



Working to Perfect the Flow of Energy

PJM Manual 37
Reliability Coordination

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~~2010~~

Prepared by
System Operation Division

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PJM Manual 37

Reliability Coordination

Table of Contents	
TABLE OF CONTENTS	II
APPROVAL	1
CURRENT REVISION	1
INTRODUCTION	2
ABOUT PJM MANUALS	2
ABOUT THIS MANUAL	2
<i>Intended Audience</i>	2
<i>References</i>	3
USING THIS MANUAL	3
<i>What You Will Find In This Manual</i>	3
SECTION 1: ROLES AND RESPONSIBILITIES	4
1.1 POLICY STATEMENTS	4
SECTION 2: FACILITIES	6
2.1 COMMUNICATIONS FACILITIES	6
2.2 DATA REQUIREMENTS	6
2.3 REAL TIME MONITORING TOOLS	6
2.4 MAINTENANCE OF REAL TIME MONITORING TOOLS	6
2.4.1 <i>Capabilities of the on-site support staff</i>	6
2.4.2 <i>Change management process</i>	7
SECTION 3: SOL AND IROL LIMITS	8
3.1 SOL AND IROL LIMIT DETERMINATION	8
3.2 MONITORING OF SOL AND IROL LIMITS	10
SECTION 4: TRANSMISSION LOADING RELIEF (TLR)	1342
SECTION 5: COORDINATION WITH NEIGHBORING RELIABILITY COORDINATORS	1514
5.1 AGREEMENTS WITH NEIGHBORING RELIABILITY COORDINATORS	1514
5.2 COMMUNICATIONS WITH NEIGHBORING RELIABILITY COORDINATORS	1645
5.2.1 <i>Communications Facilities</i>	1645
5.2.2 <i>Required Notifications</i>	1645
5.3 MITIGATING OPERATIONAL PROBLEMS	1746
ATTACHMENT A: PJM RELIABILITY PLAN	1918
ATTACHMENT B: EXCERPT FROM PJM OPERATING AGREEMENT	7043
ATTACHMENT C: CHANGE CONTROL REVIEW BOARD	7144
ATTACHMENT D: CONSTRAINT PRIORITIZATION	8356



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David Souder, Manager
Operations Planning

Current Revision

~~Revision 06 (01/01/2010):~~

- ~~• Updated SOL definition to include all facilities 230kV and above, removing reference to MP-1.~~
- ~~• Added reference to NAESB Business Practice WEQ-008 and other editorial changes in Section 4~~

Revision 07 (mm/dd/1/2011):

- Annual Review
- Removed OVEC from PJM RC footprint.
- Added the CLVLND Reactive Transfer Interface within table in *Section 3.1 SOL and IROL Limit Determination.*
- Updated *Attachment A: PJM RTO Reliability Plan.*

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Introduction

Welcome to the ***PJM Manual for Reliability Coordination***. In this Introduction, you will find the following information:

- What you can expect from the PJM Manuals in general (see *–About PJM Manuals–*).
- What you can expect from this PJM Manual (see *–About This Manual–*).
- How to use this manual (see *–Using This Manual–*).

About PJM Manuals

The PJM Manuals are the instructions, rules, procedures, and guidelines established by PJM for the operation, planning, and accounting requirements of PJM and the PJM Energy Market. The manuals are grouped under the following categories:

- Transmission
- PJM Energy Market
- Generation and transmission interconnection
- Reserve
- Accounting and billing
- PJM administrative services

For a complete list of all PJM Manuals, go to www.pjm.com and select “Manuals” under the “Documents” pull-down menu.

About This Manual

The ***PJM Manual for Reliability Coordination*** focuses on how PJM and the PJM Members are expected to carry out reliability coordination duties in accordance with the PJM Reliability Plan.

The ***PJM Manual for Reliability Coordination*** consists of five sections. The sections are as listed in the table of contents beginning on page ii.

PJM shall annually review and update this manual and provide a copy to neighboring Reliability Coordinators, Transmission Operators, Balancing Authorities, and appropriate Regional Reliability Organizations.

Intended Audience

The Intended Audiences for the ***PJM Manual for Reliability Coordination*** are:

- *PJM Reliability Coordinators and system operators*— Declare and implement normal operating procedures and emergency procedures.
- *Transmission Owner and Generation Owner Operators* — Respond to PJM dispatcher requests for emergency procedures.



- *PJM RTO Balancing Authorities and Transmission Operators* – coordinate operation of Balancing Authority (BA) and Transmission Operator (TOP) operations with PJM Reliability Coordinator (RC).
- PJM Reliability Coordinators and operations staff — Perform system studies.

References

The references to other documents that provide background or additional detail directly related to the *PJM Manual for Reliability Coordination* are:

- PJM Manual for [Balancing Operations \(M12\)](#)
- PJM Manual for [Transmission Operations \(M03\)](#)
- PJM Manual for [System Restoration \(M36\)](#)
- PJM Manual for [Operations Planning \(M38\)](#)
- PJM Manual for [Emergency Operations \(M13\)](#)
- PJM Manual for [Generator Operational Requirements \(M14d\)](#)
- PJM Manual for [Certification and Training Requirements \(M40\)](#)
- PJM Manual for [Definitions & Acronyms \(M35\)](#)

Using This Manual

We believe that explaining concepts is just as important as presenting procedures. This philosophy is reflected in the way we organize the material in this manual. We start each section with an overview. Then we present details, procedures or references to procedures found in other PJM manuals. The following provides an orientation to the manual's structure.

What You Will Find In This Manual

- A table of contents that lists two levels of subheadings within each of the sections
- An approval page that lists the required approvals and a brief outline of the current revision.
- Sections containing the specific guidelines, requirements, or procedures including PJM actions and PJM Member actions
- Attachments that include additional supporting documents, forms, or tables in this PJM Manual
- A section at the end detailing all previous revisions of this PJM Manual



Section 1: Roles and Responsibilities

Welcome to the *Roles and Responsibilities* section of the **PJM Manual for Reliability Coordination**.

- This section of the manual addresses PJM and the PJM Members' responsive actions to obligations as the PJM Reliability Coordinator.

1.1 Policy Statements

PJM is the Reliability Coordinator for PJM members within the PJM Balancing Authority Area ~~and the Ohio Valley Electric Cooperative (OVEC)~~. PJM operates in compliance with the PJM Reliability Plan (Attachment A – [PJM Reliability Plan](#)).

PJM's authority is addressed in the following document, which all PJM members must sign:

PJM Operating Agreement (PJM Website link:
<http://www.pjm.com/documents/agreements/~media/documents/agreements/oa.ashx>)

In this document, the PJM members commit to comply with PJM Reliability Coordinator directives unless such actions would violate safety, equipment, or regulatory or statutory requirements (See Attachment B – [Excerpt from PJM Operating Agreement regarding authority of PJM](#)). Under these circumstances, the Transmission Operator, Transmission Owner, Balancing Authority, Generator Operator, Transmission Service Provider, Load-Serving Entity, or Purchasing-Selling Entity shall immediately inform PJM, the Reliability Coordinator, of the inability to perform the directive so that the PJM may implement alternate remedial actions. ~~(OVEC, as a PJM Reliability Coordinator client, has executed a separate agreement with PJM which details similar obligations.)~~

PJM has clear decision-making authority to act and to direct actions to be taken by Transmission Operators, Transmission Owners, Balancing Authorities, Generator Operators, Load-Serving Entities, and Purchasing-Selling Entities within its Reliability Coordinator Area to preserve the integrity and reliability of the Bulk Electric System. These actions shall be taken without delay, but no longer than 30 minutes.

PJM shall act in the interests of reliability for the overall Reliability Coordinator Area and the Interconnection before the interests of any of its members or other entity. PJM is committed to supporting its fellow Reliability Coordinators. PJM has developed coordination agreements with cooperation with its neighboring Reliability Coordinators for the purpose of clarifying roles and responsibilities with these entities and for coordinating response when necessary. [NERC Standard IRO-001, R1-R3, R7-R-9]

PJM executes the Reliability Coordinator tasks with a group of highly trained and qualified system operators, all of whom maintain current NERC Certification as Reliability Operators.

PJM Actions:

PJM is responsible for the following activities:

- Preparing a PJM Reliability Plan and obtaining approval for the plan from the NERC Operating Committee and appropriate RRO Committees.
- Staffing the Reliability Coordinator activities with trained and certified system operators who maintain the NERC Certification for Reliability Operators.



- Implementing coordination agreements with other Reliability Coordinators.
- Taking actions that it determines are consistent with Good Utility Practice and are necessary to maintain the operational integrity of the PJM RTO and the Eastern Interconnection
- Coordinating emergency procedures and RCIS notifications.
- Directing the operations of any PJM Members ~~and OVEC~~ as necessary to manage, alleviate, or end an emergency, including but not limited to emergency purchases/sales and load shedding.
- Providing information to and receiving information from PJM Members, ~~OVEC~~, and other Reliability Coordinators, as appropriate to manage, alleviate, or end an Emergency in the PJM RTO or in another Reliability Coordination Area.
- Monitoring voltages, tie flows, line loading, EMS alarms, interchange schedules, ACE Control, Frequency, NERC IDC and RCIS.

