Working to Perfect the Flow of Energy

PJM Manual 03:
Transmission Operations

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Prepared by:

Operations Support Division

Transmission Operations Department

PJM Manual 03:

Transmission Operations

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Approval

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Simon Tam, Manager

Transmission Operations

Current Revision

Revision ~~44~~ 45 (~~11/01/2013~~):

- Section 1.7: Added Relay Subcommittee for SPS review.
- Section 2.1 and throughout: Replaced 'Data Management Department' with 'Real Time Data Management Department' and updated M-03A Appendix title.
- Section 3.7 and throughout: Updated Allegheny Power (AP) to First Energy South
- Section 3.7 and Section 5: Updated Black Oak SVC settings
- Section 3.8: Added the new Zion EC-Pleasant Prairie 345 kV tie line to the ComEd interface.
- Section 3.8: Added the new Hayes-Beaver 345 kV line to the Cleveland interface.
- Section 3.9 Exhibit 5: Updated FE South (AP) Voltage Limits
- Section 4.2.12: Updated the nuclear plant circuit breaker list
- Section 5: Added note to Load Shed Directive section indicating PJM will post load shed directive to Emergency Procedures Website
- Section 5: Added note for TO and GO to notify PJM of SPS status, degradation or potential failure to operate.
- Section 5: Removed the MISO owned Zion-Lakeview SPS
- Section 5: Removed L10805 study requirement from Powerton stability procedure
- Section 5: Removed Prospect Heights bus tie schemes (SPOG 2-15)
- Section 5: Revised and added new Calumet inductor banks to L17723 & L17724 procedure
- Section 5: Revised Dresden #2 Voltage Limits
- Section 5: Revised Davis-Besse Voltage Limits
- Section 5: Revised nuclear voltage note for trending in the EMS

- Section 5: Updated Belmont SPS Procedure
- Section 5: Updated Seneca pumping procedure
- Section 5: Updated Conemaugh/Hunterstown ~~S~~stability ~~L~~limits table
- Section 5: Updated outage condition for which Conemaugh SPS can be activated to allow full plant output.
- Section 5: Updated Homer City stability limits table
- Section 5: Removed Ronco stability procedure
- Section 5: Removed FE South (AP) Bus Voltage Exceptions procedure
- Section 5: Updated DEOK single breaker derate table
- Section 5: Updated DLCO ~~S~~single ~~B~~breaker ~~D~~derates ~~T~~table
- Section 5: ~~Deleted~~Removed Smith Mountain High Speed Reclosing procedure
- Section 5: Removed Branchburg – Deans 500 kV Substation Contingency Procedure
- Section 5: Changed Branchburg – Ramapo 5018 references to Hopatcong – Rampo 5018
- Section 5: Added a step to notify MISO of status change for University Park North SPS.
- Section 5: Added a step to notify MISO of status change for Davis Crk SPS.
- Section 5: Added a step to notify MISO of status change for Dresden SPS.
- Section 5: Added a step to notify MISO of status change for Zion SPS.
- Section 5: Added a step to notify MISO of status change for Byron SPS.
- Section 5: Added a step to notify MISO of status change for Kincaid SPS.
- Section 5: Added a step to notify MISO of status change for Powerton SPS.
- Section 5: Added a step to notify VACAR of status change for Clover SPS.
- Section 5: Added a step to notify NYISO of status change for East Sayre-North Waverly SPS.
- Section 5: Added a step to notify MISO and TVA of status change for Rockport SPS.
- Section 5: Added a step to notify NYISO of status change for Warren-Falconer SPS.
- Section 5: Added a step to notify NYISO of status change for Salem SPS.
- Section 5 and Attachment A: Removed Brandon Shores-Riverside SPS.

- Section 5 and Attachment A: Added Concord Street and Mt. Washington SPS procedures
- Section 5: Removed BGE single breaker derate table, Cross Town common trench circuit ratings table, and 230kV Harbor Crossing Cables ratings table. Added hyperlinks to the OASIS system information page for all tables.
- Section 5: Removed note #2 from the Bath County Stability Restriction Table
- Section 5: Added South Anna / Louisa CT Islanding Scheme
- Section 5: Added the Virginia Hills reactor to the Northern Virginia High Voltage control section
- Attachment A: Added a column to the SPS listing to notify impacted neighbors.
- Attachment B: Updated open-ended voltage table.
- Attachment E: Added Dravosburg 138/69 kV transformer #1 sectionalizing scheme list.
- Attachment E: Removed PPL Juniata #1 and #2 transformer from sectionalizing scheme list.
- ~~Section 2.1.1 and 2.1.3: Added language regarding emergency rating change approval~~
- ~~Section 3.3.3: Added applicability for individual generating units greater than 20 MVA, added 161 kV default voltage schedule, and added GO/GOPs voltage schedule performance monitoring to Note 1.~~
- ~~Section 3.5.1: Clarified that the voltage coordination pertains to generator voltage schedules.~~
- ~~Sections 3.5.2 and 3.5.3: Added variable reactor tap adjustment.~~
- ~~Section 3.7: Added variable reactors language.~~
- ~~Section 3.8: Added BC/PEPCO interface definition.~~
- ~~Sections 3, 5, and Attachment A: Removed Powerton/Joliet SPS procedure and references.~~
- ~~Section 4.2.9.1: Added "reductions in demand" option for Direct Billing for Late Outages.~~
- ~~Section 4.2.11: Deleted a reference to tie line list.~~
- ~~Section 4.3: Replaced outage submittal language with references to the appropriate section for the actual requirements.~~
- ~~Section 4.5.1: Replaced outage submittal language with references to the appropriate section for the actual requirements~~
- ~~Section 5: Changed references of Power Team to Exelon/Constellation.~~

- ~~Section 5: Added purpose statement for the 5043 and 5044 procedure.~~
- ~~Section 5: Revised Note for Artificial Island to indicate it is not the only place limited by dynamic stability.~~
- ~~Section 5: Added a note about lack of redundancy for the Quad Cities/Cordova SPS procedure.~~
- ~~Section 5: Added the note for Conesville 345 kV Plant Operating Guidelines~~
- ~~Section 5: Added Tidd 138kV Switchyard Operating Guidelines for Overduty Circuit Breakers~~
- ~~Section 5: Added the note in Fast Valving Scheme for Rockport Plant Operating Guidelines~~
- ~~Section 5: Added the note in Emergency Unit Tripping for Rockport Plant Operating Guidelines~~
- ~~Section 5: Clarified language for Twin Branch Argenta operation procedure~~
- ~~Section 5: Updated Cook Unit Isolation on Select Circuits procedure~~
- ~~Section 5: Updated Gavin Mountaineer Rolling Hills Stability proceedure~~
- ~~Section 5: Updated Seneca Plant Stability procedure~~
- ~~Section 5: Added Darby Plant Stability procedure~~
- ~~Section 5: Removed Elrama and Mitchell Area Operating Procedure~~
- ~~Section 5: Updated Sunbury transformer single breaker rating~~
- ~~Section 5 and Attachment A: Removed the West Shore SPS.~~
- ~~Section 5 and Attachment A: Removed the Virginia Beach SPS.~~
- ~~Section 5 and Attachment A: Removed the Harmony Village SPS.~~
- ~~Section 5: Updated Bath County Stabilty Guide table~~
- ~~Section 5: Updated switching actions for Dresden L1223 line outage~~
- ~~Section 5: Removed Pepco common trench cable ratings table and added a link to the PJM system information page~~
- ~~Attachment A: Removed the Crawford 1-8 Bus Tie Scheme.~~
- ~~Attachment A: Clarified Susquehanna Unit 1 & 2 SPS operation.~~
- ~~Attachment E: Added Round Top-Newberry 115 kV sectionalizing scheme~~
- ~~Attachment F: Replaced the STE rating list with a link to an OASIS posting of the STE rating list.~~

Introduction

Welcome to the ***PJM Manual for Transmission Operations***. 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 the PJM RTO 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 Transmission Operations*** is one of a series of manuals within the Transmission set. This manual focuses on specific transmission conditions and procedures for the operation of the Bulk Electric System and Designated Transmission Facilities.

The **PJM Manual for *Transmission Operations*** consists of five sections and five attachments. These sections are listed in the table of contents beginning on page ii.

Intended Audience

The Intended audiences for the PJM Manual for Transmission Operations are:

- PJM dispatchers
- PJM operations planning staff
- Transmission Owners
- Local Control Center dispatchers
- PJM Members

References

There are several reference documents that provide both background and detail. The ***PJM Manual for Transmission Operations*** does not replace any of the information in these reference documents. These documents are the primary source for specific requirements and implementation details. The references to the ***PJM Manual for Transmission Operations*** are:

- Transmission Owners Agreement
- Transmission Use Agreement
- EMS Users Manual
- PJM Control Center and Data Exchange Manual (M-1)
- PJM Manual for Transmission Service Request (M-02)
- PJM Manual for Energy Management System Model Updates and Quality Assurance (M-03A)
- PJM Manual for Balancing Operations (M-12)
- PJM Manual for Emergency Operations (M-13)
- PJM Manual for Reliability Coordination (M-37)
- PJM Manual for Operations Planning (M-38)

Using This Manual

Because we believe that explaining concepts is just as important as presenting the procedures, we start each section with an overview. Then, we present details and procedures. This philosophy is reflected in the way we organize the material in this manual. The following paragraphs provide 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 the revision history
- 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 the PJM Manual

Section 1: Transmission Operations Requirements

Welcome to the *Transmission Operations Requirements* section of the PJM Manual for **Transmission Operations**. In this section you will find the following information:

- An overview of the general services provided by PJM (see "Overview").
- A description of PJM's transmission operating guidelines (see "Transmission Operating Guidelines").
- A description of PJM's Real-Time Reliability Model (see "PJM's Real-Time Reliability Model").
- A description of PJM Transmission Facilities (see "PJM Transmission Facilities").
- A description of Transmission Owner facilities (see "Local Transmission Facilities").
- Guidelines on how to modify facilities in the Transmission Facilities List (see "Facilities under PJM Congestion Management Control")
- An overview of how special protection systems (SPS) are reviewed, approved, communicated, and documented.

1.1 Overview

PJM is the Reliability Coordinator for the PJM RTO and is responsible for all regional Reliability coordination as defined in the NERC and Regional Standards and applicable PJM Operating Manuals.

PJM operates the transmission grid in compliance with good utility practice, NERC standards, and PJM policies, guidelines and operating procedures, including, but not limited to:

- This PJM Transmission Operations Manual,
- NERC and RRO Standards as references during normal and emergency operations of the PJM transmission grid,
- Individual transmission owners Operating Procedures submitted to PJM to identify specific operating problems that could affect operation of the interconnected PJM transmission grid.

The Bulk Electric System (BES) is defined as facilities 100kV and higher. Transmission Owners (TOs) shall operate the Bulk Electric System Facilities and all System Operating Limits (SOL) (see M-37) in accordance with the PJM Operating Manuals and follow PJM instructions related to PJM responsibilities, including, but not limited to:

- Rules regarding TOs performing the physical operation and maintenance of the SOL Facilities,
- Directing changes in the operation of transmission voltage control equipment,

- Taking those additional actions required to prevent an imminent Emergency Condition or to restore the PJM transmission grid to a secure state in the event of a PJM system emergency.

Note 1: PJM reviews this manual annually, with periodic updates as required. PJM coordinates identified issues with PJM TOs, PJM GOs and neighboring RCs. As PJM and neighboring Reliability Coordinators deem necessary, PJM will facilitate conference calls that include neighboring Reliability Coordinators, neighboring Transmission Operators, neighboring Balancing Authorities, PJM TOs and PJM GOs. PJM will notify PJM TOs and PJM GOs as necessary regarding issues communicated by neighboring Reliability Coordinators. PJM distributes revisions to this manual to neighboring Reliability Coordinators, neighboring Transmission Operators, neighboring Balancing Authorities, PJM Transmission Owners and PJM Generation Operators.

Note 2: AEP is the registered TOP for the AEP 138kV and below facilities. PJM is the registered TOP for all other BES facilities on the AEP transmission system. Under normal operating conditions AEP will coordinate with PJM to re-dispatch generation to control flows on their 138kV and below monitored facilities. In an Emergency, AEP will notify PJM of any unilateral actions it has taken with respect to the re-dispatch of generation as soon as practicable, but no later than 30 minutes, so that PJM can coordinate with the impacted parties.

1.2 Responsibilities for Transmission Owner's Operating Entity

The responsibilities for a Transmission Owner's operating entity within PJM that are defined below are required to maintain the safe and reliable operation of the transmission system within PJM. Transmission Owners operate and maintain the transmission system and are responsible for local reliability. The transmission Owner under PJM's direction takes all actions required to mitigate transmission system reliability emergencies. The responsibilities identified below are consistent with the NERC Functional Model for interconnected system operation.

This list is a collection of significant operational responsibilities and obligations of a Transmission owner that are included in the PJM TOA and the PJM manuals. It is not intended to be an all-inclusive list of every responsibility and obligation of a Transmission owner.

- Subject to code of conduct.
- Establish ratings of its transmission facilities and provides these ratings to PJM. (Section 4.11 of TOA)
- Operates transmission facilities in accordance with good utility practice and PJM procedures. (Section 4.5 of TOA)
- Maintains transmission facilities in accordance with good utility practice and PJM policies and procedures.
- Maintains appropriate voltage profiles.
- Provides local network integrity by defining operating limits, developing contingency plans and monitoring operations if applicable.

- Provides telemetry of transmission system to PJM and other Transmission Owners. (Section 4.9 of TOA)
- Operates BES transmission system facilities under the direction of PJM. (Section 4.5 of TOA)
- Requests PJM to assist in mitigating operating limit violations.
- Implement procedures called for by PJM. (Section 4.5 of TOA)
- Provide real-time operations information to PJM and other Transmission Owners as required.
- Provide maintenance and construction plans to PJM and other Transmission Owners as required.
- Takes action to maintain local reliability and public safety. (Section 4.7 of TOA)
- All actions impacting BES facilities shall be approved by PJM unless immediate actions are required to avoid loss of life, ensure safety or protect equipment. Such actions shall be communicated to PJM as soon as practical.
- Supplies engineering data for transmission system models to PJM and other transmission owners as required.
- Develops, documents, and communicates operator guidance, as necessary.
- Submit outage requests to PJM according to PJM requirements (Section 4.8 of TOA)
- Plan and coordinate transmission system outages with other transmission system operators as required. (Section 4.8. of TOA)
- Work with other transmission system operators and PJM to mitigate identified reliability concerns for planned system outages
- The transmission owner shall maintain a continuously staffed transmission control center. The control center should meet all of the communication and information system requirements defined in the PJM manuals. (Section 2 of PJM Manual for Control Center Requirements)

Note 1: Under circumstances where the Transmission Owner or Generator Operator cannot follow the directive of PJM (such action would result in safety violation, damage equipment, or violate regulatory or statutory requirements), they shall immediately inform PJM of the inability to perform the directive so that PJM can implement alternate remedial actions.

Note 2: A PJM Transmission Owner shall disconnect an affected facility if an overload on a transmission facility or an abnormal voltage or reactive condition persists and equipment is endangered. The PJM Transmission Owner shall notify PJM prior to switching so PJM can perform a study, if time permits, otherwise, immediately thereafter.

Personnel Requirements – Transmission system operators shall:

- Obtain required PJM Certification and Continuing Training Requirements (Section 1 and Section 2 of PJM Manual 40: PJM Certification and Training Requirements)
- Be competent and experienced in the routine and abnormal operation of interconnected transmission systems.
- Be accountable to take any action required to maintain the safe and reliable operation of the transmission system.
- Have thorough knowledge of PJM procedures and their application.
- Have a working knowledge of NERC and applicable RRO Standards and how they coordinate with PJM manuals.
- Have a working knowledge of adjacent transmission system operator's switching and blocking procedures.
- Have an understanding of routine protection schemes for the PJM transmission system.
- Have knowledge of how to evaluate desired system response to actual system response.
- Have knowledge of and be able to evaluate and take action on transmission system equipment problems.
- Have knowledge of the general philosophy of system restoration and the philosophy and procedures of their company as well as that of PJM.
- Have initial and continuing training that addresses the required knowledge and competencies and their application in system operations.
- Develop, document and maintain switching and blocking procedures consistent with OSHA 29 CFR Part 1910.269.
- Transmission system operators shall be accountable for directing field forces in transmission system switching activities.
- Follow-up on significant system events with an investigative process to analyze, document and report on operating abnormalities.

1.3 Transmission Operating Guidelines

PJM directs the operation of all SOL according to approved NERC Standards. In doing this, PJM considers transmission constraints, restrictions, and/or limitations in the overall operation of the PJM RTO. Describing this operation is the focus of this manual. The PJM RTO shall be operated such that the following are not exceeded:

- transmission facility thermal limits

- voltage limits
- transfer limits
- stability limits
- IROL

Although, the PJM RTO shall be operated such that limitations are not violated, it is recognized that occasionally, for various reasons, thermal limitations can be exceeded for short periods under controlled conditions without adversely impacting system reliability or damaging equipment. All exceptions must be documented in Section 5 of this manual. For example, the Constraint Management Mitigation procedure can be used during short time switching periods when adhering to all of the requirements and parameters.

Should the PJM RTO at any time enter into an unknown operating state due to a catastrophic failure of the ICCP links or loss of EMS analysis tools, it will be considered an Emergency and operations shall be restored to respect proven reliable power system limits within 30 minutes in accordance with NERC standards. PJM relies on Transmission Owners to serve as a back-up to PJM, monitoring BES facilities, when the PJM EMS is inoperable (TOP-007-1). PJM Transmission Owners shall notify PJM dispatch within 15 minutes when their TO analysis packages are unavailable (TOP-004-2 R4). In general, PJM may be in an unknown state when both PJM and TO analysis packages are unavailable.

PJM operates the PJM RTO so that immediately following any single malfunction or failure, the facility loadings are within appropriate thermal limits, while maintaining an acceptable voltage profile. For details about PJM's thermal operation, please see Section 2: Thermal Operating Guidelines. For more information about PJM's voltage requirements, refer to Section 3: Voltage and Stability Operating Guideline. These potential malfunctions or failures, such as the sudden and unplanned loss of a generating unit, transmission line, or transformer, are called contingencies. PJM defines a contingency as a possible event resulting in the failure or malfunction of one or more SOL.

PJM Dispatch utilizes EMS Network Applications and market tools in order to maintain system reliability. Network applications evaluate pre-/post-contingency thermal and voltage limits. In addition, the Transfer Limit Calculator (TLC) simulates transfers in order to assess voltage collapse conditions for reactive interfaces. PJM Operators generate reports which provide generator shift factors, phase angle regulator sensitivity factors, and load distribution factors. The information contained within these reports, the PJM State Estimator solution and unit bid information serves as the input data for PJM Market Tools. Through the use of PJM Market Tools, PJM Operators have the ability to use cost-effective generation adjustments to control thermal/voltage constraints on a pre-contingency basis.

Note: PJM Transmission Owners that own BES facilities and serve load greater than 300 MW must have a real-time analysis package or have their BES facilities be observable within another TO analysis package.

Prior to initiating redispatch to control flows within limit criteria, PJM Dispatch compares PJM EMS Security Analysis results with Transmission Owners EMS Security Analysis Results. Pre-contingency, Post-Contingency flows and ratings are compared. If a difference exists between PJM and Transmission Owner Security Analysis results, PJM will operate to the

most conservative results until the difference can be rationalized. If the difference is significant, the following guides will be followed to quickly resolve the difference:

- PJM and Transmission Owner identify modeling issue and operate to most conservative solution.
- PJM investigates modeling issue and attempts to resolve within 1 hour. This may involve verification of distribution factors using Seasonal PSS/E load flow case.
- If discrepancy is > 5% and expected to last 2 hours, PJM Dispatch will contact PJM support staff and request Transmission Owner to contact support staff.
- PJM and Transmission Owner on-call support staff will work toward resolving modeling difference.
- PJM and Transmission Owner agree to defer to most accurate analysis in lieu of operating to most conservative results, when difference is understood or resolved.
- PJM and Transmission Owner support staff attempt to correct modeling differences within 24 hours.

Contingency Analysis

- Single Contingency — One event that takes one or more facilities out of service. A Single Facility is any one component of the SOL, excluding bus sections that can be removed from service by its own primary relay and breaker protective equipment. Single contingencies may disconnect multiple generating facilities (plant with single connection leads to the bulk power system) or multiple transmission facilities (radial lines with tapping substations) from service.
- PJM Security Analysis applications simulate the single facility failure or malfunction of critical equipment (facilities simulated in contingency analysis are not restricted to the PJM monitored facility list) including lines, transformers, Phase Angle Regulators (PARs), generators, capacitors, and reactors whose loss or failure could result in limit violations on PJM Monitored Facilities.

Note 1: PJM does not normally model or operate to single breaker failures due to the low probability of occurrences; however, Section 5 of this manual contains an operating procedure to mitigate single breaker failures.

Note 2: Under some unusual conditions, including severe weather or other special circumstances such a change to the Homeland Security Level, PJM should consider implementing conservative operation including control for the simultaneous occurrence of more than one contingency, substation circuit breaker outages, circuit breaker failure, and substation bus outages as appropriate (PJM Emergency Procedures Manual (M13) Sections 3 and 4).

PJM uses appropriate pre and post contingency procedures which are documented in this manual to:

- maintain acceptable voltage levels
- maintain operation within stability limits
- maintain operation within transfer limits
- minimize the risk of cascading interruptions to the transmission system
- prevent physical damage to system transmission facilities
- eliminate thermal overloads

The consequences of violating these limits may lead to PJM RTO instability, voltage collapse, equipment damage, or loss of customer load. The objective of PJM is to operate the transmission facilities such that system reliability is maintained. Once a contingency occurs the system is readjusted as required and analysis for the next worst contingency is performed. The PJM dispatcher directs actions to restore the system to an acceptable state. For more information see Section 2: Thermal Operating Guidelines and Section 3: Voltage and Stability Operating Guidelines.

- Double Contingency — Two different events that occur simultaneously and result in the loss of two or more facilities.

Note 1: A single contingency can consist of one or more transmission facilities. A double circuit tower line (DCTL) contingency is the simultaneous loss of two single contingencies.

Note 2: If a Transmission Owner wishes to operate to control for DCTL contingencies, it may do so using its own internal equipment after communicating with the PJM dispatcher.

Note 3: PJM system operations will implement actions to control for system congestion caused by DCTL contingencies resulting from the declaration of Conservative Operations. PJM will issue a PCLLRW when calculated post-contingency flows exceed Long Term Emergency (LTE) ratings. PJM will initiate redispatch of generation when calculated post-contingency flows exceed the Load Dump (LD) rating permitting off-cost generation to set LMP.

1.4 Reclosing EHV Lines That Have Tripped

The PJM RTO uses two philosophies when reclosing EHV lines that have tripped and the automatic reclose has not been successful. These philosophies differ based on the EHV line automatic reclosing design and operating practice.

1.4.1 PJM Mid-Atlantic Region

If an EHV (Extra High Voltage) aerial transmission line trips and does not automatically reclose, it should be manually reclosed within five minutes after tripping. If an EHV line trips and returns to service by automatically reclosing (or by manually reclosing if auto reclosing fails to occur and the line is tried-back once manually), the PJM dispatcher is authorized to operate at the current transfer levels or at reduced transfer levels. If an EHV line trips and does not return to service when reclosed automatically (or if manual reclosing also fails after the line is tried-back once manually), PJM performs the following activities:

- immediately reduces the reactive operating limits to the level with the line out-of-service
- order the line to be tried-back within five minutes after conferring with the Transmission Owner(s) of the line

If the line returns to service after the five minute try-back, the reactive operating limits may remain reduced until a patrol of the line has been completed or until the PJM dispatcher judges that the limit reduction is no longer necessary. If the aerial patrol does not locate the cause of the tripping, the reactive operating limits should be returned to normal. The Transmission Owners, however, must complete a foot patrol of the circuit no later than the next daylight period (weather permitting).

If an EHV line that was successfully reclosed 5 minutes after the trip-out trips a second time, the transfer limit should be re-evaluated and reduced if necessary until patrol is completed (or the source of the trouble is definitely determined by another means - aerial patrol, report of trouble, etc.). Manual try-backs on lines which trip a second time after having been successfully reclosed five minutes after tripping are not attempted until some period of time has elapsed (30 minutes or longer). PJM directs reclosing with the concurrence of the Transmission Owners.

1.4.2 PJM Western Region

The majority of the ~~Allegheny Power~~First Energy South 345 & 500 kV circuits utilize a high speed reclose of approximately 28 cycles without sync check and 34 cycles with sync check. The time delayed reclose varies greatly from station to station and is given in section IV.C.5 of the ~~Allegheny Power~~First Energy South System Operations Manual. Phase angle closing requirements also vary and are also given in the same section of the Manual.

If an EHV circuit locks out after a high speed reclose and one time delay reclose; AP will patrol the circuit prior to trying it again. If a circuit utilizes supervisory control for one of its reclose attempts, AP will evaluate the weather conditions prior to trying a supervisory reclose.

The Duke Energy Ohio-Kentucky 345 and 138kV transmission circuits utilize automatic reclosing. If a circuit locks out after an automatic reclose, DEOK will patrol the circuit before attempting a reclose. For any supervisory reclose attempts, DEOK will work with PJM to evaluate weather, system, and equipment conditions prior to attempting the reclose.

1.4.3 PJM Southern Region

The Dominion Virginia Power 500 kV transmission lines within the PJM Southern region will automatically reclose multiple times. If the line goes to lockout, it is not to be reclosed manually until the line has been patrolled by Dominion Virginia Power operations personnel.

Note 1: Transmission Owners shall promptly notify PJM of any BES facility that have tripped and coordinate restoration efforts.

1.5 PJM's Real-Time Reliability Model

PJM's Real-Time Reliability Model is a computer representation of the power system facilities in the PJM RTO and other Balancing Authorities that may impact the reliable operation of the PJM system. The model resides and is maintained by the PJM staff on the PJM Energy Management System (EMS). The PJM EMS Network Application programs utilize the model to continuously calculate the real-time state and determine the security of the PJM system. The Security Constrained Economic Dispatch (SCED) dispatches every generator in the model. The model is also used to calculate real-time Locational Marginal Prices. The model is created and maintained from input data received by PJM from various sources including Transmission Owners, Generation Owners, Load Serving Entities, and other Balancing Authorities. The model is only as accurate as the input data used to derive it; therefore, timely and accurate data updates are critical.

1.5.1 Model Information and Data Requirements

- The Transmission Owner is responsible to provide the information and data needed by PJM about the Transmission Owner System.
- Telemetry data requirements are defined in the PJM Control Center Requirement Manual (M01).
- System analytical model information and update requirements are defined in the Energy Management System Model Updates and Quality Assurance (M03A), Section 2.

1.5.2 PJM Transmission System Model Update

PJM performs periodic updates to the PJM Real-Time Reliability Model. The Data Management Working Group (DMWG) representative, a working group under the direction of the System Operations Subcommittee (SOS), must submit timely transmission model changes to be included in these updates consistent with the requirements contained within the PJM Energy Management System (EMS) Model Updates and Quality Assurance (M03A).

1.5.3 PJM Transmission Facilities

PJM Transmission Facilities are those facilities used in the transmission of electrical energy that:

- Are included in the PJM tariff
- have demonstrated to the satisfaction of PJM to be integrated with the PJM RTO Transmission System, and integrated into the planning and operation of the PJM RTO to serve all of the power and transmission customers within the PJM RTO
- Transmission facilities that meet all other requirements including having sufficient telemetry to be deemed 'observable' by the PJM State Estimator, PJM Network Applications, or the PJM Real-Time Reliability Model can be considered for inclusion as monitored for real-time and contingency analysis for the purpose of identifying transmission constraints.

- The Transmission Owner of a facility that meets all requirements, including observability for the Real-Time Model, (see "Monitored Transmission Facilities") must specifically request that a facility be "Monitored" by PJM using the process and timeline identified at the end of this section.(see "Process to Change the PJM Congestion Management Facilities List).
- Each Transmission Owner must specifically identify any tariff facility that is not under the operational control of PJM.
- Include NERC BES facilities

1.5.4 Reportable Transmission Facility

Transmission Owners are required to report scheduled and forced outages for Reportable Transmission Facilities. Outage information is reported through EDART and through the status obtained via computer link to the EMS. In general, a Transmission Facility is reportable if a change of its status can affect, or has the potential to affect, a transmission constraint on any Monitored Transmission Facility or otherwise impedes the free-flowing ties within the PJM RTO and adjacent areas. All Transmission Facilities included in the PJM Reliability Model must be reported to PJM with as much advance notice as possible. The PJM Web site (http://www.pjm.com/markets-and-operations/transmission-service/transmission-facilities.aspx) lists Reportable Transmission Facilities by Transmission Zone. Transmission Owners are responsible for ensuring the accuracy of this data. Updates are made as required correlating to system model updates. Note that ALL Congestion Management (monitored) and Reliability Coordination facilities are to be included by default as Reportable Transmission Facilities. As explained above, PJM has also identified other facilities as Reportable Transmission Facilities, because they can affect the overall transmission system. Instructions and a timeline for reporting outages are provided in Section 4 of this manual under the heading Reportable Transmission Facility Outages.

Codes associated with Reportable Facilities are defined as:

Yes, Reportable

- The facility must be modeled in the PJM EMS and status information must be conveyed to the PJM EMS via the data link;
- The TO must generate eDART tickets when facility outages are required; and,
- Call the PJM dispatcher to ensure proper communication and coordination of switching and system security.

Low-Priority Reportable;

- The facility must be modeled in the PJM EMS and status information must be conveyed to the PJM EMS via the data link; and,
- The TO must generate eDART tickets when facility outages are required.
- Call the PJM dispatcher when the facility is returned to service to ensure proper time stamp.

No, Not Reportable

- The facility may, or may not, be in the PJM EMS model; and,
- The facility is not expected to significantly impact PJM system security or congestion management.

With the growth of Reportable Facilities included in the PJM model, the Low-Priority Reportable Code is expected to accommodate the need to have facility status accurately modeled while reducing the need for phone calls to coordinate outages and streamlining this process.

PJM may require that all Tariff Facilities are Reportable. All EHV (345 kV and above), 230 kV, and all tie-line facilities are flagged as Yes, Reportable and are not eligible for Low-Priority Reportable status. Tariff Facilities will generally default to Yes, Reportable. It may be acceptable to consider selected lower voltage Tariff facilities (161 kV, 138 kV, 115 kV and 69 kV) as Low-Priority Reportable depending upon the impact of the facility upon system security and/or congestion management. With recommendations from the TO, the PJM Manager, Model Management Department is responsible for re-assigning Tariff facilities as Low-Priority Reportable or Not Reportable.

PJM operating studies focus on the impact of Reportable Facilities upon security. It is the TO's responsibility, after internal study, to ensure that system security will not be adversely impacted for the outage of a Low-Priority facility. The TO must notify PJM of a potential problem associated with a Low-Priority Reportable facility outage prior to switching. The TO should provide 30 minutes' notice to the Power Director in order for PJM to confirm the TO's analysis and make the appropriate adjustments. If, as a result of a Low-Priority Reportable outage, an unanticipated system security violation occurs, PJM will direct the TO to return the facility to service.

1.5.5 Observable Transmission Facility

- The term "observable" indicates that sufficient real-time analog and digital telemetry is supplied to PJM such that it is possible to accurately calculate the bus voltage and/or MVA flow for the facility in question.
- Facility must be accurately modeled in PJM EMS
- The facility must have sufficient redundancy of telemetry to be "observable" in the PJM State Estimator

1.5.6 Monitored Transmission Facility

Monitored Transmission Facilities are an Observable Facility and are broken into 2 categories.

Monitored for Markets and Reliability Facilities are accepted for congestion control.

Monitored for Reliability Facilities does not permit congestion to set LMP.

Both are monitored and controlled for limit violations using PJM's Security Analysis programs. Control of limit violations to Monitored Transmission Facilities may result in

constrained operation including manual redispatch; redispatch setting LMP and TLR curtailments. Additional details are contained within the PJM Balancing Operations Manual (M12), Attachment B: Transmission Constraint Control Guidelines.

PJM OATT Facilities shall be monitored for any of the following criteria:

- Vital to the operation of the PJM RTO
- Affects the PJM RTO's interconnected operation with other Balancing Authorities
- Affects the capability and reliability of generating facilities or the power system model that is used by PJM to monitor these facilities
- Significantly impact transmission facilities if outaged
- Affects the PJM Energy Market if outaged
- May result in constrained operations to control limit violations
- A NERC BES facility

PJM must be provided the applicable normal, emergency, and load dump ambient ratings for the transmission facility. Applicable ratings include, sixteen ambient temperature sets (32°F – 95°F, day and night) and limiting equipment identification.

- Monitoring requested by the Transmission Owner

The monitored facilities are included in the Transmission Facilities List. The Transmission Facilities List is located on the PJM website (http://www.pjm.com/services/transm-facilities.jsp).

Transmission Owners may add an Observable Transmission Facility as a Monitored Transmission Facility under PJM monitoring and control by sending notice to the Manager, PJM Model Management Department. A Monitored Transmission Facility shall remain a Monitored Controllable Transmission Facility until the Transmission Owner requests in writing for it to be removed. See the previous information on Observable Transmission Facilities Discussion.

1.5.7 External Transmission Facilities

Those transmission facilities outside PJM RTO and/or facilities not entitled to transmission service under the PJM OATT are, for the purpose of transmission operations, considered external transmission facilities.

1.5.8 Non-PJM OATT Transmission Facilities

The Transmission Owners are responsible for the operation of their transmission facilities not included in the PJM OATT or at a lower voltage level than NERC BES facilities; provided, however, that the operation of these facilities does not compromise the reliable and secure operation of other transmission facilities within the PJM RTO. Transmission Owners are expected to comply with requests from PJM to take such actions with respect to coordination of the operation of their facilities not included in the PJM OATT as may be necessary to preserve the reliable and secure operation of the PJM RTO. At the request of

the Transmission Owner, PJM will assist the Transmission Owners in alleviating any constraint within the PJM RTO. Because PJM may dispatch and schedule generation to alleviate a constraint only on a PJM OATT Facility, Transmission Owners do not rely on PJM procedures to control constraints on any facility not included in the PJM OATT. Generation assignments for transmission limitations on Non-PJM OATT facilities are the financial obligation of the Transmission Owner. Generation assignments for limits based on generating station/equipment limits on Non-PJM OATT facilities are the financial obligation of the Generation Owner requesting the limit.

1.5.9 Transmission Facilities Not Monitored by PJM

The Transmission Owners are responsible for the operation of their Local Area Transmission Facilities and facilities that are included in the PJM tariff but not "PJM Monitored Transmission Facilities". However, the operation of Local Area Transmission Facilities should not compromise the reliable and secure operation of other transmission facilities in the PJM RTO. Transmission Owners are expected to comply with requests from PJM to take such actions with respect to coordination of the operation of their Local Area Transmission Facilities as may be necessary to preserve the reliable and secure operation of the PJM RTO.

1.5.10 Local Facility Protection

At the request of the Transmission Owner, PJM will assist the Transmission Owners in alleviating any local area constraint or condition. PJM may dispatch and schedule generation to alleviate a constraint only on Monitored Transmission Facilities, therefore Transmission Owners should not rely on PJM SOL procedures to control constraints on their Non-Tariff facilities, Local Transmission Facilities or non-monitored facilities. Generation assignments for transmission limitations on non-monitored facilities are the financial obligation of the Transmission Owner.

1.5.11 Facilities under PJM Congestion Management (Reliability and Markets) Control

PJM has developed requirements that Transmission Owners must follow in order for PJM to operate generation to control loading or voltage on transmission facilities. All facilities under congestion management must be observed in the PJM EMS with sufficient telemetry to provide accurate and reliable state estimation (some redundant metering is generally required).

Generally, the Telemetry Requirements for Congestion Management Control are:

For a transmission facility to be under PJM Congestion Management Control, the facility must be "observable" (as defined later in this section) with sufficient telemetry redundancy in the PJM State Estimator. In general, the telemetry requirements for a line/transformer to be "observable" with sufficient redundancy are:

- The branch has MW/MVAR telemetry at both ends and there is some MW/MVAR telemetry for other branches/injections at buses connecting to the branch.

OR

- The branch has MW/MVAR telemetry at only one end there is good MW/MVAR telemetry for other branches/injections at buses connecting to the branch.

OR

- The branch has no MW/MVAR telemetry at either end but it has almost perfect MW/MVAR telemetry for other branches/injections at buses connecting to the branch.

In general, the telemetry requirements for a bus to be "observable" are:

- The bus has at least one voltage telemetry point and it also has some MW/MVAR telemetry for its branches and injections.

OR

- The bus does not have any voltage telemetry point but a voltage telemetry point is available at the immediate neighbor bus (of the same voltage level) AND the bus being evaluated has most of the MW/MVAR telemetry for its branches and injections.

Note: See PJM Control Center and Data Exchange (M01) Manual for specific requirements.

1.5.12 Process to Change the PJM Congestion Management Control Facilities List

The process and timeline required to make adjustments to the existing Congestion Management Control Facilities List is described in detail in the ***PJM Energy Management System Model Updates and Quality Assurance (M03A) Manual***, Section 2.

