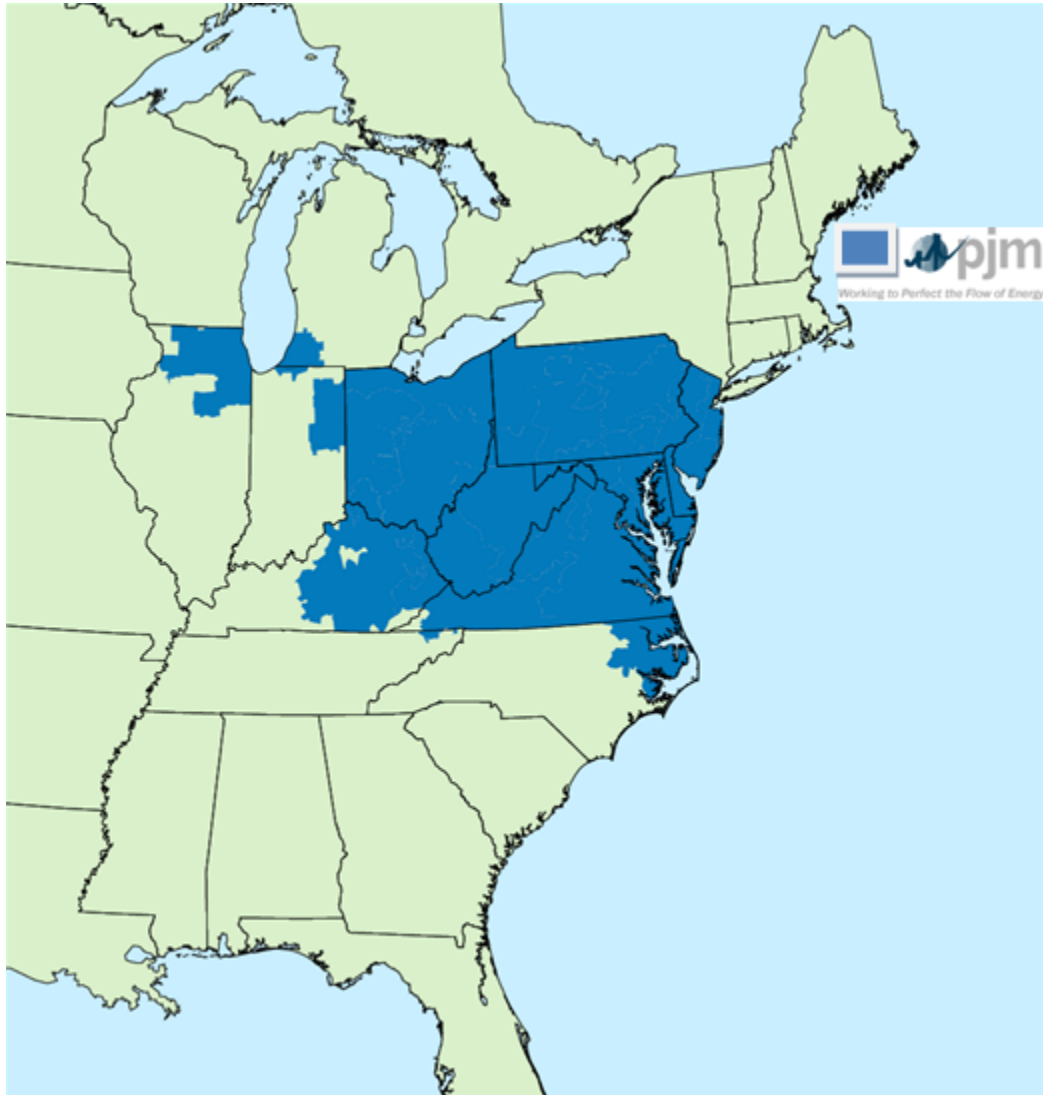


## Attachment A: PJM Reliability Plan

### PJM RTO Reliability Plan



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## Introduction

The North American Electric Reliability Corporation (NERC) requires every Region, sub-region, or interregional coordinating group to establish a Reliability Coordinator to provide the reliability assessment and emergency operations coordination for the Balancing Authorities and Transmission Operators within the Regions and across the Regional boundaries.

PJM Interconnection, LLC (PJM) serves as the Reliability Coordinator (RC) for its transmission-owning members. PJM is responsible for regional system reliability, which includes responsibility for both the Bulk Electric System, and lower voltage facilities that have been turned over to PJM for operational control. The PJM functions associated with the reliability of the Bulk Electric System include review and approval of planned facility transmission line outages and generation outages based upon current and projected system conditions, monitoring of real time loading information and calculating post-contingency loadings on the transmission system, administering loading relief procedures, re-dispatch of generation, and ordering curtailment of transactions and/or load. PJM operates a single Balancing Authority (BA) in its footprint and is also responsible for system control performance. PJM reliability procedures and policies are consistent with NERC and Regional **Reliability Organization (RRO) Entity** Standards. PJM operates **within** multiple NERC **RROs Regional Entities** and recognizes each **RRO's Regional Entity's** policies and standards.

