Working to Perfect the Flow of Energy

PJM Manual 03:

Transmission Operations

Revision: 44

Effective Date: November 1, 2013

Prepared by:

Operations Support Division

Transmission Operations Department

PJM Manual 03:

Transmission Operations

Table of Contents

Table of Exhibits

Approval

Approval Date: 11/01/2013

Effective Date: 11/01/2013

Simon Tam, Manager

Transmission Operations

Current Revision

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.

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 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 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).

<u>Generally, the Telemetry Requirements for Congestion Management Control are:</u>

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 Planning Committee
  - PJM Operating Committee
  - PJM Market Implementation Committee
  - PJM Markets and Reliability Committee
- 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 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.

PJM's 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 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 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	30 minutes

	cascading.	

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 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 545.0kV and 550kV and 575 MVAR capacitive to hold voltages between 505kV and 510kV.

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 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 kV – 3 Sec

Black Oak 500 kV	#3 162.5 MVAR	550 kV – 10 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 • 5010 Peach Bottom – Limerick 500kV line • 5025 Rock Springs – Keeney 500kV line

Transfer Interface	Interface Definition
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 • Carlisle – Beaver 345kV line • Erie West – Ashtabula 345kV line • Ford – Beaver 138kV line • Greenfield – Beaver 138kV line • NASA – Beaver 138kV line • Henrietta – Beaver 138kV line • West Akron – Hickory 138kV line

Transfer Interface	Interface Definition
	• 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 • Oglesby – 7713 138 kV line • Edwards – 74_Kewanee 138 kV line • Marseile – 6102 138 kV line • Hennepin – 6101 138 kV line

Transfer Interface	Interface Definition
	• Lakeview – Zion 138 kV line • 1352 – Powerton 138 kV line • Albany – Garden Plain 138 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	*	*	*	*	*	*	*	*	*	*
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					**Drop** – Voltage Drop Limit			
	'*' – same as PJM criteria				'-' not applicable				**** Applicable upon Integration on 6/1/13**											

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:

Peach Bottom:	**Limerick:**
Unit 2: CB 215	Unit 1: CB 535
CB 225	CB 635
Unit 3: CB 15	Unit 2: CB 235
CB 65	CB 335
Salem:	**Oyster Creek:**
Unit 1: 1 – 5 B.S. 10X	GD1
5 – 6 B.S. 11X	GC1
Unit 2: 9 – 10 B.S. 30X	

1 – 9 B.S. 32X

Hope Creek:	**Calvert Cliffs:**
BS 6 – 5 50X	Unit 1: 552 – 22
BS 2 – 6 52X	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.

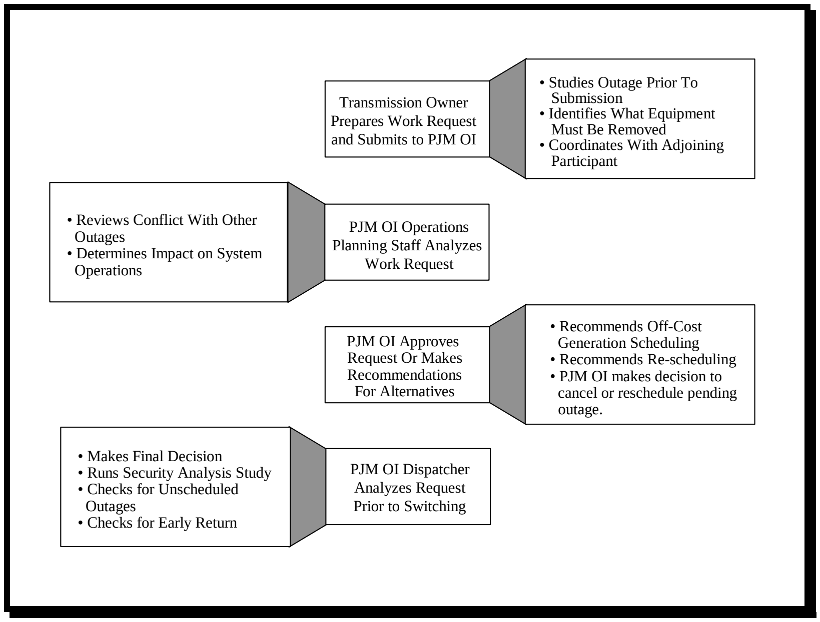


Exhibit 6: Transmission Outage Request Process

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.

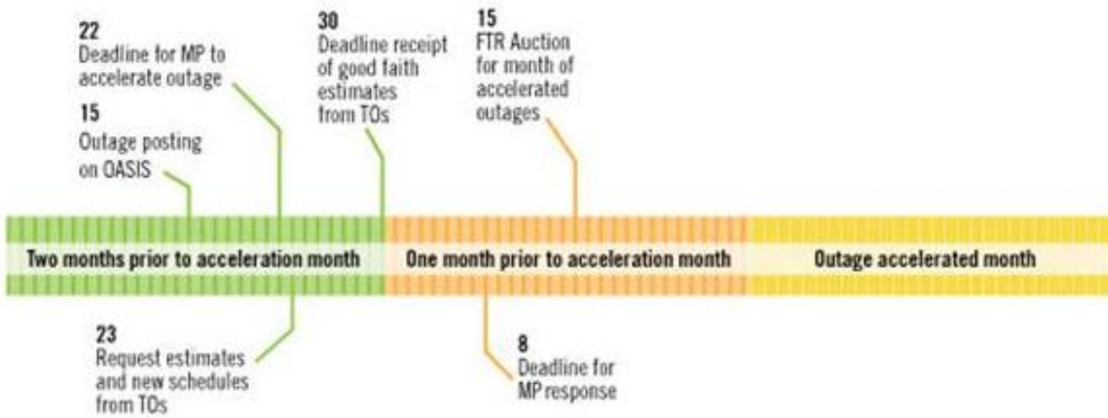
Note: Inside a substation refers to the substation equipment (including the measurement and metering equipment) to the point of interconnection to the EHV network. The interconnection point may be within the physical limits of the substation perimeter.

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.

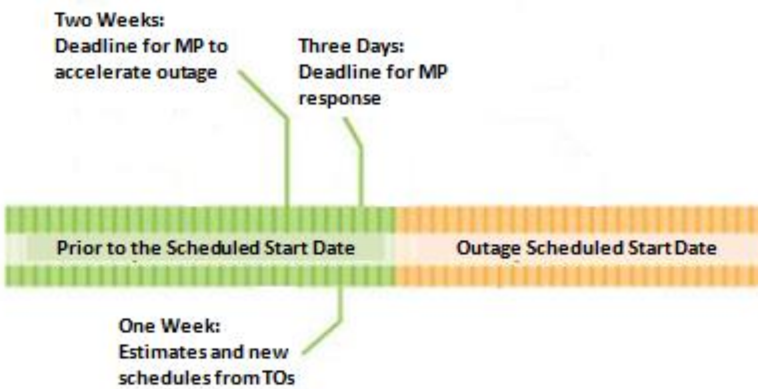
ii) PJM shall give participants only one chance to make a request to accelerate an outage. Meaning, if after the first round of requests there is not enough money to accelerate the outage, the outage would not be accelerated.

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

Welcome to the Operating Procedures PJM RTO Operation section of the PJM Manual for Transmission Operations. In this section you will find the following information: An index of the specific procedures which are contained in this manual and listed or referenced by the Transmission Provider. Each Transmission Zone within the PJM RTO has a separate section for applicable Operating Procedures. Some Balancing Authorities also have a separate section. The procedure itself that was provided by the Transmission Provider to PJM may be attached in the applicable section.

	Type of Operating Procedure	**Transmission Operations Manual Section Ref**
PJM RTO Operation		
Load Shed Determination Procedure	Procedure	Section 5 PJM
Load Shed Directive	Directive	Section 5 PJM
Constraint Management Mitigation During Scheduled Switching Procedure	Constraint/Limitation	Section 5 PJM
Single Breaker Contingency Mitigation Procedure	Limitations	Section 5 PJM
BGE/PEPCO.NOVA/Doubs Area Operating Procedure	Limitations	Section 5 PJM
PJM/NY-ISO PAR Operations	PARS	Section 5 PJM
PSEG/ConEd Wheel	PARS	Section 5 PJM
5018 Branchburg – Ramapo PAR Coordination	PARS	Section 5 PJM
Loop Flows Around Lake Erie (MISO, NY-ISO, IMO & PJM)	Limitations	Section 5 PJM
Recognition of Automatic Sectionalizing Schemes	Sectionalizing Schemes	Section 5 PJM
Automatic Special Protection Schemes (SPS) Operating Criteria	Sectionalizing Schemes	Section 5 PJM
PJM/NY-ISO Transfers	Contingency/Transfers	Section 5 FE-PN
FE East/AP Tie Lines	Thermal contingency	Section 5 FE-PN
Voltage Control at Nuclear Stations	Voltage Limitations	Section 5 PJM
Atlantic City Electric Company (AE) - PHI		
Directional Ratings	Ratings	Section 5 AE
Delmarva Power (DPL) – PHI		

	Type of Operating Procedure	Transmission Operations Manual Section Ref
Directional Ratings	Ratings	Section 5 DPL
American Electric Power (AEP)		
Cook Unit Isolation on Select Circuits	Unit Isolation	Section 5 AEP
Kammer Operating Procedures	Limitations	Section 5 AEP
Conesville 345 kV Plant Operating Guidelines	Unit Stability	Section 5 AEP
Rockport Operating Guide	Unit Stability	Section 5 AEP
Smith Mountain 138 kV station Stability	Stability	Section 5 AEP
Gavin – Mountaineer Stability	Stability	Section 5 AEP
Tidd 345 kV Station Voltage Concerns	Voltage	Section 5 AEP
Additional Regional Procedures	Procedures	Section 5 AEP
Twin Branch – Argenta (Conservative Operations)	Procedures	Section 5 AEP
Bath County SPS	Protection Scheme	Section 5 DVP
Loop Flows Around Lake Erie (MISO, NY-ISO, IMO & PJM)	Limitations	Section 5 PJM
AEP Single Breaker Derates	Ratings	Section 5 AEP
Baltimore Gas & Electric Company (BC & BGE)		
Calvert Cliffs Voltage Limitations	Voltage Limitations	Section 5 BC
Nottingham-Cooper 230 kV Line Limitations	Line Limitation	Section 5 PECO
Breaker Derate Table	Ratings	Section 5 BC
Westport Breaker Limitations and Gould Street Generation Operations	Generator Limitations	Section 5 BC
Cross Town Common Trench Circuit Ratings Changes	Ratings	Section 5 BC
Brandon Shores – Riverside SPS [SPS]	Special Purpose Scheme	Section 5 BC
Commonwealth Edison (ComEd)		
Elmhurst SVC	SVC	Section 5 ComEd
Kincaid Stability Trip Scheme	Unit Stability	Section 5 ComEd

	Type of Operating Procedure	Transmission Operations Manual Section Ref
Powerton Stability Limitations	Unit Stability	Section 5 ComEd
Quad Cities and Cordova Stability Limitations	Unit Stability	Section 5 ComEd
East Frankfort TR83 345/138 kV Transformer SPS	Special Purpose Scheme	Section 5 ComEd
Byron and Lee County Operating Guides	Unit Stability	Section 5 ComEd
University Park North Energy Center Restriction	Unit Stability	Section 5 ComEd
Elgin Energy Center Stability Bus Tie Scheme	Unit Stability	Section 5 ComEd
Marengo 138 kV Bus Operation	Voltage and Thermal	Section 5 ComEd
Damen 138 kV Bus Operation	Constraints	Section 5 ComEd
Normally Open Bus Tie Circuit Breakers	Voltage and Thermal Limitations	Section 5 ComEd
Dresden 345 kV Bus Operations with Lines Out of Service	Limitations	Section 5 ComEd
Burnham – Taylor (L17723) 345 kV Line Operation	Voltage	Section 5 ComEd
Lakeview Special Protection Scheme [SPS]	Special Purpose Scheme	Section 5 ComEd
138 kV Phase Shifting Transformer Operations	PARs	Section 5 ComEd
Waukegan 138 kV Bus Tie 4-14 Operation	Voltage and Thermal Limitations	Section 5 ComEd
Ridgeland 138 kV Bus Tie 4-14 Operation	Thermal Contingencies	Section 5 ComEd
Wolfs Crossing – Sandwich 138kV 14302 line	Special Protection Scheme	Section 5 ComEd
Electric Junction – North Aurora 138kV 11106 line	Special Protection Scheme	Section 5 ComEd
Wolfs TR81	Special Protection Scheme	Section 5 ComEd
Transformer Operation at 138 kV Line Tie Breaker Substations	Switching Options	Section 5 ComEd
Davis Creek 345 kV Bus Tie 2-3 Auto-closing	Special Protection Scheme	Section 5 ComEd

	Type of Operating Procedure	Transmission Operations Manual Section Ref
Dresden Unit 2 Trip Scheme	Special Protection Scheme	Section 5 ComEd
Islanding Prevention Scheme for TSS 941 Grand Ridge Generation	Load Rejection Scheme	Section 5 ComEd
Northbrook Transfer Trip	Special Protection Scheme	Section 5 ComEd
Zion Generation Stability Trip	Unit Stability	Section 5 ComEd
Camp Grove Islanding	Unit Restriction	Section 5 ComEd
Directional Ratings	Ratings	Section 5 ComEd
Dayton Power and Light Company (DAY)		
Darby Plant Stability Restriction	Stability	Section 5 Day
Dominion Virginia Power (DVP)		
Clover Generator Shed Scheme	Protection Scheme	Section 5 DVP
Northern Virginia High Voltage Control	Voltage Control	Section 5 DVP
Lexington Area Loss-of-Load Contingency Mitigation Procedure	Contingency	Section 5 DVP
Marsh Run and Remington CT Stability Restrictions	Stability	Section 5 DVP
Bath County Stability Restrictions	Stability	Section 5 DVP
Bath County SPS	Protection Scheme	Section 5 DVP
Carolina Substation 22 Line	Protection Scheme	Section 5 DVP
Carolina Substation 54 Line	Protection Scheme	Section 5 DVP
Dominion Single Breaker Derates	Ratings	Section 5 DVP
Duke Energy Ohio Kentucky (DEOK)		
Dimmick - Port Union 138kV Line Relief Procedure	Switching Option	Section 5 DEOK
Normally open Red Bank CB 920 138kV auto Closing Scheme	Switching Option	Section 5 DEOK
Todd Hunter 345/138kV Transformers Relief Procedures	Switching Option	Section 5 DEOK
Breaker Derate Table	Rating	Section 5 DEOK

	Type of Operating Procedure	Transmission Operations Manual Section Ref
Duquesne Light Company (DLCO)		
DLCO Single Breaker Derates	Ratings	Section 5 DLCO
Crescent TR1 345/138kV Autotransformer Relief Procedure	Switching Options	Section 5 DLCO
DLCO Common Trench Cable Ratings	Cable Ratings	Section 5 DLCO
First Energy – ATSI (FE-ATSI)		
Mansfield Unit Stability Restrictions	Stability	Section 5 FE-ATSI
First Energy (FE-JC, FE-PN & FE-ME)		
Neptune Regional Transmission System	Ratings	Section 5 FE-JC
PJM/NY-ISO Transfers	Actuals / Contingencies	Section 5 FE-PN
FE East / AP Tie Lines	Actuals / Contingencies	Section 5 FE-PN
Warren - Falconer 115kV Relay	Special Purpose Relay	Section 5 FE-PN
East Sayre – North Waverly 115 kV Relay	Special Purpose Relay	Section 5 FE-PN
Yards Creek – 230kV Relay (Pumping)	Special Purpose Relay	Section 5 FE-JC
PSE&G Artificial Island Stability	Stability	Section 5 PSE&G
Conemaugh/Hunterstown Stability Limits	Stability	Section 5 FE-PN
Conemaugh #2 Stability Trip	Stability Trip Scheme	Section 5 FE-PN
Keystone - Conemaugh 5003 Re-Close	Stability	Section 5 FE-PN
Homer City #2 & #3 Stability Trip	Stability Trip Scheme	Section 5 FE-PN
Homer City Stability Limits	Stability	Section 5 FE-PN
Seneca Stability	Stability	Section 5 FE-PN
Seneca Pumping	Pumping	Section 5 FE-PN
PECO Energy Company (PE or PECO)		
Nottingham-Cooper 230 kV Line Limitations	Line Limitations	Section 5 PECO
Muddy Run Restrictions	Stability	Section 5 PECO
Peach Bottom 1 500/230 kV Transformer Special	Special Purpose Relay	Section 5 PECO

	Type of Operating Procedure	Transmission Operations Manual Section Ref
Protection Scheme		
Peach Bottom '45' 500 kV CB Outage	Special Purpose Relay	Section 5 PECO
Peach Bottom '35' 500 kV CB Outage	Special Purpose Relay	Section 5 PECO
Peach Bottom Off-site Power Supply Voltage Limits	Voltage Limits	Section 5 PECO
Limerick 4A and 4B 500/230 kV Transformer Banks	Transformer Ratings	Section 5 PECO
Linwood Special Protection Scheme	Special Protection Scheme	Section 5 PECO
Pennsylvania Power & Light Company (PPL)		
Sunbury 500/230 kV Transformer Ratings	Equipment Ratings	Section 5 PPL
Susquehanna #1 and #2 Units Contingency	Contingency	Section 5 PPL
5043 and 5044 (Alburtis-Wescosville-Susquehanna) Transfer Trip Scheme	Special Purpose Relay	Section 5 PPL
Northeast PA (NEPA) Transfer Limit	Stability	Section 5 PPL
Montour Stability Restrictions	Stability	Section 5 PPL
Steel City – Hosensack 500kV Reclosing Limitation	Reclosing Limitation	Section 5 PPL
Operation of 23030 Tie at Mountain UGI	Tie Operations	Section 5 UGI
UGI/PL 66 kV Tie Line Operation	Tie Operations	Section 5 UGI
Conemaugh Unit Stability	Stability	Section 5 FE-PN
Conemaugh #2 Unit Stability Trip Scheme-Conemaugh-Juniata 500kV Outage	Stability	Section 5 FE-PN
Sunbury Transformer 22 & 23 Operating Restrictions	Operating Restrictions	Section 5 PPL
Double Circuit Tower Line Contingencies (DCTL) Associate with Susquehanna-Roseland Delay	Contingency – Thermal	Section 5 PPL
Montour Runback Scheme (SPS)	Special Purpose Relay	Section 5 PPL
Potomac Electric Power Company (PEPCO)		
Chalk Point Transformer #5 Operation	Breaker Ratings	Section 5 PEPCO
Common Trench Cable Rating	Cable Ratings	Section 5 PEPCO
Public Service Electric & Gas Company (PSE&G)		

	Type of Operating Procedure	Transmission Operations Manual Section Ref
PSE&G Artificial Island Stability	Stability	Section 5 PSE&G
Branchburg/Deans 500 kV Substation Contingency	Contingency-Thermal	Section 5 PSE&G
Closing Normally Open Bus Section Breakers (Hudson and Marion)	Operating Restrictions	Section 5 PSE&G
Double Circuit Tower Line Contingencies (DCTL) Associated with Susquehanna-Roseland Delay	Contingency-Thermal	Section 5 PSE&G
Breaker Derate Table	Ratings	Section 5 PSE&G
PJM/NY-ISO PAR Operation	PARS	Section 5 PJM
PSE&G/ConEd Wheel	PARS	Section 5 PJM
5018 Branchburg – Ramapo PAR Coordination	PARS	Section 5 PJM
First Energy – South (Allegheny Power - AP)		
Loop Flows Around Lake Erie (MISO, NY-ISO, IMO & PJM)	Limitations	Section 5 PJM
FE East/AP Tie Lines	Actuals / Contingencies	Section FE-PN
Bath County SPS	Protection Scheme	Section 5 DVP
Contingency Overloads in the Willow Island Area	Thermal Contingency	Section 5 AP
Belmont SPS	Protection Scheme	Section 5 AP
Breaker Derate Table	Ratings	Section 5 AP
Ronco Stability	Generator Stability	Section 5 AP
Black Oak SVC	SVC	Section 5 AP
Black Oak 500/138kV #3 Transformer SPS	Protection Scheme	Section 5 AP
Bus Voltage Exceptions	Ratings	Section 5 AP
RECO		
UGI		
Operation of 23030 Tie at Mountain UGI	Tie Operations	Section 5 UGI
UGI/PL 66 kV Tie Line Operation	Tie Operations	Section 5 UGI
New York ISO (NYISO)		

	Type of Operating Procedure	Transmission Operations Manual Section Ref
PJM/NY-ISO PAR Operation	PARS	Section 5 PJM
PJM/NY-ISO Transfers	Contingency/Transfers	Section 5 FE-PN
Ramapo PAR Operating Instruction	PARS	Section 5 NYISO
5018 Branchburg – Ramapo PAR Coordination	PARS	Section 5 PJM
ISO-New England (ISO-NE)		
ISO-NE Contingencies	Contingencies	Section 5 ISO-NE
Millstone Point Contingency	Contingencies	Section 5 ISO-NE
NEPEX Emergencies	Constraints	Section 5 ISO-NE
Loop Flows Around Lake Erie (MISO, NY-ISO, IMO & PJM)	Limitations	Section 5 PJM
Midwest Independent System Operator (MISO)		
MISO – PJM Joint Operating Guide: Safe Operating Mode	Constraints: Conservative Operations	Section 5 PJM
MISO – PJM Manual Shadow Price Override	Constraints: Conservative Operations	Section 5 PJM

Index of Operating Procedures for PJM RTO Operation

The PJM RTO Operation has Operating Procedures that are adhered to by PJM and in cooperation with others. These procedures include the following:

	Type of Operating Procedure	Transmission Operations Manual Section Ref
PJM RTO Operation (PJM)		
Load Shed Determination Procedure	Procedure	Section 5 PJM
Load Shed Directive	Procedure	Section 5 PJM
Constraint Management Mitigation During Scheduled Switching Procedure	Constraint/Limitation	Section 5 PJM
Single Breaker Contingency Mitigation Procedure	Limitations	Section 5 PJM
BGE/PEPCO/NOVA/Doubs Area Operating Procedure	Limitations	Section 5 PJM
PJM/NY-ISO PAR Operation	PARS	Section 5 PJM
PSEG/ConEd Wheel	PARS	Section 5 PJM
5018 Branchburg – Ramapo PAR Coordination	PARS	Section 5 PJM
Loop Flows Around Lake Erie (MISO, NY-ISO, IMO & PJM)	Limitations	Section 5 PJM
Recognition of Automatic Sectionalizing Schemes	Sectionalizing Schemes	Section 5 PJM
Automatic Special Protection Schemes (SPS) Operating Criteria	Sectionalizing Schemes	Section 5 PJM
PJM/NY-ISO Transfers via First Energy	Contingency/Transfers	Section 5 FE-PN
FE East/AP Tie Lines	Thermal Contingency	Section 5 FE-PN
Voltage Control at Nuclear Stations	Voltage Limitations	Section 5 PJM
Back To Index		

Load Shed Determination Procedure

As stated within the *Facility Ratings* section, thermal ratings on facilities are derived with specific times in order to alleviate a facility. The highest rating that a facility can have on the PJM system is its Load Dump (LD) rating.

It is not permitted for any monitored facility to be intentionally operated above its LD rating.

- Per Thermal Limit Operation Criteria, the operator has 5 minutes to reduce the flow across the facility (or facilities) to below the Emergency rating.
- Should any monitored facility become overloaded (with the most likely cause being an unplanned multiple contingency event) to the point that it is exceeding its LD rating, it is imperative that the facility be alleviated immediately below its Emergency rating.

Additionally, should any monitored facility become overloaded to the point that it is exceeding its Emergency rating, that facility must be alleviated below either:

- The facility's Short Time Emergency (STE or ST) rating within 15 minutes (if one is provided)
- The facility's Long Time Emergency (LTE or LT) rating within "X" minutes if loading is between LTE and STE rating. "X" depends upon the duration of the STE rating as documented in Manual 3. STE ratings are typically 2 hour, 1 hour or 30 minute ratings.
- If the facility's LTE and STE ratings are equal, the time to correct is 15 minutes

For a facility exceeding its LD, STE or LTE rating, PJM and TO Operators should utilize the following steps:

- STEP 1: Contact between the PJM and TO should be made immediately. In particular for a facility exceeding its LD rating, there is minimal time for delay outside of the initial recognition of the event.
- STEP 2: Compare real-time (RT) flows to state estimator (SE) flows.
    - If there are no discrepancies, move on to STEP 3.
    - For any discrepancies:

➢ If the reason for the discrepancies is NOT immediately obvious, PJM and TO shall agree upon the most-conservative values.

➢ If the reason for the discrepancies is immediately obvious, and the facility is determined not to be in an LTE, STE or LD overload:

▪ PJM and TO should work together as needed to resolve the discrepancy.

▪ PJM and TO operators should log the discrepancy.

▪ Cease Load Shed Determination Procedure if it is determined that the facility is not in an overload situation. Otherwise, go to next step.

- STEP 3: Compare LD and Emergency (LTE and STE, if both are provided) ratings between PJM and TO.
    - If there are no ratings discrepancies, move on to STEP 4.
    - For any discrepancies:

➢ If the reason for the discrepancies is NOT immediately obvious, PJM and TO shall agree upon the most-conservative/lowest values.

➢ If the reason for the discrepancies is immediately obvious, and the facility is determined not to be in an LTE, STE or LD overload:

▪ PJM and TO should work together as needed to resolve the discrepancy.

▪ PJM and TO operators should log the discrepancy.

▪ Cease Load Shed Determination Procedure if it is determined that the facility is not in an overload situation. Otherwise, go to next step.

- STEP 4: Switching and or Generation Option
    - For a LD rating overload, there are only 3 options available to alleviate:

➢ A reclose attempt on a facility that just tripped and caused the present Load Dump overload; And/or …

➢ A Pre-Studied Switching Solution; And/or …

➢ ONLINE Generation Redispatch; Provided the generation has significant enough ramp-rate and relief potential to alleviate the overload within the given time constraints (5 minutes for a LD overload from the time Flow exceeded the LD rating). If reducing generation or shedding load are both options, generation should be reduced before shedding load.

➢ If a Pre-Studied Switching Solution or ONLINE Generation Redispatch is not immediately implemented … Go to STEP 5.

> ***Note:***
>
> A *Pre-Studied Switching Solution* must be …
>
> - A switching solution that had been agreed upon by both the TO and PJM which:
>   - Had been studied prior to the initiating event for the present Load Dump overload. (Including those for a PCLLRW, if applicable.)
>   - The study should have accurately reflected the initiating event and present system topology for the area presently experiencing the Load Dump overload.
>   - The switching solution CANNOT place any other facility into a Normal Rating overload.

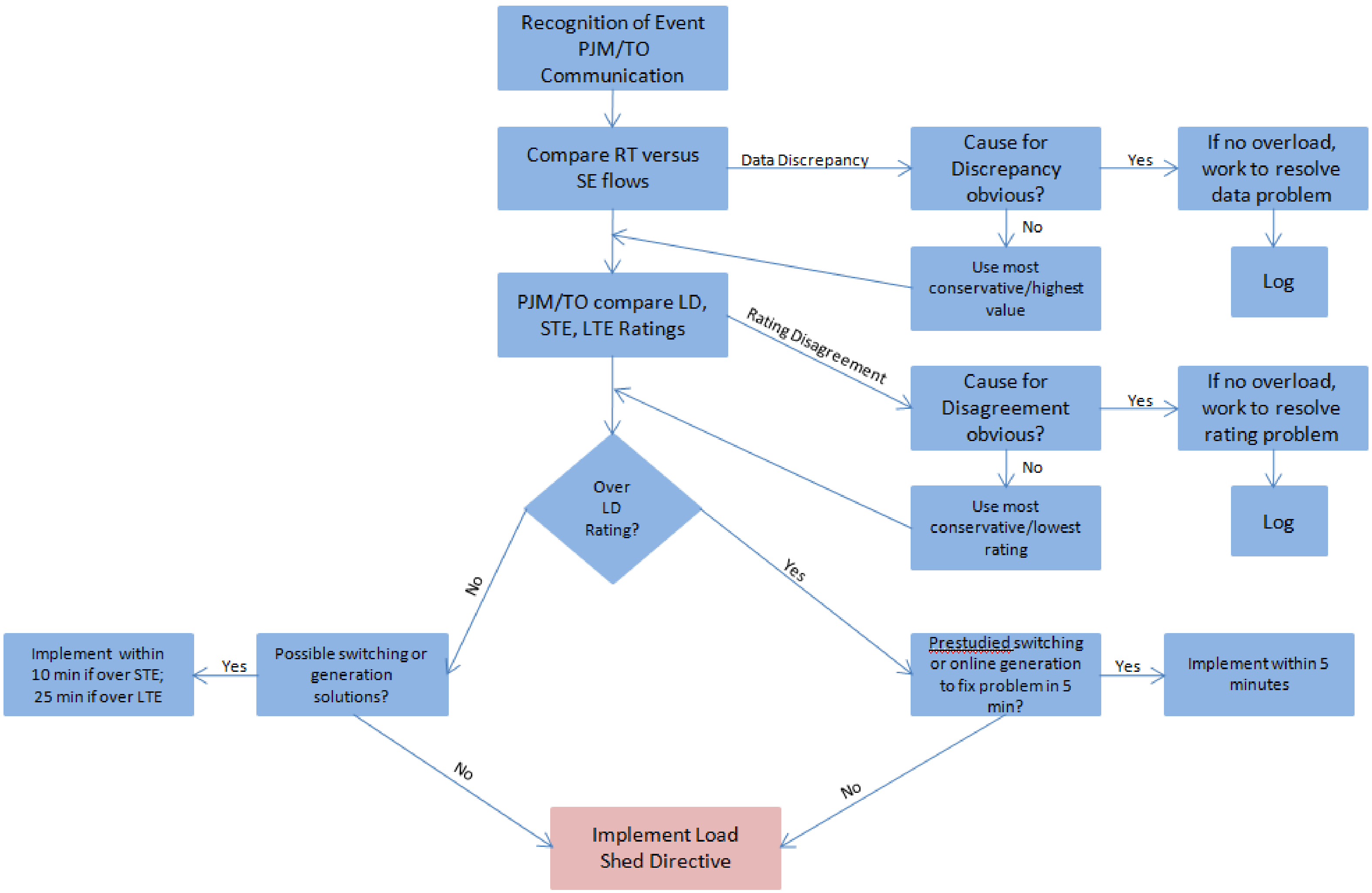
- For an Emergency (LTE or STE) rating overload:

- Operators may have time to study Switching Solutions and/or Generation Redispatch.
- Once an Emergency rating overload is 5 minutes away from becoming a Violation (see bullets below) AND if a Switching Solution and/or Generation Redispatch is not expected to alleviate the overload in the next 5 minutes …Go to STEP 5.

- For STE<>LTE
    - 10 minutes after a facility exceeds its STE rating (15 minutes to alleviate from the time of the initial overload)
    - Within "X" minus 5 minutes after a facility exceeds its LTE rating yet remains below its STE rating. ("X" depends upon the duration of the STE rating as documented in Manual 3. STE ratings are typically 2 hour, 1 hour or 30 minute ratings.)
- For STE = LTE
    - If the STE and LTE ratings are equal, 10 minutes after a facility exceeds the Emergency rating (15 minutes to alleviate from the time of the initial overload)

- STEP 5: Commence **Load Shed Directive** immediately and without delay.

LOAD SHED DETERMINATION FLOW CHART FOR A FACILITY EXCEEDING RATING



Load Shed Directive

After completion of the **Load Shed Determination Procedure**, both parties should be in agreement as to the extent of the overload and the need to alleviate.

Keywords:

> *Overloaded Facility* = Facility in an Overload of either its EM or LD rating, using End A and End B names as well as applicable voltage(s).
>
> *Facility Flow* = Value, in MVA, for the agreed upon flow across the Overloaded Facility as determined in **Step 2** of the **Load Shed Determination Procedure**.
>
> *Rating* = Rating for the *Overloaded Facility* which is presently being exceeded. (LD, STE or LTE)
>
> *Overload Time* = Initial time, in military -- Eastern Prevailing Time, the *Overloaded Facility*'s *Overloaded Facility Flow* began exceeding its *Overloaded Rating*.
>
> *Desired Flow* = If rating being exceeded is the LD rating, *Desired Flow* would be the nearest Emergency rating (STE or LTE). If the rating being exceeded is either the STE or LTE rating, the *Desired Flow* would be the Emergency rating (STE or LTE).
>
> *Load Shed Area* = If an overloaded facility is overloaded with flow from End A to End B, then End B would be the applicable *Load Shed Area*. If an overloaded facility is overloaded with flow from End B to End A, then End A would be the applicable *Load Shed Area*.

> ***Note:***
>
> The amount of load shed required in a *Load Shed Area* is typically dependent upon the amount of load under SCADA control in the *Load Shed Area*. As such, the TO may have to shed a substantial amount of load that significantly reduces the flow across the *Overloaded Facility* (sometimes well below the NL rating on said facility) due to limited SCADA control.
>
> However, this is the desired effect, to protect the *Overloaded Facility*. If significant load shed is required, the TO should shed the load first to protect the facility … then, in coordination with PJM, fine-tune the load shed afterwards with the help of additional TO personnel (substation, switchman, etc.).

Directive Script:

- The following is meant to be a template script for issuance of a Load Shed Directive.
- The Script should be readily available to both PJM and TO operators as a reference.
- The intent of the script is for familiarity and easy recognition of the gravity of the situation.
- Both operators should take special note that the tone of the Directive is meant to be formal, clear and specific.
- At the beginning, during and at the completion of the Directive, there should be no ambiguity as to what is taking place or what needs to be done to alleviate the situation. As such, no extraneous conversation

outside of the directive should take place either during the Directive or at the end of the Directive.

- If at any time during the issuance of the Directive, either party becomes distracted for any reason, they should cancel the order and commence from the beginning.

Example Script, Keywords:

PJM Operator, Name: John Doe

TO Company: XYZ Energy.

TO Operator, Name: A.J. Jones

Present Time = 1208.

Overloaded Facility = Victorstation 345/138kV #2 Transformer (which is presently overloaded with flow from the 345kV high side down to the 138kV low side)

Facility Flow = 705 MVA.

Rating = LD rating. (650 MVA)

Overload Time = 1206

Desired Flow = 590 MVA LTE/STE rating

Load Shed Area = Victorstation 138kV and below

Example Script, Verbiage:

[Beginning of Example Directive Script]

PJM Operator:

"This is PJM Dispatcher John Doe with a Load Shed Directive."

"As of 1208, the Victorstation 345/138kV #2 Transformer is determined to be exceeding its Load Dump rating of 650 MVA and is presently loaded at 705 MVA. The facility has been exceeding its Load Dump rating since 1206."

TO Operator:

"I agree that as of 1208, the Victorstation 345/138kV #2 Transformer is determined to be exceeding its Load Dump rating of 650 MVA and is presently loaded at 705 MVA. I also agree that the facility has been exceeding its Load Dump rating since 1206."

PJM Operator:

"At this time PJM is initiating a Load Shed Directive to reduce the flow across the Victorstation 345/138kV #2 Transformer to a level not to exceed 590 MVA. XYZ Energy should commence load shed in the Victorstation 138kV and below area immediately."

TO Operator:

"I agree that a Load Shed Directive has been ordered to immediately commence load shed in the Victorstation 138kV and below area with the intent to reduce the flow across the Victorstation 345/138kV #2 Transformer down to a flow that does not exceed 590 MVA."

PJM Operator:

"Please call me back to confirm once the load shed is completed."

[End of Directive Script]

Constraint Management Mitigation during Scheduled Switching Procedure

Purpose / Introduction

PJM operates its SOL in agreement with the NERC Operating Guidelines. In doing this, PJM considers many transmission constraints, restrictions, and/or limitations in the overall operation of the PJM RTO. The PJM RTO is operated such that the following limits are not violated:

- transmission facility thermal limits
- reactive transfer limits
- voltage limits
- stability limits

PJM operates the PJM RTO so that immediately following any single malfunction or failure; the facility loadings are within thermal limits (under normal rating real time or under the emergency rating post-contingency), while maintaining an acceptable voltage profile. However, there are situations where exceeding thermal limits for a predetermined brief period of time would not adversely impact system or equipment reliability. Initiating this procedure in lieu of other adjustments will result in maintaining system integrity by keeping lines/facilities in service during these short-term excursions, and may reduce the occurrence of unnecessary off-cost operations.

Scope

The intent of this procedure is to recognize that occasionally, and for various reasons facility thermal ratings can be exceeded on an actual basis for short time periods without damaging equipment. The reason these limits can be exceeded briefly is the relatively lengthy thermal time constants for heat build-up in equipment when MVA loading is the consideration. Short-term voltage deviations are less tolerable than thermal overloading issues, although past practice and LCC (Local Control Center) experience can dictate when these excursions are allowable. The keys to success of this procedure are effective communication and coordination.

Risks

This procedure will not position the system in an unacceptable state. However, there is always the possibility of equipment failure resulting in unplanned situational constraints (i.e. extending the short-term nature of the job) that would necessitate immediate remediation efforts. A pre-determined solution to these constraints must be in place should any contingency occur which would negate the short-term nature of the job.

General Requirements

The following are steps that should be considered and agreed upon prior to allowing the constraint management mitigation procedure.

- Pre-agreement by PJM OPD, PJM and LCC Dispatch, and whatever other parties are appropriate (parties involved with the mitigating strategies).
- Each planned event is pre-studied on a case by case basis. Each operation is defined in the Manuals or desk procedures as meeting the criteria of acceptable switching event, and agreed to by all parties.

Parameters

- PJM will NOT allow operation over the applicable emergency rating (actual) on a planned basis for any period of time. Operation over the normal rating will be tolerated for up to 5 minutes provided a pre-determined solution to the constraint is in place should any event occur that would negate the short-term nature of the job.
- PJM will NOT allow operation over the Load Dump rating on a post contingency basis for any period of time. Operation over the applicable Emergency Rating on a post contingency basis will be tolerated for up to 5 minutes provided a pre-determined solution to the constraint is in place should any event occur that would negate the short-term nature of the job.
- The LCC's planned outage should take no longer than 5 minutes. In the event the outage does not go as planned, the LCC and PJM pre-coordinated mitigating strategy (i.e., "back out plan") will be implemented to bring the overloaded facility within limits in 15 minutes or less from the start of the outage. The back out plan must be acceptable to all parties and should include sufficient redundancy to ensure reliable operation and provide constraint relief in this timeframe.
- The agreed upon back out plan should not impact other member companies:
    - switching shall not cause overloads to other company equipment not previously studied and agreed to by all parties
    - switching out company "B" equipment to avoid switching in the requesting company area unless Company "B" is willing.
- The back out plan must be reevaluated for actual system conditions (a study just prior to event might determine that the plan is no longer acceptable).
- LCC is responsible to provide accurate information that is mutually agreed upon and repeatable for future operational use.

Procedure

Refer to the attached flow chart of the Constraint Management Mitigation Procedure.

- PJM study will be used for the SOL. There may be exceptions on underlying facilities where the LCC has more detailed modeling.

- PJM will operate to its standard of 15 minutes or less to return an affected facility (over normal rating real time or over the emergency rating post-contingency) to within limits. Normal off cost operations will be initiated if any event occurs which would negate the short-term nature of the job.
- PJM EMS has the ability to utilize individual LCC ambient temperature facility ratings. PJM EMS can adjust ratings as required with input for local LCC temperatures. Normally the most conservative values will be used. PJM, with input from the LCC, will make the final determination of the appropriate ratings
- Additionally, for those occasions where temperature sets do not conflict, but PJM system security analysis conflicts with a particular LCC analysis, PJM will consider LCC input in the final determination of which results to use.
- The resolution of these issues should be done as far in advance of the actual event as possible, to eliminate any last minute confusion or unnecessary discussion.

Note: A study too far in advance may be useless. The study just prior to switching will determine if the procedure is used. Prior arrangements do not supersede the final real-time PJM study.

- The PJM PD will complete Constraint Logger studies immediately prior to the event to ensure rapid decision making and execution in the event of required system redispatch.

Example:

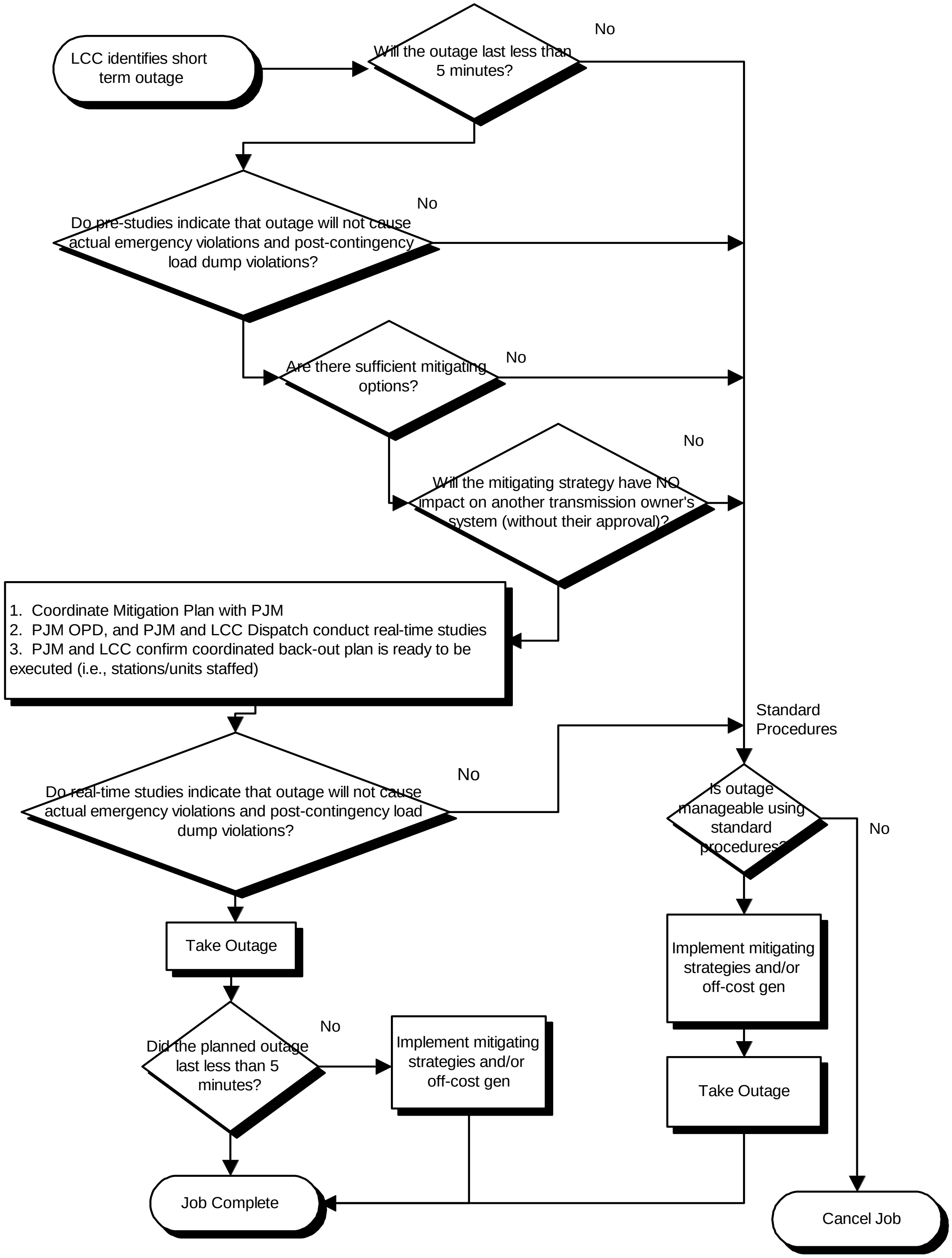
A LCC requests an outage on a Bulk Electric System transformer with no high side circuit breaker requiring a brief outage (less than 5 minutes) of a 500 kV transmission line.

Studies indicate that during the switching, a parallel 230 kV transmission line will exceed its normal rating but not its applicable emergency rating real time, and/or will exceed its applicable post contingency emergency rating but not its post contingency load dump rating for loss of another facility.

PJM and the LCC determine that opening a 230 kV breaker at another substation, splitting the bus and leaving the 230 kV line isolated on a single transformer can alleviate the constraint. Opening this breaker will not impact any other transmission owners. The 230 kV breaker can be opened in a minute or two if there are problems switching the 500kV line causing the outage to take longer than expected. All affected parties are in agreement that this plan is acceptable.

Immediately prior to the scheduled outage of the Bulk Electric System transformer, both PJM and the LCC repeat their studies to confirm that opening the 230 kV breaker will provide the expected relief in the event that the 500kV line switching takes longer than expected.

The 500 kV line is switched out and back as expected and the job is complete. A brief violation was experienced as expected, but switching action on the 230 kV breaker was avoided and the 230 kV bus remained intact.


LCC identifies short term outage
Will the outage last less than 5 minutes?
No
Do pre-studies indicate that outage will not cause actual emergency violations and post-contingency load dump violations?
No
Are there sufficient mitigating options?
No
Will the mitigating strategy have NO impact on another transmission owner's system (without their approval)?
No
1. Coordinate Mitigation Plan with PJM
2. PJM OPD, and PJM and LCC Dispatch conduct real-time studies
3. PJM and LCC confirm coordinated back-out plan is ready to be executed (i.e., stations/units staffed)
Standard Procedures
Do real-time studies indicate that outage will not cause actual emergency violations and post-contingency load dump violations?
No
Is outage manageable using standard procedures?
No
Take Outage
Implement mitigating strategies and/or off-cost gen
Did the planned outage last less than 5 minutes?
No
Implement mitigating strategies and/or off-cost gen
Take Outage
Job Complete
Cancel Job

Single Breaker Contingency Mitigation Procedure

Purpose/Introduction: Under certain outage conditions, specifically facility/breaker outages which open ring busses or impact breaker and ½ schemes, the unplanned trip of a single breaker can result in worse post-contingency flows that the outage of the line/transformer associated with the breaker. PJM Security Analysis will not identify these circumstances since PJM does not normally operate for single breaker contingencies. The purpose of this single breaker contingency mitigation procedure is to define operating guidelines to assist in mitigating single breaker contingencies in lieu of pre-contingency redispatch. However, if an increased risk of breaker failure is identified through diagnostic equipment and real-time alarming, PJM will operate for the single-breaker contingency on a pre-contingency basis.

General Requirements

Pre-Contingency:

- Transmission Owner support staff to alert PJM Reliability Engineers of system conditions where single breaker outages are more severe than the loss of line/transformer associated with the breaker. Transmission Owner support staff should alert PJM Reliability Engineers prior to the outage which results in the single-breaker contingency being the most limiting contingency, so that instructions are provided to the operator in advance.
- PJM / Transmission Owner support staff to review pre-contingency switching options to mitigate single breaker contingency. Switching options many include the outage of the affected facility pre-contingency.
- PJM/Transmission Owner support staff to review post-contingency switching options to mitigate single breaker contingency. This switching option most likely will included the outaging of the facility associated with the single breaker contingency.
- PJM/Transmission Owner operators to be aware of impact of single breaker contingency and mitigation strategy via written instructions.

Post-Contingency:

- Transmission Owner operator to implement post-contingency switching options via SCADA. PJM operator to redispatch system to return system within designated limits in preparation for next contingency

BGE/PEPCO/NOVA/Doubs Area Operating Procedure

Purpose / Introduction

The BGE/PEPCO/Doubs/Northern Virginia (NOVA) sub area of PJM RTO

The BGE/PEPCO sub area has an import capability of approximately 4000-4700 MW, and under times of high system demand and/or reduced generation availability in these zones, imports to the area may be near or above this value. In addition, under high demand conditions, voltage profiles in the Doubs and Northern PEPCO and Waugh Chapel areas can be at the low end of acceptable ranges or can decay quickly in a short period of time. PJM, AP, PEPCO, BGE and Dominion monitor and trend 500kV and 230kV voltages on their systems and monitor contingency analysis results for their facilities, including the major constraints into the areas. Equipment outages associated with key 500 kV facilities could significantly decrease the import capability (such as but not limited to 500 kV transmission lines, 500 kV substation equipment, 500 and 230 kV capacitor banks, and 500-230 kV transformers associated with the Doubs, Bedington, Black Oak, Brighton, Waugh Chapel, Conastone, Loudoun and Pleasant View.). Outages of key generators could significantly impact voltages and import capability (Morgantown, Chalk Point, Calvert Cliffs, Possum Point, Brandon Shores and Dickerson Units).

Under certain load/generation patterns (i.e. Mid-Atlantic/PJM South projected load 70,000 – 75,000 MW and BGE/PEPCO imports of 4000 – 4700 MW), PJM will enable real-time analysis to determine maximum allowable imports into BGE/PEPCO and re-evaluate voltage profiles in the Western AP/Northern Dominion/BGE-PEPCO areas. PJM provides the current BGE/PEPCO Import value and the calculated limit to BGE, PEPCO, and Dominion via the data link. PJM also coordinates with the impacted LCCs and determine what the recommended course of action shall be for the next contingency if the actual import level is less than the maximum import limit. The purpose of this procedure is to define a coordinated plan between PJM, BGE, PEPCO, Dominion and AP to effectively control thermal/voltage constraints under peak load conditions.

General Requirements

- PJM/LCC support staff to evaluate BGE/PEPCO Import Interface when Hot/Cold Weather Alert, Heavy Load Voltage Schedule Alert or Maximum Emergency Generation Alert is issued or anticipated to be issued for Mid-Atlantic/PJM South or AP/BGE/PEPCO/NOVA areas.
- PJM Dispatch to enable BGE/PEPCO Import Interface in TLC when Heavy Load Voltage Schedule Warning or Maximum Emergency Generation Action is issued for PJM RTO, Mid-Atlantic, PJM South or AP/BG/PEPCO/NOVA areas.
- PJM Dispatch to issue Heavy Load Voltage Schedule
- PJM Dispatch to issue Heavy Load Voltage Schedule in impacted areas.
- PJM Dispatch to request Reactive Reserve Check. PJM and LCC dispatchers should closely monitor reactive performance of key generators.
- PJM/LCC Dispatch to evaluate the impact of switching solutions on pre/post contingency flows/voltages for Doubs, Conastone, Loudoun, Clifton, and Pleasant View 500/230kV transformers.
- PJM Dispatch to ensure all effective units are on line (economic or out-of-merit), and reactive output and reserves dispatched effectively in BGE, PEPCO, eastern AP and Dominion.

- PJM Dispatch to utilize Voltage Stability Analysis (VSA) tool to maximize efficiency of reactive resource deployed:
    - Review impact of non-cost measures such as LTC adjustments
    - Evaluate impact of adjusting MVAR output.
    - Evaluate impact of reducing unit MW in order to increase MVAR output or MVAR reserves.
- PJM Dispatch to implement Active Load Management in BGE and PEPCO (and Mid-Atlantic if effective)
- PJM Dispatch to issue H2 for appropriate companies
- PJM Dispatch to load 100 % Spin in BGE and PEPCO (and other effective areas)
- PJM Dispatch to load Max Emergency in BGE and PEPCO (and other effective areas)
- PJM Dispatch to issue Load Response Program in BGE/PEPCO/NOVA/Eastern AP
- PJM Dispatch to review contracts to see what contracts negatively impact the voltages and facilities and which can be cut. Issue TLR on appropriate flowgate. Review TLR options to reduce the impact of circulation.
- PJM Dispatch to determine deliverability of Reserve Sharing, notify impacted parties. Reserve Sharing is considered undeliverable if there is insufficient capacity or delivery would result in actual voltage or actual thermal violations. Contact Dominion's Local Control Center (LCC) and Market Operation Center (MOC) if VACAR reserves are not available in the PJM-South (Dominion) Zone, or if they cannot be delivered to Progress Energy - Carolina or the VACAR companies prior in addition to contacting external Reliability Coordinators via the SERC Hotline.
- PJM Dispatch to implement 5% Voltage reduction in BGE, PEPCO, Eastern Allegheny Power System (Potomac Edison Area) and Northern Virginia.
- PJM Dispatch to issue H3 for appropriate companies
- PJM Dispatch to implement Rotating Load shedding in most effective areas. Do not drop load pre-contingency unless one of the following conditions exist:
- All other actions have been taken and imports are above the allowable import limit, such that for a contingency a collapse would occur.
- Voltages are decaying rapidly or are below emergency low limits.

- PJM Dispatch to issue H4 for appropriate companies

PJM/NY-ISO PAR Operation

Waldwick Microprocessor - Operating to Load Dump Ratings

Note: Short term emergency/load dump are the same rating just different terminology. The PSE&G EMS only has three ratings sets and the name for the Load Dump is Short Term Emergency.

PJM Load Dump Rating = PSE&G Short Term Emergency Rating

The purpose of the Waldwick microprocessor is to monitor power flow through eight facilities at Waldwick Switching Station. The microprocessor allows the listed facilities to be operated to the short term emergency/load dump rating on a contingency basis. If an actual overload occurs and the flow on any of the listed facilities exceeds the long term emergency rating, the microprocessor will respond. The response will initially occur as a warning alarm, followed 5 minutes later by actual corrective action in the form of PAR tap moves to return all monitored facilities to their long term emergency rating. **(However, PAR moves should be made to control the overload before the microprocessor responds).** In the case of multiple overloads, the microprocessor acts to change the PAR setting on the most heavily loaded PAR-controlled circuit first. The five-minute delay applies only to the initial move. Action continues until the loading on all circuits is at or below their long term emergency ratings. Correction of the overload down to its normal rating is the responsibility of PJM dispatcher.

When the microprocessor is in-service, the short term emergency/load dump ratings can be used on a contingency basis. If the microprocessor is out of service, the long term emergency ratings must be used. When the microprocessor is out of service and the station is manned, PSE&G and PJM can operate to the STE/LD ratings.

This procedure applies to the following facilities PS- NYISO PAR controlled facilities:

- J-3410
- K-3411
- Waldwick 345-1
- Waldwick 345-2
- Waldwick 345-3
- E-2257
- F-2258
- O-2267

This procedure applies to the following facilities because these lines are in series with the E-2257 and F-2258:

- N-2266 (Extension of E-2257)
- M-2239 (Extension of E-2257)
- L-2238 (Extension of E-2257)
- V-2222 (Extension of F-2258)

PSE&G/ConED Wheel

Purpose/Background

This operating procedure concerns the interpretation of two transmission agreements between ConEd and PSE&G that were executed in 1975 and 1978 (the "400 MW contract" and the "600 MW contract, respectively). These two agreements are referred to collectively herein as the "600/400 MW contracts." Together, the 600/400 MW contracts entitle ConEd to transfer up to 1,000 MW from points west of New York City through the PSE&G transmission system for re-delivery into New York City from the Southwest. As of 5/1/2012, the historical 600/400MW contracts have been rolled over pursuant to section 2.2 of the PJM Tariff and are now firm point-to-point service

The operating procedures address several ties between the two utilities' systems, and thus, between the NYISO and PJM. Specifically, these are:

- The "J and K" transmission lines, which go from PSE&G's South Mahwah substation to their Waldwick substation, both in Bergen County, New Jersey. The "J" transmission line becomes the "69" line from South Mahwah to Ramapo, and the "K" transmission line becomes the "70" line from South Mahwah to Ramapo. The Ramapo substation is owned and operated by ConEd in Rockland County, NY.
- The "A line," which goes from PSE&G's Linden Switching Station in Union County, New Jersey to ConEd's Goethals substation on Staten Island.
- The "B and C lines," which go from PSE&G's Hudson Switching Station in Jersey City, New Jersey to ConEd's Farragut Switching Station in Brooklyn, New York.

Flows over each of these lines are partially controllable by Phase Angle Regulators ("PARs"). Taken together, the 600/400 MW contracts provide for ConEd to deliver up to 1,000 MW of power to Waldwick, and for PSE&G to re-deliver the same amount from Waldwick to Farragut or Goethals on behalf of ConEd.

The operating procedure follows the following general provisions:

- A "desired flow" methodology will be used to schedule service under the 600/400 MW contracts,
- The NYISO and PJM will be responsible for maintaining the real-time desired flow at the A/B/C interface and at the J/K interface within

defined bandwidths for periods when neither, or both, are facing the need to redispatch (or operating "off-cost");

- The NYISO and PJM will follow specific procedures in the event that they cannot maintain flows within the desired bandwidths, due to facility outages, insufficient PAR angle capability, or lack of redispatch capability;
- The NYISO and PJM will direct the operation of the A, B, C, E, O, F and 5018 PARs, thereby exercising control over them (ConEd and PSE&G will continue to physically operate the PARs but will do so at NY-ISO's and PJM's behest);
- The A, B, C, J, and K lines will be available for third party uses on an open-access basis;
- ConEd will schedule service under the 600/400 MW contracts on a day-ahead basis (but will have an opportunity to make real-time changes);
- PJM will provide reasonable advance notice of when it expects to have to redispatch to support deliveries under the 600/400 MW contracts;
- PJM will redispatch, at PSE&G's expense to support flows under the 600/400 MW contracts;
- The NYISO and PJM will establish the distribution of flows over the A, B, C, J, and K lines for their own day-ahead markets and will cooperate to determine a single real-time distribution of flows for the real-time market.

The Protocol's first section specifies that the NY-ISO's and PJM's existing emergency procedures will take priority over the rules established by the Protocol in the event of a system emergency and also describes an emergency procedure under which the NY-ISO and PJM may agree to alleviate PJM emergencies attributable to PSE&G outages by delivering 400 MW to the NY-ISO at Goethals for re-delivery to PSE&G at Hudson. This "reverse wheel" provision incorporates an emergency mechanism that was always part of the 400 MW contract. Such emergency transfers would not be counted for purposes of the "Real-Time Market Desired Flow" calculation described below.

Additional Operating Procedures

1.0 Two Day-ahead Actions:

PJM Actions
PJM shall post constraint forecast information indicating if there is the potential for off-cost operations, two days prior to the operating day by 9 pm. PJM shall analyze transmission and generation outages in accordance with Appendix 2B to determine if the 600/400 MW contract flow is expected to be feasible under a security constrained dispatch in PJM. If any portion of the flow is not expected to be feasible under a security-constrained dispatch, PJM will post (on its OASIS) the portion of the flow that

is expected to be feasible.
NYISO Actions
Identify PJM posted constraint information for operational analysis and election analysis.
PSE&G Actions
Identify PJM posted constraint information for operational analysis.
ConEd Actions
Identify PJM posted constraint information for operational analysis and election analysis.

2.0 Day Ahead Scheduling:

2.1 Before NY Market closes

PJM Actions
NYISO Actions
PSE&G Actions
.
ConEd Actions
ConEd shall submit a contract election (NY-DAE) in the NY-ISO's Day-Ahead Market for the 600/400 MW contracts.

2.2 After NY Market closes

PJM Actions
NYISO Actions

The NYISO shall establish New York (aggregate A/B/C interface and aggregate J/K interface) Desired Flow (NYDF) schedules for NYISO Day Ahead. The default distribution of flows of 1/3 each for A, B, C and ½ each for J, K. The NY-ISO shall establish the distribution of flows for the NYISO DAM. The NY-ISO shall run the New York Day Ahead. The NY-ISO shall post DAM results. The NY-ISO shall provide NYDF schedules and post nodal prices for the J/K (Ramapo), B/C (Farragut) and A (Goethals) pricing points. Under outage conditions of the A, B, C, J, or K lines, the initial estimate of individual line flow distribution shall be based on an assumption that flows should be equalized among those remaining lines comprising the interface.
PSE&G Actions
ConEd Actions
ConEd shall submit a contract election (PJM-DAE) in the PJM Day Ahead Market prior to 12 noon: ConEd shall submit a contract election for the 600 MW contract **and** ConEd shall submit a contract election for the 400 MW contract.

2.3 After PJM Market closes

PJM Actions
PJM shall establish the PJM (aggregate A/B/C interface and aggregate J/K interface) Desired Flow (PJMDF) schedules for PJM Day Ahead. PJM shall establish the distribution of flows for the PJM DAM. The default distribution of flows of 1/3 each for A, B, C and ½ each for J, K. The NY-ISO shall establish the distribution of flows for the NY-ISO DAM. PJM shall run the PJM Day Ahead Market. The amount of the PJM-DAE which clears will become the PJM Day Ahead Schedule amount (PJM-DAS). PJM Day Ahead results shall be posted. The PJM posting will include the PJM-DAS, nodal prices for the J/K (Waldwick), B/C (Hudson) and A (Linden) pricing points. Under outage conditions of the A, B, C, J, or K lines, the initial estimate of individual line flow distribution shall be based on an assumption that flows should be equalized among those remaining lines comprising the interface.
NY-ISO Actions
PSE&G Actions
ConEd Actions

3.0 In Day Operations:

3.1 Schedule Coordination and Schedule Changes

ConEd Actions
ConEd will submit schedule change or schedule confirmation 75 minutes before each hour to NYISO. ConEd shall have the option to request a modification in the Real-Time Market from its Day Ahead Market election (NY_DAE and PJM_DAE) for each hour. ConEd must request a Real-Time election (RTE) modification through NYISO at least 75 minutes prior to the dispatch hour (or a shorter notice period that is agreed upon by the NY-ISO and PJM.).
NY-ISO Actions
The NY-ISO shall notify PJM and ConEd of the schedule change (RTE) through a phone call and updating the schedule in the EMS (ISN / ICCP data exchange). NYISO shall calculate the aggregate A/B/C and aggregate J/K Real-Time Market Desired Flows (RTMDF) in real time, continuous throughout the operating day, and provide them to PJM through ISN / ICCP data exchange. The desired distribution of flows on the A, B, C, J, and K lines for the in-day markets shall be established by PJM and the NY-ISO in accordance with Appendix 7. The actual A/B/C interface flows shall be within +/- 100 MW of the aggregate RTMDF for the A/B/C interface and aggregate actual J/K interface flows shall be within +/- 100 MW of the aggregate RTMDF for the J/K interface. Note - Actions taken in these steps will be logged, and PSE&G and ConEd will be notified of PAR moves related to these steps.
PJM Actions
PJM operator will get schedule change from NY-ISO through ISN / ICCP and / or phone call. Note – Schedule change will be entered into DMT by the Transaction Coordinators in order for settlements to receive the real-time election. PJM shall calculate the aggregate A/B/C and aggregate J/K Real-Time Market Desired Flows (RTMDF) in real time, continuous throughout the operating day, and provide them to NYISO and PSE&G through ISN / ICCP data exchange. The desired distribution of flows on the A, B, C, J, and K lines for the in-day markets shall be established by PJM and the NY-ISO in accordance with Appendix 7. The actual A/B/C interface flows shall be within +/- 100 MW of the aggregate RTMDF for the A/B/C interface and aggregate actual J/K interface flows shall be within +/- 100 MW of the aggregate RTMDF for the J/K interface. Note - Actions taken in these steps will be logged, and PSE&G and ConEd will be notified of PAR moves related to these steps.
PSE&G

4.0 If there is In-Day Congestion:

These steps should be taken by PJM and NYISO Dispatchers, in the following order, to maintain the actual flow on the JK and ABC interfaces to within +/-100MWs of their Desired Flows:

4.1 Coordinate PAR adjustments to align the desired flows on A, B, C, J, and K within predefined thresholds.

4.2 NYISO may request an adjustment to the flow distribution for ABC, moving flow from the A line to the B and C lines, provided that the adjustment does not exceed 125 MW if it would cause or increase off-cost conditions in PJM. The NYISO shall notify PJM and ConEd of this change through a phone call and this value should also be entered by NYISO dispatchers into their EMS, at which point it will become available to PJM via ICCP link.