1.6 PJM Procedure to Assign Line Designations for New Facilities 500 kV and Above

The following details the PJM process for assigning line designations for new facilities 500kV and above:

- PJM Transmission Planning receives approval from PJM Transmission Expansion Advisory Committee (TEAC) and PJM Board for new 500kV and above facilities.
- PJM Transmission Planning notifies PJM Operations Planning Department (OPD) of approval of new 500kV and above facility.
- PJM OPD reviews the new circuit configuration and the master list of existing PJM 500kV and above facilities.
- PJM OPD notifies the appropriate TO's of the preliminary designated line number.
- PJM OPD proposes the new circuit designation to:
  - Manager Dispatch
  - Manager Real-Time Data Management

- Manager Model Management
- Manager Transmission Planning
- Manager Forward Market Operations
- Manager Real-time Market Operations

- Upon PJM internal approval, PJM OPD finalizes the new proposed designation by notifying:
  - PJM: Dispatch, Data Management, Model Management, and Transmission Planning
  - Committees: SOS-T, PC & OC
  - TO's: Appropriate TO's

1.7 PJM Procedure to Review Special Protection Systems (SPS)

The following details the committee structure review process for Special Protection Systems (SPS) and general timeline. This structure is to ensure there are sufficient analysis, notice and training on Special Protection Systems prior to implementation. The general process is as follows:

- PJM Participant/Committee forwards SPS to PJM for review.
- PJM Planning, PJM Operations Planning Department and Transmission Owner(s) review scheme and system impact. PJM will provide a recommendation. PJM will also identify whether the scheme is needed for reliability purposes including operational performance. If the scheme is required for reliability purposes, for operational performance, or to restore the system to the state existing prior to a significant transmission facility event, the scheme will be implemented as soon as possible.
- PJM will use reasonable best efforts to post the SPS information immediately.
- SPS Owner discusses the scheme at the following PJM Committees:
  - PJM System Operations Subcommittee - Transmission
  - PJM Relay Subcommittee
    1. *Only for SPS impacting facilities 200 kV and above. The review should be done at the Relay Subcommittee prior to the Planning Committee.*
  - PJM Planning Committee
  - PJM Operating Committee
  - PJM Market Implementation Committee
  - PJM Markets and Reliability Committee

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- PJM staff/participant obtains any required Regional Reliability Organization endorsement.
- PJM staff documents the SPS scheme and revises Manual M3.
- PJM staff discusses the scheme at the PJM Dispatcher Training Task Force.

Committee review of the SPS and documentation process should be completed within 2 months. Depending upon the Regional Reliability Organization (RRO) review process, endorsement may require 3 to 6 months. For SPS schemes not required for reliability, operational performance, or to restore the system to the state existing prior to a significant transmission facility event, a minimum of 90 days will be required between posting the SPS information and the actual in-service date of the SPS.

Section 2: Thermal Operating Guidelines

Welcome to the *Thermal Operating Guidelines* section of the ***PJM Manual for Transmission Operations***. In this section you will find the following information:

- How PJM operates to prevent thermal problems (see "Thermal Limit Operations Criteria").

2.1 Thermal Limit Operation Criteria

The PJM RTO SOL are operated so that loading on all PJM SOL are within normal continuous ratings, and so that immediately following any single facility malfunction or failure, the loading on all remaining facilities can be expected to be within emergency ratings. (All deviations from normal procedure must be approved and documented in Section 5.)

This principle requires that actions should be taken before a malfunction or failure occurs in order to control post-contingency loading on a pre-contingency basis. Some examples of possible pre-contingency actions include pre-arranged approved switching, use of approved special purpose relays, Phase Angle Regulator tap adjustments (PARs), redispatch, and transaction curtailment. These actions can be used pre-contingency to control post-contingency operation so as not to exceed emergency ratings. These pre-contingency options are simulated by PJM's Operations Planning Department when they perform the day-ahead analysis of the system.

Following any malfunction or failure, all remaining facilities or procedures of PJM are utilized, as required in accordance with Exhibit 1 or as practical, to restore PJM RTO conditions within 30 minutes to a level that restores operation within normal ratings and protects against the consequences of the next malfunction or failure. Transmission overloads, both actual and post-contingency, are corrected within this time requirement. PJM uses the following techniques to control contingency or system violations:

- adjusting PARs
- switching reactive devices in/out of service or adjusting generator MVAR output
- switching transmission facilities in/out of service
- adjusting generation MW output via redispatch
- adjusting imports/exports
- issuing a TLR (Transmission Loading Relief)

If the above directed actions do not relieve an actual or simulated post-contingency violation, then emergency procedures may be directed, including dropping or reducing load as required.

A Transmission Owner has the right to use its own devices after coordinating with PJM (i.e., Phase Angle Regulators PARs) to correct for double circuit tower line contingency overloads in their own system, ensuring that this corrective action does not aggravate an existing contingency or create a new contingency. When a Transmission Owner detects a double

circuit tower line contingency and the PJM RTO detects a single contingency, both of which require different corrective strategies, the Transmission Owner and the PJM RTO dispatchers communicate to work out an overall solution for both problems, provided the net impact in MWs shifted for other Transmission Owners does not exceed that which is required for the single contingency.

Note 1: Under normal operations, PJM does not operator for double-circuit tower line (DCTL) contingencies, however, PJM may operate for DCTL contingencies if Conservative Operations are declared.

Note 2: Generation redispatch for DCTL contingencies will be borne by the Transmission Owner and will not be allowed to set LMP while not under Conservative Operations.

Note 3: PJM system operations will implement actions to control for system congestion caused by DCTL contingencies resulting from the declaration of Conservative Operations. PJM will issue a PCLLRW when calculated post-contingency flows exceed Long Term Emergency (LTE) ratings. PJM will initiate redispatch of generation when calculated post-contingency flows exceed the Load Dump (LD) rating permitting off-cost generation to set LMP.

2.1.1 Facility Ratings

Three sets of thermal limits are provided for all monitored equipment:

- normal limit
- emergency limit
- load dump limit

PJM systems expect Normal (continuous), Emergency (long term and short term emergency are set equal unless specifically approved otherwise) and Load Dump limits.

Eight ambient temperatures are used with a set for the night period and a set for the day period; thus, 16 sets of three ratings are provided for each monitored facility. Ambient temperatures of 95°, 86°, 77°, 68°, 59°, 50°, 41°, and 32°F for both day and night periods are collated to constitute the 16 rating set selections. All Transmission Owners' and the PJM RTO's security analysis programs must be able to handle all 16 sets and allow operating personnel to select the appropriate rating set to be used for system operation. With a minimum of two set selections required daily (day/night), the Transmission Owner and the PJM RTO security analysis programs use these 16 ambient temperature rating sets for monitoring actual and contingency overloads. All temperatures associated with the ambient temperature rating data sets are in degrees Fahrenheit.

Certain facility ratings can be further adjusted by average bus voltage. The PJM RTO security analysis programs do not reflect these voltage adjustments in the 16 ambient temperature rating set selections. Coordination is required to ensure reliable PJM RTO operations.

The PJM RTO examines the set of thermal ratings that apply to Monitored Transmission Facilities during all operating periods. The PJM RTO dispatcher selects the ambient

temperature rating sets, using the system weather forecasts. The PJM RTO dispatcher performs the following actions:

- Any discrepancy between the PJM RTO and a Transmission Owner for a facility rating is logged and reported to the PJM Real Time Data Management Department for resolution. The immediate resolution for a rating discrepancy is to use the lower of the two disputed values until a more permanent resolution can be affected.
- If it becomes necessary in actual operations to initiate off-cost operation for a facility, the operation is based on PJM RTO security analysis program information, unless a more limiting condition is detected by the Transmission Owner's security analysis program.
- When a Transmission Owner's facility is experiencing constraints in an area that has an actual temperature (degrees Fahrenheit) less than the ambient temperature rating set being used by the on-line programs, the actual temperature in the area is used to select a more appropriate rating set for that facility. The selection is made from the remaining 15 sets. This adjustment is exercised when both the PJM RTO and the Transmission Owner are in agreement, and have logged that agreement.
- Any adjustment to facility ratings, such as the temporary use of a different rating, must be approved by PJM. These changes must be submitted to PJM through the Transmission Equipment Ratings Monitor (TERM) consistent with PJM Manual 3A, Energy Management System Model Updates & Quality Assurance, Appendix A: ~~Processing Ratings in TERM~~TERM Processing Ratings Data Check List. TERM is an internet-based interactive database located through eDART. The procedure and the rating are reviewed prior to approval by PJM If an emergency rating change is needed, the change can initially be approved via phone call to PJM; however, a TERM ticket must still be entered by the next business day.

Load Dump ratings are determined to aid the system operator in identifying the speed necessary to relieve overloads. Operation at a Load Dump rating should not result in any facility tripping when actually loaded at that value for at least 15 minutes. For a facility loading to approach the Load Dump rating, either multiple contingencies must have occurred or the system had been operated beyond first contingency limits.

Note1: PJM dispatchers must return actual flows below Emergency ratings within 15 minutes and below Load Dump ratings within 5 minutes, as indicated in the tables below.

2.1.2 Short-Time Emergency Ratings

The existence of approved short–time rating can affect the time allowed before implementing load shedding. If ratings exist that have a shorter-time rating than the

emergency ratings then additional time may be available prior to implementing load shedding.

If the actual flow is greater than the emergency rating but less than the short-time rating then the time to correct (using load shedding) is equal to the time referenced by the short-time rating. (e.g. If a 30 minute rating is provided and the actual flow exceeds the emergency rating but does not exceed the 30 minute rating, then the time to correct, using load shedding, is 30 minutes not 15 minutes).

If other real-time monitoring is available such as transformer temperature, line tension, etc, the Transmission Owner may request that special procedures for their use be evaluated by PJM, and if appropriate included in Section 5 of this manual to evaluate the urgency of identified load shed as an alternatives.

If the actual flow is greater than the short-time rating but less than the Load Dump rating, then the time to correct, using load shedding is 15 minutes.

2.1.3 How to Change Facility Ratings

Facility ratings may change due to equipment outages, equipment upgrades, or other identified reasons. Changes to facilities ratings must be requested by the transmission owner via TERM. Similar to the process for submitting a transmission outage request, the request to change ratings should be made consistent with PJM Manual 3A, Energy Management System Model Updates & Quality Assurance, Appendix A: ~~Processing Ratings in TERM.~~TERM Processing Ratings Data Check List.

PJM's ~~Data Management Department~~Real Time Data Management Department evaluates the request. The request must be evaluated before the start date of the ticket, but preferably, it is approved two days prior to the start date. PJM's Real Time Data Management Department evaluates the request by comparing the old and new ratings and checking them against any future outages for reasonableness. The transmission owner can look into TERM to see if their request has been approved.

After a request has been approved, PJM's Real Time Data Management Department implements the changes into the EMS. The transmission owner can see the actual date of implementation via TERM. If there is no implementation date listed, the change has not been put into PJM's EMS yet.

While the change is being implemented by Data Management, they will inform both PJM Dispatch and Operations Planning Departments of the upcoming change so they can account for it in their future analysis.

Note that, if an emergency rating change is needed (typically outside of normal business hours), the change can initially be approved via phone call to PJM; however, a TERM ticket must still be entered by the next business day.

Legend
NON-COST
OFF-COST
LOAD SHEDDING

Thermal Limit Exceeded	Corrective Actions	Time to correct with Load Shed (Note 1)
Normal Rating ***(Actual flow greater than Normal Rating but less than Emergency Rating)***	**Non-cost actions, off-cost actions, emergency procedures except load shed.**	**Correct in 15 minutes, load shed is not used.**
Emergency Rating **(Actual flow greater than Emergency Rating but less than Load Dump Rating**	**All of the above plus shed load to control violation below Emergency Rating.**	**Within 15 minutes of violation** **(Note #2)**
Load Dump Rating **(Actual flow greater than Load Dump Rating)**	**All of the above plus shed load to control violation below Emergency Rating.**	**Within 5 minutes of violation**

Exhibit 1: PJM Actual Overload Thermal Operating Policy

Note1: TO must dump load without delay upon receipt of PJM Directive to dump load.

Note2: TOs have the option of providing STE limits that are at least 30-minutes in duration. The STE rating allows the time before load shed to be extended provided the actual flow does not exceed the STE rating. If the actual flow is above the LTE but below STE, load must be shed within the times indicated in Attachment F for the facility, if other corrective actions were not successful.

Thermal Limit Exceeded	If Post-Contingency simulated loading exceeds limit	Time to correct
Normal	**Trend – continue to monitor. Take non-cost actions to prevent contingency from exceeding emergency limit.**	**N/A**
Emergency	**Use all effective actions and emergency procedures except load dump.**	**30 minutes**

Load Dump	**All of the above however, shed load only if necessary to avoid post-contingency cascading.**	**30 minutes**

Exhibit 2: PJM Post-Contingency Simulated Thermal Operating Policy

Note: System readjustment should take place within 30 minutes. PCLLRW should be implemented as post-contingency violations approach 60 minutes in duration. However, PCLLRW can be issued sooner at the request of the Transmission Owner or if the PJM Dispatcher anticipates controlling actions cannot be realized within 60 minutes due to longer generator start-up + notification times.

Section 3: Voltage & Stability Operating Guidelines

Welcome to the *Voltage & Stability Operating Guidelines* section of the ***PJM Manual for Transmission Operations***. In this section you will find the following information:

- A description of the voltage, voltage related transfer, and stability limits. (see "Voltage, Transfer, & Stability Limits")
- A description of the voltage operation and voltage limits (see "Voltage Operation and Voltage Limits").
- A description of the voltage control actions for low voltage operation (see "Voltage Control Actions, Low Voltage Operation").
- A description of the voltage control actions for high voltage operation (see "Voltage Control Actions, High Voltage Operation").
- How PJM operates capacitors (see "Bulk Electric System Capacitor Operations").
- A description of the transfer limits (see "Transfer Limits").
- A description of the stability operation (see "Stability Limits").
- A description of PJM's load relief expectations for voltage concerns (see "Load Relief Expectations").
- A description of Interconnection Reliability Operating Limits (IROLs)

3.1 Voltage, Transfer, & Stability Limits

In addition to the thermal limits referenced in Section 2, PJM operates the PJM RTO considering voltage and stability related transmission limits as follows:

- Voltage Limits – High, Low, and Load Dump actual voltage limits, high and low emergency voltage limits for contingency simulation, and voltage drop limits for wide area transfer simulations to protect against wide area voltage collapse.
- Transfer Limits – The MW flow limitation across an interface to protect the system from large voltage drops or collapse caused by any viable contingency.
- Stability Limits – limit based on voltage phase angle difference to protect portions of the PJM RTO from separation or unstable operation.

3.2 Voltage Operating Criteria and Policy

PJM will operate the facilities that are under PJM's operational control such that no PJM monitored facility will violate normal voltage limits on a continuous basis and that no monitored facility will violate emergency voltage limits following any simulated facility malfunction or failure.

Typically, high voltage emergency limits are equipment related while low voltage limits are system related.

If a limit violation develops, the system is to be returned to within normal continuous voltage limits and the system is to be returned to within emergency voltage limits for the simulated loss of the next most severe contingency. The system re-adjustment should take place within 30 minutes but a 60-minute maximum time is allowed prior to issuing a Post-Contingency Local Load Relief Warning.

In addition, the post-contingency voltage, resulting from the simulated occurrence of a single contingency outage, should not violate any of the following limits:

- Post-contingency simulated voltage lower than the Emergency Low voltage limit, or higher than the High voltage limit.
- Post-contingency simulated voltage drop greater than the applicable Voltage Drop limit (in percent of nominal voltage).
- Post-contingency simulated angular difference greater than the setting of the synchro-check relay less an appropriate safety margin (ten degrees for a 500 kV bus). The angular difference relates to the ability to reclose transmission lines.

PJM bus voltage limits by voltage level are as shown in Exhibit 3.

PJM operation requires that actions should be taken on a pre-contingency basis in order to control operations after a malfunction or failure happens. Some examples of possible pre-contingency actions include pre-arranged approved switching of capacitors or reactors, Phase Angle Regulator tap adjustments (PARs), redispatch, and transaction curtailment. These actions can be used pre-contingency to control post-contingency operation so as not to exceed emergency ratings on a simulated basis. These pre-contingency options are considered by PJM for inclusion in the day-ahead analysis. PJM does not have an Under Voltage Load Shed program, controlling to voltage limits on a pre-contingency basis in order to avoid load shed.

Voltage Drop Violation limits are utilized to prevent voltage instability, which could result in system voltage collapse. Voltage Drop Violation limits will be evaluated by PJM based on studied system voltage characteristics. For voltage equipment levels below 500 kV, the limit can vary over a range of values depending on local transmission system characteristics.

Load dump limits are provided to aid the system operator in identifying the speed necessary to relieve constraints. Operation at a load dump limit should not result in any facility tripping or voltage collapse when actually operated at that value for at least 15 minutes. In order for an operator to be faced with actual voltages approaching the load dump limit either multiple contingencies must have occurred or the system had been operated beyond first contingency limits. PJM will review with each TO the PJM default voltage limits and the appropriateness of using individual TO limits based on design and documented past operation.

The following chart details PJM's Voltage Operating Policy for an actual violation.

Voltage Limit Exceeded	If Actual voltage limits are violated	Time to correct (minutes)
High Voltage	**Use all effective non-cost and off-cost actions.**	**Immediate**
Normal Low	**Use all effective non-cost actions, off-cost actions, and emergency procedures except load dump.**	**15 minutes**
Emergency Low	**All of the above plus, shed load if voltages are decaying.**	**5 minutes**
Load Dump Low	**All of the above plus, shed load if analysis indicates the potential for a voltage collapse.**	**Immediate**
Transfer Limit Warning Point (95%)	**Use all effective non-cost actions. Prepare for off-cost actions. Prepare for emergency procedures except load dump.**	**Not applicable**
Transfer Limit	**All of the above, plus shed load if analysis indicates the potential for a voltage collapse.**	**15 minutes or less depending on the severity**

The following chart details PJM's Voltage Operating Policy for a Post-Contingency Simulated Operation.

Voltage Limit Exceeded	If post contingency simulated voltage limits are violated	Time to correct (minutes)
High Voltage	Use all effective non-cost actions.	30 minutes
Normal Low	Use all effective non-cost actions.	Not applicable
Emergency Low	Use all effective non-cost actions, off-cost actions, and emergency procedures except load dump.	15 minutes
Load Dump Low	All of the above plus, shed load if analysis indicates the potential for a voltage collapse.	5 minutes
Voltage Drop Warning	Use all effective non-cost actions.	Not applicable
Voltage Drop Violation	All effective non-cost and off-cost actions plus, shed load if analysis indicates the potential for a voltage collapse.	15 minutes

3.3 Voltage Limits

PJM and the Transmission Owners established PJM Base Line Voltage Limits to protect equipment and assure the reliable operation of the Bulk Electric System. Deviations and exceptions to these Base Line limits are recognized based on equipment and local system design differences.

3.3.1 PJM Baseline Voltage Limits

PJM Baseline Voltage Limits									
Limit	**765 kV**	**500 kV**	**345 kV**	**230 kV**	**161 kV**	**138 kV**	**115 kV**	**69 kV**	**34 kV**
High	803.2 (1.05)	550.0 (1.10)	362.0 (1.05)	242.0 (1.05)	169.0 (1.05)	145.0 (1.05)	121.0 (1.05)	72.5 (1.05)	37.4 (1.10)
Normal Low	726.8 (.95)	500.0 (1.00)	328.0 (.95)	219.0 (.95)	153.0 (.95)	131.0 (.95)	109.0 (.95)	65.5 (.95)	31.3 (.92)
Emergency Low*	703.8 (.92)	485.0 (.97)	317.0 (.92)	212.0 (.92)	148.0 (.92)	127.0 (.92)	106.0 (.92)	63.5 (.92)	30.6 (.90)
Load Dump*	688.5 (.90)	475.0 (.95)	310.0 (.90)	207.0 (.90)	145.0 (.90)	124.0 (.90)	103.0 (.90)	62.0 (.90)	0.0
Voltage Drop Warning*	5.0%	2.5%	4.0-6.0%	4.0-6.0%	4.0-6.0%	4.0-6.0%	4.0-6.0%	4.0-6.0%	5.0%
Voltage Drop Violation**	8.0-10.0%	5.0-8.0%**	5.0-8.0%	5.0-8.0%	5.0-10.0%	5.0-10.0%	5.0-10.0%	5.0-10.0%	8.0%
	* Refer to PJM Manual for Emergency Procedures (M-13) ** The voltage drop violation percentage may vary dependent on PJM analysis.								

Exhibit 3: PJM Base Line Voltage Limits

3.3.2 Voltage Limit Exceptions

Some transmission systems within the PJM RTO are operated by PJM (in accordance to the design of the Transmission Zone LCC) to different voltage limits for voltage levels 230 kV and below. Transmission Zone exceptions to the PJM voltage limits are shown in Exhibit 5 at the end of this section. These limits apply on a Transmission Zone basis and are used in lieu of the PJM limits shown in Exhibit 3.

In addition, there are some cases where equipment limitations impose more restrictive voltage limits that apply to a specific bus. These bus-specific voltage limits appear in Exhibit 5 at the end of this section.

- Refer to Attachment C – Requesting Voltage Limit Exceptions to the PJM Base – Line Voltage Limits

3.3.3 Generator Voltage Schedules

PJM defines default Generator Voltage Schedules as follows:

PJM Default Generator Voltage Schedules									
Voltage Level (kV)	**765**	**500**	**345**	**230**	**161**	**138**	**115**	**69**	**66**
Schedule (kV)	760.0	525.0	350.0	235.0	164.0	139.5	117.0	70.0	67.0
Bandwidth (+/- kV)	+/-10.0	+/- 8.0	+/- 7.0	+/- 4.0	+/- 4.0	+/- 3.5	+/- 3.0	+/- 2.0	+/- 1.5

PJM Transmission Owners must supply and communicate voltage schedules and a low and high bandwidth or the PJM default voltage schedule as noted in the above table to all Generation Owners in the zone meeting the following criteria:

- individual generating units greater than 20 MVA
- generators that aggregate to 75MVA or greater that are connected to a common bus
- black start generators
- any other Generation Owners/Operators that request a voltage schedule

Generators are required to maintain the same voltage schedule when AVR is out of service unless directed otherwise. PJM Transmission Owners are required to coordinate voltage schedules, as well as adjustments to voltage schedules with PJM Dispatch. PJM Dispatch will approve/deny adjustments based on PJM EMS Security Analysis results. PJM may elect to deviate from voltage schedules based on load levels, transfer patterns, transmission or generation outages, or as required to honor pre-/post-contingency voltage limits or to maximize transfer capability based on PJM Security Analysis. Generation Owners shall communicate concerns regarding Transmission Owner voltage schedule/bandwidth or PJM Default Voltage Schedule/Bandwidth to PJM for resolution. Any Transmission Owner or Generation Owner/Operator wishing to exempt a generator from following a voltage schedule must provide a written request to the PJM System Operations Subcommittee Chair, to include the engineering basis for such exemption and the type of schedule (reactive or power factor) that will be communicated to the generator.

PJM Transmission Owners have the authority to direct generators to adjust voltage schedules after coordinating with PJM Dispatch. PJM also has the responsibility and authority to direct generators to increase or decrease MVAR output as well as direct the switching of reactive control devices to maintain voltages as system conditions dictate.

Only PJM has the authority to request a generator to adjust voltage schedules if such a direction adversely impact the units MW output. In addition, only PJM has the authority to order a generator on line in the condensing or generating mode to provide voltage support. Also, if a generator is scheduled to come off line either by PJM or the owning company, only PJM has the authority to order the generator to remain on line in the condensing or generating mode to provide voltage/MVAR support.

Generation Owners must coordinate any voltage schedule issues with PJM through the PJM Transmission Owner.

Note 1: PJM uses the Generation Performance Monitor (GPM) to track a generators ability to follow a designated voltage schedule. GPM compares the integrated 30 minute average to the designated voltage schedule and flags performance outside a threshold. PJM expects the GO/GOPs to monitor their unit's performance using a comparable methodology. Generation Owners are expected to resolve performance issues within 30 minutes through generator modifications or updating reactive D-curve and/or voltage regulator status within eDart.

Note 2: If the generator is unable to maintain its voltage schedule within defined bandwidths, ***and*** there is additional calculated leading or lagging MVAR reserves based on submitted Facility Reactive Capability Curves (D-Curves) the generator is required to notify PJM and the TO that they cannot maintain their assigned voltage schedule and provide updated Facility Reactive Capability Curves (D-Curves) via eDart.

Note 3: If the Generator is unable to maintain voltage schedules within bandwidth ***and*** the generator is operating at full lead or full lag MVAR based on submitted Facility Reactive Capability Curves (D-Curves) the generator is required to notify PJM and the TO that they cannot maintain their assigned voltage schedules and PJM will determine if MW reduction is required in order for unit to adjust MVAR output to maintain voltage schedule.

Note 4: PJM requires PJM Transmission Owners to notify generators (that meet the criteria documented in 3.3.3 above) within their transmission zone in writing of Transmission Owner voltage schedules or PJM default schedules (this notification shall include generators connected to systems owned by entities that are not PJM Transmission Owners such as municipalities or electric cooperatives). If the TO is not able to provide a TO voltage schedule to generators (municipalities, electric cooperatives, etc.), the TO must notify PJM; and PJM will notify the generator in writing of PJM default voltage schedule.

3.4 Notification and Mitigation Protocols for Nuclear Plant Voltage Limits

The maintenance of acceptable actual and post-contingency voltages at the substations of nuclear power plants is critical to assuring that the nuclear safety systems will work properly if required. In order to provide this assurance, the nuclear power plant operators must be notified whenever actual or post-contingency voltages are determined to be below acceptable limits. This requirement applies to all contingencies involving the tripping of the nuclear plant generator or any transmission facility as the contingent element. The notification is required even if the voltage limits are the same as the standard PJM voltage limits.

Nuclear plants may have voltage limits that are more restrictive than standard PJM voltage limits. In the case where standard PJM voltage limits, as defined by the Transmission Owner (TO), are more restrictive, PJM will direct redispatch without consultation of nuclear plants after all non-cost measures are implemented; however, PJM will still notify the Nuclear Owner of the violation to the limit. Off-cost generation will set Locational Marginal Prices (LMP). In the case where nuclear plant voltage limits are more restrictive than standard PJM

voltage limits, all costs required to mitigate the violations will be borne by the generation owner.

PJM's EMS models and operates to the most restrictive substation voltage limit for both actual and N-1 contingency basis. PJM will initiate notification to nuclear plants if the PJM EMS results indicate nuclear substation voltage violations. This notification should occur within 15 minutes for voltage contingency violations and immediately for actual voltage violations. To the extent practical, PJM shall direct operations such that the violation is remedied within 30 minutes, with a Post-Contingency Local Load Relief Warning issued prior to 60 minutes.

3.4.1 Communication

All communication of future and current operations between PJM and the nuclear plant should be through the transmission owner (TO). If there is any confusion about a communication, the plant can talk directly with PJM, however, the transmission owner should be appraised of the discussion – if PJM to a nuclear plant direct discussions are needed the preferred method would be a 3-way call among all parties (i.e., inclusion of TO). If off-cost operations are required based on a more restrictive Nuclear Plant voltage limit, the Nuclear Plant or their representative (Nuclear Duty Officer) may consult with the related MOC and evaluate whether an alternative such as operating at a reduced output would alleviate the voltage violation and is more cost effective. PJM will provide the approximate nuclear plant reduction, if applicable.

3.4.2 Information Exchange

Normally, PJM does not provide information relative to transmission operation to any individual Market participant without providing that information to all. However, in this unique condition where the public safety requirement is to have a reliable source for safe unit shutdown and/or accident mitigation; it is imperative that specific information be provided to a nuclear plant (this information should not be provided to their marketing members). If PJM operators observe voltage violations or anticipate voltage violations (pre or post-contingency) at any nuclear stations; PJM operators are permitted to provide the nuclear plant with the actual voltage at that location, the post-contingency voltage at that location (if appropriate) and limiting contingency causing the violation. The operation for more restrictive Nuclear Plant Voltage Limits at these nuclear stations should not be posted or provided to the Market via eData, once off-cost operations are initiated.

PJM Action:

- PJM notify nuclear plant, through Transmission Owner, of calculated post-contingency violations to modeled voltage limits (Transmission Owner or more limiting Nuclear Plant Voltage Limits).
- PJM notify nuclear plant, through Transmission Owner, of violations to actual voltage limits (Transmission Owner or more limiting Nuclear Plant Voltage Limits).
- Violations of more restrictive Nuclear Plant Voltage Limits must be agreed upon by the nuclear plant and logged by PJM.

- All non-cost actions should be implemented prior to MW adjustments.
- All costs required to mitigate violations of more restrictive Nuclear Plant Voltage Limits will be borne by the generation owner.
- Controlling actions must be cost-capped, if applicable.
- LMP shall not be used to control the voltage at these locations.
- TLR shall not be used to control the voltage at these locations.
- PJM will monitor the appropriate voltage limits based on changes provided.
- PJM notify nuclear plant, through Transmission Owner, when voltage level is restored within limits (and stable).
- Attempt to control more restrictive nuclear plant voltage limitations within 30 minutes.

Transmission Owner Action:

- The Transmission Owner shall independently monitor for Nuclear Plant actual and contingency voltage violations as reflected on the Transmission System.
- Transmission Owner will communicate this notification from PJM to the nuclear plant (Transmission Owner or more limiting Nuclear Plant Voltage Limit violations).
- Transmission owners will monitor the appropriate voltage limits based on changes to more limiting Nuclear Plant Voltage Limits as provided by the Nuclear Duty Officer (NDO).

Nuclear Plant Action:

- Nuclear plant will notify PJM, through Transmission Owner Shift Managers, when different (new or default) voltage limits shall be used based on various plant service loading conditions, design basis calculation revisions.
- Determine internal plant options, and if appropriate, provide revised limits.
- Coordinate with MOC to evaluate PJM provided redispatch option (no cost or unit information will be provided).
- Provide PJM with decision to redispatch – if applicable.
- Provide PJM with decision that nuclear plant will closely monitor plant activities and will take action within the plant if conditions change and inform PJM not to implement off-cost.
- Provide PJM with clear direction if they do not want PJM to perform redispatch.

Note: PJM dispatch's goal is to resolve all voltage security violations (i.e., n-1 contingency) within 30 minutes, however; inherent communication delays related to off-cost agreement for nuclear plant voltage limits may not permit this goal to be achieved.

3.5 Voltage Control Actions

3.5.1 Voltage Coordination

PJM is responsible for the overall coordination of the Bulk Electric System voltage scheduling. In general, since voltage schedules have a significant effect on local voltages PJM authorizes the Local Transmission Control Center to establish and adjust generator voltage schedules after gaining PJM approval. Whenever the voltage schedule impacts the overall PJM economic/reliable operation then PJM shall exercise its operational control and direct changes to the generation voltage/reactive schedules, capacitor/reactor schedule/status, and transformer LTC operation for the overall reliable/economic operation of PJM.

- PJM requires that automatic capacitor switching capability on facilities 230kV and above be documented in Section 3 of this manual. PJM authorizes the Local Transmission Control Center to automatically or manually switch/adjust reactive devices connecting to 138kV and below without notifying PJM. Transmission Owners shall evaluate the impact of switching BES capacitor/reactors or adjusting BES LTC on voltage limits and lagging/leading MVAR reserves. The evaluation may require use of EMS Security Analysis or other analysis packages depending on system conditions and proximity to limits. Transmission Owners shall request PJM to study the impact of switching capacitor/reactors or LTC adjustments if the TO determines they are unable to analyze the impact on SOL .
- When deviating from the generator voltage schedule the Transmission Owner shall coordinate with the PJM dispatcher so that PJM can determine if the change is detrimental to PJM reliable/economic operation.
- When PJM requests to change voltage or VAR schedule, PJM should discuss the changes with the Transmission Owner and if the recommendation does not cause a defined limitation the Transmission Owner should implement the PJM request. PJM has operational control of the reactive facilities (transmission caps, LTC's, and generator regulation). If internal plant limits (or Transmission Owner local limits) restrict the request they should be logged so that PJM can investigate and recommend changes to plant facilities if appropriate.
- Generation Owners that possess generation resources equipped with Power System Stabilizers are required to communicate PSS status to the appropriate Transmission Owner as well as to PJM via the E-DART outage reporting system.

3.5.2 Low Voltage Operation

The PJM dispatcher uses PJM Real-time data and security analysis based programs as the primary tool to evaluate the current state of the PJM EHV system on a simulated post-contingency basis, as well as the anticipated future conditions of the PJM EHV system on a simulated post-contingency basis. PJM security analysis programs detect the contingencies that can cause any monitored bus to violate its low voltage and voltage drop limits.

The PJM RTO uses the following techniques to control low voltage:

- switching capacitors in-service
- switching reactors out-of-service
- adjust variable reactor tap positions
- adjusting voltage set point of static VAR compensators (SVC)
- operating synchronous condensers
- changing transformer tap positions
- changing generation excitation
- adjusting generation MW output (i.e.: to change line flows)
- adjusting transactions
- adjusting PARs
- switching transmission facilities in/out of service

The PJM Base-Line Voltage Limits (see Exhibit 3) and how they would be applied to reliable system operation is:

- PJM will use the “PJM Base-Line Voltage Limits” as the default “PJM Voltage Reliability Operating Limit”. If a PJM Transmission Owner identifies a specific voltage reliability limit that is more restricting than the PJM Base-Line Voltage Limits, PJM will use that voltage reliability limit provided by the Transmission Owner as the PJM Voltage Reliability Operating Limit. However, this use will depend on the condition that the facility is specifically identified as a PJM Open Access Transmission Tariff (“PJM OATT”) facility, and the limit is specifically identified as required for reliable operation.
- The PJM Voltage Reliability Operating Limit will be the more restrictive of either the PJM Base-Line Voltage Limit or the Transmission Owner provided voltage reliability limit.
- PJM does not charge or bill a PJM Transmission Owner for off-cost operation of a PJM OATT facility as described above. In addition, these PJM Voltage Reliability Operating Limits will be used in PJM System Planning reinforcement evaluations. PJM shall evaluate the need to upgrade any restricting facility and study the validity of that reliability limit.

3.5.3 High Voltage Operation

The PJM dispatcher uses PJM Real-time data and security analysis based programs as the primary tool to evaluate the current state of the PJM EHV system on a simulated post-contingency basis, as well as the anticipated future conditions of the PJM EHV system on a simulated post-contingency basis. PJM security analysis programs detect the contingencies that can cause any monitored bus to violate its high voltage limits.

The PJM RTO uses the following techniques to control high voltage:

- switching capacitors out-of-service
- switching reactors in-service
- adjust variable reactor tap positions
- adjusting voltage set point of static var compensators (SVC)
- operating synchronous condensers
- changing transformer tap positions
- changing generation excitation
- adjusting generation MW output (i.e.: to change line flows) for actual voltage violations only
- adjusting PARs
- switching transmission facilities in/out of service

PJM performs the following actions to correct high voltage conditions (see PJM Manual M-13, Section 2.4.8 for additional Real Time emergency actions):

- The PJM dispatcher requests that switchable capacitors be disconnected and switchable reactors be connected.
- The PJM dispatcher requests Local Control Center operators to direct all generators, synchronous condensers and SVCs within their zone to absorb reactive power.
- The PJM dispatcher requests neighboring Balancing Authorities to assist in reducing voltage.
- The PJM dispatcher adjusts 500/230 kV transformer taps to optimize system voltage. Adjustment of transformer taps will be coordinated and agreed to between PJM and the Transmission Owner before changes are made. The greatest effect to control system voltage is attained by adjusting all 500/230 kV transformer taps.
- The PJM dispatcher requests the Transmission Owners to open approved and effective EHV circuits. The PJM dispatcher performs the following tasks:
    - Verifies thermal conditions with on-line study programs
    - Uses computer programs to study the simulated effects of switching and the steady state voltage response

- Directs operation to open both terminals by the LCC (open the terminal without a controlling source or the highest voltage bus first)

Opening EHV Lines for Voltage Control

When high voltage conditions are expected on the PJM RTO, the PJM dispatcher uses PJM Security Analysis programs to study possible actions (i.e., opening an EHV line) and coordinates an operational plan before the situation becomes severe. If system voltages get too high, it may be difficult (if not impossible) to remove a line from service due to the voltage rise experienced at the open end of the circuit being removed from service. Corrective actions have a maximum effect only when they are accomplished prior to experiencing the problem.

During high voltage conditions, opening an EHV circuit has a positive effect in reducing system voltages for two reasons:

- it increases losses on the rest of the PJM EHV system
- it eliminates the capacitive charging of the line

PJM has identified several circuits that, in the past, have been effective in controlling general PJM RTO high voltage conditions when they are removed from service. Suggested EHV circuits to be studied are:

AEP area

a. Jacksons Ferry-Wyoming 765kV line

b. Dumont-Greentown 765kV line

Mid Atlantic Area

a. Juniata-Alburtis 5009 500kV line

NOTE: This option is not available until Susquehanna has a PSS installed on unit #1 which is scheduled for spring of 2012.

b. TMI-Hosensack 5026 500kV line

c. Conemaugh-Juniata 5005 500kV line

NOTE: This option may be preferable if one or both Conemaugh units are off-line. Also note that this outage will impose stability restrictions on the Conemaugh units if both are on-line as defined in M-03 Section 5.

d. Juniata-TMI 5008 500kV line

Note: First Energy requires a person on site (TMI) when the 5008 or 5026 line is returned to service. The PJM dispatcher schedules the return time of the line at least two hours in advance of switching.

Dominion and First Energy Areas

a. Mt. Storm-Meadow Brook 5529 500kV line

b. Carson-Suffolk 544 500kV line

c. Ox-Glebe 248 230kV line

High voltage problems of localized nature may be more effectively controlled by selective measures in the particular area. For example, if all Homer City units are out of service and high voltage presents a problem in the area, the PJM dispatcher may decide to open the Homer City - Stolle Road 345 kV line.

