriate

Capacity Shortages - Actions

Voltage Reduction

- PJM 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

Capacity Shortages - Actions



Manual Load Dump

- Purpose:
 - Issued to provide 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:
 - Implemented when PJM cannot provide adequate capacity to meet load or critically overloaded transmission lines or equipment cannot be relieved in any other way and/or low frequency operation occurs within a part(s) of the RTO

Capacity Shortages - Actions

Manual Load Dump

- **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
 - Order appropriate members to dump load
 - Notification to PJM Management, PJM public information personnel, and member companies

Capacity Shortages - Actions

Manual Load Dump

- **PJM Actions:**
 - Advise members to consider the use of public appeals to conserve energy
 - Notification to other Control Areas through the RCIS
 - Notifications to DOE, FEMA, and NERC offices
 - Notification to FERC via the FERC Division of Reliability's electronic pager system
 - Issue a NERC Energy Emergency Alert Level 3
 - PJM Management issues a system-wide or Control Zone specific Public/Media Notification Message H-4 (Should be issued prior to Manual Load Dump Action)

Capacity Shortages - Actions

Manual Load Dump

- **PJM Actions:**
 - Initiates Shortage Pricing if the region where the manual load dump action has been initiated corresponds with an entire Synchronized Reserve Zone or Sub-Zone
 - Cancels the action and restores required regulation, when appropriate
 - 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

Capacity Shortages - Actions

Manual Load Dump

- **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

Capacity Shortages - Actions

Manual Load Dump

- 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

Manual 13 - Attachment E

Attachment E: Manual Load Dump Allocation Tables

Winter/Summer Required Manual Load Dump PJM Mid-Atlantic Region																
MW	PS	PE	PPL Zone		BC	GPU	PEPCO ZONE		AE		DPL Zone					Rockland
			PPL	UGI			PEPCO	SMECO	AECO	Vineland	DPL	ODEC	DEMEC	Dover	Easton	
%	17.66%	14.57%	11.97%	0.32%	12.11%	19.98%	10.14%	1.35%	4.13%	0.26%	4.84%	1.19%	0.41%	0.27%	0.11%	0.70%
500	88	73	60	2	61	100	51	7	21	1	24	6	2	1	1	3
1000	177	146	120	3	121	200	101	13	41	3	48	12	4	3	1	7
1500	265	218	180	5	182	300	152	20	62	4	73	18	6	4	2	10
2000	353	291	239	6	242	400	203	27	83	5	97	24	8	5	2	14
3000	530	437	359	10	363	599	304	40	124	8	145	36	12	8	3	21
4000	707	583	479	13	484	799	406	54	165	10	194	48	16	11	4	28
5000	883	728	599	16	606	999	507	67	206	13	242	60	21	14	5	35

Manual Load Dump Allocation - PJM Mid-Atlantic Region

Winter/Summer Required Manual Load Dump Eastern Portion of PJM Mid-Atlantic Region Only													
MW	PS	PE	PL East	JC	ME East	AE		DPL Zone					Rockland
						AE	Vineland	DPL	ODEC	DEMEC	Dover	Easton	
%	30.97%	25.54%	3.15%	18.19%	1.28%	7.24%	0.45%	8.48%	2.09%	0.72%	0.47%	0.19%	1.22%
500	155	128	16	91	6	36	2	42	10	4	2	1	6
1000	310	255	31	182	13	72	4	85	21	7	5	2	12
1500	465	383	47	273	19	109	7	127	31	11	7	3	18
2000	619	511	63	364	26	145	9	170	42	14	9	4	24

Manual Load Dump Allocation - Eastern Portion of 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, Eastern Portion of 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 2012 summer but applicable to both 2012 summer and 2012/2013 Winter Load conditions

Exhibit 16: Manual Load Dump Allocation Tables

Resources & References

- PJM Manual 13: Emergency Operations, Revision 56 (2014) Linked from;
<http://www.pjm.com/~media/documents/manuals/m13.ashx>