## A. Responsibilities – Authorization

1. Authority to Act - PJM is responsible for the reliable operation of the Bulk Electric System within its Reliability Coordination Area in accordance with NERC Standards, Regional policies and standards. PJM's authority to act is derived from a set of agreements all PJM members have executed (See Appendix A). PJM has clear decision-making authority to act and to direct actions taken by its members within its Reliability Coordination Area to preserve the integrity and reliability of the Bulk Electric System.

1.1 PJM has a Wide Area view of its Reliability Coordination Area and neighboring areas that have an impact on PJM's area. PJM has the operating tools, processes

and procedures, including the authority, to prevent or mitigate emergency operating situations in both next-day analysis and during real-time conditions per the NERC Standards and Regional policies and standards, as well as the governing documents listed in Appendix A of this document.

1.2 PJM has clear decision-making authority to act and to direct actions taken by its members within its Reliability Coordination Area to preserve the integrity and reliability of the Bulk Electric System. PJM's responsibilities and authorities, as well as its members' responsibilities, are clearly defined in the governing documents.

1.3 PJM has not delegated any of its Reliability Coordinator responsibilities.

2. Independence - PJM will act in the best interest of ensuring reliability for its Reliability Coordination Area and the Eastern Interconnection before that of any other entity. This expectation is clearly identified in the governing documents (see Appendix A).

3. PJM Operating Instructions Compliance - Per the governing documents (see Appendix A), the PJM local control centers shall carry out required emergency actions as directed by PJM, including the shedding of firm load if required, unless such actions would violate safety, equipment, regulatory, or statutory requirements.

## **B. Responsibilities – Delegation of Tasks**

PJM has not delegated any Reliability Coordination tasks.

## **C. Common Tasks for Next-Day and Current-Day Operations**

This section documents how PJM conducts current-day and next-day reliability analysis for its Reliability Coordination Area.

1. Determination of Interconnection Reliability Operating Limits (IROLs) – PJM determines IROLs based on local, regional and inter-regional studies including seasonal assessments and ad hoc studies. The majority of the PJM IROLs are voltage stability interfaces.

During real time operations, PJM calculates the actual flow for the reactive interface IROLs using Transmission Limit Calculator (TLC). TLC uses a state estimator snapshot, calculates a voltage collapse transfer limit, and establishes an operating limit based on a back off from the calculated collapse point. These limits are calculated approximately every 5 minutes using the current system topology and posted to the PJM website in close to real time.

2. Operation to prevent the likelihood of a SOL or IROL violation in another area of the Interconnection and operation when there is a difference in limits – PJM, through the Joint Operating Agreement with other Reliability Coordinator neighbors, coordinates operations to prevent the likelihood of a SOL or IROL in another area. These agreements include data exchange, Available Transfer Capability coordination, and Outage Coordination and are listed in Appendix B.

Local control centers in the PJM Reliability Coordination Area are required to follow directives provided by PJM and operate to NERC Standards to prevent the likelihood that a disturbance, action, or non-action in its Reliability Coordination Area will result in a SOL or IROL violation in another area of the Interconnection. When there is a difference in derived limits, PJM utilizes the most conservative limit until the difference is resolved.

3. Operation under known and studied conditions and re-position without delay and no longer than 30 minutes – PJM ensures entities within its Reliability Coordination Area always operate under known and studied conditions and they return their systems to a secure operating state following contingency events within approved timelines, regardless of the number of contingency events that occur or the status of their monitoring, operating and analysis tools. PJM also ensures its local control centers re-position the system to be within all IROLs following contingencies within 30 minutes.

On a daily basis, PJM conducts next-day security analyses utilizing planned outages, forecasted loads, generation commitment, and expected net interchange. The analyses include contingency analysis and voltage stability analysis on key interfaces. These analyses model peak conditions for the day and are conducted utilizing first contingency (n-1) analysis. Results and mitigation are documented in the Next-Day Security Analysis Report and distributed to PJM staff and neighboring Reliability Coordinators. The Next-Day Security Analysis Report is posted to a secure website available to the PJM local control centers and neighbors. Mitigation plans are formed as needed for potential violations determined in the next day security analysis.

In real time, PJM relies on its telemetry and real-time analysis tools to monitor real time system conditions to identify potential IROL and SOL problems. PJM's operational philosophy is to operate on a pre-contingency basis; that is, to mitigate a simulated overload condition before it occurs.

4. PJM provides transmission service within the PJM Reliability Coordination area. PJM communicates IROLs within its wide-area view and provides updates as needed via reports, morning conference calls, and the ALL-CALL system and real-time via voice and messaging.