3.6 EHV Transformer LTC Operation

The PJM dispatcher has operational control of and coordinates the operation of the EHV LTC transformer taps. In general, EHV LTC transformer tap changers are not operated under automatic voltage control but are operated in coordination with all other Bulk Electric System voltage control facilities.

Operation of the PJM RTO is coordinated in an attempt to minimize capacitor switching operation and transformer tap changes. PJM coordinates with the Local Control Centers, all switching of the Bulk Electric System capacitors & reactors to assist the system for actual or post-contingency situations. Local conditions may require some deviations.

3.7 Bulk Electric System Capacitor/SVC Operation

The PJM dispatcher coordinates the operation of Bulk Electric System capacitors. Capacitors should be kept in service whenever they are beneficial to the PJM RTO transfer capability or reliability.

Note: The capacitor banks at each installation operate independently of each other under normal switching operations. Under normal conditions, the PJM dispatcher does not request that both banks of capacitors at one location be brought on or off simultaneously; generally at least five minutes between switching is desirable. The PJM dispatcher monitors the system voltage profile and the transfer capability of the PJM RTO and requests capacitor switching or transformer tap changes in a timely manner.

Operation of the PJM RTO is coordinated in an attempt to minimize capacitor switching operation and transformer tap changes. PJM coordinates with the Local Control Centers, all switching of the 230 kV and 500 kV capacitors and variable reactors to assist the system for actual or post-contingency situations. Local conditions may require some deviations. The 500 kV LTC transformer taps should be adjusted to control the system voltage regardless of the capacitor's in or out-of-service status. A bank of capacitors should not be switched in-service if the voltage on the bus, upon which it is located, would violate voltage limits.

The PJM RTO maximum voltage limits should not be exceeded on an actual or simulated post-contingency basis. As the PJM RTO voltage approaches limits, the PJM dispatcher analyzes and estimates the future system voltages and decides if there will be a need to remove any or all capacitors from service. The PJM dispatcher arranges to remove capacitors from service prior to the PJM RTO voltage reaching the maximum limits.

If PJM's simulated post-contingency analysis or a Transmission Owner's real-time monitoring program detects that the first contingency loss of a facility results in a Bulk Electric System bus exceeding its high limit, the PJM dispatcher evaluates the removal of any or all capacitors at that bus from service as necessary.

Prior to expected light-load periods, capacitors should be switched out-of-service before reaching limits if the PJM dispatcher expects that the switching operation is required in the future.

~~AP~~ First Energy South 500kV switched capacitor banks at the Black Oak Substation are all under automatic control of the Black Oak Static Var compensator (SVC). The SVC is capable of producing 145 MVAR inductive to hold voltages between ~~545~~535.0kV and 5~~54~~0kV and 575 MVAR capacitive to hold voltages between ~~505kV~~ 520kV and 5~~10~~25kV.

First Energy's 230 kV capacitor banks at the Atlantic and Larrabee Substations are all under automatic control of the Atlantic Static Var Compensator (SVC).

DPL's 230 kV capacitor bank at Indian River is under automatic control of Indian River SVC.

ACE's 230 kV capacitor bank at Dennis is under automatic control of Dennis SVC and 230 kV capacitor bank at Cardiff is under automatic control of Cardiff SVC.

The following capacitor installations are equipped with Programmable Logic Controllers (PLCs) and are the first automatically switchable 500 kV capacitors on the PJM RTO EHV system:

Capacitor Installation	Banks
Juniata	2-250 MVAR Banks
Conemaugh	1-200 MVAR Bank
Conastone	1-200 MVAR Bank
Limerick	1-200 MVAR Bank
Hunterstown	1-100 MVAR Bank

Exhibit 4: Capacitor Installations with PLCs

To improve system voltages, the PJM dispatcher may switch capacitors with PLCs in service prior to switching in service non-PLC capacitors in other areas.

PLC initiated switching is limited to a basic voltage scheme:

- Capacitor automatic tripping generally is set to occur as follows:
  - Voltage above 555 kV – 15 seconds
  - Voltage at 555-550 kV – 15 to 60 seconds
  - Voltage at 550-545 kV – 1 to 15 minutes
  - Voltage at 545 kV – 15 minutes
- Capacitor automatic closing generally is set to occur as follows:
  - Voltage below 470 kV – 1 second
  - Voltage at 475-470 kV – 1 to 15 seconds
  - Voltage at 500-475 kV – 15 to 60 seconds

- Voltage at 510-500 kV – 1 to 15 minutes
- Voltage at 510 kV – 15 minutes

- Juniata 500kV Capacitors – PLC automatic closing is turned ON, while the automatic tripping is turned OFF.
- Elroy 500kV Capacitors - two 300 MVAR capacitors (600 MVAR total) are located at Elroy 500kV substation. Control systems have been set to have the first 300 MVAR of capacitors on system within 10 cycles from the beginning of the voltage collapse with the second 300 MVAR of capacitors on system 20 cycles from the beginning of the system event. Automatic switching will initiate when a 5% voltage reduction on all three phases over a 5 cycle time period occurs, resulting in the closure of the first cap bank CB (no time delay). 10 cycles after the first initiate the SEL 451 will initiate closure of the second cap bank CB.
- The LSR Auto/Manual 43 Control Switch, located on Elroy control panel #1, SHALL be placed in the manual position via EMS to disarm the auto scheme for the following conditions:
  - Maintenance outages at Elroy including Elroy 500 kV #2 Bus, 20-1 capacitor, 22-1 capacitor, 155 CB, or 175 CB.
  - PJM issues a High System Voltage Action.
- When PJM cancels the High System Voltage action, the Elroy capacitors are to be placed in the auto position.

Note: The Elroy 500kV Capacitors do not have SCADA control to turn on, but SCADA is available to turn them off. The can be manually turned on, but require personnel on-site (45 minutes advance notice required). PJM can, in emergency conditions when all other means of reactive supply are exhausted, request PECO to send someone to turn on the Elroy capacitor banks provided that PJM Operations has determined that the capacitor banks are no longer needed for post contingency voltage control at that time and that the use of the capacitors for pre-contingency voltage control would not lead to a voltage collapse situation should a contingency occur.

The PJM Operations Planning staff develops modifications to transmission limitations as necessary. As additional capacitor installations are placed into service, new transmission limitations and operating guidelines are issued.

~~Allegheny Power's~~FE South EHV capacitors are operated in the manual mode but have automatic trips for high voltage:

Substation	Capacitor	HV Trip / Delay *	SVC control HV Trip / Delay **
Bedington 500 kV	#2 162.5 MVAR	550 kV – 8 Sec	
Bedington 500 kV	#3 162.5 MVAR	550 kV – 10 Sec	
Black Oak 500 kV	#2 162.5 MVAR	550 kV – 8 Sec	~~545~~ 85 MVAR~~kV~~ inductive –

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			~~3~~300 Sec
Black Oak 500 kV	#3 162.5 MVAR	550 kV – 10 Sec	85 MVAR inductive – 300 Sec~~545 kV – 3 Sec after #2~~
Doubs 500 kV	#2 246 MVAR	530 kV – 180 Sec	
Meadow Brook 500 kV	#2 200 MVAR	535 kV – 10 Sec	

* Capacitors have a 5-minute time delay after tripping before they can be reclosed.

**** Capacitor breaker disconnects will open making capacitor unavailable until on-site inspection is made and disconnects reclosed.**

3.7.1 Returning EHV Lines That Were Open for Voltage Control

While a transmission line may be open-ended for only a short period of time during line energization and de-energization, the open terminal voltage may exceed acceptable levels as a result of line charging. This can cause serious equipment damage. The steady state voltage at the open end of an uncompensated transmission line is always higher than the voltage at the sending end. This phenomenon, known as the Ferranti effect, occurs because of the capacitive charging current flowing through the series inductance of the line. The equation representing the Ferranti effect is:

$$V_1 = V_2 / \cos(BL)$$

where:

- V1 – Open End Voltage
- V2 – Closed End Voltage
- B – Phase Constant (0.11587/mile for all compensated transmission lines)
- L – Line Length in Miles

In the event PJM security analysis programs are not available, the Ferranti equation may be used as a guide to potential voltage rise during PJM 500 kV line switching operations. Voltage rise (V_1) for three (3) source terminal (closed end) voltage levels (V_2) are listed:

- 500 kV
- 525 kV
- 550 kV

Attachment B presents the open circuit terminal voltage for the 500 kV lines.

PJM dispatch analyzes open-ended voltages when lines are energized/de-energized. PJM dispatch adjusts the system to ensure the instantaneous voltages do not violate the Emergency High Voltage Limit.

Transmission Owners are permitted to establish Short-term 30 minute Emergency Voltage Limits which can be used for short-duration events, such as planned switching. The short-

term 30 minute Emergency Voltage Limits are higher than the Emergency High Voltage Limits. PJM Dispatch shall use the short-term 30 minute emergency voltage limits when evaluating open-ended voltages. The following transmission zones have established Short-term 30 Minute Emergency Voltage Limits:

- AEP 920kV (765kV System)

Depending on current/anticipated system conditions, there may not be a near-term time-frame conducive to controlling open-ended voltages within Emergency High or Short-term 30 Minute Emergency High Voltage Limits.

The following guidelines should be utilized to restore the transmission facility to service:

- On-peak planned outages/returns should be delayed until projected system conditions permit open-ended voltages to be controlled within Emergency High Voltage Limits, but no longer than 24 hours.
- Off-peak planned outages/returns should be delayed until projected system conditions permit open-ended voltages to be controlled within Emergency High Voltages, but no longer than the next on-peak period.
- PJM Dispatch can deviate from guidelines above if reliability issues are projected with the transmission facility out-of-service or if delaying the outage raises reliability concerns.

Note: On-Peak is defined as Monday – Friday, excluding Holidays. Off-peak is defined as Saturday – Sunday, and Holidays.

3.7.2 Voltage Control Options for Non-Tariff Facilities

On occasion, PJM is requested to dispatch generation to protect PJM member equipment/facilities where that equipment is not included in the PJM tariff, and therefore not accommodated by standard PJM redispatch. PJM will accommodate requests for scheduling and dispatching off-cost generation. In the examples below, PJM describes conditions where charging for off-cost generation may result.

Off-cost examples:

- If requested to run generation for a distribution related problem PJM will accommodate a member's request for "off-cost" operation. Appropriate billing will be made to the requestor. [A PJM Transmission Owner may request limits to PJM OATT facilities to protect their distribution system reliability (non-PJM OATT facilities). PJM will bill the PJM Member for any resulting off-cost operation.]
- If requested to run generation to protect a generating station or other non-tariff facility, PJM can accommodate a PJM member's request for the "off-cost" generation assignment. PJM will bill the PJM Member for any resulting off-cost operation.
- If requested to run generation for a Transmission Owner determined non-PJM reliability limit, PJM will accommodate that member's

request for "off-cost" operation. Appropriate billing will be made to the requestor.

As an alternative to PJM directed off-cost generation, the requestor could enter into an agreement with any generation provider; this agreement would be treated independent from the PJM billing process.

3.7.3 Addressing Voltage Limits at Generators and other Non-PJM OATT Facilities (including Distribution)

- For a limitation at a Generator, Generation station facility, or other non-PJM OATT facility, either the Transmission Owner or PJM Member can request PJM to operate for any requested voltage limits at a specific bus that are identified as more restricting than the PJM Base-Line Voltage Limits.
- These requested voltage limits are submitted in writing by the PJM Member to the PJM Manager – Transmission Operations Department.
- PJM will evaluate these limits for reasonableness.
- PJM Operations Planning Department will return confirmation to the requestor when these requested voltage limits are implemented in the PJM EMS.
- The PJM Member will be billed for any "Off-Cost" operation.

Transmission Owners should submit their exceptions to PJM Base-Line Voltage Limits for PJM OATT facilities by using a standardized format. Generation Owners and other PJM Members may request PJM to operate to a different Voltage Limit than the PJM Base-Line Voltage limits for a Generator or other non-PJM OATT facility by using a standardized format.

3.8 Transfer Limits (Reactive/Voltage Transfer Limits)

Post-contingency voltage constraints can limit the amount of energy that can be imported from and through portions of the PJM RTO. The PJM EMS performs automated online full AC security analysis transfer studies to determine Transfer Limits for the use in real-time operation. The PJM Transfer Limit Calculator (TLC) simulates worse case transfers, with the simulation starting point being the most recent State Estimator solution. The TLC executes in the PJM EMS approximately every 5 minutes automatically recommending updated Transfer Limits to the PJM Dispatcher. The TLC determines a collapse point for each interface. Each interface consists of a number of 138, 345, 500, and/or 765 kV lines. PJM has established the following EHV interfaces in the PJM RTO:

Transfer Interface	Interface Definition
Eastern (Eastern)	• 5044 Wescosville – Alburtis 500kV line • 5009 Juniata – Alburtis 500kV line • 5026 TMI – Hosensack 500kV line

Transfer Interface	Interface Definition
	• 5010 Peach Bottom – Limerick 500kV line • 5025 Rock Springs – Keeney 500kV line
Central (Central)	• 5004 Keystone – Juniata 500kV line • 5005 Conemaugh – Juniata 500kV line • 5012 Conastone – Peach Bottom 500kV line
5004/5005 (5004/5005)	• 5004 Keystone – Juniata 500kV line • 5005 Conemaugh – Juniata 500kV line
Western (Western)	• 5004 Keystone – Juniata 500kV line • 5005 Conemaugh – Juniata 500kV line • 5006 Conemaugh – Hunterstown 500kV line • 5055 / 522 Doubs – Brighton 500kV line
Bedington – Black Oak (Bed-Bla)	• 544 Black Oak – Bedington 500kV line
AP South (AP South)	• 512 Mt Storm – Doubs 500kV line • 540 Greenland Gap – Meadowbrook 500kV line • 550 Mt Storm – Valley 500kV line • Mt Storm – Meadowbrook (TrAIL) 500kV line
AEP - Dominion (AEP-DOM)	• Kanawha River – Matt Funk 345kV line • Wyoming – Jacksons Ferry 765kV line • Baker – Broadford 765kV line
Cleveland (CLVLND)	• Chamberlain – Harding 345kV line • Hanna – Juniper 345kV line • Star – Juniper 345kV line • Davis Besse – Beaver 345kV line • Hayes-Beaver 345kV line • Carlisle – Beaver 345kV line • Erie West – Ashtabula 345kV line • Ford – Beaver 138kV line

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Transfer Interface	Interface Definition
	• Greenfield – Beaver 138kV line • NASA – Beaver 138kV line • Henrietta – Beaver 138kV line • West Akron – Hickory 138kV line • West Akron – Brush 138kV line • Johnson – Beaver 138kV line • Black River – Beaver 138kV line • Black RIver – Lorain 138kV line • National - Lorain 138kV line
ComEd (ComEd)	• Dumont – Wilton Center 765 kV line • St. John – Crete 345 kV line • Latham – 2102 345 kV line • Brokaw – Pontiac 345 kV line • Sub 39 – Cordova 345 kV line • Paddock – Wempletown 345 kV line • Rockdale – Wempletown 345 kV line • Arcadian – Zion 345 kV line • Pleasant Prairie – Zion 345 kV line • Pawnee – Kincaid 345 kV line • No Pana – Kincaid 345 kV line • Tazewell – Powerton 345 kV line • Sheffield – Burnham 345 kV line • Munster – Burnham 345 kV line • Tazewell – Kendall 345 kV line • Sheffield – Stateline 345 kV line • Rock Creek – Quad Cities 345 kV line • Sub 91 – Quad Cities 345 kV line • Lanesville – Kincaid 345 kV line • Olive – University Park 345 kV line • Wolf Lake – Stateline 138 kV line • Kewanee – 74_Kewanee 138 kV line • Roxana – Stateline 138 kV line

Transfer Interface	Interface Definition
	• Oglesby – 7713 138 kV line • Edwards – 74_Kewanee 138 kV line • Marseile – 6102 138 kV line • Hennepin – 6101 138 kV line • Lakeview – Zion 138 kV line • 1352 – Powerton 138 kV line • Albany – Garden Plain 138 kV line • Pleasant Prairie – Zion EC PLPL41 345 kV line
BC/PEPCO (BC/PEPCO)	• Doubs - Brighton 500 kV line • Hunterstown - Conastone 500 kV line • Peach Bottom - Conastone 500 kV line • Possum Point – Burches Hill 500 kV line • Dickerson – Aqueduct 230 kV line • Doubs – Dickerson 23102 230 kV line • Cooper – Graceton 230 kV line • Pleasant View – Dickerson 230 kV line • Otter Creek – Conastone 230 kV line • Safe Harbor - Graceton 230 kV line • Face Rock – Five Forks #1 115 kV line • Face Rock – Five Forks #2 115 kV line

- The transfers across an interface are the MW flows across the transmission paths. The transfer limits are the MW transfer beyond which reactive and voltage criteria are violated.

The reactive transfer limits are used to limit the total flow over the interfaces. The reactive limits are either pre-contingency MW limits, or post-contingency MW limits, based on a post-contingency voltage drop in the PJM RTO.

The PJM dispatchers continuously monitor and control the flow on each transfer interface so that the flows remain at or below the transfer limits. This ensures that no single contingency loss of generation or transmission in or outside the PJM RTO causes a voltage drop greater than the applicable voltage drop criteria.

In addition, special operating procedures, addressing reactive issues, are identified in Section 5.

Additional interfaces will be established by PJM Operations Planning as required.

3.9 Stability Limits

The PJM RTO established stability limits for preventing electrical separation of a generating unit or a portion of the PJM RTO. PJM recognizes three types of stability:

- Steady State Stability - A gradual slow change to generation that is balanced by load.
- Transient Stability - The ability of a generating unit or a group of generating units to maintain synchronism following a relatively severe and sudden system disturbance. The first few cycles are the most critical time period.
- Dynamic Stability - The ability of a generating unit or a group of generating units to damp oscillations caused by relatively minor disturbances through the action of properly tuned control systems.

PJM will operate the facilities that are under PJM operational control such that the PJM system will maintain angular and voltage stability following any single facility malfunction or failure.

In general, stability is not a limiting constraint on the PJM RTO.

In addition to the special operating procedures addressing stability limit issues that are presented in Section 5, PJM utilizes a real-time Transient Stability Assessment (TSA) tool. TSA can monitor and determine transient stability of the system subject to a select set of EMS contingencies for balanced and unbalanced faults. PJM models a select set of three-phase faults with normal clearing and single-phase faults with delayed clearing.

TSA computes stability limits by using real time network models. It interfaces with the EMS and uses the State Estimation solution. Other input data includes the dynamic model for over 3000 generators and fault clearing times for specific equipment. For equipment without a specific fault clearing time, TSA will use zonal default clearing times. TSA also calculates and provides recommended stability control measures to prevent generator instability. Typically, the control measure is expressed in terms of generator-specific MW adjustment.

ZONE	161 kV					138 kV					115 kV					69 kV				
	LD	EL	NL	NH	Drop	LD	EL	NL	NH	Drop	LD	EL	NL	NH	Drop	LD	EL	NL	NH	Drop
PJM	145 0.90	148 0.92	153 0.95	169 1.05	5-10%	124 0.90	127 0.92	131 0.95	145 1.05	5-10%	103 0.90	106 0.92	109 0.95	121 1.05	5-10%	62 0.90	63.5 0.92	65.5 0.95	72.5 1.05	5-10%
PS						*	131	135	*	*										
PE						128	131	135	145	7						63.5	65.5	67.5	*	7
PL						*	*	*	*	*	*	*	*	*	*	60.3	61.6	63.7	70.3	*
UGI																59.4	60.7	62.7	*	*
BC											*	*	*	*	*					
JC											*	*	*	*	10	*	*	*	*	*
ME						*	*	*	*	*	*	*	*	*	10	*	*	*	*	*
PN						*	*	*	*	*	*	*	*	*	10					
PEP						*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
AP						~~121~~*	~~124~~*	~~128~~*	*	~~8~~10	*	*	*	*	*	*	*	*	*	*
AE						*	130	*	*	8						62	65	65.5	72.5	8
RECO							124.2	127	144.9	8										9
DPL						124	130	131	145	10						62 62	65 65	65.5 65.5	74 72.5	10 8
AEP						*	*	*	*	8	*	*	*	*	8	*	*	*	*	8
DLCO						*	*	*	*	8						*	*	*	*	8
DAYT						*	*	*	*	8						*	*	*	*	8
ATSI						*	*	*	*	*						*	*	*	*	*
CPP						*	*	*	*	*						*	*	*	*	*
DEOK						118.8	121.4	125.4	141.9	10						59.4	60.7	62.7	70.9	10
CE						*	*	*	*	10						*	*	*	*	10
DOM						*	126	127	*	10	104	105	106	121	10	*	*	65	75	10
EKPC	*	148.9	153.8	*	*	*	127.7	131.8	*	*										

Key:	**LD** – Load Dump	**EL** – Emergency Low	**NL** – Normal Low	**NH** – Normal High	**Drop** – Voltage Drop Limit
	'*' – same as PJM criteria	'-' not applicable			

ZONE	765 kV					500 KV					345 kV					230 kV				
	LD	EL	NL	NH	Drop	LD	EL	NL	NH	Drop	LD	EL	NL	NH	Drop	LD	EL	NL	NH	Drop
PJM	688 0.90	703 0.92	726 0.95	803 1.05	10%	475 0.95	485 0.97	500 1.00	550 1.10	5-8%	310 0.90	317 0.92	328 0.95	362 1.05	5-8%	207 0.90	212 0.92	219 0.95	242 1.05	5-8%
PS						*	*	*	*	5	*	*	*	*	8	*	218.5	225.5	*	*
PE						*	*	*	*	5						213.5	218.5	225.5	242	7
PL						*	*	*	*	5						*	*	*	*	*
UGI																*	*	*	*	*
BC						*	*	*	*	5						*	*	*	*	*
JC						*	*	*	*	5						*	*	*	*	*
ME						*	*	*	*	5						*	*	*	*	*
PN						* *	* *	515 *	535 540	5 5	*	*	*	*	8	*	*	*	*	*
PEP						*	*	*	*	5						*	*	*	*	*
AP	*	~~688.5~~*	~~703.8~~ *	~~841.5~~ *	10	*	*	*	542.5	8	*	*	*	*	8	*	*	*	*	*
AE						*	*	*	*	5						*	*	*	*	*
RECO											*	319	*	*	8					
DPL						*	*	*	*	5						207	212	219	244	8
AEP	*	*	*	*	10	*	*	*	*	8	*	*	*	*	8					
DLCO											*	*	*	*	8					
DAYT											*	*	*	*	8					
ATSI											*	*	*	*	8					
CPP																				
DEOK											*	*	*	*	8					
CE	*	726.7	749.7	*	10						*	327.7	338.1	*	10					
DOM						*	*	505	535.5	6						*	*	*	*	8
EKPC ~~**~~											*	319.1	329.5	*	*					
Key:	**LD** – Load Dump					**EL** – Emergency Low					**NL** – Normal Low					**NH** – Normal High				
		'*' – same as PJM criteria				'-' not applicable					~~** Applicable upon Integration on 6/1/13~~						**Drop** – Voltage Drop Limit			

Exhibit 5: Bus and Zone Specific Variations to PJM Base Line Voltage Limits

Note: Transmission Owners shall not set UVLS settings on BES facilities higher than the PJM Load Dump Voltage Limit (0.90 pu)

3.10 Interconnection Reliability Operating Limit (IROL)

The Interconnection Reliability Operating Limit is 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 Electric System to instability, uncontrolled separation(s) or cascading outages. PJM Reliability Coordination Manual (M37) defines PJM's methodology for determining, monitoring, and controlling IROL facilities.

Section 4: Reportable Transmission Facility Outages

Welcome to the *Reportable Transmission Facility Outages* section of the ***PJM Manual for Transmission Operations***. In this section, you will find the following information:

- A description of the general principles of scheduling outages (see "General Principles").
- How the Transmission Owner schedules a transmission facility outage (see "Scheduling Transmission Outage Requests").
- How PJM processes a Transmission Outage Request (see "Processing Transmission Outage Requests").
- A description of the equipment failure procedures (see "Equipment Failure Procedures").
- A description of the Transmission Acceleration Outage Process

4.1 General Principles

Transmission Owners have the right and obligation to maintain and repair their portion of the transmission system. PJM approves all Reportable Transmission Facility outages prior to removal of the equipment from service. PJM will coordinate scheduled outages of all Reportable Transmission Facilities with planned generation outages that are submitted to PJM and may affect PJM RTO operation. For purposes of scheduling, Reportable Transmission Facilities include, but are not limited to, lines, transformers, phase angle regulators, buses, breakers, disconnects, Bulk Electric System capacitors, reactors, and all related equipment.

PJM maintains a list of Reportable Transmission Facilities. Each Transmission Owner submits the tentative dates of all transmission outages of Reportable Transmission Facilities to PJM as far in advance as possible.

Procedures and timelines are established for the scheduling, coordinating, requesting, studying, approving, and notifying of the transmission outage to/by the appropriate Transmission Owner and PJM. The procedures and timelines are identified in this section and are periodically reviewed and revised.

Under certain conditions such as extreme weather, peak load, heightened homeland security, etc. PJM will evaluate the need to operate the Power Grid in a more conservative manner. Actions that may be taken in these special circumstances include, but are not limited to, canceling or rescheduling outages and returning outaged equipment to service. The status of rescheduled outages is described in detail under the subheading, "*Rescheduling Outages".*

4.2 Scheduling Transmission Outage Requests

Each Transmission Owner shall submit the tentative dates of all planned transmission outages of Reportable Transmission Facilities to PJM via eDART as far in advance as possible and update PJM at least monthly. For transmission outages exceeding five days,

the TO shall use reasonable efforts to submit the planned outage schedule via eDART one year in advance but no later than 0000 hours on the first of the month six months in advance of the requested start date along with a minimum of monthly updates.

PJM maintains a planned transmission outage schedule for a period of at least the next 13 months. The planned transmission outage schedule is posted, subject to change, on the PJM Open Access Same-time Information System (OASIS). Planned transmission outages are given priority based on the date of submission. All planned transmission outages will be posted on OASIS within 20 minutes of Transmission Owner submittal of the outage through the PJM eDart system, with further updates as new information is provided in eDart. PJM periodically reviews all submissions of planned transmission outages and considers the effect of proposed transmission outages upon the integrated operation of the transmission system using established operating reliability criteria, as described within Sections 2 and 3 of this manual. Advance notification assures that the outage is reflected in both the ATC analysis and the FTR Auction.

Outages scheduled for the following Planning year (i.e. June 1 – May 31) exceeding 30 days in duration are to be submitted via eDART before February 1 for use in the annual FTR auction. For example, outages scheduled to begin between June 1, 2009 and May 31, 2010 are to be submitted before February 1, 2009. Estimated start and stop dates are acceptable.

4.2.1 Requirements

The TO is required to submit all outage requests in excess of 5 calendar days in duration before the 1st of the month six months in advance of the start of the outage. Outages exceeding 30 calendar days in duration for the following planning cycle (June 1 – May 31) must be submitted before February 1. The most restrictive deadline will be enforced. In other words, an outage exceeding 30 days in duration starting in June would have to be submitted no later than November 30th at 2359 hours to be considered on-time. The TO is required to submit all other outage requests before the 1st of the month prior to the month of the requested start date of the outage. Recognizing that this may not always be possible, the following table illustrates the different time frames in which an Outage Request can be submitted and the different Actions PJM can take. The "PJM Actions" are defined in more detail in the Section: "*Processing Transmission Outage Requests, PJM Actions*".

Request Submitted	Ticket Received Status	PJM Actions
Outage > 30 Calendar Days		
Before February 1 (for the following planning cycle June 1 – May 31)OR by the 1st of the month six months prior to the starting month of the outage (whichever is more restrictive)	"On Time"	The outage will be approved, provided it does not jeopardize system reliability.

Request Submitted	Ticket Received Status	PJM Actions
On or after February 1 (for the following planning cycle June 1 – May 31) OR on or after the 1st of the month six months prior to the starting month of the outage (whichever is more restrictive)	"Late"	The outage may be cancelled if it causes congestion requiring off-cost operations.
5 Calendar days < Outage <= 30 Calendar Days		
Before the 1st of the month six months prior to the starting month of the outage	"On Time"	The outage will be approved, provided it does not jeopardize system reliability.
On or after the 1st of the month six months prior to the starting month of the outage	"Late"	The outage may be cancelled if it causes congestion requiring off-cost operations.
Outage <= 5 Calendar Days		
Before the 1st of the month prior to the starting month of the outage	"On Time"	The outage will be approved, provided it does not jeopardize system reliability.
On or after the 1st of the month prior to the starting month of the outage, and before 0800 three days before the start of the outage	"Late"	The outage may be cancelled if it causes congestion requiring off-cost operations.
After 0800 three days before the start of the outage	"Past Deadline"	Only Emergency or Exception requests (i.e., a generator tripped and the TO is taking advantage of the situation) will be considered.

When the Transmission Owners notify PJM using eDART of an Outage Request, the notification includes the following information:

- Date
- Facility and associated elements
- All line and transformers that will be outaged or open ended as a result of the scheduled maintenance must be included in the outage request. For example, an outage request for CB work that open ends a line must include the line as being out of service in the ticket. This

will ensure proper posting of all outages to the PJM OASIS and the NERC System Date Exchange (SDX) site.

- Planned switching times
- Job description
- Availability/emergency return time

Note: Outages can be classified by PJM as Market Sensitive if necessary. This option is used in specific instances:
Market Sensitive - any equipment or facility that reveals the future status of a generating unit. Generally, these outages are not posted on the PJM OASIS.

4.2.2 Hotline / In Service Work Requests /Protective Relay Outages/Failures

To properly coordinate the operation of the Bulk Electric System, Transmission Owners must notify PJM of Hot-line work and Protective Relay Outages. While no specific advance time notice is required, several days notice is requested to enhance coordination. The notification includes the following information:

- An outage of either the primary or back-up relay protection associated with any EHV circuit 345kV and above; an outage of any other major relay protection scheme significant to EHV operation; an outage of an automatic recloser protection associated with an EHV circuit 345kV and above, or any hotline work (reclosers in or out) on EHV facilities 345kV and above. PJM dispatcher is informed prior to auto-reclosers being taken out of service. All planned outages shall be submitted via e-Dart. All unplanned outages shall be communicated to PJM Dispatch and submitted via e-Dart.

Note: Under normal system conditions, Transmission Owners may elect not to restore "automatic reclosing" during multiple-day daily EHV equipment Hotline work. However, "automatic reclosing" must be restored from June 1st – August 31st (peak loads). In addition, PJM may request the TO to restore Hotline work during other projected peak load conditions, during thunderstorms or inclement weather, or during other unusual conditions which could adversely impact system reliability.

- In the case of Bulk Electric System facilities with no back-up relay protection, the Transmission Owner or Generation Owner should remove the facility from service before removing the primary relay protection when possible. If the facility cannot be removed from service, the Transmission Owner or Generation Owner shall notify PJM Dispatch verbally and through eDart of the impacted facility(s) and the remote fault clearing points. PJM Dispatch will modify the EMS Network Contingency analysis to reflect the remote clearing.
- In the case of any EHV automatic recloser outages of 345kV and above, some limitations may need to be placed on the number of reclosers that may be outaged concurrently. Under normal conditions, PJM does not restrict the number of automatic reclosers that are out-

of-service. However, under certain operating conditions, the number of automatic reclosers out-of-service in that electrical area may need to be limited if an analysis indicates potential reliability concerns. For example, if an EHV line is out-of-service, this will hold true. In this case, the requesting Transmission Owners are informed of the situation and asked to reschedule the work.

- Instances when relay testing or construction personnel are working in EHV substations, other than those in conjunction with scheduled facility outages previously approved by PJM, which may jeopardize the reliable operation of the substation.
- Transmission and Generation Owners shall notify PJM Dispatch of any protection system failures or unavailability that impact the capability of protection relay systems on any facility on the list of Reportable facilities if such unavailability may result in a change in remote clearing, requiring PJM to modify PJM EMS Network Application Contingencies or switching the impacted facility out-of-service. PJM Dispatch shall notify affected Transmission Owners, Transmission Operators and Reliability Coordinators to ensure contingencies are modeled properly in Security Analysis. (PRC-001-1 R2.2). PJM Dispatch shall log such contingency modifications in the PJM SmartLog system.

Note1: PJM relies on Transmission and Generation Owners to identify, assess and notify PJM of changes, degradations, or outages to relay systems that impact normal fault clearing.

Note 2: Facilities with degraded or no relay protection will be switched out-of-service; unless by doing so would create a load shed situation. In this case, PJM would model the remote clearing points and operate to control any resulting contingencies using normal operating procedures including PCLLRWs. These actions should be completed within 30 minutes of identification of the protection problem.

4.2.3 Energizing New Facilities

In order for PJM to properly model changes in system configuration, as much advanced notification as possible is required when a new facility, a reconfigured facility, or a facility that has been out of service for an extended period of time is scheduled to be energized. This also includes a re-conductoring or equipment replacement that changes impedance or rating of a facility. Transmission Owners must notify PJM of such changes by checking the Cut-In flag in the eDART outage ticket. This information should be submitted to PJM as far in advance as possible to ensure inclusion in the quarterly EMS model update but at minimum shall be consistent with the outage submittal rules. If energizing a new facility involves multiple outages in different periods, the Cut-In flag shall only be checked for the outage that upon completion will result in the energized facility.

4.2.4 Protection System Coordination

Each Generation Owner shall coordinate any new protection system or protection system change with their local Transmission Owner and PJM (email to Regional_Compliance@PJM.com). PJM will collect the information on these changes from the Generation Owner and post on the secure PJM Relay Subcommittee SharePoint site. [PRC-001-1, R3 and R5].

Note: PJM relies on Transmission and Generation Owners to notify PJM of changes or degradations to relay systems that changes normal fault clearing. PJM models such change within the PJM EMS system by modifying PJM Security Analysis Contingencies.

4.2.5 Generator Voltage Regulator Changes

An outage of any unit generator voltage regulator, supplementary excitation control, or power system stabilizers must be communicated to PJM though eDART as far in advance as possible. The Generator Owner must submit these outages. (Refer to the Generator Operational Requirements Manual, M-14D.)

4.2.6 Peak Period Outage Scheduling Guidelines

Transmission owners should avoid scheduling any outage in excess of 5 days in duration with no or greater than 5 day restoration time that may result in increased risk to system reliability during peak summer and winter periods. These periods are defined as June 15 – August 31 and January 1 – February 28, respectively. These outages include those that may result in:

- Actual or post-contingency thermal or voltage issues with insufficient generation for control
- Constraints that are load sensitive with limited controlling actions
- Stability issues or bottled generation

Transmission owners shall screen for such outages prior to submittal in eDART and look to reschedule during shoulder months. PJM shall screen for such outages when performing outage analysis. The transmission owners are encouraged to schedule non-impactful outages during peak seasons.

PJM may grant exception to ensure RTEP upgrades are installed within specified timeframes or as special circumstances warrant.

4.2.7 Outage Scheduling Exceptions

- PJM reserves the right to approve, deny, or reschedule any outage deemed necessary to ensure system reliability on a case by case basis regardless of date of submission.
- Outages not submitted on-time but scheduled in conjunction with existing outages will be reviewed and approved by PJM on a case-by-case basis in order to take advantage of expected system conditions.

- Any outage not expected to impact the transmission system reliability or result in system congestion may be approved if submitted by 8:00 a.m. 3 days in advance regardless of duration.
- Transmission Owners should use reasonable efforts to assess all outages and submit changes to outage tickets due to last minute cancellation or other modification to PJM whenever possible by 06:00 a.m. but by no later than 11:00 a.m. one day in advance for input into the day-ahead market model.

4.2.8 Emergency and Forced Outages

PJM recognizes that Emergency Outages must be taken. If it is determined that the outage may create an unreliable operating condition the outage will not be approved, but it will be recognized by PJM that the outage will occur.

Transmission Owners report forced transmission outages of Transmission Facilities to PJM, to directly connected Balancing Authorities and to any Other PJM member that may be affected as soon as the forced transmission outage occurs or as soon as it is anticipated that forced outage will occur. The Transmission Owner also submits an eDART ticket for the outage with all pertinent information that is available at that time and updates the ticket as new information becomes available.

For emergency outages that require the scheduling of manpower, ordering of parts, etc…and therefore cannot come out of service immediately the TO shall submit a ticket in eDART for the future date in which the outage is expected to come out of service, set the Emergency flag, and write a description in the eDART ticket explaining the emergency condition and why the outage cannot come out of service immediately.

4.2.9 Rescheduling Outages

A planned transmission outage that is rescheduled or canceled because of inclement weather or at the direction or request of PJM retains its on-time status (if applicable) and priority as a planned transmission outage with the PJM approved rescheduled date. If an outage request is rescheduled or canceled (for reasons other than inclement weather and not at the direction of PJM), the rescheduled or canceled and resubmitted outage is treated as an unplanned outage request. The revised outage request may lose its priority as an “on-time” outage as indicated by the following:

Revisions to “On-Time” scheduled outages lasting 5 Days or less

If the revised outage request will occur entirely during the originally scheduled month, it will retain its “on-time” status if applicable.

If the revised outage request will occur during a different month, the revision must be submitted by the first of the month prior to the revised month in which the outage will take place to be considered “on-time”.

If the revised outage request results in the ticket duration being greater than 5 days, the ticket’s on-time status will be re-evaluated as if submitted for the first time.

Revisions to “On-Time” scheduled outages exceeding 5 Days in duration

If the revised outage request will occur entirely during the originally scheduled month, it will retain its "on-time" status if applicable.

If the outage request moves to a new month which is further out into the future, the revision must be submitted by the first of the month prior to the revised month in which the outage will take place to be considered "on-time".