PJM Member Actions:

PJM Members are responsible for performing the following activities:

- Taking any action, as requested or directed by PJM, to manage, alleviate, or end an Emergency or other reliability issue.
- Cooperating with other Transmission and Generation Owners and PJM to carry out requests and instructions received from PJM for the purpose of managing, alleviating, or ending an Emergency or other reliability issue in the PJM Reliability Coordinator area or neighboring Reliability Coordinator area.



Section 2: Facilities

Welcome to the *Facilities* section of the **PJM Manual for Reliability Coordination**. In this section, you will find the following information:

- A description of the communications facilities that are used to perform Reliability Coordination activities in PJM.
- The data requirements and data exchange process for the population of the real time monitoring tools
- A description of the real time monitoring tools that PJM uses to perform Reliability Coordination activities.
- Procedures for the maintenance of the real time analysis tools

2.1 Communications Facilities

The communications facilities that PJM and its members use to carry out its Reliability Coordinator duties are explained in PJM Manual, M-01, Control Center Requirements, Section 3. [NERC Standard IRO-002, R1, R4]

2.2 Data Requirements

The data exchange requirements and facilities that PJM and its members use to carry out its Reliability Coordinator duties are explained in PJM Manual, M-01, Control Center Requirements, Section 3. [NERC Standard IRO-002, R2, R3]

2.3 Real Time Monitoring Tools

The real time monitoring tools that PJM uses to carry out its Reliability Coordinator duties are explained in PJM Manual, M-01, Control Center Requirements, Section 1. [NERC Standard IRO-002, R4-R7; IRO-003, R1-R2]

2.4 Maintenance of Real Time Monitoring Tools

2.4.1 Capabilities of the on-site support staff

PJM maintains a highly qualified and trained staff to provide support to the real time monitoring tools. The EMS and its associated applications are supported by Engineering Support that is in System Operations. This group has full time people on staff during normal business hours, which maintain the EMS database, the advanced applications, and troubleshoot EMS problems. This group is on-call to the control room staff on off-hours, to address real time problems.

Other real time applications are supported by Operations Development, which also reports to System Operations. This group is responsible for non-EMS applications that also comprise the set of tools for real time monitoring. They are also full time during normal business hours, with call out support for off-hours requests from the control room.

Backing up the System Operations support staff is the Information Technology Operations Center (ITOC). ITOC is staffed on site on a 24 x 7 basis with IT professionals with primary



responsibility for the corporate applications, some of which are used indirectly in the real time monitoring role. The ITOC is also the focal point for marshalling support forces in the off-hours to respond to control room concerns.

2.4.2 Change management process

Changes to the Real Time Monitoring Tools are implemented in accordance with the procedures contained in the Change Control Review Board. (See Attachment C – [Change Control Review Board](#)) [NERC Standard IRO-002, R9].



Section 3: SOL and IROL Limits

Welcome to the *Monitoring SOL and IROL Limits* section of the PJM Manual for **Reliability Coordination**. In this section, you will find the following information:

- Process for determining SOL and IROL limits
- How PJM monitors SOL and IROL limits

3.1 SOL and IROL Limit Determination

An Interconnected Reliability Operating Limit (IROL) is defined as the value (such as MW, MVAR, Amperes, Frequency, or Volts) derived from, or a subset of, the SYSTEM OPERATING LIMITS, which if exceeded, could expose a WIDESPREAD AREA of the BULK ELECTRICAL SYSTEM to instability, uncontrolled separations or cascading outages.

PJM performs an IROL analysis in the Planning and Operating Horizons. Planning studies are performed consistent with the ideology contained within M14 A through E, evaluating credible “double-contingencies” modeling firm transactions, consistent with planning criteria. Operating studies are performed consistent with the ideology contained within the PJM Transmission Operations Manual (M03), evaluating “single-contingencies”.

The Base Case is generally developed using both 50/50 (diversified and non-diversified) forecasted load levels, net PJM Interchange level determined from the MMWG Series case that is adjusted for firm point-to-point contracts associated with generation for recent RFC-NPCC(MEN)/RFC-SERC(VEM) analysis.

PJM typically screens a large set of possible limiting contingencies as identified in the MEN-VEM-TASG-OATF results at forecasted 50/50 (diversified and non-diversified) peak loads, facilities identified as contributory to the 2003 blackout, the RFC (ECAR) list of Critical Facilities, MAAC assessment limits, and operating experience.

PJM’s Operational methodology to determine IROL facilities simulates transfers across a facility or interface (combination of facilities), comparing thermal and voltage violations associated with a facility.

The transfers are simulated by increasing the load at the Sink (Control Area(s) or subset of Control Area) with the corresponding generation increase at the Source (typically west of the facility/interface being studied) until a voltage violations/collapse is reached.

Thermal Violations that do not result in wide-spread voltage violations / collapse are controlled via load shed procedures documented in PJM Manuals (PJM Transmission Operations Manual M03 -Section 2 and PJM Emergency Procedures Manual M13 - Section 5). These procedures require PJM to take emergency actions, including load dump to return flows below Emergency Ratings within 15 minutes and below Load Dump Ratings within 5 minutes. Transmission Owners are required to provide thermal ratings consistent timeline defined above.

PJM classifies a facility as an IROL facility on the PJM system if wide-area voltage violations occur at transfer levels that are near the Load Dump thermal limit. Under conditions where only a thermal violation exists, PJM staff will have sufficient time to dump load post-contingency to avoid voltage collapse, and therefore, the facility will not be classified as an



IROL facility. Exceptions to this criterion are evaluated on a case-by-case basis. Current IROL facilities are defines as follows:

Transfer Limit / Thermal Rating	Reportable IROL Violation
Eastern Reactive Transfer Interface	Flow exceeds Last Convergent Case Limit for 30 minutes (T _v)
Central Reactive Transfer Interface	Flow exceeds Last Convergent Case Limit for 30 minutes (T _v)
5004/5005 Reactive Transfer Interface	Flow exceeds Last Convergent Case Limit for 30 minutes (T _v)
Western Reactive Transfer Interface	Flow exceeds Last Convergent Case Limit for 30 minutes (T _v)
AP South Reactive Transfer Interface	Flow exceeds Last Convergent Case Limit for 30 minutes (T _v)
Bedington – Black Oak Reactive Transfer Interface	Flow exceeds Last Convergent Case Limit for 30 minutes (T _v)
AEP-DOM Reactive Transfer Limit	Flow exceeds Last Convergent Case Limit for 30 Minutes (T _v)
<u>Cleveland (CLVLND) Reactive Transfer Interface</u>	<u>Flow exceeds Last Convergent Case Limit for 30 Minutes (T_v)</u>
Kammer 765/500kV Xfmr. Thermal Rating	Post-contingency Simulated Flows exceed the Load Dump Limit for 30 Minutes (T _v)
Belmont #5 765/500 kV Xfmr Thermal Rating	Post-contingency Simulated Flows exceed the Load Dump Limit for 30 Minutes (T _v)

Any facility that is not considered an IROL facility and is 230kV or above is consider a System Operating Limit (SOL).

PJM Actions:

- Perform periodic review of facilities and margins as needed after seasonal assessment (OATF Inter regional Winter/Summer) studies are completed.
- Discuss identified IROL with the impacted TO/TOP(s).
- Developed Operations Guide for each IROL
- Document Transmission Operator load shedding program
- Develop PI display for each IROL
- Provide IROL training to system operators
- Develop IROL visualization



- Distribute Manual 37 documentation to external systems and provide a response to technical comments within 45 calendar days of receipt to include whether a change will be made to the SOL/IROL Methodology documentation, including reason.

PJM Member Actions

- Participate in periodic review of IROL facilities as part of seasonal assessment (OATF-Inter regional Winter/Summer).
- Discuss identified IROL with PJM staff.
- Understand IROL Operations Guide
- Document load shedding program
- Provide IROL training to system operators

3.2 Monitoring of SOL and IROL Limits

Monitoring of the SOL and IROL limits is accomplished through the use of the tools described in the PJM Transmission Operations Manual, M-03, Sections 2 and 3. [NERC Standard IRO-003, R1,R2]

PJM monitors SOL and IROL limits via the PJM EMS. PJM Dispatch prioritizes constraints based on the impact to System Reliability. IROL facilities are facilities that if exceeded have the potential to result in voltage collapse. All other monitored facilities that are not considered IROL facilities and are 230kV or above are considered System Operating Limits (SOL). Clear guidance and supporting procedures are essential to ensure proper prioritization when attempting to mitigate multiple constraints. This includes guidance when generating units are not following dispatch instructions and the appropriate use of Post-Contingency Local Load Relief Procedures. The following list of actions provides general prioritization guidelines, recommended operator actions, and associated timelines for SOL and IROL limits.