5. PJM process for issuing Operating Instructions – PJM uses a number of communications tools for issuing/receiving of Operating Instructions. The primary communications means is the PJM All-Call System (All-Call) which is a dedicated telephone-based system which sends the Operating Instruction / message to all control centers simultaneously and confirms response. In addition, PJM will follow the verbal message with Emergency Procedures messages on its website through a specific application that runs within its Data Viewer tool and as well direct phone contact as necessary.

## D. Next Day Operations

This section documents how PJM conducts next-day reliability analyses for its Reliability Coordination Area.

1. Reliability Analysis and System Studies – PJM conducts next-day reliability analyses for its Area to ensure the Bulk Power System can be operated reliably in normal and post contingency conditions.

On a daily basis, PJM conducts next-day security analyses utilizing known outages, forecasted loads, generation commitment and dispatch, and expected net interchange using the study capability in the PJM EMS. Base case flows on all monitored facilities are compared against the normal rating. Post-contingency flows for all monitored facilities are compared against their emergency rating for all contingencies. Voltage stability analysis is conducted on key critical interfaces to determine a flow limit.

Mitigation plans are formed as needed for potential violations determined in the next day security analysis. Mitigation is of the form of additional generation commitment, system

reconfiguration, generation re-dispatch, use of NERC TLR or other local flow mitigation procedures.

2. Information Sharing – Generation Owners and Transmission Owners in the PJM Reliability Coordination Area and neighboring Reliability Coordinator areas provide to PJM all information required for system studies, such as critical facility status, load, generation, Operating Reserve projections, and known interchange transactions.

The entities in the PJM Reliability Coordination Area provide generation and transmission facility statuses to the PJM outage scheduling application (eDART), forecasted loads, operating reserves, and known interchange transactions via e-tags. PJM shares this information via an SDX file every fifteen minutes. For entities outside PJM, SDX files are downloaded and loaded into appropriate systems.

Sharing of Study Results - When conditions warrant or upon request, PJM shares the results of its system studies with the entities within its Reliability Coordination Area and/or with other Reliability Coordinators. Study results for the next day shall be available no later than 15:00 Eastern Prevailing Time, unless circumstances warrant otherwise.

A Next-Day Security Analysis Report is available to PJM and member operations staff and neighboring Reliability Coordinators via secure website. PJM holds daily conference calls with MISO, and others, as necessary, as part of this process.

## E. Current Day Operations

This section documents how PJM conducts current-day reliability analyses for its Reliability Coordination Area.

1. PJM uses a suite of real time network analysis tools to continuously monitor all Bulk Power System facilities, including sub-transmission information as needed, within the PJM Reliability Coordination Area and adjacent areas, as necessary, to ensure, at any time, PJM is able to determine any potential SOL and IROL violations within its Reliability Coordination Area.

PJM utilizes a state estimator and real-time contingency analysis as the primary tool to monitor facilities. The state estimator model includes all BES as well as facilities, generally 69 kV and above, in the PJM Reliability Coordination Area. The model also has extensive representation of neighboring facilities in order to provide an effective wide-area view. This model is updated quarterly and may be updated on demand for emergencies.

Real Time Contingency Analysis (RTCA) is performed on contingencies utilizing the state estimator model approximately every 1-2 minutes. Contingencies include all PJM Reliability Coordination Area equipment which has been turned over to PJM for operational control, and neighboring contingencies that would impact PJM Reliability Coordination Area facilities.

In order to continuously monitor its reactive interfaces, PJM uses a real time calculation tool named Transmission Limit Calculator (TLC). TLC takes a state estimator snapshot and calculates a voltage collapse equivalent flow for the interface, based on current real time telemetry and topology. A back off flow is established to prevent operating to an actual voltage collapse, and PJM operates to maintain flows below this limit.

SCADA alarming is utilized to alert PJM of any actual low or high voltages or facilities loaded beyond their normal or emergency limits.

In addition to the above applications, PJM utilizes a dynamically updated transmission overview display to maintain a wide area view. All transmission facilities 500 kV and above are depicted

on the overview with flows (MW and MVAR), indication of facilities out of service, high and low voltage warning and alarming. For more detailed monitoring, bus level one-line diagrams are utilized for station level monitoring and information. The one-line diagrams are populated with the real time telemetered information as well as the state estimated solution.