4.2.1 If NYISO limits the A-Line flow, any amount redistributed in excess of 125 MW should be adjusted using the Desired Flow Offset.

4.2.2 All instances of redistribution of flow outside of the 125MW bandwidth for the A line must be logged.

4.3 Coordinate Ramapo PAR adjustments on the 5018

4.4 Curtail all transactions that are "Not Willing to Pay Congestion"

NOTE: This is a PJM action only.

4.5 Rebalance the A line flows back within the 125MW bandwidth (see step 4.2). If rebalance is not achievable, confirm a Desired Flow Off-Set has been entered

4.6 Redispatch

4.6.1 If ABC/JK and Ramapo PAR moves are exhausted AND there is congestion, the limited party will redispatch to control the congestion and maintain the Wheel.

4.6.2 However, if the Wheel is outside of the 100MW bandwidth, PAR moves are exhausted AND there is **<u>no congestion</u>**, redispatch will **<u>NOT</u>** be initiated.

4.7 The limited party will issue a TLR 3a/b on the appropriate Flowgate in order to curtail all remaining non-firm contracts.

4.8 If all of the above options have been exhausted, coordinate a Desired Flow Offset

5.0 <u>Operation of the PARs</u>

5.1 <u>General</u>

PJM and the NY-ISO have operational control of all PARs and direct the operation of the PARs, while PSE&G and ConEd have physical control of the PARs. The ConEd dispatcher adjusts the PAR taps at Ramapo, Goethals and Farragut at the direction of the NYISO. The PSE&G dispatchers set the PAR taps at Waldwick at the direction of PJM.

This procedure outlines the steps taken to coordinate tap changes on the PARs in order to control power flow on selected transmission lines between New York and New Jersey. The facilities are used to provide transmission service and to satisfy the 600/400 MW contracts, other third party uses, and to provide emergency assistance as required. These tie-lines are part of the interconnection between the PJM and NYISO. These PAR operations will be coordinated with the operation of other PAR facilities including the 5018 PARs. The 5018 PAR will be operated taking into account this Operating Protocol.

The ties are controlled by PARs at the following locations:

- Waldwick (F-2258, E-2257, O-2267)
- Goethals (A-2253)
- Farragut (C-3403, B-3402)
- Ramapo (5018)

This section addresses the operation of the PARs at Waldwick, Goethals, and Farragut as these primarily impact the delivery associated with the 600/400 MW contracts between PSE&G and ConEd.

PJM and the NY-ISO will work together to maintain reliable system operation, and to implement the "RTMDF" within the bandwidths established by this Operating Protocol while endeavoring to minimize the PAR tap changes.

RTMDF calculations will be made for the 'ABC Interface', and the 'JK Interface'. Desired line flow calculations will be made for A, B, and C lines (default loading is balanced each 1/3 of the ABC Interface), and for the J and K lines (default loading is balanced each ½ of the JK Interface).

6.0 <u>Normal Operations</u>

The desired flow calculation process is a coordinated effort between PJM and the NY-ISO. PJM and the NY-ISO have the responsibility to direct the operation of the PARs to ensure compliance with the requirements of the Operating Protocol. However, one of the objectives of this procedure is to minimize the movement of PARs while implementing the requirements of the 600/400 MW contracts. PJM and the NYISO will employ a +/- 100 MW bandwidth for each of the ABC and JK Interfaces to ensure that actual flows are maintained at acceptable levels.

In general, PAR Tap movements shall be limited to 400 per month based on an average of 20 operations (per PAR) in a 24-hour period. If, in attempting to maintain the desired bandwidth, tap movements exceed these limits, then the bandwidth shall be increased in 50 MW increments until the tap movements no longer exceed 20 per day, unless PJM and the NY-ISO agree otherwise. It will be the responsibility of both ConEd and PSE&G to report violations of the tap movement limits to NYISO and PJM.

7.0 Emergency Operations

If an emergency condition exists in either the NY-ISO or PJM, the NY-ISO dispatcher or PJM dispatcher may request that the tie line flows between New York and New Jersey be adjusted to assist directing power flows in the respective areas to alleviate the emergency situation. The taps on the PARs at Waldwick, Goethals, and Farragut may be moved either in tandem or individually as needed to mitigate the emergency condition. Cooperatively responding to emergency conditions in either the NY-ISO or PJM overrides any requirements of this Protocol for the duration of the declared emergency. Details describing the Emergency shall be logged.

8.0 Transmission Constraints and Outages Associated with the Contracts

8.1 Constraints

The following transmission constraints are identified as potential constraints that may result in off-cost operation due to transfers associated with the 600/400 MW contracts. The constraints included in the listing should be considered representative of the kinds of constraints that may exist within PJM or NY-ISO. If such transmission constraints are limiting, then the affected ISO/RTO may be subject to off-cost operation due to transfers associated with the 600/400 MW contracts. Other constraints, not listed here, may arise that could cause either ISO/RTO to operate off-cost. This list may be revised by NY-ISO/PJM to reflect system changes or security monitoring technique changes in their respective Balancing Authorities.

NY-ISO

- UPNY-ConEd Interface
- Dunwoodie-South Interface
- Dunwoodie-Mott Haven - Rainey 345 KV
- Rainey-Farragut 345 KV
- Sprainbrook-W49th Street 345 KV
- W49th Street-Farragut 345 KV
- Ramapo-Ladentown 345 KV
- Ramapo-Buchanan 345 KV
- Buchanan-Millwood 345 KV
- Buchanan-Eastview 345 KV
- Millwood-Eastview 345 KV
- Eastview-Sprainbrook 345 KV
- East Fishkill-Pleasantville 345 KV
- Pleasantville-Dunwoodie 345 KV
- Pleasant Valley-East Fishkill 345 KV

- Linden-Goethals 230 KV A-2253 PAR
- Farragut-Hudson 345 KV B-3402 PAR
- Farragut-Hudson 345 KV C-3403 PAR
- Waldwick – South Mahwah 345 KV K-3411
- Waldwick – South Mahwah 345 KV J-3410

PJM

- Athenia 230 KV Athenia 220-2 xformer
- Athenia 230 KV Athenia 220-1 xformer
- Branchburg 500 KV Branchburg 500-1 xformer
- Branchburg 500 KV Branchburg 500-2 xformer
- Branchburg 500 KV Branchburg 500-3 xformer
- Deans 500 KV Deans 500-1 xformer
- Deans 500 KV Deans 500-2 xformer
- Deans 500 KV Deans 500-3 xformer
- Hudson 230 KV Hudson Hudson2 xformer
- Interface East
- Athenia-E Rutherford S-1345 138 KV
- Bayonne-Marion L-1338 138 KV
- Bayonne-PVSC I-1335 138 KV
- Bergen-E Rutherford R-1344 138 KV
- Bergen-Homestead F-1306 138 KV
- Brunswick-Edison H-1360 138 KV
- Edison-Meadow Road Q-1317 138 KV
- Edison Meadow Road R-1318 138 KV
- Linden-North Avenue T-1346 138 KV
- Plainsboro-Trenton D-1330 138 KV
- Adams-Bennetts Lane V-2248-3 230 KV
- Athenia-Clifton PS K-2263 230 KV
- Athenia-Saddlebrook Q-2217 230 KV
- Bergen-Hoboken R-2270 230 KV
- Bergen-Leonia T-2272 230 KV

- Branchburg-Somerville C-2203 230 KV
- Branchburg-Readington M-2265 230 KV
- Cedar Grove-Clifton PS K-2263-3 230 KV
- Cedar Grove-Roseland Y-2277 230 KV
- Cedar Grove-Roseland F-2206 230 KV
- Goethals-Linden A-2253 230 KV
- Greystone-Portland S1007 230 KV
- Hawthorne-Hinchmans Ave N-2266 230 KV
- Hillsdale-New Milford V-2222 230 KV
- Hoboken-Newport PS R-2270 230 KV
- Leonia-New Milford O-2293 230 KV
- Roseland-Whippany A-941 230 KV
- Branchburg-Ramapo 5018 500KV
- Goethals-Linden 230 KV A-2253 PAR or Circuit
- Hudson-Farragut 345 KV B-3402 PAR or Circuit
- Hudson-Farragut 345 KV C-3403 PAR or Circuit
- Waldwick-Fairlawn 230 KV O-2267 PAR or Circuit
- Waldwick-Hawthorne 230 KV E-2257 PAR or Circuit
- Waldwick-Hillsdale 230 KV F-2258 PAR or Circuit
- Waldwick-South Mahwah 345 KV K-3411
- Waldwick-South Mahwah 345 KV J-3410

8.2 Outages

600 MW Contract – It is not anticipated that one primary facility outage will preclude PJM from providing redispatch for the 600 MW contract. However, combinations of two or more outages of the facilities, listed below, could preclude PJM from accommodating all or part of the 600 MW delivery, even with redispatch. In this case, PJM will provide notification to NYISO.

400 MW Contract – The outage of one or more facilities in the following list, may impact redispatch costs regarding the delivery of all or portions of the 400 MW contract:

- Branchburg-Ramapo 500 KV 5018
- South Mahwah-Waldwick J 345 KV J-3410/69
- South Mahwah-Waldwick K 345 KV K-3411/70

- Hudson-Farragut B-3402
- Hudson-Farragut C-3403
- Linden-Goethals 230 KV A-2253
- Athenia-NJT Meadows- Essex-Hudson 230 KV C-2281-P-2216-A-2227
- New Milford-Leonia-Bergen-Penhorn-Hudson 230 KV O-2293-T-2272-X-2250
- Waldwick-Hillsdale-New Milford 230 KV F-2258-V-2222
- Waldwick-Fairlawn 230 KV O-2267
- Waldwick-Hawthorne-Hinchmans Ave-Cedar Grove 230 KV E-2257 – N-2266-M-2239-L-2238
- Roseland-Cedar Grove-Clifton-Athenia B 230 KV Y-2277-B-2228
- Roseland-Cedar Grove-Clifton-Athenia K 230 KV F-2206-K-2263
- Linden-Bayway 230 KV H-2234
- Linden-Minue Street R 230 KV R-2218
- Linden-Minue Street G 230 KV G-2207
- Roseland-Whippany A-941
- Branchburg-Readington-Roseland M-2265-U-2221
- Roseland-Montville-Newton-Kittatinny E-2203 – N-2214-T-2298
- Deans-Aldene W-2249

In addition, forced or maintenance outages of one or more of the following generators may impact redispatch costs regarding the delivery of all or portions of the 400 MW contract provided that any such maintenance outage is approved by PJM. Otherwise, each of these generators will be considered to be available to support the 600/400 MW contracts under a security constrained dispatch in PJM's Day-Ahead and Real-Time Markets.

- Hudson #1
- Hudson #2
- Bergen #1
- Bergen #2
- Linden #1
- Linden #5, 6, 7, 8

5018 Branchburg – Ramapo PAR Coordination

- PJM and the NYISO have developed a summary guide to assist operators to meet the requirements of the Market to Market/Ramapo Coordination Agreement Movement of the 5018 PAR is based on a certain set of criteria that is triggered based upon "Ramapo Congestion". This procedure does not take precedent over the Con ED/PSE&G A-B-C and J-K Wheeling Agreement.
    - "Ramapo Congestion" - is the difference between the Ramapo congestion component pieces of the LMPs at Branchburg (PJM) and Ramapo (NYISO). If the difference between these two values is anything but zero, there is Ramapo Congestion.
    - Flowgates that can impact "Ramapo Congestion" are called "Ramapo Coordinated Flowgates"
- Target Ramapo = (RamapoInterchangeFactor) + (ActualJK + RECo_Load – ActualABC) – (Auto Correction FactorJK – Auto Correction FactorABC)

Where,

$Target_{Ramapo}$ = Calculated Target Value for the flow on each Ramapo PAR (PAR3500 and PAR4500)

RamapoInterchangeFactor = 61% of the net interchange schedule between PJM and NYISO over the AC tie lines distributed evenly across the in-service Ramapo PARs; A positive value indicates flows from PJM to NYISO and a negative value indicates flows from NYISO to PJM.

$Actual_{JK}$ = Telemetered real-time flow over the JK interface. A positive value indicates flows from NYISO to PJM and a negative value indicates flows from PJM to NYISO.

RECo_Load = 80% of the telemetered real-time Rockland Electric Company Load

$Actual_{ABC}$ = Telemetered real-time flow over the ABC interface. A positive value indicates flows from PJM to NYISO and a negative value indicates flows from NYISO to PJM.

Auto Correction $Factor_{JK}$ = The JK interface Auto Correction component of the JK interface real-time desired flow as described in Schedule C to the Agreement. A positive value indicates flows from NYISO to PJM and a negative value indicates flows from PJM to NYISO

Auto Correction $Factor_{ABC}$ = The ABC interface Auto Correction component of the ABC interface real-time desired flow as described in Schedule C to the Agreement. A positive value indicates flows from PJM to NYISO and a negative value indicates flows from NYISO to PJM.

- When there is no Ramapo Congestion, a bandwidth of 200 mw will be used to determine when the PAR will be moved.
- When Ramapo Congestion exists, the parties will coordinate to reduce overall system congestion.

- If either PJM, NYISO, PSE&G, or ConEd declares an Emergency Procedure, maintaining system reliability has precedence over the Market to Market/Ramapo Coordination Agreement.

Suspension of M2M Settlement when a request for Taps on Common PARs to Prevent Overuse is Refused:

- If a Party requests that taps be taken on any Common PAR to reduce the requesting Party's overuse of the other Party's transmission system, refusal by the other Party or its Transmission Owner(s) to permit taps to be taken to reduce overuse shall result in the Ramapo PAR settlement component of M2M being suspended for the requesting Party until the tap request is granted. The refusing Party shall not be relieved of any of its M2M settlement obligations.
    - The Ramapo 3500 and Ramapo 4500 PAR status should be set to unavailable in the NYISO EMS during these conditions and shall be coordinated between NYISO and PJM.

➢ If the congestion patterns shift or PAR taps are allowed and taken so that Overuse is no longer occurring the Ramapo 3500 and Ramapo 4500 PAR status should be set to available in the NYISO EMS and shall be coordinated between NYISO and PJM

- The Parties shall suspend Ramapo PAR settlements when: (a) the Branchburg – Ramapo 500kV 5018 transmission line is out of service; or (b) there is a simultaneous outage of Ramapo PAR3500 and Ramapo PAR4500;
    - The Ramapo 3500 and Ramapo 4500 PAR status should be set to unavailable in the NYISO EMS during these conditions and shall be coordinated between NYISO and PJM
- All actions taken should be logged.

PROCEDURE with NO Ramapo Congestion:

- PJM and NYISO will coordinate the 5018 Branchburg-Ramapo PAR to maintain the flow of the Branchburg – Ramapo 500kV line within the +/- 200 MW desired flow bandwidth at all times, provided doing so does not adversely impact the Con ED/PSE&G A-B-C and J-K Wheeling Agreement or create congestion as indicated below.

PROCEDURE with Ramapo Congestion:

- NYISO and PJM will bind internal constraints following their normal processes. No special steps are required to "activate" Ramapo Coordinated Flowgates. The impacts are automatically reflected in the congestion component of the LMPs.

- When Ramapo Congestion exists in either NYISO or PJM, the operators will coordinate to move the 5018 PARs, regardless of the Target Flow and its associated bandwidth, in the direction that will reduce overall Ramapo Congestion
- Example:
  - Ramapo Congestion Cost in NYISO is $100.
  - Congestion cost in PJM is $50.
  - The NYISO and PJM operators will coordinate to move the 5018 PARs toward NYISO to reduce the congestion cost. PAR moves will be taken until the congestion is balanced between the two systems (i.e. overall congestion is reduced).

Loop Flows around Lake Erie (MISO, NY-ISO, IMO & PJM)

As a result of natural circulation and scheduled transactions, it is expected that moderate to heavy circulating flows around Lake Erie may result in transmission limitations. Whenever additional transfers are made between certain different Balancing Authorities, limitations may develop that require adjustments in these transfers in order to remain within first-contingency limits. Loop power flows that occur in PJM or an adjoining operating area can result in serious difficulties that adversely affect the reliability of the member systems. It is important to have an understanding of the way in which changes in generation and transmission can influence these circulating power flows. With this knowledge and by utilizing full communication between Balancing Authorities concerning outages to key facilities and scheduled interconnection interchanges, it is possible to correct the power flows causing the difficulties.

In the event that a problem does occur, it is important to have corrective procedures that stipulate the responsibilities of affected Balancing Authorities and give guidance with respect to priorities. If at any time a loop power flow condition arises which may jeopardize any individual Balancing Authority’s reliability, then certain principles apply and are described in the PJM Balancing Operations Manual and the PJM Emergency Operations Manual.

As a NERC Reliability Coordinator, PJM observes and implements NERC Transmission Load Relief (TLR) Procedure in accordance with NERC Standards.

PJM also participates in the Lake Erie Emergency Re-dispatch (LEER) Agreement to facilitate emergency re-dispatch among Balancing Authorities surrounding Lake Erie (MISO, NY-ISO, IMO, and PJM) to avoid the shedding of firm customer load.

Recognition of Automatic Sectionalizing Schemes

Several PJM transmission owners use line and substation designs that automatically switch equipment in order to isolate faulted system elements (e.g., a line or a transformer) from unfaulted elements. Within the protection schemes for these system elements, sufficient fault detection and control capability is provided to automatically isolate the faulted element and then restore remaining equipment to service.

Recognition of these design features is integrated into PJM operational systems by the selective utilization of short term (load dump) thermal ratings when performing contingency analysis for the loss of the multiple element configuration and utilizing emergency thermal ratings for contingency analysis for the individual elements of the multiple element configuration. This analytical approach ensures that following the normal operation of the automatic sectionalizing scheme, there will be no violations of emergency thermal ratings and that there will be no violations of load dump thermal ratings during the period when the multiple element contingency has occurred. The *Voltage and Stability Operating Guidelines* outlined in Section 3 of this manual will continue to be applied with the analysis for these criteria utilizing the loss of the multiple element configurations.

The identification and qualifying analysis for automatic sectionalizing schemes follows these process steps:

- The transmission owner identifies a candidate automatic sectionalizing scheme and provides PJM with specific information to permit analysis of the scheme. Technical information provided for the candidate scheme includes:
- A description of the transmission elements currently monitored as a multiple element contingency
- A description of those elements that will be isolated and either remain out of service or restored for successful operation of the automatic sectionalizing scheme
- PJM performs analysis to ensure that there are no voltage collapse or stability concerns with the operation of the transmission system utilizing the candidate scheme and the associated load dump ratings.

If the candidate scheme passes the qualifying analysis, PJM staff, with input from the Transmission Owner, develops appropriate documentation and discusses the candidate scheme at the following PJM Committees:

- System Operation Subcommittee and Dispatcher Training Task Force
- Operating Committee
- Planning Committee
- Market Implementation Committee
- Markets and Reliability Committee

Documentation for the candidate scheme will include:

- Descriptive information on the scheme as provided by the transmission owner
- Any proposed manual revisions to provide on-going documentation of the scheme and its operational characteristics.

Following discussion of the candidate scheme with the Committees, PJM will proceed with the implementation of appropriate system changes to recognize the scheme with the formal integration of the scheme into PJM systems occurring not earlier than 90 days after the final committee review unless required for reliability, operational performance, or to restore the system to the state existing prior to a significant transmission facility event, in which case the scheme will be implemented as soon as practicable. PJM will conduct an annual review of automatic sectionalizing schemes to ensure that the results of the initial qualifying analysis remain in effect. A list of accepted Automatic Sectionalizing Schemes is located in Attachment E.

Automatic Special Protection Scheme (SPS) Operating Criteria

Under normal operating conditions, PJM's EMS will perform an N-1 contingency analysis for the loss of each Bulk Electric System line and transformer within the PJM RTO. PJM will then control as indicated in **Manual M-03 Section 3: Thermal Operating Criteria**.

When PJM's EMS indicates that a simulated N-1 contingency will result in an overload on a facility that can be mitigated by a Special Protection Scheme (SPS) that has been documented in **PJM Manual M-03 Section 5: "Index and Operating Procedures for PJM RTO Operation"***, the following actions should be taken:

PJM Actions:

1.) PJM will contact the Transmission Owner based on EMS results and direct the SPS to be changed from its 'Normal Status' (enabled/disabled). PJM will also verify that the SPS is operational and that its status can be changed.

2.) Once the Transmission Owner has changed the SPS status, PJM will modify the contingency definition(s) to simulate the N-1 condition and the subsequent activation of the associated SPS within the PJM EMS System.

3.) PJM will log activation/deactivation for an SPS that is a change from its 'Normal Status'

4.) PJM will control all actual facility loadings below the normal ratings and all subsequent contingency loadings below the emergency limits as indicated in **PJM Manual M-03, Section 3: Thermal Operating Criteria**.

TO Actions:

Upon PJM's direction, for any SPS involving a transmission line, the TO will change the SPS from its 'Normal Status' (enable/disable)

The TO will not place the SPS back in its 'Normal Status' until PJM has directed to do so.

GO Actions:

Upon PJM' direction, for any SPS involving a generating unit, the GO will change the SPS from its 'Normal Status' (enable/disable)

The GO will not place the SPS back in its 'Normal Status' until PJM has directed to do so.

Note: PJM does not receive telemetered status of all SPS schemes (with the exception of Bath County and a few others). Unless a change in status is directed by PJM, the PJM TO and GO notify PJM of any change in status from 'Normal Status' (enabled/disabled). PJM logs all such changes and modifies contingency definitions within the PJM EMS to reflect such changes.

Due to the redundancy built into each SPS, PJM considers the loss of a facility and the subsequent failure of the associated SPS to be a double contingency. Therefore, PJM will not take any pre-contingency actions to control for this N-2 scenario.

*PJM will not recognize a Special Protection Scheme (SPS) in Real Time operations unless it has been documented in PJM Manual M-03 Section 5: "Index and Operating Procedures for PJM RTO Operations" and gone through the Committee Structure for approval as indicated in PJM Manual M-03 Section 1: "Transmission Operations Requirements".

Voltage Control at Nuclear Stations

NUCLEAR VOLTAGE LIMITS

The following table contains voltage limits for nuclear facilities within the PJM RTO footprint where they deviate from PJM default voltage limits.

Facility	Owner	Trans Zone	NL*	EL	Voltage Drop	NH
Calvert Cliffs (P-13000-1 or P-13000-2 outaged)	Constellation	BG&E	520.0	510.0	N/A	N/A
Dresden 2 – TR 86 LTC in AUTO	Exelon	Comed	328.6	328.5	2.8%	N/A
Dresden 2 – TR 86 LTC in MANUAL*	Exelon	Comed	341.8	341.7	N/A	N/A
Dresden 3 – TR 32 LTC in AUTO	Exelon	Comed	328.6	328.5	3.6%	N/A
Dresden 3 – TR 32 LTC in MANUAL*	Exelon	Comed	340.7	340.6	N/A	N/A
Byron U1 & U2	Exelon	Comed	341.4	341.4	N/A	N/A
Quad Cities	Exelon	Comed	348.3	348.2	N/A	N/A
Braidwood U1	Exelon	Comed	349.3	349.2	N/A	N/A
Braidwood U2	Exelon	Comed	349.3	349.2	N/A	N/A
LaSalle U1 & U2	Exelon	Comed	353.1	353.0	N/A	N/A
TMI	Exelon	FE-E (ME)	223.0	223.0	N/A	N/A
Oyster Creek	Exelon	FE-E (JC)	227.0	223.7	N/A	N/A
Peach Bottom Unit #2 (Peach Bottom 230kV limits)	Exelon	PECO	225.0	225.0	1.3%	N/A
Peach Bottom Unit #2 (Peach Bottom Tap 230kV Limits)	Exelon	PECO	225.0	225.0	1.8%	N/A

Facility	Owner	Trans Zone	NL*	EL	Voltage Drop	NH
Peach Bottom Unit #2 (13kV Tertiary Tap Limits)	Exelon	PECO	13.5	13.5	1.5%	N/A
Peach Bottom Unit #2 (Peach Bottom 500kV Limits)	Exelon	PECO	500.0	485.0	N/A	538.0
Peach Bottom Unit #3 (Peach Bottom 230kV limits)	Exelon	PECO	225.0	225.0	1.3%	N/A
Peach Bottom Unit #3 (Peach Bottom Tap 230kV Limits)	Exelon	PECO	225.0	225.0	1.8%	N/A
Peach Bottom Unit #3 (13kV Tertiary Tap Limits)	Exelon	PECO	13.5	13.5	1.5%	N/A
Peach Bottom Unit #3 (Peach Bottom 500kV Limits)	Exelon	PECO	500.0	485.0	N/A	538.0
Limerick Unit #1 500kV Limits	Exelon	PECO	500.0	500.0	2.5%	N/A
Limerick Unit #1 230kV Limits	Exelon	PECO	225.5	225.0	2.5%	N/A
Limerick Unit #1 (Limerick Tap 69kV Limits)	Exelon	PECO	67.5*	N/A	2.9%*	N/A
Limerick Unit #2 500kV Limits	Exelon	PECO	500.0	500.0	2.5%	N/A
Limerick Unit #2 230kV Limits	Exelon	PECO	225.0	225.0	2.5%	N/A
Limerick Unit #2 (Limerick Tap 69kV Limits)	Exelon	PECO	67.5*	N/A	2.9%*	N/A
Hope Creek 1	PS	PS	500.0	493.0	2.5%	N/A
Salem 1	PS	PS	500.0	493.0	2.0%	N/A
Salem 2	PS	PS	500.0	493.0	2.0%	N/A
Susquehanna 230kV T10 bus limit with only one start-up transformer (T10 or T20) in service	PL	PL	216.7	216.7	2.0%	N/A
Susquehanna 230kV T20 bus limit with only one start-up transformer (T10 or T20) in service	PL	PL	216.7	216.7	2.0%	N/A

Facility	Owner	Trans Zone	NL*	EL	Voltage Drop	NH
Susquehanna 230kV T10 bus limit with both start-up transformers (T10 & T20) in service	PL	PL	212.0	212.0	5.0%	N/A
Susquehanna 230kV T20 bus limit with both start-up transformers (T10 & T20) in service	PL	PL	212.0	212.0	5.0%	N/A
N. Anna Unit #1 & Unit #2 (N.Anna 500kV Bus Limits)	DVP	Dominion	510.0	505.0	3.5%	535.5.
N. Anna Unit #1 & Unit #2 (N.Anna 230kV Bus Limits)	DVP	Dominion	226.3	224.0	3.5%	239.2
Surry Unit #1 & Unit #2 (Surry 500kV Bus Limits)	DVP	Dominion	510.0	505.0	4.5%	530.0
Surry Unit #1 & Unit #2 (Surry 230kV Bus Limits)	DVP	Dominion	222.3	220.0	6.0%	239.2
Beaver Valley Unit 1 (345kV Limits)	First Energy	Duquesne	342.5	339.8	N/A	355.0
Beaver Valley Unit 2 (345kV Limits)	First Energy	Duquesne	342.5	339.8	N/A	355.0
Beaver Valley Unit 1 (138kV Limits)	First Energy	Duquesne	135.5	131.0	0.5%	142.5
Beaver Valley Unit 2 (138kV Limits)	First Energy	Duquesne	135.5	131.0	0.5%	142.5
Davis-Besse 345kV Limits	First Energy	ATSI	340.8	339.1	N/A	356.4
Perry 345kV Limits	First Energy	ATSI	334.6	332.9	N/A	351.9

* Notes:

NL:

Facilities with NL less than 3 kV higher than the EM limit will have their NL limit increased in the PJM EMS to 3 kV higher than the EM to allow for contingency trending.

Limerick:

The Limerick Tap 69kV Power Source is an additional source that PECO/Exelon can energize to supply station service power to Limerick. It is normally out of service with the limits only applicable when the Limerick Tap 69kV Power Source is in service.

2 weeks advance notice is required for events requiring the use of the Limerick Tap 69kV Power Source. Exelon/Constellation will enter the following information into the PJM E-Dart system as a Generator Outage Ticket - 0 MW reduction with the information below in the comments field.

a) Unit # (1 or 2)

b) Status of Limerick Tap 69kV Power Source

c) Reason (Ex: Limerick Primary Power Source out of service)

d) Start time and date of event

d) Duration (If known)

2 hours prior to energizing the Limerick Tap 69kV Power Source, Limerick will verbally communicate to the TSO that the Limerick Tap 69kV Power Source will be in-service and that the Limerick Tap 69kV Nuclear Voltage Limits must be monitored. TSO will communicate the verbal notification to PJM. TSO and PJM will analyze system conditions using EMS State Estimation and adjust the system as appropriate to maintain elevated voltages while the Limerick Tap 69kV Power Source is in-service.

Limerick will verbally communicate with the TSO after the Limerick Tap 69kV Power Source has been removed from service. TSO will communicate to PJM the removal of the Limerick Tap 69kV Power Source. This notification will trigger the removal of the Limerick Tap 69kV Nuclear Voltage Limit monitoring from the TSO and PJM state estimators.

For emergent events, Limerick will verbally communicate to the TSO and Exelon/Constellation when the Limerick Tap 69kV Power Source is required and the state estimator limits must be changed to monitor the Limerick Tap Nuclear Voltage limits. The TSO and PJM will perform an evaluation within 20 minutes of the notification to determine whether the Limerick actual and post trip contingency voltages are within the Limerick Tap 69kV Nuclear Voltage Limits.

Dresden:

Dresden normally operates with their LTC in Auto Operations. Dresden is required to operate to higher voltage limits when the associated LTC is placed in manual mode. The communication requirements for operating the Dresden LTCs in manual are as follows:

1. Advance notice: 2 weeks for an event requiring Manual LTC operation:

Exelon/Constellation will enter the following information into the PJM E-Dart system as a Generator Outage Ticket - 0 MW reduction with the information below in the comments field.

a) Unit # (2 or 3)

b) Voltage limit required (number)

c) Reason (Example: Dresden Diesel Testing: LTC Manual)

d) Start time and date of event

d) Duration (If known)

PJM and ComEd Transmission System Operations (TSO) will perform advance studies based on the above information to ensure adequate actual and post trip contingency voltage is maintained during the scheduled event. Notifications should be initiated to the Exelon Nuclear (NDO) if off-cost generation must be authorized. The PJM MC will send an e-mail to PJM Reliability Engineers regarding the eDART ticket number requiring higher voltage limits.

2. Notification two-hour prior to event:

Dresden will verbally communicate to the TSO that the LTC Manual Voltage Limit is required. TSO will communicate the verbal notification to PJM. This two-hour prior notification is the trigger to change the state estimator in the TSO and PJM EMS*, performing additional real-time analysis and adjusting the system as appropriate to maintain elevated voltages while the LTC is in manual.

*The PJM Western Region Dispatcher will manually update the EMS Emergency Low Voltage limits, via display ‘Disp > SA Config > Thresholds > Busbar’ as follows:

a) For the Dresden TR32 LTC Control Mode changes, update all Dresden 345kV emergency low voltages limits labeled “VLRED”.

b) For the Dresden TR86 LTC Control Mode changes, update all Dresden 345kV emergency low voltage limits labeled “VLBLUE”.

3. Returning the transformer LTC to automatic:

Dresden will verbally communicate with TSO after the LTC has been returned to automatic. TSO will communicate to PJM the return of the LTC to automatic. The communication will trigger returning the TSO and PJM state estimator to the automatic limit.

4. Emergent events requiring a transformer LTC to be placed in manual:

Dresden will verbally communicate to TSO and Exelon/Constellation that a transformer LTC has been placed in manual and that the state estimator limit must be changed to the manual limit. The communication should occur as soon as possible. TSO will communicate with PJM that the state estimator limit is to be changed to the manual limit and TSO will perform an evaluation within 20 minutes of the notification to determine whether the Dresden actual and post trip contingency voltages are within the LTC manual voltage limits.

Day-Ahead actions:

The Reliability Engineer (RE) shall perform day-ahead studies to identify reliability issues for the RTO. As part of those studies, the RE will identify potential voltage violations at the Nuclear plants, according to the following guidelines:

- Whenever a post-contingency low voltage is seen at a nuclear station for loss of a generator at this same station in the EMS study output display, this would be the flag that indicates possible low voltage or voltage drop violation and trigger the notification protocol.

- Additionally, the day-ahead analysis should confirm that the studied generation pattern is not masking potential nuclear voltage violations with specific attention paid to the status of generation that may be assumed to be on over the peak hours due to cost (economics) but in actual operation may need to be brought on-line earlier in the day due to post-contingency low voltages.

1. The appropriate PD will inform the impacted transmission zone, who in turn will inform the Nuclear Duty Officer (NDO). The notification may include a request for authorization to operate off-cost generation to prevent a violation of the limit. (There will be cases where the notification will not trigger the need for off-cost generation. The Nuclear Plant may decide to reconfigure their system or adjust maintenance activities to mitigate the potential violation.)

Real-Time Operator actions:

1. As actual voltages or post-contingency voltages approach (generally ~3 kV) the defined limits for the loss of a nuclear generator, the PJM dispatcher will evaluate corrective options and communicate recommended actions to the impacted transmission zone. (There will be cases where the notification will not trigger the need for off-cost generation. The Nuclear plant may decide to reconfigure their system or adjust maintenance activities to mitigate the potential violation.)
2. If the nuclear plant has already pre-authorized the operation of generation, based on day-ahead analysis results, then immediately proceed to load the most effective, available generation to prevent reaching the limit.

   <u>For post-contingency voltages that result from the loss of a Nuclear generating unit;</u> If the Nuclear generator, through the transmission zone or Market Operations Center, has already pre-authorized off-cost operation, based on day-ahead analysis results, then immediately proceed to load the most effective, available generation to prevent reaching the limit.

   The transmission owner will inform the nuclear plant of potential or actual voltage violations, contingency element and all corrective measures. If the contingency causing the violation is an affiliate generator then provide the identity of that generator, however, if the contingency is a transmission facility or other generator contingency, then inform them that the contingency is not an affiliate unit tripping - the identity of the transmission facility should not be revealed. If pre-authorization of off-cost operation has not been approved, authorization for off-cost operation should be requested through the nuclear plants MOC.
3. PJM and the transmission owner shall implement all available non-cost options to mitigate the potential voltage violation.
4. PJM, Transmission Owner and the nuclear plant should continue to monitor system and plant conditions and keep each other appraised of changes. PJM should coordinate activities to control the voltage including:
   - Continue evaluating non cost actions

- Nuclear Plant shall evaluate station equipment configuration and determine actions available to permit adjustment to station voltage limit
- If the contingency (loss of nuclear generating unit) voltage limit is approached (~3 kV) or shows Orange on the SA display, inform the Nuclear Plant, through the Transmission Owner, and request authorization to implement redispatch/off-cost operation at the expense of the nuclear plant.
- The Nuclear Plant, through the transmission owner, shall respond (as soon as possible) and either authorizes PJM to implement redispatch/off-cost; provide revised voltage limits; or inform PJM that they do not want PJM to implement redispatch/off-cost and that they will closely monitor the plant operation recognizing that the voltage is lower than the Nuclear Plant defined limit. If applicable, the Nuclear Plant will inform PJM through the Transmission Owner of the potential time required before shutdown. (2 hour clock vs. 7 day clock).
- Corrective measures are to be implemented to prevent reaching the nuclear plant voltage limit.
- If corrective measures are not sufficient to relieve the violations, PJM will inform the Nuclear Plant, through the Transmission Owner, providing information on the voltage violations, including severity and expected duration.

5. Once authorization is received, commence mitigation operations and continue until voltages are within the limits. Called-on generation will be cost-capped if appropriate and will be released if PJM's and/or the Transmission Owner studies indicate the voltages are within the limits again. Details of off cost actions shall be logged for settlement purposes.
6. When the voltage level is no longer an operating limitation, PJM will notify the Nuclear Plant, through the Transmission Owner, that operation for the nuclear plant voltage limit is closed or completed.
7. If no additional corrective measures are available or existing measures are not sufficient to relieve the violations, PJM will inform the Nuclear Plant, through the Transmission Owner, the details of voltage violations, including severity of violations and expected duration.

Corrective Actions (non-cost and off cost)

PJM shall study and implement all non-cost and off cost measures to improve plant voltages within defined limitations. These measures include but are not limited to the following:

Non-Cost Measures

1. Raising the VAR output of other units in the area.
2. Switching of bulk and distribution capacitors in the area.
3. Utilizing the Load Tap Changers (LTC) in the area.

4. Examining other system configuration options such as closing normal-open breakers, voltage schedule adjustments and coordination of area generator reactive output where effective and available. (PJM shall verify with the Transmission Owner the fault duty characteristics of normal-open breakers to determine acceptability of closing, where applicable).

Off-Cost Measures

All of the available non-cost steps shall be completed prior to redispatch. Before the implementation of off cost operations, PJM will confirm with the Nuclear Plant, through the Transmission Owner, the need to redispatch, obtain their authorization for the redispatch, or receive revised internal plant voltage limits. The Nuclear Plant may elect to make other adjustments within their plants to comply with their internal voltage limits.

Notification for Loss of PJM EMS Capability

The Nuclear Plant must be notified via the Transmission Owner if the ability to perform the voltage drop/post-contingency low voltage calculations is lost for any reason. The Nuclear Plant must provide notification to the NRC if the ability to assess the voltage limits is unavailable.

Some Transmission Owner's EMS are not capable of calculating post-contingency voltage drops or post-contingency low voltages. Therefore, the PJM EMS is the only tool available to perform such calculations. If the PJM EMS is not available, the capability to assess the voltage limits may not be available.

Some Transmission Owner's EMS are not capable of calculating post-contingency voltage drops but are capable of calculation post-contingency low voltages. Therefore, the PJM EMS is the only tool available to perform such calculations. If the PJM EMS is not available, the capability to assess the voltage limits may not be available.

Index of Operating Procedures for Atlantic City Electric (AE) Transmission Zone - PHI (Pepco Holdings, Inc.)

The Atlantic City Transmission Zone has Operating Procedures that are adhered to by PJM. These procedures include the following:

	Type of Operating Procedure	Transmission Operations Manual Section Ref
Atlantic City Electric Company (AE) - PHI (Pepco Holdings, Inc.)		
Directional Ratings	Ratings	Section 5 AE
Back To Index		

Directional Ratings

At present, PJM's EMS and TERM both assume the rating for a facility is the same regardless of the direction of the flow. The following facilities have distinct Directional Ratings that are flow dependant.

The Directional Rating is utilized ONLY when a trend indicates actual or contingency flow (as demonstrated via study analysis through the implementation of the contingency in question) is in the direction specified within the table below. If actual or post-contingency flow is in the opposite direction of the table below, the default TERM ratings should be utilized. Summer (59 degree temp set and up) and Winter (50 degree temp set and below) ratings are provided in MVA below.

				Summer		Winter	
Line	kV	From Bus	To Bus	NL	EM	NL	EM
Monroe – Williamstown Tap 0716-1	69	Williamstown Tap	Monroe	123	158	142	178
Clayton – Williamstown Tap 0716-2	69	Williamstown Tap	Clayton	99	111	107	120
Beckett – Deepwater 0722-1	69	Beckett	Deepwater	119	144	142	173

PJM Actions:

If the State Estimator indicates an actual trend on a facility in the table above with MW flow in the direction shown:

- Confirm flow and directional rating with the TO
- If confirmed, utilize the appropriate facility rating in the EMS and log the rating change

If Security Analysis indicates a contingency trend on a facility in the table above:

- Implement the contingency, and examine the post-contingent MW flow

- Confirm the post-contingency flow and directional rating with the TO
- If confirmed, utilize the appropriate facility rating in the EMS and log the rating change

Index of Operating Procedures for Delmarva Power (DPL) Transmission Zone - PHI (Pepco Holdings, Inc.)

The Delmarva Power Transmission Zone has Operating Procedures that are adhered to by PJM. These procedures include the following:

	Type of Operating Procedure	Transmission Operations Manual Section Ref
Delmarva Power (DPL) - PHI (Pepco Holdings, Inc.)		
Directional Ratings	Ratings	Section 5 DPL
Back To Index		

Directional Ratings

At present, PJM's EMS and TERM both assume the rating for a facility is the same regardless of the direction of the flow. The following facilities have distinct Directional Ratings that are flow dependant.

The Directional Rating is utilized ONLY when a trend indicates actual or contingency flow (as demonstrated via study analysis through the implementation of the contingency in question) is in the direction specified within the table below. If actual or post-contingency flow is in the opposite direction of the table below, the default TERM ratings should be utilized. Summer (59 degree temp set and up) and Winter (50 degree temp set and below) ratings are provided in MVA below.

				Summer		Winter	
Line	**kV**	**From Bus**	**To Bus**	**NL**	**EM**	**NL**	**EM**
Indian River – Robisonville 13705	138	Indian River	Robisonville	275	336	317	381

PJM Actions:

- If the State Estimator indicates an actual trend on a facility in the table above with MW flow in the direction shown:
  - Confirm flow and directional rating with the TO
  - If confirmed, utilize the appropriate facility rating in the EMS and log the rating change
- If Security Analysis indicates a contingency trend on a facility in the table above:
  - Implement the contingency, and examine the post-contingent MW flow
  - Confirm the post-contingency flow and directional rating with the TO

If confirmed, utilize the appropriate facility rating in the EMS and log the rating change.

Index of Operating Procedures for American Electric Power (AEP) Transmission Zone

The American Electric Power Transmission Zone has Operating Procedures that are adhered to by PJM. These procedures include the following:

	Type of Operating Procedure	Transmission Operations Manual Section Ref
Cook Unit Isolation on Select Circuits	Unit Isolation	Section 5 - AEP
Kammer Operating Procedures	Limitations	Section 5 - AEP
Conesville 345 kV Plant Operating Guidelines	Unit Stability	Section 5 - AEP
Rockport Operating Guide	Unit Stability	Section 5 - AEP
Smith Mountain 138 kV station Stability	Stability	Section 5 - AEP
Gavin - Mountaineer Stability	Stability	Section 5 - AEP
Tidd 345 kV Station Voltage Concerns	Voltage	Section 5 - AEP
Additional Regional Procedures	Procedures	Section 5 - AEP
Twin Branch – Argenta (Conservative Operations).	Procedures	Section 5 - AEP
Bath County SPS	Protection Scheme	Section 5 DVP
Loop Flows Around Lake Erie (MISO, NY-ISO, IMO & PJM)	Limitations	Section 5 PJM
AEP Single Breaker Derates	Ratings	Section 5 - AEP
Back To Index		

Cook Unit Isolation on Select Circuits

This procedure addresses the possible need to reduce unit outputs at the Cook generating station for certain bus topologies that isolate the units on individual circuits.

AEP Actions:

- AEP maintains voltage schedules as appropriate

PJM Actions:

- PJM determines if there are unit restrictions based on the following table:

Unit isolated on single circuit	Changes to Cook voltage schedules	Cook Unit maximum output
Cook Unit #1 is isolated on Cook-Hiple 345 kV	Maintain 345 bus voltage schedule at 1.03 pu	Unit #1 max is 600 MWN
Cook Unit #1 is isolated on Cook-Twin Branch #1 345 kV	Maintain 345 bus voltage schedule at 1.03 pu	Unit #1 max is 700 MWN
Cook Unit #1 is isolated on Cook-Twin Branch #2 345 kV	Maintain 345 bus voltage schedule at 1.03 pu	Unit #1 max is 600 MWN
Cook Unit #1 is isolated on Cook-Palisades #1 345 kV	Maintain 345 bus voltage schedule at 1.03 pu	Unit #1 max is 550 MWN
Cook Unit #1 is isolated on Cook-Palisades #2 345 kV	Maintain 345 bus voltage schedule at 1.03 pu	Unit #1 max is 500 MWN
Cook Unit #1 is isolated on Cook-Olive 345 kV	Maintain 345 bus voltage schedule at 1.03 pu	Unit #1 max is 750 MWN
Cook Unit #1 is isolated on Cook 345/765 kV T4 autotransformer, Cook U2 online or offline	Maintain 345 bus voltage schedule at 1.03 pu	Unit #1 max is 800 MWN
Cook Unit #2 is isolated on Cook-Dumont 765 kV	Maintain 345 bus voltage schedule at 1.0 pu	Unit #2 full output allowed

Kammer Operating Procedures (AEP Operating Memo T026)

These procedures were developed to provide secure service to the approximately 520 MWs of load at Ormet while keeping the system within loading limits and preventing violations of the 50 kA short circuit limits on the Kammer 138 kV CBs. Many station configurations are needed to meet the loading and short circuit criteria. Ormet installed capacitors represent approximately 275 MVAR of total reactive load compensation.

The major sources at Kammer are the three Kammer 138kV 200MW units and two Kammer 345/138kV 450MVA, ‘T300’ and ‘T100B’, transformers. All three Kammer units are equipped with unit disconnects to allow the unit breakers to be closed when the unit is out of service.

Operation of the Kammer 138kV Generating Units

The following assumes that if all Kammer 138kV units (#1, #2 & #3) are not online, that the remaining units are available on reserve shutdown and can be brought online as needed. Kammer #1, #2 and #3 are all equipped with Automated Load Rejection (ALR) controls.

Ormet Load at 520 MW:

- AEP requires at least two Kammer 138kV units on-line. One for System Restoration and one for Transmission Security issues.
- AEP requires a minimum of 200 MW of support from the Kammer 138kV plants for Transmission Security issues. (100MW minimum per unit.)

Should one of the two units trip offline:

PJM Actions:

Do one of the following:

- If only one unit remains on-line, direct the unit to a minimum output of 200MW or it's Eco.Max, whichever is lower. Direct EITHER the unit on reserve shutdown OR the unit that just tripped offline, whichever has a faster time to start, to be brought on-line to provide minimum System Restoration and Transmission Security support.
- Alternatively, if two units remain on-line, both units should be run for AEP System Restoration and for Transmission Security issues at a minimum output of 100MW per unit.

Ormet Load at 350 MW:

- AEP requires at least one Kammer 138kV unit on-line for System Restoration and for Transmission Security issues.
- AEP requires a minimum of 100 MW of support from the Kammer 138kV plants for Transmission Security issues. (100MW minimum for the unit.)

Should the unit trip offline:

PJM Actions:

- Do one of the following:
    - If any of Kammer #1, #2 or #3 remain on-line, the unit should be run for AEP System Restoration and for Transmission Security issues at a minimum output of 100MW.
    - Alternatively, direct EITHER a unit on reserve shutdown OR the unit that just tripped offline, whichever has a faster time to start, to be brought on-line to provide for AEP System Restoration and Transmission Security support at a minimum output of 100MW.

Ormet Load at 265 MW:

- AEP requires at least one Kammer 138kV unit on-line for System Restoration and for Transmission Security issues.

- The Kammer 138kV unit can operate at its economic minimum (or higher, as needed).

Should the unit trip offline:

PJM Actions:

- Do one of the following:
  - If any of Kammer #1, #2 or #3 remain on-line, the unit should be run for AEP System Restoration and for Transmission Security issues and can operate down to its economic minimum (or higher, as needed).
  - Alternatively, direct EITHER a unit on reserve shutdown OR the unit that just tripped offline, whichever has a faster time to start, to be brought on-line to provide for AEP System Restoration and Transmission Security support. The unit can operate down to its economic minimum (or higher, as needed).

Kammer Substation 138kV Configurations

The following Kammer Substation 138kV configurations attempt to setup the station so that the next contingency will not severely impact service to Ormet or exceed the emergency ratings of any facility. The configurations indicate OPEN devices. All other 138kV devices are assumed to be either in a CLOSED position or their previous position unless otherwise noted. Capacitor Bank CB 'BB' position is not a part of these configurations, but can be closed as needed for voltage support provided it is available.

- Reference for Kammer 138kV Device Status table:
  - Kammer Units – refers to Kammer #1, #2 & #3
  - T100B – refers to the Kammer T100B 345/138kV transformer
  - T300 – refers to the Kammer T300 345/138kV transformer
  - KAM-ORM #1 – refers to the Kammer-Ormet #1 138kV line
  - KAM-ORM #1 Extndd – refers to an Extended Outage of the Kammer-Ormet #1 138kV line. The time frame would be greater than 1 week in duration. An outage of this length should NOT be scheduled unless all three Kammer units are scheduled to be online.
  - GEO-KAM – refers to the George Washington-Kammer 138kV line
  - WAY-KAM – refers to the Wayman-Kammer 138kV line

- I or J @ GEO – refers to the ‘I’ or ‘J’ 138kV CBs at George Washington substation
- ● – Open device (If device Status is blank, CB is Closed.)
- M – Closed CB with controls on Manual

	Kammer 138kV Device Status [Additional Switching may be required at other stations. See Notes below]														
	'B'	'C'	'D'	'E'	'F'	'I'	'J'	'K'	'L'	'N'	'O'	'S'	'T'	'Z'	'XX'
All Three Kammer Units Online … Plus the following:															
System Normal		•	•		•									•	•
Loss of T100B [1]		•		•	•									•	•
KAM-ORM #1 Outage [2 & 3]		•	•	•	•									•	•
KAM-ORM #1 Extndd [2, 4 & 5]		•	•	•			•	M	•					•	•
GEO-KAM Outage [6 & 7]	•	•	•		•							•	•	•	
WAY-KAM Outage [7]	•	•	•		•					•	•			•	
I or J @ GEO [7]	•	•	•		•									•	
Two Kammer Units Online … Plus the following:															
System Normal		•	•		•									•	•
Loss of T100B [1, 5 & 8]	•			•	•									•	•
KAM-ORM #1 Outage [2 & 5]		•	•	•										•	•
GEO-KAM Outage [6 & 9]		•										•	•	•	•
WAY-KAM Outage [9]		•								•	•			•	•
I or J @ GEO [9]		•												•	•
One Kammer Unit Online … Plus the following:															
System Normal [10]		•												•	•
Loss of T300 [1 & 11]	•	•												•	•
Loss of T100B [1, 8 & 11]	•			•	•									•	•

	Kammer 138kV Device Status [Additional Switching may be required at other stations. See Notes below]														
	'B'	'C'	'D'	'E'	'F'	'I'	"J'	'K'	'L'	'N'	'O'	'S'	'T'	'Z'	'XX'
No Kammer Units Online AND Ormet Load > 265 MW … Plus the following:															
System Normal [12]		●												●	●
Loss of T300 [1 & 13]	●	●												●	●
Loss of T100B [1 & 13]	●			●	●									●	●
No Kammer Units Online AND Ormet Load ≤ 265 MW … Plus the following:															
System Normal		●												●	●
Loss of T100B [1 & 8]	●			●	●									●	●

Notes:

1 Work to restore facility as quickly as possible.

2 Ormet to OPEN their 138kV #1 CB.

3 This circuit outage opens the low side of transformer T100B.

4 Bypasses Kammer Unit #2 into KAM-ORM #3 by opening the Kammer 'L' and 'J' 138kV CBs. Ties T100B into Kammer 138kV Bus #1 by closing Kammer 'F' 138kV CB.

5 OPEN the George Washington 'I' 138kV CB, open-ending the GEO-KAM 138kV line to stay within the 50 kA short circuit limitations at Kammer.

6 OPEN the George Washington 'I' 138kV CB.

7 In this configuration, the loss of Ormet load or a 138kV bus outage at Ormet will leave 600 MWs of generation with only 2 outlets and potential overloads. In order to alleviate, the Natrium and West Bellaire circuits are tied to Bus #2 to provide additional exits for the Kammer generation. This results in opening the low side of T300 which is necessary to stay below the 50kA short circuit limitations for the Kammer 138kV CBs.

8 The loss of T100B causes loading problems on the Kammer – Natrium 138kV line, which tries to feed the Ormet load via the surrounding 138kV transmission system. In order to alleviate this, T300 is tied to 138kV Bus #1.

9 In this configuration, the loss of Ormet load or a 138kV bus outage at Ormet will leave 400MWs of generation with only 2 outlets and potential overloads. In order to alleviate, T100B is tied to Kammer 138kV Bus #1 and Bus #2 to provide another outlet for the Kammer generation.

10 Having only one 138kV Kammer Unit online causes heavy loading on the KAM-ORM #1 circuit. In order to alleviate, T100B is tied to Kammer 138kV Bus #1 and Bus #2.

11 A scheduled outage of this facility is NOT recommended unless 2 Kammer units are scheduled online. If Ormet load is projected to remain < 350MW for the duration of the outage, an outage may be scheduled with one Kammer unit scheduled online.

12 The loss of all three Kammer Units causes an overload on T100B if Ormet has 6 potlines online (530MW load). In order to alleviate, T300 is tied to Bus #1. With 4 potlines online (320MW load) the loading on T100B should be within acceptable values. If the loading on T100B does approach the facility normal rating, tie T300 to Bus #1. It is important to CLOSE Kammer 'C' 138kV CB first, then OPEN Kammer 'B' 138kV CB in order to avoid momentarily removing T30 from the system and causing a heavier overload on T100B. The concern of tying T300 to Bus #1 is that the West Bellaire 138kV circuit becomes the only source feeding the entire Mitchell plant load. Keeping T300 tied to Bus #3 and Bus #4 provides Mitchell plant load with another source.

13 The loss of this transformer results in a transformer bank loading on the remaining Kammer 345/138kV transformer which may exceed its emergency rating. Voltage at Ormet should be within acceptable values. AEP to monitor temperatures and work with Ormet to rotate pot lines or shed load to keep transformer loadings below emergency limits.

PJM Actions:

Contingency Definitions and Operating Limits

Each contingency that could affect any facility impacted by post-contingency switching at Kammer is defined by two contingency definitions in the PJM EMS. One definition models the post-contingency switching as part of the contingency. The other definition will not model the post-contingency switching as part of the contingency. In the event that PJM Security Analysis identifies a contingency overload on any of the following area facilities, PJM will confirm with AEP the post-contingency switching that will be implemented in the event of actual contingent facility tripping, and control to the appropriate contingency definition.

- Kammer – Natrium 138 kV line
- Kammer – George Washington 138 kV line
- Kammer – Ormet #1 138 kV line
- Kammer 345/138 kV T300 transformer
- Kammer 345/138 kV T100B transformer
- Natrium-George Washington 138 kV line
- West Bellaire – Brues 138 kV line
- Fort Henry-Sand Hill 138 kV line
- Fort Henry-Tidd 138 kV line
- Brues-Sand Hill 138 kV line
- Wayman-Sand Hill 138 kV line
- Tidd-Sand Hill 138 kV line
- Kammer-Wayman 138 kV

PJM will control to the load dump rating for contingency definitions not including the post-contingency switching.

Conesville 345 kV Plant Operating Guidelines (AEP Operating Memo T027)

The Conesville 345kV generating plant has certain stability limitations on output levels under certain system conditions. In particular, outages of 345 kV outlets from Conesville may result in limitations on the plants maximum output.

PJM Actions:

- PJM to use the following table to determine if any limitations will exist at the Conesville Plant due to stability concerns.

SYSTEM OPERATING CONDITION		RECOMMENDED MAXIMUM NET PLANT OUTPUT
No.	**DESCRIPTION**	
No Prior Outage		
1.	None (Normal)	1650 MW
Single Prior Outage		
2.	Conesville-Corridor 345 kV line	1650 MW
3.	Conesville-Bixby 345 kV line	1650 MW
4.	Conesville-Hyatt 345 kV line	1650 MW
5.	Conesville 345/138 kV autotransformer	1650 MW
6.	Any 1 remote facility out of service	1650 MW
Double Prior Outages (See Note 1)		
7.	Any Conesville 345kV line and Conesville 345/138kV autotransformer	1500 MW
8.	Any 2 Conesville 345kV lines	1350 MW
9.	Conesville-Corridor 345 kV line and Bixby-Beatty 345 kV line	1650 MW
10.	Conesville-Corridor 345 kV line and Bixby-Kirk 345 kV line	1650 MW
11.	Conesville-Corridor 345 kV line and Bixby-Marquis 345 kV line	1650 MW
12.	Conesville-Corridor 345 kV line and Bixby 345/138 kV autotransformer	1650 MW
13.	Conesville-Corridor 345 kV line and Hyatt-Corridor 345 kV line	1650 MW
14.	Conesville-Corridor 345 kV line and Hyatt-Hayden 345 kV line	1650 MW
15.	Conesville-Corridor 345 kV line and Hyatt-Marysville 345 kV line	1650 MW
16.	Conesville-Corridor 345 kV line and Hyatt-Tangy 345 kV line	1650 MW

	SYSTEM OPERATING CONDITION	RECOMMENDED MAXIMUM NET PLANT OUTPUT
No.	DESCRIPTION	
17.	Conesville-Corridor 345 kV line and Hyatt-West Millersport 345 kV line	1650 MW
18.	Conesville-Corridor 345 kV line and Hyatt 345/138 kV autotransformer	1650 MW
19.	Conesville-Bixby 345 kV line and Hyatt-Corridor 345 kV line	1650 MW
20.	Conesville-Bixby 345 kV line and Hyatt-Hayden 345 kV line	1650 MW
21.	Conesville-Bixby 345 kV line and Hyatt-Marysville 345 kV line	1650 MW
22.	Conesville-Bixby 345 kV line and Hyatt-Tangy 345 kV line	1650 MW
23.	Conesville-Bixby 345 kV line and Hyatt-West Millersport 345 kV line	1650 MW
24.	Conesville-Bixby 345 kV line and Hyatt 345/138 kV autotransformer	1650 MW
25.	Conesville-Bixby 345 kV line and Corridor-Hyatt 345 kV line	1650 MW
26.	Conesville-Bixby 345 kV line and Corridor-Kirk 345 kV line	1650 MW
27.	Conesville-Bixby 345 kV line and Corridor 345/138 kV autotransformer	1650 MW
28.	Conesville-Hyatt 345 kV line and Corridor-Hyatt 345 kV line	1650 MW
29.	Conesville-Hyatt 345 kV line and Corridor-Kirk 345 kV line	1650 MW
30.	Conesville-Hyatt 345 kV line and Corridor 345/138 kV autotransformer	1650 MW
31.	Conesville-Hyatt 345 kV line and Bixby-Beatty 345 kV line	1650 MW
32.	Conesville-Hyatt 345 kV line and Bixby-Kirk 345 kV line	1650 MW
33.	Conesville-Hyatt 345 kV line and Bixby-Marquis 345 kV line	1650 MW
34.	Conesville-Hyatt 345 kV line and Bixby 345/138 kV autotransformer	1650 MW
35.	Conesville-Bixby 345 kV line and Conesville-Ohio Central 138kV line	1650 MW
36.	Conesville 345/138 kV autotransformer and any remote facility	1650 MW
37.	Any 2 remote facilities out of service	1650 MW
Prior Outage of Kirk 345 kV Station		
38.	Kirk 345 kV station	1650 MW

No.	SYSTEM OPERATING CONDITION DESCRIPTION	RECOMMENDED MAXIMUM NET PLANT OUTPUT
39.	Corridor 345 kV line and Kirk 345 kV station	1650 MW
40.	Bixby 345 kV line and Kirk 345 kV station	1650 MW
41.	Hyatt 345 kV line and Kirk 345 kV station	1650 MW
42.	Conesville 345/138kV autotransformer and Kirk 345 kV station	1650 MW

Note 1: The Conesville 345 kV station has four outlets, namely: Conesville-Bixby, Conesville-Corridor, Conesville-Hyatt, and 345/138 kV T7. With any three Conesville 345 kV outlets out of service, total plant output at 345 kV station should be reduced below the normal thermal capability of the remaining outlet or the stability limit; whichever is lower

Rockport Operating Guide [SPS]

The following provides transmission system operating personnel with guidelines to operate the Rockport Plant and the surrounding bulk electric system in Southern Indiana. The guidelines were designed to maximize Rockport Plant output, while maintaining system reliability. They were developed based on extensive steady-state and system dynamics analyses to identify potential thermal, voltage and stability problems under a variety of system operating conditions.