PJM Actions:

- PJM Dispatch shall confirm pre-/post-contingency flows and ratings with PJM TO/TOP or external RC.
- PJM Dispatch shall proactively propagate constraints into UDS in order to prepare for unanticipated system events. Constraints above 95% shall be propagated into UDS, but not necessarily bound.
- PJM Dispatch shall evaluate and prioritize constraints, looking for common controlling actions. In general, constraints shall be prioritized in the following manner. Actual violations may hold a higher priority depending on their magnitude and voltage level.
 - Non-Converged contingencies
 - IROL Violations
 - Reactive Transfers
 - Actual Violations
 - Contingency Violations



- PJM dispatch shall utilize UDS to ensure the proper re-dispatch of the system when unanticipated system events force multiple constraints.
- PJM Dispatch shall implement controlling actions in the following order if time permits:
 - Non-cost measures
 - Curtailing ~~Not-willing-to-pay~~ transactions that adversely impact constraint.
 - Cost-Effective re-dispatch
 - Dispatch sufficient generation to control constraints within the allotted timeframe.
 - Review regulation assignments and their impact on constrained operations. Localized constraints may require de-committing specific regulating units.
 - Direct generation shift via UDS and phone to ensure generation is following set-points.
 - Review initial dispatch orders to ensure cost-effective constraint control.
 - Monitor generation dispatch and contact units that are not performing.
 - Market-to-Market Re-dispatch
 - Emergency Procedures, including ~~safe operating mode~~ and TLR (note: TLR for excessive circulation may be declared prior to initiating off-cost). Curtail transactions that source/sink in priority order if there is insufficient time to declare TLR. Adjust internal curtailments per IDC.
 - If there are insufficient resources available to control constraints within 60 minutes, dispatch shall have formulated and communicated a load dump plan to impacted TO/TOP, issuing a Post-Contingency Local Load Relief Procedure.
 - Manually direct generation as required
- Report IROL Limit violation exceeding 30 minutes (T_v) or any SOL violations that have become an IROL violation because of changed system conditions to the Regional Reliability Organization (RRO) and NERC within 24 hours.
- Report SOL Limit violations exceeding 30 minutes. A violation is defined as a non-converged contingency or actual thermal overload violating a limit consistent with the facilities rating duration (i.e. normal limit = 24 hours, LTE limit = 4 hours).

PJM Member Actions:

- PJM Dispatch shall confirm pre-/post-contingency flows and ratings with PJM TO/TOP or external RC.
- TO/TOP Dispatch shall monitor facilities and communicate limit violations to PJM Dispatch.
- Generation Owner Dispatch shall follow UDS desired set point.
- Generation Owner Dispatch shall communicate generator issues that will prohibit units from following UDS desired set points.



A chart that demonstrates in which order PJM Reliability Coordinators prioritize constraints, available actions and associated timelines are included within this manual as Attachment D – Constraint Prioritization.



Section 4: Transmission Loading Relief (TLR)

This is the Transmission Loading Relief section of the *PJM Manual for Reliability Coordination*. In this section you will find the following information:

- How PJM uses TLR and other procedures to implement loading relief on transmission lines.

PJM monitors designated transmission facilities within the PJM RTO as well as tie-lines with adjacent interconnected control areas. When PJM determines overload conditions exist on any designated facility, or would exist for the first contingency loss of another facility, PJM will take all reasonable necessary action(s) to restore transmission facilities within operating security limits.

PJM will generally not use TLR to mitigate a transmission overload (actual or simulated) unless it has exhausted all other means available, short of load shedding (reconfiguration, re-dispatch within the PJM market area, market-to-market (M2M) re-dispatch with MISO, etc.).

During periods of excessive circulation, PJM may use TLR and curtail transactions that are not willing to pay congestion on the PJM system. However, under normal system conditions, PJM will re-dispatch internal generation to the extent possible and if more relief is needed, PJM will perform the following actions:

- Invoke the NERC Transmission Loading Relief Procedure, in accordance with NERC Standard IRO-006 and NAESB Business Practice WEQ-008
- Curtail external transactions and/or charge external customers for the cost of congestion as specified in the PJM Open Access Transmission Tariff

If all transactions for which transmission customers have elected not to pay through congestion have been curtailed and further relief is still required on the transmission facility, PJM will begin to curtail all transactions (internal and external) for which transmission customers have elected to pay through congestion, in priority order. [NERC Standard IRO-006, R1-R6]

PJM Actions:

- PJM implements all non-cost measures to control transmission flows.
- PJM curtails transactions with transmission service in PJM that are "not willing to pay through congestion".
- PJM adjusts output of generators off-cost to alleviate overloads/implements M2M.
- PJM re-dispatches to the fullest extent possible, excluding Maximum Emergency Generation, and initiates the NERC TLR procedure.
- PJM curtails external transmission customers not willing to pay through congestion and charges other external customers willing to pay for the cost of congestion, as set forth in the PJM Open Access Transmission Tariff.
- PJM curtails transmission customers willing to pay through congestion (and no longer charges those curtailed for congestion) in priority order.



PJM Member Actions:

- External transmission customers may elect, in accordance with section 1.10.6A of the Open Access Transmission Tariff, to pay congestion charges during Transmission Loading Relief in the PJM RTO.
- PJM transmission customers may elect to curtail their own transactions at any time if congestion charges have become too great.



Section 5: Coordination with Neighboring Reliability Coordinators

Welcome to the *Coordination with Neighboring Reliability Coordinators* section of the **PJM Manual for Reliability Coordination**. In this section, you will find the following information:

- A summary of coordination agreements between PJM and neighboring Reliability Coordinators.
- How PJM communicates with neighboring Reliability Coordinators.
- How PJM works with neighboring Reliability Coordinators to mitigate operational problems.

5.1 Agreements with Neighboring Reliability Coordinators

PJM has developed coordination agreements with its neighboring Reliability Coordinators, as follows:

Joint Operating Agreement between the Midwest Independent
Transmission System Operator, Inc. and PJM Interconnection, L.L.C.

(See PJM Website link:

<http://www.pjm.com/documents/agreements/~media/documents/agreements/joa-complete.ashx>)

Joint Reliability Coordination Agreement among and between Midwest
Independent Transmission System Operator, Inc., PJM Interconnection,
L.L.C., and Tennessee Valley Authority

(See PJM Website link:

<http://www.pjm.com/~media/documents/agreements/joint-reliability-coordination-agreement-miso-pjm-tva.ashx>)

Joint Operating Agreement between New York Independent System Operator, LLC and PJM Interconnection, L.L.C.

(See PJM Website link:

<http://www.pjm.com/documents/agreements/~media/documents/agreements/20071102-nyiso-pjm.ashx>)

Joint Operating Agreement between VACAR South and PJM Interconnection, L.L.C.

(See PJM Website link:

<http://www.pjm.com/documents/agreements/~media/documents/agreements/executed-pjm-vacar-rc-agreement.ashx>)



Joint Operating Agreement between Progress Energy Carolinas and PJM Interconnection, L.L.C.

(See PJM Website link:

<http://www.pjm.com/~media/documents/agreements/20081114-progress-pjm-joa.ashx>)

The coordination agreements detail requirements to which both parties are committed to preserve reliability. The agreements address a wide range of topics, including data exchange, ATC calculation, outage coordination, emergency operations, etc. These agreements provide for the ongoing cooperation between the signatories by the establishment of joint operating committees that meet periodically to discuss and resolve operational issues. [NERC Standard IRO-014, R1, R2, R3, R4]

5.2 Communications with Neighboring Reliability Coordinators

5.2.1 Communications Facilities

PJM communicates with its neighboring Reliability Coordinators in a number of ways, governed by the urgency of the issue. The communications vehicles include:

- Regular telecommunications over the public switched telephone network
- Satellite telephones
- E-mail
- Reliability Coordinators Information System (RCIS)
- NERC Hotline

5.2.2 Required Notifications

Certain operational situations are of a magnitude that notification to neighboring Reliability Coordinators is necessary. These situations are explained in PJM Manual M-13, Emergency Operations. They include:

- Capacity Emergencies
- Extreme Weather—e.g. Tornadoes, Hurricanes, Extreme Temperatures, Solar Magnetic Disturbances, etc.
- Sabotage or Terrorism Incidents (if the event is significant to the PJM system and may impact neighboring systems)
- Transmission Security Emergencies—Heavy Load/Low Voltage situations, IROL limit violations (if the emergency could cause an impact on the neighboring Reliability Coordinator's system)
- Other events—Events which are of such a nature or magnitude that they could impact the operations of the neighboring Reliability Coordinator(s), in the judgment of the operator.

In addition, the PJM Reliability Coordinator is responsible to monitor system frequency and ACE control ~~for the OVEC and PJM Balancing Authorities.~~



The preferred communications method in the above situations is the telephone with a message also being entered on the RCIS. [NERC Standard IRO-015, R1]

PJM Actions:

- Monitor the transmission system and other media news and weather outlets to identify threats or risks to the reliability of the system.
- If an emergency situation, identified above, is in progress, or imminent, provide notification to the neighboring Reliability Coordinators by phone or conference call. Also, enter a message on the RCIS. If the situation is of a magnitude that coordinated action or assistance may be necessary, organize a conference call on the NERC hotline, commercial teleconferencing service, or Critical Warning Information Network (CWIN).
- If the situation is sabotage or terrorism related, notify the appropriate law enforcement authorities.
- Once the situation is concluded, provide a notification as in 2 above that the situation has been concluded and that no further action is required.

PJM Member Actions:

- Monitor system conditions and identify potential or actual emergency situations to PJM as soon as possible to permit PJM to organize assistance from the neighboring Reliability Coordinators, if required.
- Follow directives from PJM that may come from neighboring Reliability Coordinators to implement action to mitigate the emergency situation.