- 1.1 PJM notifies neighboring Reliability Coordinators of operational concerns (e.g. declining voltages, excessive reactive flows, or an IROL violation) that it identifies within the neighboring Reliability Coordination Area via direct phone calls, conference calls, NERC hotline calls, and/or RCIS messages. PJM has joint operating agreements with neighboring Reliability Coordinators that are listed in Appendix B. PJM directs actions to provide emergency assistance to all Reliability Coordination neighbors, during declared emergencies, which is required to mitigate the operational concern to the extent that the same entities are taking in kind steps and the assistance would be effective.
2. PJM maintains awareness of the status of all current critical facilities whose failure, degradation or disconnection could result in an SOL or IROL violation within its Reliability Coordination Area via State Estimator, RTCA, SCADA alarming, and transmission displays. PJM is aware of the status of any facilities that may be required to assist Reliability Coordination Area restoration objectives via these same displays and tools.
3. PJM is continuously aware of conditions within its Reliability Coordination Area, and includes real time information in its reliability assessments via automatic updates to the state estimator, TLC, and transmission displays. PJM monitors its Reliability Coordination Area parameters, including the following:
  - 3.1 Current status of Bulk Power System elements (transmission or generation including critical auxiliaries) such as Automatic Voltage Regulators, Remedial Action Schemes (RAS), and system loading are monitored by state estimator, RTCA, SCADA Alarming, and transmission displays. PJM members are required to report to PJM when Automatic Voltage Regulators are not in-service or status changes of RAS.
  - 3.2 Current pre-contingency element conditions (voltage, thermal, or stability) are monitored by state estimator, SCADA Alarming, TLC, and transmission displays.
  - 3.3 Current post- contingency element conditions (voltage, thermal, or stability) are monitored by RTCA, TLC, and transmission displays.
  - 3.4 System real reserves are monitored versus what is required in EMS. Reactive reserves versus what is required are monitored via monitoring adequacy of calculated post-contingent steady state voltages versus voltage limits, voltage stability interfaces against limits, and reactive reserves versus required for defined zones. Reactive Reserve Checks are made as needed when reactive reserves in real-time indicate lower than expected.
  - 3.5 Capacity and energy adequacy conditions are determined Day Ahead (DA) and monitored real time in accordance with our Market Processes to maintain the required levels of reserves.
  - 3.6 Current ACE, System Frequency and BAAL are displayed in trend charts to the PJM Generation Dispatcher.

3.7 Current local procedures, such as operating procedures, are monitored and coordinated with local control centers and implementation documented in the PJM logs. TLR procedures in effect are monitored via the NERC Interchange Distribution Calculator, and also documented on the PJM logs.

3.8 Generation dispatch is performed for the PJM Balancing Authority Area by the PJM Generation Dispatcher using the Security Constrained Economic Dispatch (SCED) application, which is a single economic constraint controlled dispatch for the entire PJM RTO area.

3.9 Planned transmission or generation outages are reported to PJM via the eDART application. In the PJM EMS, any current Transmission Facility outages which are not associated with an eDART ticket, such as unplanned outages, will automatically create an eDART ticket.

3.10 Contingency Events are monitored by state estimator, RTCA, SCADA Alarming, and transmission displays. Local control centers report Contingency Events on non-monitored facilities to PJM.

4. PJM monitors Bulk Power System parameters that may have significant impacts upon its Reliability Coordination Area and neighboring Reliability Coordination areas with respect to:

4.1 PJM maintains awareness of all Interchange Transactions that wheel-through, source, or sink in its Reliability Coordination Area via NERC E-tags and NERC IDC displays. Interchange Transaction information is made available to all Reliability Coordinators via NERC E-tags. PJM monitors internal transactions in its market area via the PJM ExSchedules application.

4.2 PJM evaluates and assesses any additional Interchange Transactions that would violate IROL or SOLs by using the NERC IDC as a look-ahead tool. As flows approach their IROL or SOLs, PJM evaluates the incremental loading next-hour transactions would have on the SOLs or IROLs and determines if action needs to be taken to prevent an SOL or IROL violation. PJM has the authority to direct all actions necessary and may utilize all resources to address a potential or actual IROL violation up to and including load shedding. PJM has EMS displays, including the reactive interface limits screen that is designed so the operators can watch and monitor specific IROL limits.

4.3 PJM monitors Operating Reserves versus each Regional requirement to ensure the required amount of Operating Reserves is provided and available as required to meet NERC Control Standards via EMS and meet the Regional obligation. If necessary, PJM will commit additional reserves including obtaining assistance from neighbors.

4.4 PJM identifies the cause of potential or actual SOL or IROL violations via analysis of state estimator results, RTCA results, SCADA Alarming of outages, TLC results, transmission displays of changes, and Interchange Transaction impacts. PJM will initiate control actions including transmission reconfiguration, generation re-dispatch, or emergency procedures to relieve the potential or actual IROL violation without delay, and no longer than 30 minutes. PJM is authorized to direct utilization of all resources, including load shedding, to address a potential or actual IROL violation. PJM will not solely rely on the NERC TLR procedure to mitigate an IROL violation.

