

# Voltage Emergencies

PJM State & Member Training Dept.

# Objectives



The Student will be able to:

- Identify the process and requirements for operating during voltage emergencies

# Heavy Load, Low Voltage Conditions

- The following procedures are used to supplement other existing procedures when system loads are heavy and bulk power voltage levels are, on an anticipated or actual basis, at or approaching voltage limits.

These procedures consist of:

- Low Voltage Alert
- Heavy Load Voltage Schedule Warning
- Heavy Load Voltage Schedule Action

# Low Voltage Alert

## Purpose

- Heighten awareness, increase planning, analysis and prepare for when heavy loads and low voltages are anticipated in an upcoming operation period
  - Issued to Generation and Transmission members
    - Can be issued for the entire PJM RTO, specific Control Zone(s) or a subset of Control Zone(s)

# Low Voltage Alert

## PJM Actions

- Conduct power flow analysis of future load and transfer increases on the PJM system
  - Evaluate and plan using the analysis, to include:
    - Ensuring necessary off-cost generation is ready to respond to transfer constraints
    - Consider changing the Reactive Transfer back off limit from 50 MW to 300 MW
- Review generation and transmission outages
- Assess impacts of transfers and be prepared to curtail transactions impacting the reactive transfer limits

# Low Voltage Alert

## PJM Actions

- Using the NERC Interchange Distribution Calculator (IDC), assess the impact of parallel flows
  - Prior to dumping load, PJM will invoke the NERC Transmission Loading Relief (TLR) process to provide relief from these parallel flows
- Enhance reactive reporting from members by requesting a Reactive Reserve Check (RRC)
- Enhance communications among System Operations Subcommittee (SOS) Transmission members via SOS conference calls to discuss the status of critical equipment, voltage trends, and possible corrective actions

# Low Voltage Alert

## PJM Member Actions

- Transmission and Generation members notify their management, stations and key personnel
- Defer and maintenance or testing affecting capacity or critical transmission
- Respond to the Reactive Reserve Check by checking status and availability of all critical reactive resources

# Heavy Load Voltage Schedule Warning

## Purpose

- Issued to members to prepare for maximum support of voltages on the bulk power system
  - Can be issued for the entire PJM RTO, specific Control Zone(s) or a subset of Control Zone(s)



# Heavy Load Voltage Schedule Warning

## PJM Actions

- Issue Heavy Load Voltage Schedule Warning to members 4 hours prior to requesting actual implementation of a Heavy Load Voltage Schedule
- Request members to verify that all actions have been taken on the distribution and sub-transmission system to support voltage at the EHV level

# Heavy Load Voltage Schedule Warning

## PJM Member Actions

- Ensure, where possible, while still observing established limits
  - Underlying reactors are out of service
  - Underlying capacitors are in service
  - Transformer taps are adjusted to ensure all distribution capacitors are in service
  - Generation Dispatchers ensure that all automatic voltage regulators are in service on generating units

# Heavy Load Voltage Schedule Action

## Purpose

- Issued at peak load periods to request maximum support of voltage on the bulk power system and to increase reactive reserves at the EHV level
  - Can be issued for the entire PJM RTO, specific Control Zone(s) or a subset of Control Zone(s)

# Heavy Load Voltage Schedule Action

## PJM Actions

- Request all companies implement Heavy Load Voltage Schedule
- Cancel when appropriate

# Heavy Load Voltage Schedule Action

## PJM Member Actions

- Ensure where possible, while still observing established limits
  - Underlying reactors are out of service
  - Underlying capacitors are in service
  - Capacitors on the 500 kV system with PLCs are in service
- Ensure all unit AVR's are in service
- Units on the 230 kV system and below should increase MVAR output as necessary to maintain scheduled bus voltages or nominal voltages, whichever is greater
  - Voltage levels should be maintained within predetermined limits at all times
- Units on the 500 kV and above system are operated to maintain a reasonable MVAR reserve
  - Reactive moves on these units should be coordinated with PJM
- Inform PJM of any units approaching max MVAR output, unit MVAR restrictions or AVR's out of service

# High System Voltage

## Purpose

- Prepare the system for expected high voltages
  - Coordinate with Transmission Owners to take steps to control high voltage prior to entering a light load period
- Take actions in real time when portions of the PJM RTO are experiencing a low load/high voltage condition

# High System Voltage

## PJM Actions

- Issue High System Voltage message
- Direct all companies to take actions to control high system voltages
  - Switchable capacitors be disconnected and switchable reactors be connected
- Generators, synchronous condensers and SVCs within their zone to absorb reactive power
  - Coordinate with Transmission and Generation Owners to direct generators to operate outside voltage schedules

# High System Voltage

## PJM Actions (*con't.*)

- Request neighboring Balancing Authorities to assist in reducing voltage
- Adjust 500/230 kV transformer taps to optimize system voltage
- PJM has identified several circuits that, in the past, have been effective in controlling general PJM RTO high voltage conditions when they are removed from service



# High System Voltage

## Member Actions:

- The TO will review and request adjustments to generator excitation (within approved bandwidth) so units absorb reactive power as modeled in the reported unit D-curve
- Generation should operate at the lower bandwidth of their voltage schedule when possible
  - Example: A generator following a voltage schedule of 235 kV +/- 4 kV should be operating to 231 kV if possible
- Voltage schedule adjustments or excitation adjustments outside of the approved bandwidth shall be coordinated with PJM
- Generation shall communicate with PJM and TOs any restrictions on a unit's ability to absorb MVARs if it varies from reported capability

# Questions?

**PJM Client Management & Services**

**Telephone: (610) 666-8980**

**Toll Free Telephone: (866) 400-8980**

**Website: [www.pjm.com](http://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 and References

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