5.3 Mitigating Operational Problems

Rapid, coordinated action is sometimes necessary to mitigate or alleviate an operational problem. Such action may require assistance from a neighboring Reliability Coordinator(s). In these situations, clear, concise communications are necessary to develop a coordinated action plan that can be implemented quickly. When working with other Reliability Coordinators, the key is to gain a mutual understanding of the problem at hand and how the other Reliability Coordinator may be of assistance. When a mutually agreed upon course of action cannot be developed, then implement the most conservative course of action. [NERC Standard IRO-016, R1]

PJM Actions:

- As part of the notification processes described above, or immediately thereafter, contact the neighboring Reliability Coordinator, if there is the potential for assistance. Concisely, yet fully, explain the situation and how the neighboring Reliability Coordinator could be of assistance.
- Be responsive to the needs of the neighboring Reliability Coordinator to require additional information to assess their ability to provide assistance. Provide any necessary information that may be needed to analyze the situation and develop a corrective action. [NERC Standard IRO-015, R3]
- PJM Reliability Coordinator shall document, in PJM SmartLog system, the need to enhance the PJM EMS Bulk Electric System external model based on real-time



system conditions. The PJM Reliability Coordinator shall communicate the need to enhance the PJM EMS Bulk Electric System external model to PJM Engineering Support via e-mail.

- Work to achieve a consensus on the course of action to be followed. In the absence of a consensus, adopt the most conservative course of action. Through the course of the discussions and during the implementation of the course of action, document steps taken and points of disagreement in the operator logs. [NERC Standard IRO-016, R2]

PJM Member Actions:

- Follow directives from PJM that may come from neighboring Reliability Coordinators to implement action to mitigate the emergency situation.

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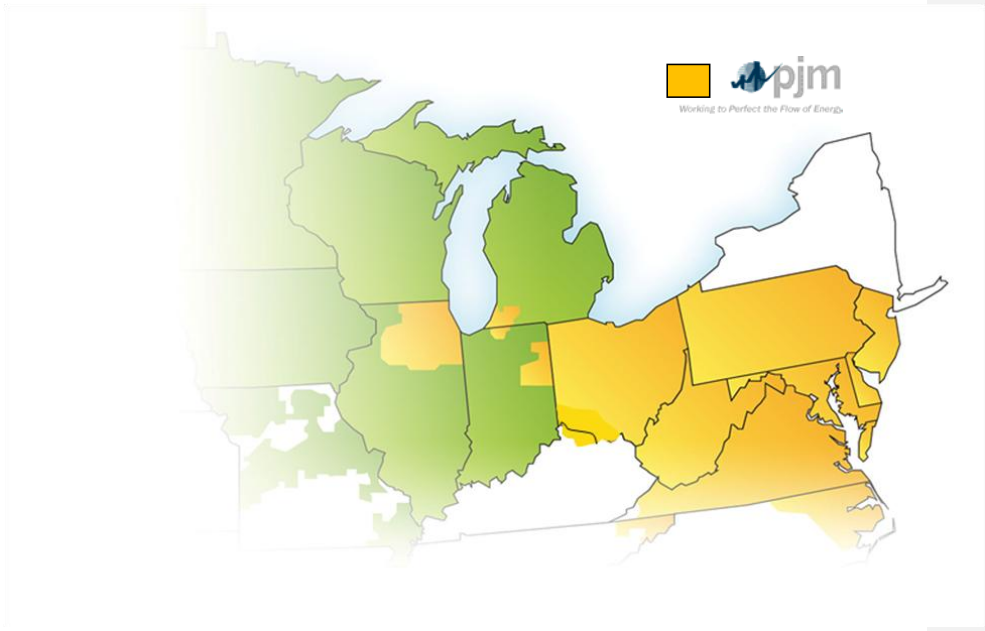
Attachment A: PJM Reliability Plan



Working to Perfect the Flow of Energy

PJM RTO Reliability Plan

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Introduction

The North American Electric Reliability Council (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.

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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) Standards. PJM operates in multiple NERC RROs and recognizes each RRO's policies and standards.

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This plan supersedes the previous PJM RTO Plan. This plan is provided to document the entry of the following systems into the PJM BA as follows:

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American Transmission Systems, Inc.
(NCR00686) Effective date: June 1, 2011

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Duke Energy—Ohio & Kentucky
(NCR00761 partial) Effective date: January 1, 2012

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City of Cleveland, Department of
Public Utilities, Division of Cleveland Public
Power (NCR00712) Effective date: June 1, 2011

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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 that all PJM members have executed (See Appendix A). PJM has clear decision-making authority to act and to direct actions to be taken by its members within its Reliability Coordination Area to preserve the integrity and reliability of the Bulk Electric System.

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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.

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1.2 PJM has clear decision-making authority to act and to direct actions to be 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.

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

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2. Independence - PJM will act in the best interest of insuring 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).

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3. PJM Directives Compliance - Per the governing documents (see Appendix A), the PJM local control centers and OVEC 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

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1. PJM has not delegated any Reliability Coordination tasks.

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

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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.

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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 that entities within its Reliability Coordination Area always operate under known and studied conditions and that 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 analysis 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 also e-mailed 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 the 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 directives – PJM uses a number of communications tools for issuing/receiving of directives. The primary communications means is the PJM All-Call System (All-Call) which is a dedicated telephone-based system which sends the directive / message to all control centers simultaneously and confirms response. In addition, PJM will issue follow the verbal message with Emergency Procedures messages on its website through a specific application that runs within its eDATA tool and as well direct phone contact as necessary.



D. Next Day Operations

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

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

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On a daily basis, PJM conducts next-day security analysis 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 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 redispatch, 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.

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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 ten minutes. For entities outside PJM, SDX files are downloaded and loaded into appropriate systems.

3. 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 distributed to PJM and member operations staff and neighboring Reliability Coordinators via e-mail. 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 analysis 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 that, 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 an actual voltage collapse as the limit, and PJM operates to maintain flows below the 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.

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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.

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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.

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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, Special Protection Systems, 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 Special Protection Systems.

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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 that they are 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 and System Frequency are displayed in a trend chart to the PJM Generation Dispatcher as part of the BAAL field test. PJM is participating in the NERC BAAL field test and adheres to this system control requirement.

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 dispatching 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. The eDart application tickets, once approved and implemented, automatically update the EMS model.

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

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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 Enhanced Electronic Scheduling (EES) 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 and 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 as needed.
- 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 redispatch, 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. Since PJM is participating in the NERC Balancing Standard Field Test, if the BAAL is outside of the acceptable range, then 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 Special Protection Systems (SPS) including any degradation or potential failure to operate as expected by the local control center. PJM factors these SPS 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

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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) that PJM will direct until relief requested by the TLR process is achieved.

2. PJM utilizes PJM Manual M-13, Emergency Operations, when it determines that IROL violations are imminent. PJM Emergency Operations documents the processes and procedures that 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 a 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 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.

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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.

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4. PJM monitors its ACE, and directs action to assist in maintaining system frequency to return within L₁₀ or BAAL limits as appropriate.

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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 that 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.

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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.

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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 ISN.

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I. Facility

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.

1. 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.

2. 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.

3. 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 that potential or actual System Operating Limit of Interconnection Reliability Operating Limit violations are identified.

3.1 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.

4. Study and Analysis Tools

4.1 PJM has adequate analysis tools, including state estimation, pre-and post-contingency analysis capabilities (thermal, stability, and voltage), and wide-

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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 that 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
- Transmission Limit Calculator
- Voltage Stability Analysis (VSA)
- Transient Stability Analysis (TSA)
- Enhanced Electronic Scheduling (EES)
- Security Constrained Economic Dispatch (SCED)
- Dispatcher Management Tool (DMT)

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

4.2 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.

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J. Staffing

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

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1 Shift supervisor*

2 Generation dispatchers*

3 to 4 Transmission dispatchers*

1 or 2 Master Coordinators

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 certification¹.

• 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 Standards.

Each week, one of the shift teams is assigned to training.

The training program consists of a set curriculum which includes tests that each person must successfully complete. At a minimum, each person must complete a minimum of 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.

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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 that 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 that 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 every year. Training records are maintained.

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APPENDIX A – PJM Governing Documents

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PJM Operating Agreement

(PJM Website link: <http://www.pjm.com/documents/downloads/agreements/oa.pdf>)

PJM Transmission Tariff

(PJM Website link:
<http://www.pjm.com/documents/downloads/agreements/tariff.pdf>)



APPENDIX B – Agreements with External Entities

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Joint Operating Agreement between the Midwest Independent Transmission System Operator, Inc. and PJM Interconnection, L.L.C.

(See PJM Website link: <http://www.pjm.com/documents/downloads/agreements/joa-complete.pdf>)

Joint Reliability Coordination Agreement among and between Midwest Independent Transmission System Operator, Inc., PJM Interconnection, L.L.C., and Tennessee Valley Authority

(See PJM Website link:

<http://www.pjm.com/documents/downloads/agreements/20050422-jrca-final.pdf>)

Midwest Independent Transmission System Operator, Inc., PJM Interconnection, L.L.C., and Tennessee Valley Authority

Congestion Management Process

(See PJM Website link:

<http://www.pjm.com/documents/downloads/agreements/041805-miso-tva-pjm-cmp.pdf>)

Joint Operating Agreement between New York Independent System Operator, LLC and PJM Interconnection, L.L.C.