If the outage request moves to a new month which is nearer to the current date, the revision must be submitted by the first of the month six (6) months prior to the revised month in which the outage will take place to be considered "on-time".

If the revised outage request results in the ticket duration being greater than 30 days, the ticket's on time status will be re-evaluated as if submitted for the first time.

Revisions to "Late" scheduled outages will be re-evaluated by PJM as "on-time" or "late" as dictated by the rules in the "Transmission Outage Scheduling - requirements" section listed previously.

PJM coordinates outage rescheduling with the PJM Transmission Owners to minimize impacts on system operations.

4.2.9.1 Direct Billing for Late Outages

In order to avoid cancellation or rescheduling of a late outage, a Transmission Owner may elect to pay for off-cost operations associated with the outage consistent with OATT Attachment K and OA Schedule 1 in cases where PJM can specifically identify and assign the costs to the T.O. and after review and approval of such request by PJM.

PJM may assign to the Transmission Owner, at their consent, the generation off-cost or reductions in demand associated with their late outage submittal related to RTEP upgrades provided that delay of such outage would result in failure to meet the reliability based in-service date. Should the T.O. elect not to pay for the off-cost operations, the emergency RTEP outage will be posted as a special notice on the PJM OASIS.

In order to minimize market impact, direct billing costs outlined in this section apply only to those outages where controlling generation or reductions in demand can be identified in advance yet are not included in the LMP calculation. Outages resulting in overloads where the generator costs cannot be isolated thereby resulting in congestion do not fall under this proposal. A Transmission Owner would not be directly assigned costs associated with late outages due to unforeseen circumstances such as but not limited to inclement weather, existing outage extensions, permitting or zoning issues, equipment delivery delays, generation, or reductions in demand availability.

4.2.10 Coordinating Outage Requests with Other TOs

In the event that a contemplated scheduled outage of one Transmission Owner's facility affects the availability of another Transmission Owner's facility, it is the responsibility of the Transmission Owner initiating the request to notify the affected TO or other Balancing Authorities for their consideration before submitting the request to PJM. If agreeable to all Transmission Owners or Balancing Authorities, the initiating Transmission Owner submits an outage request to PJM all other PJM Members that may be affected are notified.

4.2.11 Coordinating Outage Requests with other RTOs

In the event of a contemplated scheduled outage of a tie between the PJM RTO, the Transmission Owner initiating the request discusses the outage with the directly connected Balancing Authority for their consideration. Likewise, if it is expected that such an outage will be extended beyond its scheduled time, this is discussed with the directly connected Balancing Authority. If agreeable to the directly connected Balancing Authority, the initiating Transmission Owner submits an outage request to PJM, all other systems that may be affected are notified. This procedure also applies to a tie between the PJM RTO and an adjacent Balancing Authority whenever the PJM RTO initiates an outage request. Adjacent Balancing Authorities are expected to follow a similar procedure.

4.2.12 Coordinating Outage Requests with Planned Nuclear Generation Outages

When a Transmission Owner submits an Outage Request that will open a Nuclear Generating Station's Unit Breaker the following guidelines shall be observed:

All Nuclear Unit breaker Outage Requests shall be coordinated closely with the Nuclear Station to coincide with a Unit outage

In the case that the Outage Request cannot be delayed until the next Unit Outage, the Nuclear station should be given at least six weeks notice. The schedule for opening the Unit Breaker must be closely coordinated with the station. The length of time that the breaker remains open should be minimized.

PJM will work with the Nuclear Station's and the Transmission Owner's outage needs.

The Nuclear Generating Stations coordinate the scheduling of a Unit Breaker outage and internal plant equipment outages and testing to minimize station risk. Adherence to outage schedule and duration is critical to the plant during these evolutions. Emergent plant or transmission system conditions may require schedule adjustments, which should be minimized. Any change to the outage schedule that impacts the Unit Breakers shall be communicated to the nuclear generator operator.

The following Nuclear Generating Stations have transmission system connections that can impact Nuclear Station Safety Systems:

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Transmission Zone	Facility	Units	Circuit Breakers		
PECO	Peach Bottom	Unit 2	CB 215	CB 225	
		Unit 3	CB 15	CB 65	
	Limerick	Unit 1	CB 535	CB 635	
		Unit 2	CB 235	CB335	
BG&E	Calvert Cliffs	Unit 1	CB 1 GEN ATB	CB 5051/1GEN ATB	
		Unit 2	CB 2 GEN ATB	CB 2GEN 72	
Comed	Dresden	DR-2	CB BT 1-7	CB BT 1-2	

		DR-3	CB 45BT 9-10	CB 45BT 10-11	
	Byron	BY-1	CB 45BT 4-5	CB 45BT 3-4	
		BY-2	CB 45BT 10-11	CB 45BT 11-12	
	Quad Cities	QC-1	CB 45BT 6-7	CB 45BT 7-8	
		QC-2	CB 45BT 10-11	CB 45BT 1-11	
	Braidwood	BR-1	CB 45BT 1-8	CB 45BT 7-8	
		BR-2	CB 45BT 10-11	CB 45BT9-10	
	LaSalle	LA-1	CB 45BT 10-11	CB 45BT 9-10	
		LA-2	CB 45BT 2-3	CB 45BT 3-4	
FE-E	Oyster Creek	Unit 1	CB GD1	CB GC1	
	TMI	Unit 1	CB GB1-02	CB GB1-12	
PS	Hope Creek	Unit 1	CB SECT 2-6	CB SECT 5-6	
	Salem	Unit 1	CB SECT 5-6	CB SECT 1-5	
		Unit 2	CB SECT 9-10	CB SECT 1-9	
PL	Susquehanna	Unit 1	CB GEN1-W	CB GEN1-E	CB SYNCHRO
		Unit 2	CB GEN 2-S	CB GEN 2-N	
Dominion	North Anna	G1	CB G102-1	CB G102-2	
		G2	CB G202	CB G2T575	
	Surry	G1	CB G102	CB G1T240	
		G2	CB G202	CB G2T567	
Duquesne	Beaver Valley	Unit 1	CB UNIT13	CB UNIT14	
		Unit 2	CB UNIT25	CB UNIT26	
ATSI	Davis Bessie	DB10	CB B34560	CB B34561	
	Perry	PR10	CB S610_TIE	CB S611_TIE	

~~**Peach Bottom:**~~

~~Unit 2: CB 215~~

~~CB 225~~

~~Unit 3: CB 15~~

~~CB 65~~

~~**Limerick:**~~

~~Unit 1: CB 535~~

~~CB 635~~

~~Unit 2: CB 235~~

~~CB 335~~

~~**Salem:**~~

~~Unit 1: 1 – 5 B.S. 10X~~

~~5 – 6 B.S. 11X~~

~~**Oyster Creek:**~~

~~GD1~~

~~GC1~~

~~Unit 2: 9 – 10 B.S. 30X~~

~~1 – 9 B.S. 32X~~

~~**Hope Creek:**~~

~~BS 6 – 5 50X~~

~~BS 2 – 6 52X~~

~~**Calvert Cliffs:**~~

~~Unit 1: 552 – 22~~

~~552 – 23~~

~~Unit 2: 552 – 61~~

~~552 – 63~~

4.2.13 Coordinating Outage Requests with Planned Generation Outages

Transmission Owners will adhere to all PJM requirements regarding Transmission Outage Requests previously detailed in this section.

PJM and Transmission Owners coordinate transmission outages with planned outages for generators submitted to PJM. In the maintenance planning process, if submitted in a timely manner, planned generator outage requests are given priority over planned transmission outage requests. PJM resolves potential outage conflicts based on system reliability. PJM performs the following activities:

- Reviews the transmission and generator maintenance schedules to coordinate major transmission and generator outages and communicates with submitting PJM Members to assist in attempting to minimize anticipated constrained operations
- Recommends adjustments to transmission outage schedules throughout the year to coincide with planned generator outages within the PJM RTO and surrounding Balancing Authorities
- Communicates with submitting PJM Members to assist in attempting to minimize the forecast PJM RTO production cost based on anticipated market-based prices

4.3 Processing Transmission Outage Requests

Transmission Owners submit Outage Requests in eDART for all outages to PJM in advance of the outage start date. The Outage Request shall be submitted as far in advance as possible. PJM considers all transmission outages in the following priority order:

- Forced or emergency transmission outages
- Transmission outage requests submitted “On Time”. Refer Section 4.2.1 for “On Time” transmission outage submission requirements.
- Transmission outage requests submitted “Late”. Refer Section 4.2.1 for transmission outage submission requirements.

Exhibit 6 presents how PJM processes Transmission Outage Requests.

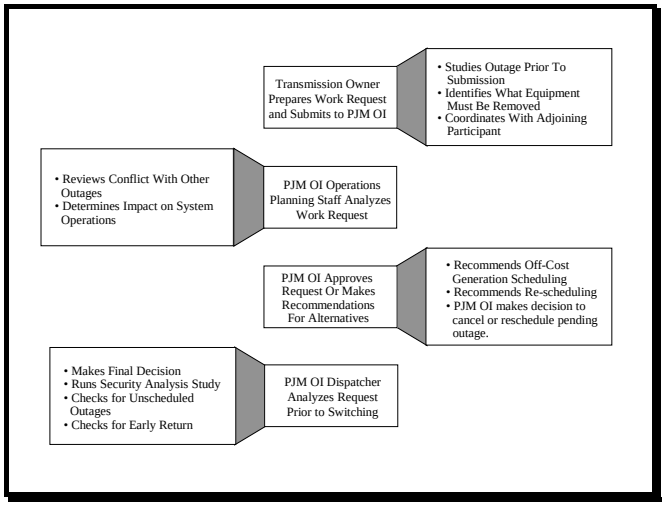


Exhibit 6: Transmission Outage Request Process

PJM Actions:

For all outages exceeding 5 days in duration PJM shall analyze these requests starting the first of the month 6 months in advance of the proposed start date. PJM shall make best efforts to contact the transmission owners with the results of this analysis by the end of the month as outlined in the example below.

Example: An outage submitted before January 1, 2009 scheduled for July 10-24, 2009 shall be studied by PJM with other expected July outages starting January 1, 2009. PJM shall make best efforts to contact TO by January 31 with results of analysis. PJM and TO shall work together to resolve any reliability issues.

If it appears that the expected outage will adversely impact system reliability, PJM will determine if a better window of opportunity exists for this work to be scheduled. PJM will coordinate between transmission and generation owners to ensure work will be done with system reliability being maintained.

If conflicting outages from different Transmission Owners are identified, the outage submitted first will have priority.

For outages 5 days or less in duration, PJM shall analyze these requests starting the first of the month preceding the outage start date and make best efforts to contact transmission owners with results of the analysis by the 15th of the month.

PJM will inform the Transmission Owners through eDART of the status of all Outage Requests (either Approved or Denied) by no later than 1400 hours two days before the requested start of the outage.

In evaluating all Transmission Outage Requests, PJM performs the following activities:

- Studies and approves all emergency outages that do not result in Emergency Procedures.
- Cancels or withholds approval of any outage that is expected to result in Emergency Procedures.
- Studies and approves all Transmission Outage Requests that are submitted “On Time” and do not jeopardize the reliability of the PJM System.
- Studies and approves all Transmission Outage Requests that are submitted “Late” and do not cause congestion on the PJM System. PJM retains the right to deny all jobs submitted after 8 a.m. three days prior to the requested start date unless the request is an emergency job or an exception request (i.e. a generator tripped and the Transmission Owner is taking advantage of a situation that was not available before the unit trip).
- Determines if a “Late” Request may cause congestion and advises the Transmission Owner of any solutions available to eliminate the congestion. If a generator Planned or Maintenance Outage request is contributing to the congestion, PJM can request the Generation Owner to defer the outage. If no solutions are available, PJM may require the Transmission Owner to reschedule the outage.
- During anticipated emergency conditions, orders all work on Reportable Transmission Facilities that can be returned to service interrupted and the facilities returned to service until the emergency condition is relieved, if possible.

PJM, as system conditions warrant, identifies opportunities for, and encourages, coordination of all generator and transmission maintenance outages. When actual or anticipated system conditions change such that, at the discretion of PJM, the rescheduling of a transmission outage is advisable, PJM informs the Transmission Owner of the conditions and available alternatives. The Transmission Owner involved considers the impacts of proceeding with the outage as advised by PJM and may either proceed knowing the estimated impacts on the remaining facilities or postpone the outage. If the outage is not postponed, PJM determines and records the appropriate impacts or changes to system limits and takes the steps required to maintain established operating reliability criteria as mentioned within Section 1 of this manual.

PJM evaluates planned outages of Reportable Transmission Facilities to determine whether an outage may cause the simultaneous loss of multiple facilities. When non-reportable equipment outages at a station occur, which can lead to the simultaneous loss of more than one reportable transmission or generator facility for any single facility malfunction or failure, PJM must be informed. The Transmission Owners are responsible to report such conditions to PJM as soon as they are recognized.

4.3.1 Notification of Transmission Outages

The Transmission Owners are responsible for reporting outages on facilities contained within the Transmission Facilities List Database (available on the PJM website – www.pjm.com). The eDART reporting system is used to inform PJM and others of the outage according to predefined indexing keys.

Transmission Owners must notify PJM of the unavailability of other transmission components that affect the capability of protection of facilities on the list of Reportable Transmission Facilities. Such unavailability may result in a degradation of protection systems which could result in remote clearing of a transmission faults requiring PJM to modify PJM EMS Network Application Contingencies or switching the impacted facility out-of-service.

Transmission Owners report forced transmission outages of Transmission Facilities to PJM, to directly connected Balancing Authorities that may be affected, and to a jointly-operating PJM Member as soon as the forced transmission outage occurs or as soon as it is anticipated that forced outage occurs or is imminent.

Transmission Owners must report outages that under expected system conditions may affect system reliability even though these facilities may not be listed as a Reportable Transmission Facility. This includes outages that may result in multiple facility trippings.

PJM dispatcher then informs all other systems that may be affected. PJM dispatcher logs all outages and, as required, reports to and makes necessary arrangements with the appropriate personnel from neighboring RTOs, ISOs, and Balancing Authorities.

4.3.2 Real-Time Switching Notification Procedures

Transmission Owners must request final approval from PJM Transmission Dispatcher one-half hour prior to the expected switching time of any reportable facility. In the case of any 500 kV facility outage, PJM is notified again just prior to switching to verify PJM RTO conditions and to notify other companies via the ALL-CALL. For all other scheduled transmission outages, 345 kV and below, PJM is notified again, to report that the facility is out of service, unless PJM specifically requests to be notified immediately prior to switching.

If for any reason, PJM dispatch approves switching for planned maintenance, and actual or contingency violations are observed, PJM dispatch will direct the facility to be returned to service until system conditions can be adjusted and the outage permitted to continue without violating operating criteria.

When a reportable facility is to be returned to service, the responsible Transmission Owner reports to the PJM Transmission Dispatcher for approval prior to returning the outaged facility to service. This is done so that any generation changes or transmission adjustments can be made to assure reliable operation of the system.

Note: In general, each neighboring RC, TOP, BA, TO, GO, TSP and LSE shall use line/equipment terminals and voltage when referring to transmission facilities of an interconnected network, utilizing uniform identifiers as needed to clarify identification and ensure accurate real-time communications.

4.4 Equipment Failure Procedures

Transmission Owners must promptly notify PJM dispatch of any equipment failures involving BES facilities. Transmission Owners promptly conduct investigations of equipment malfunctions and failures and forced transmission outages in a manner consistent with good utility practice and NERC, RFC, and SERC Standards. Causes of failures shall be communicated to PJM dispatch as they are determined. In order to permit other Transmission Owners to take advantage of information leading to possible trends in equipment failures the Transmission Owners supply the results of such investigation to PJM, other Transmission Owners, and the appropriate entities in NERC, RFC and SERC. Transmission Owners establish guidelines for the level of resources to be applied to restore equipment to service following a failure. The Transmission Owners obtain from PJM the information and support services needed to comply with their obligations.

4.5 Transmission Outage Acceleration Process

Welcome to the *Transmission Outage* Acceleration Process section of the PJM Manual for ***Transmission Operations***. In this section, you will find the following information:

- A description of the general principles of requesting Transmission Facility Outage Acceleration (see "General Principles").
- A timeline of the process.
- How PJM processes a Transmission Outage Acceleration Request (see "Processing Transmission Outage Acceleration Requests").

4.5.1 General Principles

Transmission Owners provide notice of planned outages to PJM in accordance with the requirements in the Open Access Transmission Tariff and applicable Transmission Owners Agreement as detailed in this Manual. (Refer Section 4.2.1 for "On time" transmission outage submission requirements).

Under certain circumstances, it may be beneficial to investigate the possibility of moving or accelerating a transmission facility outage if shortening the overall outage time or moving the start/stop dates can alleviate transmission congestion or revenue inadequacy. To accommodate outages that may be accelerated under this process, PJM will review all outages exceeding 5 days in duration submitted by the Transmission Owners under the 6 month requirement as outlined above and forced outages projected to last into the month of the analysis window. This analysis will begin on the first of the month 60 days in advance of the outage start dates. If such outage meets the criteria as outlined in the next section it may be posted for acceleration under this process.

If transmission facility outage acceleration is possible, the costs incurred by the Transmission Owner in accelerating the outage will be paid by the PJM Member(s) who request the outage acceleration. To accommodate a request for the Transmission Owner to move or accelerate an outage, additional costs such as overtime, weekend/holiday, or contractor costs may be incurred.

The decision as to whether an outage can be moved or accelerated would be at the sole discretion of the Transmission Owner. If a Transmission Owner determines in its own reasonable judgment that it cannot move a planned outage or accelerate a planned or forced outage, this decision must be respected by PJM and by participants making the request(s). The Transmission Owner would follow Good Utility Practice, applicable OSHA standards, as well as any and all company safety protocols in determining whether to move or accelerate an outage and by how much, and would also consider any restrictions/requirements contained in collective bargaining agreements.

4.5.2 Criteria for Outage Acceleration

Outages that qualify for this process include the planned outages that will exceed five days and are estimated to cause more than $500,000 in congestion revenue inadequacy. Also qualifying for this process are forced outages projected to last into the month of the analysis window and are estimated to cause more than $500,000 in congestion revenue inadequacy. These outages will be posted to the PJM OASIS approximately four weeks prior to the FTR auction period that would include the outage.

Planned outages affecting the interconnection of a generating unit to the transmission system qualify for outage acceleration regardless of expected congestion revenue inadequacy.

Note: Outages that directly affect a generator's connection to the transmission system will NOT be posted on OASIS because they may reveal the future status of a generating unit.

4.5.3 Timelines for the Outage Acceleration Process

PJM will start reviewing all outages exceeding five days 2 months before the first of the month in which the outages are scheduled to begin. Outages that meet the acceleration criteria will be posted on OASIS by the 15th of the month. Market participants have 1 week to express willingness to accelerate an outage. The Transmission Owner then has 1 week to provide a good faith estimate for acceleration.

Market participants can express willingness to accelerate or reschedule outages that affect the interconnection of a generating unit at any time up to two weeks prior to the outages' scheduled start date. The Transmission Owner then has one week from the request to provide a good faith estimate for acceleration.

4.5.4 Processing Transmission Outage Acceleration Requests

Participants must make a request for acceleration of an outage within one week of the outage being posted. For an outage affecting the interconnection of a generating unit, participants must make a request for acceleration up to two weeks prior to the outage's scheduled start date. If one or more requests are received to accelerate an outage, PJM will contact the Transmission Owner and request a revised schedule and cost estimate to accelerate. PJM shall not reveal the identity of the Market Participant(s) making such request(s) to the Transmission Owner.

The transmission owner will provide PJM with a response that the outage can or cannot be accelerated within one week of the notification by PJM. If the outage can be accelerated the

Transmission Owner will provide an updated schedule that either moves the outage or shortens the duration of the outage along with the associated costs for acceleration. Either option should result in a projected reduction of revenue inadequacy caused by the outage.

Once the estimate is received from the Transmission Owner, PJM will contact the participant(s) that made a request to accelerate the outage and provide them with the details of the estimate.

a) If only one participant has made a request, that one participant can decide whether to accelerate or not and is then solely responsible for the actual Transmission Owner's acceleration costs.

b) If multiple participants make requests to accelerate, PJM would (1) provide the TO estimate to each participant; (2) notify the participants that there are multiple request to accelerate without revealing the identity of the other participant(s) making the other requests; and (3) collect a willing to pay amount from each participant. Based on the total amount the participants are willing to pay to accelerate, PJM would make a determination whether to move forward with the acceleration.

c) Once it is decided to move forward with the acceleration the Transmission Owner shall update eDART with the new outage schedule.

Determination would be made based on PJM judgment if the committed acceleration request amounts exceed the estimate by a sufficient margin. As a general guideline, for outages outside of a plant or substation, this margin should be a multiple of 2 times the Transmission Owner's estimate for transmission outages. For outages inside the plant, the margin should be a multiple of 5.

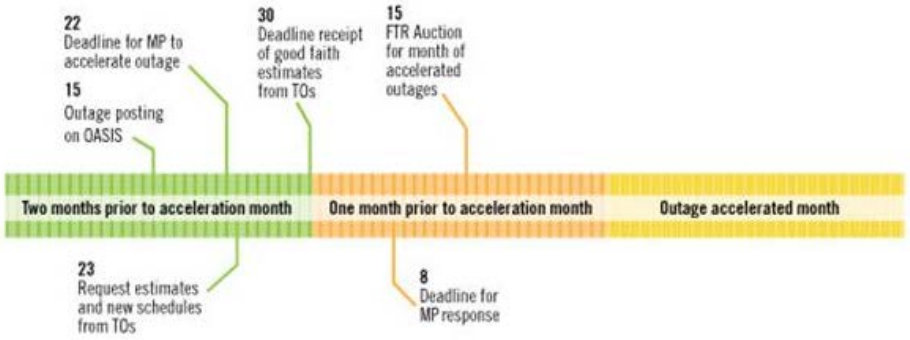
Note: Inside a substation refers to the substation equipment (including the measurement and metering equipment) to the point of interconnection to the EHV network. The interconnection point may be within the physical limits of the substation perimeter.

i) Actual costs to accelerate would be divided pro-rata across the participants who requested the acceleration, based on the amount they provided with the request.

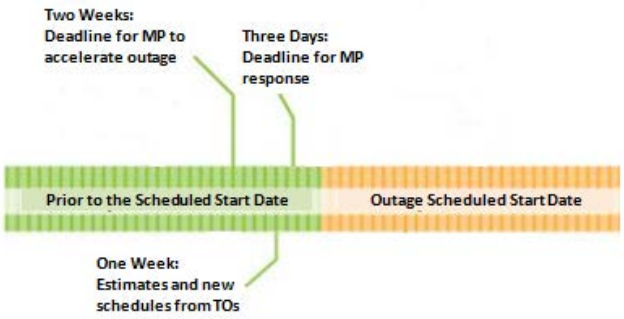
ii) PJM shall give participants only one chance to make a request to accelerate an outage. Meaning, if after the first round of requests there is not enough money to accelerate the outage, the outage would not be accelerated.

iii) Participants would only be able to submit an offer for the acceleration quoted by the TO. For example, if the TO says it will cost $50,000 to reduce a two week outage to one week, participants cannot request to accelerate only to 10 days.

Timelines for the Acceleration of Planned and Forced Outages



Timelines for the Acceleration of Planned Outages
Affecting Interconnection of a Generating Unit



If PJM determines that the acceleration should proceed, PJM will then request that the Transmission Owner moves ahead with the acceleration. All of the financial risks associated with the outage acceleration will be borne by those market participants who choose to participate in the specific outage acceleration; the transmission owner will not be responsible for any of these additional costs. If, despite the good faith efforts of the transmission owner, the acceleration estimated is exceeded, or the transmission owner is not able to successfully complete the outage on the accelerated schedule, the market participants will bear the full cost of the acceleration.

It shall be the responsibility of the Transmission Owner to make every reasonable effort to contact PJM prior to exceeding the original estimate by 20% of the cost to accelerate to determine if work should continue at the accelerated schedule or be completed at the original schedule. PJM will then contact the impacted participant and advise the TO how to

proceed based on the revised estimate provided by the TO, feedback from the participant, and the amount of funds offered to fund the acceleration.

Section 5: Index and Operating Procedures for PJM RTO Operation

This content can be found in the Critical Energy Infrastructure Information (CEII) version of Manual 03 -Transmission Operations.

Attachment A: SPS Listing

TO	ERO	SPS Name	Planning or Operational	Telem. (Y/N)	Year of Installation	Default Status	Notifie Neighbor
Description							
AEP	RFC	**Rockport Fast Valving Scheme**	Operational	N	2009	Armed	
Fast Valving (FV) control reduces turbine mechanical power by 50% within one second following certain contingencies to prevent stability problems. Mechanical power is restored automatically within ten seconds.							
AEP	RFC	**Rockport Emergency Unit Tripping**	Operational	N	2009	Disarmed	
Emergency Unit Trip (EUT), the intentional turbine trip of one unit to achieve rapid reduction in total output for any contingency on the Rockport-Jefferson 765 kV line, thus improving the voltage and stability performance of the Rockport area.							
AEP	RFC	**Rockport Unit Special Protection System**	Operational	N	2009	Armed	MISO, TVA
Both Rockport units fast valve and respond similarly when at the same MVA output levels; there is the potential that both units will trip simultaneously. This SPS is to prevent the tripping of both units by the imbedded safety operating limits systems.							
AP-FE	RFC	**Belmont SPS**	Operational	Y	2011	Disarmed	
When armed trips a selected Pleasants Unit whenever two are online, and pending planning study results a single Oak Grove CT whenever two Oak Grove CT's are on-line, during an outage to either the Belmont 765/500kV transformer or the Belmont – Harrison 500kV '528' line to prevent unit instability and the overloading of 138kV outlets.							
AP-FE	RFC	**Black Oak 500/138kV #3 Transformer**	Operational	Y	2010	Armed	
Prevents overloads on the Black Oak #3 500/138kV transformer by opening the #3 138kV Low Side CB, BO-3, via relay upon the loss of the Black Oak – Hatfield 500kV line.							
~~BC~~	~~RFC~~	~~**Brandon Shores – Riverside SPS**~~	~~Operational~~	~~Y~~	~~2011~~	~~Disarmed~~	
~~Mitages line overload concerns on one of the Brandon Shores – Riverside 230kV circuit when the parallel Brandon Shores – Riverside 230kV is lost. The SPS at Brandon Shores will initiate a unit trip of either Brandon Shores Unit 1 or Brandon Shores Unit 2 when the Brandon Shores – Riverside 2344/2345 is lost and current on opposite circuit exceeds 1800 AMPS for 30 seconds.~~							

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TO	ERO	SPS Name	Planning or Operational	Telem. (Y/N)	Year of Installation	Default Status	Notified Neighbor
Description							
BC	RFC	Concord Street SPS	Operational	Y	2014	Armed	
The SPS will trip approximately 19 MW of load from Greene St and Concord St when flow on a select set of lines exceeds the emergency rating. following N-1-1 contingencies defined in section 5.							
BC	RFC	Mt. Washington SPS	Operational	Y	2014	Armed	
The SPS will operate and trip the 13kV tie breakers ~~and block the bay C/O at Mt. Washington when voltages are depressed.~~at Mt. Washington and drop half of the Mt. Washington load if voltage is below .92 per unit following N-1-1 contingencies defined in section 5.							
COMED	RFC	**Aurora Bus Fault**	Planning	N	2004	Armed	
Trips one or two of the Aurora 5-10 CTs provided 5 or 6 of the units are online AND a multi-phase fault occurs upon the Aurora Energy Center 138kV bus AND the fault fails to clear the bus. (NOTE: *Non-Operational due to being Bus Fault contingent.*)							
COMED	RFC	**Byron Unit Stability Trip Scheme**	Operational	N	Pre-1995	Armed	MISO
Unit stability operating schemes in place at Byron to prevent instability of the Byron units upon the loss of station outlets.							
COMED	RFC	**Cordova (Quad Cities) Unit Stability Trip Scheme**	Operational	N	2001	Armed	MISO
Unit trip scheme will intentionally trip Quad City Unit 2 for a specific multi-line outage scenario when Quad City Unit 1 is also in service to maintain stability of the Quad City units. Will also trip the Cordova units for the multi-line outage scenario provided at least one Quad City unit is in service.							
COMED	RFC	**Davis Creek 345kV Bus Tie 2-3 Auto-Closing**	Operational	N	2004	Armed	MISO
Scheme in place to auto-close the normally open 345kV '2-3' Bus Tie CB at 86 Davis Creek upon sensing the loss of the Braidwood – Davis Creek L2002 345kV line. This prevents overloads on the Davis Creek 345/138kV TR82.							

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TO	ERO	SPS Name	Planning or Operational	Telem. (Y/N)	Year of Installation	Default Status	Notifie Neighbor
Description							
COMED	RFC	**Dresden Unit 2 Trip Scheme**	Operational	N	2004	Armed	MISO
To prevent Dresden Unit 2 from becoming isolated in to Dresden TR81, this scheme will trip Dresden Unit 2 anytime the 345kV '1-2' AND '6-7' are open for any reason.							
COMED	RFC	**East Frankfort TR83 Trip Scheme**	Operational	N	2006	Armed	
To prevent overloads on the East Frankfort 345/138kV TR83 following the loss of the Goodings Grove – East Frankfort L11602 345kV line. With the line out of service, if the loading on TR83 exceeds its emergency rating for 10 seconds, the secondary 138kV CB will open.							
COMED	RFC	**Electric Junction – North Aurora L11106 line**	Operational	N	2006	Armed	
Transfer Trip of CS 0605 at TSS North Aurora along 138kV line L11106 upon sensing an open breaker on the Electric Junction end of 138kV L11106. (Which can occur for a fault on the 138/34.5kV TR76 at Electric Junction.)							
COMED	RFC	**Elgin Unit Stability Trip Scheme**	Operational	N	2002	Armed	
Upon sensing a multi-phase fault on either 138kV line L96001 or L96002 (Elgin – Spaulding lines) will isolate the Elgin units by tripping the remote end of the line (Spaulding) and initiating a transfer trip to Elgin Energy Center. If the 138kV '2-3' bus tie at 79 Spaulding is operated in the closed position, it is possible for all four Elgin EC units could be tripped for a multi-phase fault with delayed clearing.							
COMED	RFC	**Highland Park Transfer Trip**	Operational	N	2007	Armed	
Prevents extreme thermal overloads and low voltage conditions along 138kV lines 1605, 1606, 15912 and 15913 out of 48 Highland Park due to the source of Waukegan feeding radially to Northbrook from a distance of ~22 miles away. When the line CBs on 15912 or 15913 open at Northbrook, the SPS will initiate primary line transfer trip on the respective 138kV line L15912 or L15913. Backup scheme is located at 48 Highland Park.							
COME	RFC	**Kincaid Unit Stability Trip Scheme**	Operational	N	Pre-1995	Armed	MISO

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TO	ERO	SPS Name	Planning or Operational	Telem. (Y/N)	Year of Installation	Default Status	Notified Neighbor
Description							
D							
To prevent first swing and/or oscillatory instability of either unit, a Multi-Phase Fault High-Speed Sectionalizing Scheme and Multiple Line Outage Scheme are in place at Kincaid. Multiple Line Outage Scheme is normally disabled when one unit is out of service.							
COMED	RFC	**Lisle Auto Sectionalizing**	Operational	N	2003	Armed	MISO
To alleviate loading on TR84, the 138kV bus tie '2-3' will auto-close and the 138kV bus tie '3-4' will trip whenever TR84 loading exceeds 500MVA.							
COMED	RFC	**Lisle Auto-Closing**	Operational	N	2003	Armed	
345kV Bus Tie '2-3' at 103 Lisle will auto-close for the line lockout of Lisle – Lombard 345kV line L10321 or L10322.							
COMED	RFC	**Powerton Unit Stability Trip Scheme**	Operational	N	Pre-1995	Armed	MISO
Multi-phase fault high-speed sectionalizing scheme, multiple line outage unit trip scheme, trip scheme for specific circuit breaker failures and an intentional unit trip scheme for 3-phase faults on certain station line outlets.							
COMED	RFC	**Quad Cities Unit Stability Trip Scheme**	Operational	N	Pre-1995	Armed	MISO
Multiple line outage unit trip scheme to prevent overloads when certain station outlets are out of service; And, a Close-in Three-phase Fault Unit Trip Scheme on Unit2 to prevent Quad Cities unit instability during a fault on 345kV line 0404 Quad Cities – H471.							
COMED	RFC	**University Park North Unit Stability Trip Scheme**	Operational	N	2002	Armed	MISO
To prevent unit instability, a Multi-phase Fault Unit Trip Scheme (345kV line L6608 or L11602) and a Single-phase Fault Unit Trip Scheme (L6608) are in place.							

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TO	ERO	SPS Name	Planning or Operational	Telem. (Y/N)	Year of Installation	Default Status	Notified Neighbor
Description							
COMED	RFC	**Waukegan 138kV Auto-Closing Scheme**	Operational	N	2004	Armed	
To prevent low voltages and transmission line overloads, a high-speed relaying scheme will automatically close 138kV '4-14' CB upon sensing the loss of either Unit 7 or Unit 8.							
COMED	RFC	**Wolfs Crossing – Sandwich Transfer Trip Scheme**	Operational	N	2007	Armed	
To prevent low voltages along 138kV Wolfs Crossing – Sandwich L14302, a primary transfer trip scheme is installed at 143 Wolfs Crossing to remote trip source terminals. The secondary relay scheme will open the 138kV 14302/11301 CB at 146 Sandwich for a power flow of 120MVA or greater flowing out of 146 Sandwich towards 143 Wolfs Crossing AND a voltage of 129.7kV or lower on the 146 Sandwich bus.							
COMED	RFC	**Wolfs Crossing TR 81 Trip Scheme**	Operational	N	2006	Armed	
To prevent overloads on the Wolfs Crossing 345/138kV TR81 and 138kV Wolfs – Frontenac L11102 line, an SPS will open 138kV CB TR81 low side CB upon sensing an open CB at Electric Junction on the 138kV Electric Junction – Wolfs Crossing L14321 line with TR81 exceeding its emergency rating.							
COMED	RFC	**Zion Generation Stability Trip Scheme**	Operational	N	2008	Armed	MISO
To prevent instability a Multi-phase Fault Unit Trip Scheme will trip Unit 2 for selected station outlet faults in delayed time to allow for operation of primary protection. Unit 2 will also trip if the stability trip scheme is disabled or the communication signal is lost for more than 60 minutes.							
DOM	SERC	**Carolina '22' Line**	Operational	Y	?	Disarmed	
To mitigate overload concerns on the Carolina – Kerr Dam (Line 22) 115kV line, when armed a non-directional overcurrent relay will open the Carolina end of the '22' line if the line rating is being exceeded.							