4.5 PJM complies with the start and end times for time error corrections as communicated by the Time Monitor. PJM communicates Geo-Magnetic Disturbance forecast information to local control centers and Generation Operators via the All-Call System and the Emergency Procedures webpage. PJM will assist in development of any required response plan and may move to conservative operating mode to mitigate impacts as needed.

4.6 PJM participates in NERC Hotline discussions, assists in the assessment of reliability of the Regions and the overall interconnected system, and coordinates actions in anticipated or actual emergency situations. PJM will disseminate this information via the All-Call system or individual phone calls.

4.7 PJM monitors system frequency and ACE via trend graph. If the BAAL is outside of the acceptable range, the PJM Regulation will be manually adjusted, if necessary, to utilize the support resources for frequency mitigation. PJM will utilize all resources, including firm load shedding, to relieve the emergent condition.

4.8 PJM coordinates with other Reliability Coordinators and its Generation Operators and local control centers, as needed, on the development and implementation of action plans to mitigate potential or actual SOL, IROL, BAAL or DCS violations. PJM coordinates pending generation and transmission maintenance outages with other Reliability Coordinators and its Generation Operators and local control centers, as needed and within code of conduct requirements, real time via telephone and next-day per the PJM outage scheduling process.

4.9 PJM will assist or request assistance as the Balancing Authority Operator for the RTO from neighboring Reliability Coordinators via the Energy Emergency Alert (EEA) notification process and will conference parties together as appropriate.

4.10 PJM monitors its ACE to identify the sources of problems contributing to frequency, time error, or inadvertent interchange and directs corrective actions per 4.7 above.

4.11 The local control centers within PJM's Reliability Area inform PJM of all changes in status of Remedial Action Schemes (RAS), including any degradation or potential failure to operate, as expected by the local control center. PJM factors these RAS changes into its reliability analyses and updates its contingency definitions as appropriate.

5. PJM issues alerts, as appropriate, to local control centers via the All-Call system, individual phone calls, when it foresees a transmission problem (such as an SOL or IROL violation, loss of reactive reserves, etc.) within its Reliability Area that requires notification. PJM issues alerts, as appropriate, to all Reliability Coordinators via the Reliability Coordinator Information System when it foresees a transmission problem (such as an SOL or IROL violation, loss of reactive reserves, etc.) within its Reliability Area that requires notification.

6. PJM confirms reliability assessment results via analyzing results of state estimator/RTCA, and discussions with local control centers and neighboring Reliability Coordinators. PJM identifies options to mitigate potential or actual SOL or IROL violations via examining existing operating procedures, system knowledge, and power flow analysis to identify and implement only those actions as necessary as to always act in the best interests of the interconnection.

## F. Emergency Operations



1. PJM utilizes PJM Manual M-13, Emergency Operations, to direct its Members to return the transmission system to within IROL or SOL limits as soon as possible, but no longer than 30 minutes. This procedure includes the actions (e.g. reconfiguration, re-dispatch or load shedding) PJM will direct until relief requested by the TLR process is achieved.
2. PJM utilizes PJM Manual M-13, Emergency Operations, when it determines IROL violations are imminent. PJM Emergency Operations documents the processes and procedures PJM follows when directing the re-dispatch of generation, reconfiguring transmission, managing Interchange Transactions, or reducing system demand to mitigate the IROL violation to return the system to a reliable state. PJM coordinates its alert and emergency procedures with other Reliability Coordinators via joint operating agreements listed in Section H.
3. PJM directs actions in the event the loading of transmission facilities progresses to or is projected to progress to an SOL or IROL violation.
  - 3.1 PJM directs reconfiguration and re-dispatch within its market area as needed to prevent or relieve SOL or IROL violations. PJM will not rely on or wait for NERC TLR to relieve IROL violations. PJM will implement NERC TLR if doing so will provide additional relief. PJM will adhere to the NERC TLR congestion report instructions including curtailing transactions and re-dispatching for market flow.
  - 3.2 PJM utilizes market-to-market re-dispatch for its market area for reciprocally coordinated flowgates with MISO and NYISO per the Congestion Management Process (see Appendix B). PJM also coordinates flowgate limits and monitors flows on facilities within TVA, Duke, Progress Energy and other RC areas in order to maintain reliable operation.
  - 3.3 PJM uses market re-dispatch, in conjunction with NERC TLR per the NERC IDC congestion relief report.
  - 3.4 PJM complies with the provisions of the NERC TLR by curtailing Interchange Transactions and re-dispatching for market flow per the NERC IDC congestion relief report.
  - 3.5 PJM will direct reconfiguration, re-dispatch for market areas, and NERC TLR reductions to relieve facilities as necessary. PJM will not rely on NERC TLR as an emergency action.
4. PJM monitors its ACE, and directs action to assist in maintaining system frequency to return within BAAL limits as appropriate.
5. PJM utilizes PJM Manual M-13, Emergency Operations, to mitigate an energy emergency within its Reliability Coordination Area. PJM will provide assistance to other Reliability Coordinators per its respective joint operating agreement listed in Appendix B.
6. PJM utilizes PJM Manual M-13, Emergency Operations, when it, or a Reserve-Sharing Group, or a Load-Serving Entity within its Reliability Coordination Area is experiencing a potential or actual Energy Emergency. PJM Emergency Operations document the processes and procedures PJM uses to mitigate the emergency condition, including a request for emergency assistance if required.
7. PJM also drills at least annually with its members on Emergency procedures.