(See PJM Website link:

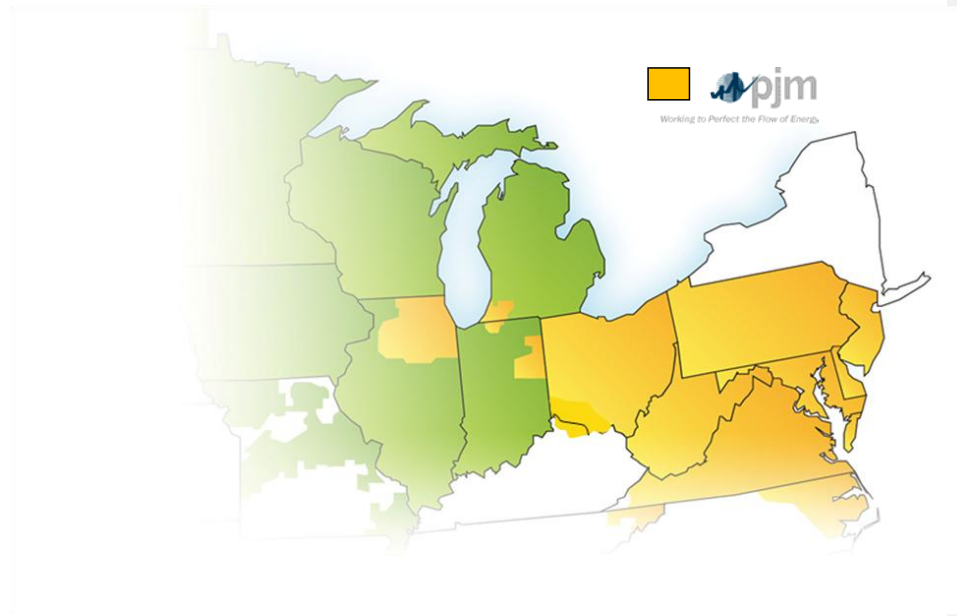
<http://www.pjm.com/documents/downloads/agreements/20071102-nyiso-pjm.pdf>)

Joint Operating Agreement between VACAR South and PJM Interconnection, L.L.C.

(See PJM Website link:

<http://www.pjm.com/documents/downloads/agreements/executed-pjm-vacar-rc-agreement.pdf>)

APPENDIX C: PJM Reliability Area Map



PJM-RTO Reliability Plan

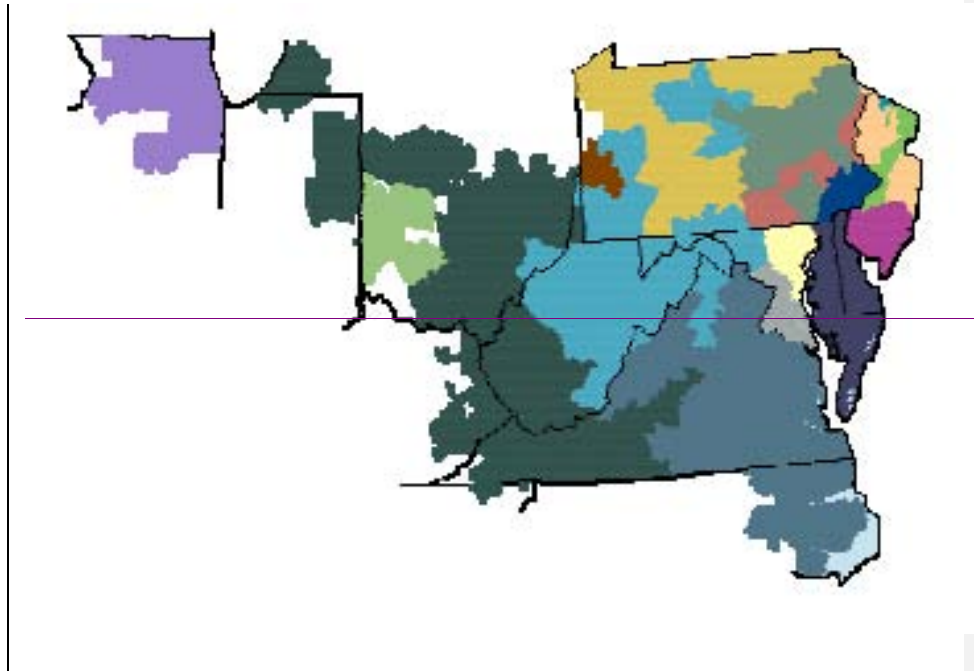




Table of Contents

Introduction.....20

A. Responsibilities — Authorization.....21

B. Responsibilities — Delegation of Tasks.....22

C. Common Tasks for Next-Day and Current-Day Operations.....23

D. Next-Day Operations.....25

E. Current-Day Operations.....27

F. Emergency Operations.....32

G. System Restoration.....34

H. Coordination Agreements and Data Sharing.....35

I. Facility.....36

J. Staffing.....38

Appendix A.....40

Appendix B.....41

Appendix C.....42



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 also provides Reliability Coordination Services for Ohio Valley Electric Cooperative (OVEC) under a separate agreement. (PJM is the Transmission Operator as defined in the NERC Functional Model and takes action through its transmission owners, who operate Local Control Centers.)

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 RRO Standards. PJM operates in multiple NERC Regional Reliability Organizations (RRO) and recognizes each Region's policies and standards.

This plan supersedes the previous PJM RTO Plan.



A. Responsibilities—Authorization

1. Authority to Act—PJM is responsible for the reliable operation of the Bulk Power 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 that all PJM members have executed (See Appendix A). PJM has clear decision-making authority to act and to direct actions to be taken by its members and OVEC within its Reliability Coordination Area to preserve the integrity and reliability of the Bulk Power 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 and Regional 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 to be taken by its members and OVEC 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 insuring 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 Directives Compliance—Per the governing documents (see Appendix A), the PJM Local Control Centers and OVEC 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, or 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 MISO and seam agreements 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 and RRO 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 that entities within its Reliability Coordination Area always operate under known and studied conditions and that 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 (T_r).~~

~~On a daily basis, PJM conducts next-day security analysis 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 also e-mailed to the PJM local control centers and neighbors. Mitigation plans are formed as needed for potential violations determined in the next day security analysis. Details of the PJM study process is documented in PJM Manual 38: Operations Planning.

In real time, PJM relies on its telemetry and real-time analysis tools to monitor the 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. (There are a limited number of lower voltage facilities that are not operated on a pre-contingency basis, but these are very few in number.)

4. PJM and OVEC both provide 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 ALLCALL system and real-time via voice and messaging.

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



D. Next-Day Operations

This section documents how PJM conducts next-day reliability analysis for its Reliability Coordination Area. Details of the PJM study process is documented in PJM Manual 38: Operations Planning.

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

On a daily basis, PJM conducts next-day security analysis 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 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 redispatch, 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 ten minutes. For entities outside PJM, SDX files are downloaded and loaded into appropriate systems.

3. 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 Central Standard Time unless circumstances warrant otherwise.



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

~~Daily Powerflow Study Cases are posted to a secure site with access available to Reliability Coordinator(s), TOP(s), or TO(s) upon request.~~



E. Current Day Operations

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

1. PJM uses a suite of real-time network analysis tools to continuously monitor all Bulk Electric System facilities, including sub-transmission information as needed, within the PJM Reliability Coordination Area and adjacent areas, as necessary, to ensure that, 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 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. PJM State Estimator Model currently includes 13,145 buses and utilizes approximately 97,500 ICGP points. This model is updated quarterly and may be updated on-demand for emergencies.

Real Time Contingency Analysis (RTCA) is performed on 4,125 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 an actual voltage collapse as the limit, and PJM operates to maintain flows below the 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 100 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 documented seams 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 Electric System elements (transmission or generation including critical auxiliaries) such as Automatic Voltage Regulators, Special Protection Systems, 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 Special Protection Systems.~~

~~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 realtime indicate that they are 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 is displayed in a trend graph to the PJM Generation Dispatcher. When ACE exceeds designated thresholds, the graph changes colors and alerts the operator of magnitude of ACE and duration ACE has exceeded the designated threshold. PJM is also participating in the NERC BAAL test and also adheres to this operating requirement.

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 dispatching is performed for the PJM balancing authority area by the PJM Generation Dispatcher using the Unit Dispatch System (UDS), which is a single economic constraint controlled dispatch for the entire RTO. OVEC is responsible for dispatching its own generation.

3.9. Planned transmission or generation outages are reported to PJM via the eDART application. The eDart application tickets, once approved and implemented, automatically update the EMS model.

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 Electric 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 Enhanced Electronic Scheduling (EES) 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 a 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/Contingency/Synchronized Reserves versus each Regional requirement to ensure the required amount of Operating/Contingency/Synchronized 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 as needed.~~

~~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 redispatch, or emergency procedures to relieve the potential or actual IROL violation without delay, and no longer than 30 minutes (T.). 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 via trend graph and receives a visual indication when ACE exceeds designated threshold. Since PJM is participating in the NERC Balancing Standard Field Test, if the BAAL is outside of the acceptable range, then 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 violations, CPS 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, Transmission Operator or Reliability Coordinator for the RTO from neighboring Reliability Coordinators via the Energy Emergency Alert (EEA), Transmission Emergency Alert or Security Emergency Alert 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 Special Protection Systems (SPS) including any degradation or potential failure to operate as expected by the local control center. PJM factors these SPS changes into its reliability analysis 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 for Emergency Operations (M-13), and Attachment D: Constraint Prioritization 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 (T_v). This procedure includes the actions (e.g. reconfiguration, re-dispatch or load shedding) that PJM will direct until relief requested by the TLR process is achieved.