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TO	ERO	SPS Name	Planning or Operational	Telem. (Y/N)	Year of Installation	Default Status	Notifie Neighbor
Description							
DOM	SERC	**Carolina '54' Line**	Operational	Y	?	Disarmed	
To mitigate overload concerns on the Carolina – Earleys '54' 115kV line, when armed a non-directional overcurrent relay will open the Carolina end of the '54' line if the line rating is being exceeded.							
DOM	SERC	**Clover Unit 2 Stability Trip Scheme**	Operational	Y	?	Disarmed	VACAR
To mitigate line overload concerns on the Northern Neck – Harmony Village '65' 115kV line, a directional power overload scheme will trip the Wan – Harmony Village '176' 115kV line 90 seconds after sensing the line '65' overload. If the overload still persists, 5 seconds later a trip will be initiated on the Harmony Village '65' line @ Harmony Village.							
JC-FE	RFC	**Yards Creek Pumping**	Operational	Y	Pre-1975	Armed	
To mitigate overload concerns on the Portland – Kittatinny 'V1010' 230kV line during times of Yards Creek hydro in pumping mode, when armed and the actual flow on the 'V010' line exceeds emergency ratings (Winter/Summer) a Yards Creek pump will trip at 60, 120 & 180 second intervals until either the line flow is below the emergency rating or all pumps have been tripped.							
PE	RFC	**Linwood (Phillips Island)**	Operational	N	Pre-1995	Armed	
To mitigate overloads on the Linwood – Chichester 230kV (220-39 & 220-43) lines, a scheme will trip the #2 & #3 CTs and the Steam Unit on the Phillips Island CC if a trip of one of the Linwood-Chichester 230kV lines results in an emergency overload of the remaining in-service parallel path.							
PE	RFC	**Peach Bottom '35' 500kV CB Outage**	Operational	Y	Pre-1995	Disarmed	
To mitigate stability concerns due to an outage of the Peach Bottom 500/230kV transformer during times of Muddy Run generation or pumping, this special purpose relay scheme will remove from service the Muddy Run 5-8 units. Armed during a Peach Bottom '35' 500kV CB outage, if the Peach Bottom '45' 500kV CB trips, the Peach Bottom '675' & '475' 230kV CBs will open and a transfer trip will be issued to the Muddy Run #2 230kV bus.							
PE	RFC	**Peach Bottom '45' 500kV CB Outage**	Operational	Y	Pre-1995	Disarmed	
To mitigate stability concerns due to an outage of the Peach Bottom 500/230kV transformer during times of Muddy Run generation or pumping, this special purpose relay scheme will remove from service the Muddy Run 5-8 units. Armed during a Peach Bottom '45' 500kV							

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TO	ERO	SPS Name	Planning or Operational	Telem. (Y/N)	Year of Installation	Default Status	Notified Neighbor
Description							
CB outage, if the Peach Bottom '35' 500kV CB trips, the Peach Bottom '675' & '475' 230kV CBs will open and a transfer trip will be issued to the Muddy Run #2 230kV bus.							
PE	RFC	**Peach Bottom #1 Transformer**	Operational	N	Pre-1995	Armed	
To mitigate stability concerns due to an outage of the Peach Bottom 500/230kV transformer during times of Muddy Run generation or pumping, this special purpose relay scheme will remove from service the Muddy Run 5-8 units. If the Peach Bottom 500/230kV #1 transformer trips, the Peach Bottom '675' & '475' 230kV CBs will open and a transfer trip will be issued to the Muddy Run #2 230kV bus.							
PE	RFC	**Planebrook 785 CB & 985 CB**	Planning	N	2008	Disarmed	
To mitigate a post contingency 230kV voltage violation , for a breaker failure operation of Planebrook 785 CB or 985 CB when the 34 kV load at Planebrook exceeds 225 MVA. The SPS mitigates the voltage depression by isolating only one Planebrook 34 kV bus to be fed from the remaining distribution transformer. A stuck 230 KV Bus Tie breaker event would initiate the SPS scheme and trip all (4) 34 KV Bus Tie CBs. Additionally, the SPS protects the remaining 230/34kV distribution transformer from a post-contingency emergency overload during peak load conditions. *(NOTE: Non-Operational due to being stuck breaker contingent.)*							
PPL	RFC	**Wescosville Transfer Trip Scheme**	Operational	N	1983	Armed	
To mitigate overload concerns on the Wescosville 500/138kV TR3, a transfer trip relay scheme will trip the '5043' (Susquehanna – Wescosville) 500kV CBs at Susquehanna whenever the '5044' (Alburtis – Wescosville) CBs are both open at Alburtis. This removes the Wescosville TR3 from service.							
PPL	RFC	**Susquehanna #1 Unit**	Operational	N	1983	Armed	
To prevent generator instability, a rejection scheme will trip Susquehanna #1 Unit whenever the Susquehanna – Harwood #1 & #2 230kV lines AND the Susquehanna – Wescosville – Alburtis 500kV circuit are all out of service simultaneously. Due to a lack of redundancy, PJM does not operate to this SPS.							
PPL	RFC	**Susquehanna #2 Unit**	Operational	N	1983	Armed	
To prevent generator instability, a rejection scheme will trip Susquehanna #2 Unit whenever the Susquehanna – Sunbury 5045 500kV line AND the Susquehanna – Wescosville – Alburtis 500kV 5043/5044 circuit are out of service simultaneously. Due to a lack of redundancy,							

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TO	ERO	SPS Name	Planning or Operational	Telem. (Y/N)	Year of Installation	Default Status	Notified Neighbor
Description							
PJM does not operate to this SPS.							
PPL	RFC	**Montour Runback Scheme**	Operational	Y	2013	Armed	
To prevent overloads on the Susquehanna-Harwood #1 and #2 230 kV lines by automatically runback or trip Montour #1 and #2 units. The SPS monitors actual line flows of the Susquehanna-Harwood lines to relieve thermal overloads. The SPS will be in service in 2013.							
PS	RFC	**Artificial Island (Salem) Cross Trip Scheme**	Operational	Y	1987	Disarmed	NYISO
To prevent generator instability of Artificial Island generation (Salem #1, Salem #2 & Hope Creek #1) during extended outages to either the '5015' Hope Creek – Red Lion or the '5038' East Windsor – New Freedom 500kV lines. Can trip either Salem #1 or Salem #2 unit depending on selection. For a '5015' line outage, will trip the selected Salem unit when armed AND relayed operation of the '5038' 500kV line occurs. For a '5038' line outage, will trip the selected Salem unit when armed AND relayed operation of the '5015' 500kV line occurs.							
PN-FE	RFC	**Conemaugh #2 Unit Stability Trip**	Operational	Y	Pre-1990	Disarmed	
To mitigate transient instability concerns during outages to the Juniata – Conemaugh '5005' 500kV line, a trip scheme will trip Conemaugh #2 Unit upon the loss of the Keystone – Conemaugh '5003' 500kV line.							
PN-FE	RFC	**East Sayre – North Waverly 115kV Relay**	Operational	Y	Pre-1990	Armed	NYISO
To mitigate overloads on the E Sayre – N Waverly 115kV line, an overcurrent relay trips the 115kV CB at E Sayre if the flow on the line reaches 128MVA.							
PN-FE	RFC	**Homer City #2 & #3 Unit Stability Trip Schemes**	Operational	Y	?	Disarmed	NYISO
To mitigate unit instability for potential configurations that would isolate either Homer City Unit #2 or #3 onto one 345kV line, a Unit Stability Trip Scheme is armed to trip Unit #2 or #3 whenever one 345kV CB is open and a second 345kV CB opening could isolate the unit.							
PN-FE	RFC	**Warren – Falconer 115kV Relay**	Operational	Y	Pre-1990	Armed	NYISO
To mitigate overloads on the Warren – Falconer 115kV line, an inverse time overcurrent relay trips the line if flow exceeds the emergency rating.							

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Attachment B: Open Circuit Terminal Voltage Control

The attached chart contains Open Circuit Terminal Voltage Control information. Open Circuit Terminal Voltage Control

				Closed Terminal Voltage (V2)								
				500 kV (1.0 pu)			525 kV (1.05 pu)			550 kV (1.1 pu)		
From Bus — To Bus	Line Number	Mileage	Closed End Voltage Increase At Switching	Chrg MVAR (Q-Base)	V1	V1 Incr	Chrg MVAR	V1	V1 Chrg	Chrg MVAR	V1	V1 Incr
Keystone - S. Bend	5001 / 513	2		0.4	500.0	0.0	0.4	525.0	0.0	0.4	550.0	0.0
Keystone - Cabot	5002	27	0.5	49.1	500.8	0.8	54.1	525.8	0.8	59.4	550.8	0.8
Keystone - Conemaugh	5003	29	0.6	42.1	500.8	0.8	46.4	525.9	0.9	50.9	550.9	0.9
Keystone - Juniata	5004	118	3.1	196.7	514.7	14.7	216.9	540.4	15.4	238.0	566.1	16.1
Conemaugh - Juniata	5005	121	4.9	201.2	515.4	15.4	221.8	541.1	16.1	243.5	566.9	16.9
Conemaugh - Hunterstown	5006	112	4.2	186.3	513.2	13.2	205.4	538.8	13.8	225.4	564.5	14.5
Peach Bottom - TMI	5007	42	0.8	67.2	501.8	1.8	74.1	526.9	1.9	81.3	552.0	2.0
Juniata - TMI	5008	44	2.6	73.1	502.0	2.0	80.6	527.1	2.1	88.5	552.2	2.2
Juniata - Alburtis	5009	88	3.7	146.7	508.0	8.0	161.7	533.4	8.4	177.5	558.8	8.8
Peach Bottom-Limerick	5010	57	1.9	98.4	503.4	3.4	108.4	528.5	3.5	119.0	553.7	3.7
Conastone - Brighton	5011	77	3.0	112.6	506.1	6.1	124.2	531.4	6.4	136.3	556.7	6.7
Conastone - Peach Bottom	5012	16	1.4	27.4	500.3	0.3	30.2	525.3	0.3	33.2	550.3	0.3
Hunterstown - Conastone	5013	40	1.7	73.2	501.6	1.6	80.7	526.7	1.7	88.6	551.8	1.8
Peach Bottom – Rock Springs	5014	34	2.2	59.1	501.2	1.2	65.1	526.3	1.3	71.5	551.3	1.3
Red Lion - Hope Creek	5015	25	1.7	49.0	500.7	0.7	54.0	525.7	0.7	59.3	550.7	0.7
Alburtis - Branchburg	5016	49	1.9	81.8	502.5	2.5	90.2	527.6	2.6	99.0	552.7	2.7
Elroy - Branchburg	5017	39	1.4	67.3	501.6	1.6	74.2	526.6	1.6	81.4	551.7	1.7

The attached chart contains Open Circuit Terminal Voltage Control information. Open Circuit Terminal Voltage Control												
				Closed Terminal Voltage (V2)								
				500 kV (1.0 pu)			525 kV (1.05 pu)			550 kV (1.1 pu)		
From Bus — To Bus	Line Number	Mileage	Closed End Voltage Increase At Switching	Chrg MVAR (Q-Base)	V1	V1 Incr	Chrg MVAR	V1	V1 Chrg	Chrg MVAR	V1	V1 Incr
Hopatcong~~Branchburg~~ – Ramapo (NYISO tie)	5018	69	2.8	120.7	504.9	4.9	133.1	530.1	5.1	146.0	555.4	5.4
Branchburg - Deans	5019	20	0.3	32.9	500.4	0.4	36.3	525.4	0.4	39.8	550.4	0.4
Deans - Smithburg	5020	18	1.3	31.0	500.3	0.3	34.1	525.3	0.3	37.5	552.7	2.7
Orchard - Salem	5021	19		38.8	500.6	0.6	42.8	525.6	0.6	46.9	550.6	0.6
Deans – E. Windsor	5022	26		27.3	500.3	0.3	30.1	525.3	0.3	33.0	550.3	0.3
Hope Creek - New Freedom	5023	43	3.7	70.8	501.9	1.9	78.0	527.0	2.0	85.6	555.4	5.4
Salem - New Freedom	5024	50	4.1	86.5	502.6	2.6	95.4	527.7	2.7	104.7	550.4	0.4
Keeney – Rock Springs	5025	26		45.1	500.7	0.7	49.8	525.8	0.8	54.6	550.8	0.8
TMI - Hosensack	5026	75	3.2	124.0	505.8	5.8	136.7	531.0	6.0	150.0	550.4	0.4
Alburtis - Hosensack	5027	5	0.0	8.2	500.0	0.0	9.0	525.0	0.0	9.9	550.0	0.0
Hosensack - Elroy	5028	18	0.7	30.1	500.3	0.3	33.2	525.3	0.3	36.4	550.3	0.3
Elroy - Centerpoint	5033	5.4	0.4	9.7	500.0	0.0	10.7	525.0	0.0	11.7	550.0	0.0
Centerpoint - Whitpain	5029	3.9	0.4	6.7	500.0	0.0	7.4	525.0	0.0	8.1	550.0	0.0
Limerick – Whitpain 5030	5030	16	0.4	27.4	500.3	0.3	30.2	525.3	0.3	33.1	556.3	0.3
Limerick – Whitpain 5031	5031	16	0.4	27.4	500.3	0.3	30.2	525.3	0.3	33.1	550.3	0.3
Keeney - Red Lion	5036	25		13.8	500.1	0.1	15.2	525.1	0.1	16.7	550.1	0.1
Hope Creek - Salem	5037	0	0.0	0.7	500.0	0.0.	0.8	525.0	0.0	0.8	550.0	0.0
East Windsor - New Freedom	5038	53		116.9	505.0	5.0	128.9	530.3	5.3	141.4	555.5	5.5
Orchard - New Freedom	5039	24		42.2	500.6	0.6	46.6	525.6	0.6	51.1	550.7	0.7

The attached chart contains Open Circuit Terminal Voltage Control information. Open Circuit Terminal Voltage Control												
				Closed Terminal Voltage (V2)								
				500 kV (1.0 pu)			525 kV (1.05 pu)			550 kV (1.1 pu)		
From Bus — To Bus	Line Number	Mileage	Closed End Voltage Increase At Switching	Chrg MVAR (Q-Base)	V1	V1 Incr	Chrg MVAR	V1	V1 Chrg	Chrg MVAR	V1	V1 Incr
Susquehanna - Wescosville	5043	67	4.0	116.4	504.6	4.6	128.4	529.8	4.8	140.9	555.0	5.0
Wescosville - Alburtis	5044	11	0.3	21.8	500.1	0.1	24.0	525.1	0.1	26.4	550.1	0.1
Sunbury - Susquehanna	5045	44	4.4	75.6	501.9	1.9	83.3	527.0	2.0	91.4	552.1	2.1
Juniata - Sunbury	5046	38	2.0	65.6	501.5	1.5	72.3	526.6	1.6	79.3	551.6	1.6
Waugh Chapel - Calvert Cliffs 1	5051	48	0.6	82.7	502.4	2.4	91.1	527.5	2.5	100.0	552.6	2.6
Waugh Chapel - Calvert Cliffs 2	5052	48	0.6	82.7	502.4	2.4	91.1	525.5	2.5	100.0	552.6	2.6
Brighton - Waugh Chapel	5053	27	1.4	45.9	500.7	0.7	50.6	525.8	0.8	55.5	550.8	0.8
Brighton - Doubs	5055 (522)	29	1.9	60.6	500.9	0.9	66.8	525.9	0.9	73.3	551.0	1.0
Burches Hill - Possum Point	5070	32	2.4	60.4	501.1	1.1	66.6	526.1	1.1	73.1	551.2	1.2
Burches Hill - Chalk Point	5071	19	1.3	39.4	500.4	0.4	43.4	525.4	0.4	47.6	550.4	0.4
Chalk Point - Calvert Cliffs	5072	18	0.6	30.6	500.3	0.3	33.7	525.3	0.3	37.0	550.4	0.4
Surry - Suffolk	531A	37.3		67.7	501.5	1.5	74.6	526.6	1.6	81.9	551.6	1.6
Suffolk-Yadkin	565A	13.3		23.9	500.2	0.2	26.3	525.2	0.2	28.9	550.2	0.2
Carson - Suffolk	544	59.6		120.8	504.0	4.0	133.2	529.2	4.2	146.2	554.4	4.4
Dooms - Cunningham	534A	32.7		57.5	501.1	1.1	63.4	526.1	1.1	69.5	551.2	1.2
Bristers - Ox	539A	23		41.0	500.6	0.6	45.2	525.6	0.6	49.6	550.6	0.6
Fluvanna - Cunningham	542A	0.3		4.0	500.0	0.0	4.4	525.0	0.0	4.8	550.0	0.0
Bristers - Morrisville	545A	7.8		14.3	500.1	0.1	15.8	525.1	0.1	17.3	550.1	0.1

The attached chart contains Open Circuit Terminal Voltage Control information. Open Circuit Terminal Voltage Control												
				Closed Terminal Voltage (V2)								
				500 kV (1.0 pu)			525 kV (1.05 pu)			550 kV (1.1 pu)		
From Bus — To Bus	Line Number	Mileage	Closed End Voltage Increase At Switching	Chrg MVAR (Q-Base)	V1	V1 Incr	Chrg MVAR	V1	V1 Chrg	Chrg MVAR	V1	V1 Incr
Lexington - Bath County	547A	34.7		60.0	501.3	1.3	66.1	526.3	1.3	72.6	551.4	1.4
Valley - Bath County	548A	51.8		87.3	502.7	2.7	96.3	527.8	2.8	105.7	553.0	3.0
Valley - Dooms	549A	17.7		31.3	500.3	0.3	34.5	525.3	0.3	37.8	550.4	0.4
Mt. Storm – Valley	550A	64.4		113.3	504.3	4.3	124.9	529.6	4.6	137.1	554.8	4.8
Bristers - Chancelor	552A	21.5		37.9	500.5	0.5	41.8	525.5	0.5	45.8	550.6	0.6
Chancelor - Ladysmith	552B	15.2		26.2	500.2	0.2	28.9	525.3	0.3	31.7	550.3	0.3
Cunningham – Elmont	553A	51		90.5	502.7	2.7	99.8	527.8	2.8	109.6	553.0	3.0
Lexington - Dooms	555A	39		70.3	501.6	1.6	77.5	526.7	1.7	85.1	551.8	1.8
Clover – Carson	556A	76.7		155.0	506.2	6.2	170.9	531.5	6.5	187.5	556.8	6.8
Chickahominy – Elmont	557A	27.7		50.0	500.8	0.8	55.2	525.9	0.9	60.5	550.9	0.9
Pleasantview – Loudoun	558A	13		23.2	500.2	0.2	25.6	525.2	0.2	28.1	550.2	0.2
Loudoun - Clifton	559A	12		21.9	500.2	0.2	24.1	525.2	0.2	26.5	550.2	0.2
Clifton - Ox	561A	7		12.8	500.1	0.1	14.1	525.1	0.1	15.5	550.1	0.1
Carson -SEPTA	562A	38.5		67.3	501.5	1.5	74.3	526.6	1.6	81.5	551.7	1.7
Carson - Midlothian	563A	37.4		68.2	501.5	1.5	75.2	526.6	1.6	82.5	551.7	1.7
Cunningham - Fluvanna	564A	0.3		4.0	500.0	0.0	4.4	525.0	0.0	4.8	550.0	0.0
Suffolk - Yadkin	565A	4.8		67.8	501.5	1.5	74.7	526.6	1.6	82.0	551.6	1.6
Surry - Chickahominy	567A	44.4		80.0	502.1	2.1	88.2	527.2	2.2	96.8	552.3	2.3
Ladysmith – Possum Pt.	568A	47.5		86.6	502.4	2.4	95.5	527.5	2.5	104.8	552.7	2.7
Morrisville - Loudoun	569A	31.9		57.3	501.1	1.1	63.1	526.1	1.1	69.3	551.2	1.2

The attached chart contains Open Circuit Terminal Voltage Control information. Open Circuit Terminal Voltage Control												
				Closed Terminal Voltage (V2)								
				500 kV (1.0 pu)			525 kV (1.05 pu)			550 kV (1.1 pu)		
From Bus — To Bus	Line Number	Mileage	Closed End Voltage Increase At Switching	Chrg MVAR (Q-Base)	V1	V1 Incr	Chrg MVAR	V1	V1 Chrg	Chrg MVAR	V1	V1 Incr
Carson –Wake (CPL tie)	570A	56.4		97.3	503.1	3.1	107.3	528.3	3.3	117.7	553.4	3.4
Ox – Possum Pt.	571A	12.8		25.0	500.2	0.2	27.6	525.2	0.2	30.3	550.2	0.2
N Anna - Morrisville	573A	32.9		58.5	501.1	1.1	64.5	526.2	1.2	70.7	551.3	1.3
Ladysmith - Elmont	574A	26.2		46.2	500.7	0.7	50.9	525.8	0.8	55.9	550.8	0.8
Ladysmith – N. Anna	575A	14.5		25.4	500.2	0.2	28.0	525.2	0.2	30.7	550.2	0.2
N. Anna - Midlothian	576A	41.3		73.3	501.8	1.8	80.8	526.9	1.9	88.7	552.0	2.0
SEPTA - Surry	578A	11.4		20.0	500.1	0.1	22.0	525.1	0.1	24.2	550.1	0.1
SEPTA - Fentress	579A	46.9		83.9	502.3	2.3	92.5	527.5	2.5	101.5	552.6	2.6
Bedington – Black Oak	544	60		109.2	503.9	3.9	120.4	529.1	4.1	132.2	554.3	4.3
Bedington - Doubs	520	32		58.4	501.1	1.1	64.4	526.2	1.2	70.6	551.2	1.2
Belmont - Harrison	528	55		99.2	503.2	3.2	109.4	528.4	3.4	120.0	553.5	3.5
Belmont – Pleasants 1		2		3.6	500.0	0.0	4.0	525.0	0.0	4.4	550.0	0.0
Belmont – Pleasants 2		2		3.6	500.0	0.0	4.0	525.0	0.0	4.4	550.0	0.0
Black Oak - Hatfield	542	61		111.4	504.0	4.0	122.8	529.2	4.2	134.8	554.4	4.4
Broadford - Sullivan (TVA tie)		50		90.3	502.6	2.6	99.6	527.7	2.7	109.3	552.8	2.8
Cabot - Cranberry	519	18.5		33.0	500.3	0.3	36.4	525.4	0.4	40	550.4	0.4
Cranberry - Wylie Ridge	532	34		63.5	501.2	1.2	70.0	526.2	1.2	76.8	551.3	1.3
Cloverdale - Lexington		44		78.7	502.0	2.0	86.7	527.1	2.1	95.2	552.2	2.2
Doubs – Mt. Storm	512	99		181.3	510.6	10.6	199.9	536.1	11.1	219.4	561.6	11.6
Doubs – Pleasant View	514	18		33.9	500.4	0.4	37.4	525.4	0.4	41.0	550.4	0.4

The attached chart contains Open Circuit Terminal Voltage Control information. Open Circuit Terminal Voltage Control												
				Closed Terminal Voltage (V2)								
				500 kV (1.0 pu)			525 kV (1.05 pu)			550 kV (1.1 pu)		
From Bus — To Bus	Line Number	Mileage	Closed End Voltage Increase At Switching	Chrg MVAR (Q-Base)	V1	V1 Incr	Chrg MVAR	V1	V1 Chrg	Chrg MVAR	V1	V1 Incr
Ft. Martin - N Longview	523	48		10.7	500.0	0.0	11.8	525.0	0.0	12.9	550.0	0.0
Ft. Martin – Pruntytown	508	28		50.5	500.8	0.8	55.7	525.9	0.9	61.1	550.9	0.9
Ft. Martin - Ronco	516	14		26.3	500.2	0.2	29.0	525.2	0.2	31.8	550.2	0.2
Greenland Gap – Mt. Storm	572	2		54.3	501.0	1.0	59.9	526.0	1.0	65.7	551.1	1.1
Harrison - 502 Jct.	521	30		54.3	501.0	1.0	59.8	526.0	1.0	65.7	551.1	1.1
502 Jct. – Kammer	525	42		76.4	501.9	1.9	84.3	527.0	2.0	92.5	552.1	2.1
502 Jct. – N Longview	504	15		26.8	500.2	0.2	29.5	525.2	0.2	32.4	550.3	0.3
502 Jct. – Mt. Storm	536	76.8		151.7	506.2	6.2	167.3	531.5	6.5	183.6	556.8	6.8
Harrison – Wylie Ridge	530	79		142.9	506.6	6.6	157.5	531.9	6.9	172.9	557.3	7.3
Hatfield - Ronco	538	2		2.6	500.0	0.0	2.9	525.0	0.0	3.2	550.0	0.0
Hatfield – Yukon	518	32		60.3	501.2	1.2	66.4	526.2	1.2	72.9	551.3	1.3
Jacksons Ferry – Antioch (Duke tie)		55		97.9	503.2	3.2	107.9	528.4	3.4	118.5	553.5	3.5
Meadowbrook - Greenland Gap	540	56		54.3	501.0	1.0	59.9	526.0	1.0	65.7	551.1	1.1
Meadowbrook - Morrisville	580	53		93.5	502.9	2.9	103.1	528.0	3.0	113.1	553.2	3.2
Mt. Storm - Pruntytown	510	46		83.0	502.2	2.2	91.5	527.3	2.3	100.4	552.5	2.5
Meadow Brook- Mt. Storm	529	60.1		118.8	503.9	3.9	131	529.1	4.1	143.8	554.3	4.3
Meadow Brook - Loudoun	535	80.8		161.1	507.0	7.0	177.7	532.3	7.3	195	557.7	7.7
Nagel – PHIPPS BEND TIE		14		26.9	500.2	0.2	29.7	525.2	0.2	32.5	550.2	0.2

The attached chart contains Open Circuit Terminal Voltage Control information. Open Circuit Terminal Voltage Control												
				Closed Terminal Voltage (V2)								
				500 kV (1.0 pu)			525 kV (1.05 pu)			550 kV (1.1 pu)		
From Bus — To Bus	Line Number	Mileage	Closed End Voltage Increase At Switching	Chrg MVAR (Q-Base)	V1	V1 Incr	Chrg MVAR	V1	V1 Chrg	Chrg MVAR	V1	V1 Incr
Nagel - Sullivan (TVA tie)		39		77.4	501.6	1.6	85.3	526.7	1.7	93.7	551.8	1.8
S. Bend -Yukon	507	38		67.4	501.5	1.5	74.3	526.6	1.6	81.5	551.6	1.6

The attached chart contains Open Circuit Terminal Voltage Control information. Open Circuit Terminal Voltage Control												
				Closed Terminal Voltage (V2)								
				765 kV (1.0 pu)			790 kV (1.03 pu)			815 kV (1.07 pu)		
From Bus - To Bus	Line Number	Mileage	Closed End Voltage Increase @ switching	Chrg MVAR (Q-Base)	V1	V1 Incr	Chrg MVAR (Q-Base)	V1	V1 Incr	Chrg MVAR (Q-Base)	V1	V1 Incr
23 Collins - 112 Wilton Center	11216	27.4		137.5	766.3	1.3	146.6	791.3	1.3	156.0	816.3	1.3
23 Collins - 167 Plano	2315	34.5		173.3	766.9	1.9	184.8	792.0	2.0	196.7	817.0	2.0
Amos - Culloden		15		76.4	765.4	0.4	81.5	790.5	0.5	86.8	815.5	0.5
Amos – Mountaineer		46		218.5	768.6	3.6	233.1	793.7	3.7	248.0	818.8	3.8
Amos - N. Proctorville		32		150.0	766.7	1.7	160.0	791.7	1.7	170.2	816.8	1.8
Axton - Jacksons Ferry		73		337.3	773.5	8.5	359.7	798.8	8.8	382.9	824.0	9.0
Baker – Broadford		125		590.8	790.8	25.8	630.1	816.6	26.6	670.6	842.4	27.4
Baker - Hanging Rock		31		140.8	766.5	1.5	150.1	791.6	1.6	159.8	816.6	1.6
Belmont - Kammer		49		220.8	768.8	3.8	235.5	793.9	3.9	250.7	819.0	4.0
Belmont – Mountaineer		66		312.1	772.4	7.4	332.8	797.6	7.6	354.2	822.8	7.8
Broadford - Jacksons Ferry		49		227.0	768.9	3.9	242.1	794.0	4.0	257.7	819.2	4.2

The attached chart contains Open Circuit Terminal Voltage Control information. Open Circuit Terminal Voltage Control												
				Closed Terminal Voltage (V2)								
				765 kV (1.0 pu)			790 kV (1.03 pu)			815 kV (1.07 pu)		
From Bus - To Bus	Line Number	Mileage	Closed End Voltage Increase @ switching	Chrg MVAR (Q-Base)	V1	V1 Incr	Chrg MVAR (Q-Base)	V1	V1 Incr	Chrg MVAR (Q-Base)	V1	V1 Incr
Cloverdale - Jacksons Ferry		65		303.2	771.9	6.9	323.4	797.2	7.2	344.2	822.4	7.4
Cloverdale - Joshua Falls		57		266.6	770.3	5.3	284.3	795.5	5.5	302.6	820.7	5.7
Cook – Dumont		36		166.3	767.1	2.1	177.3	792.2	2.2	188.7	817.2	2.2
Cornu - Hanging Rock		0.4		2.5	765.0	0.0	2.7	790.0	0.0	2.8	815.0	0.0
Culloden – Baker		34		149.2	766.7	1.7	159.1	791.7	1.7	169.3	816.8	1.8
Culloden – Gavin		42		195.2	767.9	2.9	208.2	793.0	3.0	221.5	818.1	3.1
Culloden - Wyoming		58		265.6	770.3	5.3	283.2	795.5	5.5	301.4	820.7	5.7
Dumont – Greentown		78		364.5	775.0	10.0	388.7	800.4	10.4	413.7	825.7	10.7
Dumont – 112 Wilton Center	11215	91		424.0	778.3	13.3	452.1	803.8	13.8	481.2	829.2	14.2
Gavin – Flatlick		15		63.8	765.3	0.3	68.1	790.3	0.3	72.4	815.3	0.3
Hanging Rock - Jefferson		161		770.7	806.8	41.8	821.9	833.2	43.2	874.8	859.6	44.6
Hanging Rock – Marquis		35		162.4	767.0	2.0	173.2	792.1	2.1	184.4	817.1	2.1

The attached chart contains Open Circuit Terminal Voltage Control information. Open Circuit Terminal Voltage Control												
				Closed Terminal Voltage (V2)								
				765 kV (1.0 pu)			790 kV (1.03 pu)			815 kV (1.07 pu)		
From Bus - To Bus	Line Number	Mileage	Closed End Voltage Increase @ switching	Chrg MVAR (Q-Base)	V1	V1 Incr	Chrg MVAR (Q-Base)	V1	V1 Incr	Chrg MVAR (Q-Base)	V1	V1 Incr
Jacksons Ferry - Wyoming		88		474.6	779.6	14.6	506.2	805.1	15.1	538.7	830.5	15.5
Jefferson – Greentown		21		590.1	790.5	25.5	629.3	816.3	26.3	669.8	842.2	27.2
Jefferson – Rockport		110		521.8	784.9	19.9	556.4	810.5	20.5	592.2	836.2	21.2
Kammer - S. Canton		80		376.7	775.5	10.5	401.7	800.8	10.8	427.5	826.2	11.2
Marysville – Dumont		180		865.1	818.0	53.0	922.5	844.7	54.7	981.8	871.4	56.4
Marysville – Flatlick		109		523.2	785.0	20.0	558.0	810.7	20.7	593.9	836.4	21.4
Mountaineer – Gavin		11		51.2	765.2	0.2	54.6	790.2	0.2	58.1	815.2	0.2
N. Proctorville - Hanging Rock		26		121.3	766.1	1.1	129.4	791.1	1.1	137.7	816.2	1.2
Maliszewski - Vassell~~Kammer~~		~~126~~		~~595.~~445	~~790.9~~765.2	~~25.9~~0.2	~~635.0~~48.0	~~816.7~~790.2	~~26.7~~0.2	~~675.8~~51.0	~~842.6~~815.2	~~27.6~~0.2
Kammer - Vassell				524.1	785.2	20.2	558.9	810.9	20.9	594.8	836.6	21.6
Maliszewski - Marysville		25		117.4	766.0	1.0	125.2	791.1	1.1	133.2	816.1	1.1
Rockport –		97		461.4	780.4	15.4	492.0	805.9	15.9	523.7	831.4	16.4

The attached chart contains Open Circuit Terminal Voltage Control information. Open Circuit Terminal Voltage Control												
				Closed Terminal Voltage (V2)								
				765 kV (1.0 pu)			790 kV (1.03 pu)			815 kV (1.07 pu)		
From Bus - To Bus	Line Number	Mileage	Closed End Voltage Increase @ switching	Chrg MVAR (Q-Base)	V1	V1 Incr	Chrg MVAR (Q-Base)	V1	V1 Incr	Chrg MVAR (Q-Base)	V1	V1 Incr
Sullivan												

Exhibit 14: Open Circuit Terminal Voltage Control

Attachment C: Requesting Voltage Limit Exceptions to the PJM Base-Line Voltage Limits

The purpose of this attachment is to provide further explanation of the how to request exceptions to the PJM Base-Line Voltage Limits as discussed in this manual Section 3: Voltage and Stability Operating Guidelines.

It is proposed that two processes be implemented to address handling Voltage Limits that are more restrictive than the PJM Base-Line Voltage Limits.

Addressing PJM OATT Facilities (see Exhibit E-1)

1. For a limitation at a PJM OATT facility, a Transmission Owner can request PJM to operate for any voltage reliability limits at a specific bus that are identified as more restricting than the PJM Base-Line Voltage Limits.
2. These voltage reliability limits shall be submitted in writing to the PJM, Manager Transmission Operations Department by the Transmission Owner's System Operations Subcommittee (SOS) representative. The request should specifically identify that the limit is required for reliable PJM operation
3. PJM will evaluate these limits for reasonableness.
4. PJM Operations Planning Department will return confirmation to the SOS representative when these voltage reliability limits are implemented in the PJM Energy Management System (EMS) as the PJM Voltage Reliability Operating Limit.
5. PJM will forward these revised PJM Voltage Reliability Operating Limits to PJM System Planning for use in reinforcement evaluations.

Addressing Generators and other Non- PJM OATT Facilities (including Distribution) (see Exhibit E-2)

1. For a limitation at a Generator or other Non- PJM OATT facility, a Transmission Owner or PJM Member can request PJM to operate for any requested voltage limits at a specific bus that are identified as more restricting than the PJM Base-Line Voltage Limits.
2. These requested voltage limits are submitted in writing by the PJM Member to the PJM Manager – Transmission Operations Department.
3. PJM will evaluate these limits for reasonableness.
4. PJM Operations Planning Department will return confirmation to the requestor when these requested voltage limits are implemented in the PJM EMS.
5. The PJM Member will be billed for any "Off-Cost" operation.

To: PJM Manager-Transmission Operations Department

From: PJM Member Company: _____ Requested By: _____

RE: Request to Operate to a Different Voltage Limit than the PJM Base-Line Voltage Limits for a Generator or Other Non-PJM Open Access Transmission Tariff Facility

We request that PJM operate to a voltage limit different from the PJM Base-Line Voltage Limits at the specific bus identified below. If this bus limitation results in "off-cost" operation appropriate billing will be made to the PJM Member/Requestor.

Authorized by: _____ (PJM Member Representative) Date: _____

Facility Identification	Voltage	LD	EL	NL	NH	% Volt Drop	*Target Implementation Date*	Comment or Reason for voltage limit exception to the PJM Base-Line Limit

Key: LD = Load Dump **EL** = Post Contingency Emergency Low **NL** = Normal Low **NH** = High **Drop** = Post Contingency Voltage Drop Limit

Submit this form to the PJM Manager-Transmission Operations Department. Attach other pertinent documentation that would provide a complete understanding of the reason for the request. PJM will contact the requestor with feedback on the status of this request or any questions. If you have any questions please call the Manager-Transmission Operations Department at (610) 666-8976. PJM will communicate; coordinate analysis and implementation dates with Local Control Center Management. Notification will be provided back to the requestor when the changes are incorporated within the PJM EMS system.

To: PJM Manager-Transmission Operations Department

From: PJM Member Company: _____ Requested By: _____

RE: Request to Operate to a Different Voltage Limit than the PJM Base-Line Voltage Limits for a Generator or Other Non-PJM Open Access Transmission Tariff Facility

We request that PJM operate to a voltage limit different from the PJM Base-Line Voltage Limits at the specific bus identified below. If this bus limitation results in "off-cost" operation appropriate billing will be made to the PJM Member/Requestor.

Authorized by: _____ (PJM Member Representative) Date: _____

Facility Identification	Voltage	LD	EL	NL	NH	Drop	Target Implementation Date	Comment or Reason for voltage limit exception to the PJM Base-Line Limit

Key: LD = Load Dump **EL** = Post Contingency Emergency Low **NL** = Normal Low **NH** = High **Drop** = Post Contingency Voltage Drop Limit

Submit this form to the PJM Manager-Transmission Operations Department. Attach other pertinent documentation that would provide a complete package. PJM will contact the requestor with feedback on the status of this request or any questions. If you have any questions please call the Manager-Transmission Operations Department at (610) 666-8976.

Attachment D: Post Contingency Congestion Management Program

PJM has historically operated on a pre-contingency basis under which it calls for off-cost generation to be run to alleviate contingency overloads. The amount of off- cost generation can total in excess of millions of dollars per year in congestion. PJM analysis indicates that the probability of contingent facility tripping during an off-cost event is less than .05%.

PJM believes that it is prudent to operate to a higher pre-contingency threshold (i.e. 30-minute rating) in areas where analysis demonstrates that there is ample fast-start generation or switching actions available to eliminate an actual overload should contingent facility tripping occur. This generation must demonstrate a history of adequate availability and response as defined below.

PJM's post-contingency congestion management program is operated for monitored facilities that meet the following criteria:

1. Outage of the contingent facility must not cause a cascading outage or precipitate uncontrolled separation within and external to the PJM Balancing Authority.
2. EHV facilities will not be included in this program. However there are cases in some areas where facilities up to and including 345kV may be studied for inclusion in the program as long as there is no adverse impact on the transmission system.
3. The transmission owner of the facility will have established a short-term emergency rating for the facility (nominally 30 minutes).
4. Facilities must have more than one fast-start combustion turbine or diesel generator in the vicinity (and off-line) to eliminate a contingency should it occur. Normally, availability of 120% of the necessary generation to obtain the required MW relief from the 30-minute rating to normal rating will need to be demonstrated to account for the possibility that some generation will not start.
5. The net area generation has to have a history of being on-line and loaded for control within 30 minutes 85% of the time. (Normally, review of the previous 12 month performance will be sufficient to establish the historical performance.)
6. Where available, condensers will be brought on-line for control once contingency flow reaches the 4-hour emergency rating.
7. This program will be implemented during non-winter months for facilities where fast-start generation is used for control. Switching procedures that demonstrate successful winter implementation may be included under the program year-round.
8. Facilities in transmission systems that were designed to operate on a post-contingency basis as outlined in the next section will be considered on a case by case basis.

Alternative Controlling Options

1. The TO may offer generation run-back schemes to control for these facilities. These will be considered as controlling actions under this program after PJM tests the ramp-rate data as supplied by the generation owner. Further discussion and analysis is needed in this area prior to accepting these options. This document will be revised once these procedures are submitted, tested, and approved.
2. The TO may offer switching and reclosing procedures to control for these facilities in accordance with applicable regional requirements. These procedures must be studied and approved by PJM. These procedures may be implemented once PJM has the capability to properly study the impacts of these options in EMS.

Local Control Centers (LCCs) must be capable of implementing the agreed upon post-contingency switching procedures via SCADA control. Additionally, LCCs must have the ability to dump sufficient load via SCADA in the event that switching procedures cannot be implemented. Load dump cannot propagate to adjacent zones.

Where feasible, the switching procedures mentioned above may be implemented on a pre-contingency basis once contingency flow exceeds the 30-minute rating and all controlling generation has been called.

Systems Designed for Post-Contingency Switching:

a. On a pre-contingency basis off-cost operations will commence once simulated contingency flow, using *guide implemented* contingency definitions, reaches the long-term emergency (LTE) rating.
b. On a pre-contingency basis off-cost operations will commence once simulated contingency flow, using *guide failed* contingency definitions, approaches the load dump (LD) rating.
c. In the event of a contingent facility tripping, the appropriate guide scheme will be used to ensure flow drops below the LTE rating on the monitored facility. If the post-contingency operating step does not reduce flow below the *normal* rating on this facility, generation re-dispatch, where available, will be used to bring flow below the normal rating.