## G. System Restoration

1. Knowledge of PJM Transmission Owner Restoration Plans – PJM is aware of each transmission owner Restoration Plan and has a written copy of each plan. During system restoration, PJM monitors restoration progress and acts to coordinate any needed assistance. PJM may direct the restoration activities, depending on system conditions.
2. PJM Restoration Plan – The PJM Restoration Procedures are contained in PJM Manual M-36, System Restoration. PJM takes action to restore normal operations once an operating emergency has been mitigated in accordance with its Restoration Plan. This Restoration Plan is drilled at least annually.
3. Dissemination of Information – PJM serves as the primary contact for disseminating information regarding restoration to neighboring Reliability Coordinators and members not immediately involved in restoration.

PJM approves, communicates and coordinates the re-synchronizing of major system islands or synchronizing points, so as not to cause a burden on member or adjacent Reliability Coordination Areas.

## H. Coordination Agreements and Data Sharing

1. Coordination Agreements: See Appendix B
2. Data Sharing – PJM determines the data requirements to support its reliability coordination tasks and requests such data from members or adjacent Reliability Coordinators. PJM provides for data exchange with local control centers and adjacent Reliability Coordinators via a secure network. PJM members provide data to PJM via ICCP. PJM provides data to entities outside PJM via direct links and Eastern Interconnection Data Sharing Network (EIDSN).

## I. Facility

1. PJM performs the Reliability Coordinator function at the PJM Headquarters in Valley Forge, PA along with the PJM Milford control center in Milford Township, PA. The Valley Forge and Milford offices have the necessary voice and data communication links to appropriate entities within PJM to perform their responsibilities. These communication facilities are staffed and available to act in addressing a real-time emergency condition.
2. Adequate Communication Links – PJM maintains satellite phones, cellular phones, and redundant, diversely routed telecommunications circuits. There is also a video link between the Valley Forge and Milford Control Rooms.
3. Multi-directional Capabilities – PJM has multi-directional communications capabilities with its members, and with neighboring Reliability Coordinators, for both voice and data exchange to meet reliability needs of the Interconnection.
4. Real-time Monitoring – PJM has detailed real-time monitoring capability of its Reliability Coordination Area and all first tier companies surrounding the PJM Reliability Coordination Area to ensure potential or actual System Operating Limit of Interconnection Reliability Operating Limit violations are identified.

PJM monitors BES elements (generators, transmission lines, buses, transformers, breakers, etc.) that could result in SOL or IROL violations within its Reliability Coordination Area. PJM monitors both real and reactive power system flows, and operating reserves, and the status of

the Bulk Power System elements that are, or could be, critical to SOLs and IROLs and system restoration requirements within its Reliability Coordination Area.

## 5. Study and Analysis Tools

PJM has adequate analysis tools, including state estimation, pre- and post-contingency analysis capabilities (thermal, stability, and voltage), and wide-area overview displays. PJM has detailed monitoring capability of the PJM Reliability Area and sufficient monitoring capability of the surrounding Reliability Areas to ensure potential reliability violations are identified. PJM continuously monitors key transmission facilities in its area in conjunction with the Members monitoring of local facilities and issues.

PJM ensures SOL and IROL monitoring and derivations continue if the main monitoring system is unavailable. PJM has backup facilities that shall be exercised if the main monitoring system is unavailable.

The systems utilized by PJM include:

- State Estimator and Contingency Analysis
- Status and Analog Alarming
- Overview Displays of PJM Transmission System via Wallboard
- One line diagrams for entire PJM Transmission System
- Dispatch Interactive Map Application (DIMA)
- Transmission Limit Calculator (TLC)
- Voltage Stability Analysis (VSA)
- Transient Stability Analysis (TSA)
- ExSchedules
- Security Constrained Economic Dispatch (SCED)
- Dispatcher Management Tool (DMT)
- Intelligent Event Processor (IEP)

PJM utilizes these tools, which provide information that is easily understood and interpreted by PJM operating personnel. Alarm management is designed to classify alarms in priority for heightened awareness of critical alarms.

PJM controls its Reliability Coordinator analysis tools, including approvals for planned maintenance. PJM has procedures in place to mitigate the effects of analysis tool outages.