2. PJM utilizes PJM Manual M-13, Emergency Operations, when it determines that IROL violations are imminent. PJM Emergency Operations documents the processes and procedures that PJM follows when directing the redispatch 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 seam coordination 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 a 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. In OVEC, PJM will direct reconfiguration and re-dispatch to resolve 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 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 L10 or 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 seams agreements listed in Appendix B. PJM also drills at least annually with its' members and neighboring RCs on Emergency procedures.~~
- ~~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 that PJM uses to mitigate the emergency condition, including a request for emergency assistance if required.~~
- ~~7. PJM also conducts semi-annually Emergency procedures drills with its members.~~



G. System Restoration

~~1. Knowledge of PJM Members' Restoration Plans – PJM is aware of each member's Restoration Plan and has a written copy of each plan. PJM has the plans and procedures of every transmission-owning member. 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 semi-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 ISN.



I. Facility

~~PJM performs the Reliability Coordinator function at the Valley Forge and Milford (June 2008), PA sites along with a local Valley Forge back up facility. All facilities 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.~~

~~1. Adequate Communication Links – PJM maintains satellite phones, cellular phones, and redundant, diversely routed telecommunications circuits. There is also a video links between Control Rooms.~~

~~2. 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.~~

~~3. 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 that potential or actual System Operating Limit of Interconnection Reliability Operating Limit violations are identified.~~

~~3.1 PJM monitors Bulk Electric System 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 Electric System elements that are, or could be, critical to SOLs and IROLs and system restoration requirements within its Reliability Coordination Area.~~

~~4. Study and Analysis Tools~~

~~4.1 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 that 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~~
- ~~Transmission Limit Calculator~~
- ~~Voltage Stability Analysis (VSA)~~
- ~~Enhanced Electronic Scheduling (EES)~~
- ~~Unit Dispatch System (UDS)~~
- ~~Dispatcher Management Tool (DMT)~~
- ~~OSI-PI Displays~~
- ~~Transient Stability Analysis (TSA)~~

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

~~4.2 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*

3 to 4 Transmission dispatchers*

1 to 2 Master Coordinators*

In addition, 1 or more Reliability Engineers* is on shift from 5:00 AM to 12:00 midnight, 7 days per week.

*All people in these positions possess the required NERC Certification.

*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 Standards.

Each week, one of the shift teams is assigned to training. The training program consists of a set curriculum which includes tests that each person must successfully complete. At a minimum, each person must complete the necessary training to maintain NERC Credentials and training requirements defined in the PJM Certification and Training Requirements—Manual 40. Additional training and drills are conducted 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 that 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 that 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 every year. Training records are maintained.~~



APPENDIX A—PJM Governing Documents

PJM Operating Agreement

(PJM Website link:

<http://www.pjm.com/documents/agreements/~media/documents/agreements/oa.ashx>)

PJM Transmission Tariff

(PJM Website link:

<http://www.pjm.com/documents/agreements/~media/documents/agreements/tariff.ashx>)

PJM/OVEC Reliability Coordination Agreement



APPENDIX B—Agreements with External Entities

Joint Operating Agreement between the Midwest Independent
Transmission System Operator, Inc. and PJM Interconnection, L.L.C.

(See PJM Website link:

<http://www.pjm.com/documents/agreements/~media/documents/agreements/joa-complete.ashx>)

Joint Reliability Coordination Agreement among and between Midwest
Independent Transmission System Operator, Inc., PJM Interconnection,
L.L.C., and Tennessee Valley Authority

(See PJM Website link:

<http://www.pjm.com/~media/documents/agreements/joint-reliability-coordination-agreement-miso-pjm-tva.ashx>)

Midwest Independent Transmission System Operator, Inc., PJM
Interconnection, L.L.C., and Tennessee Valley Authority

Congestion Management Process

(See PJM Website link:

<http://www.pjm.com/documents/agreements/~media/documents/agreements/20080502-miso-pjm-tva-baseline-cmp.ashx>)

Joint Operating Agreement between New York Independent System Operator, LLC and
PJM Interconnection, L.L.C.

(See PJM Website link:

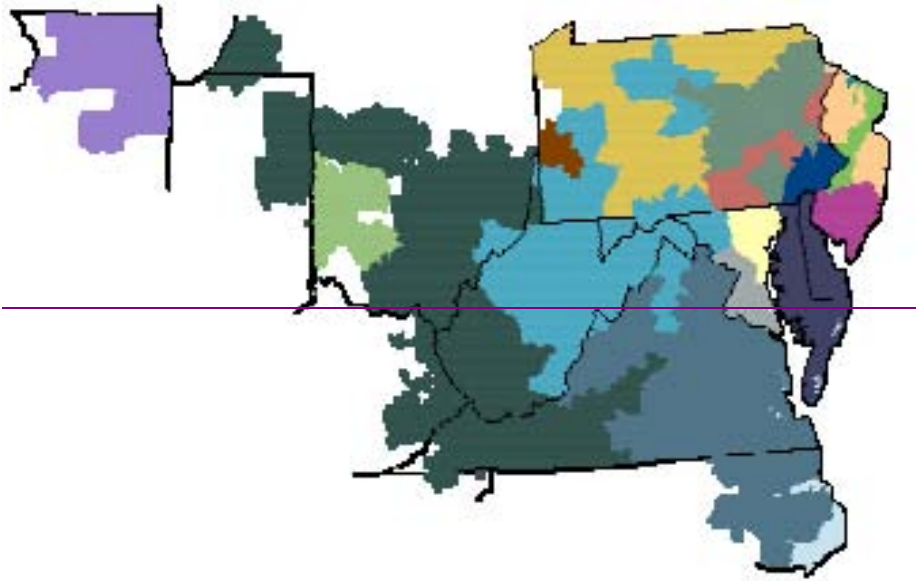
<http://www.pjm.com/documents/agreements/~media/documents/agreements/20071102-nyiso-pjm.ashx>)

Joint Operating Agreement between VACAR South and PJM Interconnection, L.L.C.

(See PJM Website link:

<http://www.pjm.com/documents/downloads/agreements/executed-pjm-vacar-rc-agreement.pdf>)

APPENDIX C: PJM Reliability Area Map





Attachment B: Excerpt from PJM Operating Agreement

Excerpt from PJM Operating Agreement, Section 10.4, as it pertains to the authority of PJM [addressing NERC Standard IRO-001-2, R2]. PJM shall:

- iv) Comply with NERC, and Applicable Regional Reliability Organization (RRO) operation and planning standards, principles and guidelines;
- v) Maintain an appropriately trained workforce, and such equipment and facilities, including computer hardware and software and backup power supplies, as necessary or appropriate to implement or administer this Agreement;
- vi) Direct the operation and coordinate the maintenance of the facilities of the PJM Region used for both load and reactive supply, so as to maintain reliability of service and obtain the benefits of pooling and interchange consistent with this Agreement, and the Reliability Assurance Agreement;
- vii) Direct the operation and coordinate the maintenance of the bulk power supply facilities of the PJM Region with such facilities and systems of others not party to this Agreement in accordance with agreements between the LLC and such other systems to secure reliability and continuity of service and other advantages of pooling on a regional basis;



Attachment C: Change Control Review Board



**Information Technology & Services
–Business Process**

Change Control Review Board



Table of Contents

TRANSFER LIMIT / THERMAL RATING	9
REPORTABLE IROL VIOLATION	9
TABLE OF CONTENTS	<u>7248</u>
1.0 PURPOSE / BACKGROUND	<u>7349</u>
1.1 PURPOSE AND DEFINITION	<u>7349</u>
1.2 BACKGROUND	<u>7450</u>
2.0 CHANGE CONTROL REVIEW BOARD	<u>7753</u>
2.1 MEMBERSHIP	<u>7753</u>
2.2 WEEKLY MEETINGS	<u>7753</u>
2.3 CCRB MEETING AGENDA	<u>7854</u>
3.0 CHANGE CONTROL REVIEW BOARD CHANGE PROCESSES	<u>7955</u>
3.1 GENERAL CHANGES	<u>7955</u>
3.2 EMERGENCY AND FAST-TRACK CHANGES	<u>8157</u>
3.3 CHANGE FREEZE PROCESS	<u>8258</u>

1.0 Purpose / Background

1.1 Purpose and Definition

This document defines the new Change Control Review Board and outlines its processes. The proposed Change Control Review Board (CCRB) will replace the current Change Management Board (CMB) meeting and its philosophy. The major difference between the two processes is the change in frequency of the meetings. The new CCRB will now meet and review changes on a weekly basis, on Wednesday's, with a follow-up meeting on Friday. Among other benefits, the shift to weekly CCRB meetings should promote better change planning and communication processes.

Note: We will continue to use the Dimensions product as our Enterprise Change Management tool, until further notice.

CCRB Communication Plan:

- Move this document through the formal PJM process/procedure approval process.
- Once the procedure and process have been approved, communicate to all employees via email, or point them to a location via PJM Post. Re-iterate the implementation date.
- Hold training and Q&A sessions to educate staff on the new Change Control Review Board process, paying particular attention to the culture change associated with the transition from daily to weekly meetings.
- Communicate success/areas of improvement to user community one month after implementation, including new change management metrics.