Roles and Responsibilities

1. **PJM.** PJM will be responsible for selecting the facilities for inclusion into the program and performing the required analysis to ensure that the facilities meet the criteria for participation. PJM will consult with and communicate with the appropriate TO, as required, to ensure that the analysis is accurate. PJM will publish the list of facilities in PJM Manual M-03, Transmission Operations and will operate to the short term rating provided by the TO. If the rating is exceeded pre-contingency, PJM will operate off-cost to mitigate the simulated overload.
2. **Transmission Owner**. The TO will review and comment on the facilities proposed under this program. If the TO disagrees with a proposed facility they may take that facility to the PJM Dispute Resolution Process and PJM will delay implementation of that facility into the program until the completion of the

process. The TO may offer additional facilities to be studied for inclusion under this program. The TO is responsible for establishing a short term rating for these facilities. These ratings will be submitted to PJM for approval. The TO will provide the necessary information to PJM to enable the appropriate analysis.

3. **Generation Owner**. The owners of the fast-response generation are to operate those units is accordance with the current PJM rules and procedures. When called upon to mitigate a transmission outage on a facility included in the program, the generation owner shall start the unit in accordance with PJM's instructions.

Process for TO to Request PJM to Change constraints/facilities in the Post-Contingency Congestion Management program

By Dec 1 - TO formally submits the request, addressed to the Manager of Transmission Operations, for PJM to change the transmission constraints/facilities in the Program starting June 1 of the following year. TO should provide all necessary information with the request for PJM to perform the required analysis.

Shortly after Dec 1 - PJM posts all pending requests (including those selected by PJM and those requested by Transmission Owners) on the PJM website shortly after the Dec 1 submittal deadline.

Dec 1 to Feb 15 - PJM System Planning, System Operations, Performance Compliance and Market Monitoring Departments perform various studies to determine if the transmission constraint can be accepted in the Program.

Mar 1 - TO will be notified whether the requested transmission constraint can be accepted in the Program.

Mar 1 to Mar 8 - PJM posts the changes to the constraint list in the Program effective June 1 on the PJM website. PJM will indicate whether the constraint is accepted for non-Winter months only or for the year-round.

Jun 1 - PJM assumes the operation of the transmission constraints under the Program.

Note this process has the same timeline as the Process to Change the PJM Congestion Management Control Facilities List as stated in Section 1 of this Manual.

Post-Contingency Congestion Management Program Constraint List

Following is a list of the transmission constraints included in the operation of the Post Contingency Congestion Management Program:

1. Talbot – Trappe Tap 69kV l/o Indian River – Milford 230kV
2. Preston – Todd 69kV l/o Indian River – Milford 230kV
3. Talbot – Tanyard 69kV l/o Indian River – Milford 230kV
4. Preston – Tanyard 69kV l/o Indian River – Milford 230kV
5. Talbot – Trappe Tap 69kV l/o Vienna 230/138kV Transformer
6. Preston – Todd 69kV l/o Vienna 230/138kV Transformer

7. Talbot – Tanyard 69kV l/o Vienna 230/138kV Transformer
8. Preston – Tanyard 69kV l/o Vienna 230/138kV Transformer
9. Bedington – Reid – Bre 138kV Line l/o Bedington – Doubs 520 500kV Line
10. Double Toll Gate – Old Chapel – Millville DT 138kV Line l/o Mount Storm – Doubs 512 500kV Line, or Meadow Brook – Morrisville 500kV Line, or Bedington – Black Oak 500kV Line
11. Monocacy: #4 230/138kV Transformer l/o Doubs – Limekiln DLF1 138kV Line, or Doubs #5 230/138kV Transformer
12. North Shenandoah #3 138/115kV Transformer l/o Mount Storm – Meadow Brook 572 500kV Line
13. West Bellaire – Windsor 138kV Line l/o Fort Martin – Ronco 516 500kV Line, or Harrison – Belmont 528 500kV Line
14. Double Toll Gate-Millville DT 138 kV line l/o Bedington - Black Oak 500 kV line + Millville - Lovettsville 138 kV line.
15. Double Toll Gate-Millville DT 138 kV line l/o Meadow Brook-Morrisville 580 500 kV line + Millville - Lovettsville 138 kV line.
16. Double Toll Gate - Millville DT 138 kV line l/o Mt Storm-Doubs 512 500 kV line + Millville - Lovettsville 138 kV line .
17. Glen Falls-Trissler 8 138 kV line l/o Harrison-Belmont 528 500 kV line + Glen Falls - Varner 138 kV line.
18. Glen Falls-Trissler 8 138 kV line l/o Harrison-Pruntytown 526 500 kV line + Glen Falls - Varner 138 kV line.
19. Long Reach - Paden City 64 138 kV line l/o Harrison - Belmont 528 500 kV line + Paden City - New Martinsville 138 kV line.
20. Long Reach - Paden City 64 138 kV line l/o Harrison-Pruntytown 526 500 kV line + Paden City - New Martinsville 138 kV line.
21. Willow Island - Long Reach 70 138 kV line l/o Harrison-Belmont 528 500 kV line + Paden City to New Martinsville 138 kV .
22. Willow Island - Long Reach 70 138 kV line l/o Harrison-Pruntytown 526 500 kV line + Paden City - New Martinsville 138 kV line.

Attachment E: Automatic Sectionalizing Schemes

American Electric Power (AEP)

1. **WestMillersport 345/138 kV T-1 Sectionalized** – Restores W. Millersport No. 1 345 kV Bus following a fault on W. Millersport 345/138 kV T-1 transformer, after isolating via the West Millersport 'X1' 345 kV air break.
2. **West Millersport 345/138 kV T-2 Sectionalized** – Restores W. Millersport No. 2 345 kV Bus following a fault on W. Millersport 345/138 kV T-2 transformer, after isolating via the West Millersport 'X2' 345 kV air break.
3. **W. Bellaire 345/138 kV T-1 Sectionalized** – Restores Kammer-W. Bellaire 345 kV and Tidd-W. Bellaire 345 kV following a fault on W. Bellaire 345/138 kV T-1 transformer.
4. **Ohio Central 345/138 kV T-1 Sectionalized** – Restores Muskingum - Ohio Central 345 kV and Galion (OE) - Ohio Central 345 kV following a fault on the Ohio Central 345/138 kV T-1 transformer.
5. **Galion (OE)-Ohio Central Sectionalized** – Restores Muskingum - Ohio Central 345 kV following a fault on the Galion (OE)-Ohio Central 345kV.
6. **Maliszewski 765/138 kV T-1 Sectionalized** – Restores Kammer-Maliszewski 765 kV line and Marysville-Maliszewski 765 kV line following a fault on the Maliszewski 765/138 kV T-1 Transformer.
7. **Belmont 765/500 kV T-5 Sectionalized** – Restores Kammer-Belmont 765 kV and Mountaineer-Belmont 765 kV following a fault on the Belmont 765/500 kV T-5 transformer.
8. **Kammer 345/138 kV T300 Sectionalized** – Restores Kammer 345 kV Bus #2 following a fault on Kammer 345/138 kV T300 transformer, after isolating via the Kammer 'TT' 345 kV air break switch.
9. **Kammer 345/138 kV Transformer 100A/100B Sectionalized** – Restores Kammer 345 kV Bus #1 following a fault on Kammer 345/138 kV transformer 100A/100B, after isolating via the Kammer 'VV' 345 kV air break switch.
10. **Kirk 345/138 T4 Sectionalized** – Restores Kirk-Jug Street 345 kV, Bixby- Kirk 345 kV, and Kirk-W. Millersport 345 kV following a fault on the Kirk 345/138 T4 transformer.
11. **Hyatt OP-Hyatt CSP (S) 345 kV Bus Tie Sectionalized** - Restores Hyatt OP-W Millersport 345 kV following a fault on the Hyatt OP-Hyatt CSP (S) 345 kV Bus Tie.
12. **Hyatt OP-W Millersport 345 kV Sectionalized** – Restores Hyatt OP-Hyatt CSP (S) 345 kV following a fault on the Hyatt OP-W Millersport 345 kV line.
13. **Hyatt OP-Hyatt CSP (N) 345 kV Bus Tie Sectionalized** – Restores Hyatt OP-Tangy 345 kV line following a fault on the Hyatt OP-Hyatt CSP (N) 345 kV Bus Tie.

14. **Hyatt OP-Tangy FE 345 kV Sectionalized** – Restores Hyatt OP-Hyatt CSP (N) 345 kV following a fault on the Hyatt OP-Tangy FE 345 kV line.
15. **Bixby 345/138 kV T2 Sectionalized** – Restores Bixby- Marquis 345 kV following a fault on the Bixby 345/138 kV T2 transformer.
16. **Bixby-Marquis 345 kV Sectionalized** – Restores Bixby 345/138 kV T2 transformer following a fault on the Bixby-Marquis 345 kV line.
17. **Jackson Road 345/138 kv T-3 Sectionalized** – Restores Cook-Jackson Rd 345 kV and Twin Branch-Jackson Rd 345 kV lines following a fault on the Jackson Road 345/138 kv T-3 transformer.
18. **Benton Harbor 345/138 kv T-1A/1B Sectionalized** - Restores Cook-Benton Harbor 345 kV and Benton Harbor-Palisades 345 kV lines following a fault on the Benton Harbor 345/138 kv T-1A/1B transformer.
19. **Kenzie Creek 345/138 kv T-1 Sectionalized** – Restores Cook-Kenzie Creek 345 kV and Kenzie Creek-Twin Branch 345 kV lines following a fault on the Kenzie Creek 345/138 kv T-1 transformer.
20. **East Elkhart 345/138 kv T-2 Sectionalized** – Restores Cook-E. Elkhart 345 kV and E. Elkhart-Hiple 345 kV lines following a fault on the East Elkhart 345/138 kv T-2 transformer.
21. **Robison Park 345/138 kv T-5 Sectionalized** – Restores Robison Park-R P Mone 345kv line following a fault on the Robison Park 345/138 kv T-5 transformer.
22. **Robison Park-RP Mone 345kv Sectionalized** – Restores Robison Park 345/138 kV transformer following a fault on the Robison Park-RP Mone 345kv line.
23. **Tanners Creek 345/138 kV T-A/B Sectionalized** – Restores Miami Fort-Tanners Creek 345 kV line and the Tanners Creek #2 345 kV bus following a fault on the Tanners Creek 345/138 kV T-A/B transformer.
24. **Fall Creek 345/138 kV T-1 Sectionalized** – Restores Noblesville-Fall Creek 345kV line following a fault on the Fall Creek 345/138 kv T-1 transformer.
25. **Fall Creek-Noblesville 345 kV Sectionalized** – Restores Fall Creek 345/138 kV T-1 transformer following a fault on the Fall Creek-Noblesville 345 kV line.
26. **Desoto 345/138 kV T-1 Sectionalized** – Restores Desoto #2 345 kV bus following a fault on the Desoto 345/138 kV T-1 transformer.
27. **East Lima-Southwest Lima 345 kV Sectionalized** – Restores East Lima 345 kV ring bus following a fault on the East Lima-Southwest Lima 345 kV line.
28. **East Lima-Maddox Creek 345 kV Sectionalized** – Restores East Lima 345 kV ring bus following a fault on the East Lima-Maddox Creek 345 kV line.
29. **Sorenson 345/138 kV T-1 Sectionalized** – Restores the Sorenson #1 345 kV bus following a fault on the Sorenson 345/138 kV T-1 transformer.
30. **Sorenson 345/138 kV T-2 Sectionalized** – Restores the Sorenson #2 345 kV bus following a fault on the Sorenson 345/138 kV T-2 transformer.

31. **South Berwick 345/69 kv T-1 Sectionalized** – Restores Fostoria-S. Berwick 345 kV line and South Berwick-Galion 345 kV line following a fault on the South Berwick 345/69 kv T-1 transformer.
32. **Olive 345/138 kv T-2 Sectionalized** – Restores Olive 345kV Bus 1 following a fault on the Olive 345/138 kv T-2 transformer.
33. **Greentown 765/138 kv T-1 Sectionalized** – Restores Greentown 765kV Ring Bus following a fault on the Greentown 765/138 kv T-1 transformer.
34. **Greentown 765/138 kv T-2 Sectionalized** – Restores Greentown 765kV Ring Bus following a fault on the Greentown 765/138 kv T-2 transformer
35. **Rockport 765/138/34 kv T-3 Sectionalized** – Restores Rockport 765kV Ring Bus following a fault on the Rockport 765/138/34 kv T-3 transformer.
36. **Cook-East Elkhart 345 kV Sectionalized** – Restores East Elkhart-Hiple 345 kV line and East Elkhart 345/138 kV T-2 transformer following a fault on the Cook-East Elkhart 345 kV line.
37. **East Elkhart-Hiple 345 kV Sectionalized** – Restores Cook-East Elkhart 345 kV line and East Elkhart 345/138 kV T-2 transformer following a fault on the East Elkhart-Hiple 345 kV line.
38. **Benton Harbor-Cook 345 kV Sectionalized** – Restores Benton Harbor-Palisades 345 kV line and Benton Harbor 345/138 kV transformer following a fault on the Benton Harbor-Cook 345 kV line.
39. **Benton Harbor-Palisades 345 kV Sectionalized** – Restores Cook-Benton Harbor 345 kV line and Benton Harbor 345/138 kV transformer following a fault on the Benton Harbor-Palisades 345 kV line.
40. **Cook-Kenzie Creek 345 kV Sectionalized** – Restores Kenzie Creek-Twin Branch 345 kV line and Kenzie Creek 345/138 kV transformer following a fault on the Cook-Kenzie Creek 345kv line.
41. **Kenzie Creek-Twin Branch 345 kV Sectionalized** – Restores the Cook-Kenzie Creek 345 kV line and Kenzie Creek 345/138 kV transformer following a fault on the Kenzie Creek-Twin Branch 345kV line.
42. **Cook-Jackson Road 345 kV Sectionalized** – Restores the Jackson Road-Twin Branch 345 kV line and the Jackson Road 345/138 kV transformer following a fault on the Cook-Jackson Road 345 kV line.
43. **Jackson Road-Twin Branch 345 kV Sectionalized** - Restores the Cook-Jackson Road 345 kV line and the Jackson Road 345/138 kV transformer following a fault on the Jackson Road-Twin Branch 345 kV line.
44. **Fostoria Central-South Berwick 345kv Sectionalized** – Restores S. Berwick-Galion 345 kV line and S. Berwick 345/69 kV transformer following a fault on the Fostoria Central-South Berwick 345kv line.
45. **Galion-South Berwick 345kv Sectionalized** – Restores the Fostoria-S. Berwick 345 kV line and S. Berwick 345/69 kV transformer following a fault on the Galion-South Berwick 345kv line.

46. **Cloverdale 765/345 kV T-10 Sectionalized** – Restores Cloverdale-Jacksons Ferry 765 kV and Cloverdale-Joshua Falls 765 kV lines following a fault on the Cloverdale 765/345 kV T-10 transformer.
47. **N. Proctorville 765/138 kV T-1 Sectionalized** – Restores Amos-N. Proctorville 765 kV and Hanging Rock-N. Proctorville 765 kV lines following a fault on the N. Proctorville 765/138 kV T-1 transformer.
48. **Tri State 345/138 kV T-1 Sectionalized** – Restores Kyger Creek - Tri State 345 kV line following a fault on the Tri State 345/138 kV T-1 transformer.
49. **Tri State 345/138 kV T-2 Sectionalized** – Restores Baker - Tri State 345 kV line following a fault on the Tri State 345/138 kV T-2 transformer.
50. **Tri State 345/138 kV T-3 Sectionalized** – Restores Baker - Tri State 345 kV line following a fault on the Tri State 345/138 kV T-3 transformer.
51. **Kyger-Tri State 345 kV Sectionalized** – Restores Tri State 345/138 kV T-1 transformer following a fault on the Kyger-Tri State 345 kV line.
52. **Sporn 345/138 kV T-3 Sectionalized** – Restores Sporn 345/138 kV Transformer T-B following a fault on the Sporn 345/138 kV T-3 transformer.
53. **Sporn 345/138 kV T-B Sectionalized** – Restores Sporn 345/138 kV Transformer T-3 following a fault on the Sporn 345/138 kV T-B transformer.
54. **Sporn 345/138 kV T-4 Sectionalized** – Restores Sporn-Kyger 345 kV line following a fault on the Sporn 345/138 kV T-4 transformer.
55. **Kanawha 345/138 kV T-B Sectionalized** – Restores Kanawha - Sporn 345 kV line following a fault on the Kanawha 345/138 kV T-B transformer.
56. **Kanawha-Sporn Line 345 kV Sectionalized** – Restores Kanawha 345/138 kV T-B transformer following a fault on the Kanawha-Sporn 345 kV line.
57. **Wyoming 765/138 kV T-1 Sectionalized** – Restores Wyoming 765/138 kV T-2 transformer following a fault on the Wyoming 765/138 kV T-1 transformer.
58. **Wyoming 765/138 kV T-2 Sectionalized** – Restores Wyoming 765/138 kV T-1 transformer following a fault on the Wyoming 765/138 kV T-2 transformer.
59. **Baker 345/138 kV T-2 Sectionalized** – Restores Baker 345k V Bus 2 following a fault on the Baker 345/138 kV T-2 transformer.
60. **East Danville 230/138 kV T4 Sectionalized** – Restores 138 kV 'P' and 'M' circuit breakers at East Danville and 138 kV 'A' and 'B' circuit breakers at East Monument following a fault on the East Danville 230/138 kV T4 transformer.
61. **East Danville 230/138 kV T5 Sectionalized** – Restores 138 kV circuit breakers 'P', 'L', 'BB', and 'J' and 69 kV circuit breakers 'H', 'F', and 'AA' and 12 kV circuit breaker 'A' at East Danville following a fault on the East Danville 230/138 kV T5 transformer.
62. **East Danville-East Monument 138 kV Sectionalized** – Restores 230 kV circuit breaker 'S' and 138 kV circuit breakers 'P' and 'M' at East Danville following a fault on the East Danville-East Monument 138 kV line.

Dayton Power and Light Company (DAY)

1. **Sugar Creek "BK-N" 345/138 kV Sectionalized –** Restores the 345kV and 138 kV Bus Breakers following a fault on the transformer.
2. **Sugar Creek "BK-S" 345/138 kV Sectionalized –** Restores the 345 kV Bus Breakers following a fault on the transformer.

   NOTE: The low side ring bus breakers "B" & "K" remain open and do not sectionalize
3. **Alpha "BK-7" 138/69 kV Sectionalized –** Restores the Alpha – Greene and Alpha – Bellbrook 138 kV lines following a fault on the Alpha "BK-7"
4. **Darby "BK-7" 138/69 kV Sectionalized –** Restores the 138 kV and 69 kV Bus Breakers following a fault on the transformers so that the two 138 kV lines are not tied through the only remaining breaker
5. **Eldean "BK-7" 138/69 kV Sectionalized -** Restores the Eldean – Miami – Staunton and the Eldean – Sidney 138 kV lines following a fault on the transformer.
6. **New Carlisle "BK-7" 138/69 kV Sectionalized –** Restores the New Carlisle – Miami 138 kV line and the New Carlisle – Phoneton 69 kV line following a fault on the transformer. Also, the New Carlisle – Bath 138 kV line and the New Carlisle – Huber Heights 69 kV lines will no longer be radially feeding distribution load following a fault on the New Carlisle "BK-7"
7. **Overlook "BK-7" 138/69 kV Sectionalized –** Restores the Knollwood – Overlook – Monument 138 kV line following a fault on the transformer.
8. **Urbana "BK-7" 138/69 kV Sectionalized –** Restores the 138 kV and 69 kV Bus Breakers following a fault on the transformer.

Dominion Virginia Electric Power (DOM)

1. **Bristers TX#1 Sectionalized** – Restores the 500kV Bus Breakers following a fault on the transformer.
2. **Bull Run-Burke 244 Sectionalized** – Restores the Bull Run #6 transformer following a fault on and isolation of the 244 line. (Effective 1/25/13)
3. **Bull Run-Loudoun 295 Sectionalized** – Restores the Bull Run #3 transformer following a fault on and isolation of the 295 line. (Effective 1/25/13)
4. **Carson-Clubhouse 238 Sectionalized**- Restores the Clubhouse 230kV bus and transformer #1 following a fault on and isolation of the 238 line. (Effective 1/25/13)
5. **Carson TX#1 Sectionalized** - Restores the 500kV Bus Breakers following a fault on the transformer.
6. **Carson TX#2 Sectionalized** – Restores the 500kV Buss Breakers following a fault on the transformer. (Effective 1/25/13)

7. **Carson-Poe 2002 Sectionalized**- Restores the 230kV bus and transformer #5 at Poe following a fault on and isolation of the 2002 line. (Effective 1/25/13)
8. **Chesterfield-Tyler-Poe 2003 Sectionalized**- Restores the 230kV bus and transformer #6 at Poe following a fault on and isolation of the 2003 line. (Effective 1/25/13)
9. **Chancellor TX#1 Sectionalized** – Restores the Ladysmith-Bristers 500kV line following a fault on TX#1.

   NOTE: A fault on the Ladysmith-Chancellor-Bristers 500kV line will clear the line and transformer. This remains a valid single contingency.
10. **Chickahominy TX#1 Sectionalized** – Restores the Elmont-Chickahominy-Surry 500kV path following a fault on the TX#1.
11. **Line 557 Chickahominy-Elmont 500kV Sectionalized** – Restores the Surry-Chickahominy and Chickahominy TX#1 following a fault on the Chickahominy-Elmont line.
12. **Clifton TX#1 Sectionalized** - Restores the 500kV Bus Breakers which restores the Loudoun-Clifton-Ox line following a fault on the transformer.
13. **Clover TX #9 Sectionalized** – Restores the Carson 500kV Bus Breakers following a fault on the transformer.
14. **556 LINE: Carson-Clover 500kV Sectionalized** – Restores the Clover 230kV Bus CBs following a fault on the 500kV line.
15. **Dooms TX #7 Sectionalized** – Restores the 500kV Bus Breakers following a fault on the transformer
16. **Dooms TX #9 Sectionalized** – Restores the 500kV Bus Breakers following a fault on the transformer. (Effective 1/25/13)
17. **Elmont TX#2 Sectionalized** –Restores the 500kV Bus Breakers following a fault on the transformer.
18. **Elmont TX #1 Sectionalized** – Restores the 500kV Bus Breakers following a fault on the transformer.
19. **Fentress TX#1 Sectionalized** – Restores Line 579 Fentress-Septa and transformer TX3 following a fault on transformer TX#1

    NOTE: A fault on Line 579 Fentress-Septa will clear the line and both transformers. This remains a valid single contingency screened in SA Group #1.
20. **Fentress TX#3 Sectionalized** – Restores Line 579 Fentress-Septa and transformer TX#1 following a fault on transformer TX#3

    NOTE: A fault on Line 579 Fentress-Septa will clear the line and both transformers. This remains a valid single contingency screened in SA Group #1
21. **Gordonsville-Charlottesville 2054 Sectionalized**- Restores the Gordonsville 230kV bus and transformer #1 following a fault on and isolation of the 2054 line. (Effective 1/25/13)

22. **Gordonsville-Louisa Ct 2088 Sectionalized**- Restores the Gordonsville 230kV bus and transformer #3 following a fault on and isolation of the 2088 line. (Effective 1/25/13)
23. **Grottoes-Dooms 272 Sectionalized**- Restores the Grottoes 230kV bus and transformer #4 following a fault on and isolation of the 272 line. (Effective 1/25/13)
24. **Halifax TX#4 Sectionalized** – Restores Line 2068A Clover-Halifax following a fault and isolation of Halifax #4 transformer. (Effective 1/25/13)
25. **Halifax TX#5 Sectionalized** – Restores Line 296 Person-Halifax following a fault and isolation of Halifax #5 transformer. (Effective 1/25/13)
26. **Halifax-Person 296 Sectionalized** – Restores the Halifax #5 transformer following a fault on and isolation of the 296 line. (Effective 1/25/13)
27. **Lakeside-Chesterfield 217 Sectionalized**- Restores the Lakeside #2, #3 and #8 transformers following a fault on and isolation off the 217 line. (Effective 1/25/13)
28. **Lanexa-Lightfoot 2113 Sectionalized** – Restores the Lanexa #2 transformer following a fault on and isolation of the Lanexa-Lightfoot 2113 line. (Effective 1/25/13)
29. **Lexington TX#1 Sectionalized** - Restores the 500kV Bus Breakers following a fault on the transformer.
30. **Lexington TX#3 Sectionalized** - Restores the 500kV Bus Breakers following a fault on the transformer.

    NOTE: A fault on the Cloverdale-Lexington 500kV line will clear the 500kV Bus and the Lexington TX3 transformer. This remains a valid single contingency screened in SA Group #1.
31. **Loudoun TX#1 Sectionalized** - Restores the 500kV Bus Breakers following a fault on the transformer.
32. **Loudoun TX#2 Sectionalized** - Restores the 500kV Bus Breakers following a fault on the transformer.
33. **Midlothian TX#2 Sectionalized** – Restores the 500kV Path from Carson-Midlothian-North Anna following a fault on the transformer.
34. **576A LINE: Midlothian – North Anna 500kV Sectionalized** – Restores the Midlothian-Carson and Midlothian TX#2 following a fault on the Midlothian – North Anna line.
35. **Morrisville TX#1 Sectionalized** – Restores the 500kV Bus Breakers following a fault on the transformer.
36. **Morrisville TX#2 Sectionalized** – Restores the 500kV Bus Breakers following a fault on the transformer.
37. **Ox TX#1 Sectionalized** - Restores the 500kV Bus Breakers following a fault on the transformer.
38. **Ox TX#2 Sectionalized** - Restores the 500kV Bus Breakers following a fault on the transformer.

39. **Peninsula-Tabb-Yorktown 288 Sectionalized** – Restores Peninsula #4 and #5 transformer and the 230kV bus at Peninsula following a fault on and isolation of the 288 line. (Effective 1/25/13)
40. **Pleasant View TX#3 Sectionalized** – Restores the 500kV breakers and path from Doubs-Pleasant View-Loudoun following a fault on the TX#3 transformer.
41. **558 LINE: Pleasant View – Loudoun 500kV Sectionalized** – Restores the Doubs-Pleasant View and Pleasant View TX#3 following a fault on the Pleasant View - Loudoun line.
42. **Possum Point TX#1 Sectionalized** - Restores the 500kV Bus Breakers following a fault on the transformer.
43. **Suffolk TX #7 Sectionalized** – Restores the 500kV Bus Breakers following a fault on the transformer.
44. **Suffolk TX #8 Sectionalized** – Restores the 500kV Bus Breakers following a fault on the transformer. (Effective 1/25/13)
45. **Surry RSS#1 Sectionalized** – Restores the 500kV Bus Breakers following a fault on the transformer.
46. **Valley TX#1 Sectionalized** – Restores the 500kV Bus Breakers following a fault on the transformer.
47. **Winfall-Suffolk 247 Sectionalized** – Restores the Winfall 230kV bus and transformer #2 following a fault on and isolation of the 247 line. (Effective 1/25/13)
48. **Yadkin TX#1 Sectionalized** - Restores Line 565A Yadkin-Suffolk and transformer TX#2 following a fault on transformer TX#1

    NOTE: A fault on Line 565A Yadkin-Suffolk will clear the line and both transformers. This remains a valid single contingency screened in SA Group #1.
49. **Yadkin TX#2 Sectionalized** - Restores Line 565A Yadkin-Suffolk and transformer TX#1 following a fault on transformer TX#2

    NOTE: A fault on Line 565A Yadkin-Suffolk will clear the line and both transformers. This remains a valid single contingency screened in SA Group #1.

Duke Energy Ohio Kentucky (DEOK)

1. **East Wood-Hillcrest 138 kV Sectionalized** – Restores the East Wood – Ford Batavia 138 kV line following a fault on the East Wood-Hillcrest 8887 138 kV line.

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Duquesne Light Company (DLCO)

1. **Dravosburg 138/69 kV transformer #1 Sectionalized** – Restores the Elwyn-Brentwood-Dravosburg Z-70 138 kV line and the Carson-Homestead- Dravosburg Z-87 138 kV line following a fault on the Dravosburg 138/69 kV transformer #1. – (Effective 8/1/2014)

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First Energy East (FE-E)

1. **Forest #1 230/115kV Transformer Sectionalized –** Restores Elko – Forest 230kV line and Glade – Forest 230kV Line following a fault on the Forest #1 230/115kV transformer.
2. **Collins-Middletown Junction 115 kV Sectionalized –** Restore Collins-Cly-Newberry-Round Top 115kV following a fault on the Collins-Middletown Junction 115 kV line.
3. **Round Top-Newberry 115 kV Sectionalized –** Restore Middletown Junction-Collins-Cly-Newberry- 115kV following a fault on the Round Top-Newberry 115 kV line.

First Energy South (FE-S)

1. **Meadow Brook #1 500/138kV Transformer Sectionalized** – Restores Meadow Brook #3 500/138kV transformer for a fault on the Meadow Brook #1 500/138kV Transformer.
2. **Meadow Brook #2 500/138kV Transformer Sectionalized** – Restores Meadow Brook #4 500/138kV transformer for a fault on the Meadow Brook #2 500/138kV Transformer.
3. **Meadow Brook #3 500/138kV Transformer Sectionalized** – Restores Meadow Brook #1 500/138kV transformer for a fault on the Meadow Brook #3 500/138kV transformer.
4. **Meadow Brook #4 500/138kV Transformer Sectionalized** – Restores Meadow Brook #2 500/138kV transformer for a fault on the Meadow Brook #4 500/138kV transformer.
5. **Bedington #1 500/138kV Transformer Sectionalized** – Restores Bedington #3 500/138kV transformer for a fault on the Bedington #1 500/138kV transformer.
6. **Bedington #3 500/138kV Transformer Sectionalized** – Restores Bedington #1 500/138kV transformer for a fault on the Bedington #3 500/138kV transformer.
7. **Pruntytown #1 500/138kV Transformer Sectionalized** – Restores Pruntytown #2 500/138kV transformer for a fault on the Pruntytown #1 500/138kV transformer.
8. **Pruntytown #2 500/138kV Transformer Sectionalized** – Restores Pruntytown #1 500/138kV transformer for a fault on the Pruntytown #2 500/138kV transformer.
9. **Pruntytown #3 500/138kV Transformer Sectionalized** – Restores Pruntytown #4 500/138kV transformer for a fault on the Pruntytown #3 500/138kV transformer.
10. **Pruntytown #4 500/138kV Transformer Sectionalized** – Restores Pruntytown #3 500/138kV transformer for a fault on the Pruntytown #4 500/138kV transformer.
11. **Doubs #1 500/230kV Transformer Sectionalized** – Restores Doubs #3 500/230kV transformer for a fault on the Doubs #1 500/230kV transformer.

12. **Doubs #3 500/230kV Transformer Sectionalized** – Restores Doubs #1 500/230kV transformer for a fault on the Doubs #3 500/230kV transformer.
13. **Doubs #2 500/230kV Transformer Sectionalized** – Restores Doubs #4 500/230kV transformer for a fault on the Doubs #2 500/230kV transformer.
14. **Doubs #4 500/230kV Transformer Sectionalized** – Restores Doubs #2 500/230kV transformer for a fault on the Doubs #4 500/230kV transformer.
15. **Bedington #2 500/138kV Transformer Sectionalized** – Restores Bedington #4 500/138kV transformer for a fault on the Bedington #2 500/138kV transformer.
16. **Bedington #4 500/138kV Transformer Sectionalized** – Restores Bedington #2 500/138kV transformer for a fault on the Bedington #4 500/138kV transformer.
17. **Belmont #1 500/138kV Transformer Sectionalized** – Restores Belmont #2 500/138kV transformer for a fault on the Belmont #1 500/138kV transformer.
18. **Belmont #2 500/138kV Transformer Sectionalized** – Restores Belmont #1 500/138kV transformer for a fault on the Belmont #2 500/138kV transformer.
19. **Cabot #2 500/138kV Transformer Sectionalized** – Restores Cabot #4 500/138kV transformer for a fault on the Cabot #2 500/138kV transformer.
20. **Cabot #4 500/138kV Transformer Sectionalized** – Restores Cabot #2 500/138kV transformer for a fault on the Cabot #4 500/138kV transformer.
21. **Cabot #1 500/138kV Transformer Sectionalized** – Restores Cabot #3 500/138kV transformer for a fault on the Cabot #1 500/138kV transformer.
22. **Cabot #3 500/138kV Transformer Sectionalized** – Restores Cabot #1 500/138kV transformer for a fault on the Cabot #3 500/138kV transformer.
23. **Yukon #1 500/138kV Transformer Sectionalized** – Restores Yukon #3 500/138kV transformer for a fault on the Yukon #1 500/138kV transformer.
24. **Yukon #3 500/138kV Transformer Sectionalized** – Restores Yukon #1 500/138kV transformer for a fault on the Yukon #3 500/138kV transformer.
25. **Yukon #2 500/138kV Transformer Sectionalized** – Restores Yukon #4 500/138kV transformer for a fault on the Yukon #2 500/138kV transformer.
26. **Yukon #4 500/138kV Transformer Sectionalized** – Restores Yukon #2 500/138kV transformer for a fault on the Yukon #4 500/138kV transformer.
27. **Wylie Ridge #1 345/138kV Transformer Sectionalized** – Restores Wylie Ridge #2 345/138kV transformer for a fault on the Wylie Ridge #1 345/138kV transformer.
28. **Wylie Ridge #2 345/138kV Transformer Sectionalized** – Restores Wylie Ridge #1 345/138kV transformer for a fault on the Wylie Ridge #2 345/138kV transformer.

Pennsylvania Power & Light Company (PPL)

1. **Alburtis 500/230kV TR1 Transformer** – Restores the 500kV High Side CBs following a fault on the transformer.
2. **Hosensack #1 230/69kV Transformer** – Restores the 230kV High Side CBs following a fault on the transformer.

3. **Hosensack #2 230/69kV Transformer** – Restores the 230kV High Side CBs following a fault on the transformer.
4. **Hosensack #3 230/69kV Transformer** – Restores the 230kV High Side CBs following a fault on the transformer.
5. **Jenkins #4 230/69kV Transformer** – Restores the 230kV High Side CBs, which will restore the 230kV path between Susquehanna and Staton, following a fault on the transformer.
~~6. **Juniata 500/230kV T1 Transformer** – Restores the 500kV High Side CBs following a fault on the transformer.~~
~~**NOTE:** The Juniata #2 and #3 500kV Capacitors will trip as part of this contingency but will not reclose~~
~~7. **Juniata 500/230kV T2 Transformer** – Restores the 500kV High Side CBs following a fault on the transformer.~~
~~8.~~6. **Lackawanna #1 230/69kV Transformer** – Restores the 230kV High Side CBs following a fault on the transformer.
~~9.~~7. **Lackawanna #2 230/69kV Transformer** – Restores the 230kV High Side CBs, which will restore the Lackawanna – Oxbow 230kV line, following a fault on the transformer.
~~10.~~8. **Quarry #1 230/69kV Transformer** – Restores the 230kV High Side CBs, which will restore the Quarry – Steel City 230kV line, following a fault on the transformer.
~~11.~~9. **Quarry #2 230/69kV Transformer** – Restores the 230kV High Side CBs following a fault on the transformer.
~~12.~~10. **Siegfried #4 230/138kV Transformer** – Restores the 230kV High Side CBs, which will restore the Siegfried – Harwood 230kV line, following a fault on the transformer.
~~13.~~11. **Siegfried #5 230/138kV Transformer** – Restores the 230kV High Side CBs following a fault on the transformer.
~~14.~~12. **South Akron #5 230/69kV Transformer** – Restores the 230kV High Side CBs, restoring the South Akron #6 230/69kV transformer, following a fault on the #5 transformer.
~~15.~~13. **South Akron #6 230/138kV Transformer** – Restores the 230kV High Side CBs, restoring the South Akron #5 230/69kV transformer, following a fault on the #6 transformer.
~~16.~~14. **South Akron #7 230/138kV Transformer** – Restores the 230kV High Side CBs following a fault on the transformer.
~~17.~~15. **Steel City 500/230kV TR1 Transformer** – Restores the 500kV High Side CBs following a fault on the transformer.
~~18.~~16. **Susquehanna 500/230kV T21 Transformer** – Restores the 500kV High Side CBs following a fault on the transformer.
~~19.~~17. **Wescosville #1 138/69kV Transformer** – Restores the 138kV High Side CBs following a fault on the transformer.
~~20.~~18. **West Hempfield #3 230/138kV Transformer** – Restores the 230kV High Side CBs following a fault on the transformer.

UGI Utilities, Inc. (UGI)

1. **Mountain #1 230/66kV Transformer** – Restores the 230kV High Side CBs, which will restore the Mountain-Susquehanna T10 230kV line, following a fault on the transformer.
2. **Mountain #2 230/66kV Transformer** – Restores the 230kV High Side CBs, which will restore the Mountain-Lackawanna 230kV line, following a fault on the transformer.

Attachment F: Short Term Emergency Ratings

The referenced attachment lists facilities with STE Ratings and their appropriate time based durations (30-minutes, 2hrs, etc). The STE ratings are used on a post-contingency basis in conjunction with operating steps listed in Manual-03 Section 5 or Attachment D as special cases to control for an actual overload as defined in Section 2 and Exhibit 1. If no associated operating step exists or the associated operating step does not reduce the loading to below the LTE rating, the duration of the rating is utilized to determine the time to shed load.