## J. Staffing

1. Staff Adequately Trained and NERC Certified – The 24 x 7 PJM shift operations team is composed as follows:

- 1 Shift Supervisor\*
- 2 Generation Dispatchers\*
- 4 Master Dispatchers\* - responsible for Transmission Dispatch

- 1 Master Coordinator

In addition, one or more Reliability Engineers\* are on shift from 5:00 AM to 12:00 midnight, 7 days per week.

\*All people in these positions possess the NERC Reliability Coordinator certification<sup>1</sup>.

- Positions that have the primary responsibility, either directly or through communications with others, for the real-time operation of the interconnected Bulk Electric System.
- Positions directly responsible for complying with NERC and **RRO Regional Entity** Standards.

Each week, one of the shift teams is assigned to training. The training program consists of a set curriculum which includes tests each person must successfully complete. At a minimum, each person must complete 32 hours per year of training and drills using realistic simulations of system emergencies, in addition to other training required to maintain qualified operation personnel.

2. Comprehensive Understanding – PJM operating personnel have an extensive understanding of the transmission system within the PJM Reliability Coordination Area, including the operating staff, operating practices and procedures, restoration priorities and objectives, outage plans, equipment capabilities, and operational restrictions.

PJM operating personnel place particular attention on SOLs and IROLs and inter-tie facility limits. PJM ensures protocols are in place to allow PJM operating personnel to have the best available information at all times.

PJM's System Operators are trained to perform their duties, both at entry level and in continuous training status. Successful completion of both written and simulator tests are required for each progression step in the control room job family. A Learning Management System is used to track the status of each operator's progress. In addition to the above training, PJM conducts other training sessions PJM System Operators are expected to complete.

3. Standards of Conduct – PJM is independent of the merchant function. PJM does not pass transmission information or data to any wholesale merchant function or retail merchant function that is not made available simultaneously to all such wholesale merchant functions. An officer of PJM has signed the NERC Reliability Coordinators Standards of Conduct. Every PJM employee, not just the operating staff, has completed training on PJM's Standards of Conduct. Refresher training on PJM's Standards of Conduct is conducted annually. Training records are maintained.

#### **APPENDIX A: PJM Governing Documents**

PJM Operating Agreement: <https://www.pjm.com/directory/merged-tariffs/oa.pdf>

PJM Open Access Transmission Tariff: <https://www.pjm.com/directory/merged-tariffs/oatt.pdf>

#### **APPENDIX B: Agreements with External Entities**

Joint Operating Agreement between the Midcontinent Independent System Operator, Inc. and PJM Interconnection, L.L.C.: <https://www.pjm.com/directory/merged-tariffs/miso-joa.pdf>

Joint Reliability Coordination Agreement among and between PJM Interconnection, L.L.C., and Tennessee Valley Authority: <https://www.pjm.com/-/media/documents/agreements/joint-reliability-agreement-jrca-pjm-tva.ashx>