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1.2 Background

PJM System Complexity:

PJM develops and maintains extremely complex, integrated computer systems. A proposed change to one application could have downstream impacts on one or more other applications. Currently, PJM does not employ a configuration management system, nor do they have a department or staff who knows all integration and or “touch-points” throughout the computing environment.

CCRB Benefits:

- Minimize system disruption due to uncontrolled changes to major components of PJM systems through an additional level of planning and change scrutiny.
- Ensure that impact/potential impact of a change is known and mitigated by conducting a more thorough review of each change by representative areas within PJM.
- Improved and clearer communications on approved changes and their impacts to a wider PJM audience due to additional impacts or potential impacts being identified.
- Increased knowledge on PJM production system configurations by a wider audience through the discussion of changes and their impacts (assist in the development of product support teams).
- Assists in the development and use of a configuration management process/repository.

CCRB Critical Success Factors:

- ITS and business buy-into this culture change (realization that this is not a “slow-down” or “red tape” but an actual focus on quality improvement).
- Attendance is required by senior level SMEs from across PJM so that the impact discussions are happening and the changes are reviewed properly.
- Authority for the board to to “reject” a change in which all impacts are not known or planning complete.
- The board members (and alternates) need to thoroughly understand and execute the process consistently and have the right level expertise to execute it.

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Planning and Testing:

The current daily CMB process does not lend itself to ensuring that proper planning or testing of changes has or will occur if the change is challenged. Additionally, the daily meeting does not lend itself to conducting a thorough review of a proposed change nor does it lend itself to having in attendance the proper SMEs due to daily workloads.

CCRB Benefits:

- Increase the operational efficiency in which changes are handled and completed.
- Ensure that a change has been tested completely before being introduced into PJM production systems.
- To maximize service periods, consolidating changes where appropriate to lessen the impact on PJM systems.
- Allow PJM resources to plan their work week by affording them the opportunity to know what changes are planned for the upcoming week and when and how they need to be involved.

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CCRB Critical Success Factors:

- Enhanced testing processes and procedures.
- Templates and calendars need to be developed in order to facilitate the meeting and communicate the board's decisions/actions.

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Reporting and Auditing:

PJM currently does not report the status of changes outside of the daily meeting. The CMB does not report on successful implementations, changes that were postponed, failed changes, or emergency changes.

CCRB Benefits:

- Provide an improved audit trail on why, when, how, and by whom changes were introduced to PJM systems based on reporting.
- Improved change metrics/reports – success, failure, emergency change use.

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- Enables other operational excellence processes to move to an improved state – Daily Service Review (DSR's) become more effective, ESR problems are easier to troubleshoot.

CCRB Critical Success Factors:

- Meaningful metrics can be collected and maintain and timely reports can be generated from the metrics.
- Reports will be reviewed and acted upon by each area reported upon.

Future Considerations:

CCRB benefits:

- Ensure the update of configuration items and baselines.
- Control changes to configuration items and baselines.
- Potential to allow members/participants to sit-in on meeting so that they are aware, first-hand of PJM system changes.
- Ensure continuous improvement of the change management process in fulfilling the relevant business objectives of the organization.

CCRB Critical Success Factors:

- Recognize ~~flaws~~ in the process early on and correct them immediately.
- Need to develop a ~~change scheduler~~ role to ensure that planned changes start and complete in their allotted time. Currently the Support Center has been identified in this role.
- A viable exception process whose use cannot be used to easily circumvent the normal process.

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2.0 Change Control Review Board

2.1 Membership

CCRB Core Team:

- The current CMB Core Team function will be incorporated into the new CCRB process. The team will be known as the ‘_CCRB Core Team’ and will operate in an advisory role, providing input into the CCRB process.

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CCRB Daily Operations:

- The Weekly Change Control Review Board membership will be comprised of IT Operations Center (ITOC) personnel.
- The ITOC Sr. Specialists will serve as the CCRB Chairperson on a weekly, rotational basis. In their absence, the Manager – IT Operations Center will serve as the CCRB Chairperson. If neither party can support the meeting, the IT Manager-on-Duty (MOD) will be responsible to facilitate the CCRB meeting.
- Those ITOC personnel on regular day shift will make up the remainder of the board for purpose of attending the weekly meeting and performing reviews of upcoming changes.

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2.2 Weekly Meetings

- The CCRB will meet every Wednesday from 10:00 am to 12:00 pm in the (room to be determined). A conference bridge will be available to enable remote participation in the CCRB.
- The CCRB Chairperson will have sole responsibility for determining the final disposition of each change based on the recommendation of the board.
- The Chair person is responsible for chairing the weekly CCRB meeting at which upcoming changes [at CMB_APPROVE] are discussed, approved, and scheduled for the following week.
- All CCRB areas and or product lines in Dimensions are expected to send a senior level PJM FTE to the weekly meeting in an advisory role. The ‘_senior level’ designation will be left up to the discretion of the Manager and the CCRB. These areas are:
 - AIX Infrastructure
 - Windows Infrastructure

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- Decision Support Systems
- Network Infrastructure
- All Application Areas
 - Corporate Applications
 - Market Applications
 - Operations Applications
- Attendance for each area will be taken and reported to management in the CCRB report. If a Dimensions product is not represented at the weekly meeting, the board shall become the default representative for the absent Dimension product representative.

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2.3 CCRB Meeting Agenda

- Review all upcoming production environment change requests submitted to the CCRB by the change coordinator as follows:
 - Approve if appropriate.
 - Modify on the spot if possible, and approve if appropriate.
 - Send back to requester for additional information for the Friday meeting.
 - Cancel at the discretion of the board.
- Disputes will be escalated to senior management by the CCRB if they cannot be resolved at the meeting.

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3.0 Change Control Review Board Change Processes

3.1 General Changes

- As stated earlier, we will continue to use the Dimensions product as our Enterprise Change Management tool (until further notice). The current Product IDs, Change Types (SCR, CR and CR_NO_TEST, etc) and other required information will remain the same. The processes outlined below speak in general terms and do not distinguish between changes that require esting, and those that do not. Therefore, changes that currently do not require testing or testing documentation (CR_NO_TEST), can disregard those references below.
- For a change to be considered by the CCRB, the change record in Dimensions must include the following:

Note: The *Change Management Inclusion Reference Guideline (DOCS #204178)* will remain the decision point in regards to what requires Full Change Management, what requires Change Management Awareness and what is Excluded from Change Management.

- An implementation start-time and end time.

Note: *ON-GOING CHANGES ARE NO LONGER VALID.* Every change must have an exact start and end time. The concept is to reduce the inefficiency of open ended changes and to promote better planning practices, so please plan accordingly for changes that could span long periods of time. There are discussions underway to design and implement maintenance windows, which may alleviate the need for some changes that currently fall into the on-going category.

- A detailed change description and migration plan, including information on departments and systems affected.
- A detailed impact assessment plan, approved by the QA Verifier.
- A detailed production test plan.
- A detailed communication plan, taking into account the nature of the change and its potential impacts/risks. Some communication plans will be more comprehensive than others, relative to the associated impact and risk. Communication plans will be reviewed by the CCRB and modified where necessary.
- A detailed back-out plan.

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- Test result documentation, if applicable
- The appropriate staff resources have been notified and officially assigned to the change.
- Each change represented at the board will have one of the following statuses at the end of the meeting:
 - **Approved** – the change has a completed and comprehensive communication plan, migration plan, back out plan, and has been tested. Changes that are approved can be scheduled for production release, as early as Thursday (day after Wednesday meeting) at noon.
 - **Approved, Not Tested** - the change has a completed and detailed communication plan, migration plan, and back out plan. The change is being tested and will have completed testing prior to implementation. Changes that are approved, not tested can be scheduled for production release, as early as Monday morning the following week, providing the change has been approved at the Friday follow up meeting.
 - **Conditional Approval** - the change is lacking a completed and detailed communication plan, migration plan, or back out plan but will be completed within the next 48 hours. The change will be reviewed again at the Friday meeting and approved if all plans are in order a scheduled date and time will be given to the change and it will be placed on the calendar for implementation as early as Monday morning the following week.
 - **Rejected** – the impact of the change cannot be determined or has not been coordinated properly, the change is lacking more than one plan or the plans do not contain enough detail, or because the change will severely impact the business or because business condition prevent its implementation.
- On the Friday following the Wednesday CCRB meeting, there will be a brief 30 minute review meeting at 13:00. This meeting will be for any change that was represented at the CCRB that was given conditional approval based upon the receipt of additional information or planning. The board will review the conditional changes to see if they meet the criteria for approval. The CCRB WILL NOT discuss new changes at this meeting.
- A post-change review on all changes will be conducted by the Daily Service Review board at the daily DSR meeting (to be defined). All emergency, failed, missed, or changes not completed in there allotted time will be reviewed by the DSR board, as a process improvement measure. Emergency change owners will be required to represent

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their change at the daily DSR meeting so that impacts to other products and or lessons learned can be identified. The results of emergency changes will then be published.