The STE rating list is posted on OASIS at this link:

http://www.pjm.com/~/media/etools/oasis/system-information/m03-attachment-f-ste-rating-list.ashx

Revision History

Revision 44 (11/01/2013):

- Section 2.1.1 and 2.1.3: Added language regarding emergency rating change approval
- Section 3.3.3: Added applicability for individual generating units greater than 20 MVA, added 161 kV default voltage schedule, and added GO/GOPs voltage schedule performance monitoring to Note 1.
- Section 3.5.1: Clarified that the voltage coordination pertains to generator voltage schedules.
- Sections 3.5.2 and 3.5.3: Added variable reactor tap adjustment.
- Section 3.7: Added variable reactors language.
- Section 3.8: Added BC/PEPCO interface definition.
- Sections 3, 5, and Attachment A: Removed Powerton/Joliet SPS procedure and references.
- Section 4.2.9.1: Added “reductions in demand” option for Direct Billing for Late Outages.
- Section 4.2.11: Deleted a reference to tie line list.
- Section 4.3: Replaced outage submittal language with references to the appropriate section for the actual requirements.
- Section 4.5.1: Replaced outage submittal language with references to the appropriate section for the actual requirements
- Section 5: Changed references of Power Team to Exelon/Constellation.
- Section 5: Added purpose statement for the 5043 and 5044 procedure.
- Section 5: Revised Note for Artificial Island to indicate it is not the only place limited by dynamic stability.
- Section 5: Added a note about lack of redundancy for the Quad Cities/Cordova SPS procedure.
- Section 5: Added the note for Conesville 345 kV Plant Operating Guidelines
- Section 5: Added Tidd 138kV Switchyard Operating Guidelines for Overduty Circuit Breakers
- Section 5: Added the note in Fast Valving Scheme for Rockport Plant Operating Guidelines
- Section 5: Added the note in Emergency Unit Tripping for Rockport Plant Operating Guidelines
- Section 5: Clarified language for Twin Branch-Argenta operation procedure

- Section 5: Updated Cook Unit Isolation on Select Circuits procedure
- Section 5: Updated Gavin Mountaineer-Rolling Hills Stability proceedure
- Section 5: Updated Seneca Plant Stability procedure
- Section 5: Added Darby Plant Stability procedure
- Section 5: Removed Elrama and Mitchell Area Operating Procedure
- Section 5: Updated Sunbury transformer single breaker rating
- Section 5 and Attachment A: Removed the West Shore SPS.
- Section 5 and Attachment A: Removed the Virginia Beach SPS.
- Section 5 and Attachment A: Removed the Harmony Village SPS.
- Section 5: Updated Bath County Stabilty Guide table
- Section 5: Updated switching actions for Dresden L1223 line outage
- Section 5: Removed Pepco common trench cable ratings table and added a link to the PJM system information page
- Attachment A: Removed the Crawford 1-8 Bus Tie Scheme.
- Attachment A: Clarified Susquehanna Unit 1 & 2 SPS operation.
- Attachment E: Added Round Top-Newberry 115 kV sectionalizing scheme
- Attachment F: Replaced the STE rating list with a link to an OASIS posting of the STE rating list.

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Revision 43 (06/01/2013):

- Sections 1-5: Changed Bulk Electric System (BES) to System Operating Limit (SOL) facilities wherever applicable to reflect recent change to SOL definition in M-37.
- Section 1.5.6: Clarified language to include all BES facilities.
- Section 3 Exhibit 5: Updated AE and DPL 500 kV voltage limits.
- Section 3.3.1: Reformatted voltage limit tables for consistency.
- Section 3.3.3: Updated the voltage coordination language in Note #4.
- Section 3.5.3: Corrected hyperlink to Powerton/Joliet SPS.
- Section 3.8: Added ComEd Interface to the list.
- Section 3.8: Updated Cleveland Interface definition.
- Section 3.9: Added Transient Stability Assessment (TSA) tool for real-time use.
- Section 4.2.1: Clarified language for Transmission Outage Request requirements.

- Section 4.2.2: Added additional Notes on relay change notification and PJM actions.
- Section 4.2.4: Updated language for Protection System Coordination.
- Section 4.3.2: Clarified real-time tie-line communication requirements.
- Section 5: Removed Transmission Overuse (re:5018 Line Flow).
- Section 5: Added 5018 Branchburg – Ramapo PAR Coordination.
- Section 5: Updated the PSE&G/ConED Wheel procedure.
- Section 5: Increased Byron 1 and 2 low voltage limits Voltage Control at Nuclear Stations.
- Section 5: Revised Beaver Valley Normal Low, Normal High, and Emergency Low voltage limits, Voltage Control at Nuclear Stations.
- Section 5: Updated the Lee Country Byron Trip Scheme Table.
- Section 5: Revised the Powerton/Joliet SPS and added CBs.
- Section 5: Updated Elmhurst SVC control modes.
- Section 5: Updated Kincaid Stability procedure.
- Section 5: Updated Powerton Stability procedure.
- Section 5: Updated Quad Cities Limitations procedure.
- Section 5: Updated East Frankfort Transformer SPS procedure.
- Section 5: Updated University Park SPS procedure.
- Section 5: Updated Lakeview SPS procedure.
- Section 5: Updated the ComEd Normally Open Bus Tie Circuit Breakers table.
- Section 5: Updated Electric Junction – North Aurora 1106 line SPS procedure.
- Section 5: Removed Powerton Jct-1352 line from directional rating list.
- Section 5: Updated the Montour Runback SPS.
- Section 5: Removed the Branchburg 1-2 and 2-3 CB single breaker derate on the 5016 line.
- Section 5: Added Marion 1-4 138 kV CB to the Closing Normally Open Bus Section breakers.
- Section 5: Deleted Sewaren Y-2251 from the single breaker derate table.

- Section 5: Revised wording for East Sayre-North Waverly overcurrent relay protection scheme.
- Section 5: Revised Warren-Falconer overcurrent relay protection scheme.
- Section 5: Updated Kammer Operating Procedures.
- Section 5: Updated single breaker derate table for AEP's Kammer T100 transformer.
- Section 5: Removed AEP Sunnyside-Torrey operating procedure.
- Section 5: Removed AEP Marysville 765kV Reactor Guidelines.
- Section 5: Removed AEP Tanners Creek 345kV Station concern.
- Section 5: Updated Gavin-Mountaineer-Rolling Hills Stability operating procedure.
- Section 5: Added, removed, and updated several AEP Regional Procedures.
- Section 5: Added Ft. Slocum-Takoma 69054 & 69167 to common trench cable rating table.
- Section 5: Updated Buzzard Point - Ritchie 23016 common trench cable rating table.
- Section 5: Added Bells Mill – Bethesda 13801 and 13802 lines to common trench cable rating table.
- Section 5: Removed Doubs-Dickerson Line contingency section.
- Section 5: Updated single breaker limit table for Waugh Chapel 230-1, 230-2, 230-3 transformer.
- Section 5: Extracted Harbor Crossing Cables (2344 & 2345 circuits) special ratings from BGE common trench cable section and updated the ratings.
- Section 5: Added Westport-Center 110552 ratings to BGE common trench cable section.
- Section 5: Removed Green Street to Concord Street 110559 and 110562 Cables rating tables in BGE common trench cable section.
- Section 5: Updated Concord Street to Monument Street 110563 and 110564 Cables rating tables in BGE common trench cable section.
- Section 5: Updated single breaker limits table for Pumphrey-Wagner 115032 line.
- Section 5: Added the note for single breaker limits table for Conastone-Peach Bottom 5012 line.

- Section 5: Removed footnote from Bath County Stability restriction table.
- Section 5: Removed the Mt. Storm Single Breaker Derates section and replaced it with a hyperlink for all of Dominions single breaker ratings. Table of contents updated to reflect changes made.
- Section 5 and Attachment A: Removed Carlls Corner CT #2 SPS.
- Section 5: Removed the Corson – Union 1402 Directional Rating.
- Section 5: Updated single breaker limit for the Doubs-Pleasant View 514 line.
- Section 5: Updated table of contents and hyperlinks.
- Attachment A: Removed Mays Chapel SPS listing.
- Attachment A: Removed MISO owned Lakeview SPS from listing.
- Attachment A: Added Carolina "22" SPS to listing.
- Attachment D: Removed several ComEd facilities from the list.
- Attachment E: Removed minor note for PPL and UGI schemes.
- Attachment E: Removed Red Bank "TB 27" and "TB 28" 345/138 kV Sectionalized Schemes.

Revision 42 (04/01/2013):

- Section 3.3.3: Updated language for voltage schedule.

Revision 41 (12/01/2012):

- Section 2.1.1: Removed language concerning the default LD rating to be 115% of the Emergency rating.
- Section 3: Added EKPC 161 kV to Exhibit 5 Deviations from PJM baseline voltages.
- Section 3.3.1: Added 161 kV to PJM baseline voltage schedule.
- Section 3.3.3: Modified generator voltage schedules language for compliance clarification.
- Section 3.7: Added 230kV Cardiff Cap under automatic control of Cardiff SVC.
- Section 3.7: Added additional conditions for the manual operation of the Elroy capacitor.
- Section 4.2.1: Changed submittal date example.
- Section 4.2.9 Added language regarding eDART transmission outage ticket revision rules.

- Section 5: Added additional ComEd facilities to the Normally Open Bus tie CB table.
- Section 5: Update the Sewaren derate table.
- Section 5: Corrected exhibit number for the Sunbury T24.
- Section 5: Updated the Quad Cities and Cordova SPS procedure.
- Section 5: Added minor revision to the Powerton/Joliet SPS.
- Section 5: Revised ratings of Sunbury 500/230kV transformer in PPL.
- Section 5 and Attachment A: Added new ATC owned Lakeview SPS incorporated into SPOG 3-10 section in ComEd.
- Section 5: Revised the West Shore SPS in PPL.
- Section 5 and Attachment A: Added the Montour SPS in PPL.
- Section 5: Added summer and winter single breaker derates for BGE's Waugh Chapel 230-1, 230-2, 230-3, and 230-4 transformers.
- Section 5: Added temperature set points for SPS at Virginia Beach and Carolina stations.
- Section 5: Changed operating procedures for Chalk Point #5 transformer operation.
- Section 5: Updated common trench cable ratings for PEPCO.
- Section 5: Removed Potomac River Station Operation procedures.
- Section 5: Renamed First Energy companies into regions.
- Section 5: Changed the Marsh Run and Remington Ct stability restrictions guide.
- Section 5 and Attachment A: Deleted Richland SPS, due to SPS deactivation as a result of Richland substation reconfiguration.
- Section 5: Updated Belmont SPS, due to Willow Island units deactivation.
- Section5: Updated Contingency Overloads in the Willow Island Area procedure, due to Willow Island unit's deactivation.
- Section 5: Updated Yards Creek SPS to incorporate new relay settings on the Portland-Kittatinny V1010 230 kV line.
- Section 5: Updated First Energy South single breaker derate table.
- Section 5: Update Seneca stability language to include equipment that is in-series with the Glade-Lewis Run 230 kV line, and hence imposes the same set of stability restrictions.
- Section 5: Updated Homer City stability language to include instruction dealing with the event that any portion of the 230 kV

Homer City-Keystone line is open or if the tie between the 230 kV South Bus and the 345 kV South Bus is open and all 345 kV breakers are closed.

- Section 5: Updated Rockport Op guide language to clarify FV scheme and unit SPS initiation description. Also removed language in SPS section per AEP's request.
- Section 5: Updated Gavin-Mountaineer stability limits and organized limits in table format. Also added language to HSR section.
- Section 5: Updated Kammer Op guide bus configuration table by replacing Brues-Kammer 138kV circuit references with Wayman-Kammer 138kV.
- Section 5: Changed terminal station names for the X-2224 line.
- Section 5: Updated the Powerton Stability Limit according to the most recent CE procedure.
- Section 5: Updated the Ridgeland Bus Tie procedure according to the most recent CE procedure.
- Section 5: Updated the Byron Operating Procedure according to the most recent CE procedure.
- Section 5: Added EKPC.
- Section 5: Added Dayton.
- Section 5: Added RECO.
- Section 5: Updated the Limerick 4A &4B transformer ratings.
- Section 5 and Throughout: Changed PP&L to PPL.
- Section 5: Removed the Branchburg single breaker derate on the 5016 line for 1-2 and 2-3 CB.
- Section 5: Removed Transmission Overuse (re:5018 Line Flow) and Added 5018 Branchburg – Ramapo PAR Coordination
- Section 5: Add Marion under PSE&G Closing Normally Open Bus Section Breakers
- Section 5: Removed the Corson – Union 1402 Directional Rating
- Attachment A: Added Brandon Shores – Riverside SPS to the list.
- Attachment B: Corrected line designation for the circuit 5038, East Windsor-New Freedom 500 kV line.
- Attachment E: Added and modified several sectionalizing schemes to the Dominion zone.
- Attachment E: Removed 'Canton Central – SE Canton 345kV' and 'SE Canton 345/138kV T-1' sectionalizing schemes (AEP) due to

installation of new high-side breaker on SE Canton 345/138kV transformer.

- Attachment E: Removed 'Jefferson 765/345kV T-1' sectionalizing scheme (AEP) due to installation of new high-side breaker on Jefferson 765/345kV transformer.
- Attachment E: Removed PEPCO sectionalizing schemes Benning T8, T9 & Benning U16, Bowie T1, Bowie T2, Burchess Hill T2.
- Attachment F: Added and removed several COMED facilities.

Revision 40 (06/01/2012):

- Annual Review
- Manual-wide, replaced 'Unit Dispatch System (UDS)' with 'Security Constrained Economic Dispatch (SCED)'
- Section 1.1, Note 2 – added more detail related to PJM and AEP coordination of AEP 138kV facility control.
- Section 1.4.2, updated to include DEOK reclosing philosophy.
- Section 2.1.1, added Note 2, 3, and 4 to reflect PJM TSS recommendation regarding determination of Load Dump Limits.
- Section 3.5.1 – Voltage Coordination – added clarity regarding coordination of capacitor operations on 230kV and above vs. 138kV and below facilities.
- Section 3.6 and 3.5.3 – High Voltage – deleted the sections in 3.6 referring to opening approved EHV facilities for voltage control and moved them to section 3.5.3. Also updated and expanded upon the facilities to open.
- Section 3.7 – BES Capacitor Operation – removed language for consistency.
- Section 3.8 – Added 138 kV lines to interface description.
- Section 3.9 Exhibit 5 – added 69 kV voltage limits for PL.
- Section 4.2.1 – Outage Scheduling Requirements – Included 30 day outage duration requirement in table and made changes for clarity.
- Section 4.2.9.1 – Direct Billing – added section to outline process for T.O. to request the ability to pay for late outage rather than have outage denied by PJM.
- Section 5-Voltage Control at Nuclear Station-Updated the high voltage limits at N. Anna & Surry stations

- Section 5-Voltage Control at Nuclear Station-Updated voltage drop limits at Peach Bottom
- Section 5: PJM RTO Operating Procedures – Updated nuclear facility voltage limits.
- Section 5 – Updated Carlls Corner SPS rating from 54 to 56 MVA.
- Section 5 – CE Operating Procedures – removed PJM Actions from 138kV Phase Shifting Transformer Ops (SPOG 3-22). Three shift dispatcher communications are not required since telemetry exists.
- Section 5 – CE Operating Procedures – Updated Zion Generating Stability Trip Scheme (SPOG 1-3-K) to reference Unit 12 and removal of fiber communication.
- Section 5 – CE Operating Procedures – Added directional relay ratings for Mazon, Crescent Ridge, and Powerton Jct.
- Section 5 – Deleted Whitpain 500-1 or 500-2 Transformer Outages section from PECO Operating Procedures, due to Whitpain 500 kV bus reconfiguration.
- Section 5 – Updated Powerton/Joliet Trip Scheme [SPS].
- Section 5 – DEOK Operating Procedures – Updated Breaker Derate Table for Foster-Sugar Creek, Foster-Pierce and Miami Fort-West Milton Lines.
- Section 5 – APS Operating Procedures – Updated Breaker Derate Table, as a result of new APS rating methodology.
- Section 5 – Revised language for the 5043 and 5044 (Alburtis-Wescosville-Susquehanna) Transfer Trip Scheme [SPS].
- Section 5 – GPU Operating Procedures – Revised Yards Creek 230 kV Relay (Pumping) [SPS] ratings from old values of 1158 MVA (Winter) / 1068 MVA (Summer) to new values of 1195 MVA (Winter) / 1147 MVA (Summer).
- Section 5 – Deleted Sunbury normal condition ratings from chart.
- Section 5 – Added Sunbury Transformer 22 & 23 operating restrictions.
- Section 5 – Added West Shore Special Protection Scheme in PP&L zone.
- Section 5 – Updated Bath County Stability Restrictions. Multiple changes to number of units allowed to pump/generate. Added 2 contingencies to list (Greenland Gap-Meadowbrook and Loudoun-Pleasant View 500kV; Lexington-Dooms and Loudoun-Pleasant View 500kV). Removed Bath-Lexington and Mt Storm 500kV Bus #1 or Bus #2 contingency.

- Section 5 – Added breaker derate table for Wagner-Lipins Corner 110534 115kV. Updated breaker names to reflect Wagner terminal for Pumphrey-Wagner 110532 115kV breaker derate table.
- Section 5 – Replaced Tables in the Rockport operating guide section and added Communication protocol and additional details for alarming EUT SPS to match AEP's version 7 of the Rockport Operating Guide.
- Section 5: AEP Operating Procedures – Updated MISO Standing Op Guide Reference for the Twin Branch-Argenta procedure
- Section 5 - Update to Kammer Operating Procedures and change in how PJM recognizes Kammer post-contingency switching.
- Section 5 – Revised Seneca Stability limits in FE zone, due to Forest Glade Tap reconfiguration.
- Section 5 – Added 'DCTL Contingencies Associated with Susquehanna-Roseland Delay' section to both PS and PPL procedures.
- Section 5 – Updated PEPCO common trench cable ratings and added Benning – Ritchie 23003 & 23004 to the table of common trench cable ratings.
- Section 5 – Updated DLCO common trench cable rating for the Arsenal – Brunot Island 345 kV circuits 305 and 306.
- Attachment A: SPS Listing – added West Shore to list.
- Attachment A – Added Powerton/Joliet Trip Scheme to SPS list.
- Attachment B – Updated Open Circuit Terminal Voltage Control, due to construction of the TRAIL project, Suffolk substation, Cranberry substation, and Centerpoint substation.
- Attachment D – Post-Contingency Congestion Management Constraints – Removed Dupont-Seaford, Cheswold-Kent, Wye Mills xfmr, Hallwood-Oak Hall due to upgrades making previous ratings obsolete.
- Attachment E - Removed Harwood #4 from sectionalizing scheme list due to retirement.
- Attachment E - Addition of two new sectionalizing schemes at Cabot station, due to installation of new #3 500/138 kV transformer.
- Attachment E - Addition of new Collins-Middletwon Junction 115 kV Sectionalizing scheme.
- Attachment E – Deletion of the East Towanda #4 230/115 kV sectionalizing scheme, due to upgrades at East Towanda station.
- Attachment E - Addition of Midlothian – North Anna 500kV line sectionalizing scheme

- Attachment E - Addition of Pleasant View – Loudoun 500kV line sectionalizing scheme
- Attachment E: Removed “S Canton – S.E. Canton 345kV Sectionalized”
- Attachment E: Removed “Twin Branch 345/138 kV T-6 Sectionalized”
- Attachment E: Added West Millersport 345/138 kV T-2 Sectionalized
- Attachment E: Added Kammer 345/138 kV T300 Sectionalized
- Attachment E: Added Kammer 345/138 kV Transformer 100A/100B Sectionalized
- Attachment E: Added East Lima-Southwest Lima 345 kV Sectionalized
- Attachment E: Added East Lima-Maddox Creek 345 kV Sectionalized
- Attachment E: Added East Danville T4 Sectionalized
- Attachment E: Added East Danville T5 Sectionalized
- Attachment E: Added East Danville-East Monument 138 kV Sectionalized
- Attachment E: Added Jackson Road-Twin Branch 345 kV Sectionalized
- Attachment E: Revised West Millersport 345/138 kV T-1
- Attachment E: Revised Canton Central-SE Canton 345 kV
- Attachment E: Revised Maliszewski 765/138 kV T-1
- Attachment E: Revised Kirk 345/138 kV T4
- Attachment E: Revised South Berwick 345/69 kV T-1
- Attachment E: Revised Jefferson 765/345 kV T-1
- Attachment E: Revised Tanners Creek 345/138 kV T-A/B
- Attachment E: Revised Desoto 345/138 kV T-1
- Attachment E: Revised Sorenson 345/138 kV T-1
- Attachment E: Revised Sorenson 345/138 kV T-2
- Attachment E: Revised Cook-East Elkhart 345 kV
- Attachment E: Revised East Elkhart-Hiple 345 kV
- Attachment E: Revised Benton Harbor-Palisades 345 kV
- Attachment E: Revised Cook-Jackson Road 345 kV

Revision 39 (11/16/2011):

- Section 1.3 – Changed to notify PJM within 15 minutes when TO analysis package is unavailable.
- Section 2.1.1 – Included language to clarify use of LTE and STE ratings consistent with M-3A, section 3.3.
- Section 2.1.3 – Modified Exhibit 1 to replace LTE/STE with Emergency Rating, modified Note 2 to describe use of STE by exception and eliminated Note 3.
- Section 3.3.3 – Modify language to better align with M14D.
- Section 3.9 – Added entries for DEOK for upcoming integration, effective 1/1/2012 with in Exhibit 5: Bus and Zone Specific Variations to PJM Base Line Voltage Limits to appropriate voltage limits.
- Section 5 – Updated PJM/NYISO PAR Operation section. Also eliminated Attachment A dealing with Waldwick area ratings.
- Section 5 – Removed Operating Procedure for Controlling the Doubs 500/230 kV Transformer Loadings for the Allegheny Power Transmission Zone and applicable index tables.
- Section 5 – Added DEOK Transmission Zone section within the Operating Procedures with an Effective Date of the PJM-DEOK Integration, 1/1/2012. Added to all applicable index tables.
- Section 5 – Added Dimmick-Port Union, Red Bank and Todd Hunter Switching, and Breaker Derate Table within the Operating Procedures for the DEOK Transmission Zone and applicable index tables.
- Section 5 – Revised the Common Trench Cable Ratings within the Operating Procedures for the DLCO Transmission Zone.
- Section 5 – Delete the Seneca Generation For FE/PJM Constrains section within the Operating Procedures for the First Energy Transmission Zone, due to ATSI integration.
- Section 5 – Homer City Stability Limits – Changed Homer City #1 and #2 Transformer references to Homer City North Auto and South Auto Transformer, respectively.
- Section 5 – Revised North Anna nuclear station voltage limits in Nuclear Voltage Limits table to appropriate voltage limits under Voltage Control at Nuclear Station section.
- Section 5 – Added Brandon Shores – Riverside SPS [SPS] for the BC Transmission Zone
- Section 5 – Updated to classify different temperature settings as part of the overall SPS at Carolina line 22 and 54 within the Operating Procedures for the DVP Transmission Zone.

- Section 5 – Revised the Common Trench Cable Ratings within the Operating Procedures for the PEPCO Transmission Zone.
- Section 5 – Powerton/Joliet Trip Scheme: added new scheme
- Section 5 – Revised Dresden Nuclear Voltage limits and communication of LTC change protocol.
- Section 5 – SPOG 2-41: Renamed Grand Ridge from SPS to Load Rejection Scheme
- Section 5 – SPOG 1-3-A: Updated current guidelines
- Section 5 – SPOGs 1-3-B, SPOG 1-3-B-1: Updated scenarios for Powerton trip and additional guidance for high Top Crop WF output during outage of L0302 & L93505
- Section 5 – SPOG 1-3-J: Added Multi-phase fault unit trip scheme for stability
- Section 5 – SPOG 2-29: Corrected bus-tie name
- Section 5 – SPOG 2-39: Minor clarifications
- Section 5 – SPOG 3-27: Added additional detail
- Section 5 – SPOG 3-31: Added additional detail
- Section 5 – SPOG 3-32: Contingency triggering SPS revised. Additional detail added
- Section 5 – Updated contingency name for “Operation of 23030 Tie at Mountain” Procedure
- Attachment A – Waldwick Microprocessor rating operations updated under section 5. This Attachment is obsolete. Replaced with SPS Listing.
- Attachment A – updated Planebrook title and description.
- Attachment E – Added Automatic Sectionalizing Schemes for the DEOK Transmission Zone for upcoming integration, effective 1/1/2012.
- Attachment E – Revised Burches Hill Automatic Sectionalizing Schemes for the PEPCO Transmission Zone due to upgrades
- Attachment E – Corrected the title of Benning 230/69kV T9 Sectionalized for the PEPCO Transmission Zone
- Added new Attachment F – STE ratings by zone.
- Section 5 – Updated AEP Smith Mountain 138 kV Station Stability Limits

Revision 38 (04/27/2011):

Throughout – Formatting changes to tables to meet with current PJM style set.

Throughout – Replaced references to "Conectiv" with "PHI – Pepco Holdings, Inc." or "AE-PHI" where appropriate.

Throughout – Replaced references to "Orange" with "Maliszewski" wherever the reference was to the former "Orange" 765/138kV substation within AEP.

Section 1.3 – Note added regarding TO requirements for real-time network analysis within *Transmission Operations Guidelines*.

Section 2.1 – Revised wording for *Note1* from "may operator" to "may operate" within *Thermal Operating Criteria* section.

Section 2, end – Revised wording for Exhibit 1 *PJM Actual Overload Thermal Operating Policy* table from a Guideline to a Policy and revised text within said table to correspond with *Load Shed Determination Procedure*.

Section 3.2 – Revised section title from *Voltage Operating Criteria & Guidelines* to *Voltage Operating Criteria & Policy* and relevant wording within section from "Guideline" to "Policy".

Section 3.3.3 – Clarified the Voltage *Schedule* and *Bandwidth* rows as being 'kV' values within the *Generator Voltage Schedules* table.

Section 3.8 – Reformatted the Interface line definitions for clarity within the *Transfer Limits* section. Added the future Mt Storm – Meadowbrook 500kV line to the AP South definition, and added the CLVLND reactive interface both with an effective date of 6/1/2011.

Section 3.9 – Revised UGI's 69kV voltage limits within *Exhibit 5: Bus and Zone Specific Variations to PJM Base Line Voltage Limits* to appropriate voltage limits for their 66kV network. Added entries for ATSI and CPP for upcoming integration, effective 6/1/2011.

Section 4.2 – Inserted subsection *4.2.6 Peak Period Outage Scheduling Guidelines*. To accommodate, former subsections 4.2.6 through 4.2.12 all advanced by one and are now 4.2.7 through 4.2.13.

Section 4.2.9 – Revised wording from ' … may loose its priority … ' to 'may lose its priority' within the *Rescheduling Outages* subsection.

Section 4.5 – Updated the *Transmission Outage Acceleration Process* to provide clarifications, aligning manual with tariff language.

Section 5 – Revised all Single Breaker Derate tables to utilize standardized 'NL', 'EM', 'LT', 'ST' and/or 'LD' limit titles where appropriate within the Operating Procedures for all Transmission Zones with applicable Single Breaker Derate tables.

Section 5 – Added *Load Shed Determination Procedure* and *Load Shed Directive* within the Operating Procedures for the PJM RTO and applicable index tables.

Section 5 – Corrected wording in reference to the "J" and "K" lines in the *PSEG/ConEd Wheel* within the Operating Procedure for the PJM RTO.

Section 5 – Revised NL & EL voltage limits for the Dresden units 2 & 3 in *Voltage Control at Nuclear Stations* within the Operating Procedures for the PJM RTO. Added Davis-Besse and Perry in same section effective upon ATSI integration, 6/1/2011.

Section 5 – Added a *Directional Ratings* procedure within the Operating Procedures for the AE Transmission Zone and applicable index tables.

Section 5 – Added *AEP Single Breaker Derates* within the Operating Procedures for the AEP Transmission Zone and applicable index tables.

Section 5 – Updated the *Smith Mountain 138kV Station Stability* procedure within the Operating Procedures for the AEP Transmission Zone.

Section 5 – Updated to classify Fast Valving and Emergency Unit Tripping as part of the overall SPS at Rockport in the *Rockport Operating Guide* within the Operating Procedures for the AEP Transmission Zone.

Section 5 – Revised the *Twin Branch – Argenta (Conservative Operations)* procedure to clearly identify the potential IROL limits within the Operating Procedures for the AEP Transmission Zone.

Section 5 – Renamed/Revised the *Pleasants and Oak Grove Operating Restrictions* to the *Belmont SPS* within the Operating Procedures for the AP Transmission Zone and applicable index tables to reflect the redundancy added to the preexisting relay scheme.

Section 5 – Added *Bus Voltage Exceptions* within the Operating Procedures for the AP Transmission Zone and applicable index tables.

Section 5 – Added/Revised rating sets for Bedington, Belmont, Black Oak, Cabot, Doubs, Ft Martin, Harrison, Hatfield, Meadowbrook, Pruntytown, South Bend, Wylie Ridge & Yukon 500kV CBs in the *Breaker Derate Table* within the Operating Procedures for the AP Transmission Zone.

Section 5 – Revised the ratings with one breaker in service for the Waugh Chapel – Calvert Cliffs '5052' 500kV line in the *Breaker Derate Table* within the Operating Procedures for the BC Transmission Zone.

Section 5 – Added a DPL Transmission Zone section within the Operating Procedures and applicable index tables.

Section 5 – Added a *Directional Ratings* procedure within the Operating Procedures for the DPL Transmission Zone and applicable index tables.

Section 5 – Added Note, explaining limitation of one pump per GSU for a duel pump trip, to *Bath County SPS* procedure within the Operating Procedures for the DOM Transmission Zone.

Section 5 – Added an FE-ATSI Transmission Zone section within the Operating Procedures with an Effective Date of the PJM-ATSI/CPP Integration, 6/1/2011. Added to all applicable index tables.

Section 5 – Added *Mansfield Unit Stability Restrictions* and *Richland Substation SPS* within the Operating Procedures for the FE-ATSI Transmission Zone and applicable index tables.

Section 5 – Removed *TMI Voltage Notification Procedures*, as the limits for 1 Auxiliary Transformer and 2 Auxiliary Transformers are now the same, within the Operating Procedures for the FE Transmission Zone and applicable index tables.

Comment [h1]: The tables (PJM RTO & FE) need reformatting as a result.

Section 5 – Renamed/Reordered Operating Procedures and associated index tables for FE Transmission Zones.

Section 5 – Added the *Homer City Stability Limits* within the Operating Procedures for the FE Transmission Zone and applicable index tables.

Section 5 – Revised the table and procedure based upon most recent study results in the *Conemaugh/Hunterstown Stability Limits* within the Operating Procedures for the FE Transmission Zone.

Section 5 – Revised wording from "500 Conemaugh – Keystone 500kV line" to "5003 Conemaugh – Keystone 500kV line" in the *Conemaugh #2 Stability Trip* within the Operating Procedures for the FE Transmission Zone.

Section 5 – Clarified control modes for the 138kV Capacitor Banks for the *Elmhurst SVC* within the Operating Procedures for the ComEd Transmission Zone.

Section 5 – Removed reference to retired SPOGs 1-3-I-1 and 1-8 within the Operating Procedures for the ComEd Transmission Zone.

Section 5 – Removed reference to retired SPOG 1-3-C-1 from *Quad Cities and Cordova Stability Limitations [SPS]* within the Operating Procedures for the ComEd Transmission Zone.

Section 5 – Removed retired SPOG 3-21 *107_Dixon 'L15621' 138 kV CB Operation* within the Operating Procedures for the ComEd Transmission Zone and applicable index tables.

Comment [h2]: Remove from Index tables for ComEd & PJM RTO.

Section 5 – Added *Wolfs TR81 [SPS]* within the Operating Procedures for the ComEd Transmission Zone and applicable index tables.

Section 5 – Revised and renamed the former *Sandwich 138kV Bus Tie Circuit Breaker [SPS]* to *Wolfs Crossing-Sandwich 138kV 14302 line [SPS]* due to changes associated with the SPS and the applicable ComEd SPOG 3-31 within the Operating Procedures for the ComEd Transmission Zone and applicable index tables.

Section 5 – Added *Electric Junction – North Aurora 138kV 11106 line [SPS]* due to changes associated with SPOG 3-27 within the Operating Procedures for the ComEd Transmission Zone and applicable index tables.

Section 5 – Added *Highland Park Transfer Trip [SPS]* within the Operating Procedures for the ComEd Transmission Zone and applicable index tables.

Section 5 – Added *Zion Generation Stability Trip [SPS]* within the Operating Procedures for the ComEd Transmission Zone and applicable index tables.

Section 5 – Added *Camp Grove Islanding* within the Operating Procedures for the ComEd Transmission Zone and applicable index tables.

Section 5 – Removed the *Elrama 138/69kV Auto Transformer Operation* procedure within the Operating Procedures for the DLCO Transmission Zone and applicable index tables due to transformer replacement.

Section 5 – Revised the *Common Trench Cable Ratings* within the Operating Procedures for the PEPCO Transmission Zone.

Section 5 – Revised status to normally 'Disabled; And, Enabled as needed' for the *Peach Bottom '45' 500kV CB SPS* and the *Peach Bottom '35' 500kV CB SPS* within the Operating Procedures for the PE Transmission Zone.

Comment [h3]: Tables may require reformatting as a result.

Section 5 – Removed 2 lines pertaining to North & South bus outage restrictions and applicable Note from the *Montour Stability Restrictions* within the Operating Procedures for the PL Transmission Zone.

Section 5 – Removed the *Hosensack – Buxmont 230kV Line Contingency* procedure within the Operating Procedures for the PL Transmission Zone and applicable index tables as the scheme is no longer required and has been disabled.

Section 5 – Associated the *PSE&G Artificial Island Stability* procedure with the *A.I. (Salem) Cross Trip Scheme* and designated it as an [SPS] within the Operating Procedures for the PS Transmission Zone.

Section 5 – Removed the 500kV '3-4' & '4-4A' CBs @ Branchburg, the New Freedom 500kV '2-6', '2-8' & '9-10' CB, the 138kV '4-5' & '5-6' CB @ Trenton and the 230kV '1-5' & '5-6' CBs @ Linden; Added the 500kV '2-6' & '5-6' CBs @ Deans; Revised the 500kV '1-3' CB @ Hope Creek; All within the *Breaker Derate Table* for the PS Transmission Zone.

Section 5 – Revised to reflect area upgrades the *Operation of 23030 Tie at Mountain* and *UGI/PL 66kV Tie Line Operation* procedures within the Operating Procedures for the UGI Transmission Zone. Removed the *Hunlock Outlet Overloads* procedure from same.

Comment [h4]: Tables may require reformatting as a result.

Section 5 – Properly identified the *Clover Generation Shed Scheme* as an "[SPS]" within the Operating Procedures for the VP Transmission Zone.

Attachment B – *Open Circuit Terminal Voltage Control* table updated to reflect present PJM EHV lines.

Attachment E – Added Automatic Sectionalizing Schemes for the PPL & UGI Transmission Zone which are effective as of March 1, 2011. Removed three Automatic Sectionalizing Schemes related to the Matt Funk 345kV for the AEP Transmission Zone due to upgrades .

Exhibits – Added wording to indicate the Juniata PLC trip for high voltage is currently off within *Exhibit 4: Capacitor Installations with PLCs*.

Revision 37 (06/18/2010):

- Annual Review
- Section 3.5 – Clarified verbiage with regard to the section pertaining to Voltage Coordination.

- Section 5 – Formatting, corrections and additions where appropriate within Index Tables.
- Section 5 – Clear designation via '[SPS]' denotation of Special Protection Schemes within PJM.
- Section 5 – Revised naming of First Energy East Tie Lines (aka, PJM/AP Tie Lines via First Energy) operating procedure to FE East/AP Tie Lines throughout Operating Procedures.
- Section 5 – Removed separate Voltage Setpoints based upon LTC's being in Auto or Manual mode for Dresden Nuclear Voltage Limits. Added distinct Voltage Drop %'s and Limits for Susquehanna when only one start-up transformer is in service or when both are in service. Added 138kV Voltage limits for Beaver Valley #1 & #2. All within the Voltage Control at Nuclear Stations section of Operating Procedures for PJM RTO.
- Section 5 – Retired the Deptford 230kV Breaker Relay within the Operating Procedures for AE Transmission Zone due to system upgrades.
- Section 5 – Additional Regional Procedures revision within the Operating Procedures for the AEP Transmission Zone. Indicate that opening the 138kV 'B' CB at Hinton is an accepted practice for alleviating loading on Kanawha River – Bradley 138kV lines. Indicate that opening the Layman 138kV CB at Corner is an accepted practice for alleviating loading on the Muskingum River – Wolf Creek – Corner 138kV line.
- Section 5 – Updated Kammer Operating Procedures to reflect current revision (rev. 5) of AEP's Kammer Operating Procedures within the Operating Procedures for the AEP Transmission Zone.
- Section 5 – Revised Rockport Operating Guide, including the removal of references to the Rapid Unit Runback procedure, to correlate with AEP's Revision 5 of the Rockport Operating Guidelines within the Operating Procedures for the AEP Transmission Zone.
- Section 5 -- Nottingham - Cooper 230 kV Line Limitations. Due to relay changes, revised "does not" to "will" in regard to contingency changes at Conowingo upon opening Bus Tie CB within the Operating Procedures for the BC Transmission Zone.
- Section 5 – Clarified applicable circuit breakers in the Single Breaker Derate section for the BC Transmission Zone.
- Section 5 – Equipment associated with cancelled ComEd SPOG 2-19 were removed from the Normally Opened Circuit Breaker Table within the Operating Procedures for the ComEd Transmission Zone.