The Rockport Plant, consisting of two 1320 MW generating units, is located in southern Indiana. There is also a 5MW diesel unit at the facility which can be used in emergencies. The Rockport Plant is integrated into the AEP System by two 765 kV transmission lines, one of which terminates at the Jefferson 765 kV Station and the other at the Sullivan 765 Station. The Jefferson Station provides additional 765 kV outlets for Rockport Plant generation to the AEP System and a 765/345 kV interconnection with OVEC. The Sullivan Station provides 765/345 kV connections to the Breed Station, which further provides four 345 kV outlets for Rockport Plant generation to the AEP System and to the networks of neighboring utilities in southern Illinois and southern Indiana.

Since the 2645 MW Rockport Plant is integrated into the AEP System with only two 765 kV outlets, supplementary control schemes are employed to enhance the voltage and stability performance of the Rockport Plant and to increase the availability of Rockport plant and the 765 kV transmission lines.

Rockport Special Controls

AEP Actions:

- AEP operator will inform PJM of changes in the status of special controls at Rockport

PJM Actions:

- PJM will consider the status of Rockport special controls when analyzing real-time or study data in the Rockport area.
- PJM will ensure the proper contingency definitions reflect status of Rockport special controls.

The following are the various special controls for the Rockport area:

Fast Valving Scheme (FV) (SPS)

Fast Valving 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. The scheme can be initiated up to 3 times within a 3-minute interval and is initiated under one of the following events when the plant net output is over 2100 MW:

- Line current\MVA on Rockport-Jefferson 765kV line is less than *450 amps\600 MVA (three-phase opening on Rockport-Jefferson 765kV line will trigger this condition); OR
- Single phase opening on Rockport-Jefferson 765kV line (with Rockport-Sullivan 765kV line out of service); OR
- Single phase opening on Rockport-Sullivan 765kV line (with Rockport-Jefferson 765kV line out of service).

*Note: The line relays monitor the current drop in the line (i.e. if the line current is already below 450amps, the line relays will not continue sending FV initiation signals to the plant).

One of the 2 Rockport units is tripped, while the other unit is fast-valved, under the following conditions:

- Fast Valving (FV) has been triggered; AND
- Plant net output is over 2100MW; AND
- There have already been 3 Fast Valving operations within 3 minutes or excessive steam generator or throttle pressure;

This control scheme is generally active at all times, unless it is forced offline or out for maintenance or by the net output dropping below 2100 MW point.

Quick Reactor Switching (QRS)

The 765kV Rockport-Sullivan 150 MVAR shunt reactor bank at Rockport automatically opens within 5 cycles and recloses in 1 minute for contingencies on the Rockport-Jefferson 765kV line. This works in conjunction with the Fast Valving scheme to improve voltage and stability after select contingencies.

Emergency Unit Tripping (EUT)   (SPS)

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. This control scheme was designed to provide operational flexibility, in terms of avoiding plant output curtailment (in anticipation of the next critical contingency) under certain operating conditions. This control is enabled manually and only for selected prior outages on the 345kV system in the Breed area. The EUT switch, when engaged, must be coordinated with the SPS selector switch, so that both switches trip the same unit.

Emergency Unit Tripping (EUT) is now defined as part of the Rockport SPS. In order to allow higher pre-contingency unit output, this scheme is utilized by operators such that a unit can be selected to be tripped upon a multi-phase fault or loss of load (current falls below 450 amps or 600 MVA) on the Rockport-Jefferson 765 kV line (three-phase fault will trigger the loss of load condition). EUT SPS alarm points, indicating the status of each unit and the current trip condition are available for monitoring on the **LRSR** display.

Each of the above supplementary controls (FV, QRS & EUT) requires that a set of three input conditions (further described in tables below) be met in order to operate:

1. *Pre-contingency Rockport area transmission status*
2. *Pre-contingency Rockport Plant output*
3. *Type of contingency*

Communication protocol and additional details for arming EUT SPS:

TOPS Engineering and PJM shall coordinate the potential arming the EUT SPS based on next-day and/or other operational study assessments, when applicable. From a current day perspective, PJM shall contact the System Control Center (SCC) Operator East desk of the option to arm the Rockport EUT SPS prior to curtailing the Rockport units for system congestion, if system conditions exist such that the Rockport EUT SPS could be utilized to alleviate system congestion.

The System Control Center (SCC) Operator East desk shall contact AEP Generation Dispatch to advise them of their option to arm the EUT SPS or follow PJM market dispatch instructions, which will reduce the Rockport plant output in order to alleviate congestion on the transmission system. Generation Dispatch shall coordinate with Production Optimization and then notify the SCC Operator East desk of the decision to arm the EUT SPS or to follow PJM market dispatch instructions. If the EUT SPS is to be armed, Generation Dispatch will notify the Rockport plant to arm the EUT SPS. The SCC Operator East desk will notify PJM and the Columbus West TDC desk of the decision to arm the EUT SPS. The Columbus West TDC will also notify the Rockport plant of the decision to arm the EUT SPS. When system conditions exist such that the EUT SPS can be disarmed, the same communication protocol outlined above shall be followed. Transmission Operations Engineering shall also coordinate with Production Optimization for scheduled outages that may result in arming the EUT SPS.

Upon arming the Rockport EUT SPS, the SCC Operator will disable the Jefferson-Rockport 765 kV contingency in the Alstom State Estimator and will enable the Rockport-Jefferson 765 kV contingency with the applicable Rockport unit trip.

Single Phase Operation (SPO)

In addition to the above supplementary controls, Single Phase Operation (SPO) is implemented on both Rockport lines to maximize availability of the plant outlets under certain fault conditions. Temporary single line-to-ground faults are the most common faults on the AEP 765kV system. For this reason single-phase switching was put in place on both 765kV outlets out of Rockport. With SPO, only the faulted phase is opened in three cycles to clear a fault while the other two healthy phases remain in service. If the fault is temporary the opened phase closes in 30 cycles after fault initiation. Use of SPO makes it possible to avoid the loss of the Rockport plant for temporary single line-to-ground faults on one Rockport outlet with the other outlet out of service.

Unit Special Protection System (SPS)

There is a need for an SPS at Rockport due to the impact that a Fast Valve operation has on the units. Both the boiler & throttle pressures in the turbine increase during each Fast Valve operation. There are imbedded safe operating limits that trip the units for excessive boiler or throttle pressures. Exceeding either of these safety limits requires the units to be tripped. Since 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. To prevent the tripping of both units by the imbedded safety operating limits systems, the SPS was installed.

The SPS monitors the boiler & throttle pressures as well as the Fast Valve (FV) initiate signal and responds with a trip of the selected unit prior to the imbedded safety operating limits tripping both units.

The enhanced Fast Valving (FV) controls and Rockport Special Protection Scheme (SPS):

- Allows up to 3 Fast Valving (FV) operations in a 3-minute interval.
- Fast Valving is initiated under one of these events when plant output is over 2100 MW:

1. Line current\MVA on Rockport-Jefferson 765kV line is less than 450 amps\600 MVA (three-phase opening on Rockport-Jefferson 765kV line will trigger this condition); **OR**

2. Single phase opening on Rockport-Jefferson 765 kV line (with Rockport-Sullivan 765 kV line out of service); **OR**

3. Single phase opening on Rockport-Sullivan 765 kV line (with Rockport-Jefferson 765 kV line out of service); and

- One of the 2 Rockport units is tripped under the following conditions:
    - FV has been triggered AND 3 FV operations have already occurred within 3 minutes; OR
    - Excessive steam generator boiler or throttle pressure exists when a Fast Valve initiate is processed:

The unit trip portion of the Rockport protection and control scheme falls under the NERC definition of a Special Protection System. Hereafter, the automatic control action involving the tripping of one unit under the above conditions is referred to as an SPS trip. This is differentiated from and Emergency Unit Trip (EUT) where the choice to select a unit trip is to allow higher output levels prior to the loss of Rockport-Jefferson 765kV line.

The SPS selector switch must be coordinated with the EUT switch, when engaged, so that both switches trip the same unit.

AEP Actions:

- SPS is considered active at all times.
- AEP will notify PJM of any change in status for the SPS
- AEP operator will inform PJM when any alarm is received of “Unit 1 SPS-Trip” or “Unit 2 SPS-Trip” and the SPS operates.

PJM Actions:

- PJM will log any change in SPS status and any operation of SPS at Rockport.

Carrier Communication Failure

A failure of the carrier communication system could cause a trip of the same phase on both the Rockport-Jefferson and Rockport-Sullivan 765 kV lines during a single line-to-ground fault. This could cause the Rockport plant to go unstable.

To guard against an unstable event, the net maximum output of the Rockport generating plant must be no greater than 2100 MW when any of the following alarms is received. If the Rockport generating plant is above 2100 MW when the alarm is received, the plant must be reduced within 30 minutes.

- Carrier Communications - Line C2C
- Carrier Current Abnormal – Line B2B
- Relay Sys Critical – Jefferson Sys. #1
- Relay Sys Critical – Jefferson D60
- Relay Sys Critical – Sullivan D60

If there is a loss of communication with the Rockport RTU, the Rockport generating plant must be reduced to 2100 MW within 30 minutes until personnel can be sent to the station to monitor alarms. After personnel have arrived at the station, the restrictions on the Rockport generating plant can be released.

AEP Actions:

- AEP will notify PJM immediately of any alarms received requiring reduction at Rockport

PJM Actions:

- PJM will log any alarm that AEP received for carrier communication failure and any reduction in Rockport as a result.

Rockport Plant Output Limits

AEP Actions:

Inform PJM of the any Status changes to the Rockport FV, EUT or the SPS systems.

PJM Actions:

- PJM will use the following tables to determine if any equipment outage in the Rockport area will limit the plant output.

Summary of Recommendations with Fast Valving SPS On

SYSTEM OPERATION CONDITION			RECOMMENDED MAXIMUM PLANT GENERATION IN MW (INCLUDING MARGIN)					
No.	DESCRIPTION	VOLTAGE SCHEDULE	LIMITING FACTOR	FV ON (BOTH UNITS)	FV ONE UNIT EUT OTHER UNIT	BREED 250 MVAR REACTOR	ROCKPORT END 150 MVAR SULLIVAN LINE REACTOR	BREED & ROCKPORT END SULLIVAN LINE REACTOR
1	Normal (no prior outage	100.50%	NA	2640	2460	Status Quo	Status Quo	Status Quo
2	Prior Outage of Rockport-Jefferson 765kV Line	102%	Thermal	≤2250	NA	Status Quo	Status Quo	Status Quo
3	Prior Outage of Rockport-Sullivan 765kV Line	102%	NA	2640		Status Quo	Status Quo	Status Quo
					2640	Status Quo	Status Quo	Status Quo
4	Prior Outage of Sullivan T-1 765-345kV Transformer	102%	Thermal	≤2250	≤2250	Status Quo	Status Quo	Status Quo
5	Prior Outage of Sullivan T-2 765-345kV Transformer	102%	Thermal	≤2250	≤2250	Status Quo	Status Quo	Status Quo
6	Prior Outage of Breed-West Casey 345kV Line	102%	Voltage	2600		Out of Service	Out of Service	Status Quo
					2640	Status Quo	Status Quo	In Service
7	Prior Outage of Breed-Wheatland 345kV Line	102%	Voltage	2640		Out of Service	Out of Service	Status Quo
					2640	Status Quo	Status Quo	In Service
8	Prior Outage of Breed-Darwin or Darwin-Eugene 345kV Line	102%	Voltage	2640		Out of Service	Status Quo	Status Quo
					2640	Status Quo	Status Quo	Status Quo
9	Prior Outage of Breed-Dequine 345kV Line	102%	Voltage	2640		Out of Service	Status Quo	Status Quo
					2640	Status Quo	Status Quo	Status Quo
10	Prior Outage of Eugene-Cayuga	102%	Voltage	2640		Out of Service	Status Quo	Status Quo

SYSTEM OPERATION CONDITION			RECOMMENDED MAXIMUM PLANT GENERATION IN MW (INCLUDING MARGIN)					
No.	DESCRIPTION	VOLTAGE SCHEDULE	LIMITING FACTOR	FV ON (BOTH UNITS)	FV ONE UNIT EUT OTHER UNIT	BREED 250 MVAR REACTOR	ROCKPORT END 150 MVAR SULLIVAN LINE REACTOR	BREED & ROCKPORT END SULLIVAN LINE REACTOR
	345kV Line				2640	Status Quo	Status Quo	Status Quo
11	Prior Outage of Breed-Dequine 345kV Line / Breed-Darwin-Eugene 345kV Double Circuit	102%	Voltage	2600		Out of Service	Out of Service	Status Quo
					2640	Status Quo	In Service	In Service

Voltage Limits with Fast Valving SPS On or Off

SYSTEM OPERATION CONDITION			RECOMMENDED MAXIMUM PLANT GENERATION IN MW (INCLUDING MARGIN)							
No.	DESCRIPTION	VOLTAGE SCHEDULE	FV (BOTH UNITS)	FV ONE UNIT EUT OTHER UNIT	FV ONE UNIT ONLY	EUT ONE UNIT ONLY	NO FV OR EUT AVAILABLE	BREED 250 WVAR REACTOR	ROCKPORT END 150 MVAR SULLIVAN LINE REACTOR	BREED & ROCKPORT END SULLIVAN LINE REACTOR
1	Normal (no prior outage	100.50%	2640	2640	2640	2640	2640			
			2640	2640	2640	2640	2640	Out		
			2640	2640	2640	2640	2640		Out	
			2640	2640	2640	2640	2640			Out
2	Prior Outage of Rockport-Jefferson 765kV Line	102%	2350	2350	2350	2350	2350			
			2500	2500	2500	2500	2500	Out		
			2450	2450	2450	2450	2450		Out	
			2600	2600	2600	2600	2600			Out
3	Prior Outage of Rockport-Sullivan 765kV Line	102%	2640	2640	2640	2640	2640			
								NA		
									NA	
										NA
4	Prior Outage of Sullivan T-1 765-345kV Transformer	102%	2550	2550	2550	2550	2550			
			2640	2640	2640	2640	2640			
			2640	2640	2640	2640	2640			
			2640	2640	2640	2640	2640			
5	Prior Outage of Sullivan T-2 765-345kV Transformer	102%	2450	2450	2450	2450	2450			
			2550	2550	2550	2550	2550	Out		
			2550	2550	2550	2550	2550		Out	
			2640	2640	2640	2640	2640			Out
6	Prior Outage of Breed-West Casey 345kV Line	102%	2350	2640	2350	2640	2350			
			2500	2640	2500	2640	2500	Out		
			2450	2640	2450	2640	2450		Out	
			2600	2640	2600	2640	2600			Out

SYSTEM OPERATION CONDITION			RECOMMENDED MAXIMUM PLANT GENERATION IN MW (INCLUDING MARGIN)							
No.	DESCRIPTION	VOLTAGE SCHEDULE	FV (BOTH UNITS)	FV ONE UNIT EUT OTHER UNIT	FV ONE UNIT ONLY	EUT ONE UNIT ONLY	NO FV OR EUT AVAILABLE	BREED 250 WVAR REACTOR	ROCKPORT END 150 MVAR SULLIVAN LINE REACTOR	BREED & ROCKPORT END SULLIVAN LINE REACTOR
7	Prior Outage of Breed-Wheatland 345kV Line	102%	2400	2640	2400	2640	2400			
			2550	2640	2550	2640	2550	Out		
			2500	2640	2500	2640	2500		Out	
			2640	2640	2640	2640	2640			Out
8	Prior Outage of Breed-Darwin or Darwin-Eugene 345kV Line	102%	2500	2640	2500	2640	2500			
			2640	2640	2640	2640	2640	Out		
			2640	2640	2640	2640	2640		Out	
			2640	2640	2640	2640	2640			Out
9	Prior Outage of Breed-Dequine 345kV Line	102%	2600	2640	2600	2640	2600			
			2640	2640	2640	2640	2640	Out		
			2640	2640	2640	2640	2640		Out	
			2640	2640	2640	2640	2640			Out
10	Prior Outage of Eugene-Cayuga 345kV Line	102%	2550	2640	2550	2640	2550			
			2640	2640	2640	2640	2640	Out		
			2640	2640	2640	2640	2640		Out	
			2640	2640	2640	2640	2640			Out
11	Prior Outage of Breed-Dequine 345kV Line / Breed-Darwin-Eugene 345kV Double Circuit	102%	2400	2640	2400	2640	2400			
			2550	2640	2550	2640	2550	Out		
			2500	2640	2500	2640	2500		Out	
			2600	2640	2600	2640	2600			Out

Stability Limits with Fast Valving SPS On or Off

SYSTEM OPERATING CONDITION			RECOMMENDED MAXIMUM PLANT GENERATION IN MW (INCLUDING MARGIN)							
No.	DESCRIPTION	VOLTAGE SCHEDULE	FV (BOTH UNITS)	FV ONE UNIT EUT OTHER UNIT	FV ONE UNIT ONLY	EUT ONE UNIT ONLY	NO FV OR EUT AVAILABLE	ROCKPORT END 150 MVAR SULLIVAN LINE REACTOR	BREED & ROCKPORT END SULLIVAN LINE REACTOR
1	Normal (no prior outage)	100.50%	2640	2640	2640	2580	2480*		
			2640	2640	2640	2540	2420*		Out
			2640	2640	2600	2480	2380*	Out	
2	Prior Outage of Rockport-Jefferson 765kV Line	102%	2480	2340	2280	2160	2080		
			2460	2340	2260	2140	2080		Out
								NA	
3	Prior Outage of Rockport-Sullivan 765kV Line	102%	2640	2640	2560	2420	2360		
			2640	2620	2520	2400	2340	Out	
									NA
4	Prior Outage of Sullivan T-1 765-345kV Transformer	102%	2640	2640	2640*	2500*	2320*		
			2640	2640	2640*	2480*	2300*		Out
			2640	2640	2580*	2420*	2240*	Out	

SYSTEM OPERATING CONDITION			RECOMMENDED MAXIMUM PLANT GENERATION IN MW (INCLUDING MARGIN)							
No.	DESCRIPTION	VOLTAGE SCHEDULE	FV (BOTH UNITS)	FV ONE UNIT EUT OTHER UNIT	FV ONE UNIT ONLY	EUT ONE UNIT ONLY	NO FV OR EUT AVAILABLE	ROCKPORT END 150 MVAR SULLIVAN LINE REACTOR	BREED & ROCKPORT END SULLIVAN LINE REACTOR
5	Prior Outage of Sullivan T-2 765-345kV Transformer	102%	2640	2640	2640*	2340	2300*		
			2640	2640	2600*	2320	2260*		Out
			2640	2640*	2560*	2280	2200*	Out	
6	Prior Outage of Breed-West Casey 345kV Line	102%	2640	2640	2520	2340	2160		
			2640	2640	2480	2320	2140		Out
			2640**	2580	2420	2280	2100	Out	
7	Prior Outage of Breed-Wheatland 345kV Line	102%	2640	2640	2640*	2480*	2300*		
			2640	2640	2620*	2440*	2280*		Out
			2640	2640*	2560*	2400*	2220*	Out	
8	Prior Outage of Breed-Darwin or Darwin-Eugene 345kV Line	102%	2640	2640	2640	2600*	2420*		
			2640	2640	2640*	2580*	2400*		Out
			2640	2640	2640*	2520*	2340*	Out	
9	Prior Outage of Breed-Dequine 345kV Line	102%	2640	2640	2640	2640*	2500*		
			2640	2640	2640	2640*	2480*		Out
			2640	2640	2640	2600*	2420*	Out	
10	Prior Outage of Eugene-Cayuga 345kV Line	102%	2640	2640	2640	2640*	2500*		
			2640	2640	2640	2640*	2480*		Out
			2640	2640	2640*	2600*	2420*	Out	
11	Prior Outage of Breed-Dequine 345kV Line / Breed-Darwin-Eugene 345kV Double Circuit	102%	2640	2640	2600*	2420*	2260*		
			2640	2640*	2560*	2400*	2220*		Out
			2640	2640*	2520*	2340*	2180*	Out	

* Subtract 50 MW if Rockport to Sullivan MW is less than 200 MW / subtract 100 MW if Rockport-Sullivan MW reverses direction
** Though transiently stable, case ends in voltage collapse in Breed area and instability of Rockport Plant.
Stability studies indicate that the status of the Breed reactor does not have a substantial impact on the stability limitations of the Rockport plant.

Summary of Recommendations with Fast Valving SPS Off

SYSTEM OPERATION CONDITION			RECOMMENDED MAXIMUM PLANT GENERATION IN MW (INCLUDING MARGIN)						
No.	DESCRIPTION	VOLTAGE SCHEDULE	LIMITING FACTOR	FV ONE UNIT ONLY	EUT ONE UNIT ONLY	NO FV OR EUT AVAILABLE	BREED 250 WVAR REACTOR	ROCKPORT END 150 MVAR SULLIVAN LINE REACTOR	BREED & ROCKPORT END SULLIVAN LINE REACTOR
1	Normal (no prior outage	100.50%	Stability	2640			Status Quo	Status Quo	In Service
					2580	2480**	Status Quo	In Service	In Service
2	Prior Outage of Rockport-Jefferson 765kV Line	102%	Thermal/ Stability	≤2250			Status Quo	Status Quo	Status Quo
					2140		Status Quo	Status Quo	Status Quo
						2080	Status Quo	Status Quo	Status Quo

SYSTEM OPERATION CONDITION			RECOMMENDED MAXIMUM PLANT GENERATION IN MW (INCLUDING MARGIN)						
No.	DESCRIPTION	VOLTAGE SCHEDULE	LIMITING FACTOR	FV ONE UNIT ONLY	EUT ONE UNIT ONLY	NO FV OR EUT AVAILABLE	BREED 250 WVAR REACTOR	ROCKPORT END 150 MVAR SULLIVAN LINE REACTOR	BREED & ROCKPORT END SULLIVAN LINE REACTOR
3	Prior Outage of Rockport-Sullivan 765kV Line	102%	Stability	2560	2400	2340	Status Quo	Status Quo	Status Quo
4	Prior Outage of Sullivan T-1 765-345kV Transformer	102%	Thermal/ Stability	≤2250	≤2251		Status Quo	Status Quo	Status Quo
						2240**	Status Quo	Status Quo	Status Quo
5	Prior Outage of Sullivan T-2 765-345kV Transformer	102%	Thermal/ Stability	≤2250	≤2251		Status Quo	Status Quo	Status Quo
						2200**	Status Quo	Status Quo	Status Quo
6	Prior Outage of Breed-West Casey 345kV Line	102%	Voltage/ Stability	2500			Out of Service	In Service	In Service
					2340	2160	Status Quo	In Service	In Service
7	Prior Outage of Breed-Wheatland 345kV Line	102%	Voltage/ Stability	2550			Out of Service	In Service	In Service
					2480**	2300**	Status Quo	In Service	In Service
8	Prior Outage of Breed-Darwin or Darwin-Eugene 345kV Line	102%	Voltage/ Stability	2640			Out of Service	In Service	In Service
					2600**	2420**	Status Quo	In Service	In Service
9	Prior Outage of Breed-Dequine 345kV Line	102%	Voltage/ Stability	2640			Out of Service	Status Quo	Status Quo
					2640**		Status Quo	Status Quo	In Service
						2500**	Status Quo	In Service	In Service
10	Prior Outage of Eugene-Cayuga 345kV Line	102%	Voltage/ Stability	2640			Out of Service	Status Quo	In Service
					2640**		Status Quo	Status Quo	In Service
						2500**	Status Quo	In Service	In Service
11	Prior Outage of Breed-Dequine 345kV Line / Breed-Darwin-Eugene 345kV Double Circuit	102%	Voltage/ Stability	2550			Out of Service	In Service	In Service
					2420**	2260**	Status Quo	In Service	In Service

*Status Quo indicates the status of the applicable equipment does not determine the limit for the recommended output, therefore, the equipment can be operated as needed.

**Subtract 50 MW if Rockport-Sullivan MW is less than 200 MW / subtract 100MW if Rockport-Sullivan reverses direction.

Rockport plant operation with prior outage of both Rockport units.

When both Rockport units are out of service there is the potential for extremely high post-contingency voltages in the Rockport area. The most severe limit is the Rockport 765 kV voltage approaching 120.3%.

PJM Actions:

PJM will monitor voltages and consider the following steps when any topology changes occur in the Rockport area.

- Jefferson 765kV CB “A2” is opened when Rockport-Sullivan 765kv is outaged and any 100 MVAR reactor at Jefferson on the Jefferson-Greentown 765kv is outaged.
- Jefferson 765kV CB “A2” is opened when Rockport-Sullivan 765kV line is outaged and any 50 MVAR reactor at either end of the Rockport-Jefferson 765kV line is outaged.
- Rockport-Jefferson 765kV circuit should be removed from service when any 100 MVAR reactor at Jefferson 765kV station on the Greentown-Jefferson 765kV line is outaged and any 50 MVAR reactor on the same phase at Jefferson or Rockport 765kV stations are outaged.
- Rockport-Jefferson 765kV circuit should also be removed from service when the Jefferson-Greentown 765kV line is outaged and any 50 MVAR reactor at either Jefferson, Rockport, or Sullivan 765kV stations are outaged.
- Rockport, Jefferson, and Sullivan 765kV stations should be monitored for the occurrence of voltage levels between 105% (803kV) and 106% (811kV). If the levels continue for more than six hours, the Rockport-Jefferson 765kV circuit should be removed from service
- If both 765kV outlets from Rockport are out of service at the same time both units are out of service, and the circuits are being restored to service, the Rockport-Jefferson circuit should be restored first.

Smith Mountain 138 kV Station Stability

<u>Overview</u>

AEP’s Advanced Transmission Studies and Technologies (ATST) updated the Smith

Mountain stability studies in May 2011 to reflect the addition of another transmission circuit outlet to the plant. The Penhook–Westlake 138 kV section addition creates a new 138 kV transmission outlet to the plant consisting of the Smith Mountain –Westlake 138 kV and Blaine–Westlake 138 kV circuits. ATST studies modeled the Leesville generation in the studies, and the effects are accounted for in the study results.

<u>Procedure</u>

The Smith Mountain Stability procedure consists of two parts described below:

Part 1: Block High Speed Reclosing (HSR) at Smith Mountain for any single circuit outage listed directly below.

- Leesville-Smith Mountain 138 kV
- East Danville-Smith Mountain 138 kV
- Opossum Creek-Smith Mountain 138 kV
- Cloverdale-Smith Mountain 138 kV

- Altavista-Leesville 138 kV
- Smith Mountain-Westlake 138 kV

Part 2: Limit Smith Mountain maximum plant MW output to the Smith Mountain Plant MW Stability Limit listed in the Smith Mountain Double Outlet Outage Table below.

SMITH MOUNTAIN DOUBLE OUTLET OUTAGE TABLE			
Line Outage #1		**Line Outage #2**	**Smith Mountain MW Stability Limit**
Smith Mntn – Cloverdale 138 kV	***AND***	Smith Mntn – Westlake 138 kV	570 MW
Smith Mntn – East Danville 138 kV	***AND***	Smith Mntn – Westlake 138 kV	570 MW
Smith Mntn – Cloverdale 138 kV	***AND***	Smith Mntn – Leesville 138 kV	465 MW
Smith Mntn – East Danville 138 kV	***AND***	Smith Mntn – Leesville 138 kV	465 MW
Smith Mntn – Cloverdale 138 kV	***AND***	Smith Mntn – East Danville 138 kV	425 MW
Smith Mntn – Cloverdale 138 kV	***AND***	Altavista – Leesville 138 kV	425 MW
Smith Mntn – East Danville 138 kV	***AND***	Altavista – Leesville 138 kV	425 MW

Note: With two circuits out of service, Smith Mountain only has three remaining 138 kV outlets. As a result, potential contingency thermal overloads on the remaining circuit outlets may occur. The Smith Mountain MW plant output may need to be reduced to relieve the contingency thermal overload.

Gavin Mountaineer - Rolling Hills Stability

High Speed Reclosing (HSR) at the Gavin 765 kV station and at opposing terminal should be blocked following the outage of the following circuits:

- Gavin-Culloden 765 kV

PJM Actions:

PJM to limit the total output at the Gavin/Mountaineer/Rolling Hills Generation Complex in order to maintain dynamic stability following the concurrent outage of two 765kV circuits/transformers resulting in the outage pairs shown in the following table.

Gavin - Mountaineer - Rolling Hills Stability Limitations													
Generating Complex		Maximum Total Generation (MW)	Outage Pairs 765kV Lines									Transformer
			Gavin Culloden	Gavin Mountaineer	Amos Mountaineer	Belmont Mountaineer	Flatlick Marysville	Marysville Maliszewski	Kammer Maliszewski	Flatlick Gavin	Dumont Marysville	Marysville 765/345kV
1	Gavin / Rolling Hills	3300		●							●	
2	Gavin / Rolling Hills	3300	●								●	
3	Gavin	2500		●					●			
4	Gavin	2500	●						●			
5	Gavin	2100*		●								●
6	Gavin	2400		●				●				
7	Gavin	2100*	●									●
8	Gavin	2400	●					●				
9	Gavin	2100*	●	●								
10	Gavin / Mountaineer	3500	●							●		
11	Gavin / Mountaineer	3500			●					●		
12	Gavin / Mountaineer	3300	●				●					
13	Gavin / Mountaineer	3300			●		●					
14	Gavin / Mountaineer	2900	●			●						
15	Gavin / Mountaineer	2900			●	●						
16	Gavin / Mountaineer	2900	●		●							

* 2200MW if Maliszewski 138kV series reactor is by-passed.

Tidd 345 kV Station Voltage Concerns

There are short circuit considerations at the Tidd station when Tidd 345 kV voltage exceeds 103 %. One possible solution to the short circuit considerations is the removal of a Tidd Unit or a 345 kV outlet from the Tidd station.

Procedures:

PJM Actions:

- PJM will study possible actions to mitigate short circuit problems at the Tidd 345 kV station and the effects of those actions on the surrounding transmission system.
-

Tidd 138 kV Switchyard Overduty Circuit Breaker

There is an over-duty condition in the Tidd 138kV switchyard when the Cardinal Unit #1 is online and configured with its GSU neutral ground switch in the closed position, and voltage is 1.03 PU (142.1V) or higher. The Tidd 345/138kV TRB should be switched in service, serving the Sunnyside 138kV circuit as part of normal operations. There is no overduty condition when Cardinal Unit #1 is online and Tidd 345/138kV TRB is energized serving only the Sunnyside 138kV circuit.

Procedures:

PJM Actions:

PJM will coordinate the switching with transmission owner and consider the following steps based on the status of Cardinal Unit #1

- If Cardinal Unit #1 is offline due to a planned outage, The Columbus East Transmission Dispatcher will de-energize Tidd 345/138kV TRB and serve Sunnyside circuit by tying to Tidd bus #2. The steps for removing TRB from service are as follows:
  - Open Tidd 138kV CB M by supervisory
  - Close Tidd 138kV CB M2 by supervisory
- In this configuration the Sunnyside 138kV circuit will be tied to Tidd 138kV bus #2. The highside of TRB will remain energized, so no switching in the 345kV yard will be needed.
- Prior to startup of the Cardinal Unit #1 Tidd 345/138kV TRB should be put in service to serve the Sunnyside 138kV circuit by the following steps:
  - Open Tidd 138kV CB M2 by supervisory
  - Close Tidd 138kV CB M by supervisory
- The Sunnyside circuit will be open ended during switching to eliminate any overduty conditions.

Additional Regional Procedures

Roanoke Transmission Region

- Overloads on the Amos 345/138 kV T-7 or T-8 transformers can be relieved by opening the Amos-Hopkins 138 kV line at Amos. This procedure was utilized prior to the installation of the Amos 765/138 kV T-6 transformer and is not expected to be used frequently. If necessary, this procedure can still be a viable alternative, especially during outages of the Amos 765/138 kV T-6 transformer.
- The Amos-St. Albans section of the **Amos-Hopkins 138 kV** line may overload for the loss of the Baker-Broadford 765 kV circuit. Loading on this circuit can be controlled by adjusting the Inez UPFC to increase the flow on the Big Sandy-Inez 138 kV circuit.
- Loading on the **Axton 765/138 kV transformer, Axton-Danville 138 kV, or Danville-E. Danville 138 kV** can be reduced by inserting the Axton 2.5%, 138 kV series reactor. However, insertion of this reactor will redistribute flows and may cause other overloads.
- The Broadford-Atkins 138 kV may overload for the loss of the Broadford-Jacksons Ferry 765 kV circuit. A series reactor with a by-pass switch has been installed at Broadford on the Broadford-Atkins line. The reactor is operated normally by-passed, but will automatically switch in-service upon the loss of the Broadford-Jacksons Ferry 765 kV circuit.
- The **Claytor – Glen Lyn 138 kV #1 or #2** circuits may overload for the loss of the Claytor – Peak Creek 138 kV circuit. Opening the 138 kV CB 'L' at Tech Drive or CB 'A' at West Bassett can be used to provide some relief. Distribution load outages in the Christiansburg area will need to be approximately 2.0 times the requested load relief. FLS procedures have been created to shed the additional Christiansburg area load.
- Overloads on the **Cloverdale-Bonsack-Roanoke 138 kV** circuit can be controlled first by by-passing the Axton 138 kV series reactor. Additional options include opening the Fieldale 138kV CB T at Roanoke station or opening the 69 kV CB's U and V at Roanoke.
- The **Danville – E. Danville 138 kV** circuit may overload for the loss of either the Jacksons Ferry-Cloverdale or Axton - Jacksons Ferry 765 kV circuits. Increasing the impedance between the Axton and Danville stations by opening the Axton No. 1 138 kV CB N at Danville will eliminate this overload concern. Opening the Danville - East Danville 69 kV Circuit will shed 10+ MW of industrial load. No distribution customers are served by AEP in the Danville Area. A FLS procedure has been created to shed the additional area load.

- The **Glen Lyn - Morgans Cut – Claytor #2 138 kV** circuit may overload for the loss of Glen Lyn – Hazel Hollow – Claytor #1 138 kV circuit. Post contingency: Open the 138 kV CB B at Glen Lyn to remove the contingency. The 69 kV CB A at Morgans Cut can be opened, but that will place 30+ MW at risk on a radial circuit.
- The **Inez UPFC** automatic flow control adjusts power flow along the Big Sandy-Inez 138 kV path. The objective is to maintain power flows below 90% of the summer emergency capability of the Big Sandy-Dewey 138 kV, Amos-Hopkins 138 kV, and Leslie-Pineville 161 kV lines.
- The **Jacksons Ferry-Peak Creek 138 kV** may overload for the loss of the Jacksons Ferry-Cloverdale 765 kV circuit. A series reactor with a by-pass switch has been installed at Jacksons Ferry on the Jacksons Ferry-Peak Creek line. The reactor is operated normally by-passed, but will automatically switch in-service upon the loss of the Jacksons Ferry-Cloverdale 765 kV circuit.
- To relieve loadings on the two **Kanawha-Bradley** 138 kV circuits, open one end of the Bradley-Hinton-Glen Lyn circuit to reduce loadings on other area facilities. However, this procedure can cause loading problems on other facilities. Careful consideration must be given to overall conditions before utilizing the existing procedure. A FLS procedure has been created to shed additional area load.
- To relieve loadings on one of the two **Kanawha-Bradley** 138 kV circuits for the loss of the Baker – Broadford 765 kV or the parallel Kanawha – Bradley 138 kV circuit: Place the 30-50% series capacitance in service on the Kanawha-Matt Funk 345kV circuit. Open Carbide Main 138kV CB D at Turner and then the Bradley 138kV CB B at Hinton if needed Post Contingency. A FLS procedure has been created to shed additional area load.
- To relieve loading on the **Kanawha River 345/138 kV T-B** for the loss of the Kanawha River – Matt Funk 345 kV circuit open Amos 345kV CB Q1 at Kanawha, Post Contingency. This removes the Amos 345kV source which eliminates the transformer overload concerns.
- Heavy loadings on the **Kanawha River – Carbondale 138 kV** circuit may be reduced by opening 69 kV CB B at Tower 117 and 46 kV CB A at Belva.
- Heavy loading on the Scottsville-Bremo 115 kV tie may be reduced by having DVP open the breakers at the Bremo station.
- Heavy loading on the **Skimmer-Balcony Falls** 115 kV tie and other facilities at the Lexington station may be reduced by having DVP open the breakers at the Balcony Falls station.
- Overloads on the **Tristate-Kenova-S. Point 138 kV** line may be reduced by opening the S. Point-Millbrook 138 kV line at Millbrook.

- Overloads on the **Tristate-W. Huntington 138 kV** line may be reduced by opening the Amos-W. Huntington 138 kV line at W. Huntington. However, this may aggravate the loading the Tristate-Kenova-S. Point 138 kV line. A FLS procedure has been created to shed additional area load.
- Heavy loading on the **Turner-Ruth 138 kV** line may be reduced by opening the Cabin Creek 138 kV CB's 'A' & 'B' (open ends lines to Kanawha River) or by opening Turner 138 kV CB 'D' (splits station), as well as, bypassing the Wyoming reactors. Loading on the Wyoming transformers and voltages in the Charleston area should be closely monitored prior to implementing this procedure. A FLS procedure has been created to shed additional area load.
- To reduce contingency loadings on the Joshua Falls-Reusens 138 kV (Joshua Falls-Gomingo section) circuit outage during heavy east transfers and loss of the Cloverdale 765/345 kV T-10 transformer, open the 138 kV bus tie breaker 'F' at Reusens (provides approximately 20% relief).

Columbus Transmission Region

- Overloads on the **Bixby-Groves 138 kV #1/2** lines may be alleviated by opening Groves 138 kV CB '9', open ending the Bexley-Groves 138 kV line, pending current system conditions.
- Overloads on the Kenny-Roberts 138 kV line may be alleviated by opening removing Roberts 345/138 kV T1 or T2 from service, pending current system conditions.
- Overloads on the **Muskingum-North Muskingum 138 kV** line can be alleviated by opening the Crooksville-North Newark 138 kV line at Crooksville, pending current system conditions.
- Heavy loadings on the **Muskingum River-Wolf Creek-Corner** 138 kV line may be reduced by one of several options. These include: 1) opening the Muskingum-Wolf Creek 138 kV line (via CB 'HG' at Muskingum); 2) opening the Washington line at Corner (via CB 80 at Corner). The action chosen will depend on local conditions at the time.
- Overloads on the **Maliszewski 765/138 kV** transformer and other Columbus metro 138 kV circuits between Maliszewski, Genoa, and Hyatt station may be alleviated by inserting the Maliszewski 138 kV series reactor.
- Overloads on the **North Crown City-Thivener SS 138 kV line section** (Gavin-North Proctorville circuit) may be alleviated by opening Gavin 138 kV CB's 'AC' & 'AC1', which open ends the Gavin-North Proctorville circuit.

- Overloads on the **Ohio Central 345/138 kV** transformer may be alleviated by inserting the Ohio Central 138 kV series reactor.
- Overloads on the **Ohio Central-Powelson 138 kV** line section (Ohio Cental-Zanesville circuit) may be reduced by opening Philo 138 kV CB ‘D’ or Zanesville 138 kV CB ‘C’, pending system conditions.
- Loadings on the **Sunnyside-Warner-Torrey 138 kV** for the loss of the S. Canton-Torrey 138 kV can be controlled by opening the S.E. Canton-Sunnyside 138 kV line at Sunnyside via supervisory control. Contingency loadings need to be watched on the SE Canton-Canton Central 138 kV and S. Canton-Torrey 138 kV circuits when this procedure is implemented.
- The **Tidd** 138 kV series reactor on transformer **T-C** must be in-service when Cardinal unit #1 is on-line in order to limit fault duties. The series reactor bypass should be closed when Cardinal unit #1 is off-line. Tidd 345/138 kV transformers T-B and T-C must never be tied into the 138 kV bus at the same time. Transformer T-B can be bypassed to the South Cadiz-Carrolton 138 kV circuit.
- Overloads on the **Tidd-Mahans Lane-Weirton 138 kV** and **Tidd-Carnegie-Weirton 138 kV** circuits may be controlled by opening the circuits on a pre/post-contingency basis via 138 kV CB’s 202 and 224 at Weirton.
- Overloads on the **Tidd-South Cadiz 138 kV** line section (Sunnyside-Tidd circuit) may be controlled by opening 138 kV CB C at Sunnyside, open ending the Sunnyside-Tidd 138 kV circuit, pending current system conditions.
- Overloads on the **Tiltonsville-Windsor 138 kV** line section (West Bellaire-Windsor circuit) may be controlled by closing the Elrama-Mitchell 138 kV APS line (if open), opening the Lagonda or the Buffalo Junction APS CB at Windsor station (APS), or opening the West Bellaire transformer via 138 kV CB’s E & E2.

Fort Wayne Transmission Region

- Heavy loading on the **Hogan – Madison** 138 kV circuit can be eliminated by:
    - Opening the Hogan – Madison circuit at Hogan (CB ‘A’). The Desoto – Madison 138kV may also need opened via Madison 138kV CB ‘N’ to control loading during this scenario
    - Opening Delaware 138kV tie CB ‘T’ may also be an option. The 34.5kV bus tie CB ‘T’ will also need opened (SCADA control not available)

- The loss of the **E. Lima – Fostoria 345 kV** circuit may overload the E. Lima – New Liberty and E. Lima – N. Findlay 138 kV circuits. To alleviate loading: 1) at New Liberty Station: open 138 kV CB 'B' (puts New Liberty on radial feed from East Lima); 2) at Fostoria Central Station: open 138 kV CB s 'J1' & 'K1' (puts North Findlay and North East Findlay on radial feed from East Lima). Please note that these specific breakers have been chosen to eliminate the potential of a parallel 34.5kV through the Melmore area from overloading.
- The Ordnance Jct. – Shawnee Rd. 138kV can be opened via CB 'T' @ Ordnance to provide approximately 50 MW of relief on either **Southwest Lima 345/138kV** transformer during contingency scenarios. However, this can cause post-contingency voltage issues at Sterling, so the solution should be studied carefully and verified with PJM. If additional relief on the transformers, the **Ordnance Jct. – Southwest Lima 138kV**, or **Southwest Lima – West Lima 138kV** is required, opening the Southwest Lima – Shelby 345kV circuit AT SHELBY ONLY can provide some relief. Opening at the Southwest Lima end will create a configuration tying the Marysville – Southwest Lima 345kV circuit to T1 and causing massive overloads.
- The Industrial Park – Wallen 138kV can be opened via CB 'G' @ Wallen to control overloads on the **Industrial Park – McKinley** and **Industrial Park – Sorenson 138kV lines**. This option is not appropriate during peak load conditions as it may overload the Anthony Tap – Lincoln 138kV.

Twin Branch – Argenta (Conservative Operations)

(**References**: 2011-S-008-E, MISO Standing Operating Guide)

<u>Monitored Element</u>: Twin Branch-Argenta 345 kV

<u>Contingent Elements:</u> Cook-Palisades 345 kV & Benton Harbor-Palisades 345 kV

Under certain conservative operations conditions (i.e. ice storm), there may be an increased probability of a multiple facility trip. The Twin Branch – Argenta 345kV was identified as a facility that could be classified as an IROL facility under an increased probability of a double circuit tower line contingency condition. The IROL limit would be a voltage collapse or violation of the Twin Branch – Argenta 345kV Load Dump limit for 30-minutes.

Operator Actions:

- Declare Conservative Operations
- Activate the double circuit tower line contingency "Cook – Palisades & Cook – Benton Harbor 345kV (icing conditions)" in the real time Security Analysis
- Control loading to the Emergency Rating
- Initiate Market to Market Coordination on Flowgate #2349 – "Twin Branch – Argenta 345kV l/o Cook-Palisades + Cook – Benton Harbor"

- Issue TLR to decrease flow to North
- Declare Safe Operating Mode and adjust effective generation.
- Increase METC/MISO Plants
- Decrease AEP/PJM Plants

Load Shedding Options

For this flowgate, load needs to be shed in the METC/MISO Control Region. The impact of the load shedding in this area varies from 22% to 34%, with an average of 28%.

Note: This is for information only purposes since the primary control for this flowgate loading rests primarily in the METC/MISO Control Region.

AEP Single Breaker Derates

For certain CB outages which isolate a line/transformer on a single CB, AEP derates the line/transformer rating due to the CB limitation which becomes limiting.

PJM needs to ensure ratings are changed to reflect this single CB limitation when a CB associated with the facility is out-of-service.

Derates for AEP Breaker Outages by Substation (MVA)						
BKR	**LINE/XFMR**	**Temp °F**	**NL**	**LT**	**ST**	**LD**
Kammer						
‘E’ 138kV	T100 345/138kV Xfrmr	ALL	381	381	381	392
‘F’ 138kV	T100 345/138kV Xfrmr	95	373	373	373	429
Note: The 32 °F NL Temp set is a Xfrmr limitation, *not* a CB limitation. (CBs limited to 586MVA NL rating.)		86	403	403	403	463
		77	434	434	434	499
		68	464	464	464	534
		59	495	495	495	569
		50	525	525	525	604
		41	556	556	556	639
		32	576 *	586	586	674

Index of Operating Procedures for Baltimore Gas & Electric (BC or BGE) Transmission Zone

The Baltimore Gas & Electric Company Transmission Zone has Operating Procedures that are adhered to by PJM. These procedures include the following:

	Type of Operating Procedure	Transmission Operations Manual Section Ref
Calvert Cliffs Voltage Limitations	Voltage Limitations	Section 5 BC
Nottingham- Cooper 230 kV Line Limitations	Line Limitation	Section 5 PECO
Breaker Derate Table	Ratings	Section 5 BC
Westport Breaker Limitations and Gould Street Generation Operations	Generator Limitations	Section 5 BC
Cross Town Common Trench Circuit Rating Changes	Ratings	Section 5 BC
Brandon Shores – Riverside SPS [SPS]	Ratings	Section 5 BC
Back To Index		

Calvert Cliffs Voltage Limitations

During normal operating conditions, the Calvert Cliffs 500 kV bus voltages can be operated using the same criteria used for other PJM 500 kV buses (within a range of 500-550 kV under normal conditions and as low as 475 in an emergency following a contingency). However, when either of the plant service transformers (P-13000-1 or P-13000-2) is out of service, the Calvert Cliffs 500 kV bus voltages should be operated within a range of 520-550 kV (normal limits) with all transmission facilities in service and 510kV to 550kV (emergency limits) during the loss of a single transmission facility (contingency).

Calvert Cliff Voltage Limits		
Plant Service Transformers (P-13000-1 & P-13000-2)	**Pre-Contingency**	**Post-Contingency**
Both xfmrs in service	500kV – 550kV	475kV – 550kV
Only one xfmr in service	520kV – 550kV	510kV – 550kV

Note that the Calvert Cliffs switchyard design is such that whenever the P-13000-1 plant service transformer is out of service, the 500 kV black bus is also out of service. Similarly, any time the P-13000-2 plant service transformer is out of service, the 500 kV red bus is also out of service. The Calvert Cliffs red and black busses are currently PJM reportable facilities.

Operating within these voltage ranges is necessary to ensure that the Calvert Cliffs degraded and loss of voltage relays (which monitor the plant vital 4 kV system for adequate voltage) do not operate and isolate the vital 4 kV busses from their normal 500 kV transmission supplies.

The under-excited reactive ampere limits (URAL) (at full MW load) with all lines in service are:

- Unit No. 1 - 280 MVAR lead
- Unit No. 2 - 300 MVAR lead

Lines out-of-service (maximum lead unit stability limits) are:

Maximum Leading Reactive MVAR For Each Unit		
Circuit Outage	**Both Units In Service**	**One Unit In Service**
5051 or 5052	200 Lead	265 Lead
5053	160 Lead	URAL
5071	260 Lead	URAL
5072	85 Lead	160 Lead

Exhibit 7: Calvert Cliffs Maximum Lead Unit Stability Limits

When the above lines are removed from service, the Calvert Cliffs units are subject to maximum lead capability stability limits. These limits must be observed prior to removing the transmission lines. Values less than the URAL setting must be observed and maintained manually.

As part of the normal sequence of providing reactive transfer limits for the PJM RTO, PJM dispatcher reviews security analysis for any potential contingencies that violate the 500 kV high voltage limit. If such a contingency is found, PJM dispatcher notifies BSOP of the contingency, confirms the actual high voltage limit being observed, and helps coordinate voltage schedule changes to relieve the contingency.

The overall philosophy is to maintain the Calvert Cliffs unit reactive output to ensure capability to absorb excess MVAR on the 500 kV bus for the loss of a generator, if operating in the lead (MVARs flowing into the unit step-up from the 500 kV bus), or the loss of a 500 kV bus. Minimizing MVAR flows at the high side of the unit step-up and keeping a uniform distribution on the 500 kV lines leaving the plant, ensures minimum contingency effects. Having no units operating obviously provides the most difficult operating conditions.

PJM Actions:

- PJM dispatcher reviews system conditions in the local area for anything abnormal that could be corrected.
- PJM dispatcher utilizes adjustments in unit reactive (if units are operating) until reaching an optimum condition, which leaves enough

leading reactive reserve to cover the worst reactive contingency for the 500 kV bus.

- PJM dispatcher adjusts tap positions at Waugh Chapel, Brighton, and Chalk Point in a coordinated effort to reduce voltage or reactive flows towards the Calvert Cliffs bus.
- PJM dispatcher ensures that the Calvert Cliffs Plant is taking all possible measures to provide the highest 500 kV high voltage limit.
- If EHV system conditions permit, PJM dispatcher makes any reasonable adjustments that can be made on the southern PJM RTO or Balancing Authorities which do not have an adverse impact on actual PJM RTO transfers. (Capacitors not required for transfers that have a beneficial effect can be considered.)
- If the study indicates that there are no adverse consequences created by selectively opening 500 kV lines in the BC/PEPCO loop, then PJM dispatcher requests the BPSO to open the transmission facility. When removing EHV lines from service there are some important things to consider. First, remember to observe the leading reactive stability limits for the Calvert Cliffs units when circuits are removed from service. Second, make sure the line removal steps always leave the Calvert Cliffs 500 kV bus more deficient of reactive power. Follow switching with on-line computer program staff to observe any system changes resulting from the switching.

Possible study suggestions include:

- if a small change is required, study opening 5051 or 5052. This removal has one of the smaller effects on the unit leading capability and keeps the Loop intact
- if a larger change is required, study opening the 5053 line. This removes the higher source voltage at Brighton and allows more control from tap changes at Waugh Chapel

If BGE BPSO indicates to PJM dispatcher that Calvert Cliffs 500 kV high voltage limit must be reduced below the 525 kV normal for any reason, or possibly increased above the normal under certain system conditions when plant conditions allow, PJM dispatcher changes the limit in the on-line computer program and manually initiates the real-time sequence, including security analysis.

Breaker Derate Table

For certain CB outages which isolate a line on a single CB, BGE derates the line rating due to the CB limitation which becomes limiting.

PJM needs to ensure line ratings are changed to reflect this single CB limitation when a CB associated with the facility is out-of-service.

BGE Single Breaker Limits for Circuits/Transformers								
		Two Breakers in Service				One Breaker in Service		
Circuit/Transformer	**Temp Set**	**NL**	**EM**	**LD**		**NL**	**EM**	**LD**
Conastone - Peach Bottom 5012	95-DAY	2650	3014	3507		2490	2815	3269
Applies to CBs: Conastone 500kV ‘B’ or ‘C’	95-NIGHT	2650	3014	3507		2490	2815	3269
	86-DAY	2702	3066	3533		2576	2901	3334
	86-NIGHT	2702	3066	3533		2576	2901	3334
	77-DAY	2754	3118	3585		2663	2966	3399
	77-NIGHT	2754	3118	3585		2663	2966	3399
	68-DAY	2806	3170	3637		2750	3053	3464
	68-NIGHT	2806	3170	3637		2750	3053	3464
	59-DAY	2858	3196	3663		2815	3118	3529
	59-NIGHT	2858	3196	3663		2815	3118	3529
	50-DAY	2910	3248	3689		2901	3183	3594
	50-NIGHT	2910	3248	3689		2901	3183	3594
	41-DAY	2962	3300	3741		2962	3248	3659
	41-NIGHT	2962	3300	3741		2962	3248	3659
	32-DAY	3014	3352	3793		3014	3334	3702
	32-NIGHT	3014	3352	3793		3014	3334	3702

Note: These ratings reflect the BGE portion of the Conastone – Peach Bottom 5012 tie line only

BGE Single Breaker Limits for Circuits/Transformers								
		Two Breakers in Service				One Breaker in Service		
Circuit/Transformer	**Temperature**	**NL**	**EM**	**LD**		**NL**	**EM**	**LD**
Cal Cliffs - Waugh Chapel 5051	95-DAY	2912	3377	3710		2702	3014	3559
	95-NIGHT	2912	3377	3923		2702	3014	3559
Applies to CBs:	86-DAY	3067	3481	3859		2806	3092	3793
Calvert Cliffs 500kV	86-NIGHT	3071	3481	4001		2806	3092	3793
‘21’ or ‘23’	77-DAY	3196	3559	4003		2910	3196	3975
	77-NIGHT	3196	3559	4079		2910	3196	3975
	68-DAY	3300	3663	4140		3014	3300	4140
	68-NIGHT	3300	3663	4157		3014	3300	4157
	59-DAY	3377	3741	4235		3092	3377	4235
	59-NIGHT	3377	3741	4235		3092	3377	4235
	50-DAY	3481	3819	4313		3196	3455	4313
	50-NIGHT	3481	3819	4313		3196	3455	4313
	41-DAY	3559	3897	4391		3300	3559	4391
	41-NIGHT	3559	3897	4391		3300	3559	4391
	32-DAY	3663	4001	4443		3377	3637	4443
	32-NIGHT	3663	4001	4443		3377	3637	4443
Cal Cliffs - Waugh Chapel 5052	95-DAY	2912	3377	3710		2702	3014	3559
	95-NIGHT	2912	3377	3923		2702	3014	3559
Applies to CBs:	86-DAY	3067	3481	3859		2806	3092	3793
Calvert Cliffs 500kV	86-NIGHT	3071	3481	4001		2806	3092	3793

BGE Single Breaker Limits for Circuits/Transformers								
		Two Breakers in Service				One Breaker in Service		
Circuit/Transformer	Temperature	NL	EM	LD		NL	EM	LD
’41 or ‘43’	77-DAY	3196	3559	4003		2910	3196	3975
	77-NIGHT	3196	3559	4079		2910	3196	3975
	68-DAY	3300	3663	4140		3014	3300	4140
	68-NIGHT	3300	3663	4157		3014	3300	4157
	59-DAY	3377	3741	4235		3092	3377	4235
	59-NIGHT	3377	3741	4235		3092	3377	4235
	50-DAY	3481	3819	4313		3196	3455	4313
	50-NIGHT	3481	3819	4313		3196	3455	4313
	41-DAY	3559	3897	4391		3300	3559	4391
	41-NIGHT	3559	3897	4391		3300	3559	4391
	32-DAY	3663	4001	4443		3377	3637	4443
	32-NIGHT	3663	4001	4443		3377	3637	4443

BGE Single Breaker Limits for Circuits/Transformers								
		Two Breakers in Service				One Breaker in Service		
Circuit/Transformer	Temperature	NL	EM	LD		NL	EM	LD
Cal Cliffs - Cal Cliffs Unit #1 5101	95-DAY	2912	3802	4050		2702	3014	3559
Applies to CBs: Calvert Cliffs 500kV ’22’ or ‘23’	95-NIGHT	2912	3802	4050		2702	3014	3559
	86-DAY	3071	3916	4155		2806	3092	3793
	86-NIGHT	3071	3916	4155		2806	3092	3793
	77-DAY	3222	4027	4257		2910	3196	3975

BGE Single Breaker Limits for Circuits/Transformers								
			Two Breakers in Service			One Breaker in Service		
Circuit/Transformer	**Temperature**	**NL**	**EM**	**LD**		**NL**	**EM**	**LD**
	77-NIGHT	3222	4027	4257		2910	3196	3975
	68-DAY	3364	4133	4354		3014	3300	4157
	68-NIGHT	3364	4133	4354		3014	3300	4157
	59-DAY	3499	4235	4450		3092	3377	4235
	59-NIGHT	3499	4235	4450		3092	3377	4235
	50-DAY	3627	4334	4541		3196	3455	4313
	50-NIGHT	3627	4334	4541		3196	3455	4313
	41-DAY	3750	4429	4630		3300	3559	4391
	41-NIGHT	3750	4429	4630		3300	3559	4391
	32-DAY	3866	4521	4716		3377	3637	4443
	32-NIGHT	3866	4521	4716		3377	3637	4443
Cal Cliffs - Cal Cliffs Unit #2 5102	95-DAY	2912	3802	4050		2702	3014	3559
Applies to CBs: Calvert Cliffs 500kV '61' or '63'	95-NIGHT	2912	3802	4050		2702	3014	3559
	86-DAY	3071	3916	4155		2806	3092	3793
	86-NIGHT	3071	3916	4155		2806	3092	3793
	77-DAY	3222	4027	4257		2910	3196	3975
	77-NIGHT	3222	4027	4257		2910	3196	3975
	68-DAY	3364	4133	4354		3014	3300	4157
	68-NIGHT	3364	4133	4354		3014	3300	4157
	59-DAY	3499	4235	4450		3092	3377	4235
	59-NIGHT	3499	4235	4450		3092	3377	4235

BGE Single Breaker Limits for Circuits/Transformers								
		Two Breakers in Service				One Breaker in Service		
Circuit/Transformer	Temperature	NL	EM	LD		NL	EM	LD
	50-DAY	3627	4334	4541		3196	3455	4313
	50-NIGHT	3627	4334	4541		3196	3455	4313
	41-DAY	3750	4429	4630		3300	3559	4391
	41-NIGHT	3750	4429	4630		3300	3559	4391
	32-DAY	3866	4521	4716		3377	3637	4443
	32-NIGHT	3866	4521	4716		3377	3637	4443

BGE Single Breaker Limits for Circuits/Transformers								
		Two Breakers in Service				One Breaker in Service		
Circuit/Transformer	Temperature	NL	EM	LD		NL	EM	LD
Waugh Chapel - Jerico Park 2340	95-DAY	1124	1456	1547		916	1036	1203
Applies to CBs: Waugh Chapel 230kV ‘2316_40’ or ‘2340’	95-NIGHT	1124	1456	1547		916	1036	1203
	86-DAY	1186	1499	1587		948	1068	1227
	86-NIGHT	1186	1499	1587		948	1068	1227
	77-DAY	1243	1542	1626		980	1092	1251
	77-NIGHT	1243	1542	1626		980	1092	1251
	68-DAY	1298	1582	1664		1012	1123	1275
	68-NIGHT	1298	1582	1664		1012	1123	1275
	59-DAY	1349	1621	1699		1036	1147	1299
	59-NIGHT	1349	1621	1699		1036	1147	1299
	50-DAY	1398	1659	1735		1068	1171	1323

BGE Single Breaker Limits for Circuits/Transformers								
		Two Breakers in Service				One Breaker in Service		
Circuit/Transformer	**Temperature**	**NL**	**EM**	**LD**		**NL**	**EM**	**LD**
	50-NIGHT	1398	1659	1735		1068	1171	1323
	41-DAY	1445	1695	1769		1092	1195	1346
	41-NIGHT	1445	1695	1769		1092	1195	1346
	32-DAY	1490	1731	1802		1123	1227	1362
	32-NIGHT	1490	1731	1802		1123	1227	1362
W Chapel - Jerico Park Tap 2341	95-DAY	1124	1456	1547		1124	1386	1547
Applies to CBs: Waugh Chapel 230kV '2341 Bus1' or '2341 Bus2'	95-NIGHT	1124	1456	1547		1124	1386	1547
	86-DAY	1186	1499	1587		1186	1422	1587
	86-NIGHT	1186	1499	1587		1186	1422	1587
	77-DAY	1243	1542	1626		1243	1470	1626
	77-NIGHT	1243	1542	1626		1243	1470	1626
	68-DAY	1298	1582	1664		1298	1518	1664
	68-NIGHT	1298	1582	1664		1298	1518	1664
	59-DAY	1349	1621	1699		1349	1554	1699
	59-NIGHT	1349	1621	1699		1349	1554	1699
	50-DAY	1398	1659	1735		1398	1590	1735
	50-NIGHT	1398	1659	1735		1398	1590	1735
	41-DAY	1445	1695	1769		1445	1637	1769
	41-NIGHT	1445	1695	1769		1445	1637	1769
	32-DAY	1490	1731	1802		1490	1673	1802
	32-NIGHT	1490	1731	1802		1490	1673	1802

BGE Single Breaker Limits for Circuits/Transformers								
		Two Breakers in Service				One Breaker in Service		
Circuit/Transformer	**Temperature**	**NL**	**EM**	**LD**		**NL**	**EM**	**LD**
Granite 230-1 Transformer L/S	95-DAY	533	729	883		519	579	684
Applies to CBs: Granite 115kV '1-5' or '1-3'	95-NIGHT	533	729	883		519	579	684
	86-DAY	552	745	900		539	594	729
	86-NIGHT	552	745	900		539	594	729
	77-DAY	571	761	900		559	614	763
	77-NIGHT	571	761	900		559	614	763
	68-DAY	590	777	900		579	634	803
	68-NIGHT	590	777	900		579	634	803
	59-DAY	607	792	900		594	649	838
	59-NIGHT	607	792	900		594	649	838
	50-DAY	625	808	900		614	664	873
	50-NIGHT	625	808	900		614	664	873
	41-DAY	641	822	900		634	684	900
	41-NIGHT	641	822	900		634	684	900
	32-DAY	658	837	900		649	699	900
	32-NIGHT	658	837	900		649	699	900
Granite 230-2 Transformer L/S	95-DAY	528	748	900		519	579	684
Applies to CBs: Granite 115kV '2-4' or '2-6'	95-NIGHT	528	748	900		519	579	684
	86-DAY	549	767	900		539	594	729
	86-NIGHT	549	767	900		539	594	729
	77-DAY	570	786	900		559	614	763
	77-NIGHT	570	786	900		559	614	763
	68-DAY	590	804	900		579	634	803
	68-NIGHT	590	804	900		579	634	803
	59-DAY	610	822	900		594	649	838
	59-NIGHT	610	822	900		594	649	838
	50-DAY	629	840	900		614	664	873
	50-NIGHT	629	840	900		614	664	873
	41-DAY	648	850	900		634	684	900
	41-NIGHT	648	850	900		634	684	900