- The CCRB board will identify and resolve any discrepancies in impact levels of changes.
- CCRB approved changes will be discussed at the DSR meeting on the day the change is scheduled to proceed.
- The Support Center and Operations Center will be contacted before each change starts and at the completion of each change. The purpose for this is to document the duration of the change and impacts should problems arise.
- The Operations Center will compile and distribute a weekly report on change activity including trends, analysis of service metrics and process metrics, and a calendar which lists the schedule of changes for the upcoming week - including day, time, and length.

3.2 Emergency and Fast-Track Changes

- Emergency changes will be handled by the current Emergency Change Process outlined in DOCS #309290.
- Fast-Track changes are described as exceptions, requiring implementation outside of the normal CCRB review process, and are not considered emergency changes.
- Fast-Track changes will now be handled as follows:
 - All Fast-Track changes must be reviewed by the following staff, before being approved for production release:
 - IT Manager-On-Duty (MOD), or Manager, IT Operations Center.
 - The CCRB Chairperson or Sr. IT Specialist, IT Operations Center.
 - For the Fast-Track change to be considered, all required documentation, testing and communication plans must be in place.
 - The frequency of Fast-Track changes will be monitored closely. A Fast-Track change report will be generated and sent to management, notifying them of these exceptions. If, based on the metrics gathered, the Fast-Track changes become excessive; the CCRB will work with management to place further restrictions on this type of change.

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3.3 Change Freeze Process

- A change freeze situation will be handled by the current Change Freeze Process outlined in DOCS #217966



Attachment D: Constraint Prioritization

THERMAL CONSTRAINT PRIORITY

Priority	Highest				Lowest	
	Non Converged Contingency 	IROL Facility	Reactive Interfaces	Actual Violations 	Contingency Violations	Limit
Highest	15 Minutes Shed load only if necessary to avoid post-contingency cascading. Communicate Load Dump Plan (PCLLRW) prior to 30 minutes if generation response is insufficient to control within 30 minute timeframe	15 Minutes Shed load only if necessary to avoid post-contingency cascading. Communicate Load Dump Plan (PCLLRW) prior to 30 minutes if generation response is insufficient to control within 30 minute timeframe (T _v). IROL Violations must be controlled within 30 minutes (T _v).	15 Minutes Shed load only if necessary to avoid post-contingency cascading. Communicate Load Dump Plan (PCLLRW) prior to 30 minutes if generation response is insufficient to control within 30 minute timeframe	5 Minutes Load All available generation. Shed load within 5 minutes to return flows within Emergency Ratings.	30 Minutes Shed load only if necessary to avoid post-contingency cascading. Communicate Load Dump Plan (PCLLRW) prior to 60 minutes if generation response is insufficient to control within 60 minute timeframe	Thermal Load Dump Rating / Reactive Last Convergent Point
	Not Applicable. Refer to Note 1 (below).	Use all effective actions. Communicate Load Dump Action within 30 minute timeframe.	Use all effective actions and emergency procedures except load shed. Communicate Load Dump Plan (PCLLRW) prior to 30 minutes if generation response is insufficient to control within 30 minute timeframe	15 Minutes Load All available generation. Shed load within 15 minutes to return flows within Emergency Ratings.	Use all effective actions and emergency procedures except load shed. Communicate Load Dump Plan (PCLLRW) prior to 60 minutes if generation response is insufficient to control within 60 minute timeframe	Thermal Emergency Rating / Reactive Recommended Limit
Lowest	Not Applicable. Refer to Note 1 (below).	Trend – continue to monitor. Take non-cost actions to prevent	Trend – continue to monitor. Take non-cost actions to prevent contingency from	15 Minutes Use all effective actions	Trend – continue to monitor. Take non-cost actions to prevent contingency from	Thermal Normal Rating / Reactive



		contingency from exceeding emergency limit.	exceeding emergency limit.	and emergency procedures except load dump. Coordinate load dump plan as overload duration approached LTE/STE rating definition (i.e. 4 hour, 2 hour, 1 hour or 30 minute rating).	exceeding emergency limit.	Operating Point Limit
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NOTE 1: Non-Converged Contingencies are considered a sliding priority, i.e. it can move up or down the priority list based on modeling accuracy or voltage level.

NOTE 2: Actual Violations are considered a sliding priority, i.e. it can move up or down the priority list based on the specific situation.

CONSTRAINT CONTROL ACTIONS

Priority	Associated Actions
Green	<p>Use all non-cost / cost-effective actions:</p> <ul style="list-style-type: none"> Non-cost measures, including approved switching. Curtailling "Not-willing-to-pay" transactions that adversely impact constraint. Cost-Effective redispatch Dispatch sufficient generation to control constraints within the allotted timeframe. This includes manual redispatch, if necessary. Initiate M2M as appropriate Review regulation assignments and their impact on constrained operations. Localized constraints may require de-committing specific regulating units. Direct generation shift via UDS and phone to ensure generation is following set-points. Review initial dispatch orders to ensure cost-effective constraint control.

	<p>Monitor generation dispatch and contact units that are not performing.</p> <p>TLR Level 3(note: TLR for excessive circulation may be declared prior to initiating off-cost). Curtail transactions that source/sink in priority order if there is insufficient time to declare TLR. Adjust internal curtailments per IDC.</p>
<p>Yellow</p>	<p>Use all non-cost / cost-effective (Green) and effective actions and Emergency Procedures:</p> <p>Emergency Procedures:</p> <p>Loading of Quickstart Generation (regardless of cost)</p> <p>100% Spinning Reserves (appropriate locations)</p> <p>PJM/MISO Safe Operating Mode, if effective</p> <p>TLR 5 (note: TLR for excessive circulation may be declared prior to initiating off-cost). Curtail transactions that source/sink in priority order if there is insufficient time to declare TLR. Adjust internal curtailments per IDC.</p> <p>Loading of Maximum Emergency Generation</p> <p>Post-Contingency Local Load Relief Warning</p> <p>If there are insufficient resources available to control constraints within 60 minutes, dispatch shall have formulated and communicated a load dump plan to impacted TO/TOPs, issuing a Post-Contingency Local Load Relief Procedure. Include post-contingency switching / generation trip options as part of Emergency Procedures Posting message.</p>
<p>Red</p>	<p>All of the above plus, shed load if violation still exceeds load dump limit after 5 minutes, Emergency Rating for 15 minutes or to avoid post-contingency cascading situation.</p> <p>Emergency Procedures:</p> <p>Voltage Reduction</p> <p>Manual Load Dump</p>

NOTE: In general, procedures shall be implemented in the following order, however, operating conditions or advance lead time may warrant procedures to be implemented in a different order.



VOLTAGE /REACTIVE PRIORITIES

Voltage Limit Exceeded	Actual Voltage Limits Violated	Post-Contingency Limits Violated
High Voltage	Immediate Use all effective non-cost and off-cost actions.	30 Minutes Use all effective non-cost and off-cost actions.
Normal Low	15 Minutes Use all effective non-cost actions, off-cost actions, and emergency procedures except load dump.	Not Applicable Use all effective non-cost actions.
Emergency Low	5 Minutes All of the above plus, shed load if voltages are decaying.	15 Minutes Use all effective non-cost actions, off-cost actions, and emergency procedures except load shed.
Load Dump Low	Immediate All of the above plus, shed load if analysis indicates the potential for a voltage collapse.	5 Minutes All of the above plus, shed load if analysis indicates the potential for a voltage collapse.
Transfer Limit Warning Point (95%)	Not Applicable Use all effective non-cost actions. Prepare for off-cost actions.	Not Applicable Use all effective non-cost actions. Prepare for off-cost actions.
Transfer Limit	15 Minutes or less All effective non-cost and off-cost actions plus, shed load if analysis indicates the potential for a voltage collapse.	15 Minutes or less All effective non-cost and off-cost actions plus, shed load if analysis indicates the potential for a voltage collapse.



Revision History

Revision 06 (01/01/2010):

- Updated SOL definition to include all facilities 230kV and above, removing reference to MP-1.
- Added reference to NAESB Business Practice WEQ-008 and other editorial changes in Section 4

Revision 05 (10/01/2009):

- Updated SOL definition and violation criteria.
- Updated links to Joint Operating Agreements.
- Updated Attachment C: Change Control Review Board

Revision 04 (06/26/2009):

- Annual Review
- Reformatted to assist in compliance tracking.

Revision 03 (02/01/2009)

Added T_V indicator to 30 minute response timeframe to IROL facilities, as appropriate, consistent with NERC standards.

Introduction: added annual review and manual distribution requirement.

Section 3: Added requirement to respond to external systems comments on SOL/IROL methodology within 45 calendar days.

Attachment D: Modified Attachment to change 15 minute threshold to 30 minutes. Changed PCLLRW issuance from 30 minute to 60 minutes. Timing changes based on controlling non-IROL constraints to 100% LTE.

Revision 02 (06/01/2008)

Section 3: Made additional updates to IROL facilities specifically the Kammer 765/500 kV transformer and the Belmont #5 765/500kV transformer Thermal Ratings.

Revision 01 (06/01/2008)

Updated all sections to include Bulk Electric System (BES)

Section 3: Updated IROL facilities

Section 5: Updated Links to Joint Operating Agreements with neighboring Reliability Coordinators.



Attachment A: Updated PJM RTO Reliability Plan

Attachment B: Updated Excerpt from PJM Operating Agreement (bullet vi)

Attachment C: Updated Change Control Review Board to latest version of document

Manual



Revision 0 (05/15/2007)

New manual