- Section 5 – Added Islanding Prevention Scheme for TSS 941 Grand Ridge Generation within the Operating Procedures for the ComEd Transmission Zone.
- Section 5 – Added procedure for Davis Creek 345kV Bus Tie 2-3 Auto-Closing [SPS] within the Operating Procedures for ComEd Transmission Zone.
- Section 5 – Added procedure for the Dresden Unit 2 Trip Scheme [SPS] within the Operating Procedures for ComEd Transmission Zone.
- Section 5 – Added language regarding to MISO notification to the Quad City/Cordova Stability Procedure within the Operating Procedures for ComEd Transmission Zone.
- Section 5 – Added Marsh Run and Remington CT Stability Restrictions to Operating Procedures for DVP Transmission Zone and associated index tables.
- Section 5 – Changed name from 'Bath County Contingency Restrictions' to 'Bath County Stability Restrictions'. Changed type from Contingency to Stability. Added reference to Fluvanna where Cunningham generation was noted. All in the Bath County Stability Restrictions section within the Operating Procedures for the DVP Transmission Zone.
- Section 5 – Clarified line/cb labeling and tripping sequence of the Virginia Beach SPS within the Operating Procedures for DVP Transmission Zone.
- Section 5 – Clarified line/cb labeling and tripping sequence of the Harmony Village SPS within the Operating Procedures for DVP Transmission Zone.
- Section 5 – Clarified line labeling and tripping sequence of the Carolina Substation 22 Line SPS within the Operating Procedures for DVP Transmission Zone.
- Section 5 – Clarified line labeling and tripping sequence of the Carolina Substation 54 Line SPS within the Operating Procedures for DVP Transmission Zone.
- Section 5 – Added Mt Storm Single Breaker Derates within the Operating Procedures for the DVP Transmission Zone.
- Section 5 – Added Crescent TR1 345/138kV Autotransformer Relief Procedure within the Operating Procedures for the DLCO Transmission Zone.
- Section 5 – Added DLCO Single Breaker Derates to Operating Procedures for DLCO Transmission Zone.

- Section 5 – Removed ratings table for Erie West #1 345/115kV Xfrmr in the Seneca Pump Operations section within the Operating Procedures for FE Transmission Zone.
- Section 5 – Corrected line voltage for the Erie South – Warren 230kV line within the Seneca Stability Procedures of the Operating Procedures for FE Transmission Zone. Previously designated as a 345kV line.
- Section 5 – Added Muddy Run Restrictions within the Operating Procedures for the PECO Transmission Zone.
- Section 5 – Revised naming of 'Nottingham – Graceton 230kV Line Limitations' to 'Nottingham – Cooper 230kV Line Limitations' due to addition of Cooper Substation within the Operating Procedures for the PECO Transmission Zone. For any reference to the '220-08' 230kV line, replaced any reference to "Graceton" with "Cooper" due to substation addition along that path within the PECO Transmission Zone.
- Section 5 – Steel City – Hosensack 500kV Line Reclosing Limitation. Clarified description of reclosing limitation and associated procedure within the Operating Procedures for the PPL Transmission Zone.
- Section 5 – Added Montour Stability Restrictions within the Operating Procedures for the PPL Transmission Zone.
- Section 5 – Removed 500kV CB Derate for the '5020' 500kV line CB Derate Table due to breaker replacement within the Operating Procedures for PSE&G Transmission Zone. Removed the 500kV CB Derate for the New Freedom '7-8' 500kV CB due to breaker replacement within same procedure.
- Section 5 – Removed section pertaining to Deans Single Breaker Derates on the Breaker Derate Table within the Operating Procedures for PSE&G Transmission Zone.
- Section 5 – Revised the Closing Normally Open Breakers section within the Operating Procedures for PSE&G Transmission Zone. Removed reference to Athenia 138kV bus due to breaker replacements the Athenia 138kV bus is now solid. Revised the Linden section due to breaker replacements on the Linden 138kV bus.
- Section 5 – Revised Single Breaker Derate Table within the Operating Procedures for APS Transmission Zone. Added ratings for North Longview substation. Corrected ratings for the Cabot 'CL6' 500kV CB. Revised Ft Martin section to reflect system upgrages.
- Section 5 – Revised name of Pleasants and Willow Island Operating Restrictions within the Operating Procedures for the APS Transmission Zone to Pleasants and Oak Grove Operating

Restrictions as it pertains to schemes to trip Pleasants and Oak Grove units. Clarified output restrictions, arming conditions, contingency control and Oak Grove circuit breakers

- Section 5 – Added Black Oak 500/138kV Transformer SPS within the Operating Procedures for the APS Transmission Zone.
- Section 5 – Added 'Note1' and 'Note2' box to the MISO Safe Operating Mode Procedure within the Operating Procedures for the MISO.
- Attachment D – Removed Yorkana #1 & #4 230/115kV transformers l/o Jackson-Yorkana 230kV line and Yorkana #3 230/115kV transformer from Congestion Management Program due to substation upgrades at Yorkana in the ME Transmission Zone.
- Attachment E – Added Automatic Sectionalizing Schemes at Burches Hill, Bowie & Benning for the PEPCO Transmission Zone and are effective as of August 1, 2010.
- Attachment E – Added Automatic Sectionalizing Schemes at Bristers, Suffolk, Surry, Morrisville & Valley for the DVP Transmission Zone and are effective as of June 1, 2010.
- Attachment E – Corrected numbering within the APS Transmission Zone.

Revision 36 (01/01/2010):

Section 2.1: Thermal Operating Guidelines: Provided clarity regarding operator timeline to control thermal overloads.

Section 3.2 Voltage Operating Criteria and Guidelines: Provided clarity on controlling simulate post-contingency high voltage limit violations.

Section 3.7: Bulk Electric System Capacitor/SVC Operations: Updated table of AP 500kV relay automatic trip settings.

Section 4.2: Scheduling Transmission Outage Requirements: Provided clarity on TO/GO reporting requirements for protective relay outages/failures.

Section 5: Index of Operating Procedures for PJM RTO Operations: Updated Voltage Control at Nuclear Station limits for Peach Bottom Station.

Section 5: Index of Operating Procedures for AE Transmission Zone: Added Logan Runback Special Protection Scheme.

Section5: Index of Operating Procedures for First Energy Transmission Zone: Updated Keystone-Conemaugh 5003 Line / Re-Close Procedure.

Section 5: Index of Operating Procedures for PECO Transmission Zone: Modified Peach Bottom Xfmr, Peach Bottom #35, and Peach Bottom #45 SPS.

Section5: Index of Operating Procedures for BGE Transmission Zone: Deleted switching procedure to control Conastone Xfmr due to increased ratings resulting from transformer replacement. Updated Breaker Derate Table.

Section 5: Index of Operating Procedures for PPL Transmission Zone: Updated Sunbury 500/230kV Xmfr rating with 1 CB out-of-service.

Section 5: Index of Operating Procedures for ComEd Transmission Zone: Updated Powerton Stability Limit (ComEd SPOG 1-3-B, 1-3-B-1) and Quad City/Cordova Stability Limit Procedure (ComEd SPOG 1-3-C, 1-3-C-1, 1-3-G).

Section 5: Index of Operating Procedures for PSE&G Transmission Zone: Inserted Breaker Derate Table. Updated Closing Normally Open Breakers (Bus Sections) to remove Roseland, Marion and Metuchen as a result of CB replacements.

Attachment E: Automatic Sectionalizing Schemes: Added FE-E (PN) and Dayton Auto sectionalizing Schemes effective 2/1/10 and 3/1/10.

Revision 35 (10/05/2009):

- Section 5 – Voltage Control at Nuclear Stations: Updated TMI voltage limits.
- Section 5 – Index of Operating Procedures for Baltimore Gas and Electric (BGE) Transmission Zone: Updated Single Breaker/Double Breaker Ratings limitations table to include Conastone 500-3 transformer
- Section 5 – Index of Operating Procedures for First Energy Transmission Zone: Updated 5003 Reclosing procedure to include studying of Keystone/Conemaugh generation redispatch to reduce phase angle to 10 degrees.
- Section 5 – Index of Operating Procedure for Commonwealth Edison (ComEd) Transmission Zone: Added SPOG 4-30, Transformer Operations at 138 kV Tie Line Breaker Substations. Updated Byron SPOG
- Section 5 – Index of Operating Procedures for PECO Transmission Zone: Changed wording to Phillips Island in Linwood Special Protection Scheme
- Section 5 – Index of Operating Procedures for FE Transmission Zone: Updated Seneca Pump Operations procedure, updates include renaming of FERD to FE TSO and correction to second pump operation
- Section 5 – Index of Operating Procedures for American Electric Power (AEP) Transmission Zone: Updated Rockport Operating Guide to include Special Protection Scheme (SPS) and section for Carrier Communication Failure. Renamed Section for Single Phase

Operation to (SPO). Updated Conesville 345kV Plant Operating Guidelines based on installation of 345/138kV autotransformer T-7.

- Attachment E: Automatic Sectionalizing Schemes: Included Belmont, Bedington, Cabot, Yukon and Wylie schemes that were left out of Attachment E in error. PJM has been operating to AP automatic sectionalizing schemes since the 2002 AP integration.

Revision 34 (5/22/2009)

- Annual Review
- Modified to change thermal constraint control 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.
- Section 3.7 - Bulk Electric System Capacitor/SVC Operation: Included operations of Elroy 500kV Capacitors (600 MVAR total).
- Section4 – Reportable Transmission Facility Outages: Eliminated use of “working” and “business” days to provide clarity and consistency to documentation of outage approval process.
- Section 5 – Index of Operating Procedure for Commonwealth Edison (ComEd) Transmission Zone: Updated Kincaid Stability Trip Scheme section.
- Updated Powerton Stability Limitations section
- Updated Byron and Lee County Operating Guides section
- Updated Quad Cities and Cordova Stability Limitations section
- Updated Normally Open Bus Tie Circuit Breakers section
- Updated Burnham – Taylor (L17723) 345 kV line Operation section
- Updated 107 Dixon ‘L15621’ 138 kV CB Operation section
- Added Sandwich Bus Tie Operation section
- Section 5 – Index of Operating Procedures for Potomac Electric Company (PEPCO) Transmission Zone: Added Potomac River Operating Procedure for Overdutied Circuit Breakers Potomac River Operations as part of existing Potomac River Station Operation during Abnormal Conditions, Island Operations, Restoration and Resynchronization procedures.
- Section 5 – Index of Operating Procedures for PECO Transmission Zone: Renamed Muddy Run Protective Relay to Peach Bottom 1 Transformer Operation

- Section 5 – Index of Operating Procedure for Public Service Electric & Gas Company (PSE&G) Transmission Zone: Updated section entitled "Closing Normally Open Breakers (Bus Sections).
- Section 5 – Index of Operating Procedures for American Electric Power (AEP) Transmission Zone: Updated Rockport Special Controls - removed Rapid Unit Runback
- Section 5 – Index of Operating Procedures for Baltimore Gas and Electric (BGE) Transmission Zone:
- Added Cross Town, Cross Harbor Cable Circuit Ratings Changes section
- Updated BGE Single Breaker/Double Breaker Ratings section
- Section 5 – Index of Operating Procedures for Duquesne Light Company (DLCO) Transmission Zone:
- Removed Procedure to relieve loading on Z-87 and Z-88 lines
- Section 5 – Index of Operating Procedures for Dominion Virginia Power (DVP) Transmission Zone – Updated Bath County Contingency Restrictions
- Section 5 – Index of Operating Procedures for Dominion Virginia Power (DVP) Transmission Zone: New Bath County Special Protection Scheme (SPS)
- Section 5 - Index of Operating Procedures for ISO New England (ISO-NE) Balancing Authority: Modified ISO-NE contingency set.
- Section 5 – Index of Operating Procedures for Midwest Independent System Operator (MISO): Modified PJM and MISO Manual Shadow Price Override Procedure.
- Attachment E: Autosectionalizing Schemes:
- Deleted Mount Storm 500kV #1 Bus Sectionalized scheme due to replacement of transformer high-side disconnect with Mt Storm RSS2.
- Deleted Cook 765/345kV transformer autosectionalizing scheme due to installation of L2 345kV CB at Cook.

Revision 33 (11/26/2008)

- Updated Section 1: Transmission Operations Requirements, clarifying AEP as registered TOP for AEP system 138kV and below.
- Updated Section 3: Generator Voltage Schedules, to provide guidance regarding actions generator should take when they are unable to meet the specified voltage schedule.

- Updated Section 5: Index of Operating Procedures for PJM RTO Operations, Voltage Control at Nuclear Stations to include Limerick Tap 69kV Power Source.
- Updated Section 5: Index of Operating Procedures for AEP to include modified Rockport schemes and removed Rockport Operations at Extended Capability section, updated Kammer Operating Procedures, and update the Gavin and Mountaineer Stability sections.
- Updated Section 5: Index of Operating Procedures for First Energy, Homer City Stability Trip Scheme and Seneca Pump Operations.
- Updated Section 5: Index of Operating Procedure for PSE&G, Artificial Island Stability procedure revised based upon new station topology.
- Updated Attachment B: Open Circuit Terminal Voltages, to reflect topology changes near Salem.
- Updated Section 5: Index of Operating Procedure for BG&G to include modified Circuit Breaker Derate table.

Revision 32 (October 3, 2008)

- Updated Section 5: Index of Operating Procedures for First Energy, TMI Voltage Notification Procedure.
- Updated Section 5: Index of Operating Procedures for New York ISO to include Ramapo PAR Operating Instructions
- Updated Attachment B to include 5021, 5038, and 5039 reconfiguration.

Revision 31 (09/15/2008)

Section 1:

- Provided clarification regarding congestion management for Monitored “Reliability and Market” versus “Reliability” Facilities.
- Deleted detailed Process to Change the PJM Congestion Management Control Facilities List, since the information is contained within Manual 3A.
- Incorporated Procedure for naming new facilities 500kV and above.

Section 3:

- Modified AP South Reactive Interface definition to include Mt. Storm – Valley 500kV line.
- Eliminated Exhibit 5.

Section 4:

- Updated section regarding rescheduling outages.
- Updated requirement to restore “automatic reclosing” to provide clarity.

Section 5:

- Update BGE Section to include Breaker Derate Table
- Updated BGE Section to include Gould Street Procedure
- Updated BGE Section to modify Conastone Xfmr Thermal Limitations procedure based on upgrade to Conastone Xfmr.
- Updated AP Section to include updated setting on Black Oak SVC.
- Updated AP Section to correct contingencies in the Pleasants and Willow Island Operating Restrictions Procedure.
- Updated AP Section to modify ratings in Breaker Derate Table.
- Updated Doubs procedure to include option to switch Dickerson – Quince Orchard (23032) below certain load levels
- Updated PPL Section to provide clarity when using adders under a multiple outage conditions.
- Updated PPL Section to include reclosing restriction on Steel City – Hosensack 500kV line.
- Updated PN Section to include Seneca Stability conditions.
- Updated PN Section to include Homer City Stability conditions.
- Updated PN Section to correct Conemaugh Stability limitations when reclosing Conemaugh – Keystone (5003) 500kV outage.
- Attachment E

- Deleted Hunterstown #4 230/115kV Sectionalized scheme due to new configuration.

Revision 30 (5/01/2008)

General:

- Annual PJM System Operations Subcommittee (Transmission) Review.
- BES Implementation

Section 1:

- BES implementation.

Section 3:

- Updated Reactive Transfer Interfaces

Section 4:

- Scheduling Transmission Outage Requests: Modified section to align tariff/manual for outage approval and outage acceleration processes.
- Provided instructions as to when “Automatic Reclosing” can remained out-of-service during multiple day “daily outages”.

Section 5:

- Automatic Sectionalizing Schemes: updated section to align with SPS notification requirements, specifically the ability to implement immediately in operations under specified conditions.
- Nuclear Voltage Control: Corrected Surry Voltage Drop Limits, included TMI and Oyster Creek.
- ComEd SPOG 1-2-E, 2-19, and 2-30 Retired
- AEP: Eliminated Galion 345kV Bypass switch procedure. Updated Kammer and Conesville procedures.
- DLCO: Added Elrama (DLCO) and Mitchell (AP) Area Operating Procedure and Elrama 138/69kV switching procedures.
- FE:
- Eliminated 5013 cross-trip relay scheme
- Combined FE subsections (JC, MetEd, and PN) into a common FE section.
- PEPCO
- Updated Potomac River Procedure based on 23108 and 23109 topology changes.
- PS:
- Modified Artificial Island cross-trip relay scheme based on commissioning of Orchard Substation and splitting of Salem – East Windsor (5021) 500kV into Salem – Orchard (5021) and Orchard – East Windsor (5038) 500kV lines.

Incorporated normally open CBs.

Revision 29 (1/18/2008)

General:

- Replaced MAAC/ECAR with RFC

Introduction:

- Added additional related manuals as references

Section 3:

- Generator Voltage Schedule: provided clarification regarding generators following PJM default voltage schedules.
- Bulk Power Capacitor/SVC Operations – provided details regarding Black Oak SVC.
- Returning EHV Lines That Were Open for Voltage Control: Added ability to use STE High Voltage Limits for switching/open-ended voltage studies.

Section 5:

Index of Operating Procedures for PJM RTO

- Added Procedure for Voltage Control at Nuclear Station

Index of Operating Procedures for ComEd

- Deleted Procedure for Voltage Control at ComEd Nuclear Stations
- Provided clarification to “Ratings associated with Cooling System Operating Modes”.
- Deleted Minnesota – Eastern Wisconsin Phase Angle Reduction (ComEd CAOP 2-16).
- Index of Operating Procedures for AP
- Added Greenland Gap to Breaker Table Derate
- Deleted Wylie Ridge Special Protection Scheme
- Added Black Oak SVC

Index for Operating Procedures for DPL(Conectiv)

- Deleted 5025 Keeney – Rock Springs
- Deleted Cecil Xfmr. Scheme
- Index for Operating Procedures for First Energy (Pennelec)
- Conemaugh Unit Stability: Added stability restriction for Hunterstown combined cycle units during an outage of the Hunterstown – Conastone (5013) 500kV line and Hunterstown 500/230kV Xfmr.

Index for Operating Procedure for PS&G

- Deleted Branchburg Special Protection Scheme (Somerville 1-2 CB)

Index of Operating Procedures for AEP

- Deleted South Canton 765/345 kV Transformer (AEP Operating Memo T-020), Conesville 138 kV Bus Configuration (AEP Operating Memo T030) and the Canton Central-Southeast Canton 138 kV line and the Harrison-Poston 138kv line procedures from the Columbus Transmission Region procedures.

Index of Operating Procedures for MISO

- Added MISO and PJM Manual Shadow Price Override Procedure

Attachment B: Updated Open Circuit Terminal Voltage Control

- Modified to include additional facilities

Attachment E: Automatic Sectionalizing Schemes

- Added list of Sectionalizing Schemes by Transmission Zone

Revision 28 (08/28/2007)

Section 3: Voltage & Stability Operating Guidelines: Added section entitled “Generator Voltage Schedules”, which defines PJM Default Generator Voltage Schedules.

Section 3: Voltage & Stability Operating Guidelines: Added bullet to Voltage Control Actions / Voltage Coordination section, which requires Generator Owners to notify PJM and Transmission Owners if Power System Stabilizer (PSS) status.

Section 5: Index & Operating Procedures for PJM RTO Operations: Added section entitled “Automatic Special Protection Scheme (SPS) Operating Criteria, explaining how PJM dispatch activates and controls for enabled SPS schemes.

Section5: Index & Operating Procedures for PJM RTO Operations: Modified Dominion - Carolina Substation 54 and 22 SPS sections to provide clarity.

Section5: Index & Operating Procedures for PJM RTO Operations: Added section entitled “Midwest ISO”, and included MISO – PJM Safe Operating Mode procedure.

Revision 27 (7/03/2007)

Section 1: Transmission Operations Requirements, Transmission Operating Guidelines: Added paragraphs providing guidelines for PJM/LCC staff to resolve modeling discrepancies.

Section 3: Voltage & Stability Operating Guidelines, Returning EHV Lines that were opened for voltage control: Added paragraph providing guidance for return EHV lines to service when open-ended voltage violations are projected during switching

Section 4: Reportable Transmission Facility Outages, Transmission Outage Acceleration Process: Multiple changes throughout section to provide increased clarity

Section 5: Index and Operating Procedures for PJM RTO Operations:

Modified Calvert Cliffs voltage limits, added Conastone Xfmr Procedure, updated ComEd Spogs (Normally Open Bus-tie Circuit Breakers, Zion TDC 282 – Lakeview (L28201) 138kV Tieline Operation, Sandwich 138kV Bus Tie 2-3 Operation, Ridgeland 138kV Bus Tie 4-14 Operation), added Neptune Regional Transmission System to FE-E_Jersey Central Section, modified PEPCO Common Trench Cable Ratings, modified communication requirements in Attachment C: Requesting Voltage Limit Exceptions to the PJM Base-Line Voltage Limits.

Revision 26 (5/24/2007)

- Changed several references to "Transmission Operator" to "Transmission Owner."
- Added a sentence in Section 5 (page 124)

Revision 25 (5/15/2007)

- Document: Updated titles to reflect NERC Functional Model terminology
- Eliminated redundancy between M01, M03 and M03a, deleting portions of Section 1: Transmission Operations Requirements, providing references where appropriate.
- Section 3:
- Updated Exhibits 3 and 6
- Modified Transfer Limit section to include additional reactive transfer limits.
- Section 5:
- Added Overuse Section (inadvertently deleted in a past update).
- Added Twin Branch – Argenta 345kV Conservative Operations section.
- Removal of Indian River 4 SPS Scheme based on Indian River 230kV reconfiguration.
- Deleted PJM/VAP Voltage Coordination Plan
- Added Dominion SPS schemes at Harmony Village, Carolina Substation 22 line, Carolina Substation 54 line, and Virginia Beach.
- Attachments:
- Eliminated Attachment B: Controlling PSE&G Con-Ed Wheel
- Eliminated Attachment D: Voltage Coordination Plan
- Retitled remaining attachments A through D.

- Modified Attachment entitled “Requesting Voltage Limit Exceptions to the PJM Base-Line Voltage Limits.
- Added post-contingency congestion management program additions which become effective June 1, 2007

Revision 24 (3/22/07)

- Section 1: Transmission Operating Guidelines – System Operating Limits

Revision 23 (03/22/2007)

- Overview: Updated titles to reflect NERC Functional Model terminology
- Section 1: Provided additional detail regarding EMS Network Applications
- Section 4: Added discussion regarding transmission line identifiers
- Section 5: Updated Calvert Cliffs kV limits
- Introduction trimmed to eliminate redundant information.
- List of PJM Manuals exhibit removed, with directions given to PJM Web site where all the manuals can be found.
- Revision History permanently moved to the end of the manual

Revision 22 (10/25/2006)

- Exhibit 1: Updated to include the new Manual 30: Alternative Collateral Program.
- Section 1: Revised PJM Procedure to Review Special Protection Systems (SPS) and moved from Section 5 to Section 1.
- Section 3: Added Interconnection Reliability Operating Limit (IROL).
    - Revised Voltage and Stability Limits chart (PECO limits corrected).
- Section 4: Revised Scheduling Transmission Outage Requests.
    - Revised table under Coordinating Outage Requests with Planned Nuclear Generation Outages.
    - Revised Processing Transmission Outage Requests.
- Section 5: Added DLCO and UGI back into full table of Index and Operating Procedures for PJM RTO Operation.
    - Added Recognition of Automatic Sectionalizing Schemes.

- Added Carlls Corner #2 CT SPS.
- Revised AEP Additional Regional Procedures.
- Added the East Frankfort TR83 345/138 kV Transformer SPS under ComEd.
- Revised the Bath County Contingency Restrictions.
- Revised Muddy Run Protective Relay.
- Revised Peach Bottom '45' 500 kV CB Outage.
- Added Peach Bottom '35' 500 kV CB Outage.
- Updated the Breaker Derate Table under Allegheny Power.

- Removed Attachment A: Definitions and Acronyms (Information available in PJM Manual 35: Definitions and Acronyms).
- Additions made to Post-Contingency Congestion Management Program Constraint List in Attachment F.

Revision 21 (3/13/06)

- Added Peach Bottom Off-Site Power Supply Voltage Limits under Section 5
- Corrected Exhibit 7: Reactive Transfer Interface Locations under Section 3

Revision 20 (02/10/06)

- Revised the Notification and Mitigation Protocols for Nuclear Plant Voltage Limits under Section 3
- Revisions on page 17
- Added the Single Breaker Failure Mitigation Procedure under Section 5
- Added the BGE/PEPCO/NOVA/Doubs Area Operating Procedure under Section 5
- Revisions were made on the following pages: 17, 39-44, 72, 77 and 82-85.

Revision 19 (02/02/06)

- Revised the Post-Contingency Congestion Management Program Constraint List under Attachment G
- Added Process for TO to Request PJM to Change constraints/facilities in the Post-Contingency Congestion Management program under Attachment G
- Revised Bath County Contingency Restrictions under Section 5
- Revised 30-Minute Rating tables under Attachment B

- Added the Transmission Outage Acceleration Process under Section 4
- Revisions were made on the following pages: 27, 29, 55, 64-67, 271-272, 282 and 284-286.

Revision 18 (12/12/05)

- Corrected Breaker Derate Table in Section 5 AP
- Corrected EHV definition in Section 1
- Added a Bath County contingency restriction under Section 5 DVP
- Added PJM Procedure to Review Special Protection Systems (SPS) under Section 5
- Edited introduction for Section 5
- Edited Reportable Transmission Facility under Section 1
- Updated Exhibit 2 in Section 1

Revision 17 (8/1/05)

- Added 500X Reactive Limit in Section 3
- Added Post-contingency Congestion Management Program document
- Added Linwood Special Protection Scheme under Section 5
- Revised Processing Transmission Outage Requests under Section 4
- Corrected PECO stability limits under Section 3
- Replaced Wylie Ridge Operating Procedure with Wylie Ridge Special Protection Scheme under Section 5
- Revised Quad City and Cordova Stability Limits under Section 5
- Added Waukegan 138 kV Bus Tie 4-14 Operation (ComEd SPOG 2-29) under Section 5
- Revised PSE&G/ConED Wheel under Section 5
- Deleted PJM/NYPP Joint Operating Procedure under Section 5
- Deleted Transmission Overuse under Section 5
- Deleted 5018 Branchburg- Ramapo Out-of-Service under Section 5
- Added Branchburg Special Protection Scheme (Bridgewater '1-2' CB) under Section 5
- Deleted Brunner Island #2 Master Fuel Trip Relay under Section 5
- Revised Powerton Stability Limitations (ComEd SPOG 1-3-B and 1-3-B-1) under Section 5

Revision 16 (5/1/05)

- Added Dominion Procedures to Section 5
- Added PJM Southern Region under Section 1 – Reclosing 500 kV Lines That Have Tripped
- Added SERC under Section 1 – Equipment Failure Procedures

Revision 15 (03/01/05)

- Deleted Sand Point Relay Procedure under Section 5 - AE
- Deleted Collins 345 kV Operating Guide under Section 5 – ComEd
- Revised Artificial Island Procedure in Section 5 – PSE&G
- Added Branchburg Special Protection Scheme in Section 5 – PSE&G
- Revised the Rockport Operating Guide under Section 5 - AEP
- Added Voltage Limit Exception Request Templates to Attachment F
- Added Reportable Facility Code Information Under Section 1 – Reportable Facilities
- Added additional comments to Real-time Switching Notifications Procedure under Section 4

Revision 14 (01/01/05)

- Added the DQE procedures to Section 5
- Added Attachment F – Requesting Voltage Limit Exceptions to the PJM Base – Line Voltage Limits
- Added Hyperlinks to all the tables in Section 5

Revision 13 (11/17/04)

- Revised Susquehanna 1 and 2 Double Contingency to clarify reporting requirements and PJM dispatch actions.

Revision 12 (10/01/04)

Added document containing the AEP procedures added to Section 5

Revision 11 (05/08/04)

Added document containing the UGI procedures added to Section 5

Revision 10 (05/01/04)

Revised to include ComEd Procedures

Added a new table reflecting ComEd's voltage exceptions

Revision 09 (01/12/04)

Section 4, "Reportable Transmission Facility Outages" on Page 54 omitted Peach Bottom Unit 3 output breaker CB65 and Limerick Unit 2 output breaker CB235. This revision corrects that omission

Revision 08 (11/17/03)

Modified Entire Document

Changed all references of PJM IA to PJM

Included guidelines on how to modify facilities in the Transmission Facilities List

Changed the central location of the Transmission Facilities List to www.pjm.com

Included both the PJM Eastern and Western philosophies on re-closing EHV lines that have tripped

Included information on how to change facility ratings

Updated list of PJM Manuals

Included charts to explain the thermal and voltage operating criteria

Added the Bedington – Black Oak and AP South interfaces to the explanation of PJM Transfer Interfaces

Added a clear explanation of the submittal requirements for transmission outages

Added all the relevant Operating Procedures of Allegheny Power into Section 5

Added and/or changed various procedures for several different Transmission Owners in Section 5

Removed Attachment B: Reportable Transmission Facilities. Changed the central location of the Transmission Facilities List to www.pjm.com

Remove Attachment E.

Revision 07 (06/01/02)

Section 3: Voltage & Stability Operating Guidelines

Added description of new procedures for reporting generating unit reactive capability via eDART.

Attachment J: PJM Generating Unit Reactive Capability Curve Specification and Reporting Procedures

Added description of new procedures for reporting generating unit reactive capability via eDART.

Revision 06 (01/24/01)

Section 1: Coordination & Direction of Transmission Operations

Added description of PJM's Real-Time Reliability Model. Removed description of Designated Transmission Facilities. Added description of PJM Transmission Facilities.

Section 2: Thermal Operating Guidelines

Revised Thermal Limit Operations. Added Thermal Operating Criteria. Relocated operating procedures to new Section 5: Operating Procedures.

Section 3: Voltage & Stability Operating Guidelines

Revised Voltage Operation and Voltage Limits. Added Voltage Operating Limits. Relocated operating procedures to new Section 5: Operating Procedures. Revised Voltage Control Actions- Low Voltage Operation and Voltage Control Actions- High Voltage Operation. Added Generating Unit Reactive Capability.

Section 4: Reportable Transmission Facility Outages

Revised this section for notifications and references to eDART.

Section 5: Operating Procedures

Added this section which contains operating procedures from sections 2 and 3. Operating procedures are identified by Transmission Zone. Removed Keeney 500/230 kV Transformer Contingency, Keeney-Basin Road 138 kV Special Purpose Relay, Burma-Piney 115 kV Relay, Balt-Wash Scheduling Import Limit, BC/PEPCO Reactive Import Limit. Revised Transmission Overuse Calculation, Muddy Run Protective Relay (Pumping/Generation Mode). Added Constraint Management Mitigation, Cedar Special Purpose Relay Scheme, Seneca Pump Operations, Procedure to Run Seneca Generation For Constraints, Potomac River Limerick Ratings 4A &4B.

Attachment B Reportable Transmission Facilities

Revised to include references to eDART. Removed multiple Exhibits which were replaced by eDART.

Attachment H: Transmission Facilities Database

Added this new section. Includes Transmission Facility List for each Transmission Zone. (This continues to be a work in progress).

Attachment I: Requesting Voltage Limit Exceptions to PJM Base-Line Limits

Added this new section to complement descriptions given in Section 3.

Attachment J: PJM Generating Unit Reactive Capability Curve Specifications and Reporting Procedures

Added this new section to complement descriptions given in Section 3.

Revision 05 (04/01/00)

Section 2: Coordination & Direction of Transmission Operations

Revised Keeney 500/230 kV Transformer Contingency, PJM Actions. Removed step 4, Maximum Scheduled Generation is loaded.

Section 3: Voltage & Stability Operating Guidelines

Revised NEPEX Emergencies. Replaced reference to Max Schedule Generation with 'highest incremental cost of generation'.

Revision 04 (08/23/99)

Section 3: Voltage & Stability Operating Guidelines

Removed "Simultaneous loss of all Hydro Quebec (HQ) HVDC interconnections linked to the HQ AC system" listed under subsection: NEPEX Contingencies.

Revision 03 (06/15/99)

Section 2: Thermal Operating Guidelines

Added contingency operations for the Doubs-Dickerson 230 kV Line.

Revision 02 (01/28/98)

Section 4: Designated Transmission Facility Outages

Changed

"The Transmission Owners have the right and obligation to maintain or repair their portion of the transmission system. PJM approves all Designated Transmission Facility outages prior to removal of the equipment from service. PJM will coordinate scheduled outages of all Designated Transmission Facilities with planned generation outages that are submitted to PJM and may affect PJM RTO operations. For purposes of scheduling, Designated Transmission Facilities include, but are not limited to, lines, transformers, phase angle regulators, buses, breakers, disconnects, Bulk Electric System capacitors, reactors, and all related equipment."

"PJM maintains a list of Designated Transmission Facilities. Each Transmission Owner submits the tentative dates of all transmission outages of Designated Transmission Facilities to PJM as far in advance as possible."

from

"The Transmission Owners have the right and obligation to maintain or repair their portion of the transmission system. The Transmission Owners rely upon PJM to coordinate scheduled outages of all Designated Transmission Facilities with planned generation outages that are submitted to PJM and may affect PJM RTO operations. For purposes of scheduling, Designated Transmission Facilities include, but are not limited to, lines, transformers, phase angle regulators, buses, breakers, disconnects, Bulk Electric System capacitors, reactors, and all related equipment."

"PJM maintains a list of Designated Transmission Facilities. Each Transmission Owner submits the tentative dates of all transmission outages of Designated Transmission Facilities to PJM as far in advance as possible. Under certain operating conditions, reportable outages are not limited to the facilities listed in the Designated Transmission Facility List (See Attachment B)."

under "General Principles."

Changed

"A planned transmission outage that is rescheduled or canceled because of inclement weather or at the direction or request of PJM retains its status and priority as a planned transmission outage with PJM approved rescheduled date. If an outage request is rescheduled or canceled for reasons other than inclement weather or at the direction of PJM, the rescheduled or canceled and resubmitted outage is treated as an unplanned outage request. PJM coordinates outage rescheduling with the PJM Members to minimize impacts on system operations."

from

"A planned transmission outage that is rescheduled or canceled because of inclement weather or at the direction or request of PJM retains its status and priority as a planned transmission outage. If an outage request is rescheduled or canceled for reasons other than inclement weather or at the direction of PJM, the rescheduled or canceled and resubmitted outage is treated as an unplanned outage request. PJM coordinates outage rescheduling with the PJM Members to minimize impacts on system operations."

under "Scheduling Transmission Outages."

Changed

"When a thermal or reactive violation is recognized to have above average impact to system operation, PJM will communicate the projected PJM RTO

impacts and offer available alternatives that reduce or eliminate the detected condition, to the affected PJM Transmission Owners. Any alternatives offered and the resultant choice will be documented by PJM. In actual operations line loading relief procedures are utilized to control Bulk Electric System transmission facility loadings and reactive constraints. The use of cost effective generation shift procedures are employed after all available zero cost options are exhausted. No outage that is determined to result in potentially unreliable operations is approved by PJM."

from

"When thermal or reactive violations are recognized, PJM communicates the projected PJM RTO impacts to the affected PJM Members. An appropriate plan to control constraints is agreed upon by affected PJM Members. Line loading relief procedures are utilized to control Bulk Electric System transmission facility loadings and reactive constraints. The use of cost effective generation shift procedures are employed after all available zero cost options are exhausted. No outage that is determined to result in potentially unreliable operations is approved by PJM."

under "Studying Projected System Conditions."

Changed

"PJM, as system conditions warrant, identifies opportunities for, and encourages, coordination of all generator and transmission maintenance outages. When actual or anticipated system conditions change such that, at the discretion of PJM, the rescheduling of a transmission outage is advisable, PJM informs the Transmission Owner of the conditions and available alternatives. The Transmission Owner involved considers the impacts of proceeding with the outage as advised by PJM and may either proceed knowing the estimated impacts on the remaining facilities or postpone the outage. If the outage is not postponed, PJM determines and records the appropriate impacts or changes to system limits and takes the steps required to maintain established operating reliability criteria as mentioned within Section 1 of this manual."

from

"PJM, as system conditions warrant, identifies opportunities for, and encourages, coordination of all generator and transmission maintenance outages. When actual or anticipated system conditions change such that, at the discretion of PJM, the rescheduling of a transmission outage is advisable, PJM informs the Transmission Owner of the conditions. The Transmission Owner involved considers the impacts of proceeding with the outage as advised by PJM and may either proceed knowing the estimated impacts on the remaining facilities or postpone the outage. If the outage is not postponed, PJM determines the appropriate impacts or changes to system limits and takes the steps required to maintain established operating reliability

criteria as mentioned within section 1 of this manual." under "Approving Transmission Outage Requests."

Revision 01 (06/13/97)

Attachment B: Reportable Transmission Facilities (Correction made 09/12/97)

Exhibit B.1: Reportable Transmission Facilities - EHV Lines

- Corrected Designations for Red Lion-Hope Creek (5015) and Keeney-Red Lion (5036)

Attachment B: Reportable Transmission Facilities

Exhibit B.1: Reportable Transmission Facilities - EHV Lines

- Added 5036 Red Lion - Hope Creek
- Added 5015 Keeney - Red Lion
- Deleted 5015 Hope Creek - Keeney

Exhibit B.2: Reportable Transmission Facilities - Transformers

- Added AT-50 Red Lion 500/230

Exhibit B.3: Reportable Transmission Facilities - Busses and Breakers

- Added Red Lion

Exhibit B.10: Reportable Transmission Facilities - AE

- Added Sands Pt - Cedar

Revision 00 (05/06/97)

This revision is the preliminary draft of the PJM Manual for ***Transmission Operations***.