BGE Single Breaker Limits for Circuits/Transformers								
		Two Breakers in Service				One Breaker in Service		
Circuit/Transformer	Temperature	NL	EM	LD		NL	EM	LD
	32-DAY	666	850	900		649	699	900
	32-NIGHT	666	850	900		649	699	900

BGE Single Breaker Limits for Circuits/Transformers								
		Two Breakers in Service				One Breaker in Service		
Circuit/Transformer	Temperature	NL	EM	LD		NL	EM	LD
Pumphrey - Wagner	95-DAY	399	529	529		399	462	529
Applies to CBs: 115kV Wagner ‘32-3 OCB’ or ‘32-3_2GB’	95-NIGHT	431	551	568		414	462	546
	86-DAY	419	551	551		419	474	551
	86-NIGHT	455	568	588		430	474	582
	77-DAY	438	571	571		438	490	571
	77-NIGHT	476	584	608		446	490	608
	68-DAY	457	590	590		457	506	590
	68-NIGHT	497	599	626		462	506	626
	59-DAY	474	609	609		474	518	609
	59-NIGHT	517	614	642		474	518	642
	50-DAY	492	627	627		490	530	627
	50-NIGHT	533	628	655		490	530	655
	41-DAY	508	642	644		506	546	644
	41-NIGHT	549	642	668		506	546	668
	32-DAY	524	656	661		518	558	661
	32-NIGHT	564	656	680		518	558	680
Wagner – Lipins Corner 110534	95-DAY	431	553	577		414	462	546
Applies to CBs: 115kV Wagner ‘110534’ or ’34-1 OCB & 34-1_3GN’	95-NIGHT	431	553	586		414	462	546
	86-DAY	455	570	587		430	474	582
	86-NIGHT	455	570	602		430	474	582
	77-DAY	476	586	597		446	490	597

	77-NIGHT	476	586	617		446	490	610
	68-DAY	497	601	607		462	506	607
	68-NIGHT	497	601	627		462	506	627
	59-DAY	516	616	616		474	518	616
	59-NIGHT	516	616	636		474	518	636
	50-DAY	535	625	625		490	530	625
	50-NIGHT	535	630	645		490	530	645
	41-DAY	549	634	634		506	546	634
	41-NIGHT	553	644	654		506	546	634
	32-DAY	558	643	643		518	558	643
	32-NIGHT	570	658	662		518	558	662
Conastone 500-3 Transformer L/S	95-DAY	827	1149	1312		827	924	1092
Applies to CBs:230kV '3TR-2323' or '500-3TR' CBs	95-NIGHT	827	1149	1312		827	924	1092
	86-DAY	858	1174	1312		858	948	1163
	86-NIGHT	858	1174	1312		858	948	1163
	77-DAY	888	1199	1312		888	980	1219
	77-NIGHT	888	1199	1312		888	980	1219
	68-DAY	916	1224	1312		916	1012	1275
	68-NIGHT	916	1224	1312		916	1012	1275
	59-DAY	944	1239	1312		944	1036	1299
	59-NIGHT	944	1239	1312		944	1036	1299
	50-DAY	971	1239	1312		971	1060	1312
	50-NIGHT	971	1239	1312		971	1060	1312
	41-DAY	997	1239	1312		997	1092	1312
	41-NIGHT	997	1239	1312		997	1092	1312
	32-DAY	1021	1239	1312		1021	1115	1312
	32-NIGHT	1021	1239	1312		1021	1115	1312

BGE Single Breaker Limits for Circuit/Transformers							
		Two breakers in Service			One Breaker in service		
Circuit/Transformer	**Temperature**	**NL**	**EM**	**LD**	**NL**	**EM**	**LD**
Waugh Chapel 230-1 transformer	95-Day	648	750	750	414	462	546
Applies to Waugh Chapel 115kV Cbs 110543SF and 110538 **Summer Ratings**	95-Night	648	750	750	414	462	546
	86-Day	648	750	750	430	474	582
	86-Night	648	750	750	430	474	582
	77-Day	648	750	750	446	490	610
	77-Night	648	750	750	446	490	610
	68-Day	648	750	750	462	506	641
	68-Night	648	750	750	462	506	641
	59-Day	648	750	750	474	518	669
	59-Night	648	750	750	474	518	669
	50-Day	648	750	750	490	530	697
	50-Night	648	750	750	490	530	697
	41-Day	648	750	750	506	546	725
	41-Night	648	750	750	506	546	725
	32-Day	648	750	750	518	558	750
	32-Night	648	750	750	518	558	750
Applies to Waugh Chapel 230kV Cbs 110543SF and 110538 **Winter Ratings**	95-Day	687	750	750	414	462	546
	95-Night	687	750	750	414	462	546
	86-Day	711	750	750	430	474	582
	86-Night	711	750	750	430	474	582
	77-Day	735	750	750	446	490	610
	77-Night	735	750	750	446	490	610
	68-Day	750	750	750	462	506	641
	68-Night	750	750	750	462	506	641
	59-Day	750	750	750	474	518	669
	59-Night	750	750	750	474	518	669
	50-Day	750	750	750	490	530	697
	50-Night	750	750	750	490	530	697
	41-Day	750	750	750	506	546	725
	41-Night	750	750	750	506	546	725
	32-Day	750	750	750	518	558	750
	32-Night	750	750	750	518	558	750

BGE Single Breaker Limits for Circuit/Transformers							
		Two breakers in Service			One Breaker in service		
Circuit/Transformer	**Temperature**	**NL**	**EM**	**LD**	**NL**	**EM**	**LD**
Waugh Chapel 230-2 transformer	95-Day	626	732	732	414	462	546
Applies to Waugh Chapel 115kV Cbs 110548SF and 110547 **Summer Ratings**	95-Night	626	732	732	414	462	546
	86-Day	626	732	732	430	474	582
	86-Night	626	732	732	430	474	582
	77-Day	626	732	732	446	490	610
	77-Night	626	732	732	446	490	610
	68-Day	626	732	732	462	506	641
	68-Night	626	732	732	462	506	641
	59-Day	626	732	732	474	518	669
	59-Night	626	732	732	474	518	669
	50-Day	626	732	732	490	530	697
	50-Night	626	732	732	490	530	697
	41-Day	626	732	732	506	546	725
	41-Night	626	732	732	506	546	725
	32-Day	626	732	732	518	558	732
	32-Night	626	732	732	518	558	732
Applies to Waugh Chapel 115kV Cbs 110548SF and 110547 **Winter Ratings**	95-Day	687	750	750	414	462	546
	95-Night	687	750	750	414	462	546
	86-Day	711	750	750	430	474	582
	86-Night	711	750	750	430	474	582
	77-Day	735	750	750	446	490	610
	77-Night	735	750	750	446	490	610
	68-Day	750	750	750	462	506	641
	68-Night	750	750	750	462	506	641
	59-Day	750	750	750	474	518	669
	59-Night	750	750	750	474	518	669
	50-Day	750	750	750	490	530	697
	50-Night	750	750	750	490	530	697
	41-Day	750	750	750	506	546	725
	41-Night	750	750	750	506	546	725
	32-Day	750	750	750	518	558	750
	32-Night	750	750	750	518	558	750

BGE Single Breaker Limits for Circuit/Transformers							
		Two breakers in Service			One Breaker in service		
Circuit/Transformer	**Temperature**	**NL**	**EM**	**LD**	**NL**	**EM**	**LD**
Waugh Chapel 230-3 transformer	95-Day	625	722	722	414	462	546
Applies to Waugh Chapel 115kV Cbs 110546SF and 110545SF **Summer Ratings**	95-Night	625	722	722	414	462	546
	86-Day	625	722	722	430	474	582
	86-Night	625	722	722	430	474	582
	77-Day	625	722	722	446	490	610
	77-Night	625	722	722	446	490	610
	68-Day	625	722	722	462	506	641
	68-Night	625	722	722	462	506	641
	59-Day	625	722	722	474	518	669
	59-Night	625	722	722	474	518	669
	50-Day	625	722	722	490	530	697
	50-Night	625	722	722	490	530	697
	41-Day	625	722	722	506	546	722
	41-Night	625	722	722	506	546	722
	32-Day	625	722	722	518	558	722
	32-Night	625	722	722	518	558	722
Applies to Waugh Chapel 115kV Cbs 110546SF and 110545SF **Winter Ratings**	95-Day	687	750	750	414	462	546
	95-Night	687	750	750	414	462	546
	86-Day	711	750	750	430	474	582
	86-Night	711	750	750	430	474	582
	77-Day	735	750	750	446	490	610
	77-Night	735	750	750	446	490	610
	68-Day	750	750	750	462	506	641
	68-Night	750	750	750	462	506	641
	59-Day	750	750	750	474	518	669
	59-Night	750	750	750	474	518	669
	50-Day	750	750	750	490	530	697
	50-Night	750	750	750	490	530	697
	41-Day	750	750	750	506	546	725
	41-Night	750	750	750	506	546	725
	32-Day	750	750	750	518	558	750
	32-Night	750	750	750	518	558	750

BGE Single Breaker Limits for Circuit/Transformers								
		Two breakers in Service			One Breaker in service		
Circuit/Transformer	**Temperature**	**NL**	**EM**	**LD**	**NL**	**EM**	**LD**
Waugh Chapel 230-4 transformer	95-Day	670	750	750	414	462	546
Applies to Waugh Chapel 115kV Cbs 110544SF and 110539SF **Summer Ratings**	95-Night	670	750	750	414	462	546
	86-Day	706	750	750	430	474	582
	86-Night	706	750	750	430	474	582
	77-Day	741	750	750	446	490	610
	77-Night	741	750	750	446	490	610
	68-Day	750	750	750	462	506	641
	68-Night	750	750	750	462	506	641
	59-Day	750	750	750	474	518	669
	59-Night	750	750	750	474	518	669
	50-Day	750	750	750	490	530	697
	50-Night	750	750	750	490	530	697
	41-Day	750	750	750	506	546	725
	41-Night	750	750	750	506	546	725
	32-Day	750	750	750	518	558	750
	32-Night	750	750	750	518	558	750
Applies to Waugh Chapel 115kV Cbs 110544SF and 110539SF **Winter Ratings**	95-Day	670	750	750	414	462	546
	95-Night	670	750	750	414	462	546
	86-Day	706	750	750	430	474	582
	86-Night	706	750	750	430	474	582
	77-Day	741	750	750	446	490	610
	77-Night	741	750	750	446	490	610
	68-Day	750	750	750	462	506	641
	68-Night	750	750	750	462	506	641
	59-Day	750	750	750	474	518	669
	59-Night	750	750	750	474	518	669
	50-Day	750	750	750	490	530	697
	50-Night	750	750	750	490	530	697
	41-Day	750	750	750	506	546	725
	41-Night	750	750	750	506	546	725
	32-Day	750	750	750	518	558	750
	32-Night	750	750	750	518	558	750

Westport Breaker Limitations and Gould Street Generation Operations

During the Gould Street Generation operation, BGE Transmission System Operations will need to take actions to prevent:

- Circuit breakers at Westport 34kV station from being overdutied
- Thermal issues at Westport and Riverside substations.

With the Gould Street Generation in service, circuit breakers in section 1 and section 2 at the Westport 34kV substation could possibly see fault current above their fault capacity.

In order to alleviate this problem, a source of current into section 1 and section 2 bus sections need to be opened.

- Westport #13 transformer should be put into hot standby by opening the low-side circuit breaker.
- Westport 110-8 transformer should be returned from hot standby to in service.

When Gould Street Generation is on, Westport 110-2 transformer should be put into hot standby by opening the low-side breakers. After Gould Street Generation is off-line, the transformer can be returned to service. For any contingency or abnormal operating condition further stressing the Westport 33kV substation during the operation of Gould Street generation, return Westport 110-2 transformer to service if not already in service.

With BRESCO generation out of service, Westport 110-2 transformer can be in service without stressing the circuit breakers in section 2 at the Westport 34kV substation over their fault capacity.

34 kV Feeder Outages / Gould Generation Limitations

- For a Gould Street – Riverside (33871) 34kV feeder outage, Gould Street Generation must be limited to 80 MW.
- For a Gould Street – Riverside (33872) 34kV feeder outage, Gould Street Generation must be limited to 65 MW.
- For a Gould Street – Westport (33851) 34kV feeder outage, Gould Street Generation must be limited to 75 MW.
- For a Gould Street – Westport (33852) 34kV feeder outage, Gould Street Generation must be limited to 75 MW.

Cross Town Common Trench Circuit Rating Changes

In the BGE system, PJM monitors multiple pairs of transmission cables that share a common trench. Under normal conditions, the Long Term Emergency, Short Term Emergency and Load Dump Ratings of these cables are limited by the total heating in the trench, primarily the result of the heat caused by the flow of power through two cables in the trench.

If one of the cables in the shared trench is out of service, due to either maintenance or a tripping (actual or simulated by PJM's Security Analysis programs), the emergency rating of the remaining in-service cable is not limited by the overall trench heating, but instead is limited by the cable itself. This change in the limit results in a higher emergency rating. Shown below are the normal and emergency ratings for the multiple cable pairs that share a common trench. Temperature dependant ratings are provided for the “both cables in-service” condition as well as the “one cable out of service” condition.

Information should be used for study purposes only – Official rating information will be communicated via TERM when Temporary Ratings and Short Term Ratings are implemented for real-time operations.

Center to Erdman 110555 & 110556 Cables

For loss of 110555,110556 in service (Summer)

	Degrees	32	41	50	59	68	77	86	95
Normal	Two Cable	175	175	175	175	175	175	175	175
4 Hour	One Cable	214	214	214	214	214	214	214	214
	Two Cable	204	204	204	204	204	204	204	204
Load Dump/ 15 min	One Cable	214	214	214	214	214	214	214	214
	Two Cable	204	204	204	204	204	204	204	204

For loss of 110555,110556 in service (Winter)

	Degrees	32	41	50	59	68	77	86	95
Normal	Two Cable	209	209	209	209	209	209	209	209
4 Hour	One Cable	251	251	251	251	251	251	251	251
	Two Cable	235	235	235	235	235	235	235	235
Load Dump/ 15 min	One Cable	251	251	251	251	251	251	251	251
	Two Cable	235	235	235	235	235	235	235	235

For loss of 110556,110555 in service (Summer)

	Degrees	32	41	50	59	68	77	86	95
Normal	Two Cable	175	175	175	175	175	175	175	175
4 Hour	One Cable	214	214	214	214	214	214	214	214
	Two Cable	204	204	204	204	204	204	204	204
Load Dump/ 15 min	One Cable	214	214	214	214	214	214	214	214
	Two Cable	204	204	204	204	204	204	204	204

For loss of 110556,110555 in service (Winter)

	Degrees	32	41	50	59	68	77	86	95
Normal	Two Cable	209	209	209	209	209	209	209	209
4 Hour	One Cable	251	251	251	251	251	251	251	251
	Two Cable	235	235	235	235	235	235	235	235
Load Dump/ 15 min	One Cable	251	251	251	251	251	251	251	251
	Two Cable	235	235	235	235	235	235	235	235

Westport to Green Street, 110553 and 110554 Cables

For loss of 110554, 110553 in service (Summer)

	Degrees	32	41	50	59	68	77	86	95
Normal	Two Cable	230	230	230	230	230	230	230	230
4 Hour	One Cable	300	300	300	300	300	296	287	280
	Two Cable	260	260	260	260	260	260	260	260
Load Dump/ 15 min	One Cable	300	300	300	300	300	300	300	300
	Two Cable	260	260	260	260	260	260	260	260

For loss of 110554, 110553 in service (Winter)

	Degrees	32	41	50	59	68	77	86	95
Normal	Two Cable	240	240	240	240	240	240	239	229
4 Hour	One Cable	310	310	310	310	310	296	287	280
	Two Cable	270	270	270	270	270	270	270	270
Load Dump/ 15 min	One Cable	310	310	310	310	310	310	310	310
	Two Cable	270	270	270	270	270	270	270	270

For loss of 110553, 110554 in service (Summer)

	Degrees	32	41	50	59	68	77	86	95
Normal	Two Cable	230	230	230	230	230	230	230	230
4 Hour	One Cable	300	300	300	300	300	296	287	280
	Two Cable	260	260	260	260	260	260	260	260
Load Dump/ 15 min	One Cable	300	300	300	300	300	300	300	300
	Two Cable	260	260	260	260	260	260	260	260

For loss of 110553, 110554 in service (Winter)

	Degrees	32	41	50	59	68	77	86	95
Normal	Two Cable	240	240	240	240	240	240	239	229
4 Hour	One Cable	310	310	310	310	310	296	287	280
	Two Cable	270	270	270	270	270	270	270	270
Load Dump/ 15 min	One Cable	310	310	310	310	310	310	310	310
	Two Cable	270	270	270	270	270	270	270	270

Concord Street to Monument Street 110564 Cable and Greene Street to Concord Street 110559 Cable

For loss of 110559, 110564 in service (Summer)

	Degrees	32	41	50	59	68	77	86	95
Normal	Two Cable	155	155	155	155	155	155	155	155
4 Hour	One Cable	209	209	209	209	209	209	209	209
	Two Cable	175	175	175	175	175	175	175	175
Load Dump/ 15 min	One Cable	209	209	209	209	209	209	209	209
	Two Cable	175	175	175	175	175	175	175	175

For loss of 110559, 110564 in service (Winter)

	Degrees	32	41	50	59	68	77	86	95
Normal	Two Cable	195	195	195	195	195	195	195	195
4 Hour	One Cable	246	246	246	246	246	246	246	246
	Two Cable	217	217	217	217	217	217	217	217
Load Dump/ 15 min	One Cable	246	246	246	246	246	246	246	246
	Two Cable	217	217	217	217	217	217	217	217

Concord Street to Monument Street 110563 Cable and Greene Street to Concord Street 110562 Cable

For loss of 110562, 110563 in service (Summer)

	Degrees	32	41	50	59	68	77	86	95
Normal	Two Cable	166	166	166	166	166	166	166	166
4 Hour	One Cable	225	225	225	225	225	225	225	225
	Two Cable	189	189	189	189	189	189	189	189
Load Dump/ 15 min	One Cable	225	225	225	225	225	225	225	225
	Two Cable	189	189	189	189	189	189	189	189

For loss of 110562, 110563 in service (Winter)

	Degrees	32	41	50	59	68	77	86	95
Normal	Two Cable	209	209	209	209	209	209	209	209
4 Hour	One Cable	265	265	265	265	265	265	265	265
	Two Cable	233	233	233	233	233	233	233	233
Load Dump/ 15 min	One Cable	265	265	265	265	265	265	265	265
	Two Cable	233	233	233	233	233	233	233	233

Monument Street to Erdman Avenue, 110557 and 110558 Cables

For loss of 110557, 110558 in service (Summer)

	Degrees	32	41	50	59	68	77	86	95
Normal	Two Cable	183	183	183	183	183	183	183	183
4 Hour	One Cable	241	241	241	241	241	241	241	241
	Two Cable	211	211	211	211	211	211	211	211
Load Dump/ 15 min	One Cable	241	241	241	241	241	241	241	241
	Two Cable	211	211	211	211	211	211	211	211

For loss of 110557, 110558 in service (Winter)

	Degrees	32	41	50	59	68	77	86	95
Normal	Two Cable	211	211	211	211	211	211	211	211
4 Hour	One Cable	269	269	269	269	269	269	269	269
	Two Cable	234	234	234	234	234	234	234	234
Load Dump/ 15 min	One Cable	269	269	269	269	269	269	269	269
	Two Cable	234	234	234	234	234	234	234	234

For loss of 110558, 110557 in service (Summer)

	Degrees	32	41	50	59	68	77	86	95
Normal	Two Cable	183	183	183	183	183	183	183	183
4 Hour	One Cable	241	241	241	241	241	241	241	241
	Two Cable	211	211	211	211	211	211	211	211
Load Dump/ 15 min	One Cable	241	241	241	241	241	241	241	241
	Two Cable	211	211	211	211	211	211	211	211

For loss of 110558, 110557 in service (Winter)

	Degrees	32	41	50	59	68	77	86	95
Normal	Two Cable	211	211	211	211	211	211	211	211
4 Hour	One Cable	269	269	269	269	269	269	269	269
	Two Cable	234	234	234	234	234	234	234	234
Load Dump/ 15 min	One Cable	269	269	269	269	269	269	269	269
	Two Cable	234	234	234	234	234	234	234	234

Westport - Center 110552 Cables

The 110552 Westport – Center temporary rating applies when one of the two parallel cables sharing a common duct is not carrying load. The same rating can be applied regardless of which of the two cables is not carrying load.

*Even though the rating of one cable can be increased in the event that the other cable is not carrying load, the overall rating for the circuit will decrease significantly. This is because the cables are in parallel as part of the same circuit, so the loss of one is going to significantly limit the circuit overall rating.

❖ **110552 Circuit Temporary Ratings (Summer)**

	Degrees	32	41	50	59	68	77	86	95
Normal	Two Cable	296	296	296	296	296	296	296	296
4 Hour	One Cable	199	199	199	199	199	199	199	199
	Two Cable	340	340	340	340	333	323	312	300
Load Dump/ 15 min	One Cable	199	199	199	199	199	199	199	199
	Two Cable	340	340	340	340	340	334	323	312

❖ **110552 Circuit Temporary Ratings (Winter)**

	Degrees	32	41	50	59	68	77	86	95
Normal	Two Cable	334	327	320	311	299	287	274	260
4 Hour	One Cable	217	217	217	217	217	217	217	217
	Two Cable	368	359	351	343	333	323	312	300
Load Dump/ 15 min	One Cable	217	217	217	217	217	217	217	217
	Two Cable	372	372	363	354	344	334	323	312

230 kV Harbor Crossing Cables (2344 & 2345 circuits) - Special Ratings

Temporary Ratings & Short Term Emergency Ratings for Circuit 2344

- Temporary ratings have been developed for circuit 2344 going from Brandon Shores – Riverside based on the following contingency conditions of the bay crossing submarine cables.
  - Both pipe cables are in service, but no oil circulation is available.
  - 1 pipe cable is in service, but no oil circulation is available

Shown below are the corresponding Summer & Winter temporary and short term emergency ratings for the conditions mentioned above. Information should be used for study purposes only – Official rating information will be communicated via TERM when Temporary Ratings and Short Term Ratings are implemented for real-time operations.

Brandon Shores – Riverside 2344 Ckt – w/ Hawkins Point to Sollers Point (2 cables in service) **(Summer)No Oil Circ.**	**Degrees**	**32**	**41**	**50**	**59**	**68**	**77**	**86**	**95**
Normal		622	622	622	622	622	622	622	622
4 Hour		887	887	887	887	887	887	887	887
Load Dump/ 15 min		887	887	887	887	887	887	887	887

Brandon Shores – Riverside 2344 Ckt – w/ Hawkins Point to Sollers Point (1 cable in service) (Summer)

No Oil Circ.	**Degrees**	**32**	**41**	**50**	**59**	**68**	**77**	**86**	**95**
Normal		311	311	311	311	311	311	311	311
4 Hour		443	443	443	443	443	443	443	443
Load Dump/ 15 min		443	443	443	443	443	443	443	443

Brandon Shores – Riverside 2344 Ckt – w/ Hawkins Point to Sollers Point (2 cables in service) (Winter)No	**Degrees**	**32**	**41**	**50**	**59**	**68**	**77**	**86**	**95**

Oil Circ.								
Normal	638	638	638	638	638	638	638	638
4 Hour	900	900	900	900	900	900	900	900
Load Dump/ 15 min	900	900	900	900	900	900	900	900

Brandon Shores – Riverside 2344 Ckt – w/ Hawkins Point to Sollers Point (1 cable in service) (Winter)

No Oil Circ.	Degrees	32	41	50	59	68	77	86	95
Normal		319	319	319	319	319	319	319	319
4 Hour		450	450	450	450	450	450	450	450
Load Dump/ 15 min		450	450	450	450	450	450	450	450

Temporary Ratings & Short Term Emergency Ratings for Circuit 2345

- Temporary ratings have been developed for circuit 2345 going from Brandon Shores – Riverside based on the following contingency conditions of the bay crossing submarine cables.
    - All pipe cables are in service, but no oil circulation is available.
    - 2 pipe cables are in service, and normal oil circulation is available.
    - 2 pipe cables are in service, but no oil circulation is available.
    - 1 pipe cable is in service, but no oil circulation

Shown below are the corresponding Summer & Winter temporary and short term emergency ratings for the conditions mentioned above.

Brandon Shores – Riverside 2345 Ckt – w/ Hawkins Point to Sollers Point (3 cables in service) **(Summer)**

No Oil Circ.	**Degrees**	**32**	**41**	**50**	**59**	**68**	**77**	**86**	**95**
Normal		850	850	850	850	850	850	850	850
4 Hour		1270	1270	1270	1270	1254	1225	1185	1155
Load Dump/ 15 min		1270	1270	1270	1270	1254	1236	1216	1197

Brandon Shores – Riverside 2345 Ckt – w/ Hawkins Point to Sollers Point (3 cables in service) **(Winter)**

No Oil Circ.	**Degrees**	**32**	**41**	**50**	**59**	**68**	**77**	**86**	**95**
Normal		875	875	875	875	875	875	875	875
4 Hour		1289	1289	1289	1272	1254	1225	1185	1155
Load Dump/ 15 min		1289	1289	1289	1272	1254	1236	1216	1197

Brandon Shores-Riverside 2345 Ckt -w/Hawkins Point to Sollers Point (2 cables in service) **(Summer)**

No Oil Circ.	**Degrees**	**32**	**41**	**50**	**59**	**68**	**77**	**86**	**95**
Normal		622	622	622	622	622	622	622	622
4 Hour		887	887	887	887	887	887	887	887
Load Dump/ 15 min		887	887	887	887	887	887	887	887

Brandon Shores – Riverside 2345 Ckt – w/ Hawkins Point to Sollers Point (2 cables in service) **(Winter)**

No Oil Circ.	Degrees	32	41	50	59	68	77	86	95
Normal		638	638	638	638	638	638	638	638
4 Hour		900	900	900	900	900	900	900	900
Load Dump/ 15 min		900	900	900	900	900	900	900	900

Brandon Shores – Riverside 2345 Ckt – w/ Hawkins Point to Sollers Point (2 cables in service) **(Summer)**

Oil Circ.	Degrees	32	41	50	59	68	77	86	95
Normal		733	733	733	733	733	733	733	733
4 Hour		1150	1150	1150	1150	1150	1150	1150	1150
Load Dump/ 15 min		1150	1150	1150	1150	1150	1150	1150	1150

Brandon Shores – Riverside 2345 Ckt – w/ Hawkins Point to Sollers Point (2 cables in service) **(Winter)**

Oil Circ.	Degrees	32	41	50	59	68	77	86	95
Normal		768	768	768	768	768	768	768	768
4 Hour		1150	1150	1150	1150	1150	1150	1150	1150
Load Dump/ 15 min		1150	1150	1150	1150	1150	1150	1150	1150

Brandon Shores – Riverside 2345 Ckt – w/ Hawkins Point to Sollers Point

(1 cable in service) **(Summer)**

No Oil Circ.	**Degrees**	**32**	**41**	**50**	**59**	**68**	**77**	**86**	**95**
Normal		311	311	311	311	311	311	311	311
4 Hour		443	443	443	443	443	443	443	443
Load Dump/ 15 min		443	443	443	443	443	443	443	443

Brandon Shores – Riverside 2345 Ckt – w/ Hawkins Point to Sollers Point

(1 cable in service) **(Winter)No Oil Circ.**	**Degrees**	**32**	**41**	**50**	**59**	**68**	**77**	**86**	**95**
Normal		319	319	319	319	319	319	319	319
4 Hour		450	450	450	450	450	450	450	450
Load Dump/ 15 min		450	450	450	450	450	450	450	450

Brandon Shores – Riverside SPS [SPS]

Contingency analysis indicates that a contingency loss of one Brandon Shores – Riverside 230kV circuit may overload the other parallel circuit and/or the Riverside 230-1/230-2 transformer leads (modeled as series device SD1/SD2; modeled as circuit 115011 /115012 in BGE). A special purpose scheme at Brandon Shores plant 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 the setting for 30 seconds.

The 'Normal Status' for this SPS will be 'DISARMED'

PJM Actions:

- PJM will discuss Security Analysis results with BGE
- PJM will direct BGE to "ARM" the SPS based on the PJM EMS contingency analysis result when the Riverside series device SD1(BGE circuit 115011)/SD2 (BGE circuit 115012) or Brandon Shores – Riverside (2344/2345) 230kV circuit is loaded up to 100% of LTE rating.
- PJM will continue to monitor Security Analysis results and determine when SPS can be "DISARMED".
- PJM will direct BGE to "DISARM" the SPS based on the PJM EMS contingency analysis result when the Riverside series device SD1(BGE circuit 115011)/SD2 (BGE circuit 115012) or Brandon Shores – Riverside (2344/2345) 230kV circuit is loaded below 100% of LTE rating.
- PJM will log the change in status for this SPS and activate/deactivate the appropriate contingencies in the Security Analysis Package.

BGE Actions:

- BGE will discuss Security Analysis results with PJM
- BGE will contact GO to predetermine which Brandon Shores unit will be tripped
- BGE will change the status of the SPS per PJM's directive to "ARM" or "DISARM" and will inform PJM once the SPS status has been changed
- BGE will communicate to PJM which Brandon Shores unit will trip as part of the SPS and activate/deactivate the appropriate contingencies in the Security Analysis Package.
- BGE will not change the status of the SPS back to 'DISARMED' until it has been directed to do so by PJM
- BGE will inform PJM of any instance where this SPS is misoperated or unable to operate as intended

GO Actions:

- GO will coordinate with BGE to predetermine which Brandon Shores unit will be tripped
- GO will inform the TO and PJM of any instance where the SPS is misoperated or unable to operate as intended

Index of Operating Procedures for Commonwealth Edison (ComEd) Transmission Zone

The Commonwealth Edison Transmission Zone has Operating Procedures that are adhered to by PJM. These procedures include the following:

	Type of Operating Procedure	Transmission Operations Manual Section Ref
Elmhurst SVC	SVC	Section 5 ComEd
Kincaid Stability Trip Scheme	Unit Stability	Section 5 ComEd
Powerton Stability Limitations	Unit Stability	Section 5 ComEd
Quad Cities and Cordova Stability Limitations	Unit Stability	Section 5 ComEd
East Frankfort TR83 345/138 kV Transformer SPS	Special Protection Scheme	Section 5 ComEd
Byron and Lee County Operating Guides	Unit Stability	Section 5 ComEd
University Park North Energy Center Restriction	Unit Stability	Section 5 ComEd
Elgin Energy Center Stability Bus Tie Scheme	Unit Stability	Section 5 ComEd
Marengo 138 kV Bus Operation	Voltage and Thermal Limitations	Section 5 ComEd
Damen 138 kV Bus Operation	Constraints	Section 5 ComEd
Normally Open Bus Tie Circuit Breakers	Voltage and Thermal Limitations	Section 5 ComEd
Dresden 345 kV Bus Operation with Lines Out of Service	Limitations	Section 5 ComEd
Burnham – Taylor (L17723) 345 kV Line Operation	Voltage	Section 5 ComEd
Lakeview Special Protection Scheme [SPS]	Special Purpose Scheme	Section 5 ComEd
138 kV Phase Shifting Transformer Operations	PARs	Section 5 ComEd
Waukegan 138 kV Bus Tie 4-14 Operation	Voltage and Thermal Limitations	Section 5 ComEd
Ridgeland 138 kV Bus Tie 4-14 Operation	Thermal Contingencies	Section 5 ComEd
Wolfs Crossing - Sandwich 138kV 14302 line	Special Protection Scheme	Section 5 ComEd

	Type of Operating Procedure	Transmission Operations Manual Section Ref
Electric Junction – North Aurora 138kV 11106 line	Special Protection Scheme	Section 5 ComEd
Wolfs TR 81	Special Protection Scheme	Section 5 ComEd
Transformer Operation at 138 kV Line Tie Breaker Substations	Switching Options	Section 5 ComEd
Davis Creek 345 kV Bus Tie 2-3 Auto-Closing	Special Protection Scheme	Section 5 ComEd
Dresden Unit 2 Trip Scheme	Special Protection Scheme	Section 5 ComEd
Islanding Prevention Scheme for TSS 941 Grand Ridge Generation	Load Rejection Scheme	Section 5 ComEd
Northbrook Transfer Trip	Special Protection Scheme	Section 5 ComEd
Zion Generation Stability Trip	Unit Stability	Section 5 ComEd
Camp Grove Islanding	Unit Restriction	Section 5 ComEd
Directional Ratings	Ratings	Section 5 ComEd
Back To Index		

Elmhurst SVC (ComEd SPOG 2-39)

At TSS 135 Elmhurst, there are two 300 MVAR Static VAR Compensators (SVC) designated as SVC 100 and SVC 200. The SVCs regulate the 138kV bus voltages with each SVC connecting to its respective 138kV bus via a 138/15 kV transformer. (A spare 138/15 kV transformer, T300, exists that can be utilized with either SVC as required.) The primary function of the SVCs is to provide high-speed dynamic VAR response during disturbances on the transmission system. In order to ensure that the full dynamic capability of the SVCs remains available, the SVCs should normally be operated such that the VAR output of the thyristor switched capacitors (TSCs) is zero.

Also at TSS 135 Elmhurst, four 57 MVAR 138kV capacitors can be switched manually via SCADA control or automatically via the SVCs to maintain SVC dynamic reserve and to provide additional voltage regulation.

Operation Modes:

- Automatic Mode -- The SVC will switch the thyristor switched capacitors on and off in response to voltages outside of the voltage dead band. This is the default mode of operation for the SVCs.
- Fixed Susceptance (aka, Manual) Mode -- The SVC controls the VAR output to the MVAR set-point specified by the operator. Possible values are 0, 75, 150, 225, and 300 MVAR.
- External Device Control Mode – The SVC will control the 138kV capacitors when this switch is set to "ON" and the 138kV Capacitor Control Mode switches are set to "Automatic." The capacitors must be manually controlled by the dispatcher when this switch is set to "OFF".
- 138kV Capacitor Control Mode – Each of the 138kV cap banks can be put in manual mode or automatic mode. Automatic mode allows the capacitors to be controlled by the SVC. In manual mode, the capacitors must be controlled by the dispatcher. This switch allows individual capacitor banks to be controlled by the SVC when the External Device Control Mode switch is set to "ON".

Definitions:

- MVAR Set Point -- The desired MVAR output of an SVC when in Fixed Susceptance Mode.
- Voltage Dead Band -- Voltage range around the voltage set-point that prevents excessive switching of the TSCs or 138 kV capacitors. The dead-band is centered around the voltage set point.
- Voltage Set Point (Vref) -- The scheduled voltage for the SVC. The SVC controller will attempt to regulate the 138kV bus voltage to within a specified range of this voltage.

ComEd Actions:

- Provide notification to PJM Dispatch with respect to:
    - Changes in Operating Mode (as defined above).
    - Changes in Voltage Set Point for the SVC.
    - Manual switching of the TSS 135 Elmhurst 57 MVAR 138kV capacitors.

PJM Actions:

- Study impacts in advance and coordinate changes to/from Automatic/Manual Mode as well as changes to the MVAR or Voltage Set Points.
- Process real time changes in Operating Mode into the PJM EMS system to ensure accurate modeling and Network Application solutions.

- Log any deviations from default Operating Mode.

Kincaid Stability Trip Schemes [SPS] (ComEd SPOG 1-3-A)

There are two stability trip schemes currently in place at Kincaid to prevent first swing and/or oscillatory instability of either unit for multi-phase faults or multiple line outages. For normal system conditions, these schemes should be in-service at all times.

PJM will notify the Midwest ISO Reliability Coordinator (RC) via voice communication immediately following any unarming and subsequent rearming of any part of the Kincaid SPS including any degradation or potential failure to operate as expected. The Midwest ISO RC will adjust their contingency analysis as needed. The line statuses are monitored only at the Kincaid station. The SPS will operate off the status of either the Kincaid line disc or both Kincaid line CBs. If the remote ends of lines 2101, 2102, or 2105 are opened, the corresponding disconnects at Kincaid must also be opened for the multiple-line-outage scheme to operate.

Multi-Phase Fault High-Speed Sectionalizing Scheme

The Multi-Phase Fault High-Speed Sectionalizing Scheme is designed to minimize required unit trips and to prevent first-swing instability of the Kincaid units in the event of a circuit breaker failure following a multi-phase fault. This is accomplished by intentionally tripping both bus sections adjacent to the faulted line in primary time for close-in multi-phase faults on the 345 kV lines.

Circuit Breaker Tripping Operations For Multi-Phase Fault High-Speed Sectionalizing Scheme

Equipment Tripped in Primary Time

Faulted Line	Normal CB Trips(1)	Additional CB Trips(2)	Additional Equipment Tripped(2)
2101	1-2, 1-3	3-5, 2-6	Unit 1, Aux 143 & 144
2102	3-5, 5-7	1-3, 7-8	L2106, Aux 143 & 144
2105	2-6, 6-8	1-2	Unit 1
2106	5-7, 7-8	3-5, 6-8	L2102, Unit 2

(1) For all line faults.
(2) Only for multi-phase faults close in to Kincaid.

The PJM EMS monitors the combined “faulted line” and “additional equipment tripped” elements as N-1 conditions on a continuous basis.

Multiple Lines Out of Service

If Kincaid–Lanesville (Ameren) (L2101), Kincaid–Latham (IP)–Pontiac(L2102) or Kincaid–N.Pana (Ameren) (L2105) are out of service and both Kincaid units are in service, intentional unit trip schemes are installed to automatically trip a Kincaid unit for multiple line outage conditions listed below. It should also be noted that the "Multi-Phase High Speed Sectionalizing Schemes" remain active during planned/unplanned line outages.

Line Outages Which Initiate a Kincaid Unit Trip		
Lines Out	**Equipment Tripped (1)**	**Additional Equipment Tripped (2)**
2101(planned) & 2105(forced)	**Line 2105, Unit #1**, CBs 1-2, 2-6 & 6-8	none
2105(planned) & 2101(forced)	**Line 2101, Unit #1** CBs 1-2, 1-3 & 2-6	CB 3-5
2101(planned) & 2102(forced)	**Line 2102, Line 2106, Unit #2**, CBs 3-5, 5-7, 7-8 & 6-8	CB 1-3
2102(planned) & 2101(forced)	**Line 2101, Line 2106, Unit #2,** CBs 1-2, 1-3, 7-8 & 6-8	**Line 2105, Unit #1,** CBs 2-6 & 3-5
2102(planned) & 2105(forced)	**Line 2105, Unit #2,** CBs 2-6, 6-8 & 7-8	**Unit #1,** & CB 1-2
2105(planned) & 2102(forced)	**Line 2102, Line 2106, Unit #2,** CBs 3-5, 5-7, 7-8 & 6-8	CB 1-3
(1) For all line faults. (2) Only for multi-phase faults close in to Kincaid.		

The multiple outage unit trip scheme is not required when one unit is out of service. If unit 2 is out of service, the automatic trip for unit 1 (2101 & 2105 outage) can be disabled. Similarly, if unit 1 is out of service, the automatic trip for unit 2 (2102 & 2105 outage) can be disabled and the trip for unit 2 (2101 & 2102 outage) is automatically disabled. If unit 2 is in service, the L2102 & L2105 multiple-line-outage trip scheme must be in service to avoid isolating unit 2 output onto the L2106 line, unless agreed upon by ComEd and PJM.

There is an increased risk of instability if the Kincaid units are operated with the voltage regulator is out of service. In addition, if the Brokaw-Lanesville line is expected to be out of service for greater than 24 hours, a stability analysis must be performed.

ComEd Actions:

- ComEd should notify PJM any time the voltage regulator at Kincaid is out of service. ComEd Transmission Operations should direct Kincaid station to maintain a generator terminal voltage above 19 kV to prevent generator instability assuming otherwise normal system conditions.

PJM Actions:

- Activate and deactivate the following contingencies:

Line Out of Service	Activate Contingency(s)	Deactivate Contingency(s)
L2101	345L2105 & Unit 1	345L2105
	345L2102 & Unit 2	345L2102
	345L2102 (multiphase w/L2101 out)	345L2102 (multiphase)
L2102	345L2105 & Unit 2	345L2105
	345L2101 & Unit 2	345L2101
	345L2101 (multiphase w/L2102 out)	345L2101 (multiphase)
	345L2105 (multiphase w/L2102 out)	345L2105 (multiphase)
L2105	345L2101 & Unit 1	345L2101
	345L2102 & Unit 2	345L2102
	345L2101 (multiphase w/L2105 out)	345L2101 (multiphase)
	345L2102 (multiphase w/L2105 out)	345L2102 (multiphase)

Powerton Stability Limitations [SPS] (ComEd SPOG 1-3-B and 1-3-B-1)

The Powerton Transmission system consists of four 345 kV lines from Powerton to Mole Creek (L0302) to Dresden (L1202), Powerton to Tazewell (Ameren) (L0304) - Kendall County Energy Center - Lockport, Powerton to Katydid (L0301), and Powerton to Goodings Grove (L0303). The 345 kV bus consists of two ring buses that are operated normally tied. There are several operating procedures in place in order to maintain stability of the Powerton Units.

Multi-Phase Fault High-Speed Sectionalizing Scheme

The objective of the multi-phase fault high-speed sectionalizing scheme is to minimize required unit trips and ensure stable operation of the Powerton units in anticipation of a circuit breaker failure following a multi-phase fault. This is accomplished by intentionally tripping the red-blue bus-tie 4-8 circuit breaker in primary time for close-in multi-phase faults on the 345 kV lines at Powerton. The scheme is normally in service.

Circuit Breaker Tripping Operations For Multi-Phase Fault High-Speed Sectionalizing Scheme		
Equipment Tripped in Primary Time at Powerton Station		
Faulted Line	**Normal CB Trips**	**Additional CB Trips**
L0301	1-2, 1-6	4-8(1)
L0302	2-3, 3-4	4-8(2)
L0303	8-9, 9-10	4-8(1)
L0304	8-11, 10-11	4-8(2)
(1) Only for close-in three-phase faults. (2) For any close-in multi-phase faults.		

Multiple Line Outage Unit Trip Scheme

The multiple line outage unit trip scheme is used at Powerton to prevent first swing instability which may occur during certain simultaneous line outage conditions. Intentional unit trip schemes are installed to automatically trip a Powerton unit for multiple line outage conditions listed below. In addition, if the 10805 line is expected to be out of service for greater than 24 hours, a stability analysis must be performed.

Multiple Line Outages Which Initiate a Powerton Unit Trip	
Lines Out	Unit(s) Tripped in Primary Time
(L0301 or L19601 Katydid-Goodings Grove) & (L0302 OR L1202 Mole Creek-Dresden) with BT 4-8 open	Unit #5
L0304 & L0303 with BT 4-8 open OR L93505 Kendall-Tazewell @ Tazewell & L0303 with BT 4-8 open	Unit #6
(L0301 or L19601 Katydid-Goodings Grove) & L0303 & L0304(1)	Unit #6
(L0301 or L19601 Katydid-Goodings Grove) & (L0302 OR L1202) & L0303 & L0304 OR (L0301 or L19601 Katydid-Goodings Grove) & (L0302 OR L1202 Mole Creek-Dresden) & L0303 & L93505Kendall-Tazewell @ Tazewell	Unit #5 and #6
(1) Unit #6 will trip only for any L0304 faults while “L0301/L19601-L0303 Trip Scheme” is in-service	

Unit Trip Scheme for Circuit Breaker Failure

The unit trip scheme for a circuit breaker failure is used at Powerton to prevent first swing instability that may occur for a breaker failure following a multiphase fault. Intentional unit trip schemes are installed to automatically trip a Powerton unit in back-up time for breaker failure conditions listed below.

Circuit Breaker Failure Scenarios Which Initiate Powerton Unit Trips				
Faulted Line	**Normal CB Trips**	**Failed CB**	**Breaker Failure Timer (2XLBB)**	**Unit Tripped in Back-Up Time**
L0301	1-2, 1-6, 4-8 (1)	1-6	~4.5	Unit #5 (1)
L0302	2-3, 3-4, 4-8 (2)	3-4	~5.0	Unit #5 (2)
L0303	8-9, 9-10, 4-8 (1)	8-9	~4.5	Unit #6 (1)
L0304	8-11, 10-11, 4-8 (2)	8-11	~3.5	Unit #6 (2)
(1) Only for close-in three phase faults				
(2) For any close-in multi-phase fault				

Unit Trip Scheme for Output Greater Than 756 MW

If a close-in three-phase fault occurs on Powerton – Mole Creek - Dresden (L0302) and Unit 5 output exceeds 756 MWs, Unit 5 will be immediately tripped.

If a close-in three-phase fault occurs on Powerton – Tazewell (L0304) and Unit 6 output exceeds 756 MWs, Unit 6 will be immediately tripped.

PJM Actions:

- Activate the following contingencies depending on which unit is exceeding 756 MWs (do not deactivate the single contingency):

Unit Exceeding 756 MWs	Activate Contingency
Powerton Unit 5	L0302 & Unit 5
Powerton Unit 6	L0304 & Unit 6

Double-line Tower Outage

During double-line tower outages of the Powerton transmission lines the loss of a unit(s) may occur if a single line contingency would occur. The following options are available to insure stable operation of the Powerton Units during double tower outages:

1. Outage of L0301 and L0303

Option A: Station Gross Output 1700 MW or Less

Operate Units #5 and #6 on separate 345 kV ring buses (bus tie 4-8 open). Both units may be operated at full available capacity simultaneously with this option. However, any outage of either 345 kV Line L0302, L1202, L0304, or L93505 will result in a tripping of the associated generating unit via load-rejection or the multiple line outage unit trip scheme.

Option B: Station Gross Output from 1100 to 1700MW

Operate Units #5 and #6 with the 345 kV bus tie 4-8 closed when the total gross output is as stated above. The L0301/L19601-L0303 Trip Scheme shall be placed in service, which will trip Unit #6 for any relay-initiated trip of L0304. The high speed sectionalizing scheme presently installed at Powerton shall remain operational. Therefore, a close-in multi-phase fault on L0302 or L93505 will result in a tripping of the associated generating unit via load-rejection or the multiple line outage unit trip scheme.

Option C: Station Gross Output Less than 1100 MW

Operate Units #5 and #6 with the bus-tie closed and remove from service the L0301/L19601-L0303 Trip Scheme discussed in Option B when the total generation output is less than 1100 MW. With the high speed sectionalizing scheme in operation, this will result in tripping of one unit via load-rejection or the multiple line outage unit trip scheme for close-in multi-phase faults on L0302, L0304 or L93505.

2. Outage of L19601 Katydid-Goodings Grove and L0303

Option A: Station Gross Output 1700 MW or Less

Operate Units #5 and #6 on separate 345 kV ring buses (bus tie 4-8 open). Both units may be operated at full available capacity simultaneously with this option. However, any outage of either 345 kV Line L0302, L1202, L0304, or L93505 will result in a tripping of the associated generating unit via load-rejection or the multiple line outage unit trip scheme.

Option B: Station Gross Output from 1100 to 1700MW

Operate Units #5 and #6 with the 345 kV bus tie 4-8 closed when the total gross output is as stated above. The L0301/L19601-L0303 Trip Scheme shall be placed in service, which will trip Unit #6 for any relay-initiated trip of L0304. The high speed sectionalizing scheme presently installed at Powerton shall remain operational. Therefore, a close-in multi-phase fault on L0302 or L93505 will result in a tripping of the associated generating unit via load-rejection or the multiple line outage unit trip scheme.

Option C: Station Gross Output Less than 1100 MW

Operate Units #5 and #6 with the bus-tie closed and remove from service the L0301/L19601-L0303 Trip Scheme discussed in Option B when the total generation output is less than 1100 MW. With the high speed sectionalizing scheme in operation, this will result in tripping of one unit via load-rejection or the multiple line outage unit trip scheme for close-in multi-phase faults on L0302, L0304 or L93505.

3. Outage of L0302 and L93505 Kendall-Tazewell OR Outage of L1202 and L93505 Kendall-Tazewell

Option A: Station Gross Output 1700 MW or Less

Operate Units #5 and #6 on separate 345 kV ring buses (bus tie 4-8 open). Both units may be operated at full available capacity simultaneously with this option. However, any outage of either 345 kV Line L0301, L19601, or L0303 will result in a tripping of the associated generating unit via load-rejection or the multiple line outage unit trip scheme.

Option B: Station Gross Output 1650 MW or Less with Unit #5 Gross Output of 800 MW or Less

Operate Units #5 and #6 with the 345 kV bus-tie 4-8 closed. Unit #6 may be operated at full available capacity, but Unit #5 gross output should be restricted to 800 MW or less. With the high speed sectionalizing scheme in operation, a close-in 3-phase fault on L0301 or L0303 will result in tripping of one unit via load-rejection or the multiple line outage unit trip scheme. Additionally, if Unit #6 is operating above approximately 800 MW output, it will be automatically tripped by the intentional unit trip scheme in the event of a close-in 3-phase fault on L0304.

If sustained high output levels (150 MW or greater) are expected from the Top Crop wind farms during an extended outage of L0302 and L93505, additional Powerton deratings may be required.

4. Outage of L0302 and L0304

Option A: Station Gross Output 1700 MW or Less

Operate Units #5 and #6 on separate 345 kV ring buses (bus-tie 4-8 open). Both units may be operated at full available capacity simultaneously with this option. However, any outage of either 345 kV Line L0301, L19601 or L0303 will result in a tripping of the associated generating unit via load-rejection or the multiple line outage unit trip scheme.

Option B: Station Gross Output Less than 1000 MW

Operate units #5 and #6 with the bus-tie closed when the total generation output is less than 1000 MW. The gross output of any single unit, however, should not exceed 800 MW. With the high speed sectionalizing scheme in operation, close-in 3-phase faults on L0301 or L0303 will result in the tripping of one unit via load-rejection or the multiple line outage unit trip scheme.

Permissible station outputs and unit tripping consequences for the operating options with two units in service are summarized in the attached table.

Following certain single line trips during tower outages, overloads may occur in the Ameren system, and some reduction in Powerton generation may be required to correct the overloads

Operating Options for Powerton Station Tower Outages

L0301 & L0303 Outage				
Option	**Bus Tie**	**Maximum Station Gross Output (1)**	**Automatic Unit Trip**	
			Unit 5	**Unit 6**
A	Open	1700 MW	Any Trip of L0302 or L1202	Any Trip of L304 or L93505
B (2)(3)	Closed	1700 MW	multi-phase fault on L0302	Any Trip of L0304 (4) or multi-phase fault on L93505
C (2)(3)	Closed	1100 MW	Multi-phase fault on L0302	Multi-ph fault on L0304 or L93505
L19601 Katydid-Goodings Grove and L0303 Outage				
Option	**Bus Tie**	**Maximum Station Gross Output (1)**	**Automatic Unit Trip**	
			Unit 5	**Unit 6**
A	open	1700 MW	Any trip of L0302 or L1202	Any trip of L0304 or L93505
B **(2)(3)**	closed	1700 MW	Multi-phase fault on L0302	Any trip of L0304 (4) or multi-phase fault on L93505
C **(2)(3)**	closed	1100 MW	Multi-phase fault on L0302	Multi-phase fault on L0304 or L93505
L0302 & L93505 Kendall-Tazewell Outage OR L1202 Mole Creek-Dresden and L93505 Kendall-Tazewell Outage				
Option	**Bus Tie**	**Maximum Station Gross Output (1)**	**Automatic Unit Trip**	
			Unit 5	**Unit 6**
A	Open	1700 MW	Any Trip of L0301 or L19601	Any Trip of L0303, some 3-ph faults on L0304 (7)
B (2)(3)	Closed	1650 MW (5)	3-ph fault on L0301	3-ph fault on L0303, some 3-ph faults on L0304 (7)

L0302 & L0304 Outage				
Option	Bus Tie	Maximum Station Gross Output (1)	Automatic Unit Trip	
			Unit 5	Unit 6
A	Open	1700 MW	Any Trip of L0301 or L19601	Any Trip of L0303
B (2)(3)	Closed	1000 MW	3-ph fault on L0301	3-ph fault on L0303

Notes:

(1) Assumes maximum available capacity of 850MW for each unit.

(2) Assumes high-speed sectionalizing scheme in service for close-in multi-phase faults.

(3) May involve a full station trip for certain circuit breaker failures.

(4) A L0301/L19601-L0303 Trip Scheme is required to maintain stability of the Powerton units for this outage condition.

(5) Unit #5 output should not exceed 800 MW gross for this outage condition.

(6) Unit #6 output should not exceed 800 MW gross for this outage condition.

(7) Unit #6 tripped for 3-phase faults on L0304 when unit output exceeds 800 MW.

PJM Actions:

If there is a planned double tower outage on L0301 and L0303, L19601 Katydid-Goodings Grove and L0303, L0302 and L93505 Kendall-Lockport, L1202 Mole Creek-Dresden and L93505, Kendall-Lockport or L0303 and L0304, use the above table to determine if there is a restriction of the Powerton generation output or if there is a condition in which one of the units would trip with the contingency loss of a single transmission line.

If there is a restriction on the Powerton generation output, PJM is to confirm and direct the Powerton generation to the appropriate output(s).

If there is a condition that would trip a Powerton unit with the contingency loss of a single transmission line, activate the contingency loss of the single contingency and the appropriate Powerton unit and do not deactivate the contingency loss of the single transmission line by itself.

Quad Cities and Cordova Limitations [SPS] (ComEd SPOG 1-3-C and 1-3-G)

Quad Cities Stability Limitations

The Quad Cities transmission system consists of five 345 kV lines. There are several operating procedures in order to maintain stability of the Quad Cities units.

Multi-Line-Outage Unit Trip Scheme

The multi-line outage unit trip scheme will intentionally trip Unit 2 for the specific multi-line outage scenarios listed below when Quad Cities Unit 1 and Unit 2 are in service. The scheme will also trip the Cordova units anytime at least one Quad Cities unit is in-service. *Note: Due to a lack of redundancy on the remote monitoring status on the L0404 and L15504 lines, PJM will not ARM the trip scheme during an outage of the L15503.*

Certain operating conditions will require the unit trip schemes to be enabled with the manually armed stability trip (MAST). The MAST switches should be operated to ensure that the Quad Cities and Cordova unit trip schemes are properly armed for outages of L0404, L15503, or L15504. Conditions for putting the MAST switches in the "ON" position are as follows:

A. MAST-03 Switch – equivalent to an outage of L15503
   - L15503 MOD open @ Nelson (TSS 155) or,
   - BT 7-8 & BT 8-9 open @ Nelson (TSS 155) or,
   - L15503 MOD open @ Cordova (TSS 940) or,
   - BT 1-3 & BT 2-3 open @ Cordova (TSS 940)

B. MAST-04 Switch – equivalent to an outage of L0404 or L15504
   - L15504 MOD open @ Nelson (TSS 155) or,
   - BT 4-5 & BT 5-6 open @ Nelson (TSS 155) or,
   - L15504 disconnect open @ Sterling Steel (ESS H471) or,
   - BT 1-2 open @ Sterling Steel (ESS H471) or,
   - L0404 MOD open @ Sterling Steel (ESS H471)

Conditions Which Trip Quad Cities Unit 2 (When Unit 1 and Unit 2[1] are In Service)

1. L0404 (Quad Cities – Sterling Steel) out of service AND
   a contingency loss of the L15503 (Nelson – Cordova)

   -OR-

2. L15504 (Nelson – Sterling Steel) out of service AND
   a contingency loss of the L15503 (Nelson – Cordova)

   -OR-

3. L0404 (Quad Cities – Sterling Steel) out of service AND
   MAST-03 switch in "ON" position

   -OR-

4. L15504 (Nelson – Sterling Steel) out of service AND
   MAST-03 switch in "ON" position

-OR-

5. MAST-04 switch in "ON" position AND

L15503 (Nelson – Cordova) out of service

Note 1: The Cordova units will trip for the same conditions if either Quad Cities Unit 1 or Unit 2 is in-service.

Note 2: There is a lack of redundancy on the remote monitoring status on the L0404 and L15504 lines. Consequently, the loss of either the L0404 or L15504 may not trigger the SPS. PJM does not monitor the tripping of the Quad Cities and/or Cordova units with the loss of L0404 or L15504 because remote monitoring of the statuses of L0404 and L15504 is not presently fully redundant. There is a small risk that a contingency loss of one of these lines may not be detected while L15503 is out-of-service and the multi-line unit trip scheme failing to operate.

Unit Stability Trip Scheme for Close-in, Three-phase Faults on 345kV Line 0404 with L15503 Out-of-Service

The trip scheme will trip Quad Cities Unit 2 if the following three conditions are met:

- A close-in, three-phase fault occurs on 345kV line 0404 and,
- Either 345kV line 15503 is out-of-service, or the MAST-03 switch is in the "ON" position.
- Quad Cities Unit 2 is in-service.

In the event of fault a close-in, three-phase on L0404, the Quad Cities units can become unstable when L15503 is out of service. The special relay protection scheme detects this condition and trips Quad Cities Unit 2 without regard for the status of Quad Cities Unit 1. If Quad Cities Unit 1 is off-line, the stability issue does not exist, and therefore this scheme can be disabled.

Conditions for Operation of the Transmission Overload Cut-out (TOCO) Switch

The TOCO switch is a means by which the multi-line-outage unit trip scheme for Quad Cities and Cordova can be disabled when system conditions allow both line to be opened without causing overloads. The TOCO switch is normally in the "ON" position. The TOCO switch may only be placed in the "OFF" position under the direction of PJM.

During an outage of L15503, the TOCO switch must be in the "OFF" position because the multi-line-outage unit trip scheme may fail to operate for a contingency loss on L0404 or L15504.

ComEd Actions:

- ComEd must notify PJM if either the Quad Cities MAST-03 or MAST-04 is being operated in the "ON" position.

PJM Actions:

PJM will notify the Midwest ISO Reliability Coordinator (RC) via voice communication immediately following the arming/disarming of the Quad City/Cordova tripping schemes and the impacts to Activated/Deactivated Contingencies. The Midwest ISO RC will adjust their contingency analysis as needed.

- Activate and deactivate the following contingencies when Quad Cities Unit 1 and Unit 2 are in-service:

Line Out of Service	Activate Contingency(s)	Deactivate Contingency(s)
L0404	345L15503 & Q.C. Unit 2 & Cordova units	345L15503
L15504	345L15503 & Q.C. Unit 2 & Cordova units	345L15503
L15503	345L0404 & Q.C. Unit 2 Stability Trip 3-Ph	N/A

- If the outage is on L15503, direct ComEd to turn the TOCO switch to the “OFF” position.

If ComEd notifies PJM that one of the MAST switches are in the “ON” position, activate and deactivate the following contingencies:

MAST Switch in “ON” Position	Activate Contingency(s)	Deactivate Contingency(s)
MAST-03	345L0404 & Q.C. Unit 2 Stability Trip 3-Ph	N/A
MAST-04	345L15503 & Q.C. Unit 2 & Cordova units	345L15503

- If the MAST-03 switch is “ON” position, direct ComEd to turn the TOCO switch to the “OFF” position.

Cordova Stability Limitations

There are relay protection schemes in place to automatically trip the Cordova units.

Three-Phase Fault Unit Trip Scheme

Detection of a three-phase fault within a zone that extends approximately three miles beyond the Quad Cities 345 kV bus will initiate a 6-cylce time. If the three-phase fault remains on the system after the 6-cycle delay, both Cordova units will trip in 12 cycles.

Multi-Line-Outage Unit Trip Scheme

*The double contingency unit trip scheme prevents overloads during simultaneous outages of lines L15503 and L0404 or L15504. The scheme is enabled by the TOCO switch and should be in service whenever at least one Quad Cities unit is in service unless there is an outage of the 15503..*This scheme should only be taken out of service after consultation with PJM or

MISO. During an outage of L15503, the TOCO switch must be in the "OFF" position because the multi-line-outage unit trip scheme may fail to operate for a contingency loss on L0404 or L15504 due to the lack of required monitoring redundancy.

Conditions Which Trip All Cordova Units (Quad Cities Unit 1 OR 2 are on-line)

1. L0404 (Quad Cities – Sterling Steel) out of service AND a contingency loss of L15503 (Nelson – Cordova).
2. L15504 (Nelson – Sterling Steel) out of service AND a contingency loss of L15503 (Nelson – Cordova).
3. L0404 (Quad Cities – Sterling Steel) out of service AND MAST-03 switch in "ON" position
4. L15504 (Nelson – Sterling Steel) out of service AND MAST-03 switch in "ON" position
5. MAST-04 switch in "ON" position AND L15503 (Nelson – Cordova) out-of-service.

Note 1: The Cordova units will trip for the same conditions if either Quad Cities Unit 1 or Unit 2 is in-service.

Note 2: There is a lack of redundancy on the remote monitoring status on the L0404 and L15504 lines. Consequently, the loss of either the L0404 or L15504 may not trigger the SPS. PJM does not monitor the tripping of the Quad Cities and/or Cordova units with the loss of L0404 or L15504 because remote monitoring of the statuses of L0404 and L15504 is not presently fully redundant. There is a small risk that a contingency loss of one of these lines may not be detected while L15503 is out-of-service and the multi-line unit trip scheme failing to operate.