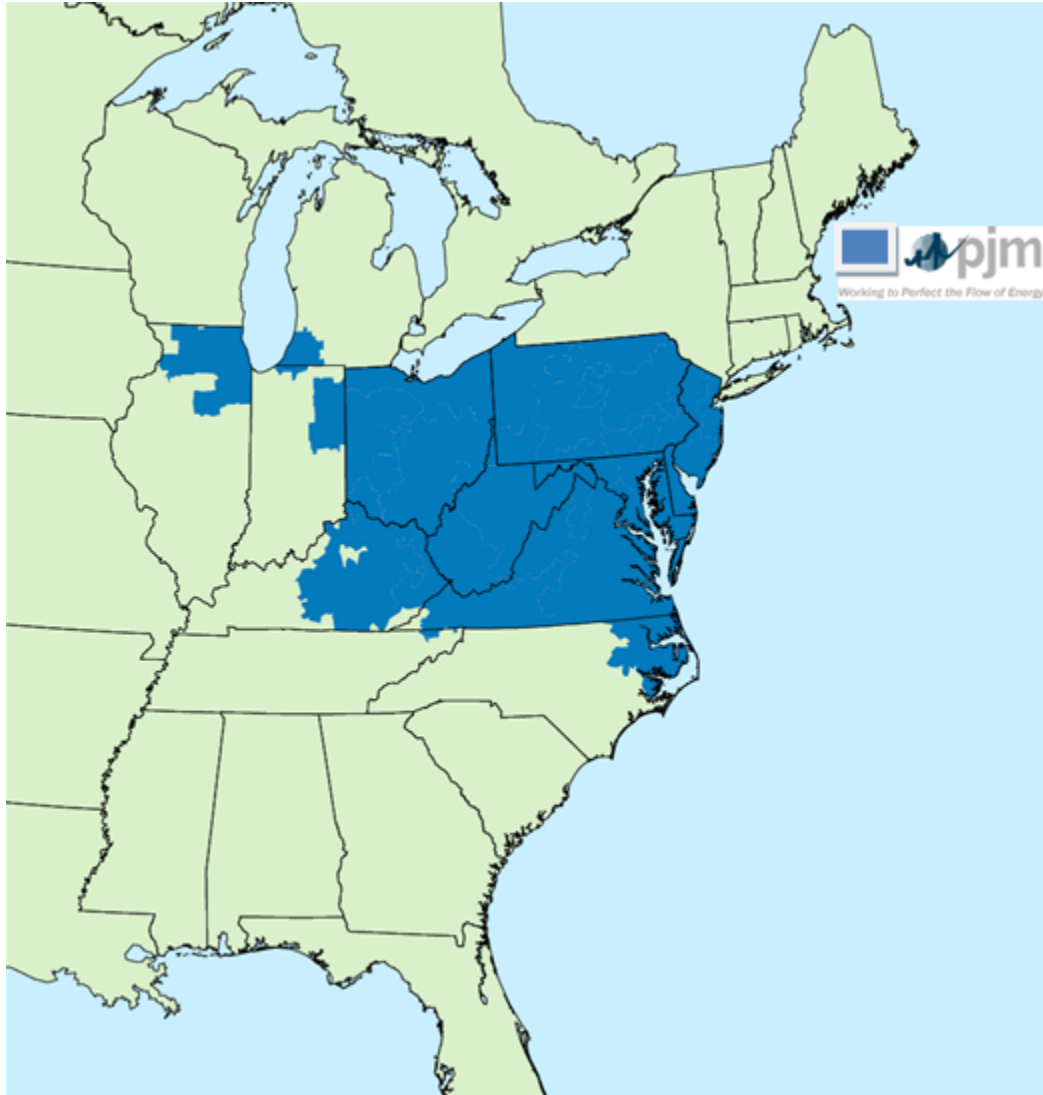
~~Midcontinent Independent System Operator, Inc., PJM Interconnection, L.L.C., and Tennessee Valley Authority~~

Congestion Management Process (MISO/PJM Joint Operating Agreement, Attachment 2): <https://www.pjm.com/directory/merged-tariffs/miso-joa.pdf>

Joint Operating Agreement ~~Among and b~~Between New York Independent System Operator, Inc. LLC and PJM Interconnection, L.L.C.: <https://www.pjm.com/~media/documents/agreements/nyiso-joa.ashx>

~~Adjacent Reliability Coordinator Coordination Agreement between Joint Operating Agreement between VACAR South and PJM Interconnection, L.L.C. and VACAR South RC:~~ <https://www.pjm.com/-/media/documents/agreements/executed-pjm-vacar-rc-agreement.ashx>

### Appendix C: PJM Reliability Area Map



### Appendix D: PJM TOs and TOPs

PJM Transmission Owner/Operator NERC Registration		
Transmission Owner/Operator	NERC Registration Number	Registration
American Electric Power	NCR00682	TO - (TOP for 138kV)
AMP Transmission, LLC	NCR11899	TO

PJM Transmission Owner/Operator NERC Registration		
Transmission Owner/Operator	NERC Registration Number	Registration
Atlantic City Electric Company	NCR00688	TO
Baltimore Gas and Electric Company	NCR00689	TO
Commonwealth Edison Company	NCR08013	TO
Cleveland Public Power	NCR00712	TO
The Dayton Power and Light Company	NCR00748	TO
Delmarva Power and Light Company	NCR00752	TO
Dominion (Virginia Electric and Power Company)	NCR01214	TO
Duke Energy Corporation	NCR00761	TO
Duquesne Light	NCR00762	TO
East Kentucky Power Cooperative	NCR01225	TO
First Energy Utilities	NCR11315	TO
General Electric International - Linden VFT	NCR11747	TO
Hudson Transmission Partners, LLC	NCR11366	TO
ITC Interconnection LLC	NCR11638	TO - TOP
Linden VFT	NCR11567	TO
Neptune Regional Transmission System, LLC	NCR00130	TO
Ohio Valley Electric Corporation	NCR00857	TO
PPL Electric Utilities	NCR00884	TO
PECO Energy	NCR08026	TO
Potomac Electric Power Company	NCR00881	TO
Public Service Electric and Gas Company	NCR00896	TO
City of Rochelle	NCR00721	TO
Rockland Electric Company	NCR00863	TO

PJM Transmission Owner/Operator NERC Registration		
Transmission Owner/Operator	NERC Registration Number	Registration
Essential Power Rock Springs, LLC	NCR00251	TO
Southern Maryland Electric Cooperative	NCR00918	TO
<b>Transource West Virginia, LLC</b>	<b>NCR11925</b>	<b>TO</b>
U.S. Department of Energy	NCR04167	TO - TOP
UGI Utilities, Inc.	NCR00935	TO