For conditions when Quad Cities Unit 1 AND 2 are on-line, refer to the Quad Cities section.

ComEd Actions:

- ComEd must notify PJM if either the Quad Cities MAST-03 or MAST-04 is being operated in the "ON" position.

PJM Actions:

PJM will notify the Midwest ISO Reliability Coordinator (RC) via voice communication immediately following the arming/disarming of the Quad City/Cordova tripping schemes and the impacts to Activated/Deactivated Contingencies. The Midwest ISO RC will adjust their contingency analysis as needed.

- Activate and deactivate the following contingencies when Quad Cities Unit 1 OR Unit 2 is on-line:

Line Out of Service	Activate Contingency(s)	Deactivate Contingency(s)
L0404	345L15503 & Cordova Units	345L15503
L15504	345L15503 & Cordova Units	345L15503

- If the outage is on L15503, direct ComEd to turn the TOCO switch to the "OFF" position.

If ComEd notifies PJM that one of the MAST switches are in the "ON" position, activate and deactivate the following contingencies:

MAST Switch in "ON" Position	Activate Contingency(s)	Deactivate Contingency(s)
MAST-04	345L15503 & Cordova Units	345L15503

- If the MAST-03 switch is "ON" position, direct ComEd to turn the TOCO switch to the "OFF" position.

East Frankfort TR83 345/138 kV Transformer [SPS] (ComEd SPOG 3-29)

There is a special purpose scheme currently in place at East Frankfort that will automatically trip the East Frankfort TR 83 345/138 kV transformer only if the following two conditions are met:

- Flow on the East Frankfort TR83 345/138 kV transformer is greater than the Long Term Emergency Rating (480 MVA).
- There is no flow on the East Frankfort – Goodings Grove (11602) 345 kV line.
- The 'Normal Status' for this SPS is 'enabled'

PJM Actions:

- If the East Frankfort TR83 345/138 kV transformer shows a contingency overload for the loss of the East Frankfort – Goodings Grove (11602) 345 kV line, the '345L11602' contingency should be deactivated and the '345L11602 & TR83 low side CB' contingency should be activated.
- If PJM is informed that this SPS is unable to operate in its 'Normal Status', the appropriate contingencies will be activated/de-activated.
- PJM will log the change from 'Normal Status' for this SPS.

TO Actions:

- TO will inform PJM of any instance where this SPS is unable to operate in its 'Normal Status' (enabled)

Byron and Lee County Operating Guides [SPS] (ComEd SPOG 1-3-F, 1-3-F-1, and 1-3-H)

Byron Operating Guide

There are unit stability operating schemes in place at Byron to prevent instability of the Byron units. For normal system conditions, these schemes should be in service at all times.

Conditions which Initiate a Byron Unit Trip:

I. With Byron Unit 2 operating while Unit 1 is out of service, Unit 2 will be tripped for any of the following conditions:
    1. Any multi-phase fault on L0627 close to Byron and a failure of breaker 3-7 at Byron concurrent with any outage of L15616

II. With Byron Unit 1 operating while Unit 2 is out of service, Unit 1 will be tripped for any of the following conditions:
    1. Any multi-phase fault on L0627 close to Byron and a failure of breaker 3-7 at Byron
    2. Any multi-phase fault on Bus 7 at Byron and a failure of breaker 3-7 at Byron

III. With both Byron units operation, Unit 1 will be tripped for any of the following conditions:
    1. Any outage of L0627 or L15501 concurrent with any outage of L15616
    2. Any multi-phase fault on L0627 close to Byron and a failure of breaker 3-7 at Byron
    3. Any multi-phase fault on Bus 7 at Byron and a failure of breaker 3-7 at Byron
    4. A three-phase fault on L0624 close to Byron and a failure of breaker 7-10 at Byron
    5. A three-phase fault on Bus 7 at Byron and a failure of breaker 7-10 at Byron
    6. Simultaneous or sequential (within 10 seconds) three-phase faults on L0621 and L0622 close to Byron
    7. Any multi-phase fault on L0627 close to Byron concurrent with any outage of either L0621 or L0622 or L0624
    8. A three-phase fault on L0621, L0622, or L0624 close to Byron concurrent with any outage of either L0627 or L15501
    9. Any multi-phase fault on L0621, L0622, or L0624 concurrent with a combined loading greater than 240 MVA on lines L93701 and L93702 and any outage of L15501

10. A three-phase fault on Bus 7 at Byron concurrent with a combined loading greater than 240 MVA on lines L93701 and L93702 and any outage of L15501.

IV. Automatic load rejection trips will occur as follows (no electrical outlet available):

1. Unit 1 will be tripped if L0621 is out of service and a failure of breaker 3-7 at Byron
2. Unit 2 will be tripped if L0622 is out of service and a failure of breaker 7-10 at Byron

PJM Actions:

- Activate and deactivate the following contingencies:

Line Out of Service	Activate Contingency(s)	Deactivate Contingency(s)
L15616	L0627 & Unit 1	345L0627
	L15501 & Unit 1	345L15501
L0621	L0627 & Unit 1	*
L0622	L0627 & Unit 1	*
L0624	L0627 & Unit 1	*
L0627	L15616 & Unit 1	345L15616
	L0621 & Unit 1	*
	L0622 & Unit 1	*
	L0624 & Unit 1	*
L15501	L15616 & Unit 1	345L15616
	L0621 & Unit 1	*
	L0622 & Unit 1	*
	L0624 & Unit 1	*

*Do not deactivate the corresponding line contingency, if there is a single phase fault, Byron Unit #1 will NOT trip.

Recommended Operating Limits to Ensure Byron Generator Stability

It is not necessary to take any corrective measures for stability for the outage of any single line provided that the protection system is normal and all stabilizer are in service.

This following gives recommended operating procedures for Byron Station to ensure generator stability. The stability protection schemes and power system stabilizers (PSS) on all Byron units and Lee County units are assumed to be normally in service. Knowledge of the stabilizer status for each Byron unit is essential for safe and reliable system operation. The following tables can be used to determine the maximum Byron station Output.

ComEd Actions:

ComEd is to notify PJM of any abnormal status of any of the protection schemes or any outages of the stabilizers.

PJM Actions:

If any of the protection schemes or stabilizers are of abnormal statuses, use the tables below to determine any limitations on the Byron generation output.

Table 1 gives recommended Byron output limitations for certain line outages when the stability trip schemes are disabled and/or stabilizers are out of service.

Table 2 gives recommended Byron output limitations, when applicable, for a variety of conditions involving outages of elements related to the stability protection schemes.

Tables 3 and 4 give the same Byron output limitations for use when Lee County units are not in service, since the operation of generators at Lee County Energy Center significantly impacts Byron stability.

Recommended Operating Limits to Preserve Byron Station Stability with Generators at Lee County Energy Center in service.

Lines Out of Service	Maximum Byron Gross Output, MW		
	Both PSS In	U1 PSS Out	U2 PSS Out
Line 15501 Out of Service			
15501/0627 – 15616 Trip Scheme In Service	No Limit	No Limit	2200 (5)
15501/0627 – 15616 Trip Scheme Disabled	2200 (2)(9)	1900 (5)(9)	1900 (5)(9)
Line 0627 Out of Service			
15501/0627 – 15616 Trip Scheme In Service	No Limit	No Limit	No Limit
15501/0627 – 15616 Trip Scheme Disabled	2200 (2)	2200 (2)	2200 (2)
Line 15616 Out of Service			
15501/0627 – 15616 Trip Scheme In Service	No Limit	No Limit	No Limit
15501/0627 – 15616 Trip Scheme Disabled	2000 (1)	1800 (4)	1800 (4)

Table 1

Protection Equipment Out of Service	Maximum Byron Gross Output, MW		
	Both PSS In	U1 PSS Out	U2 PSS Out
The entire 15501/0627 – 15616 Stability Trip Scheme			
Lines 0627, 15501 & 15616 In Service	No Limit (12)	No Limit (12)(13)	No Limit (12)(13)

Line 0627 Out of Service	2200 (2)	2200 (2)	2200 (2)
Line 15501 Out of Service	2200 (2)(9)	1900 (5)(9)	1900 (5)(9)
Line 15616 Out of Service	2000 (1)	1800 (4)	1800 (4)
Equipment Monitoring Status of Line 15616 (11)			
Lines 0627, 15501 & 15616 In Service	No Limit (12)	No Limit (12)(13)	No Limit (12)(13)
Line 0627 Out of Service	2200 (2)	2200 (2)	2200 (2)
Line 15501 Out of Service	2200 (2)(9)	1900 (5)(9)	1900 (5)(9)
Line 15616 Out of Service	2000 (1)	1800 (4)	1800 (4)
Line 15616 Out of Service, 15501/0627-15616 Trip Scheme Armed (10)	No Limit	No Limit	No Limit
Equipment Monitoring Status of Line 0627 (11)			
Lines 0627& 15616 In Service	No Limit (12)	No Limit (12)(13)	No Limit (12)(13)
Line 15616 Out of Service	2000 (1)	2000 (1)	2000 (1)
Line 0627 Out of Service	2200 (2)	2200 (2)	2200 (2)
Line 0627 Out of Service, 15501/0627-15616 Trip Schemed Armed (10)	No Limit	No Limit	No Limit
Equipment Monitoring Status of Line 15501 (11)			
Lines 15501 &, 15616 In Service	No Limit (12)	No Limit (12)(13)	No Limit (12)(13)
Line 15616 Out of Service	2000 (1)	1800 (4)	1800 (4)
Line 15501 Out of Service	2200 (2)(9)	1900 (5)(9)	1900 (5)(9)
Line 15501 Out of Service, 15501/0627-15616 Trip Schemed Armed (10)	No Limit	No Limit	No limit

Table 2

Recommended Operating Limits to Preserve Byron Station Stability with lines out of service and NO Generators at Lee County Energy Center In Service.

Lines Out of Service	Maximum Byron Gross Output, MW			
	Both PSS In	**U1 PSS Out**	**U2 PSS Out**	**Both PSS Out**
Line 15501 Out of Service				
15501/0627-15616 Trip Scheme In Service	No Limit	No Limit	No Limit	No Limit
15501/0627-15616 Trip Scheme Disabled	2200 (2)	2200 (2)	2200 (2)	1500 (5)
Line 0627 Out of Service				
15501/0627-15616 Trip Scheme In Service	No Limit	No Limit	No Limit	No Limit
15501/0627-15616 Trip Scheme Disabled	2200 (2)	2200 (2)	2200 (2)	1500 (5)
Line 15616 Out of Service				
15501/0627-15616 Trip Scheme In Service	No Limit	No Limit	No Limit	2000 (6)
15501/0627-15616 Trip Scheme Disabled	2000 (1)	2000 (1)	2000 (1)	1500 (8)

Table 3

Recommended Operating Limits to Preserve Byron Station Stability with Protection equipment out of service and NO Generators at Lee County Energy Center In Service.

Protection Equipment Out of Service	Maximum Byron Gross Output, MW			
	Both PSS In	U1 PSS Out	U2 PSS Out	Both PSS Out
The Entire 15501/0627 – 15616 Stability Trip Scheme				
Lines 0627, 15501 & 15616 In Service	No Limit (12)	No Limit (12)	No Limit (12)	1500 (8)
Line 0627 Out of Service	2200 (2)	2200 (2)	2200 (2)	1500 (5)
Line 15501 Out of Service	2200 (2)	2200 (2)	2200 (2)	1500 (5)
Line 15616 Out of Service	2000 (1)	2000 (1)	2000 (1)	1500 (8)
Equipment Monitoring Status of Line 15616 (11)				
Lines 0627, 15501 & 15616 In Service	No Limit (12)	No Limit (12)	No Limit (12)	1500 (8)
Line 0627 Out of Service	2200 (2)	2200 (2)	2200 (2)	1500 (5)
Line 15501 Out of Service	2200 (2)	2200 (2)	2200 (2)	1500 (5)
Line 15616 Out of Service	2000 (1)	2000 (1)	2000 (1)	1500 (8)
Line 15616 Out of Service, 15501/0627-15616 Trip Scheme Armed (10)	No Limit	No Limit	No Limit	No Limit
Equipment Monitoring Status of Line 0627 (11)				
Lines 0627 & 15616 In Service	No Limit (12)	No Limit (12)	No Limit (12)	1500 (8)
Line 15616 Out of Service	2000 (1)	2000 (1)	2000 (1)	1500 (8)
Line 0627 Out of Service	2200 (2)	2200 (2)	2200 (2)	1500 (5)
Line 0627 Out of Service, 15501/0627-15616 Trip Schemed Armed (10)	No Limit	No Limit	No Limit	No Limit
Equipment Monitoring Status of Line 15501 (11)				
Lines 15501& 15616 In Service	No Limit (12)	No Limit (12)	No Limit (12)	1500 (8)
Line 15616 Out of Service	2350 (14)	2350 (14)	2350 (14)	1500 (8)
Line 15501 Out of Service	2200 (2)	2200 (2)	2200 (2)	1500 (5)
Line 15501 Out of Service, 15501/0627-15616 Trip Schemed Armed (10)	No Limit	No Limit	No Limit	No Limit

Table 4

Notes for Tables:

1. Limitation to prevent transient instability following a three phase fault on L0627.

2. Limitation to prevent transient instability following a three phase fault on L15616.

4. Limitation to prevent dynamic instability following any trip of L15501.

5. Limitation to prevent dynamic instability following any trip of L15616.

8. Limitation to prevent dynamic instability following any coincident outages of L0627 or L15501 & L15616.

9. A limitation is also required for Lee County units.

10. The trip scheme(s) must be manually "armed" at Byron as would normally be activated by the microwave signal for the line outage.

11. This includes the microwave channel and any other equipment involved in communicating the status of this transmission line to the trip scheme at Byron.

12. Extended system operation with Byron station at full output while the unit trip scheme(s) are inoperable is not recommended. Any trip of L15616 coincident with a three phase fault on L0627 or any trip of L15501 or L0627 coincident with a three phase fault on L15616 may cause generator instability.

13. Extended system operation with Byron station at full output while a stabilizer is not in service is not recommended. Any coincident trips of L15616 or L15501 may cause generator instability.

14. Limitation to prevent transient instability following a three-phase fault on L15501.

Lee County Operating Guide

Lee County units should not operate if both Byron stabilizers are out of service. If only one Byron unit is on-line and operating without its stabilizer, Lee County units may operate provided the combined gross output of Byron and Lee County do not exceed 1500 MW.

During certain single lines out of service it may be desired to disable the Byron Unit Trip Scheme(s). The following table gives recommended Lee County output limitations for certain line outages when the Byron Unit Trip Scheme(s) are disabled. The following tables also give the recommended Lee County output limitations when any Lee County units are operating without power system stabilizers (PSS).

Line Out of Service	Maximum Lee County Gross Output, MW		
	All Lee PSS In	Any Lee PSS Out	
		2 Byron PSS In	1 Byron PSS In
Line 15501 (Nelson – Lee County)Out of Service			
15501/0627-15616 Trip Scheme in Service	No Limit	No Limit	80
15501/0627-15616 Byron Trip Scheme Disabled	480	160	160
Line 0627 Out (Byron – Lee County) Out of Service	No Limit	400	400
Line 15616 (Cherry Valley – Silver Lake) Out of Service			
15501/0627-15616 Byron Trip Scheme In Service	No Limit	No Limit	240
15501/0627-15616 Byron Trip Scheme Disabled	No Limit	240	240
Line 15502 (Nelson – Electric Jct.) Out of Service	No Limit	480	320

ComEd Actions:

- ComEd is to notify PJM of any abnormal status of any of the protection schemes or any outages of the stabilizers.

PJM Actions:

- If any of the above lines are out of service, call ComEd to determine the following information:
  - The Status of the Byron Trip Scheme (dependant on the line that is out of service).
  - The status of Lee County stabilizers.
  - If any of the Lee County PSS are out of service, the status of the Byron stabilizers.
- Using the above chart, determine if there is a limit of the maximum Lee County generation output.
- Confirm and Direct Lee County generation to restrict the maximum generation output.

University Park North Energy Center Restriction [SPS] (ComEd SPOG 1-3-I)

The power system stabilizers (PSS) on all units at University Park North Energy Center are assumed to be normally in service. If a University Park unit is operating with a PSS out of service, that unit will be limited to a gross output of 30 MWs.

The output of University Park North Energy Center units should be restricted if the stability trip communication channel between TSS 66 and TSS 970 is permanently lost. Any channel outage exceeding 60 minutes should be considered a permanent loss of channel. Under such conditions, each University Park North unit should be limited to an output of 35 MW.

ComEd Actions:

- ComEd is to notify PJM of any outages of the University Park Units PSS.
- Notify PJM of the loss of stability trip communication channel between TSS 66 and TSS 970.

PJM Actions:

- If any of the University Park Units PSS are out of service, confirm and direct that University Park Unit to a gross output of 30 MWs.
- If the stability trip communication channel between TSS 66 and TSS 970 is out of service for more than 60 minutes, confirm and direct that University Park Unit to a gross output of 35 MWs.

Elgin Energy Center Stability Bus Tie Scheme [SPS] (ComEd SPOG 1-3-J)

The Elgin Energy stability trip scheme will automatically trip Elgin Energy Center (EC) units to prevent instability. The scheme must be in service when any of the Elgin Energy Center (EC) units are operating.

Multi-phase Fault Unit Trip Scheme

A multi-phase fault on L96001 or L96002 will initiate a 12-cycle timer. If the multi-phase fault remains on the system after the 12-cycle delay, the Elgin EC units on the same color as the fault will be isolated from the system. The blue Elgin EC units are isolated from the system by tripping the line 96001 circuit breaker at TSS 79 Spaulding and initiating a transfer trip to Elgin EC. The red Elgin EC units are isolated from the system by tripping the line 96002 circuit breaker at TSS 79 Spaulding and initiating transfer trip to Elgin EC.

If 138kV red-blue bus tie 2-3 at TSS 79 is operated in the closed position, it is possible that all four Elgin EC units could be tripped for a multi-phase fault cleared in delayed time.

TSS 960 Elgin EC 138kV Bus Tie Interlock Scheme

An interlock scheme has been installed at TSS 960 Elgin EC to prevent closing the 138kV bus tie circuit breaker unless either 138kV motor operated bus tie disconnect is open. The intent of this scheme is to prevent Elgin EC from connecting all four units to either color through a single 138kV line 96001 or 96002. It is permissible for Elgin EC to operate up to three units on either color through a single 138kV line.

In the event that Elgin EC operates three units on either color, the Spaulding 2-3 138 kV bus tie circuit breaker will be operated in the closed position. This will help ensure that the 138/34.5 kV transformers at TSS 79 are connected to a balanced 138kV source.

PJM Actions:

- If the L96001 or L96002 138 kV line is out of service and the Elgin bus tie is closed, confirm that only three Elgin units are in service.

Marengo 138 kV Bus Operation (ComEd SPOG 2-2-B)

The 138 kV circuit breaker between Belvidere – Pleasant Valley – Marengo (L12204) and Belvidere – Marengo – Woodstock (L12205) at Marengo should be left in the closed position during summer months to avoid potential low voltage and or emergency overload conditions for the single contingency outage of Cherry Valley – Belvidere – B465 (L15624) or Silver Lake – Crystal Lake – Pleasant Valley – McHenry (L13809) during heavier load conditions.

Damen 138 kV Bus Operation (ComEd SPOG 2-2-C)

The 138 kV circuit switcher ‘BT2-3 CS’ at Damen, can be closed for emergency supply to Evergreen Park, Damen and Wallace provided this operation does not form a closed 138 kV path between Blue Island or Wildwood and Bedford Park.

Normally Open Bus Tie Circuit Breakers

The following stations have normally open bus tie circuit breakers that may need to be closed due to transmission equipment out of service. This should be studied and agreed upon with ComEd prior to closing.

Some of the following stations have normally open bus tie breakers and associated guides that indicate studying the closing of the Normally Open breaker in the event of certain outages or other conditions. For each line or transformer outage that could affect these stations there are two contingency definitions in our EMS system. One contingency will have a ‘G’ (Guide) appended to the end of the contingency title and one will have a ‘GF’ (Guide Failed) appended to the end of the contingency title. The contingencies with a ‘G’ appended indicate the normally open bus tie breaker at the appropriate station has been closed as part of the contingency definition. The contingencies with a ‘GF’ appended indicate the normally open bus tie breaker at the appropriate station was not closed in the contingency definition.

Other stations have an automatic scheme in place one contingency will be marked with an ‘S’ (Scheme) and one with an ‘SF’ (Scheme Failed). The contingencies with a ‘S’ appended indicate the normally open bus tie breaker at the appropriate station has been closed as part of the contingency definition. The contingencies with a ‘SF’ appended indicate the normally open bus tie breaker at the appropriate station was not closed in the contingency definition

ComEd Actions:

- Breaker outage/abnormal: ComEd will notify PJM operators whenever a normally open bus tie breaker defined in this procedure is in any abnormal status or condition that would prevent its ability to be closed according to the relevant guide.
- Relay or scheme change/fail/abnormal: If the automatic breaker closing is changed or disabled at Electric Junction or Lisle then ComEd must notify the PJM operator.

PJM Actions:

- Planned Outages: If removal of a line or transformer causes problems at one of the stations in this procedure with a guide in place study closing the normally open bus tie breaker and confirm/coordinate with ComEd
- Contingency Overloads: If a contingency appears in real time, we will need to confirm with ComEd if the normally open circuit breaker with be closed. If the normally open CB will be closed, PJM will control to the 'G' or 'S' contingencies. If the normally open CB will remain open, PJM will control to the 'GF' and 'SF' contingencies.

N.O. Circuit Beaker	Equipment Out of Service	Reason for closing the N.O. CB	Contingency w/ N.O. CB Closed	Contingency w/ N.O. CB Open	Additional Information
Northbrook 2-3 138 kV N.O. Bus Tie CB (SPOG 2-10)	Northbrook #81 Transformer	To Prevent Low Voltage Conditions Should Another Element Trip	Northbrook TR 81 R G	Northbrook TR 81 R GF	
	Northbrook #82 Transformer		Northbrook TR 82 R G	Northbrook TR 82 R GF	
	Northbrook – Skokie (8805) 138 kV Line		138L8805 G	138L8805 GF	
	Northbrook – Skokie (8806) 138 kV Line		138L8806 G	138L8806 GF	
Prospect Heights 2-3 138 kV N.O. Bus Tie CB (SPOG 2-15)	Prospect Heights #81 Transformer	To Prevent Low Voltage Conditions Should Another Element Trip	PROSPECT HTS TR 81 R S	PROSPECT HTS TR 81 R SF	
	Prospect Heights #84 Transformer		PROSPECT HTS TR 84 R S	PROSPECT HTS TR 84 R SF	
	Prospect Heights - Des Plaines (11701) 138 kV Line		138L11701 G	138L11701 GF	
	Prospect Heights - Des Plaines (11702) 138 kV Line		138L11702 G	138L11702 GF	
Diversey 2-11 138 kV N.O. Bus Tie CB (SPOG 2-22)	Diversey - Clybourn (4013) 138 kV Line	To Prevent the loss of Diversey or Clybourn load in the event of an additional 138 kV line outage or in the case of the 11418 line to prevent an	138L4013 G	138L4013 GF	138 kV line 4018 must be opened
	Clybourn – W Loop (14807) 138 kV Line		138L14807 G	138L14807 GF	138 kV line 4018 must be opened

N.O. Circuit Beaker	Equipment Out of Service	Reason for closing the N.O. CB	Contingency w/ N.O. CB Closed	Contingency w/ N.O. CB Open	Additional Information
	Diversey - Northwest (11413) 138 kV Line	overload on 138L4525 for l/o 138L5826	138L11413 G	138L11413 GF	138 kV line 4018 must be opened
Wayne 6-9 345 kV N.O. Bus Tie CB (SPOG 3-17)	Tollway - Wayne (14402) 345 kV Line	To eliminate overloads on Wayne #81 transformer or the Wayne - Spaulding 138 kV line	345L14402 R G	345L14402 R GF	
Wayne 2-3 138 kV N.O. Bus Tie CB (SPOG 3-17)	Tollway - Wayne (14402) 345 kV Line & Wayne TR81 345/138 kV Transformer	To eliminate overloads on Spaulding – Tollway (7903) 138 kV Line	345L14402 and 144_Wayne TR 81 R G	345L14402 and 144_Wayne TR 81 R GF	
Lisle 2-3 345 kV N.O. Bus Tie CB (SPOG 3-11)	Lisle - Lombard (10321) 345 kV Line	To Prevent overloads on Lisle # 82 and #83 transformers	345L10321 S	345L10321 SF	[SPS]
	Lisle - Lombard (10322) 345 kV Line		345L10322 S	345L10322 SF	[SPS]
Grand 12-13 and 16-17 138 kV N.O. Bus Tie CBs and Madison 4-6 and 1-9 138 kV N.O. Bus Tie CBs (SPOG 2-27)	Grand – W Loop (5826) 138 kV line	To prevent against load loss at Ohio TSS 65 and/or Madison TSS 36 for loss of a second cable	138L5826 G	138L5826 GF	At Grand, close 12-13, open 11-12 At Madison, close 4-6, open 3-4
	Grand – W Loop (5828) 138 kV line		138L5828 G	138L5828 GF	At Grand, close 16-17, open 15-16. At Madison, close 1-9, open 8-9
	Madison – DeKoven (3610) 138 kv line		138L3610 G	138L3610 GF	At Grand, close 12-13, open 11-12

N.O. Circuit Beaker	Equipment Out of Service	Reason for closing the N.O. CB	Contingency w/ N.O. CB Closed	Contingency w/ N.O. CB Open	Additional Information
					At Madison, close 4-6, open 3-4
	Madison – Dekoven (3611) 138 kV line		138L3611 G	138L3611 GF	At Grand, close 16-17, open 15-16. At Madison, close 1-9, open 8-9
	Fisk – Dekoven (1110) 138 kV line		138L1110 G	138L1110 GF	At Grand, close 12-13, open 11-12 At Madison, close 4-6, open 3-4
	Fisk – Dekoven (1111) 138 kV line		138L1111 G	138L1111GF	At Grand, close 16-17, open 15-16. At Madison, close 1-9, open 8-9
	Madison – Grand (5810) 138 kV line		138L5810 G	138L5810 GF	At Grand, close 12-13, open 11-12 At Madison, close 4-6, open 3-4
	Madison – Grand (5811) 138 kV line		138L5811 G	138L5811 GF	At Grand, close 16-17, open 15-16. At Madison, close 1-9, open 8-9
Libertyville 2-3 138 kV N.O. Bus Tie	Libertyville #81 Transformer	To Prevent overloads on Prospect Heights # 81	154 Libertyville Tr81 R G	154 Libertyville Tr81 R GF	

N.O. Circuit Beaker	Equipment Out of Service	Reason for closing the N.O. CB	Contingency w/ N.O. CB Closed	Contingency w/ N.O. CB Open	Additional Information
CB (SPOG 2-31)		transformer			
	Libertyville #83 Transformer		154 Libertyville Tr83 R G	154 Libertyville Tr83 R GF	
Grenshaw 1-8 and 4-5 138kV N.O. Bus Tie CBs (SPOG 2-32)	Taylor – Grenshaw (15301) 138kV line	To Prevent overloads on State Line – Washington Park (0702) 138 kV line	138L15301 G	138L15301 GF	
Washington Park 138kV N.O. Bus Tie 3-4 CB (SPOG 2-34)	State-Wash (0702), State-Wash (0705), Jeff-Wash (13701), Gren-Univ (17401), or Wash-Univ (17404) 138kV line	To Prevent overloads on the 138 kV system	138L0705 G	138L0705 GF	
			138L17404 G	138L17404 GF	
			138L17401 G	138L17401 GF	
Itasca 138kV N.O. Bus Tie 2-3 CB (SPOG 2-37)	Lombard – Itasca (12001) 345 kV line and Itasca Tr. 81	To Prevent overloads on Lombard Tr. 84 or Lombard Tr. 82	345L12001T G	345L12001T GF	
			101 Itasca Tr81 R G	101 Itasca Tr81 R GF	
	Lombard – Itasca (12002) 345 kV line and Itasca Tr. 82		345L12002T G	345L12002T GF	
			101 Itasca Tr82 R G	101 Itasca Tr82 R GF	
Silver Lake 138kV	13808 138kV line	To Prevent overloads on	138L13808 G	138L13808 GF	

N.O. Circuit Beaker	Equipment Out of Service	Reason for closing the N.O. CB	Contingency w/ N.O. CB Closed	Contingency w/ N.O. CB Open	Additional Information
N.O. Bus Tie 2-3 CB (SPOG 2-38)	13809 138kV line	the 138 kV system	138L13809 G	138L13809 GF	
	Silver Lake #82		138 Silver Lake Tr82 R G	138 Silver Lake Tr82 R GF	
	Silver Lake #83		138 Silver Lake Tr83 R G	138 Silver Lake Tr83 R GF	
Skokie 345kV N.O. Bus Tie 2-3 (SPOG 3-23)	Golf Mill – Skokie (8823) 345kV line	To Prevent overloads on Golf Mill to Skokie 138 kV Line 8801	345L8823 R G	345L8823 R GF	

Dresden 345 kV Bus Operation with L1223 Out of Service (ComEd SPOG 2-17)

If the 345 kV circuit Dresden – Electric Junction (L1223) is out of service with the ring bus closed and Dresden Unit 3 is on-line, 345 kV bus tie circuit breaker 'BT1114 CB' at Station 12, Dresden, should be opened. Alternatively, the 4-8 345kV bus tie may be closed if system conditions permit. Before opening the 4-8 breaker, ComEd must confirm that no circuit breakers will be overdutied. Also confirm with ComEd if any additional switching is required at remote locations to support the closing of bus tie 4-8.

Burnham – Taylor (L17723) 345 kV Line Operation (ComEd SPOG 3-6)

The high capacitance of each of these cables is compensated for by a 120 MVar shunt inductor at Calumet TSS 150. Without an inductor in service, inadvertent opening of the Burnham end of either line can result in excessive voltage at the bus at Taylor, on the open line, and associated equipment. Overvoltage would be most severe at lighter system load levels and with abnormal terminal conditions, but can also be above equipment ratings during higher system load levels depending on system configuration.

Energizing and De-energizing L17723 and L17724

Lines 17723 and 17724 can be energized or de-energized from either the Burnham or the Taylor ends when system configuration is otherwise normal. Because of the complexity of the system and the number of possible configurations, it is recommended to check predicted voltage from the state estimator before energizing or de-energizing the lines if the system is in an abnormal configuration.

L17723 and L17724 should never be energized from a 138 kV transformer circuit breaker. Energization in this manner can cause high temporary overvoltages resulting in arrester failure, degradation of transformer insulation, and circuit breaker flashover.

Operation of L17723 and L17724 without Shunt Inductors:

L17723 or L17724 should not be normally operated without its 120 MVAr shunt inductor at Calumet in service. However, the inductors may be opened on peak load days when the system load is expected to be 18,000 MW or greater, or if the system voltage is otherwise expected to be inadequate. The following conditions must be met:

1. The Burnham 345 kV, West Loop 345 kV, and Taylor 345 kV buses are normal.
2. The voltages at Burnham and Taylor 345 kV buses are not greater than 346 kV before an inductor is opened.

Return the inductors to service when any of the following conditions are met:

1. Condition 1 above is no longer true
2. Bus voltages at Taylor or Burnham exceed 348 kV
3. The system has peaked and load has fallen below 17,000 MW

If an inductor is faulted, the line will be tripped and locked out. Under certain system conditions, it may be necessary to operate a line for extended periods without its inductor for transmission system reliability reasons. For sustained operation of either line without its inductor, Transmission Planning should be consulted to determine if conditions permit continued operation in this manner. It may be necessary to bypass one or both series inductors to avoid excessive voltages.

Ratings associated with Cooling System Operating Modes

Lines 17723 and 17724 share a common oil return pipe. Operation of the forced cooling system on both lines simultaneously leaves the system susceptible to a pipe failure or dig-in, which could cause a pressure transient to trip both lines. To eliminate this possibility, it is recommended that the oil cooling systems be normally operated in static mode with all three pipes isolated from each other.

After failure of one line, the 2-hour emergency rating on the remaining line is 935 MVA. After 2 hours, if cooling has been initiated on the remaining line the allowable loading is 835 MVA. If cooling is not started within 2 hours, loading should be brought down below the 791 MVA static rating.

ACOP must be on for 6 hours or more to obtain the full effect. After 6 hours, a single line can be operated at higher ratings. See table below.

Number of Circuits In Service	Cooling Mode	Summer (MVA)		Winter (MVA)	
		Normal	Emergency	Normal	Emergency
2	Static (normal configuration)	550	791	600	844
1	2-hour Emergency Rating (Static)	706	935	765	1020
1	Static (2 hours +)	706	791	765	844
1	ACOP (first 6 hours)	706	835	765	920
1	ACOP (After 6 + hours)	847	941	934	1006
2	ACOP (6 + hours, risk of common mode failure)	762	856	849	922

Lakeview Special Protection Scheme (ComEd SPOG 3-10)

(**References**: MISO 2012-S-004-E-Southwest_Wisconsin_Interface Operating Guide)

The ATC Lakeview SPS is designed to prevent the 138 kV tieline L28201 from Zion to Lakeview (ATC) from exceeding its emergency rating following the outage of one or both of the subsequent lines:

- Zion Station 22 to Pleasant Prairie (ATC) 345 kV Red (L2221)
- Zion Station 22 to Arcadian (ATC) 345 kV Blue (L2222)

The SPS is normally in-service. The SPS will trip the Lakeview 138kV breaker 28201, opening 282 Zion - Lakeview L28201, if the flow from Lakeview towards 282 Zion is greater than or equal to 264 MVA for 10 seconds. This trip setting is equal to the summer emergency rating of the L28201.

PJM Actions:

- When contingency overloads are seen on the 282 Zion - Lakeview L28201 and the SPS is enabled:
  - Activate the appropriate SPS contingency
  - Suppress the normal contingency
- PJM will request MISO to disable the SPS for a prior outage of any of the following facilities along the Kenosha - Waukegan 138kV path:
  - 16 Waukegan - 282 Zion 138 kV line (L1609)
  - 282 Zion - Lakeview 138 kV Tie line (L28201)
  - Lakeview - Kenosha 138 kV line (9341)
  - Kenosha 138 kV bus tie CB 4-5
  - Lakeview 138 kV bus tie CB 4-5
  - 282 Zion 138 kV L1609/28201 CB
- In certain situations, it may be necessary to open the Kenosha - Waukegan 138kV path pre-contingency. PJM will evaluate the opening of this path pre-contingency for the following conditions:
  - Constraints are seen along the Kenosha - Waukegan 138kV path and the SPS is disabled or unable to control.
  - Prior outage to the 22 Zion - Pleasant Priarie 345 kV line (L2221), as this may increase the thermal transfer capability between ATC and ComEd.
- If either PJM or MISO has issued an EEA 1 or higher, the Zion - Lakeview line may need to be opened pre-contingency, prior to redispatch to ensure generation is not bottled in the deficient Control Zone.

- If MISO or PJM should request the 138kV path be opened, the following switching should occur based on the direction of flow:
- Open 1609/28201 CB at 282 Zion if post-contingency flow on Zion – Lakeview 138kV flow is into ATC.
- Request MISO to open the 4-5 CB at Lakeview if post-contingency flow on Zion-Lakeview 138kV flow is into ComEd.
- Line 28201 can be opened through mutual consent of the involved companies.
- Notify ComEd of any changes to the status of the SPS.

ComEd Actions:

- Notify PJM of any concerns related to the operation of the SPS.

138 kV Phase Shifting Transformer Operations (ComEd SPOG 3-22)

The ComEd system includes ten 138 kV phase shifting transformers on transmission circuits around the city. The primary purpose of these phase shifters is to optimize and control power flow so as to maximize the utilization and reliability of the cables that supply the City of Chicago load center. The system has been designed so that power flows into the city from all directions.

Physical control of phase shifter set points should be chosen by Operations to avoid normal and first contingency overloads on cables and phase shifters using a real time contingency analysis program. Settings should be updated as conditions change throughout the day to ensure that the most reliable configuration is maintained. PJM will have operational control of the phase shifters, where ComEd may request changes to the PARs for effective transmission control. The PJM and ComEd Dispatchers will decide on operating strategies for each day.

Waukegan 138 kV Bus Tie TR4-14 Bus 2 CB Operation [SPS] (ComEd SPOG 2-29)

A high-speed relaying scheme is in place at the Waukegan station that will automatically close 138kV Bus Tie TR4-14 Bus 2 CB for the loss of Unit 7 or Unit 8. This will prevent low voltages or transmission line overloads for the loss of a 138 kV line.

Bus Tie TR4-14 Bus 2 CB should be opened when both Waukegan Unit 7 and Unit 8 are online to prevent circuit breakers from becoming overdutied.

Ridgeland 138 kV Bus Tie 4-14 Operation (ComEd SPOG 2-25)

The normally open 138 kV Bus Tie 4-14 at Ridgeland TSS 192 should be closed for the outage of either 138 kV red line L1315 (Ridgeland-Crawford) or 138 kV line L5105 (McCook-Ridgeland) to maintain service continuity to the Ridgeland transformers for subsequent contingencies.

The combined outage of line L1315 and line L5105 can result in the loss of supply to the two 138/69 kV transformers. Additionally, the outage of 138 kV line L5105 may cause thermal contingency overload on TR 83 at Station 13_Crawford.

Wolfs Crossing-Sandwich 138kV 14302 line [SPS] (ComEd SPOG 3-31)

Low voltage issues can occur along the Wolfs Crossing - Sandwich 138kV line 14302 right-of-way if the 14302 circuit breaker to open at TSS 143 Wolfs Crossing under heavy load conditions. To eliminate the potential low voltage issues, a SCADA controlled Special Protection System is in place and normally enabled.

Both the primary scheme at TSS 143 Wolfs Crossing and the secondary scheme at TSS 146 Sandwich have the capability to be disabled via SCADA. Reasons for disabling the scheme include: 138kV bus maintenance, 138kV breaker maintenance or when operational studies show tripping is not required based upon system loading.

The primary scheme will initiate transfer trip on line 14302 for an open breaker at TSS 143 Wolfs Crossing.

The secondary scheme will open the 138kV 14302/11301 circuit breaker at TSS 146 Sandwich if the following two conditions are BOTH sensed:

- A power flow of 120MVA or greater flowing towards TSS 143 Wolfs Crossing.
- A voltage of 129.7kV or lower on the TSS 146 Sandwich bus.

ComEd Actions:

- Notify PJM of any changes to the status of the primary or secondary SPS.

PJM Actions:

- In the event that the relay schemes described above fail to trip line 14302 and low voltages occur along the right-of-way for line 14302, PJM will direct the following switching:
- CLOSE the 138kV ‘2-3’ bus tie circuit switcher at TSS 106 Montgomery
- OPEN the 138kV line 14302 circuit switcher at TSS 106 Montgomery
- If the 14302 circuit breaker at TSS 143 Wolfs Crossing is expected to be taken out of service for maintenance and studies indicate a low voltages results along the 14302 right-of-way, coordinate the following with ComEd:

1. At TSS 106 Montgomery
    - CLOSE the 138kV ‘2-3’ bus tie circuit switcher
    - OPEN the 138kV line 14302 circuit switcher
2. Disable the Line 14302 primary and secondary SPS schemes

- For a return of the 14302 circuit breaker at TSS 143 Wolfs Crossing, coordinate the following with ComEd:

1. CLOSE the Line 14306 CB at TSS 143 Wolfs Crossing.
2. Enable the Line 14302 primary and secondary SPS schemes.
3. Restore TSS 106 Montgomery to normal.

Electric Junction – North Aurora 138kV 11106 line [SPS] (ComEd SPOG 3-27)

The primary source of 138kV Line 11106 is two 345/138kV autotransformers at TSS 111 Electric Junction. Under heavy load conditions, opening Line 11106 circuit breaker at TSS 111 would cause the load to be fed from distant sources at Cherry Valley, Nelson and Wolfs Crossing, resulting in low voltage along the Line 11106 circuit. To eliminate the potential low voltage issues, a SCADA controlled Special Protection System is in place and normally enabled. Both the primary and secondary schemes at TSS 111 Electric Junction have the capability to be disabled via SCADA. The schemes should be normally in-service.

The primary relay scheme will initiate transfer trip on line 11106 for an open breaker at TSS 111 Electric Junction.

The secondary relay scheme is initiated by line 11106 circuit breaker open, with no corresponding line 11106 line fault, sending a direct transfer trip over direct fiber to TSS 56 North Aurora, tripping via DC interlock and tripping circuit switcher 0605 at TSS 56 North Aurora.

ComEd Actions:

- Notify PJM of any changes to the status of the primary or secondary SPS.

PJM Actions:

- In the event that the relay schemes described above fail to trip line 11106 and low voltages occur along the right-of-way for line 11106, PJM will direct the following switching:

1. At TSS 56 North Aurora
    - CLOSE the 138kV ‘2-3’ bus tie circuit switcher
    - OPEN the 138kV line 11106 circuit switcher

- If the 11106 circuit breaker at TSS 111 Electric Junction is expected to be taken out of service for maintenance and studies indicate a low voltages results along the 11106 right-of-way, coordinate the following with ComEd:

1. At TSS 56 North Aurora
    - CLOSE the 138kV ‘2-3’ bus tie circuit switcher
    - OPEN the 138kV line 11106 circuit switcher
2. Disable the Line 11106 primary and secondary SPS schemes

- For a return of the 11106 circuit breaker at TSS 111 Electric Junction, coordinate the following with ComEd:

1. CLOSE the Line 11106 CB at TSS 111 Electric Junction.
2. Enable the Line 11106 primary and secondary SPS schemes.
3. Restore TSS 56 North Aurora to normal.

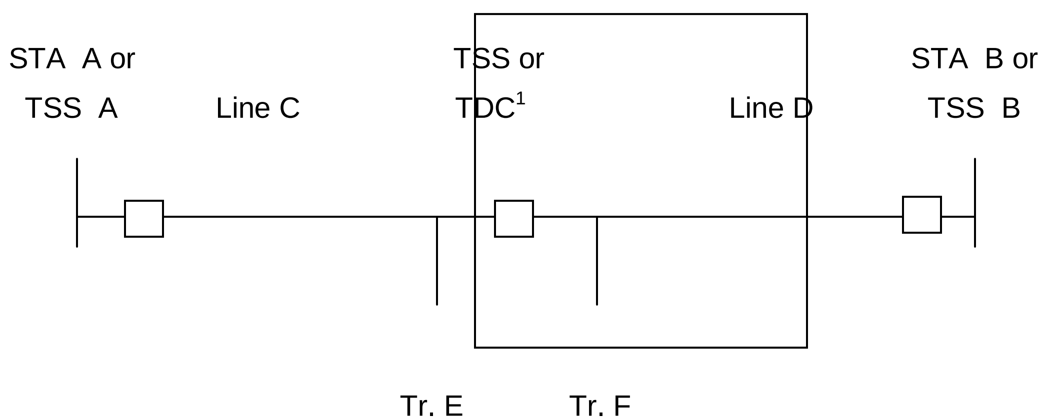
Wolfs TR 81 [SPS] (ComEd SPOG 3-28)

Under certain operating conditions for which 345 kV line 14321 becomes open-ended at Electric Junction TSS 111, such as a 345 kV bus 2 fault at Electric Junction, TR 81 at Wolfs and 138 kV line 11102 from Wolfs to Frontenac TDC 581 tap can become overloaded. Tripping or manually opening the Wolfs TR 81 circuit breaker eliminates both overloads. To automate the response to line 14321 becoming open-ended, a Special Protection Scheme (SPS) was installed at TSS 143 Wolfs.

The SPS will detect loads of less than 15 MW and 15 MVAR on 345 kV line 14321 either into or out of 345 kV blue bus 1 at Wolfs. This loading is greater than the line charging current of line 14321 and will indicate an open 14321 circuit breaker at TSS 111 Electric Junction. While under this condition, a relay will be armed to trip the TR 81 138 kV secondary circuit breaker if loading on TR 81 exceeds its emergency rating for 10 seconds. The transmission system is designed to operate such that the loss of 14321 and TR 81 will not result in any other overloads.

Transformer Operations at 138kV Line Tie Breaker Substations (ComEd SPOG 4-30)

A “Line Tie Breaker Substation” is defined as a 138kV substation where the two lines feeding the substation are connected via a circuit breaker (CB). A simplified one-line is shown below.



[1]The breaker at this location is the Line Tie CB. Note that there may be 2 or more transformers (Tr.s) at this location.

Line Tie CB Substations pose some operating risks that are not present in the more prevalent station configuration where distribution transformers are fed from segregated red and blue lines. At Line Tie CB Substations, a failure of the Line Tie CB will result in an all out at the Substation. Substations that are fed from segregated red and blue lines are not typically exposed to a single equipment failure that would result in an all out at the substation. There are three main risks associated with operations at Line Tie CB Substations:

- Line C or a Line D faults accompanied by a Line Tie CB failure will result in a complete outage to the Line Tie CB Substation.
- Depending on station fault current levels, configuration, current transformer connections, and transformer high side interrupting device capability, Tr. E or Tr. F faults may necessitate tripping the Line Tie CB (see table on page 2 for details). In these cases, a Tr. E or a Tr. F fault accompanied by a Line Tie CB failure will result in a complete outage to the Substation.
- If automatic reclosing is applied at the Line Tie CB (typically this is the case if the remote station is a generating station) and the Line Tie CB is out of service, automatic reclosing will not occur if a fault occurs on Line C or Line D.

The following operations are recommended to help avoid outages/extended outages at Line Tie CB Substations:

- Given normal 138kV configuration and no operational issues associated with interrupting power flow between TSS A and TSS B, open the Line Tie CB prior to reenergizing Tr. E or Tr. F. This will eliminate the possibility that a transformer relay operation especially important to apply at stations where transformer faults trip the Line Tie CB (see table on page 2 for details).
- When the Line Tie CB is out of service, recognize that the automatic line reclosing may also be out of service. If the automatic line reclosing is out of service (reclose dead is located at the Line Tie coupled with a Line Tie CB failure will result in an all out at the Substation. This is CB Substation), be prepared to give a SCADA close to the appropriate TSS circuit breaker if a line fault occurs to test the line.

A list of Line Tie circuit breaker substations follows:

Line Tie CB Station	Associated 138kV Line #1	Associated 138kV Line #2	Open Line Tie CB prior to energizing Tr.
TSS 151 Woodstock	12205	14106	Yes[1]
TSS 55 Hegewisch	0703	17714	Yes[1]

Line Tie CB Station	Associated 138kV Line #1	Associated 138kV Line #2	Open Line Tie CB prior to energizing Tr.
TSS 83 Glidden	11106	11323	Yes
TSS 124 Maryland	11902	12411	Yes
TSS 132 Garden Plain	13219	15518	Yes
TDC 648 Norridge	3707	19801	Recommended[2]
TSS 123 Marengo	12204	12205	Recommended[3]
ESS Z100 Tower Automotive	0704	17712	No
TDC 282 Zion	1609	28201	No
TDC 372 Sterling	12411	15511	No
TDC 431 Shorewood	0908	1210	No
TDC 505 Oak Park	3709	19209	No
TSS 146 Sandwich	11301	14302	No
TSS 149 Wilmington	1207	8607	No

[1] The two substations with the highest probability of a station all out due to a Line Tie CB failure are TSS 151 Woodstock and TSS 55 Hegewisch.

[2] Recommended only if backfeed is removed from the 12kV Transformers (reference SPOG 4-13 “Cable Lines with High Voltage Problems”).

[3] Recommended only if there are no low voltage or transmission contingency overload issues (reference SPOG 2-2-B “TSS 123, Marengo 138kV Bus Operation During Summer Months”). Note that the TSS 123 Marengo Bus Tie is closed in the summer months only.

Davis Creek 345kV Bus Tie 2-3 Auto-Closing [SPS] (ComEd SPOG 2-24)

Under certain operating conditions after the loss of Braidwood to Davis Creek 345kV Line 2002 and associated TR 83, Davis Creek TR 82 (Red) can overload. 345kV Bus Tie 2-3 at Davis Creek will auto-close and eliminate this overload. For the loss of 345 kV Line 2004, the Line 2004 MOD will automatically open and 345 kV bus tie 1-2 will automatically close, restoring 345 kV Bus 2. Bus tie 2-3 will return to its pre-fault state.

For the loss of 345 kV Line 17907, the Line 17907 MOD will automatically open and 345 kV bus tie 3-4 will automatically close, restoring 345 kV Bus 3. Bus tie 2-3 will return to its pre-fault state.

Dresden Unit 2 Trip Scheme [SPS] (ComEd SPOG 2-35)

If 345 kV Bus Ties 1-2 and 6-7 at Station 12 Dresden are both open for any reason, Dresden Unit 2 will trip. This automatic scheme prevents Dresden Unit 2 from becoming isolated into Dresden TR 81.

Islanding Prevention Scheme for TSS 941 Grand Ridge Generation [Load Rejection] (ComEd SPOG 2-41)

TSS 941 Grand Ridge wind generation can be islanded into the distribution system at TSS 61 Streator and Ameren's Marseilles Tr. 3 under certain operating scenarios. An automatic relay trip system has been installed at TSS 105 Kickapoo Creek, TSS 61 Streator and Station 1 LaSalle to detect this condition.

With the protection system in service, it is not necessary to take any corrective measures. The automatic relay trip system monitors the status of 138 kV circuit breaker contacts at TSS 105 Kickapoo Creek, TSS 61 Streator and Station 1 LaSalle. Based on the status of these breakers, the scheme will automatically open the 138 kV line 94101 circuit breaker at TSS 105 Kickapoo and trip TSS 941 Grand Ridge wind generation off-line.

The automated operation to trip generation at Grand Ridge is part of the anti-islanding protection for the generator, which also includes other generator protection systems. The automated operation will not occur until the generation has been removed from the Bulk Electric System (BES) through the opening of the 138 kV breakers.

The 138kV CBs monitored by the scheme are as follows:

- 'L0112' @ Station 1 LaSalle
- 'L0112' and 'L94101' @ TSS 105 Kickapoo Creek
- 'L6101', 'L6102' and 'BT 2-3' @ TSS 61 Streator

The TO should take immediate action to trip TSS 941 Grand Ridge generation offline manually if the automatic relay trip system is NOT in service AND the following conditions are met,:

- EITHER the 138kV 'L0112' CB @ TSS 105 Kickapoo Creek OR the 'L0112' CB @ Station 1 LaSalle is detected as OPEN

AND

- EITHER the 'L6101' OR 'L6102' OR the 'BT 2-3' @ TSS 61 Streator is detected as OPEN

Northbrook Transfer Trip [SPS] (ComEd SPOG 3-32)

Opening of 138 kV line 15912 or 15913 circuit breakers at Northbrook TSS 159 could result in extreme thermal overloads and low voltage conditions along 138kV lines 1606, 1605, 15912, and 15913 due to the source of Waukegan feeding radially to Northbrook from a distance of approximately 22 miles away. To automate the response to either an outage of line 15912 or 15913 circuit breakers at Northbrook, an SPS was installed at TSS 159 Northbrook with a back-up scheme at TSS 48 Highland Park.

The TSS 159 Northbrook special protection system will respectively initiate the primary line transfer trip scheme on either line 15912 or line 15913 whenever the line 15912 or line 15913 circuit breaker contact status is detected open. Generally, this condition will be the result of a bus fault, breaker failure, low SF6 gas condition, or normal switching of the line 15912 or 15913 circuit breakers.

The line 15912 back-up scheme, located at TSS 48 Highland Park, will open the blue bus tie circuit breaker 3-4, TR79 34 kV CB, and TR72 12kV CB at TSS 48 Highland Park for a power flow of 100 MW or greater out of Highland Park and a voltage of 131.1 kV or lower.

The line 15913 back-up scheme, located at TSS 48 Highland Park, will open the red bus tie circuit breaker 1-2 and TR77 34 kV CB at TSS 48 Highland Park for a power flow of 100 MW or greater out of Highland Park and a voltage of 131.1 kV or lower.

Both the primary Northbroook TSS 159 scheme and the back-up scheme at Highland Park TSS 48 have the capability to be disabled via SCADA or a local control switch. This may be desirable during maintenance of the 138 kV bus and/or breakers at Northbrook TSS 159 to alleviate the potential for unintended or unnecessary operations. The schemes may be disabled when operational studies show tripping is not required based on system loading.

ComEd Actions:

- Notify PJM of any changes to the status of the primary or back-up schemes.

PJM Actions:

- In the event that the relay schemes failed to transfer trip and thermal overloads or low voltages occur, PJM will direct the manual transfer of all 212 Northbrook and 213 Deerfield load from the affected line to the other via the 138 kV circuit switchers at each station.
- If the 15912 or 15913 lines at TSS 159 Northbrook is expected to be taken out of service for maintenance and causes thermal overloads or low voltages, coordinate the following with ComEd:
    - CLOSE the 138kV bus tie ‘2-3’ circuit switcher at either 212 Northbrook or 213 Deerfield or both stations depending on system condition
    - OPEN the line circuit switcher at either 212 Northbrook or 213 Deerfield or both stations depending on system condition
    - DISABLE the corresponding line primary or secondary SPS schemes
- For a return of the line 15912 or line 15913 CB at TSS 159 Northbrook, coordinate the following with ComEd:
    - CLOSE the Line CB at TSS 159 Northbrook.

- ENABLE the line primary and secondary SPS schemes.
- Restore 212 Northbrook and 213 Deerfield to normal.

Zion Generation Stability Trip [SPS] (ComEd SPOG 1-3-K)

At TSS 974 Zion Energy Center, if all three units are operating, the scheme will automatically trip Unit 12 for selected faults cleared in delayed time, to prevent instability.

If all three units are operating, the scheme will also automatically trip Unit 12 if the stability trip scheme is disabled, or if the associated communication signal is lost, for more than 60 minutes.

- This scheme should be in-service at all times.
- Zion Energy Center should be limited to a maximum of 2 units in service for any communication channel outage exceeding 60 minutes.
- In the event of a loss of communication alarm, TSO shall notify the Zion Energy Center Control Room and a response plan will be initiated by the parties to determine the cause of the alarm and to implement appropriate corrective actions.

A Multi-phase Fault Unit Trip Scheme installed at TSS 974 Zion Energy Center is required to prevent first swing instability for selected faults cleared in delayed time. These trips are initiated after a six cycle time delay to allow for the operation of primary protection. All Zion Energy Center units will remain stable following faults cleared by primary protection (within 6 cycles) and no unit trips will be initiated.

Detection of a multi-phase fault by relays looking out from TSS 974 on L2223 with a reach extending beyond the Zion Station 22 345kV bus will initiate a 6-cycle timer. If the multi-phase fault remains on the system after the 6 cycle delay, Zion Energy Center Unit 12 will be tripped if all three units are operating.

The output of Zion Energy Center units should be restricted if the stability trip scheme communication channel is permanently lost or if the stability trip scheme is disabled for any other reason. Any channel outage exceeding 60 minutes should be considered permanent. Under such conditions, Zion Energy Center should be limited to a maximum of 2 units in service. The scheme is designed to automatically trip Zion Energy Center Unit 12 if the communication signal is lost for 60 minutes and if all three units are operating. The loss of communication for the stability trip scheme is indicated by a differential channel failure alarm for L97401 that is transmitted to both the Transmission Dispatcher via SCADA and to the generating plant. In the event of a loss of communication alarm, TSO shall notify the Zion Energy Center Control Room and a response plan will be initiated by the parties to determine the cause of the alarm and to implement appropriate corrective actions.

Camp Grove Islanding (ComEd SPOG 2-40)

Camp Grove wind generation can become islanded into Station 3 Powerton during outages of either the '1352' (Powerton – Havana – Lilly ComEd to Ameren tie line) or the '7421' (Toulon – Kewanee) 138kV lines.

ComEd will open the 138kV TR 042 CB (which feeds a back-up transformer to main station power transformer TR 542 @ Station 3 Powerton) to isolate the transformer if either line is out-of-service:

- 138kV line 1352 (Powerton – Havana – Lilly)
- 138kV line 7421 (Toulon – Kewanee)

PJM Actions:

If either the '1352' or '7421' 138kV lines are out-of-service, PJM should notify the GO for Camp Grove wind generation that they are in a potential islanding situation should they lose their remaining outlet for any reason.

If ComEd is unable to open the 138kV TR 042 CB @ Powerton, Camp Grove generation should be forced off-line to protect equipment at @ Powerton. Once ComEd is able to open the 138kV TR042 CB @ Powerton, Camp Grove wind generation can commence generation as conditions permit.

Directional Ratings

At present, PJM's EMS and TERM both assume the rating for a facility is the same regardless of the direction of the flow. The following facilities have distinct Directional Ratings that are flow dependant.

The Directional Rating is utilized ONLY when a trend indicates actual or contingency flow (as demonstrated via study analysis through the implementation of the contingency in question) is in the direction specified within the table below. If actual or post-contingency flow is in the opposite direction of the table below, the default TERM ratings should be utilized.

				Summer		Winter	
Line	**kV**	**From Bus**	**To Bus**	**NL**	**EM**	**NL**	**EM**
Flow from Mazon to L7713	138	77_Mazon	L7713	115	115	115	115
Flow from Crescent Ridge to L7713	138	981 Crescent Ridge	L7713	174	174	174	174

PJM Actions:

- If the State Estimator indicates an actual trend on a facility in the table above with MW flow in the direction shown:

- Confirm flow and directional rating with the TO
- If confirmed, utilize the appropriate facility rating in the EMS and log the rating change
- If Security Analysis indicates a contingency trend on a facility in the table above:
- Implement the contingency, and examine the post-contingent MW flow
- Confirm the post-contingency flow and directional rating with the TO

Index of Operating Procedures for Dayton Power and Light Company (DAY)

The Dayton Transmission Zone has no special Operating Procedures for this section of the manual.

	Type of Operating Procedure	Transmission Operations Manual Section Ref
Darby Plant Stability Restriction	Stability	Section 5 DAY
Back To Index		

Darby Plant Stability Restriction

Purpose: To provide Instructions to PJM dispatch, Dayton Power & Light, AEP Generation, and Darby Plant regarding operating restrictions of Darby unit's during a forced or planned outage of either the Atlanta-Stuart 345 kV line or the Beatty-Adkins 345 kV line. The intent is to ensure Darby Transient Stability while the Plant is operating more than two units until transmission network modifications are implemented to address transient stability violation.

PJM and AEP Planning studies confirm that Darby Plant must be limited to two units during a forced or planned outage of either the Atlanta-Stuart 345 kV line or the Beatty-Adkins 345 kV line in order to ensure the Darby Plant is transiently stable.

Procedure for the forced outage scenario. More than two Darby CT's are on-line and either Atlanta-Stuart or Beatty-Adkins 345 kV transmission line trips out-of-service.

1. PJM instructs Darby plant to remove unit(s), so that only two units remain on-line. Restriction is not units specific; hence any two CT's can remain on-line.
2. Darby Plant will determine which unit(s) to trip, and will initiate a controlled shut-down of selected units to occur within 15 minutes.
3. AEP Generation (based on the Plant determination) will notify PJM Generation Dispatch which units are coming off line.

Procedure for the planned outage scenario. Atlanta-Stuart 345 kV line or Beatty-Adkins 345 kV line is scheduled to be out-of-service.

1. AEP or Dayton Power & Light submits a planned outage to PJM, for the Atlanta-Stuart 345 kV line or the Beatty-Adkins 345 kV line.
2. PJM eDART will send out automated notification to AEP Generation (once when outage is received and a second time three days prior to the outage start date) informing them of an outage timeframe.
3. Darby Plant will be limited to two CT's for duration of the outage.
4. PJM OPD and RE will document Darby limitation in eDART and provide the limitation to the Day Ahead Markets.
5. AEP Generation to communicate the restriction to the Darby Plant.

Note 1: Darby Plant can operate without any transient stability restrictions during a forced or planned outage of the Adkins-Atlanta 345 kV transmission line.

Note 2: If a forced or planned outage of the Atlanta-Stuart or the Beatty-Adkins 345 kV transmission line were to coincide with the Atlanta 345/69 kV transformer, Darby Plant can operate without any transient stability restrictions.

Index of Operating Procedures for Dominion Virginia Power (DVP) Company

The Dominion Virginia Power Transmission Zone has Operating Procedures that are adhered to by PJM.

	Type of Operating Procedure	Transmission Operations Manual Section Ref
Clover Generator Shed Scheme	Protection Scheme	Section 5 DVP
Northern Virginia High Voltage Control	Voltage Control	Section 5 DVP
Lexington Area Loss-of-Load Contingency Mitigation Procedure	Contingency	Section 5 DVP
Marsh Run and Remington CT Stability Restrictions	Stability	Section 5 DVP
Bath County Stability Restrictions	Stability	Section 5 DVP
Bath County SPS	Protection Scheme	Section 5 DVP
Carolina Substation 22 Line SPS	Protection Scheme	Section 5 DVP
Carolina Substation 54 Line SPS	Protection Scheme	Section 5 DVP
Dominion Single Breaker Derates	Ratings	Section 5 DVP
Back To Index		

Clover Generator Shed Scheme [SPS]

There are two generating units at Clover connected to three transmission lines (Clover – Briery-Farmville 230 kV line, Clover – Halifax 230 kV line, and Clover – Carson 500 kV line). This GEN SHED (Generator Shed) scheme was installed due to studies showing problems with Clover generator unit stability and line overload problems when there is only one transmission outlet available. The studies are based on a net 441 MW (at the transmission bus) which equates to 465 MW gross output. This assumes a 25 MW station service for each unit.

DVP Actions:

DVP, at PJM's direction, should arm the generation shed scheme as soon as one of the following conditions occurs when both Clover units are on line and the combined net generation of both Clover units is 441 MW or higher.

- One of the three transmission lines into Clover is automatically opened and remains open (either at both ends or at any end).
- If any of the three lines are opened manually (at either end), the GEN SHED scheme should be armed prior to opening the line.

- If the 230 kV breaker 296T2068, or line MOAB switch 29629M opens at Halifax, (automatically or manually), or the Halifax-Person 230 kV line #296 is open at the Progress Energy CP&LE end.
- If the 230 kV breaker 235T298 opens (automatically or manually), or line switch 23539 is open at Farmville, or the Bremo -Farmville 230 kV line #298 is open at any point.

Whenever the generation shed scheme is armed (one line radial or de-energized) and either of the two remaining lines trips, 230 kV circuit breakers ‘G212’ and ‘G2TL9’ will trip and lockout along with the main transformer for unit no.2.

Even with one line radial or de-energized, the generation shed scheme not armed, and one unit on line with a total generation below 441 MW, there is still a chance that the unit may not remain stable if either of the two remaining lines trip.

PJM Actions:

PJM monitors the DVP system and directs the arming/disarming of this scheme per the above listed criteria.

Northern Virginia High Voltage Control

Historically, several 230 kV buses in the Northern Virginia area experience high voltage during the light load periods of the spring and fall seasons. The substations experiencing the problem include but are not limited to the following; Glebe, Glen Carlyn, Ox, Jefferson St., Braddock, Clifton, Arlington.

Following are the recommended steps to lower the high voltage in the area mentioned above:

- Make sure that all distribution capacitor banks are off line unless absolutely necessary.
- Remove all transmission capacitors in the area unless required for the system condition.
- If the above steps do not lower the voltage to a satisfactory level and voltage in the area shows an increasing trend, consider taking the 230 kV Glebe-Ox line #248 underground transmission line out of service. Run contingency analysis in the State Estimator to make sure the outage does not result in any other system contingencies.
- If the voltage still stays high even after taking line #248 out of service, consider taking one of the two parallel 230 kV underground lines from Braddock to Annandale (e.g. line #297). Before the line is outaged, the Northern ROC should be consulted and the 34.5 kV tie breaker T342 at the Annandale substation be closed.
- In order to maintain integrity of the underground transmission line cables, none of the above lines should be taken out on a daily basis and the put back to service. If the load forecast shows that the load will be low for next few days then it is a good idea to keep the lines open for few days also.

PJM Actions:

- PJM dispatcher monitors voltages in the area and should initiate a security analysis study for the appropriate switching.
- If the study indicates no actual or contingency overloads result from the switching, the PJM dispatcher contacts DVP to determine if conditions permit to perform the appropriate switching.
- PJM dispatcher will request DVP to perform the appropriate switching

Lexington Area Loss-of-Load Contingency Mitigation Procedure

This procedure outlines steps to be taken to manage potential loss of load resulting from the normally open position of the Hinton – Fudge Hollow 138 kV and Balcony Falls – Skimmer 115 kV lines. These circuits are operated normally open due to high contingency loading from high West-East and/or South-North transfers and/or operation of pumps at Bath County.

The normally open status of these lines creates the potential for significant loss of load under certain unusual contingency conditions. If the Lexington 500/230 kV transformer #1 is out of service, loss of the Lexington – Cloverdale 500 kV line or the other Lexington 500/230 kV transformer will cause a loss of all 115 kV load fed from Lexington as well as all load on the 230 kV lines from Lexington including the 138 kV load in the Westvaco area. Also, if either Lexington 230/115 kV transformer is out of service, loss of the other transformer will drop all 115 kV load fed from Lexington.

The normally open status of these lines negatively affects stability in the Altavista area. For any extended outage of the Altavista – Halifax 115 kV line, the Balcony Falls – Skimmer 115 kV line should be closed to help maintain adequate support of the Altavista area. AEP should be notified before this line is closed.

DVP Actions:

- If any of the Lexington transformers are scheduled to be out of service, DVP system operators must be aware of the potential for loss of load. Day ahead studies should be run by DVP to determine whether or not the load can be restored quickly and safely. These results should be communicated to PJM.
- DVP system load up to approximately 12000 MW: The Hinton – Fudge Hollow 138 kV and Balcony Falls – Skimmer 115 kV lines may be able to pick up the entire load. It may be beneficial to preemptively close these lines when the potential for loss of load exists.
- DVP system load above 12000 MW: The Hinton – Fudge Hollow 138 kV and Balcony Falls – Skimmer 115 kV lines may not be able to pick up the entire load.

PJM Actions:

- PJM should be aware whenever any of the Lexington transformers are scheduled to be out of service, there is a potential for loss of load in DVP.

- PJM dispatcher should initiate a security analysis study of the appropriate switching to be performed by DVP.
- PJM dispatcher should continue to monitor the situation and assist DVP in any way possible.

Marsh Run and Remington CT Stability Restrictions

This guide is in place to safe guard against system instability based on accepted and established planning standards and criteria.

The restrictions below are from the stability aspect only. Real-time contingency analysis performed by PJM and DVP may place further restrictions/limitations upon plant operation in order to stay within voltage and/or thermal limits.

System instability is a concern when any of the following outages occur in conjunction with the Remington CT-Gainsville 2114 line.

Transmission Facility Out of Service in combination with the Reminton CT-Gainsville 2114	Maximum Number of Remington CTs Allowed	Maximum Number of Marsh Run CTs Allowed
System Normal OR Remington CT-Gainsville 2114	4	3
Marsh Run – Morrisville '2039' 230kV line **OR** Marsh Run – Morrisville '2040' 230kV line	Only two units to be allowed in any combination (two at Remington & none at Marsh Run **OR** two at Marsh Run & none at Remington **OR** one at Remington & one at Marsh Run with at least 30 MVARs out of each unit at the generation terminals)	
Remington CT – Remington '2077 230kV line	3 (see *Note 1*)	3 (see *Note 1*)
Remington CT – Marsh Run '299' 230kV line	2 (see *Note 1*)	3 (see *Note 1*)
Remington – Marsh Run '280' 230kV line	2 (see *Note 1*)	3 (see *Note 1*)
Marsh Run – Morrisville '2039' 230kV line **AND** Marsh Run – Morrisville '2040' 230kV line	None (see *Note 2*)	None (see *Note 2*)

Note 1: No unit should be allowed to absorb any reactive power as seen at the generator terminals. Also, severe thermal overload on the 230/115kV transformer at Remington CT and/or Remington CT – Remington '6' 115kV line may further restrict operation.

Note 2: If the Marsh Run – Morrisville '2039' & '2040' 230kV lines trip simultaneously (e.g. tower failure), with or without a fault, all Marsh Run and Remington CT units would become unstable. DVP System Protection has confirmed that the out-of-step (OOS) protection exists and is in-service (enabled) on both the Marsh Run and Remington units and will trip these units upon detecting instability.

Bath County Stability Restrictions

This guide is in place to safe guard against system instability based on accepted and established planning standards and criteria.

The maximum number of units allowed is the limit to be observed immediately following the listed transmission facility outage(s) in order to be prepared for the next single contingency, should it occur. The limits listed below are with both the Lexington and the Valley series capacitors in service. If any one of the two series capacitors is by-passed for any reason, it is recommended that one less unit should be on line for each mode, combined with the following additional restrictions on allowed number of units:

Pumping mode:

- None of units should operate at more than 460 MW.

Generating mode:

- None of units should operate at more than 480 MW.

Transmission Facility Out of Service	Maximum Number of Pumping Units Allowed	Maximum Number of Generating Units Allowed
None – System Normal	6	6
Bath – Valley 500 kV line (see notes 1 and 2)	2	3
Bath – Lexington 500 kV line(see notes 1 and 3)	4	4
Dooms – Lexington 500 kV line	2	2
Mt. Storm – Valley 500 kV line (3 pumps if Cunningham Generation < 300 MW)	4	6
Mt. Storm – Pruntytown 500 kV line	5	6
Mt. Storm – Doubs 500 kV line	6	6
Doubs – Pleasant View 500kV line	6	6
Mt. Storm – Greenland Gap 500 kV line	6	6
Greenland Gap – Meadowbrook 500kV line	6	6

Transmission Facility Out of Service	Maximum Number of Pumping Units Allowed	Maximum Number of Generating Units Allowed
Valley – Dooms 500 kV line	5	5
Dooms – Cunningham 500 kV line	4	6
Cunningham – Elmont 500 kV line (4 pumps if Cunningham Generation < 300 MW)	6	6
Lexington – Cloverdale 500 kV line (3 pumps if Cunningham Generation < 300MW)	4	5
Loudoun – Morrisville 500kV line	6	6
Jackson's Ferry – Cloverdale 765 kV line	4	6
Jackson's Ferry – Wyoming 765 kV line	6	6
Cloverdale 765/345 kV transformer	5	6
One Cloverdale 500/345 kV transformer	6	6
Both Cloverdale 500/345 kV transformers	4	5
Baker – Broadford 765 kV line	6	6
North Anna – Ladysmith 500kV Line	6	6
Dooms – Cunningham **and** Mt. Storm – Valley 500 kV lines	1	4
Dooms – Cunningham **and** Mt. Storm – Doubs 500 kV lines	4	6
Dooms – Cunningham **and** Mt. Storm – Pruntytown 500 kV lines	4	6
Dooms – Cunningham **and** Mt. Storm – Greenland Gap 500 kV lines	4	6
Dooms – Cunningham **and** Greenland Gap - Meadowbrook 500 kV lines	4	6
Dooms – Cunningham **and** Lexington – Cloverdale 500 kV lines	1	2
Dooms – Cunningham **and** One Cloverdale 500/345 kV transformer	3	5
Dooms – Cunningham **and** Both	1	2

Transmission Facility Out of Service	Maximum Number of Pumping Units Allowed	Maximum Number of Generating Units Allowed
Cloverdale 500/345 kV transformers		
Dooms – Cunningham **and** Cloverdale 765/345 kV transformer	3	5
Dooms – Cunningham **and** Cloverdale – Matt Funk 345 kV lines	4	6
Dooms – Cunningham **and** Cloverdale – Jackson's Ferry 765 kV lines	3	6
Lexington – Cloverdale **and** Mt. Storm – Valley 500 kV lines	1	2
Cunningham – Elmont **and** Mt. Storm – Doubs	6	6
Cunningham – Elmont **and** Cloverdale – Jackson's Ferry 765 kV lines	4	5
Bath – Valley **and** Valley – Dooms 500 kV lines (see notes 1 and 2)	2	3
Bath – Valley **and** Valley – Mt. Storm (see notes 1 and 2).	2	3
Bath – Valley **and** Mt. Storm – Greenland Gap (see notes 1 and 2).	2	3
Bath – Valley **and** Greenland Gap – Meadowbrook (see notes 1 and 2)	2	3
Bath – Valley **and** Lexington – Dooms 500 kV lines (see notes 1 and 2).	0	0
Bath – Lexington **and** Valley – Dooms 500 kV lines (see notes 1 and 3).	0	1
Bath – Lexington **and** Mt. Storm – Valley 500 kV lines (see notes 1 and 3)	1	1
Lexington – Dooms **and** Valley – Dooms 500 kV lines	2	2
Mt. Storm – Valley **and** North Anna – Ladysmith	4	6
Mt Storm – Greenland Gap **and** Doubs – Pleasant View 500kV line	6	6
Greenland Gap – Meadowbrook and	6	6

Transmission Facility Out of Service	Maximum Number of Pumping Units Allowed	Maximum Number of Generating Units Allowed
Doubs – Pleasant View 500kV line		
Greenland Gap – Meadowbrook and Loudoun - Pleasant View 500kV line	6	6
Lexington – Dooms and Loudoun – Pleasant View 500kV line	2	2

The above analysis is based on the maximum unit capability of 505 MW each in generating mode and 485 MW each in pumping mode.

Notes:

1. The Bath County plant will be isolated when one of the two lines out of the plant is out of service (with or without any other outages) and the remaining line trips. The generation protection scheme should be evaluated to make sure units are protected from being damaged due to such an event.
2. An islanding condition may occur for a breaker failure scenario at Lexington substation when the Bath-Valley line is out (with or without any other outages) for a fault on either the Lexington-Cloverdale 500 kV line or the Lexington-Dooms 500 kV line. The Bath County plant will be among the islanded area which would include the following load buses: Buena Vista, Bustleburg DP, Clifton Forge, Covington, Craigsville, Effinger, Fairfield, Glasgow, Goshen, James Lee Rockbridge Westvaco, East Mill. Should the islanding condition occur when Bath County is operating in generating mode, over-speed of Bath County units would occur resulting in over-frequency and likely unacceptable voltages. The amount of over-frequency will depend on the amount of generation/load imbalance in the island when this occurs. The customer equipment in the islanded area may be at risk depending on their sensitivity to the voltage and frequency excursions. Should the islanding condition occur when Bath County is operating in pumping mode, the entire island will be without any generating source (except may be any customer owned generation at Westvaco) and most load in the islanded area would be lost, including the pumping load. In order to eliminate the above stated islanding condition for the breaker failure scenario, it is recommended that the Lexington breaker 555T566 be kept open whenever the Bath-Valley line is out of service. As a long-term solution, installation of a new 500 kV breaker at Lexington would avoid creation of the island for the breaker failure scenario. The limits listed in the above tableare based the Lexington breaker 555T566 being open whenever the Bath-Valley line is out of service.
3. A breaker failure scenario at Valley substation when the Bath-Lexington line is out (with or without any other outages) for a fault on either the Valley-Mt. Storm 500 kV line or the Valley-Dooms 500 kV line would leave Bath County units connected through a single 500-230 kV transformer connection at the Valley substation. This could create thermal overload for the transformer and unacceptable voltage profile depending on how many units are running at Bath County. In order to eliminate this problem, it is recommended that the Valley breaker 549T550 be kept open whenever the Bath-Lexington line is out of service. The limits listed in Table 1 below are based the Valley breaker 549T550 being open whenever the Bath-Lexington line is out of service.

Bath County SPS [SPS]

Background

The Bath County Pump Storage facility consists of 6 pumps/generators located between the Valley and Lexington 500kV substations. Historical operation of the Bath County units in pumping mode has indicated N-1 overloads on the Cloverdale-Lexington 500kV line and the Cloverdale 6A & 6B parallel 500/345kV Transformers, which are in series with the Cloverdale-Lexington 500kV line. To minimize the N-1 overloads, and to allow Bath County to achieve a higher pond level via pumping, a dual redundant Special Protection Scheme (SPS) was developed to trip either one or two Bath County pumps if the actual flows on the Cloverdale 6A/6B Transformers were to exceed their temperature adjusted emergency ratings.

The PJM EMS sends a temperature-dependent ratings index, referred to in this document as the Lexington Index, to the DVP EMS over ICCP. The rating index that PJM sends is directly correlated to the AEP Roanoke (AEPRN) rating set in the PJM EMS. The DVP EMS forwards this Lexington Index to Bath County and to Lexington, where the SPS is physically located. Independently, ratings corresponding to the index, and representing the parallel combination* of the Cloverdale 6A & 6B 500/345 kV transformer ratings, are pre-loaded in the Lexington SPS by substation technicians. When the SPS is armed (for either 1 or 2 pump rejection), the Lexington-Cloverdale 500 kV line MVA flow data is limit checked against the ratings corresponding to the Lexington Index. Trip signals (pump rejection) are sent from Lexington to Bath County if actual overloads exceeding the emergency ratings are detected.

> **As a result of the SPS utilizing the 6A/6B combined transformer ratings, the SPS cannot be armed if either the 6A or 6B transformer is out of service. Refer to the section below titled "SPS Unavailability" for additional restrictions.*

The following table indicates how the AEP Roanoke Temperature index is mapped to provide the Lexington index:

MAP			**Combined ratings of Cloverdale Ts**							
PJM Temp	**PJM**	**Lex.**	**MVA**				**Amps**			
	Index	Index	N	**LTE****	STE	LD	N	**LTE****	STE	LD
95D, 95N	1,2	1	1480	**1718**	1718	1950	1709	**1984**	1984	2252
86D, 86N	3,4	2	1530	**1764**	1764	1950	1767	**2037**	2037	2252
77D, 77N	5,6	3	1582	**1810**	1810	1968	1827	**2090**	2090	2272
68D, 68N	7,8	4	1632	**1858**	1858	1984	1884	**2145**	2145	2291
59D, 59N, 50D, 50N	9,10,11,12	5	1684	**1904**	1904	2000	1945	**2199**	2199	2309
41D, 41N, 32D, 32N	13,14,15,16	6	1786	**1950**	1950	2016	2062	**2252**	2252	2328

**The highlighted column represent the Amp flow at which the SPS will activate when armed. The corresponding MVA flow is also shown in bold.

Operating Procedure:

1.) Prior to the status change (on-line or off-line) of any Generator or Pump at Bath County, the Dominion MOC and AETS will provide at least 20 minutes notice to PJM.

2.) If the PJM, AEP or Dominion Real Time EMS Security Analyses or the PJM, AEP or Dominion EMS Study Security Analysis indicate N-1 overloads on the Cloverdale 6A/6B Transformers approaching 100% of their temperature adjusted Emergency ratings, the PJM Transmission Operator will contact the AEP and Dominion Transmission Operators to confirm flows, limits, and ambient temperatures for the Roanoke area. If needed, the PJM Transmission Operator will update the temperature dependent ratings utilized in the EMS.

3.) PJM, AEP and Dominion Transmission Operators will study arming the Bath County SPS and determine the number of pumps to be tripped to alleviate the N-1 overloads on the Cloverdale 6A/6B transformers.

   a. In a Powerflow study, PJM, AEP and Dominion Transmission Operators will modify the contingency(s) overloading the Cloverdale 6A/6B Transformers to include the SPS activated trip of one or two Bath County pumps<u>. If this analysis indicates the trip of the pump is more adverse to system conditions than allowing the pump to operate, the SPS would not be armed (i.e.) If the pump is actually a help to system conditions, tripping the pump would not be required</u>.

4.) Following agreement from AEP and Dominion, PJM will then direct the Dominion MOC to arm the Bath County SPS to trip either one or two Bath County pumps depending upon the severity of the Cloverdale 6A/6B Transformer overloads as shown in the Powerflow study results. The Dominion MOC operator will verbally confirm activation of the SPS and notify PJM of which Bath County pump(s) will be tripped if the SPS were to be triggered. If the SPS is being armed to allow an additional pump to be brought on-line, PJM will grant permission*** to start the pump at this time.

   ***If the Pump is requested for AETS, PJM will call AETS to grant the pump after the Dominion MOC has confirmed the SPS is armed.

   a. AEP, Dominion, AETS and PJM will receive direct indication, via ICCP link, of the Bath County SPS Status, including which pump(s) are armed to trip. This will be displayed to the PJM Operators on the Bath County EMS one-line display.

5.) PJM will modify the Real Time contingency analysis to include the SPS activated trip of one or two Bath County pumps for any contingency that results in an overload on the Cloverdale 6A/6B Transformers.

   a. PJM will also continue to analyze all N-1 contingencies **WITHOUT** the trip of any Bath County pumps in the Real Time EMS "*Special*" Security Analysis view. This view will be used to determine when the SPS is no longer required and will not trigger due to reduced loading on the Cloverdale 6A/6B transformers. Overloads resulting from this analysis **WILL NOT** be controlled to unless the SPS would not trigger based on reduced Cloverdale 6A/6B transformer loading, resulting in violations to other facilities on the system. PJM will contact the Dominion MOC and direct them to disarm the SPS.

   b. PJM will also continue to analyze all N-1 contingencies **WITHOUT** the trip of any Bath County pumps in the calculation of all Reactive Transfer Limit Interfaces. PJM **WILL** control to these limits.

6.) Should the SPS activate and a pump or pumps trip, the MOC will disarm the SPS to bring the process back to its initial state (i.e. Step #1 above).

Note:

The Bath County SPS can only be armed to trip 1 pump per Bath County 500kV Generator Step-Up [GSU] transformer. Bath County #1 & #2 pumps are fed via the Bath County TR12 GSU. Bath County #3 & #4 pumps are fed via the Bath County TR34 GSU. Bath County #5 & #6 are fed via the Bath County TR56 GSU. As such, for a valid combination of 2 pumps being armed to trip via the Bath County SPS, they must be a combination of units on two distinct GSU transformers. Invalid combinations for a multi-pump trip via the Bath County SPS are any 2 pumps on the same GSU. (i.e., Pump #1 & #2 cannot be armed to trip together via the SPS; Pump #3 & #4 cannot be armed to trip together via the SPS; Pump #5 & #6 cannot be armed to trip together via the SPS.)

SPS Unavailability

If any of the following circumstances should occur, the Bath County SPS should be considered as unavailable and should be disarmed, unless under manual control as noted below:

1.) If either the Cloverdale 6A or 6B 345/500kV transformer is out of service, PJM will direct the Dominion MOC to disarm the SPS.

2.) If the Dominion MOC has any alarms indicating the redundancy of the SPS scheme has been compromised, they will contact PJM. PJM will analyze the system assuming the SPS is unavailable and direct the Dominion MOC to remove Bath County pumps based on this analysis. PJM will then direct the Dominion MOC to disarm the SPS.

3.) If the PJM/DOM ICCP link is down, the Lexington Rating Index will not be sent from PJM to the Dominion EMS or the Bath County SPS. The last Index value sent will be maintained in the SPS. If this value requires change, PJM will direct the Dominion Transmission Operator to manually over-ride the value. Indication of manual over-ride is provided to PJM and the Dominion Transmission Operator and MOC. Restoration of the ICCP link will require removal of the manual over-ride by the Dominion Transmission Operator. An extended outage of the ICCP link may require disabling the SPS.

4.) If the Dominion MOC has an alarm indicating the SCADA link between the Dominion SOC and Lexington is lost, the Lexington Rating Index will remain at the last value received. The Dominion MOC will notify PJM. PJM will direct the Dominion MOC to remove Bath County pumps as necessary and then disarm the SPS.

5.) If any re-rate is required for the Cloverdale 6A/6B transformers, the AEP Transmission Operator will notify the PJM Transmission Operator of the rating change. The PJM Transmission Operator will determine if the Bath SPS will continue to adequately protect the system and may direct the Dominion MOC to disarm the SPS until the new ratings can be coordinated between all parties and loaded into the SPS. (Rating coordination procedure below)

6.) If any re-rate is required for the Cloverdale-Lexington 500kV line, the AEP and/or Dominion Transmission Operator will notify the PJM Transmission Operator of the rating change. The PJM Transmission Operator will determine if the Bath SPS will continue to adequately protect the system and may direct the Dominion MOC to disarm the SPS until the new ratings can be coordinated between all parties and loaded into the SPS. (Rating coordination procedure below)

Ratings Coordination Procedure

To ensure the temperature adjusted thermal limitation of the Cloverdale 6A/6B 500/345kV transformers and the Cloverdale-Lexington 500kV line are properly coordinated with the Bath County SPS, any permanent or temporary changes to the temperature adjusted ratings of these facilities must be coordinated through AEP, Dominion Transmission, Dominion Generation and PJM. The following procedure will be followed:

Cloverdale 6A/6B Transformer ratings changes:

1.) AEP TOPS Engineering submits a ratings change request for the Cloverdale 6A/6B transformers to PJM via TERM (see PJM Manual M-03 Section 2 for additional details). The AEP TOPS Engineer will also send an email notification to PJM (ems_model_update_group@pjm.com), indicating that the TERM ticket has been entered.

2.) PJM Data Management Department and Operations Planning Department will review the change to determine if the Cloverdale 6A/6B transformers will remain more limiting than the Cloverdale-Lexington 500kV line.

   a. If the combined Cloverdale 6A/6B transformer ratings remain more limiting than the Cloverdale – Lexington 500 kV line, PJM Data Management Department will notify Dominion SOC of the change and request the SPS be modified to include the revised ratings.

   b. If the Cloverdale – Lexington 500 kV line will be more limiting than the combined Cloverdale 6A/6B transformer ratings, PJM will notify the Dominion SOC that the line is now the more limiting facility and request that the SPS be modified to trigger at the appropriate, more limiting, line ratings.

3.) Dominion SOC will notify the Dominion MOC and establish a time/date to initiate a relay reset and have substation technicians update the ratings used in the Bath County SPS. Dominion SOC will also coordinate the timing of the change with PJM to ensure a mutually agreed upon time frame.

4.) Dominion SOC will notify PJM and the Dominion MOC when the work is complete.

5.) PJM Data Management Department will notify AEP TOPS Engineering and PJM Transmission Operations that the SPS has been updated and is available for use in Operations.

<u>Cloverdale-Lexington 500kV line derates:</u>

1.) Based upon equipment ownership, either AEP TOPS Engineering or the Dominion SOC submits a ratings change request for the Cloverdale-Lexington 500kV line to PJM via TERM (see PJM Manual M-03 Section 2 for additional details). The submitter of the ratings change will also send an email notification to PJM (ems_model_update_group@pjm.com) indicating that the TERM ticket has been entered.

2.) PJM Data Management Department and Operations Planning Department will review the change to determine if the 500kV line has become more limiting than the combined rating of the Cloverdale 6A/6B transformers.

   a. **<u>If the Cloverdale 6A/6B transformers remain more limiting than the Cloverdale – Lexington 500 kV line, the SPS does not need to modified.</u>**

b. If the line becomes more limiting, PJM will notify the Dominion SOC and request the SPS be modified to trigger at the revised line ratings as opposed to the transformer ratings.

3.) Dominion SOC will notify the Dominion MOC and establish a time/date to initiate a relay reset and have substation technicians update the ratings used in the Bath County SPS. Dominion SOC will also coordinate the timing of the change with PJM to ensure a mutually agreed upon time frame.

4.) Dominion SOC will notify PJM and the Dominion MOC when the work is complete.

5.) PJM Data Management Department will notify AEP TOPS Engineering and PJM Transmission Operations that the SPS has been updated and is available for use in Operations.

Carolina Substation 22 Line SPS [SPS]

[Controlling flows on the Carolina – Kerr Dam (Line 22) 115kV line]

Contingency analysis indicates that a contingency loss (typically the Carolina – Kerr Dam (Line 90) 115kV line) may overload the Carolina - Kerr Dam (Line 22) 115kV line. An SPS (non directional overcurrent relay) has been installed to open 2202 CB at Carolina if the load rating is being exceeded, leaving all Line 22 tapped load fed radially from Kerr Dam Substation.

This SPS has six temperature based set points:

- 95°= 95 MVA
- 86°= 101 MVA
- 77°= 106 MVA
- 68°= 112 MVA
- 59°= 117 MVA
- 41°= 127 MVA

The ‘Normal Status’ for this SPS will be ‘disabled’

DVP Actions:

- DVP will change the status of the SPS per PJM’s directive and will inform PJM once the SPS status has been changed.
- Prior to arming the SPS, DVP should coordinate with PJM about the temperature set point. Any changes to the active temperature set point should be directed by and coordinated through PJM.
- DVP will not change the status of the SPS back to ‘Normal Status’ (disabled) until it has been directed to do so by PJM.

- DVP will inform PJM of any instance where this SPS is unable to operate as intended.

PJM Actions:

- PJM monitors the DVP system and directs the arming/disarming of this scheme per the above listed criteria.
- PJM will coordinate the temperature set point with DVP.
- PJM will log the change from 'Normal Status' for this SPS and activate/de-activate appropriate contingencies in EMS once informed that the change has been made.

Carolina Substation 54 Line SPS [SPS]

[Controlling flows on the Carolina – Earleys (Line 54) 115kV line]

Contingency analysis indicates that a contingency loss (typically the Roanoke Valley NUG - Earleys (Line 2012) 230kV line) may overload the Carolina - Earleys (Line 54) 115kV line. An SPS (non directional overcurrent relay) has been installed to open the 5402 115kV CB at Carolina if the load rating is being exceeded, leaving all Line 54 tapped load fed radially from Earleys Substation. The SPS has six set points at different temperature settings.

The 'Normal Status' for this SPS will be 'disabled'

DVP Actions:

- DVP will change the status of the SPS per PJM's directive and will inform PJM once the SPS status has been changed.
- Prior to arming the SPS, DVP should coordinate with PJM about the temperature set point. Any changes to the active temperature set point should be directed by and coordinated through PJM.
- DVP will not change the status of the SPS back to 'Normal Status' (disabled) until it has been directed to do so by PJM
- DVP will inform PJM of any instance where this SPS is unable to operate as intended.

PJM Actions:

- PJM monitors the DVP system and directs the arming/disarming of this scheme per the above listed criteria.
- PJM will coordinate the temperature set point with DVP.
- PJM will log the change from 'Normal Status' for this SPS and activate/de-activate appropriate contingencies in EMS once informed that the change has been made.

Dominion Single Breaker Ratings

Dominion's single breaker ratings can be found on the OASIS System Information page under the ratings section at the following link:

http://www.pjm.com/markets-and-operations/etools/oasis/system-information.aspx

*Internal groups at Dominion utilize the 100°F temperature set point listed within the Dominion Single Breaker Ratings document that should be ignore by all other users. For further guidance on PJM temperature set points and thermal operating criteria refer to Section 2: Thermal Operating Guidelines.

Index of Operating Procedures for Duke Energy Ohio Kentucky (DEOK) Transmission Zone - (effective 1/1/2012)

The Duke Energy Ohio Kentucky Transmission Zone has Operating Procedures that are adhered to by PJM. These procedures include the following:

Duke Energy Ohio Kentucky (DEOK)	**Type of Operating Procedure**	**Transmission Operations Manual Section Ref**
Dimmick - Port Union 138kV Line Relief Procedure	Switching Option	Section 5 DEOK
Normally open Red Bank CB 920 138kV auto Closing Scheme	Switching Option	Section 5 DEOK
Todd Hunter 345/138kV Transformers Relief Procedures	Switching Option	Section 5 DEOK
Breaker Derate Table Back to Index	Rating	Section 5 DEOK

Dimmick – Port Union 138kV Line

During periods of high load, the Dimmick – Port Union 138kV line can become overloaded in the event of the contingent or actual loss of another facility. (Typically, the loss of the Foster 345/138kV #11 transformer.)

On the Dimmick – Port Union 138kV line, should either the actual flow exceeds its NL rating or the contingency flow exceed its EM rating, load transfer at the Cornell substation may be a feasible method of control. The following ***Cornell Load Transfer*** switching is operable via Supervisory Control:

- CLOSE 138kV N.O. ABS 982 at CORNELL
  - (Ties Dimmick – Port Union 138kV line to the Red Bank – Terminal 138kV line)
- OPEN 138kV ABS 979 @ CORNELL
  - (Breaks the tie and transfers the Cornell BK1, BK3 & BK4 loads from the Dimick – Port Union 138kV line to the Red Bank – Terminal 138kV line)

PJM Actions:

- When conditions warrant, study the Cornell Load Transfer as a potential mitigation strategy for alleviating overloads to the Dimmick – Port Union 138kV line.
- Coordinate study results with the TO.
- Direct switching provided real-time conditions permit and no other SOL are violated during and as a result of the switching.

TO Actions:

- Notify PJM if the Cornell Load Transfer is unavailable for any reason.
- Coordinate mitigation strategy via Cornell Load Transfer under PJM direction.

Normally open Red Bank CB 920 138kV auto Closing Scheme

Under certain light load conditions, generation patterns, and outage conditions Red Bank CB 920 138 kV Auto Closing Scheme could be activated, to alleviate loading on the 138 kV circuits in vicinity of the Red Bank station, by restoring 138/345 kV transformer feed.

The 'Normal Status' of this Auto Closing Scheme will be 'disabled'.

For the Contingency loss of TB 27, Red Bank CB 920 auto closing scheme could be enabled, so that CB 920 is closed after the Red Bank-Terminal 345 kV line is restored and CB 918 is locked out.

For the Contingency loss of TB 28, Red Bank CB 920 auto closing scheme could be enabled, so that CB 920 is closed after the Red Bank-Terminal 345 kV line is restored and CB 922 is locked out.

PJM Actions:

- When conditions warrant, study the Red Bank Auto Closing Scheme as a potential mitigation strategy for alleviating overloads on the 138 kV circuits in vicinity of the Red Bank station.
- Coordinate study results with the TO.
- PJM will log the change from 'Normal Status' for this Auto Closing Scheme and activate/de-activate appropriate contingencies in EMS once informed that the change has been made.

TO Actions:

- When conditions warrant, advise PJM to study the Red Bank Auto Closing Scheme as a potential mitigation strategy for alleviating overloads on the 138 kV circuits in vicinity of the Red Bank station.
- Notify PJM if the Red Bank Reclosing Scheme is unavailable for any reason.
- Coordinate mitigation strategy for the Red Bank Reclosing Scheme under PJM direction.

Todd Hunter 345/138kV Transformers

During periods of high load, the loss of any two Todd Hunter 345/138kV transformers can result in overloads on the transformer remaining in service. System reconfiguration through the creation of radial load pockets on the Todd Hunter 138kV and 69kV systems may become necessary in order to control congestion on the remaining Todd Hunter 345/138kV transformer.

System conditions will dictate whether one or all of the following switching options may be implemented.

Switching Options:

A. Radialize Beckett load
   1. OPEN Todd Hunter 935 and 937 138kV CBs
   2. OPEN Beckett 869 138kV ABS
   3. CLOSE Todd Hunter 935 & 937 138kV CBs

B. Radialize Millikin load
   1. OPEN Todd Hunter 929 and 931 138kV CBs
   2. OPEN Millikin 952 138kV ABS
   3. CLOSE Todd Hunter 929 and 931 138kV CBs

C. Radialize Nickel load
   1. OPEN Warren 872 138kV CB

D. Radialize Clinton County load to AEP's Hillsboro substation
   1. OPEN Warren 873 138kV CB

E. Radialize Trenton area load to AEP's College Corner substation
   1. OPEN Trenton 806 138kV CB

F. Isolate Carlisle 69kV
   1. OPEN Carlisle 952 138kV CB (High-Side of Carlisle 138/69kV #2 transformer)

G. Isolate Shaker Run and Foster area loads
   1. OPEN Shaker Run 824 and 828 138kV CBs
   2. OPEN Foster 961 138kV CB

3. OPEN Foster 967 138kV CB
4. CLOSE Cornell 982 138kV ABS
5. OPEN Cornell 980 138kV ABS
6. OPEN Dimmick 830 138kV ABS

PJM Actions:

- When conditions warrant, study the above switching as a potential mitigation strategy for alleviating overloads on Todd Hunter 345/138kV #15, #16 or #17 transformer.
- Coordinate study results with the TO, any impacted neighboring TO and/or VACAR.
- Direct switching provided real-time conditions permit and no other SOL are violated during and as a result of the switching.

TO Actions:

- Notify PJM if the above switching options are unavailable for any reason.
- Reconfigure load as needed on the 69kV system.

Breaker Derate Table

For certain CB outages which isolate a line on a single CB, DEOK derates the line rating due to the CB limitation which becomes limiting.

PJM needs to ensure line ratings are changed to reflect this single CB limitation when a CB associated with the facility is out-of-service.

Derates for DEOK Breaker Outages by Substation (MVA)					
BKR Outage	**LINE/XFMR**	**Temp. °F**	**NL**	**EM**	**LD**
Foster 345 kV					
‘1343'	Foster-Hillcrest	All	1040	1195	1243
‘1349'	Foster-Hillcrest	95	1144	1315	1367
		86	1144	1315	1367
		77	1144	1315	1367
		68	1144	1315	1367
		59	1144	1315	1367
		50	1456	1673	1740
		41	1456	1673	1740
		32	1456	1673	1740
‘1349'	Foster-Bath	95	1144	1315	1367

Derates for DEOK Breaker Outages by Substation (MVA)					
BKR Outage	**LINE/XFMR**	**Temp. °F**	**NL**	**EM**	**LD**
		86	1144	1315	1367
		77	1144	1315	1367
		68	1144	1315	1367
		59	1144	1315	1367
		50	1456	1673	1740
		41	1456	1673	1740
		32	1456	1673	1740
'1351'	Foster-Bath	All	1040	1195	1243
'1355' or '1357'	Foster-Sugar Creek	All	1040	1195	1243
'1359'	Foster-Pierce	All	1040	1195	1243
Hillcrest 345 kV					
'1425' or '1427'	Foster-Hillcrest	95	1241	1396	1551
		86	1241	1396	1551
		77	1241	1396	1551
		68	1241	1396	1551
		59	1241	1396	1551
		50	1560	1793	1864
		41	1560	1793	1864
		32	1560	1793	1864
Miami Fort 345 kV					
'1401' or '1415'	Miami Fort-Terminal	All	1040	1195	1243
'1405' or '1407'	Miami Fort-West Milton	All	1040	1195	1243
'1407' or '1413'	Miami Fort-Woodsdale	All	1040	1195	1243
Port Union 345 kV					
'1369'	Port Union-Foster	All	1040	1195	1243
'1371' or '1373'	Port Union-Zimmer	All	1040	1195	1243
'1373' or '1375'	Port Union-Terminal	All	1040	1195	1243
Shaker Run 138 kV					
'822' or '828'	Shaker Run-Rockies Express	All	406	430	478
'824' or '828'	Shaker Run-Bethany	95	327	368	409
		86	327	368	409
		77	327	368	409
		68	327	368	409
		59	327	368	409
		50	406	430	478
		41	406	430	478
		32	406	430	478
Terminal 345 kV					

Derates for DEOK Breaker Outages by Substation (MVA)					
BKR Outage	**LINE/XFMR**	**Temp. °F**	**NL**	**EM**	**LD**
‘1301' or '1303'	Terminal-Miami Fort	All	1040	1195	1243
‘1301' or '1307'	Terminal -East Bend	All	1040	1195	1243
‘1303' or '1305'	Terminal-Port Union	All	1040	1195	1243
‘1309' or '1311'	Terminal-Red Bank	All	1040	1195	1243
Todhunter 345 kV					
‘1381' or '1383'	Todhunter-Woodsdale 4561	All	1040	1195	1243
‘1385' or '1387'	Todhunter-Foster	All	1040	1195	1243
‘1389' or '1395'	Todhunter-Woodsdale 4562	All	1040	1195	1243
Todhunter 138 kV					
‘925' or '927'	Todhunter-Rockies Express	All	406	430	478
Woodsdale 345 kV					
‘1505' or '1507'	Woodsdale-Miami Fort	All	1040	1195	1243
‘1511' or '1513'	Todhunter-Woodsdale 4562	All	1040	1195	1243
‘1517' or '1519'	Todhunter-Woodsdale 4561	All	1040	1195	1243
‘1519' or '1521'	Woodsdale-Madison	All	1040	1195	1243

Index of Operating Procedures for Duquesne Light Company (DLCO)

The Duquesne Light Company (DLCO) Transmission Zone has Operating Procedures that are adhered to by PJM.

Duquesne Light Company (DLCO)	Type of Operating Procedure	Transmission Operations Manual Section Ref
DLCO Single Breaker Derates	Ratings	Section 5 DLCO
Crescent TR1 345/138kV Autotransformer Relief Procedure	Switching Options	Section 5 DLCO
DLCO Common Trench Cable Ratings	Cable Ratings	Section 5 DLCO
Back To Index		

DLCO Single Breaker Derates

For certain CB outages which isolate a line on a single CB, DLCO derates the line rating due to the CB limitation which becomes limiting.

PJM needs to ensure line ratings are changed to reflect this single CB limitation when a CB associated with the facility is out-of-service.

Derates for DLCO Breaker Outages by Substation (MVA)						
BKR	**LINE/XFMR**	**Temp °F**	**NL**	**LT**	**ST**	**LD**
Beaver Valley						
‘312-3’ or ‘312-4’	Beaver Valley – Sammis [FE] ‘312’ 345kV	All	1195	1195	1195	1231
‘314-3’ or ‘314-4’	Beaver Valley – Clinton ‘314’ 345kV	All	1195	1195	1195	1231
‘318-3’ or ‘318-4’	Beaver Valley – Crescent ‘318’ 345kV	All	1195	1195	1195	1231
Cheswick						
‘LF53-4’	Cheswick – Logans Ferry ‘Z-53’ 138kV	All	359	382	382	394

Derates for DLCO Breaker Outages by Substation (MVA)						
BKR	**LINE/XFMR**	**Temp °F**	**NL**	**LT**	**ST**	**LD**
Collier						
‘315’ or ‘325’	Clinton – Collier ‘324’ 345kV	All	1195	1195	1195	1231
‘314’ or ‘324’	Collier – Tidd [AEP] ‘301’ 345kV	All	1195	1195	1195	1231
Crescent						
‘BEAV1DUQ’ or ‘BEAV2DUQ’	Beaver Valley – Crescent ‘318’ 345kV	All	1195	1195	1195	1231
‘MANSFIE1’ or ‘MANSFIE2’	Crescent – Mansfield [FE] ‘315’ 345kV	All	1195	1195	1195	1231

Crescent TR1 345/138kV Autotransformer Relief Procedure

The Crescent – Mansfield[FE] ‘315’ 345kV circuit No. 1 Bus section breaker at Crescent (the ‘MANSFIE1’ 345kV CB in the PJM EMS) can be opened to relieve the Crescent No. 1 345/138 kV autotransformer for the loss of the Crescent No. 2 345/138 kV autotransformer. This switching can be performed on either a pre-contingency or post-contingency basis.

NOTE: Opening the ‘MANSFIE1’ 345kV CB at Crescent causes a derate to be applied on the Crescent-Mansfield [FE] ‘315’ 345kV line as per the DLCO Single Breaker Derate operating procedure.

DLCO Common Trench Cable Ratings

The Arsenal-Brunot Island (305 & 306) 345kV circuits are underground cables that share a common trench. The rating of these circuits is based on the total heating in the trench and the operation of a forced cooling system. The forced cooling system was designed such that the combined continuous rating of the 305 and 306 circuits would not decrease for the loss of either circuit. To achieve this design requirement, the total heat in the system must be controlled such that no thermal limits would be exceeded during the transition from two parallel circuits to a single forced cooled circuit. This heat threshold may reduce the individual forced cooled emergency and load dump ratings with both 305 and 306 circuits in-service below their static emergency and load dump ratings. Ratings are provided for the operating conditions of the 305 and 306 circuits.

MVA Ratings for the Arsenal-Brunot Island (305) 345kV circuit

	Temperatures	Static		Cooled	
		305 & 306 in-service	306 out of service	305 & 306 in-service	306 out of service*
Normal	All	377	377	418	837
Emergency	All	596	596	523	837
Load Dump	All	993	993	693	862

* The 305 circuit should be operated to these ratings for the contingency of the 306 circuit

MVA Ratings for the Arsenal-Brunot Island (306) 345kV circuit

	Temperatures	Static		Cooled	
		305 & 306 in-service	305 out of service	305 & 306 in-service	305 out of service*
Normal	All	377	377	418	837
Emergency	All	596	596	523	837
Load Dump	All	993	993	693	862

* The 306 circuit should be operated to these ratings for the contingency of the 305 circuit

Index of Operating Procedures for Eastern Kentucky Power Cooperative (EKPC)

The EKPC Transmission Zone has no special Operating Procedures for this section of the manual (applicable upon Integration on 6/1/13).

Index of Operating Procedures for First Energy - West (ATSI)

The First Energy - West (ATSI) Transmission Zone has Operating Procedures that are adhered to by PJM.

First Energy - West (ATSI)	Type of Operating Procedure	Transmission Operations Manual Section Ref
Mansfield Unit Stability Restrictions	Stability	Section 5 FE-ATSI
Back To Index		

Mansfield Unit Stability Restrictions (WCC-EOP-114)

This guide is in place to safe guard against system instability which can take place during certain abnormal system configurations at the Mansfield substation.

Whenever a Mansfield generating unit is connected to only one transmission line or connected to a bus that is connected to only one transmission line, the following steps shall be performed:

PJM Actions:

- Confirm Mansfield abnormal substation configuration with the TO.
- Direct the GO to promptly reduce the power output to the two boiler feed pump [2-BFP] minimum load on the specific generator(s) affected by the abnormal substation configuration.
- Coordinate Mansfield bus restoration steps with TO.
- Once the affected generator(s) are no longer connected to only one transmission line or connected to a bus connected to only one transmission line, direct the GO to resume following PJM dispatch.

TO Actions:

- Confirm Mansfield abnormal substation configuration with PJM.
- Coordinate Mansfield bus restoration steps with PJM.
- Notify PJM when Mansfield has returned to normal substation configuration and the affected Mansfield unit(s) are no longer required to remain at 2-BFP minimum load.

NOTE: For scheduled work that would result in any Mansfield generating unit(s) to be connected to only one transmission line or connected to a bus that is connected to only one transmission line, the affected Mansfield generating unit(s) should be reduced to *2-BFP* minimum load PRIOR to permission to proceed with switching.

Index of Operating Procedures for First Energy-East (JC, PN, ME)

The First Energy- East Transmission Zones has Operating Procedures that are adhered to by PJM.

First Energy-East	Type of Operating Procedure	Transmission Operations Manual Section Ref
Neptune Regional Transmission System	Ratings	Section 5 FE-JC
PJM/NY-ISO Transfers	Actuals / Contingencies	Section 5 FE-PN
FE East / AP Tie Lines	Actuals / Contingencies	Section 5 FE-PN
Warren - Falconer 115kV Relay	Special Purpose Relay	Section 5 FE-PN
East Sayre – North Waverly 115 kV Relay	Special Purpose Relay	Section 5 FE-PN
Yards Creek – 230kV Relay (Pumping)	Special Purpose Relay	Section 5 FE-JC
PSE&G Artificial Island Stability	Stability	Section 5 PSE&G
Conemaugh/Hunterstown Stability Limits	Stability	Section 5 FE-PN
Conemaugh #2 Stability Trip	Stability Trip Scheme	Section 5 FE-PN
Keystone - Conemaugh 5003 Re-Close	Stability	Section 5 FE-PN
Homer City #2 & #3 Stability Trip	Stability Trip Scheme	Section 5 FE-PN
Homer City Stability Limits	Stability	Section 5 FE-PN
Seneca Stability	Stability	Section 5 FE-PN
Seneca Pumping	Pumping	Section 5 FE-PN
Back To Index		

Neptune Regional Transmission System (NRTS)

The Neptune Regional Transmission System is a merchant transmission system intererconnecting two regional control areas, PJM and NYISO. NRTS is suitable for contract deliveries across the interconnection because the System's HVDC technology allows for specific and constant power transfer levels and changes to that level be "set" in terms of magnitude and time by the Neptune RTS operator, as directed by the PJM dispatcher.

The NRTS is a monopolar, 500 kV, high voltage direct current interconnection consisting of two converter stations:

- The western terminus, the Sayreville Converter Station, interconnects PJM at the Raritan River Substation.
- The eastern terminus, the Duffy Ave. Converter Station, interconnects NYISO at the Newbridge Road Substation.

The NRTS has a nameplate power transfer capability of 600 MW, a continuous power transfer capability of 660 MW, a minimum power flow of 60 MW and an 4-hour overload capability of 750 MW measured at the Newbridge Road 138 kV point of interconnection for power flow into Long Island and measured at the Raritan River Substation for those instances when the NYISO directs the LIPA System Operator to provide emergency power into PJM.

This operating guide is intended to provide system operators with guidelines to determine appropriate operations on the NRTS. For the detailed Common Operating Instructions, refer to the Neptune Common Operating Instructions (Neptune COI). Currently, the Neptune COI addresses import operation from the PJM system. At the time that export operation is desired, the Neptune COI will be amended. However, upon the direction of both ISO's exporting in emergency conditions is permissible.

PJM's Operating Jurisdiction

PJM is the regional Control Area designated with operational control authority over the Neptune Regional Transmission System (NRTS). The PJM dispatcher is responsible for PJM system security, coordinating power transfers across NRTS with NYISO, and issuing dispatch orders to the NRTS operator. This includes normal, abnormal, emergency response and equipment removal and restoration operations. PJM will also process NRTS derates, planned outage requests and coordinate them with NYISO.

In the event of an emergency, the TLR process should be followed for reducing flow on the DC circuit.

Equipment Limits

Line Limits

Neptune RTS Load Limits								
TRANSMISSION LINE		Normal		Long Term Emergency		Short Term Emergency		NOTE
		Continuous		4 Hours		15 Minutes		
		S	W	S	W	S	W	
NRTS-RARITAN RIVER 230 KV LINE	Import MW	660	660	750	750	n/a	n/a	1
	Export MW	685	685	785	785	n/a	n/a	1
345-501 Line	Import MW	660	660	750	750	n/a	n/a	1
	Export MW	685	685	785	785	n/a	n/a	1

Notes: 1.Import at Point(s) of Delivery, Newbridge Road Substation
2. Limiting element is either converter station

Transformer Limits at Newbridge Road Station

The following refers to transformer capacity only, not line ratings.

LIPA Transformer Load Limits				
Number of Autotransformers in service	Cooling Systems in service			Unit
	2	1	0	
2	900	720	540	MVA
1	450	360	270	MVA

Notes: 1. Ammeter Scale Limit is 700 Amperes (AMP).
2. Amperes (AMP) is calculated at indicated kV.
3. Megavolt-Ampere (MVA) is calculated at indicated kV.

Voltage Limits

VOLTAGE REGULATION	Weekdays, 0630 to 2230 Hours	Weekends, Holidays, 0630 to 2230 hours
Nominal	230 kV	230 kV
Normal	235 kV	233 kV
Light	233 kV	233 kV
Heavy	236 kV	

Newbridge Road 138 kV Bus		
VOLTAGE REGULATION	**Heavy Load Period 0700 to 2200 Hours Monday through Saturday except holidays**	**Light Load Period Other Hours**
Nominal	138kV	138 kV
Maximum Limit	144.9kV	144.9 kV
Minimum Limit	135.24kV	135.24 kV

PJM/NY-ISO Transfers

NY-ISO and PJM agree that the 115 kV facilities (North Waverly-East Sayre, Warren-Falconer, and Tiffany-Goudey) may be opened if the facility is an actual or post-contingency limit on the PJM RTO or NY-ISO operation. The North Waverly-East Sayre 115 kV line is equipped with an overcurrent relay with a trip setting of 128 MVA. The Warren-Falconer 115 kV line is also equipped with an overcurrent relay with trip settings for summer and winter of 116 MVA and 136.4 MVA, respectively. These relays are described later in this section.

PJM Actions:

- PJM dispatcher initiates a study for the appropriate switching.
- If the study indicates no actual or contingency overloads result from opening the tie, PJM dispatcher contacts First Energy and NY-ISO to determine if conditions permit the opening of the proposed facilities.
- If agreed by all PJM Members (PJM, First Energy, and NY-ISO), PJM dispatcher instructs FIRST ENERGY to open the appropriate facilities.
- PJM dispatcher logs the PJM-NY-ISO net tie flow in order to get an indication of the PJM-NY-ISO transfers so that reclosure conditions can be determined.
- Based on local security reasons, PJM dispatcher initiates the reclosure of these lines at the request of FIRST ENERGY or NY-ISO.

- PJM dispatcher initiates the reclosure of these lines as soon as practical after transfers between the PJM RTO and NY-ISO decline below the value noted in Step 4.

FE East/AP Tie Lines

FE procedures exist to control thermal contingencies that occur on the AP 138/115 kV tie lines. The following facilities may be opened if they impose an actual or post-contingency limit on PJM operation:

First Energy East/AP Tie Line	Voltage
Carroll – Germantown	138 kV
Grand Pt. – Roxbury	138/115 kV
Garrett – Tap	138/115 kV
Social Hall – E. Blairsville	138 kV
Burma – Piney	115 kV

Exhibit 8: First Energy East/AP Tie Lines

PJM Actions:

- PJM dispatcher initiates a security analysis study for the appropriate switching.
- If the study indicates no actual or contingency overloads result from opening the tie, PJM dispatcher contacts First Energy East and AP to determine if conditions permit the opening of the proposed facilities. (Note: The AP and First Energy 138 kV and 115 kV systems are modeled, but not necessarily monitored, by PJM.)
- If agreed by all PJM Members (PJM, First Energy, and AP), PJM dispatcher instructs First Energy to open the appropriate facilities.
- PJM dispatcher uses a power flow analysis as an indication for reclosure.
- Based on local security reasons, PJM dispatcher initiates the reclosure of these lines at the request of First Energy or AP.
- PJM dispatcher initiates the reclosure of these lines to service when a power flow analysis indicates
-

Warren-Falconer 115 kV Relay [SPS]

The Warren-Falconer 115 kV line employs definite time overcurrent relays (primary and back up) to trip the line on overload. This relay scheme will trip for flow in either direction. The relay is set to operate if the flow on any phase exceeds the ratings as follows:

Relay Set Point	Period of the Year
116 MVA Short-Term Emergency	On or about May 1 through October 31
136.4 MVA Short-Term Emergency	On or about November 1 through April 30

Exhibit 9: Warren-Falconer 115 kV Relay Set Points

Whenever there is a contingency overload on the Warren-Falconer 115 kV line for the loss of some other facility (such as the Erie South-Erie East 230 kV line or the Erie East-South Ripley 230 kV line), the multiple contingency (loss of Warren-Falconer 115 kV and the other facility) is added to PJM security analysis program's contingency list. Both single contingencies (loss of Erie South-Erie East 230 kV line and the Erie East-South Ripley 230 kV line) are suppressed. PJM dispatcher should also continue to monitor and perform studies on the single contingency losses (Erie South-Erie East and the Erie East-South Ripley) to ensure system reliability while the relay is being employed.

For line overloads of the Warren - Falconer 115kV WF line, the Falconer 115kV CB @ Warren is normally opened by the FE SD. A study shall be performed prior to opening 115kv Falconer CB @ Warren to ensure system reliably.

East Sayre – North Waverly 115 kV Relay [SPS]

The North Waverly-East Sayre 115 kV line employs definite time overcurrent relays (primary & backup). The relays trip the circuit breaker at East Sayre when primary current flow on any phase exceeds 128 MVA at nominal voltage for 20 seconds. This relay scheme is valid for flow in either direction.

Whenever there is a contingency overload on the North Waverly-East Sayre 115 kV line for the loss of some other facility (such as Hillside-East Towanda 230 kV line), the multiple contingency (loss of North Waverly-East Sayre 115 kV line and the other facility) in PJM security analysis program's contingency list. The single contingency (loss of Hillside-East Towanda 230 kV line) is suppressed.

Yards Creek – 230kV Relay (Pumping) [SPS]

This overcurrent relay installed at Kittatinny operates as follows:

- When the actual flow on the Portland-Kittatinny V1010 230 kV line exceeds 1195 MVA for 60 seconds, the No. 2 pump is dropped.
- If the flow still exceeds 1195MVA for another 60 seconds (120 seconds from the initial overload), then the No. 3 pump is dropped, and if the flow still exceeds 1195MVA for yet another 60 seconds (180 seconds from the initial overload), the No. 1 pump is dropped.

This scheme is designed so that each pump is dropped at a specific time from the initial overload as follows:

- No. 1 pump - 180 seconds
- No. 2 pump - 60 seconds

- No. 3 pump - 120 seconds

PJM dispatcher must be aware that FE (East) randomly loads these pumps so that, under the worst condition, the line flow exceeds 1195 MVA and the No. 1 pump is operating; it takes 180 seconds for the pump to be dropped. This tripping scheme reduces the loading on the Portland-Kittatinny 230 kV line by 60 MW to 200 MW, depending on the number of units pumping and the specific contingency involved.

During the Yards Creek pumping periods, PJM dispatcher uses the following manual monitoring procedure to determine the limit to be used on the Portland-Kittatinny 230 kV circuit:

- Obtain generator distribution factors for the Yards Creek generation on the particular contingency involved.
- Multiply the generator distribution factor from #1 by 140 MW, which is the Yards Creek pumping load.
- Multiply the product from #2 by the number of Yards Creek units pumping at the time.
- Subtract the product in #3 from the contingency flow. This produces the "corrected" contingency flow (pump load removed).
- Compare the result from #4 with the Emergency (STE) rating. Corrective off-cost operation is taken if this flow exceeds the STE limit.

The following is an example of the manual monitoring procedure:

Assume that the contingency is the loss of the Portland-Greystone 230 kV line on the Portland-Kittatinny 230 kV line and there are three Yards Creek units pumping. The procedure is as follows:

GEN DFACTS effect of Yards Creek on the contingency is 0.422.

Multiply:

$$(Pump\ Load)*(GEN\ DFACT)=(140\ MW)*(0.422)$$

$$(140\ MW)*(0.422)=59\ MW$$

Multiply:

$$(Product\ of\ (b))*(Number\ of\ Pumps)=(59\ MW)*(3)$$

$$(59MW)*(3)=177\ MW$$

Subtract:

$$(\text{Contingency Flow from On-line Programs})-(\text{Product of (c)})$$

$$\text{Assume Contingency Flow equals 800 MW; therefore:}$$

$$\text{"Corrected" Contingency Flow} = 800\ \text{MW} - 177\ \text{MW} = 623\ \text{MW}$$

Compare result from #4 of 623 MW with four-hour rating of 1195 MW.

Note: In this case, the "corrected" contingency flow of 623 MW is below the four-hour rating of 1195 MW; therefore, no corrective action is needed. For this example, off-cost operation is required to keep the contingency flow on the Portland-Kittatinny line below 1195 MW winter (1018 MW + 177 MW) provided no other actual or contingency flow is more limiting.

Conemaugh/Hunterstown Stability Limits

In October of 2010, PJM Planning, in coordination with FirstEnergy Planning, completed an updated stability analysis to determine MW output restrictions to the Conemaugh #1, #2 and Hunterstown Combined Cycle units under various transmission outages and generation patterns.

PJM Actions:

- During an outage of any facility listed in the table below, PJM will direct NRG to reduce the generation output at Conemaugh and Hunterstown to maintain the stability restrictions listed.

	All Hunterstown CTs & Steam on-line		Hunterstown Steam + 2 CT on-line		Hunterstown Steam +1 CT on-line		Hunterstown CC off-line	
Outage Scenario	**Cone.**	**Hunt.**	**Cone.**	**Hunt.**	**Cone.**	**Hunt.**	**Cone.**	**Hunt.**
Keystone – Conemaugh 5003	**1437**	**895**(2)	**1437**	**597**(5)	**1456**	**298**	**1418**	**0**
Conemaugh – Juniata 5005 (1)	**1518**	**895**	**1518**	**597**	**1506**	**298**	**1462**	**0**
Conemaugh – Hunterstown 5006	**1568**	**711**	**1568**	**597**	**1562**	**298**	**1587**	**0**
Hunterstown – Conastone 5013	**1700**(3)	**660**	**1700**	**597**	**1700**	**298**	**1700**	**0**
5013 + Hunterstown 500/230kV XFMR	**850**(4)	**895**	**1312**	**597**	**1556**	**298**	**1625**	**0**

*(1): Limitation when Conemaugh Unit #2 SPS is **NOT** enabled. When Conemaugh Unit #2 SPS is in-service, there are no stability limitations See below for more detail.*
(2): Maximum winter net output of Hunterstown.
(3): Maximum net output of Conemaugh.
(4): One of the Conemaugh units should be turned off.
*(5): 597 = 183*2 (CTs) + 346*2/3 (ST,) ST output is proportionally reduced.*

Conemaugh #2 Stability Trip [SPS] (Conemaugh – Juniata '5005' 500kV Line Outage)

Note: In order for a stability trip scheme to function properly, Conemaugh #4 and #5 500 kV circuit breakers must be open and isolated. If line jumpers are opened and breakers #4 and #5 are closed to restore buses at Conemaugh, the stability trip scheme is defeated.

A stability trip scheme is available at Conemaugh, which allows full plant output at Conemaugh and Hunterstown during an outage of the 5005 Juniata-Conemaugh 500 kV line. The stability trip scheme operates to trip the Conemaugh #2 Unit upon the loss of the Keystone-Conemaugh (5003) 500 kV line, eliminating the transient instability for the Conemaugh and Hunterstown Units. Under normal system conditions and following a pre-evaluation of the 5005 Conemaugh-Juniata 500 kV line outage, the scheme is enabled at the direction of PJM dispatcher. Prior to enabling the SPS NRG should be consulted to determine if reducing the units uneconomically is the preferred solution.

The stability trip scheme is not enabled under the following conditions:

- Either the Conemaugh #4 or #5 500 kV circuit breakers are closed.
- Upon the trip of the 5005 Conemaugh-Juniata 500 kV line, until system conditions can be studied by operations personnel.
- When the PJM RTO is determined to be capacity limited.
- The trip scheme is disabled prior to implementing a Maximum Emergency Generation Action, but re-enabled prior to implementing a Manual Load Dump Action.
- When system conditions warrant the reduction of Conemaugh generation below the MW levels in the table above due to:
    - economics
    - reactive/thermal constraints
    - plant maintenance

PJM Actions:

- PJM dispatcher directs NRG to have the Conemaugh plant enable/disable the stability trip scheme based on system conditions outlined above.
- PJM dispatcher verifies that Conemaugh #4 and #5 500 kV circuit breakers are open and isolated.
- PJM dispatcher records the stability trip scheme status on the daily log sheet.
- PJM dispatcher updates PJM SA to reflect change in status of the stability trip scheme.
- PJM dispatcher informs all Local Control Centers via the ALL-CALL of a change in status of the stability trip scheme.

Keystone-Conemaugh 5003 Re-Close

Keystone-Conemaugh (5003) line will normally be operated with the recloser “in service” on #3 CB at Conemaugh. This will allow re-closing with a sync-check angle set at 10° or less. The logic will also automatically allow closing at 60° or less if both Conemaugh units are off-line (there are B contacts in the Gen. Isolating Disconnect Switches). If one or both of the Conemaugh units are on and the phase angle is greater than 10°, but less than 25°, a manual breaker close can be performed from the Conemaugh Plant Control Room or from the EMS after operating a defeat switch which disables the PLU scheme. Once the PLU defeat switch has been operated, the Control Room operator has a (2) minute time window to manually close the circuit breaker and parallel the 5003 line at Conemaugh. Prior to reclosing the line and operating the PLU defeat switch, NRG desires the phase angle to be reduced to as close to 0 degrees as possible. This may be achieved by manually lowering Keystone Generation and manually raising Conemaugh Generation. PJM will evaluate the projected phase angle using the PJM EMS Study mode and communicate the results to NRG and First Energy. The cost of manual dispatch directives to reduce phase angle will be borne by NRG and will not set LMP.

Note: Power Load Unbalance relay is designed to rapidly reduce steam pressure when unbalance exists between unit steam pressure and electrical output.

In the event 5003 Keystone-Conemaugh line trips, the combined output of Conemaugh units #1 & #2 should immediately be reduced to 1570 MW's for stability reasons (see Section 3: Voltage and Stability Operating Guidelines) and proceed as follows:

- If the Keystone terminal remains open, follow established procedures to determine cause of trip, correct problem and test the line from Keystone.
- If Conemaugh terminal remains closed, with the Keystone terminal open, de-energize the Conemaugh terminal, and follow established procedures to determine cause of trip, correct problem and try-back line from Keystone (5003 line right-of way is Keystone).Once the 5003 Keystone-Conemaugh line has been tested and remains energized from Keystone, or if the Keystone terminal successfully recloses, the Conemaugh terminal should not be closed to parallel the line until all reasonable actions have been taken to reduce the angle across the open CB at Conemaugh to between -20 degrees to +25 degrees. In extreme emergency system conditions, it would be acceptable to increase the closing angle to -25 and +30 degrees resulting in very slight fatigue damage to the shaft systems.
- NRG may desire the phase angle to be reduced to as close to 0 degrees as possible by manually lowering Keystone Generation and manually raising Conemaugh Generation. PJM will evaluate the projected phase angle using the PJM EMS Study mode and communicate the results to NRG and First-Energy (FE). The cost of manual dispatch directives to reduce phase angle will be borne by NRG and will not set LMP.
- PJM and the FE Reading Transmission System Operator should determine the phase angle across the open breaker at Conemaugh. FE Reading EMS telemeters the phase angle to the TSO. PJM EMS displays the 5003 phase angle across the open # 3 CB at Conemaugh.

Homer City #2 & #3 Stability Trip [SPS]

Homer City Unit #2 Unit Stability Trip Scheme

During an outage of the Homer City "301" or "303" 345kV CBs, a subsequent trip of the remaining "301" or "303" CB would isolate the Homer City #2 Unit on the Homer City-Handsome Lake-Wayne 345kV line, resulting in unit instability.

To enable the Homer City #2 Unit to operate at full load without stability concerns during an outage of the "301" CB, a Unit Stability Trip Scheme has been installed to trip the Homer City #2 unit should the "303" CB open.

The Unit Stability Trip Scheme is also designed to trip the Homer City #2 Unit during an outage of the "303" CB, should the "301" CB open. The operational mode is determined via a selector switch in the Homer City control room.

Note: In 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 (CB 211 and/or Circuit Switcher 44) is open and all 345 KV breakers are closed, then CB 307 is to be opened. This will prevent the possibility of a stuck CB 307 (which is not a part of the stability trip scheme) initiating an unstable condition on Unit 2 and/or Unit 3.

PJM Actions:

- Prior to an outage of the 301 or 303 345kV CB, PJM will direct EMMT to have Homer City arm the Unit Stability Trip Scheme.
- PJM will notify NYISO when the Stability Trip Scheme is enabled/disabled.
- Modify the EMS contingencies as follows if the 301 CB is open:
  - Deactivate the contingency, "Homer City South Auto 345/230kV Transformer".
  - Activate the contingency, "Homer City South Auto 345/230kV transformer and the Homer City Unit #2".
- Modify the EMS contingencies as follows if the 303 CB is open:
  - Deactivate the contingency, "Homer City North Auto 345/230kV Transformer".
  - Activate the contingency, "Homer City North Auto 345/230kV transformer and the Homer City Unit #2".

Homer City Unit #3 Unit Stability Trip Scheme

During an outage of the Homer City "304" or "306" 345kV CBs, a subsequent trip of the remaining "304" or "306" CB would isolate the Homer City #3 Unit on the Homer City-Stolle Road 345kV line, resulting in unit instability.

To enable the Homer City #3 Unit to operate at full load without stability concerns during an outage of the "304" CB, a Unit Stability Trip Scheme has been installed to trip the Homer City #3 unit should the "306" CB open.

The Unit Stability Trip Scheme is also designed to trip the Homer City #3 Unit during an outage of the “306” CB, should the “304” CB open. The operational mode is determined via a selector switch in the Homer City control room.

PJM Actions:

- Prior to an outage of the 304 or 306 345kV CB, PJM will direct EMMT to have Homer City arm the Unit Stability Trip Scheme.
- PJM will notify NYISO when the Stability Trip Scheme is enabled/disabled.
- Modify the EMS contingencies as follows if the 304 CB is open:
  - Deactivate the contingency, “Homer City South Auto 345/230kV Transformer”
  - Activate the contingency, “Homer City South Auto 345/230kV transformer and the Homer City Unit #3”.
- Modify the EMS contingencies as follows if the 306 CB is open:
  - Deactivate the contingency, “Homer City North Auto 345/230kV Transformer”
  - Activate the contingency, “Homer City North Auto 345/230kV transformer and the Homer City Unit #3”.

Homer City Stability Limits

In January of 2011, PJM Planning, in coordination with FirstEnergy Planning, completed an updated stability analysis to determine net MW output restrictions Homer City #1, #2 & #3 units under various transmission outages and generation patterns.

PJM Actions:

- During an outage of any facility listed in the table below, PJM will direct EMMT to reduce the generation (all values within table are net MW) output at Homer City to maintain the stability restrictions listed.

Outage Scenario	All Homer City Units on-line	Homer City #1 off-line		Homer City #2 off-line		Homer City #3 off-line	
	Combined Max	Max #2	Max #3	Max #1	Max #3	Max #1	Max #2
Homer City – Handsome Lake 345kV line	**1590** *(a)* **1570** *(b)*	**680**	708	688	708	688	688
Homer City – Handsome Lake 345kV line AND Homer City – Watercure 345kV line	**1350** *(c)*	**620**	**530**	**620**	**580**	**620**	**570**
Homer City 345/230kV Transformer North Auto OR South Auto Outage	**688 on HC#1** **1288 on HC#2 & HC#3 combined**	**1288 on HC #2 & HC #3 combined**		**688**	708	688	688
Homer City – Stolle Rd 345kV line	**1855**	688	708	688	708	688	688
Homer City – Watercure 345kV line OR Homer City – Shelocta – Keystone 230kV line	**1860**	688	708	688	708	688	688

***(a)**: 1590 Net Maximum combined output where Homer City #1 >= 530 MW, Homer City #2 >= 300 MW & Homer City #3 >= 300 MW.*
***(b)**: 1570 Net Maximum combined output where 530 MW > Homer City #1 >= 300 MW, Homer City #2 >= 300MW & Homer City #3 >= 300 MW.*
***(c)**: 1350 Net Maximum combined output where Homer City #1 >= 400 MW, Homer City #2 >= 300 MW & Homer City #3 >= 300 MW.*

Seneca Stability

Purpose: The following Seneca plant operating guidelines provide instructions to PJM dispatch, FE Transmission, FE Solutions, and Seneca Plant regarding operating restrictions to ensure Seneca Transient Stability is maintained while Seneca is operating two pumps until transmission network modifications can occur to address PJM transient stability violation.

PJM and FE Planning studies confirm that Glade “B42” circuit breaker (CB on a Glade ring bus, located between Seneca and Forest 230 kV lines) must be switched open for Seneca to operate 2 pumps simultaneously in order to ensure the Seneca Plant is transiently stable. Additional network modifications will be required to permit Glade "B42" circuit breaker to be closed, while Seneca is operating two pumps.

Procedure for approving Seneca to operate the second pump:

Whenever FE Solutions requests PJM to grant permission for Seneca to operate the second pump, PJM and FE Dispatch will discuss EMS study analysis results. If analysis results support operations of second Seneca pump and:

Glade "B42" CB switching is available

1. PJM instructs FE transmission to open Glade "B42" circuit breaker prior to Seneca commencing operation on the second pump.
2. PJM instructs FE-East Transmission to maximize Seneca Lagging MVAR in such a fashion that Seneca 230 kV bus voltage is maintained above 1.008 pu (231.84 kV), while ensuring voltage limits are not violated during the operation of the second Seneca pump.
3. PJM instructs FE-East Transmission to place Glade capacitor into service as system conditions permit, ensuring voltage limits are not violated.

Glade "B42" CB switching is unavailable: Any Three Shawville units are required to be on-line to permit a 2nd. Seneca pump to be placed into service. FE-East Transmission should provide as much notice as possible when "B42" CB switching is unavailable based on Shawville notification and start-up timing requirements.

1. PJM instructs FE Solutions to initiate the second pump operation.
2. PJM instructs FE-East Transmission to have Seneca operate to the heavy load voltage schedule during the operation of the second Seneca pump.
3. PJM instructs FE-East Transmission to have Shawville operate to the heavy load voltage schedule during the operation of the second Seneca pump.
4. PJM instructs FE-East Transmission to place Glade capacitor into service as system conditions permit, ensuring voltage limits are not violated.

Note: PJM will perform real-time stability study prior to permitting two pumps operations, if PSS on either Seneca unit one or unit two is unavailable.

Purpose: The following Seneca plant operating guidelines provide both pumping and generating restrictions during the following operating conditions:

1. Forest – Glade 230kV line outage
2. Glade – Lewis Run 230kV line outage or Lewis Run 230/115 kV #4 transformer outage or Lewis Run bus tie breaker B25 115 kV outage or Lewis Run-Farmers Valley 115 kV line outage or Farmers Valley bus tie breaker B1 115 kV outage
3. Glade – Warren 230kV line outage
4. Erie South – Warren 230kV line outage

Note: An outage to any 230kV outlet for the Seneca units may result in unit instability for the next contingent event along with the potential for damage to the Seneca units. Failure to comply with the unit restrictions noted below may result in voltage swings that could lead to a loss of load.

Forest – Glade 230kV line outage
Pumping: No pumping
Generating: 1 generator – Max Output
A three phase fault on the Erie South – Warren 230 kV line may cause unit instability at Seneca if the plant is either generating OR pumping. Seneca pumping cannot be throttled; therefore, Seneca cannot Pump during the line outage. Seneca is limited to ONE generator operation at full output during the line outage.

Glade – Lewis Run 230kV line outage or Lewis Run 230/115 kV #4 transformer outage or Lewis Run bus tie breaker B25 115 kV outage or Lewis Run-Farmers Valley 115 kV line outage or Farmers Valley bus tie breaker B1 115 kV outage
Pumping: 1 pump, Up to Max Loading on Unit 1 or Unit 2 only
Generating: 3 generators, 445 MW Max Total Output
A single line to ground fault on the Glade – Warren 230kV line may cause unit instability at Seneca while pumping. A single line to ground fault on the Erie South – Warren 230kV line with a stuck breaker at Warren may cause unit instability at Seneca while generating. Seneca is restricted to one pump operation during the line outage. Seneca may generate with all three units, with the above maximum restrictions, during the line outage.

Glade – Warren 230kV line outage
Pumping: 1 pump, Up to Max Loading on Unit 1 or Unit 2 only
Generating: 3 generators, 445 MW Max Total Output
A single line to ground fault on the Glade – Lewis Run 230 kV line may cause unit instability at Seneca if the plant is either generating OR pumping. Seneca is restricted to one pump operation during the line outage. Seneca may generate on all three units, with the above maximum restrictions, during the line outage.

Erie South – Warren 230kV line outage
Pumping: No pumping
Generating: 1 generator Max Output with B5 (#5) CB open at Glade
A three phase fault on the Forest – Glade 230 kV line may cause unit instability at Seneca if the plant is either generating OR pumping. Seneca pumping cannot be throttled; therefore, Seneca cannot pump during the line outage. Seneca is limited to ONE generator operation at full output during an outage of the Erie South-Warren 230 kV line. Under this condition, the Glade B5 (#5) 230 kV breaker must be OPENED to prevent Seneca instability for a stuck Glade B5 (#5) 230 kV breaker. If the Glade B5 (#5) 230 kV breaker cannot be switched open during this outage, NO GENERATING will be permitted during the Erie South-Warren 230 kV line outage.

Seneca Pumping

Overview

The purpose of this procedure is to ensure continued reliable system operations on the PJM/FE system, while operating to within applicable ratings in order to allow for pumping at Seneca Generating Station. PJM will monitor system conditions for actual or post-contingency overloads. First Energy has agreed to have one or both pumps off-line in 5 minutes should a contingency occur in order to return post-contingency flows to within normal ratings.

Procedure to Approve Pumping Operation:

1. The FECE Dispatcher shall call PJM Dispatching and First Energy Reading Dispatch (FE TSO) 45 minutes prior to (desired) actual pump operations.
2. The PJM Power Dispatcher, using forecasted system conditions, will study pump operation. This will include running a PF/SA study by turning on a Seneca pump, and verifying NY-ISO generation patterns at Dunkirk and South Ripley.
3. The PJM Power Dispatcher shall respond back to the FECE Dispatcher within 15 minutes with the results of their analysis.

   a. **First Pump Operations** – Control to LTE & activate "line + pump" contingency

   - Once the pump is operating, the PJM PD will activate "line + pump" contingency in the EMS and will monitor and control for all resultant thermal and voltage violations that exceed LTE limits. The PJM PD will also monitor the "line only" contingency on the PJM EMS SA Specials display and will control for all resultant thermal and voltage violations that exceed their Load Dump limits.
   - The FECE Dispatcher shall alert the Seneca Plant Operator that pump tripping may be required and initiate "pump trip" protocol (i.e., alert station personnel to turn on beeper/cell phone in case of implementation).
   - FE TSO to take the line out-of-service at Glade to immediately dump the Seneca pump if Seneca Plant Operator does not cease Seneca pumping within 5 minutes.

   b. **Second Pump Operations**

   - Once the second pump is operating, the PJM PD will activate "line + 2 pump" contingency in the EMS and will monitor and control for all resultant thermal and voltage violations that exceed LTE limits. The PJM PD will also monitor the "line only" contingency on the PJM SA Specials display and will control all resultant thermal and voltage violations to their Load Dump limits.
   - The FECE Dispatcher shall alert the Seneca Plant Operator that pump tripping may be required and initiate "pump trip protocol" (i.e.,

alert station personnel to turn on beeper/cell phone in case of implementation).

- FE TSO to take the line out-of-service at Glade to immediately dump the Seneca pump if Seneca Plant Operator does not cease Seneca pumping within 5 minutes.

c**. Off-cost Operations w/ Seneca Pumping**

- First Seneca Pump

i. The PJM PD will control all facilities to their LTE ratings for the "line + pump" contingency.

ii. The PJM PD will control all facilities to their LD ratings for the "line only" contingency.

- Second Seneca Pump

i. The PJM PD will control all facilities to their LTE ratings for the "line + 2 pump" contingency.

ii. The PJM PD will control all facilities to their LD ratings for the "line only" contingency.

- Off-cost Operations – PJM will curtail non-firm transactions not willing to pay congestion, and redispatch economic generation as appropriate. PJM will implement Interregional Congestion Management with NYISO and request Dunkirk / Huntley Generation to redispatch for the Erie West 345/115kV #1 Xfmr to allow continued operation of the first Seneca pump.

Note: In addition to the LTE & LD limits, FE has additional PJM approved STE ratings for the Erie West 345/115kV #1 Xfrmr.

Note: PJM will request FECE to remove a pump from service if pumping results in an actual overload that cannot be controlled via redispatch.

Note: FE TSO installed temperature monitors and is investigating dynamic ratings on the Erie West 345/115kV #1 Xfmr.

Pre-Contingency Switching Options to Allow Seneca Pumping due to Actual Overloads (applicable under transmission outage conditions – Erie West #3 345/115kV Xfmr).

Step 1: Primary Switching Option - Coordinate with FE-E opening the Handsome Lake 345kV CB at Wayne (Handsome Lake – Wayne 345kV line opened at Wayne only). This switching option exists to allow continued operation of the first Seneca pump or to maximize pumping capabilities under certain operating conditions (described below), which would be restricted in real-time due to actual overloads (usually on the Erie West – Erie South 345kV line). Transactions "Not Willing to Pay through Congestion" should be curtailed prior to switching.

Step 2: Initiate off-cost operations to control loading.

Step 3: Initiate Interregional Congestion Management procedure (if applicable). Procedure can be implemented to control loading on Erie West 345/115kV #1 xfmr.

Step 4: Issue a TLR 3A/B to maintain flows at or below their current levels.

Step 5: Periodically reevaluate returning opened facilities to service.

Note: Seneca pumping may adversely impact Non-Market FE-E BES Facilities. In the event that further corrective actions are required to control Non-market BES facilities beyond non-cost actions, PJM will:

1. Issue a Post-Contingency Local Load Relief Warning (PCLLRW), with a post-contingency plan to reduce Seneca pumping or

2. At the request of FE-E Transmission, PJM will restrict Seneca pumping pre-contingency with lost-opportunity costs being borne by FE-E Transmission. Such curtailments of Seneca pumping for non-market BES facilities must be logged by PJM Dispatch.

Post-Contingency (Post-Event) Switching Options (applicable under transmission outage conditions – Erie West #3 345/115kV Xfmr).
Primary Option: FE TSO has agreed to open the Perry – Ashtabula 345kV line @ Perry once an actual overload can no longer be controlled via re-dispatch, there is insufficient time to control via a TLR, or no other switching options are available. This option is only available if load dump is imminent and shall be coordinated with FE TSO and MISO.

- FE-W will open at Perry S620 and S621 (as per PJM EMS Single-line breaker designation) 345kv CBs via SCADA control (takes the Perry to Ashtabula Tap 345kv line section out of service). This will also reduce the push from the Perry nuclear unit and still allow voltage support to Erie West from Ashtabula Tap.

Note: FE-W indicated that the 8-T transformer at Ashtabula Tap would be left in service. This transformer is limited by reverse power flow of 270mw (per FE-W support). If this transformer needs to be opened along with the S620 and S621 CBs at Perry voltage support from Ashtabula Tap will be lost. FE-E, FE-W and MISO should perform and discuss local studies whenever PJM has declared a Load Dump Warning for Erie West #1 Xfmr to ensure there is no delay in the implementation of switching.

Secondary Option: Open the Erie West – Ashtabula 345kV line @ Erie West depending on post-contingency configuration of Erie West 345kV bus (Erie West #5 and #6 345CBs in-service) and status of Handsome Lake – Wayne 345kV line (Handsome Lake 345CB @ Wayne in-service). Erie West 345/115kV #1 xfmr must remain in-service to provide voltage support to Erie Area. Switching must be coordinated with FE-E, FE-W and MISO.

Note: Conditions may exist that would dictate switching of the Perry – Ashtabula 345kV line pre-contingency in order to maximize Seneca Pond Level. These limited operating conditions include:

- Capacity Deficient Conditions on PJM or FE systems.

- Localized transmission outages requiring Seneca Generation for reliability purposes.

These conditions must be forecasted, studied and approved by PJM, MISO, MET, and LCC support staff. Switching of the Perry – Ashtabula 345kV (***and Transformer***) line will only occur if either of the acceptable conditions defined above are met, generation redispatch is exhausted and outaging of the line does not violate reliability criteria.

Index of Operating Procedures for PECO Energy (PE or PECO) Transmission Zone

The PECO Energy (PE or PECO) Transmission Zone has Operating Procedures that are adhered to by PJM. These procedures include the following:

	Type of Operating Procedure	Transmission Operations Manual Section Ref
PECO Energy (PE or PECO)		
Nottingham- Cooper 230 kV Line Limitations	Line Limitation	Section 5 PECO
Muddy Run Restrictions	Stability	Section 5 PECO
Peach Bottom 1 500/230 kV Transformer Special Protection Scheme	Special Purpose Relay	Section 5 PECO
Peach Bottom '45' 500 kV CB outage	Special Purpose Relay	Section 5 PECO
Peach Bottom '35' 500 kV CB outage	Special Purpose Relay	Section 5 PECO
Peach Bottom Off-Site Power Supply Voltage Limits	Voltage Limits	Section 5 PECO
Limerick 4A and 4B 500/230 kV Transformer Banks	Transformer Ratings	Section 5 PECO
Linwood Special Protection Scheme	Special Protection Scheme	Section 5 PECO
Back To Index		

Nottingham - Cooper 230 kV Line Limitations

The Nottingham - Peach Bottom Tap - Cooper 230 kV line (220-08) is modeled in PJM security analysis programs. The configuration between Nottingham and Peach Bottom Tap is represented in PJM security analysis programs.

When the reactor is in service, the reactor by-pass should be out of service. With the reactor by-pass out of service, MW flow must pass through the reactor.

When the reactor is out of service, the reactor by-pass should be in service. With the reactor by-pass in service, MW flow follows the path of lowest impedance and bypasses the reactor.

Note: It is not necessary to change the status of the reactor if the status of the by-pass and 220-08 line are modeled correctly.

The operation of the reactor on the 220-08 line impacts power flows by changing the impedance of the transmission system. The reactor is used as an operating tool to benefit the transmission system and minimize contingency flows. PECO Energy requests PJM dispatcher's approval prior to switching the reactor in or out of service. PECO Energy notifies BGE of the status of the reactor.

PJM Actions:

To control actual and contingency overloads on the Nottingham-Cooper 220-08 line, PJM performs the following actions:

- PJM dispatcher checks the status of the Nottingham reactor. If the reactor is available but not in service, PJM dispatcher requests PECO Energy to switch it in service.
- If the Nottingham reactor is out of service or unavailable and thermal overloads still exist, PJM dispatcher evaluates the possibility of opening the Conowingo 230 kV bus tie CB. In order to determine the effect of opening the Conowingo bus tie CB, a contingency analysis study program is run with only the bus tie CB taken out of service. If determined by PJM dispatcher(upon consideration of flows on critical lines, generation patterns, and the study run) that opening the Conowingo 230 kV bus tie CB will adequately reduce the flow on the 220-08 line and will not create a more severe problem in the PJM RTO, PJM dispatcher requests PECO Energy to open the Conowingo bus tie CB. Otherwise, PJM dispatcher proceeds to the next course of action, Step 3.

When opening the Conowingo Bus Tie CB, PJM dispatcher considers the following information:

- Opening the Conowingo 230 kV bus tie CB usually reduces the contingency flow on the 220-08 line, but it can create contingency problems on the Nottingham-Bradford 230 kV line (220-05).
- Reclosing of the Conowingo 230 kV bus tie CB is made as soon as a power flow analysis shows that the contingency flow problem on the 220-08 line no longer exists with the Conowingo bus tie CB in service.
- The status of the Conowingo 230 kV bus tie CB will change the generation that is lost with the tripping of the 220-88 or the 220-03 lines. If the Conowingo-Bradford (220-88) line trips, units #1-7 at Conowingo trip. Similarly, if the Conowingo-Nottingham (220-03) line trips, units #8-11 at Conowingo trip.

Note: Due to potential overloads on the 230/35 kV transformer at Colora substation, DPL must be notified prior to opening the Conowingo bus tie CB.

If it is determined that opening the tie CB at Conowingo does not adequately reduce the contingency flow on the 220-08 line or that it creates other more severe problems on the system, then PJM dispatcher evaluates the possibility of opening the 220-08 line.

- PJM dispatcher considers any major transmission paths scheduled out of service. The most significant of these paths are the Peach Bottom-Rock Springs-Keeney 500 kV line (5025/5014), Peach Bottom-Limerick 500 kV line (5010), and Peach Bottom-Conastone

500 kV line (5012). If a major line is out, PJM operations planning staff re-evaluates the operating procedures for opening the 220-08 line. Unless instructed otherwise, if a major line is out of service, PJM dispatcher operates off-cost for 220-08, as required.

- If conditions on the system permit the opening of the 220-08 line, PJM dispatcher runs a contingency analysis study taking the 220-08 line out of service. If determined by PJM dispatcher determines (upon consideration of flows on the reactive transfer limit interfaces, flows on critical lines, load patterns, generation patterns, and the study run) that opening the 220-08 line solves the problem without creating more severe problems on the system, PJM dispatcher contacts PECO Energy and BGE to determine if they have any local conditions which make it undesirable to open the 220-08 line. If both PECO Energy and BGE approve, PJM dispatcher requests PECO Energy to open the 230 kV CB at Nottingham on the Cooper - Peach Bottom Tap - Nottingham circuit.
- If opening the 220-08 line does not solve the problem, creates worse problems, or either PECO Energy or BC do not agree to open the line, then PJM dispatcher operates off-cost, as required.

When opening the 220-08 line, PJM dispatcher considers the following information:

- When the 220-08 line is open, the position of the Conowingo bus tie CB is left to the discretion of the PECO Energy operators. It is expected that the Conowingo 230 kV bus tie CB is normally to be kept closed.
- Thermal overloads on the 220-08 line caused by the loss of Peach Bottom - Conastone 500 kV line (5012) can be relieved by opening the 220-08 line. However, opening this line decreases total eastern import capability.
- Opening the 220-08 line increases flows on the reactive transfer limit interfaces. If the system is near a reactive limit, it may be advisable to operate off-cost for 220-08 rather than open the line.
- If the 220-08 line is open and a major line is forced out of service, PJM dispatcher attempts to close the 220-08 line. It remains closed until the effects of the outage on the system can be evaluated in terms of reopening the 220-08 line.
- Reclosure of the 220-08 line is made after PJM dispatcher determines, using the contingency analysis study program, that the line can be safely returned.

Whenever the contingency loadings cannot be controlled with the above procedures, PJM dispatcher operates off-cost as required.

Muddy Run Restrictions

For a Peach Bottom #1 500/230 kV Transformer outage, certain output restrictions apply to Muddy Run while in Generation Mode both during switching as well as for the extent of the outage in order to maintain area stability.

During switching, Muddy Run is limited to 4 Generators maximum for stability.

With the Peach Bottom #1 500/230 kV Transformer out of service, Muddy Run is limited to 6 Generators maximum for stability.

System conditions and projected voltage will dictate the number of Muddy Run Pumps that can be on-line both during the switching and for the duration of an outage of the Peach Bottom #1 500/230 kV Transformer. Muddy Run Pumps may need to be reduced in order to maintain transmission voltage levels within system operating limits.

Peach Bottom 1 Transformer Special Protection Scheme [SPS]

This special protection scheme operates for the loss the Peach Bottom 500/230 kV transformer. When the Peach Bottom transformer trips, the relay will trip the Peach Bottom 675 CB and 475 CB and will initiate a transfer trip to the Muddy Run #2 Bus. This will trip the Muddy Run #5, 6, 7, and 8 units. This scheme is normally in-service.

Peach Bottom '45' 500 kV CB Outage Special Protection Scheme [SPS]

If the Peach Bottom 45 CB is open and/or out of service and the Peach Bottom 35 CB trips (resulting in the loss of the Peach Bottom #1 500/230 kV transformer), this will initiate a trip of the Peach Bottom 675 CB and 475 CB and initiate a transfer trip to the Muddy Run #2 Bus. This will trip the Muddy Run #5, 6, 7, and 8 units. In the case of the Peach Bottom – TMI 5007 500 kV line tripping (including the 35 CB) the PJM IO dispatcher should deactivate the Peach Bottom – TMI (5007) contingency and activate the contingency for the loss of the Peach Bottom – TMI (5007) 500 kV line and the Muddy Run units 5-8. This scheme is normally Disabled; and Enabled as needed.

Peach Bottom '35' 500 kV CB Outage Special Protection Scheme [SPS]

If the Peach Bottom 35 CB is open and/or out of service and the Peach Bottom 45 CB trips (resulting in the loss of the Peach Bottom #1 500/230kV transformer), this will initiate a trip of the Peach Bottom 675 CB and 475 CB and initiate a transfer trip to the Muddy Run #2 Bus. This will trip the Muddy Run #5, 6, 7, and 8 units. This scheme is normally Disabled; and Enabled as needed.

Peach Bottom Off-site Power Supply Voltage Limits

Post-contingency voltages at the substations of nuclear power plants are critical to assuring that the nuclear safety systems will work properly if required. In the case of Peach Bottom, the facilities of concern are the off-site power supplies, specifically:

- Cooper – Peach Bottom Tap – Nottingham (220-08) 230kV facility
- Peach Bottom – Newlinville (220-34) 230kV facility

- Peach Bottom 500/230kV transformer.

Consistent with PJM, Transmission Owner, and Nuclear Plant actions defined in Section 3: Voltage and Stability Operating Guidelines, subsection entitled “Notification and Mitigation Protocols for Nuclear Plant Voltage Limits” of this manual, PJM and LCC Transmission Owner should analyze and communicate violations to voltage limits on the Peach Bottom 500kV, Peach Bottom 230kV, and Peach Bottom Tap 230kV facilities.

Limerick 4A and 4B 500/230 kV Transformer Banks

The ratings on the Limerick 4A and 4B banks are dependent upon the tertiary amp flow and the direction of MW flow. In normal operation, MWs will flow from the 500 kV side to the 230 kV. However, there are conditions in which flow on the 4A and 4B banks will be from the 230 kV side to the 500 kV. Prior to initiating off-cost operation for any actual or contingency overloads, PJM dispatcher should call the PE dispatcher to obtain the Tertiary amp flow and the direction of MW flow on the 4A and 4B banks. Exhibits below present the ratings based on Tertiary Amps and MW flow direction.

Power Flow from 230 kV to 500 kV - MVA

Tert. Amps	Season	Normal	Emergency	Load Dump
(1-420)	Summer	420	574	655
(1-420)	Winter	477	611	688
(421-840)	Summer	413	567	649
(421-840)	Winter	470	604	682
(841-1255)	Summer	406	560	641
(841-1255)	Winter	464	597	675
(1256-1675)	Summer	400	553	635
(1256-1675)	Winter	457	590	668
(1676-2095)	Summer	393	547	628
(1676-2095)	Winter	450	583	661
(2096-2510)	Summer	386	540	621
(2096-2510)	Winter	443	576	654

Exhibit 10: Limerick 4A & 4B Power Flow from 230 kV to 500 kV – MVA

Power Flow from 500 kV to 230 kV - MVA

Tert. Amps	Season	Normal	Emergency	Load Dump
(1-420) (1-420)	Summer Winter	417 474	571 608	653 686
(421-840) (421-840)	Summer Winter	407 464	561 598	642 676
(841-1255) (841-1255)	Summer Winter	397 454	551 588	632 666
(1256-1675) (1256-1675)	Summer Winter	387 444	541 578	622 655
(1676-2095) (1676-2095)	Summer Winter	377 434	531 568	612 645
(2096-2510) (2096-2510)	Summer Winter	367 424	521 558	602 635

Exhibit 11: Limerick 4A & 4B Power Flow from 500 kV to 230 kV - MVA

Linwood Special Protection Scheme [SPS]

The Linwood special protection scheme has been designed to reduce congestion on the Linwood-Chichester 230 kV lines for loss of one line on the other by tripping the #2 CT, #3 CT, and the steam unit at the Phillips Island station.

If the Phillips Island station is operating at its full load of 750 MW, the operation of the SPS will result in a reduction of approximately 580 MW of Phillips Island generation almost instantaneously.

PJM Actions:

The following contingencies should be enabled whenever SA indicates that the loss of either Linwood-Chichester 230 kV line by itself will result in an overload on the parallel Linwood-Chichester 230 kV line. PJM will then control this contingency loading to account for the tripping of the Phillips Island #2 CT, #3 CT, and the steam unit.

"Linwood-Chichester (220-39) & SPS (2 CTs and steam)"

"Linwood-Chichester (220-43) & SPS (2 CTs and steam)".

Index of Operating Procedures for Pennsylvania Power & Light (PPL) Transmission Zone

The Pennsylvania Power & Light (PPL) Transmission Zone has Operating Procedures that are adhered to by PJM. These procedures include the following:

	Type of Operating Procedure	Transmission Operations Manual Section Ref
Pennsylvania Power & Light (PPL)		
Sunbury 500/230 kV Transformer Ratings	Equipment Ratings	Section 5 PPL
Susquehanna #1 and #2 Units Contingency	Contingency	Section 5 PPL
5043 and 5044 (Alburtis-Wescosville-Susquehanna) Transfer Trip Scheme	Special Purpose Relay	Section 5 PPL
Northeast PA (NEPA) Transfer Limit	Stability	Section 5 PPL
Montour Stability Restrictions	Stability	Section 5 PPL
Steel City – Hosensack 500kV Reclosing Procedure	Reclosing Limitation	Section 5 PPL
Operation of 23030 Tie at Mountain UGI	Tie Operations	Section 5 UGI
UGI/PL 66 kV Tie Line Operation	Tie Operations	Section 5 UGI
Conemaugh Unit Stability	Stability	Section 5 FE-PN
Conemaugh #2 Unit Stability Trip Scheme-Conemaugh-Juniata 500kV Outage	Stability	Section 5 FE-PN
Sunbury Transformer 22 & 23 Operating Restrictions	Operating Restrictions	Section 5 PPL
Double Circuit Tower Line Contingencies (DCTL) Associate with Susquehanna-Roseland Delay	Contingency – Thermal	Section 5 PPL
Montour Runback Scheme (SPS)	Special Purpose Relay	Section 5 PPL
Back To Index		

Sunbury 500/230 kV Transformer Ratings

The ratings for the Sunbury 500/230 kV transformer is reduced when one of the two 230 kV CBs is open. The temperature dependent ratings applicable to the Sunbury 500/230 kV transformer change if one of the transformer's 230 kV CBs is open. Under some conditions, with one 230 kV CB open, the disconnect switches of the remaining 230 kV CB are the limiting facilities. The table below presents the applicable ratings, in MVA.

Sunbury 500/230 XFMR - One 230 kV CB Open Daytime and Nighttime			
Temperature	**Norm**	**Emergency**	**Load Dump**
95F	693	855	983
86F	747	881	1013
77F	798	907	1042
68F	828	931	1071
59F	855	956	1099
50F	881	980	1127
41F	907	1003	1154
32F	931	1027	1180

Exhibit 12: Day or Night Ratings - MVA

Susquehanna #1 and #2 Units Contingency

PPL has identified certain auxiliary equipment outages for which the single contingency loss of another facility results in an automatic or delayed trip of both Susquehanna units. When both units are in service, the critical auxiliary equipment is normally expected to be in service. However, the forced outages of auxiliary equipment may occur.

When it has been determined that a single contingency loss of one component results in the loss of both Susquehanna units within 15 to 30 minutes of each other, the following procedure is implemented.

PPL Actions:

The PPL LCC dispatcher notifies PJM dispatcher via eDART and verbally, of the circumstances surrounding the outage. Specifically, if a transmission facility outage resulting in a Susquehanna #1 and #2 unit contingency. Information exchanged includes:

- outaged facility which sets up the contingency
- reason for the outage
- contingency which causes the loss of both Susquehanna units
- start date and start time for the outage
- estimated end date and end time for the outage
- availability and/or priority (if rescheduling is possible)

The PPL MOC dispatcher notifies PJM dispatcher via eDART and verbally, of the circumstances surrounding the outage. Information exchanged includes:

- outaged facility which sets up the contingency

- reason for the outage
- contingency which causes the loss of both Susquehanna units
- expected amount of time between unit trips (less than 15 minutes, 15 to 30 minutes, etc.)
- start date and start time for the outage
- estimated end date and end time for the outage
- availability and/or priority (if rescheduling is possible)

It is the responsibility of the PPL MOC to notify PJM when the system returns to a normal state and PJM no longer needs to carry additional-spinning or monitor for double contingency loss. This notification to PJM should include coordination with the PPL LCC and Susquehanna plant.

PJM Actions:

Upon notification from the PPL dispatcher of the circumstances surrounding the outage, the following actions are performed depending on anticipated delay in single contingency loss of both units:

Auxiliary outage results in a single contingency loss of both units within 15 minutes.

- The PJM Power Director models the single contingency loss of both Susquehanna 1 and 2 units in the PJM Security Analysis and Transfer Limit Calculation packages. The PJM Power Director orders off-cost generation adjustments in the most economical manner based on the Security Constrained Economic Dispatch (SCED) solution.
- PJM Scheduling Coordinator maintains the PJM Mid-Atlantic Spinning Reserve at a value between 75 - 100% of the combined output of Units #1 and #2 for the duration of the outage, until the MOC closes the eDART ticket.

Auxiliary outage resulting in a single contingency loss of both units within 15 - 30 minutes.

- PJM Scheduling Coordinator and Generation Dispatcher are to ensure 100% of the Mid-Atlantic Spin requirement is satisfied. PJM Scheduling Coordinator tracks Tier 1 estimate and adjusts as needed to ensure 100% Spin Requirement is covered.
- PJM Power Director should periodically perform a powerflow study analysis to have an understanding of what the system will look like after both units are off-line. The study will detect potential voltage, reactive transfer limits, and/or thermal problems.
- PJM Power Director should determine the location of replacement energy (amount / start-up time) in the event both units would need to come off-line.
- PJM Generation Dispatch should rely on quick start and shared reserves if necessary.

- PJM Dispatch will continue to posture the system in reliable manner until PPL MOC closes eDART ticket.

5043 and 5044 (Alburtis-Wescosville-Susquehanna) Transfer Trip Scheme [SPS]

The purpose of the 5043 and 5044 Tranfer Trip Scheme is prevent thermal overloads on the Wescosville 500/138 kV Transformer 3. The relay scheme trips the Transformer 3 138kV CB at Wescosville whenever the 5044 (Alburtis-Wescosville) circuit breakers at Alburtis are opened due to a fault or switching at Alburtis. This results in the removal of the Wescosville #3 500/138 kV transformer whenever both of the 5044 terminal CBs at Alburtis are open.

Whenever a contingency exists such that both of the 5044 terminal CBs at Alburtis are opened, the on-line computer contingency list is adjusted to reflect the multiple contingency loss of the facility causing the contingency and the 5043 and 5044 lines (Alburtis-Wescosville-Susquehanna). By changing the contingency list in this way, the removal of the Wescosville 500/138 kV transformer is accounted for by the EMS.

For example, if the Wescosville East CB at Alburtis were out-of-service, the loss of the Alburtis 500/230 kV transformer normally opens the Wescosville West CB at Alburtis, isolating the 5044 line. However, this scheme causes a transfer trip of the Transformer 3 138kV CB at Wescosville when the Wescosville West CB at Alburtis opens. This results in the removal of the 5043 and 5044 lines and the Wescosville #3 500/138 kV transformer. Therefore, the multiple contingency (loss of Alburtis 500/230 kV transformer, 5043, and 5044) is added to PJM security analysis program’s contingency list.

Northeast PA (NEPA) Transfer Limit

A transfer limit indicator has been developed in order to ensure transient stability in Northeastern Pennsylvania. This indicator consists of a set of transmission lines whose total MW flow is monitored and controlled. The sum of the MW flow across the transmission lines of the NEPA interface have been determined to provide an accurate indication of the synchronous stability power export limit.

The set of transmission lines in the NEPA transfer interface is:

- Susquehanna-Wescosville 500 kV line
- Siegfried-Harwood 230 kV line
- Harwood-East Palmerton 230 kV line
- Siegfried-Frackville 230 kV line
- Juniata-Sunbury 500 kV line
- Lackawanna-Peckville 230 kV line
- Lackawanna-Oxbow 230 kV line
- Montour-Elimsport 230 kV line
- Montour-Clinton 230 kV line
- Sunbury-Elimsport 230 kV line

Planned outages of key transmission facilities are normally scheduled to coincide with planned unit maintenance outages. For a forced outage of a key transmission facility, generation within the NEPA (aka Northern PL) interface may need to be reduced to protect the system from the next contingency.

PJM RTO maintains the stability transfer limit and monitors and controls the transfer limit flows. Whenever it is determined that the flow across the NEPA transfer interface is exceeding its limit, PJM RTO determines where and the amount of generation that must be reduced within this interface to reduce the flow across the NEPA interface.

During normal operations, the NEPA transfer export limit is adjusted based on out of service generation and transmission facilities. With all generation and transmission lines in-service, the base stability NEPA transfer limit is 3900 MW. Subtractors associated with specific generation and transmission facility outages are then applied to this base number to determine the actual transfer export limit.

Note: Under multiple outage conditions, the NEPA adders are cumulative until an off-line stability analysis can be performed or a real-time Transient Stability Analysis Tool is deployed.

Montour Stability Restrictions

Certain 230kV bus configurations at Montour require Montour #1 unit output restrictions to prevent instability should another contingency occur. The table below presents either a single 230kV circuit breaker outage or a 230kV bus outage precondition at Montour. For each precondition, any required switching as well as the corresponding Montour #1 gross output restrictions in order to maintain stability are presented.

Montour Stability Restrictions	
Montour Outage Condition	**Montour #1 Max Output Restriction (MW - Gross)**
SUSQ T10 230kV CB	600
MONTOUR GEN1 230kV CB	600
SUSQ 230kV CB	No restrictions
MONTOUR GEN2 230kV CB	No restrictions

Steel City-Hosensack 500kV line Reclosing Limitation

Analysis has determined that if the Steel City-Hosensack 500kV line is reclosed under a standing phase angle separation of more than 10-degrees, the Bethlehem Power Unit may trip due to a unit protection relay.

To prevent an unplanned trip of the Bethlehem Power generation plant, PPL has modified the reclosing relay settings so that automatic or manual reclosing of this line is not allowed when the standing phase angle separation between the Hosensack and Steel City 500kV buses is greater than 10 degrees or the rotating angle is greater than 5 degrees.

As a result, prior to attempting automatic or manual reclose of this line, PPL and PJM will determine the standing phase angle separation between the Hosensack and Steel City 500kV buses. PJM will then direct Bethlehem Power generation to reduce generation output as needed to lower the angle difference to below 10-degrees. PJM will then approve PPL to reclose the line.

Sunbury Transformer 22 & 23 Operating Restrictions

The Sunbury 230/69 kV transformers 22 & 23 are overdutied depending on the status of the Sunbury units. Under certain conditions, the Sunbury transformer 22 or 23 may need to be opened. The following procedure is applied:

If Sunbury Units #1, #2, and #3 are offline, the Sunbury transformer 22 & 23 LTCs will be in auto.

If one or more Sunbury Units or CT (#1, #2, #3, or CT) are online, one Sunbury transformer LTCs will be in manual and the other Sunbury transformer will be removed from service.

The removal of one Sunbury 230/69 kV transformer is required to avoid overdutied condition on the 69 kV system.

Double Circuit Tower Line Contingencies (DCTL) Associate with Susquehanna-Roseland Delay

In order to mitigate potential operational impacts caused by delays in the Susquehanna-Roseland 500kV upgrade project, PJM has incorporated several double circuit tower line (DCTL) contingencies into the normal EMS contingency set.

DCTL Contingency Descriptions

1	Loss of GILBERT - MORRISTOWN C2003 230 kV line + MORRISTOWN 230 / 34.5 kV #5 transformer + PORTLAND - GREYSTONE S1007 230 kV line
2	Loss of PORTLAND - GREYSTONE S1007 230 kV line + KITTATINNY – POHATCONG L2012 230 kV line +POHATCONG 230 / 34.5 kV #1 transformer
3	Loss of GILBERT - MORRISTOWN C2003 230 kV line + MORRISTOWN 230 / 34.5 kV #5 transformer + GILBERT - GLEN GARDNER V1036 230 kV line
4	Loss of POHATCONG - WEST WHARTON A2001 230 kV line + PORTLAND - GREYSTONE S1007 230 kV line
5	Loss of PORTLAND - KITTATINY V1010 230 kV line + KITTATINY 230 / 34.5 kV #1 transformer + PORTLAND - GREYSTONE S1007 230 kV line
6	Loss of WEST WHARTON - CHESTER H2034 230 kV line + CHESTER 230 / 34.5 kV #4 transformer + POHATCONG - WEST WHARTON A2001 230 kV line
7	Loss of WHIPPANY - GREYSTONE J1024 230 kV line + WHIPPANY - GREYSTONE Q1031 230 kV line + WHIPPANY 230 / 34.5 kV BK 7 transformer + WHIPPANY 230 / 115 kV BK 12 transformer

PJM Actions:

PJM system operations will implement the following actions to control for system congestion caused by these DCTL contingencies.

- Post-contingency flows exceed Long Term Emergency (LTE) rating
  - PJM dispatch will issue a PCLLRW.
- Post contingency flows exceed Load Dump (LD) rating
  - PJM dispatch will initiate the redispatch of off-cost generation, controlling flows to 100% of the LD rating on a pre-contingency basis within SCED. Constraints will be permitted to set PJM LMP.

Montour Runback Scheme [SPS]

The purpose of the Montour Runback Scheme is to control actual thermal overloads on the Susquehanna-Harwood #1 or #2 line by automatic runback of the Montour #1 and #2 units.. Use of this scheme will minimize the need for pre-contingency constraint mitigation. The scheme monitors the actual line flows and initiates an automatic runback and potentially a tripping of the Montour #1 and #2 units if actual flows exceed normal or emergency ratings. The SPS is set up to utilize the real-time PJM ratings of the Susquehanna-Harwood #1 and #2 lines.

When the SPS operates for flows over the Normal rating, but less than the Emergency rating, the Montour #1 and #2 units will be directed by PJM to reduce to a level that alleviates the overload. If the flow is still over the normal, after 15 minutes, the scheme automatically runback both Montour units to less than or equal to 400 MW net each in less than 5 minutes. The units are expected to remain at reduced output levels until PJM communicate that the Montour units can return to normal output levels.

The normal SPS status is ‘ARMED’. The scheme is configured to operate in one of two ways depending on the actual line flows:

- **LTE Rating > Actual Flow > Normal Rating:** If the actual flow on either the Susquehanna - Harwood #1 or #2 230 kV line exceeds its NORMAL rating, the scheme will immediately initiate an alarm to the Montour control room and PPL SCADA. PJM will direct PPL Generation to reduce the Montour units to desire output to relieve the overload. When the overload condition exists for longer than 15 minutes, the scheme will initiate the runback signal to reduce the Montour units to less than or equal to 400 MW net each.
- **Actual Flow > LTE Rating:** If the actual flow on either the Susquehanna - Harwood #1 or #2 230kV line exceeds its LTE rating, the scheme will immediately and simultaneously initiate an alarm and the automatic runback of both Montour units to less than or equal to 400 MW net each. If loading on the Susquehanna - Harwood circuits is not reduced below the LTE rating after 5 minutes, the scheme will initiate the trip of Montour #1 unit. If the first unit trip does not reduce loading on the Susquehanna - Harwood lines below the LTE rating,

the scheme will then initiate the trip of Montour #2 unit after one minute.

Procedure:
The SPS is normally 'ARMED'. Under certain emergency conditions, PJM may deactivate the SPS. In such case, PJM will direct PPL to disarm the scheme and place it in the 'UNARMED' position. When Security Analysis indicates a contingency thermal overload on the Susquehanna-Harwood #1 or #2 line, PJM will verify the status of the Montour SPS and evaluate its impact. If the SPS resolve the contingency thermal overload and does not cause other issues, PJM will maintain the 'ARMED' status or will change to 'ARMED' status if the SPS is 'UNARMED'.

PJM Actions:

- PJM will direct PPL Transmission to arm the SPS scheme 'ARMED' or disarm the SPS scheme 'DISARMED'.
- PJM will log changes in status for this SPS and activate/deactivate the appropriate contingencies in the Security Analysis package.
- If a contingency occurs to cause actual flow on the Susquehanna-Harwood #1 or #2 line to exceed NORMAL but below LTE rating:
    - PJM will immediately direct PPL Generation to lower the Montour units. *Note: if the actual thermal overload exists for longer than 15 minutes, the SPS will hard runback on both units to less than or equal to 400 MW net each.*
- If a contingency occurs to cause actual flow on the Susquehanna-Harwood #1 or #2 line to exceed LTE rating:
    - The SPS will immediately initiate a hard runback on both Montour units.
- PJM will notify PPL Generation when the Montour units can return to normal output after the SPS has been initiated.

PPL Actions:

- PPL Transmission will notify PJM if the SPS status needs to be changed.
- PPL Transmission will notify PJM of any misoperation of the SPS or if the SPS is unable to operate as intended.
- PPL Transmission will notify PJM if the Susquehanna RTU is down or there is a communication failure.
- PPL will "ARMED" or "DISARMED" the SPS as directed by PJM.

GO Actions:

- PPL Generation will lower Montour output as directed by PJM.
- PPL Generation will inform the PPL Transmission and PJM of any misoperation of the SPS or if the SPS is unable to operate as intended.

- PPL Generation will manually initiate the generation output reduction or unit trip in the event that the SPS fails.
- PPL Generation will not raise unit generation output above 400 MW after runback is initiated until directed to do so by PJM.

Index of Operating Procedures for Potomac Electric Company (PEPCO) Transmission Zone

The Potomac Electric Company (PEPCO) Transmission Zone has Operating Procedures that are adhered to by PJM. These procedures include the following:

	Type of Operating Procedure	Transmission Operations Manual Section Ref
Potomac Electric Power Company (PEPCO)		
Chalk Point Transformer #5 Operation	Breaker Ratings	Section 5 PEPCO
Common Trench Cable Ratings	Cable Ratings	Section 5 PEPCO
Back To Index		

Chalk Point Transformer #5 Operation

The 230 kV breakers at Chalk Point are overdutied when all steam generation at Chalk Point and Morgantown are on-line. Therefore, under normal conditions, the #4 unit at Chalk Point is operated on the 500 kV bus whenever it is on-line and both transformers at Chalk Point are in service. The operating procedures for the #5 transformer are as follows:

- Normal Operation — With Chalk Point #4 off-line, the #5 transformer supplies the 230 kV bus through breaker 7a. With Chalk Point #4 on-line and operating on the 500 kV bus through breaker 7b, the #5 transformer load-tap-changer is used to maximize unit #4 MVAs output within voltage limits. Both breakers 7A and 7C will be open.
- Abnormal Operation — When outages of transformer #5, transformer #6, or breaker 7b prevent unit #4 from being isolated on the 500 kV bus, the unit is operated on the 230 kV bus as follows:
    - with transformer #5 out of service, unit #4 is operated on the 230 kV bus through breaker 7c. All four CTs (3,4,5,6) or one of the other steam units (U1, U2, or U3) must be made unavailable.
    - with transformer #6 out of service, transformer #5 remains connected to the 230 kV bus to maintain a tie with the 500 kV system. . All four CTs (3,4,5,6) or one of the other steam units (U1, U2, or U3) must be made unavailable.
    - with breaker 7b out of service, All four CTs (3,4,5 and6) and one of the four steam units (U1, U2, U3, or U4) must be made

unavailable. Transformer #5 will stay connected to the 230kV system via breaker 7A.

Common Trench Cable Ratings

In the PEPCO system, PJM monitors multiple sets of transmission cables which share a common trench. Under normal conditions, the Long Term Emergency, Short Term Emergency and Load Dump Ratings of these cables are limited by the total heating in the trench, primarily the result of the heat caused by the flow of power through two cables in the trench.

If one of the cables in the shared trench is out of service, due to either maintenance or a tripping (actual or simulated by PJM's Security Analysis programs), the emergency rating of the remaining in-service cable is not limited by the overall trench heating, but instead is limited by the cable itself. This change in the limit results in a higher emergency rating. Summer/Winter ratings are provided for “all cables in-service” condition as well as the “one cable out of service” condition.

PEPCO Common Trench Cable Ratings can be found on the OASIS System Information page under the ratings section at the following link:

http://www.pjm.com/markets-and-operations/etools/oasis/system-information.aspx

Index of Operating Procedures for Public Service Electric & Gas Company (PSE&G) Transmission Zone

The Public Service Electric & Gas Company (PSE&G) Transmission Zone has Operating Procedures that are adhered to by PJM. These procedures include the following:

	Type of Operating Procedure	Transmission Operations Manual Section Ref
Public Service Electric & Gas Company (PSE&G)		
PSE&G Artificial Island Stability	Stability	Section 5 PSE&G
Branchburg/Deans 500 kV Substation Contingency	Contingency-Thermal	Section 5 PSE&G
Closing Normally OpenBus Section Breakers (Hudson and Marion)	Operating Restrictions	Section 5 PSE&G
Double Circuit Tower Line Contingencies (DCTL) Associate with Susquehanna-Roseland Delay	Contingency – Thermal	Section 5 PSE&G
Breaker Derate Table	Ratings	Section 5 PSE&G
PJM/NYPP PAR Operation	PARS	Section 5 PJM
PSE&G/ConED Wheel	PARS	Section 5 PJM
5018 Branchburg – Ramapo PAR Coordination	PARS	Section 5 PJM
Back To Index		

PSE&G Artificial Island Stability

A.I. (Salem) Cross Trip Scheme [SPS]

PSE&G has modified the cross trip relay scheme at Salem such that it can be used for an extended outage of either 5015 Red Lion-Hope Creek or 5038 New Freedom-East Windsor 500 kV lines. The cross trip relay scheme was originally placed in service at Salem to improve stability of Artificial Island generation (Salem #1, Salem #2, and Hope Creek #1) during the extended outage of 5015 Hope Creek-Keeney in 1987. The relay scheme has been modified so that it can be used during an extended outage of 5038 New Freedom-East Windsor line.

When the 5015 Red Lion-Hope Creek line is out-of-service, the cross trip scheme can be armed on the 5038 and is designed to trip a Salem unit if there is a relay operation on the 5038 New Freedom-East Windsor line relays or both 5038 500 kV breakers open at New Freedom or at East Windsor. When arming the scheme to trip a Salem unit upon a relay operation of 5038, a First Energy operator must be sent to East Windsor to change the status. An AE-PHI operator must also set the selector switch at Orchard to “armed”. These steps are in addition to the PSE&G arming process.

When the 5038 New Freedom-East Windsor line is out-of-service, the cross trip scheme can be armed on the 5015 and is designed to trip a Salem unit if there is a relay operation on the 5015 Red Lion-Hope Creek line relay. Also, when armed with 5038 New Freedom-East Windsor line out-of-service, the cross trip scheme is designed to trip a Salem unit if both 5015 500 kV breakers open at Hope Creek or at Red Lion.

The cross trip scheme can be armed to trip either the Salem #1 or the Salem #2 unit. Following operation of the cross tripping, the remaining Artificial Island generation remains stable on 5021, 5023, 5024 and 5039 (Salem-Orchard, Hope Creek-New Freedom, Salem-New Freedom and Orchard-New Freedom lines).

Typically, the cross trip scheme is only armed during extended outages of 5015 Red Lion-Hope Creek or 5038 New Freedom-East Windsor, and if Artificial Island generation output is restricted. With the cross trip scheme armed, the probability of a unit tripping increases slightly. To minimize unit trippings, the scheme is disarmed (after making the appropriate Artificial Island MW reductions) for the following conditions:

- Unit Reductions - Operating conditions may require unit reductions below the appropriate Artificial Island stability limits for the cross trip off. Examples of such operating conditions are minimum generation problems or thermal overloads.
- Storm Situations:
    - thunder and lightning within 50 miles of Salem, Hope Creek, New Freedom, Deans or Red Lion/Keeney
    - ice/winter storms predicted in the area.
    - high winds/hurricane (winds in excess of 50 mph in area)
- Forest fires in the Salem/Deans/New Freedom (or Hope Creek/Red Lion/Keeney) right-of-ways.
- Equipment Repairs on the line which initiates cross tripping (5038 or 5015).

Power system stabilizers are installed on Salem No. 1, Salem No. 2 and Hope Creek No. 1 to improve the dynamic stability of the artificial island. The stabilizers are in service whenever possible. Unit reductions and/or increased MVAR outputs are necessary if one or both stabilizers are out-of-service during three unit operations.

Note: The artificial island complex is one of the places in the PJM RTO currently subject to dynamic stability restrictions. Artificial island generation can be limited for either dynamic or transient stability.

Generator stability limits are specified in terms of maximum gross MW output levels. The gross MW limits can change depending on:

- number of units operating
- cross trip relay scheme status

- unit stabilizer status (for Salem #1, Salem #2, and Hope Creek #1)
- gross MVAR output levels
- transmission outages

PSE&G Actions:

PJM Dispatch is responsible for determining the appropriate artificial island limitations.

The PSE&G System Operator is responsible for monitoring actual conditions and forecasted weather conditions.

The PSE&G System Operator notifies PJM dispatcher as soon as possible after it is determined that changes in artificial island MW and/or MVAR outputs are required.

If and when it becomes necessary to change status of the relay scheme armed to disarmed, disarm to armed, or armed to trip the other Salem unit), the PSE&G System Operator notifies PJM dispatcher.

PSE&G reduces generation before disarming the scheme (or arm the scheme before increasing generation) at Salem and Hope Creek. In this way, maximum system reliability is maintained.

First Energy Actions:

Dispatch an operator to East Windsor to change status if the trip scheme is being used in conjunction with a relay operation on the 5038 line or at East Windsor.

AE-PHI Actions:

At the request of PSE&G, set the Orchard selector switch to “armed”.

PJM Actions:

PJM dispatcher records the relay scheme status on the daily log sheet.

PJM dispatcher updates PJM security analysis program’s contingency list to reflect the change in status of the relay scheme.

Branchburg/Deans 500 kV Substation Contingency

Severe thermal violations exist with the loss of the Branchburg and Deans 500kV stations. Although PJM does not operate to be able to withstand Maximum Credible Disturbances, some basic good operating practices and training can be employed to lessen the impact on the PJM RTO if they occur. The guidelines included in this section provide this philosophy.

Thermal violations are aggravated when limited generation is running on the PSE&G system. The thermal violations are reduced as more PSE&G generation is scheduled.

The monitoring of the Maximum Credible Disturbance loss of the Branchburg and Deans 500kV stations is not performed as part of a continuous real-time analysis. However, if conditions exist for a more probable loss of either of these stations, PSE&G dispatchers notify PJM dispatchers so that an in-depth system analysis can be performed.

A Maximum Credible Disturbance analysis indicates severe thermal overloads on Buckingham - Pleasant Valley 230 kV circuit for the loss of the Branchburg 500 kV station (under certain operating conditions).

Severity of post contingency flows on Buckingham - Pleasant Valley (L220-12) 230kV line is dependent on steam generation running in PSE&G. The following strategy is offered to PJM dispatchers depending on the severity of post contingency flows and steam generation available.

- load synchronized reserves in New Jersey (PSE&G and FE East Areas)
- load quick start combustion turbines in New Jersey (PSE&G and FE East Areas)
- increase steam generation and load available combustion turbines in New Jersey, specifically in the PS and FE East Areas
- raise Trenton-Steel Tap PAR
- review lowering PECO Energy area generation (especially Cromby generation)
- request FE East to analyze separating the 230/34.5 kV system at East Flemington. Coordinate opening circuit switchers if analysis determines switching to be feasible.
- perform power flow analysis of opening the Buckingham-Pleasant Valley (L220-12) 230kV line. Coordinate opening Buckingham-Pleasant Valley (L220-12) 230kV line if analysis determines switching to be reliable. PSE&G, FE East , and PECO Energy must concur with the opening of Buckingham - Pleasant Valley.

A Maximum Credible Disturbance analysis also indicates thermal overloads on Branchburg-Bennett's Lane (X-2224) 230 kV circuit for the loss of the Deans 500 kV station under certain operating conditions.

Severity of post contingency flows on Branchburg-Bennett's Lane (X-2224) 230kV line is dependent on steam generation running in PSE&G. The following strategy is offered to dispatchers depending on severity of post contingency flows and steam generation available for control.

- load spinning reserves in PSE&G
- load quick start combustion turbines in PSE&G
- increase lambda for PSE&G steam and load available PSE&G combustion turbines
- raise Linden-Goethals and Linden-Bayway PARs
- lower Ramapo-Branchburg PARs.

Note: If the preceding measures prove to be inadequate or untimely, load is interrupted in PSE&G in accordance with the **PJM Manual for Emergency Operations (M-13)**. Load is interrupted in 500 MW increments, unless system conditions warrant otherwise.

Closing Normally Open Bus Section Breakers (Hudson and Marion)

This section describes conditions that may permit the closing of normally open bus tie breakers on the Hudson 230kV bus & Marion 138kV bus. At present, the Hudson 230kV bus & Marion 138kV bus are operated normally split. Closing any of these busses may result in overstressing breakers in that station or some other station, except under conditions as outlined in these procedures.

(Note: the term “lines” includes autotransformers.)

This guide considers only the interrupting capability of the circuit breakers. Problems of power flow and relaying will also have to be considered in conjunction with closing these busses.

Hudson

The Hudson 230-kV bus may be closed under the following circumstances: (Note: the term "lines" includes autotransformers.):

All Generators Out-of-Service plus

- A-2227 (Essex) out of service
- A-2227 (Essex) and 220-2 (Marion) out of service
- A-2227 (Essex) and 345-2 (Farragut) out of service
- A-2227 (Essex) and P2268 (S. Waterfront) out of service
- A-2227 (Essex) and 220-1 (Marion) out of service
- A-2227 (Essex) and 345-1 (Farragut) out of service
- A-2227 (Essex) and X-2250 (Belleville) out of service
- A-2227 (Essex) and Y-2225 (Penhorn) out of service
- 220-2 (Marion) and 345-1 (Farragut) out of service
- 220-2 (Marion) and 345-2 (Farragut) out of service
- 220-1 (Marion) and 345-1 (Farragut) out of service
- 220-1 (Marion) and 345-2 (Farragut) out of service
- 345-1 (Farragut) and 345-2 (Farragut) out of service
- 220-1 (Marion) and X-2250 (Belleville) out of service
- 345-1 (Farragut) and X-2250 (Belleville) out of service
- 345-2 (Farragut) and X-2250 (Belleville) out of service
- 220-1 (Marion) and 220-2 (Marion) out of service

Marion

The following is a list of possible line, generator, and autotransformer outages at Marion that must be out-of-service in order to close the Marion 138 kV bus:

- Essex – Kearny (W-1349) 138 kV line
- Hudson 220-1 autotransformer
- Hudson 220-2 autotransformer
- N-1314 & U-1321 (Both out-of-service simultaneously)
- F-1306, Kearnty #13 & Kearny #14 (All out-of-service simultaneously)

Double Circuit Tower Line Contingencies (DCTL) Associate with Susquehanna-Roseland Delay

In order to mitigate potential operational impacts caused by delays in the Susquehanna-Roseland 500kV upgrade project, PJM has incorporated several double circuit tower line (DCTL) contingencies into the normal EMS contingency set.

DCTL Contingency Descriptions

1	Loss of GILBERT - MORRISTOWN C2003 230 kV line + MORRISTOWN 230 / 34.5 kV #5 transformer + PORTLAND - GREYSTONE S1007 230 kV line
2	Loss of PORTLAND - GREYSTONE S1007 230 kV line + KITTATINNY – POHATCONG L2012 230 kV line +POHATCONG 230 / 34.5 kV #1 transformer
3	Loss of GILBERT - MORRISTOWN C2003 230 kV line + MORRISTOWN 230 / 34.5 kV #5 transformer + GILBERT - GLEN GARDNER V1036 230 kV line
4	Loss of POHATCONG - WEST WHARTON A2001 230 kV line + PORTLAND - GREYSTONE S1007 230 kV line
5	Loss of PORTLAND - KITTATINY V1010 230 kV line + KITTATINY 230 / 34.5 kV #1 transformer + PORTLAND - GREYSTONE S1007 230 kV line
6	Loss of WEST WHARTON - CHESTER H2034 230 kV line + CHESTER 230 / 34.5 kV #4 transformer + POHATCONG - WEST WHARTON A2001 230 kV line
7	Loss of WHIPPANY - GREYSTONE J1024 230 kV line + WHIPPANY - GREYSTONE Q1031 230 kV line + WHIPPANY 230 / 34.5 kV BK 7 transformer + WHIPPANY 230 / 115 kV BK 12 transformer

PJM Actions:
PJM system operations will implement the following actions to control for system congestion caused by these DCTL contingencies.

- Post-contingency flows exceed Long Term Emergency (LTE) rating
- PJM dispatch will issue a PCLLRW.
- Post contingency flows exceed Load Dump (LD) rating
- PJM dispatch will initiate the redispatch of off-cost generation, controlling flows to 100% of the LD rating on a pre-contingency basis within SCED. Constraints will be permitted to set PJM LMP.

Breaker Derate Table

For certain CB outages which isolate a line on a single CB, PS derates the line rating due to the CB limitation which becomes limiting.

PJM needs to ensure line ratings are changed to reflect this single CB limitation when those CB's on the attached list are being worked on.

BKR Outage	LINE/XFMR	Temp. °F	NL	EM	LD
Hope Creek					
500 kV 1-3	5015	95	2477	3016	3468
		86	2598	3113	3580
		77	2714	3208	3689
		68	2824	3301	3796
		59	2931	3391	3900
		50	3034	3480	4002
		41	3133	3567	4102
		32	3230	3652	4200
Hope Creek					
500 kV 3-4	5015	95	2707	3016	3468
		86	2813	3113	3580
		77	2916	3208	3689
		68	3016	3301	3796
		59	3113	3391	3900
		50	3208	3480	4002
		41	3301	3567	4102
		32	3391	3652	4200
Deans					
500 kV 2-6 or 5-6	5022	95	2707	3016	3468
		86	2813	3113	3580
		77	2916	3208	3689
		68	3016	3301	3796
		59	3113	3391	3900

BKR Outage	LINE/XFMR	Temp. °F	NL	EM	LD
		50	3208	3480	4002
		41	3301	3567	4102
		32	3391	3652	4200
Hope Creek					
500 kV 1-5 or 5-6	5023	95	2477	3016	3468
		86	2598	3065	3524
		77	2714	3112	3579
		68	2815	3159	3633
		59	2867	3205	3686
		50	2917	3250	3738
		41	2967	3295	3790
		32	3016	3339	3840
Salem					
500 kV 1-8 or 2-8	5021	95	2477	3016	3468
		86	2598	3065	3524
		77	2714	3112	3579
		68	2815	3159	3633
		59	2867	3205	3686
		50	2917	3250	3738
		41	2967	3295	3790
		32	3016	3339	3840
Salem					
500 kV 2-6 or 5-6	5024	95	2477	3016	3468
		86	2598	3065	3524
		77	2714	3112	3579
		68	2815	3159	3633

BKR Outage	LINE/XFMR	Temp. °F	NL	EM	LD
		59	2867	3205	3686
		50	2917	3250	3738
		41	2967	3295	3790
		32	3016	3339	3840
Salem					
500 kV 2-10 **OR**	5037	95	2477	3016	3468
Hope Creek 500 kV 2-4		86	2598	3113	3580
		77	2714	3208	3689
		68	2824	3301	3796
		59	2931	3391	3900
		50	3034	3480	4002
		41	3133	3567	4102
		32	3230	3652	4200
Deans					
230 kV 2-6 or 5-6	Deans 500-1	95	812	1038	1194
		86	839	1067	1227
		77	865	1094	1259
		68	890	1121	1290
		59	915	1148	1302
		50	938	1174	1302
		41	961	1199	1302
		32	983	1224	1302
Deans					
230 kV 2-8 or 7-8	Deans 500-2	95	812	1038	1194
		86	839	1067	1227
		77	865	1094	1259

BKR Outage	LINE/XFMR	Temp. °F	NL	EM	LD
		68	890	1121	1290
		59	915	1148	1302
		50	938	1174	1302
		41	961	1199	1302
		32	983	1224	1302
Deans					
230 kV 2-10 or 9-10	Deans 500-3	95	784	1038	1183
		86	809	1067	1199
		77	834	1094	1213
		68	858	1121	1228
		59	881	1148	1245
		50	903	1172	1258
		41	925	1188	1274
		32	946	1204	1290
Hudson					
230 kV 7-8 or 7-12	B-3402	95	560	740	851
		86	560	764	878
		77	560	787	905
		68	560	795	931
		59	608	832	957
		50	608	854	982
		41	608	863	1006
		32	608	863	1030
Hudson					
230 kV 1-2 or 1-6	A-2227	95	688	815	937
		86	729	831	955

BKR Outage	LINE/XFMR	Temp. °F	NL	EM	LD
		77	747	847	973
		68	764	862	991
		59	781	877	1009
		50	798	892	1026
		41	815	907	1043
		32	831	922	1060
Aldene					
230 kV 4-6	N-2240	95	688	831	955
		86	736	853	981
		77	770	876	1007
		68	788	897	1032
		59	806	918	1056
		50	823	939	1080
		41	840	959	1103
		32	857	979	1126
Sewaren					
138 kV 4-5 or 5-6	Sewaren 220-1	95	399	444	510
		86	414	458	527
		77	429	472	543
		68	444	486	559
		59	458	499	574
		50	472	512	589
		41	486	525	604
		32	499	538	618
West Orange					
S-1319 138kV CB	S-1319	95	318	374	430

BKR Outage	LINE/XFMR	Temp. °F	NL	EM	LD
Applies when circuit is in service and on the West Orange Transfer Bus		86	330	384	442
		77	342	394	453
		68	353	404	464
		59	364	413	475
		50	374	423	486
		41	385	432	496
		32	395	440	507
West Orange					
T-1320 138kV CB	T-1320	95	318	374	430
Applies when circuit is in service and on the West Orange Transfer Bus		86	330	384	442
		77	342	394	453
		68	353	404	464
		59	364	413	475
		50	374	423	486
		41	385	432	496
		32	395	440	507

Index of Operating Procedures for First Energy-South (AP) Control Zone

The First Energy-South (AP) Control Zone has Operating Procedures that are adhered to by PJM. These procedures include the following:

	Type of Operating Procedure	Transmission Operations Manual Section Ref
First Energy- South (AP)		
Loop Flows Around Lake Erie (MISO, NY-ISO, IMO & PJM)	Limitations	Section 5 – PJM
FE East/AP Tie Lines	Thermal Contingency	Section 5 – FE-PN
Bath County SPS	Protection Scheme	Section 5 – DVP
Contingency Overloads in the Willow Island Area	Thermal Contingency	Section 5 – AP
Belmont SPS	Protection Scheme	Section 5 – AP
Breaker Derate Table	Ratings	Section 5 – AP
Ronco Stability	Generator Stability	Section 5 – AP
Black Oak SVC	SVC	Section 5 – AP
Black Oak 500/138kV #3 Transformer SPS	Protection Scheme	Section 5 – AP
Bus Voltage Exceptions	Ratings	Section 5 – AP
Back To Index		

Contingency Overloads in the Willow Island Area

This chart details the AP plan for contingency overloads on the Willow Island – Eureka 138 kV line for loss of the Kammer – South Canton 765 kV line. The pre-contingency solution is to open the bus tie breaker at Willow Island and open the Belmont 614 breaker at Willow Island.

Plan for Contingency Overloads in the Willow Island Area Precautions: If possible, post-contingency reconfiguration should be modeled prior to switching.			
	Conditions	**Description of Steps**	**Options**
Contingency	Kammer-South Canton 765kV line or Harrison-Belmont 500kV line or other possible contingencies		
Limiting facilities	Willow Island-Long Reach-Paden City-Natrium 138kV lines		
Precontingency switching options	Open the N-S 138kV bus tie bkr and the 614 Belmont 138kV line bkr at Willow Island.	This action will isolate the Willow Island-Long Reach 70 138kV line from the affect of the outage of Kammer-South Canton 765kV line.	
Off-cost Options-PJM	Oak Grove, Gorsuch, Pleasants generators may have output lowered.		
Load Dump Warning	Yes, for area between Willow Island and Natrium.		
External load or transaction participation	AEP load at or near Natrium could be a factor, but reconfiguration will eliminate the need for Load Dump.		
Post-Contingency Actions	Loading exceeds Normal (continuous) rating	PJM will issue Load Dump Order. Open the Natrium 68 138kV breaker at Paden City. Alternately, open the 64 breaker at Long Reach or the 70 breaker at Long Reach or the 70 breaker at Willow Island (in order of preference).	If unable to operate any breakers remotely, request AEP to open the Paden City 64 breaker at Natrium.

Belmont SPS [SPS]

During an outage of the Belmont-Harrison #528 500 kV line with the Pleasants units 1 and 2 running at an output of greater than 1150 Net MW, the loss of the Belmont #5 765/500 kV transformer will result in the generators becoming unstable with potential damage to the units very likely. An outage of the Belmont #5 765/500 kV transformer and the loss of the Belmont-Harrison #528 500 kV line with Pleasants units 1 and 2 running at an output greater than 1150 MW has the same impact.

Load flow studies with worst case generation dispatch in the Parkersburg area have determined that a Special Protection Scheme (SPS) must be armed and an Oak Grove generator and/or a Pleasants generator selected to trip during an EHV contingency.

Beside the plant stability restriction and in conjunction with the SPS, there are additional unit specific restrictions to be in place during an outage of the Belmont-Harrison #528 500 kV line or Belmont #5 765/500 kV transformer.

1. If Pleasants unit 1 output is greater than 520 MW, Pleasants unit 2 output shall be restricted to 520 MW.
2. If Pleasants unit 2 output is greater than 520 MW, Pleasants unit 1 output shall be restricted to 520 MW.
3. If only a single Pleasants unit is running, output of the running Pleasants unit shall be restricted to 520 MW.

The Table below will provide guidance in determining which of the two Pleasants units shall be selected to trip based on the MW output in order to prevent a stability problem and prevent severe thermal overloads on the 138 kV lines in the Parkersburg area should the second EHV contingency occur.

Pleasants Plant output	Pleasants Unit 1 output (MW)	Pleasants Unit 2 output (MW)	Pleasants Unit to be tripped
Case I	between P_{min} and 520	between P_{min} and 520	either Unit 1 or Unit 2
Case II	between 520 and P_{max}	between P_{min} and 520	Unit 1
Case III	between P_{min} and 520	between 520 and P_{max}	Unit 2

The SPS should be armed whenever an outage takes place on either the Harrison – Belmont #528 500kV line **or** the Belmont #5 765/500kV transformer to prevent overloading on the 138kV lines in the Parkersburg area and to prevent the generators from becoming unstable.

For an outage of the Belmont #5 765/500 kV transformer:

The SPS will be armed only after all normal switching has been performed to remove the Belmont #5 765/500 kV transformer from service.

Note: Due to recent FE rating changes, retirement of both Willow Grove units and new Pleasant plant individual unit stability restrictions, PJM in process of confirming the need to trip a single Oak Grove CT's as a part of Belmont SPS scheme.

With ONE Pleasants unit on and BOTH Oak Grove Combustion Turbine units on, the SPS is armed to trip either Oak Grove Combustion Turbine unit 1 by opening the Oak Grove 138 kV breakers B3 and B6, or Oak Grove Combustion Turbine unit 2 by opening the Oak Grove 138 kV breakers B1 and B4. There is a 60 second time delay before a transfer trip signal is sent to trip a single Oak Grove Combustion Turbine unit.

PJM Actions:

- Call FE to determine which Oak Grove unit will be removed from service.
- Deactivate the contingency “Belmont – Harrison 500kV line” from Group 1.
- Activate the appropriate contingency:
- If Oak Grove unit 1 is to be tripped, activate the contingency, “BEL-HAR 500kV & OakGrv CT #1 (SPS)” in Group 1 and control resulting contingencies to the LTE rating for the SPS.
- If Oak Grove unit 2 is to be tripped, activate the contingency, “BEL-HAR 500kV & OakGrv CT #2 (SPS)” in Group 1 and control resulting contingencies to the LTE rating for the SPS.

With BOTH Pleasants units on and BOTH Oak Grove Combustion Turbine units on, the SPS is armed to trip a Pleasants unit and either Oak Grove Combustion Turbine unit 1 by opening the Oak Grove 138 kV breakers B3 and B6, or Oak Grove Combustion Turbine unit 2 by opening the Oak Grove 138 kV breakers B1 and B4. There is a 60 second time delay before a transfer trip signal is sent to trip a single Oak Grove Combustion Turbine unit.

PJM Actions:

- Call FE to determine which Pleasants unit and which Oak Grove unit will be removed from service.
- Deactivate the contingency “Belmont – Harrison 500kV line” from Group 1.
- Activate the appropriate contingency:
    - If Pleasants unit 1 and Oak Grove unit 1 are to be tripped, activate contingency, “BEL-HAR 500kV & OakGrv CT #1 & Plsnts #1 (SPS)” in Group 1 and control resulting contingencies to the LTE rating for the SPS.
    - If Pleasants unit 1 and Oak Grove unit 2 are to be tripped, activate contingency, “BEL-HAR 500kV & OakGrv CT #2 & Plsnts #1 (SPS)” in Group 1 and control resulting contingencies to the LTE rating for the SPS.
    - If Pleasants unit 2 Oak Grove unit 1 are to be tripped, activate contingency, “BEL-HAR 500kV & OakGrv CT #1 & Plsnts #2

(SPS)" in Group 1 and control resulting contingencies to the LTE rating for the SPS.

- If Pleasants unit 2 Oak Grove unit 2 are to be tripped, activate contingency, "BEL-HAR 500kV & OakGrv CT #2 & Plsnts #2 (SPS)" in Group 1 and control resulting contingencies to the LTE rating for the SPS.

For an outage of the Harrison – Belmont #528 500 kV line:

The SPS will only be armed after all normal switching has been performed to remove the Belmont-Harrison #528 500 kV line from service.

With ONE Pleasants unit on and BOTH Oak Grove Combustion Turbine units on, the SPS is armed to trip either Oak Grove Combustion Turbine unit 1 by opening the Oak Grove 138 kV breakers B3 and B6, or Oak Grove Combustion Turbine unit 2 by opening the Oak Grove138 kV breakers B1 and B4. There is a 60 second time delay before a transfer trip signal is sent to trip a single Oak Grove Combustion Turbine unit.

PJM Actions:

- Deactivate the contingency "Kammer-Belmont-Mountaineer 765 kV line" from Group 1.
- Deactivate the contingency "Belmont 765/500kV XF (Sectionalized)" from Group 1.
- Activate the appropriate contingency:
- If Oak Grove unit 1 is to be tripped, activate contingency, "KAM-BEL-MOU 765kV & OakGrv CT #1 (SPS)" in Group 1. Also activate contingency, "BEL TR#5 765/500kV (Sctnlzd) & OakGrv CT #1 (SPS)" in Group 1. Control any resulting contingencies to the LTE rating for the SPS.
- If Oak Grove unit 2 is to be tripped, activate contingency, "KAM-BEL-MOU 765kV & OakGrv CT #2 (SPS)" in Group 1. Also activate contingency, "BEL TR#5 765/500kV (Sctnlzd) & OakGrv CT #2 (SPS)" in Group 1. Control any resulting contingencies to the LTE rating for the SPS.

With BOTH Pleasants units on and BOTH Oak Grove Combustion Turbine units on, the SPS is armed to trip a Pleasants unit and either Oak Grove Combustion Turbine unit 1 by opening the Oak Grove 138 kV breakers B3 and B6, or Oak Grove Combustion Turbine unit 2 by opening the Oak Grove138 kV breakers B1 and B4. There is a 60 second time delay before a transfer trip signal is sent to trip a single Oak Grove Combustion Turbine unit.

PJM Actions:

- Call FE to determine which Pleasants unit and which Oak Grove unit will be removed from service.
- Deactivate the contingency "Kammer-Belmont-Mountaineer 765 kV line" from Group 1.

- Deactivate the contingency “Belmont 765/500kV XF (Sectionalized)” from Group 1.
- Activate the appropriate contingencies:
  - If Pleasants unit 1 and Oak Grove unit 1 are to be tripped, activate contingency “KAM-BEL-MOU 765kV & OakGrv CT #1 & Plsnts #1 (SPS)” in Group 1. Also activate contingency “BEL TR#5 765/500kV (Sctnlzd) & OakGrv CT #1 & Plsnts #1 (SPS)” in Group 1. Control any resulting contingencies to the LTE rating for the SPS.
  - If Pleasants unit 1 and Oak Grove unit 2 are to be tripped, activate contingency “KAM-BEL-MOU 765kV & OakGrv CT #2 & Plsnts #1 (SPS)” in Group 1. Also activate contingency “BEL TR#5 765/500kV (Sctnlzd) & OakGrv CT #2 & Plsnts #1 (SPS)” in Group 1. Control any resulting contingencies to the LTE rating for the SPS.
  - If Pleasants unit 2 and Oak Grove unit 1 are to be tripped, activate contingency, “KAM-BEL-MOU 765kV & OakGrv CT #1 & Plsnts #2 (SPS)” in Group 1. Also activate contingency “BEL TR#5 765/500kV (Sctnlzd) & OakGrv CT #1 & Plsnts #2 (SPS)” in Group 1. Control any resulting contingencies to the LTE rating for the SPS.
  - If Pleasants unit 2 and Oak Grove unit 2 are to be tripped, activate contingency, “KAM-BEL-MOU 765kV & OakGrv CT #2 & Plsnts #2 (SPS)” in Group 1. Also activate contingency “BEL TR#5 765/500kV (Sctnlzd) & OakGrv CT #2 & Plsnts #2 (SPS)” in Group 1. Control any resulting contingencies to the LTE rating for the SPS.

Breaker Derate Table

For certain CB outages which isolate a line on a single CB, FE derates the line rating due to the CB limitation which becomes limiting.

FE (AP’s) single breaker ratings can be found on the OASIS System Information page under the ratings section at the following link:

http://www.pjm.com/markets-and-operations/etools/oasis/system-information.aspx

PJM needs to ensure line ratings are changed to reflect this single CB limitation when those CB's on the OASIS posting list are being outaged.

Ronco Stability

Stability Restriction Details:

Only two of three Ronco units may be on-line when either of the following lines are out of service:

Hatfield-Yukon (518) 500 kV line

Ronco-Fort Martin (516) 500 kV line

If either of the above lines is removed from service (tripping, maintenance, etc) and all three Ronco units are operating, the PJM operator must notify Duke Energy to immediately shut down one unit at the Ronco facility.

PJM Actions:

If the Hatfield-Yukon (518) 500 kV line or the Ronco-Fort Martin (516) 500 kV line trips and all three Ronco units are on line, contact Duke Energy and request that one unit be shut down. If either line trips and fewer than three Ronco units are on line at the time, no action is necessary.

Log the event and inform outage analysis group.

Black Oak SVC

Black Oak SVC Details:

AP 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 between 145 MVAR inductive to hold voltages between 545 kV and 550kV and 575 MVAR capacitive to hold voltages between 505kV and 510kV.

Normal Operating Mode:

- Q-optimizer “ON”
- Capacitor breakers in “AUTO”.
- Automatic Voltage Control Mode
- “ON” setpoint at 504kV with 22 second time delay.
- “OFF” setpoint at 544kV with 3 second time delay.
- Normal Mode (+575 MVAR, -145 MVAR)

Note 1: The Q-optimizer control scheme will not prevent manual switching of the capacitors, but the capacitor breakers must be changed to MANUAL to switch and then returned to AUTO for SVC control of the capacitors.

AP Actions:

- Communicate change from Normal Operating Mode (defined above) to PJM Dispatch.
- Capacitors at Bedington and Doubs are kept on-line pre-contingency to maximize transfer limits and because of the SVC post-contingency

control of the Black Oak capacitors. Capacitors at Bedington and Doubs should be switched on first and off last.

- Coordinate manual switching of Black Oak capacitors with PJM Dispatch, ensuring return of capacitors to “AUTO” setting for SVC control of the capacitors.
- Changes to the Q-Optimizer, Control Mode and B Ref values must be coordinated with PJM.

PJM Actions:

- Process changes from Normal Operating Mode (defined above) into PJM EMS system (Q-optimzer, Control Mode, B Ref values, derated capability (i.e. alternate modes) to ensure accurate model and Network Application solutions.
- Capacitors at Bedington and Doubs are kept on-line pre-contingency to maximize transfer limits and because of the SVC post-contingency control of the Black Oak capacitors. Capacitors at Bedington and Doubs should be switched on first and off last.
- Coordinate manual switching of Black Oak capacitors with AP Dispatch.

Black Oak 500/138kV #3 Transformer [SPS]

Black Oak SPS Details:

Potential overloads on the Black Oak 500/138kV #3 Transformer can occur for the contingency loss of the Black Oak – Hatfield 500kV line. A Special Protection Scheme has been designed to open the Black Oak #3 138kV Low Side CB, BO-3, via relay upon the loss of the Black Oak – Hatfield 500kV line. This SPS is redundant, automatic and local to the Black Oak substation. The SPS can be placed under manual control so that the SPS can be disabled for switching.

FE(AP) Actions:

- FE (AP) will notify PJM of any change in status for the SPS

PJM Actions:

- PJM will monitor status of SPS
- PJM will adjust the active contingency list as required depending upon current status of SPS (enabled or disabled)

Bus Voltage Exceptions

Per Exhibit 5 (Bus and Zone Specific Variations to PJM Base Line Voltage Limits) found at the end of Section 3, Voltage and Stability Operating Guidelines, the AP 138kV network as a whole operates to an alternate set of Normal Low, Emergency Low and Load Dump voltage limitations. The following AP 138kV substations are exceptions to the AP limits contained within Exhibit 5:

Bus	138 kV		
	LD	EL	NL
Baker	122.0	126.0	130.0
Hardy	122.0	126.0	130.0
North Petersburg	122.0	126.0	130.0
Seneca Caverns	122.0	126.0	130.0

Index of Operating Procedures for RECO Transmission System

The RECO Transmission Zone has no special Operating Procedures for this section of the manual.

Index of Operating Procedures for UGI Transmission System

UGI has Operating Procedures that are adhered to by PJM. These procedures include the following:

	Type of Operating Procedure	Transmission Operations Manual Section Ref
UGI		
Operation of 23030 Tie at Mountain	Tie Operations	Section 5 UGI
UGI/PL 66 kV Tie Line Operation	Tie Operations	Section 5 UGI
Back to Index		

Operation of 23030 Tie at Mountain

The 23030 230 kV tie at Mountain is operated normally opened. The 23030 tie was intended to provide the Mountain Substation with two independent sources in the event of an outage of either the Mountain – Susquehanna T10 – Montour 230 kV line or the Mountain – Lackawanna 230 kV line.

The 23030 tie is also used to:

- Provide a source to PPL's Susquehanna T-10 Ring Bus to feed Susquehanna T-10 transformer during an outage of the Susquehanna T-10 – Montour 230 kV line.
- Provide a source to PPL's Lackawanna 230 kV substation for voltage support.

In order to close the 23030 tie at Mountain, the 23010 230 kV circuit breaker at Mountain and the 23020 230 kV circuit breaker at Mountain must initially be open when switching the

23030 tie closed. After the 23030 tie is closed, the 23010 and 23020 230kV circuit breakers are then closed.

PJM Actions:

- The PJM dispatcher initiates a study for the closing of the 23030 tie. This two-part study needs to include the switching configuration required to close the 23030 and the final configuration with the 23030 closed.
- If the studies indicate no actual or contingency violations result from closing the tie, PJM dispatcher contacts UGI and PL to determine if conditions permit the closing of the 23030 tie.
- If agreed by PJM, UGI, and PL, the PJM dispatcher instructs UGI to close the 23030 tie.
- If the 23030 disconnect is being closed, the PJM PD will activate the contingency “Mountain XF3 (UGI) w/ 23030 closed”, and deactivate contingency “Mountain XF 230/66 kV (UGI).
- PJM dispatcher initiates the opening of the tie as soon as practical.

UGI/PL 66 kV Tie Line Operation

There are three 66 kV tie lines between the PL and UGI transmission systems. The normally open ties are the Swoyersville – Stanton 66 kV line which is open at Swoyersville and the Plymouth - Jenkins 66 kV line which is open at Hanover. The Hunlock - Berwick 66 kV line is normally closed. The normal status of these ties may change to facilitate transmission outages in the area.

Identified conditions that require abnormal system configuration:

- For an outage on a Plymouth – Mountain 66 kV line (#1 or #2), Hanover – Plymouth section of the Plymouth – Jenkins line, or for an outage of the Plymouth #1 66 kV bus, the Plymouth – Jenkins 66 kV tie must be closed at Hanover.
- For an outage of the Plymouth #1 66 kV bus or the Hanover – Plymouth section of the Plymouth – Jenkins line, the Hanover #1 transformer will be fed radial from Jenkins and the Hanover 13 kV bus tie will be opened. A two-part study will need to be done to include the switching configuration (closing in the normally open Plymouth – Jenkins at Hanover) and the final configuration for taking these outages.
- For an outage on the Swoyersville – Mountain #1 66 kV line or for an outage of the Swoyersville #2 66 kV bus, the Swoyersville – Stanton 66 kV tie must be closed at Swoyersville.

PJM Actions:

- The PJM dispatcher initiates a study for the closing and/or opening of the appropriate tie line(s).
- If the study indicates no actual or contingency violations result from opening and/or closing the tie line(s), the PJM dispatcher contacts UGI and PL to determine if conditions permit the opening and or closing of the tie line (s).
- If agreed by PJM, UGI, and PL, the PJM dispatcher instructs UGI to close and/or open the tie line(s).
- The PJM dispatcher initiates the return of the tie lines to their normal status as soon as practical. Index of Operating Procedures for New York ISO (NY-ISO) Balancing Authority

The New York ISO (NY-ISO) Balancing Authority has Operating Procedures that are adhered to by PJM. These procedures include the following:

	Type of Operating Procedure	Transmission Operations Manual Section Ref
New York ISO (NYISO)		
PJM/NY-ISO PAR Operation	PARS	Section 5 PJM
PJM/NY-ISO Transfers via First Energy	Contingency/Transfers	Section 5 FE-PN
Ramapo PAR Operating Instruction	PARS	Section 5 NYISO
5018 Branchburg – Ramapo PAR Coordination	PARS	Section 5 PJM
Back To Index		

Ramapo Par Operating Instruction

General:

This procedure provides the operating guidelines for the operation, control, and scheduling of energy on the Branchburg-Ramapo 500 kV transmission line, designated 5018. these guidelines are in accordance with the “Essential Elements of a Transmission Agreement between the New York Power Tool (NYPP) and the Pennsylvania-New Jersey-Maryland Interconnection (PJM)”, dated July 25, 1985.

This procedure shall be used as a guide by the system operators of the NYPP and PJM for scheduling and controlling the hourly flow of energy that will be interchanged between the two power tools on the Branchburg-Ramapo (5018) 500kV line.

This operating instruction does not supersede the agreement between Public Service Electric and Gas Company (PS) and Consolidated Edison Company (Con Ed) regarding the operating of the Phase Angle Regulators (PARs) that control the flows on the PS-Con Ed tie lines. The Ramapo's PARs shall not be set such that the resulting flows on these PS-Con Ed ties are in violation of the PS-Con Ed agreement and cannot be corrected with adjustments to the PS-Con Ed PARs.

During system disturbances or emergencies, the appropriate most restrictive emergency procedures of the NYPP, PJM, Con Ed, and PS, if necessary, shall supersede the provisions of this procedure.

Definitions of Terms Used in this Operating Instruction

PJM Transmission Limited:

The Actual flows of any one or more of the following exceed the operating points (95% of limits): Western Transfers, Central transfers, Eastern transfers.

Rating points (95% of limits): Western Transfers, Central transfers, Eastern transfers.

NYPP Transmission Limited:

The actual flows across any one or more of the following exceed the operating points: Central Eat Interface, West-Central Interface, Leeds-Pleasant Valley (91 Line), Leeds-Pleasant Valley (92 Line); or the post contingency flow on the 91 line for the loss of the 92 line or vice versa exceeds the four hour emergency limit for that line.

Spillover:

A condition that exists when the settings on the Ramapo (PARs) result in actual flows exceeding the allowable flows on the other PS-Con Ed ties to an extent that these flows cannot be controlled by adjusting the PS-Con Ed PARs. Spillovers can be recognized by one or more of the PS-Con Ed PARs reaching its maximum tap setting.

Actual Flow:

The metered flow on the Branchburg to Ramapo 500kV line.

Desired Flow:

The calculated flow from Branchburg to Ramapo that reflects the current PJM/NYPP interchange schedule, the payback schedule, the PS-Con Ed PAR imbalance, and any protection items that are required due to operations outside of the two pools. (See the section on calculating Desired Flow for a more detailed description).

Target Flow:

When it becomes necessary to move the Ramapo PARs to correct a transmission limitation or Spillover, the first step is to determine what the Actual Flow from Branchburg to Ramapo would have to be to correct the problem. This flow is the Target Flow.

Transmission Use:

The use of one power pool's transmission system by the other. Transmission use is defined as the Actual Flow from Branchburg to Ramapo minus the Desired Flow. If the Actual Flow into Ramapo is greater than the Desired Flow then the difference is NYPP's use of PJM's transmission. If the Actual Flow into Ramapo is less than the Desired Flow, then the difference is PJM's use of NYPP's transmission.

Acceptable Transmission Use:

In order to accommodate each pool's internal dispatch and external transactions, a range of Transmission Use that is to be considered acceptable has been negotiated. Transmission Use is acceptable if it is below the value of:

1) 400 MW until December 31, 1991, or
2) After December 31, 1991, the greater of:
    A) 30% of NYSEG's share of available Homer City generating capacity, or
    B) A phased reduction from the 400 MW initial value by 40 MW/year commencing January 1, 1992.

Thus, effective January 1, 1992, Acceptable Transmission use is 360 MW.

If both pools are Limited, NYPP is allowed to use PJM's transmission up to the acceptable limit. If neither pool is Limited, then there is no limit on Acceptable Use, but the objective is still zero (0) transmission use.

Transmission Overuse:

If one of the pools becomes Limited and the other's transmission Use exceeds the acceptable level, then that pool is making Transmission Overuse. The pool making the Overuse should take steps to correct the problem by either allowing the Ramapo PARs to be adjusted, or adjust its own internal system. Until that Pool's Transmission Use falls within the acceptable limits the other pool is entitled to compensation for the Overuse of its transmission in accordance with the Transmission Use Agreement.

PS-Con Ed Ties:

The following lines make up the PS-Con Ed Ties referred to throughout this instruction:

South Mahwah 345 – Waldwick 345 (J-3410)

South Mahwah 345 – Waldwick 345 (K-3411)

Hudson 345 – Farragut 345 (B-3402)

Hudson 345 – Farragut 345 (C-3403)

Linden 230 – Goethels 230 (A-2253)

PS-Con Ed PARs:

The following PARs control the flows on the PS-Con Ed Ties:

- At Waldwick: Three PARs on the following 230 kV lines:
    - Hawthorne 230 – Waldwick 230 (E-2257)
    - Hillsdale 230 – Waldwick 230 (F-2258)
    - Fairlawn 230 – Waldwick 230 (O-2267)
- At Farragut: Two PARs on the following 345 kV line:
    - Hudson 345 – Farragut 345 (B-3402)
    - Hudson 345 – Farragut 345 (C-3403)

- At Goethels: One PAR on the following 230 kV line:
  - Linden 230 – Goethels 230 (A-2253)

Introduction:

The main point of the agreement between PJM and NYPP regarding the control of the Ramapo PARs is that, ideally, the flow on the Branchburg-Ramapo 500 kV line should be set to maintain the zero Transmission Use when neither pool is Limited. However, in recognition of internal conditions and external transaction of wither pool bandwidth of Acceptable Transmission Use had been negotiated. This means that at any point in time, the Actual Flow in the line can be broken down into two components; a Desired Flow component and a Transmission Use component.

Desired Flow is a calculated value. It takes into account the scheduled PJM – NYPP interchange, the PS – Con Ed PAR imbalance, and protection items for operations outside of both pools. Calculating desired Flow is described in a subsequent section. A way to conceptualize desired Flow is to realize that if there were no PJM-NYPP interchange, no PS-Con Ed PAR imbalance, and no protection items, then the Desired Flow would be zero.

Even if the Desired Flow is zero, it is likely that the Actual Flow would not be zero. This difference between actual and Desired Flows is the Transmission Use. As long as the Actual Flow is within a negotiated bandwidth of the Desired Flow, then the Transmission Use is considered acceptable. In order to avoid unnecessary PAR operations, the PARs will only be moved if one of the pools becomes Limited or Spillover occurs. This means that Transmission Use could exceed the acceptable level as long as there are no limitations. Transmission Use could also exceed the acceptable level if it would help one of the pools avoid a Limit and the other pool did not become Limited. However, when one pool is exceeding Acceptable Transmission Use and the other becomes Limited, then the first pool should, within reason, take action to reduce its Transmission Use to acceptable levels. Otherwise, it owes the other pool compensation for overusing its transmission.

An Example:

For the first hour the Desired Flow is calculated to be 600 MW into Ramapo. The Actual Flow is 700 ME into Ramapo. This means that NYPP is making 100 MW of Transmission Use which is within the 400 MW acceptable range.

NYPP determines that it will become Limited and requests that the PARs be adjusted to change the Actual Flow to 900 MW into Ramapo. It is determined that this will cause neither a PJM Limit nor Spillover and the PAT tap change is made. Since the desired Flow is still 600 MW this means that NYPP is now making 300 MW of Transmission Use.

As time goes on, the scheduled PJM-NYPP interchange drops and the Desired Flow now becomes 400 MW into Ramapo. Since the Actual Flow is still 900 MW NYPP is now making 500 MW of Transmission Use. This is beyond the 400 MW acceptable range but since PJM is not Limited, the PARs are not moved and NYPP does not owe PJM any compensation for Transmission Overuse.

Later PJM becomes Limited and requests that the PARs be adjusted to reduce the Actual Flow to 300 Mw. It is determined that his will cause neither a NYPP Limit nor Spillover and the PAR tap change is made. Since the Desired Flow is still 400 MW PJM is now making 100 MW of Transmission Use.

In a subsequent period the PJM-NYPP schedule changes such that the Desired Flow becomes 300 Mw into Ramapo/ In the same period, NYPP becomes Limited and requests the Actual Flow be increased to 800 MW. It is determined that any increase will cause a PJM Limitation. At this point, both pools are Limited and NYPP requests that it receive the maximum Acceptable Transmission Use the agreement allows it under these conditions. The PARs are adjusted to increase the actual flow into Ramapo. Each pool now should make its own internal adjustment to correct any Limitation that this flow has caused or not completely corrected.

Procedure with both Ramapo PARs in service:

Thirty minutes prior to the start of the next hour, the system operators of the NYPP and PJM will determine if either or both of the pools expect to be Transmission Limited.

If it is determined that there are no Limitation then the Ramapo PARs will maintain their current tap position

If it is determined that there are Limitations, then the appropriate following shall be used.

Case 1: The Actual Flow on the Branchburg-Ramapo 500 kV line exceeds the normal rating, or the post contingency flow exceeds the 4 hour emergency rating.

The Actual Flow must now be brought back within the rating requirements.

1) Determine the Ramapo PAR tap change(s) that would reduce the Actual Flow to within the rating's requirements, and also the effect on the PS-Con Ed ties.
2) If no PAR tap change(s) can be made because the Ramapo PARs are at their maximum tap setting, or because Spillover would occur, then generation should within reason, be increased in the appropriate pool to reduce the flow to within ratings requirements.
3) If the PAR tap change(s) can be made, then do so. If this causes either or both pools to become Limited, then each pool will correct its Limitations with adjustments to its own generation.

Case 2: PJM is Limited

PJM may now request a Ramapo PAR shift that will reduce the Branchburg to Ramapo flow in order to allow additional West to East transfers, thus reducing or eliminating PJM off cost generation.

1) Determine the Target Flow that would correct the PJM Limitation.
2) If the Target Flow exceeds the Branchburg-Ramapo normal rating, or the post contingency flow exceeds the 4 hour rating, then revise the Target Flow to stay within the ratings requirements.
3) Determine the PAR tap change(s) that will reduce the Actual Flow to at least the Target Flow. That is, if the Target Flow lies between two tap positions then the PAR tap should be moved to reduce the Actual Flow to less than the Target Flow.

4) Determine if the PAR tap change(s) will cause a NYPP system Limit. If it does, then flow from Branchburg to Ramapo cannot be lowered by the requested amount. Revise the Target Flow upward enough to prevent the NYPP Limitation and return to Step 3.

5) Determine if the PAR tap change(s) will cause Spillover. If it does, then the flow from Branchburg to Ramapo cannot be lowered by the requested amount. Revise the Target Flow upward enough to prevent the Spillover condition and return to Step 3.

6) If no PAR tap change(s) can be made because the Ramapo PARs are at their maximum tap settings or a NYPP Limitation or Spillover will occur AND the Actual Flow from Branchburg to Ramapo is greater than the Desired Flow by more than the acceptable level of use, then Transmission Overuse has occurred. NYPP should, within reason, increase generation to eliminate this Overuse and PJM is entitled to compensation for the use of its transmission in accordance with the Transmission Use Agreement until the Overuse is eliminated. If the elimination of the Overuse does not correct the PJM Limitation, then return to Step 1.

   If no PAR tap change(s) can be made and the Actual Flow is greater than the desired but within the acceptable limits, the NYPP is making Acceptable Transmission Use and PJM must correct its Limitation with adjustments to its own generation.

7) If the PAR tap change(s) can be made, the do so. If this does not completely correct the Limitation the PJM must complete the correction with adjustments to its own generation. If this is the case, then the PARs should now be in positions such that, should system conditions remain the same, then any PAR movements requested by one pool will cause Limitation in the other and the “Both pools are Limited” case has been reached.

Case 3: NYPP is Limited

NYPP may now request a Ramapo PAR shift that will increase the Branchburg to Ramapo flow in order to allow additional economy transfers, thus reducing or eliminating NYPP off cost generation.

- Determine the Target Flow that would correct the NYPP Limitation.
- If the Target Flow exceeds the Branchburg-Ramapo normal rating, or the post-contingency flow exceeds the 4 hour rating, then revise the Target Flow to stay within the ratings requirements.
- Determine the PAR tap change(s) that will increase the Actual Flow to at least the Target Flow. That is, if the Target Flow lies between two tap position, then the PAR tap should be moved to increase the Actual Flow to greater than the Target Flow.
- Determine if the PAR tap change(s) will cause a PJM system Limit. If it does, then the flow from Branch bur to Ramapo cannot be increased by the requested amount. Revise the Target Flow downward enough to prevent the PJM Limitation and return to Step 3.

- Determine if the PAR tap change(s) will cause Spillover. If it does, then the flow from Branchburg to Ramapo cannot be increased by the requested amount. Revise the Target Flow downward enough to prevent the Spillover condition and return to Step 3.
- If no PAR change(s) can be made because the Ramapo PARs are at their maximum tap settings or a PJM Limitation or Spillover will occur AND the Actual Flow from Branchburg to Ramapo is less that the Desired Flow by more than the acceptable limit, then Transmission Overuse has occurred. PJM should, within reason, increase generation to eliminate this Overuse and NYPP is entitled to compensation for the use of its transmission in accordance with the Transmission Use Agreement until the Overuse is eliminated. If the elimination of the Overuse does not correct the NYPP Limitation, then return to Step 1.

If no PAR tap change(s) can be made and the Actual Flow is greater than the desired but within the acceptable limits, the PJM is making Acceptable Transmission Use and NYPP must correct its Limitation with adjustments to its own generation.

- If the PAR tap change(s) can be made, the do so. If this does not completely correct the Limitation the PJM must complete the correction with adjustments to its own generation. If this is the case, then the PARs should now be in positions such that, should system conditions remain the same, then any PAR movements requested by one pool will cause Limitation in the other and the "Both pools are Limited" case has been reached.

<u>Case 4: Both PJM and NYPP are Limited</u>

NYPP may now request up to, but no greater than, the Acceptable Transmission Use on the Branchburg to Ramapo line.

1) Determine the Target Flow that reflects the NYPP request for Acceptable Transmission Use.

2) If the Target Flow exceeds the Branchburg-Ramapo normal rating, or the post-contingency flow exceeds the 4 hour rating, then revise the Target Flow to stay within the ratings requirements.

3A) If the Target Flow is greater than the Actual Flow then follow steps 4A to 7A.

<u>Case 4: Actual Flow must be raised to Target Flow.</u>

<u>(Transmission Use is less than the acceptable level)</u>

4A) Determine the Ramapo PAR tap change(s) that will adjust the Actual Flow to as close to the Target Flow as possible. That is, if the Target Flow lies between two tap positions then the PAR tap should be moved to adjust the Actual Flow to as close to the Target Flow as possible.

5A) If no PAR tap change(s) can be made because the Ramapo PARs are at their maximum tap settings, then PJM should, within reason, increase generation to allow NYPP its requested transmission Use.

6A) If the PAR tap change(s) can be made because the Ramapo PARs are at their maximum tap settings, then PJM should, within reason increase generation to allow NYPP its requested transmission Use.

7A) If the PAR tap change(s) causes Spillover, then generation must be adjusted to correct the Spillover condition. If the flow into PS at Waldwick is greater than allowed and/or the flow out of PS at Hudson/Linden is less than allowed, then PJM must increase generation. If the flow into PS at Waldwick is less than allowed, and/or the flow out of PS at Hudson/Linden is greater than allowed, the NYPP must increase generation.

3B) If the Target Flow is less than the Actual Flow then follow Steps 4B to 7B.

Case 4B: Actual Flow must be lowered to target Flow

(Transmission Use is greater than the acceptable level)

4B) Determine the Ramapo PAR tap change(s) that will adjust the Actual Flow to as close to the Target Flow as possible. That is, if the Target Flow lies between two tap positions, then the PAR tap should be moved to adjust the Actual Flow to as close to the Target Flow as possible.

5B) If no PAR tap change(s) can be made because the Ramapo PARs are at their maximum tap settings, then Transmission Overuse by NYPP has occurred. NYPP, should, within reason, increase generation to eliminate this Overuse and PJM is entitled to compensation for the use of its transmission in accordance with the Transmission Use Agreement until the Overuse is eliminated. When the Overuse is corrected, return to Step 1 if both pools are still Limited.

6B) If the PAR tap change(s) can be made, then do so. If this does not completely correct the Limitations then both pools must complete the corrections with adjustments to their own generation.

7B) If the PAR tap change(s) causes Spillover, then generation must be adjusted to correct Spillover condition. If the flow into PS at Waldwick is greater than allowed, and/or the flow out of PS at Hudson/Linden is less than allowed, then PJM must increase generation. If the flow into PS at Waldwick is less than allowed, and/or the flow out of PS at Hudson/Linden is greater than allowed, and/or the flow out of PS at Hudson/Linden is greater than allowed, then NYPP must increase generation.

Case 5: Neither PJM nor NYPP is LIMITED but Spillover occurs:

Case 5A: Branchburg to Ramapo flow too low

If the flow into PS at Waldwick is less than allowed, and/or the flow out of PS at Hudson and Linden is more than allowed, then the flow from Branchburg to Ramapo must be increased or NYPP generation must be increased to correct this Spillover condition. This is because the flow from Branchburg to Ramapo is insufficient to meet the NYPP demand. This is because the flow from Branchburg to Ramapo is insufficient to meet the NYPP demand. This causes additional flow through PS into NYPP via Waldwick and Hudson/Linden. The flow at Waldwick opposes the normal flow and the net result is lower flow into PS. The flows at Hudson and Linden coincide with the normal flows and the net results are higher flows out to NYPP.

1) Determine the Target Flow that would correct this Spillover condition.
2) If the target Flow exceeds the Branchburg – Ramapo normal rating, or the post-contingency flow exceeds the 4 hour emergency rating, then revise the Target Flow to stay within the ratings requirements.
3) Determine the Ramapo PAR tap change(s) that will increase the Actual Flow to at least the Target Flow. That is, if the Target Flow lies between two tap positions, then the PAR tap should be moved to increase the Actual Flow to greater than the Target Flow.
4) If the PAR tap change(s) can be made, then do so. If this does not completely correct the Spillover condition, then NYPP or PJM will correct the remainder of the Spillover condition by shifting generation.
5) NYPP or PJM Limitations which occur as a result of moving the PAR to eliminate Spillover should be corrected by shifting generation.

<u>Case 5: Neither PJM nor NYPP is LIMITED but Spillover occurs:</u>

<u>Case 5A: Branchburg to Ramapo flow too high</u>

If the flow into PS at Waldwick is more than allowed, and/or the flow out of PS at Hudson and Linden is less than allowed, then the flow from Branchburg to Ramapo must be decreased or PJM generation must be increased to correct this Spillover condition. This is because the flow from Branchburg to Ramapo is too high for PJM demand. This is because the flow from Branchburg to Ramapo is insufficient to meet the NYPP demand. This causes additional flow through NYPP into PS via Waldwick and Hudson/Linden. The flow at Waldwick coincides with the normal flow and the net result is higher flow into PS. The flows at Hudson and Linden oppose the normal flows and the net results are higher flows out of NYPP.

1) Determine the Target Flow that would correct this Spillover condition.
2) If the target Flow exceeds the Branchburg – Ramapo normal rating, or the post-contingency flow exceeds the 4 hour emergency rating, then revise the Target Flow to stay within the ratings requirements.
3) Determine the Ramapo PAR tap change(s) that will reduce the Actual Flow to at least the Target Flow. That is, if the Target Flow lies between two tap positions, then the PAR tap should be moved to reduce the Actual Flow to greater than the Target Flow.
4) If the PAR tap change(s) can be made, then do so. If this does not completely correct the Spillover condition, then PJM of NYPP will correct the remainder of the Spillover condition by shifting generation.
5) NYPP or PJM Limitations which occur as a result of moving the PAR to eliminate Spillover should be corrected by shifting generation.

<u>Calculating Desired Flow:</u>

Desired Flow =

(–) 0.61 * (NYPP to PJM scheduled interchange)

+ 0.72 * (PS-Con Ed PAR imbalance)

(–) Payback Schedule

+ Protection Items (if any – see the following description)

Where:

NYPP to PJM scheduled interchange includes firm (including wheels), economy, and emergency interchange.

PS-Con Ed PAR imbalance is the difference between the flow entering PS at Waldwick and the flow leaving PS at Hudson and Linden. A positive imbalance indicates more entering PS than leaving.

Payback schedule represents the repayment of "banked" MWHrs. MWHrs will only be banked under unusual circumstances such as an extended outage of the Ramapo PARs.

Protection items are adjustments to the Desired Flow to protect each pool from major operational changes of the other and to protect both from major operational effects of outside pools on PJM and/or NYPP. They are calculated as follows:

Where:

Lake Erie Circulation =

(OH to NYPP Scheduled Interchange) – (OH to NYPP Actual Interchange)

Net Impact =

(0.36 * (OH to NYPP Scheduled Interchange)) – (0.10 * (West to PJM Scheduled Interchange)

<u>If Lake Erie Circulation exceed 500 MW AND circulation exceeds 3.5 times Net Impact.</u>

Protection Item =

(– 0.33) * (Lake Erie Circulation – Net Impact)

If – Net Impact > 0.10 * (0.95 * (NYPP West/Central Limit))

Or Net Impact > 0.10 * (PJM Western Operating Point)

Protection Item =

0.33 * Net Impact

RAMAPO PAR OPERATING INSTRUCTION

Emergency Operation:

For the purpose of this procedure, an emergency exists whenever the NYPP is declared to be in the "Alert State" or PJM is declared to be in the "Voltage Warning" condition.

During emergency operation of either pool and upon request of the pool experiencing the emergency, the Target Flow on the Branchburg-Ramapo (5018) 500 kV line will be set to relieve the emergency to the extent possible. Under these circumstances, compensation for the use of transmission will be suspended.

Operation with One or Both PARs Out of Service:

If one PAR is scheduled or forced out of service the other PAR shall remain in service to control the flow subject to the rating of one PAR.

If while operating with one PAR in service an emergency is expected in one or both pools, the system operators of both systems will jointly determine if the remaining PAR should be bypassed. In making this decision, the following factors should be considered:

A) Bypassing the PAR will increase the rating on the Branchburg to Ramapo line and may resolve the problem.

B) Bypassing the PAR will increase the circulation through PJM or the NYPP. This could help or hinder the solution of the problem.

If it is necessary to bypass the remaining PAR then the system operators of both the NYPP and PJM shall adjust their systems so that during the outage needed to bypass the PAR both systems will remain within contingency limits.

Index of Operating Procedures for ISO New England (ISO-NE) Balancing Authority

The ISO New England (ISO-NE) has Operating Procedures that are adhered to by PJM. These procedures include the following:

	Type of Operating Procedure	Transmission Operations Manual Section Ref
ISO-New England (ISO-NE)		
ISO-NE Contingencies	Contingencies	Section 5 ISO-NE
Millstone Point Contingency	Contingencies	Section 5 ISO-NE
ISO-NE Emergencies	Constraints	Section 5 ISO-NE
Loop Flows Around Lake Erie (MISO, NY-ISO, IMO & PJM)	Limitations	Section 5 PJM
Back To Index		

ISO-NE Contingencies

Joint ISO-NE/NYISO/PJM studies identify external contingencies that can have a worse effect on the PJM RTO and NYISO than the worst internal contingency for which these individual systems are normally protected. The contingencies of concern are:

- loss of the Phase II (Sandy Pond) HVDC tie
- loss of multiple Millstone Point generating units
- loss of Millstone unit #3
- loss of Seabrook
- loss of both the Lake Road + Ocean State generating stations
- loss of both Mystic 8 and 9 power blocks

Procedures to address each contingency are described in this section.

Loss of Phase II Imports

ISO-NE has several large source contingencies the loss of which can have a worse effect on PJM RTO and NYISO Balancing Authority than the worst internal contingency for the individual systems. The purpose of this procedure is to protect the PJM RTO and NYISO from the loss of any of these large New England source contingencies.

The NE Source Contingency Limit is calculated for each of the three PJM reactive transfer limits as follows

NE Source Contingency Limit = Adjusted NE Contingency Limit

= Base NE Contingency Limit + Actual Transfer Margin

The base NE Source contingency limit is determined by PJM operations planning staff. The adjusted NE Source contingency limit is used to limit all large New England source contingencies, discussed later in this manual. Under normal conditions, PJM does not operate off-cost to maintain these margins.

PJM Actions:

- PJM dispatcher notifies the ISO-NE dispatcher of any change and the effective time of that change in the base NE Source contingency limit.
- An alarm is issued if the NE Source Contingency exceeds the adjusted NE Source contingency limit. PJM dispatcher requests ISO-NE to reduce the Phase II schedule.

Other Balancing Authority Actions:

- ISO-NE determines the NE Source Contingency limit assuming zero margin on the PJM transfer limits.
- If the Phase II limit is less than the desired NE Source Contingency size, ISO-NE requests authorization to utilize available margin on the PJM RTO's most limiting interface.

Millstone Point Contingency

This procedure is designed to prevent the occurrence of a generation contingency at Millstone Station of a magnitude that has adverse consequences on NYISO and/or PJM reactive conditions. Through use of this procedure, the Maximum Allowable Millstone Generator Contingency (MAMGC) can be calculated and the station limited accordingly. This value is determined based on reactive conditions in the PJM RTO and NYISO, so that the contingency loss of generation at Millstone has no greater impact than the worst reactive contingency in either of these areas.

At Millstone Station, there are two generating units with the following capabilities:

Millstone Station Units	Capability (MW)
Unit 2	865
Unit 3	1235
Total	2100

Exhibit 13: Millstone Station Unit Capabilities

The Severe Line Outage Detection (SLOD) system is continuously armed to trip unit 3 at Millstone Station when the following conditions exist simultaneously:

- total generation at Millstone Station is greater than 1650 MW
- three of the following four critical transmission paths (critical paths) are open:
  - Millstone-Manchester 310 line
  - Millstone-Southington 348 line
  - Millstone-Card Street 383 line
  - Millstone-Montville 371 line

The loss of either pairs 348/310 and 383/371, which exit Millstone Station on common towers, are considered a single contingency for the purposes of this procedure. The loss of either pair interrupts two of the four critical paths.

With all four critical paths closed, one transmission contingency is not expected to cause a Millstone generator to trip. If one of the four critical paths is open, the loss of another critical path is not expected to cause a Millstone generator to trip. However, the loss of two critical circuits on common towers is considered a single contingency. Therefore, with one critical path open, another contingency can interrupt two more critical paths and trigger SLOD, thus tripping Millstone 1 and 3 (capability 1235 MW and assuming all three units are in service). With two critical paths on different towers open, another contingency can interrupt another critical path and trigger SLOD, thus tripping Millstone 3. However, with two critical paths on common towers open, a single contingency can trip all three Millstone generators (capability 2100 MW).

Abnormal conditions at Millstone Station may require that loss of all on-line Millstone generators be recognized as a single contingency. Conditions that can result in simultaneous loss of all Millstone generators include severe weather conditions or severe problems with equipment in the 345 kV switchyard.

When such a condition is reported to ISO-NE, the Balancing Authority coordinator asks CONVEX to request Millstone and/or Northeast Utilities Transmission Operations to assess the likelihood of the loss of the entire station. If the assessment indicates that the simultaneous loss of all Millstone generators can occur, the ISO-NE Balancing Authority coordinator makes every attempt to inform and consult with ISO-NE supervision prior to ordering generation reductions at Millstone Station. If after ten minutes, the Balancing Authority coordinator is unable to contact ISO-NE supervision, the ISO-NE Balancing Authority coordinator recognizes the loss of Millstone Station as a single contingency, takes appropriate action, and, as soon as possible thereafter, advises ISO-NE supervision of the action(s) taken.

The Maximum Allowable Millstone Generator Contingency (MAMGC) is calculated for each of the three PJM RTO reactive transfer limits as follows:

MAMGC = Adjusted NE Source Contingency Limit

= Base NE Source Contingency Limit + Actual Transfer Margin

The base NE Source contingency limit is determined by the operations planning staff. The adjusted NE Source contingency limit is used to limit NE Source Contingencies. The adjusted NE Source contingency limit cannot exceed 2200 MW.

Other Balancing Authority Actions:

Whenever a condition exists such that the actual Millstone Generation Contingency (MGC) is greater than the Maximum Allowable Millstone Generation Contingency (MAMGC), the following actions are taken by CONVEX and ISO-NE:

- Contact PJM dispatcher for the following purposes:
  - to inform of the amount and unit numbers of the Millstone Generation Contingency
  - to confirm the actual MW loading of each of the three PJM RTO interfaces involved in calculating the NE Source Contingency limit
  - to request that the loading on each of the three interfaces be restricted to no more than the current loading
- Inform NYISO and PJM of the generation change ordered in New England.
- Request that NYISO and the PJM RTO study their transmission loading conditions and inform ISO-NE of any transmission thermal limit violations which result from the greatest New England Source contingency after the New England Sources reaches the reduced output level. If thermal limit violations result from the New England Source contingency, requests NYISO and/or PJM dispatcher to inform ISO-NE how much New England Sources must be reduced to avoid

post contingency thermal limit violations. MAMGC becomes this value. Direct CONVEX to reduce Millstone generation to that level. Inform NYISO and PJM dispatcher that the abnormal conditions affecting Millstone generation no longer exists.

- If a transmission outage that interrupts one of the four critical paths at Millstone is required for emergency maintenance purposes, ISO-NE notifies ISO-NE and PJM dispatcher as soon as possible. When the outage occurs, the actions described above are taken, as required.

PJM Actions:

- The PJM RTO does not increase transfers across the three reactive interfaces until informed by ISO-NE that the New England Source Contingency reductions have been accomplished (30 minutes maximum). PJM dispatcher adds the MGC to the contingency list in order to monitor resulting thermal contingencies. The contingency added is either the loss of Millstone Units 3 or loss of both Millstone Units. If the Inter-Pool Network link to ISO-NE goes down, information and necessary data are to be exchanged via telephone communications every 15 minutes and when significant system changes occur.
- PJM dispatcher advises NYISO of current MGC and current system conditions. PJM dispatcher requests that NYISO interface loading is held at or below current levels.
- PJM dispatcher calculates MAMGC based on NYISO and the PJM control reactive conditions. PJM dispatcher directs ISO-NE to reduce the sum of the outputs on the New England generators which can be lost as a result of a single contingency to the MAMGC level.

After ISO-NE reports to PJM dispatcher that the New England generation has been reduced, PJM dispatcher checks for thermal contingencies based on the loss of the Millstone generation. If thermal violations exist, PJM dispatcher determines how much further New England generation must be reduced, in order to relieve the thermal contingencies.

- When ISO-NE informs PJM dispatcher that the abnormal transmission conditions affecting New England generation no longer exist, PJM dispatcher deletes the New England generation multiple unit contingency from PJM security analysis programs.

New England generation is not increased until the conditions which cause the returned to service, or weather conditions improve such that loss of station is no longer a possible first contingency).

ISO-NE Emergencies

Significant unit outages and reduced generation reserves in the ISO-NE system can result in high system imports, transmission limitations, and/or the possible need for load relief. ISO-

NE may ask for a reactive transfer limit margin or other assistance to permit or improve imports into any area that is transmission limited. Transmission constraints include:

- PJM RTO restrictions on New England Source Contingencies
- NYISO Central/East restrictions

It is important that NYISO agree that a PJM off-cost action for Central/East or any NYISO restriction results in permitting increased transfers from NYISO to ISO-NE.

ISO-NE agrees to provide reimbursement for PJM incurred off-cost operations when providing requested support during ISO-NE emergencies. Careful coordination, communication, and documentation of operations during these emergency conditions are a requirement.

PJM maintains contact with ISO-NE on a daily basis as required for anticipated emergency conditions. Determinations are made for anticipated emergency conditions and for the commitment of any PJM RTO equipment. Any commitment of equipment is logged and communicated to PJM dispatchers. PJM is responsible for coordinating any day-ahead requests for assistance and maintaining an adequate reactive transfer limit margin.

When requests for a reactive transfer limit margin are made in advance and time permits, Marginal Scheduler is run with the transfer limits reflecting both the with and without margin conditions. If any units are started to provide the requested margin, the unit information is logged and passed to PJM accounting staff. Any margin requests are applied to East, Central, and West transfer limits.

When ISO-NE declares an Emergency and requests PJM RTO assistance, PJM dispatcher determines and coordinates a strategy with NYISO to provide any support that PJM has available to meet the request. The support can include:

- supplying energy
- adjusting current PJM RTO conditions
- providing additional reactive transfer limit margin
- supporting NYISO in a coordinated effort to improve the ISO-NE condition

The magnitude of support includes altering the PJM RTO operations to include off-cost up through the highest incremental cost of generation. PJM managers are notified when off-cost operation is required to provide ISO-NE support.

Normally, PJM dispatcher attempts to minimize NYISO transmission overuse when ISO-NE requires a reactive transfer limit margin, but care is exercised such that both the PJM RTO and NYISO are operated to provide maximum relief for the ISO-NE emergency condition. PJM, NYISO and ISO-NE communicate often to keep abreast of current and changing system conditions. The exact nature of problems and strategies to provide support to ISO-NE is communicated and logged.

PJM Actions:

- PJM dispatcher confirms the emergency declaration with ISO-NE and develops an understanding of the assistance requested.

- PJM dispatcher reviews any proposed actions or adjustments with NYISO and ISO-NE.
- PJM dispatcher informs ISO-NE when off cost operations are required and those costs are billed to ISO-NE.
- PJM dispatcher makes cost effective generation adjustments.
- PJM dispatcher logs the request for assistance and any generator or cost assignments.
- PJM dispatcher notifies PJM managers.
- PJM dispatcher restores the PJM RTO to normal operations as soon as conditions permit.
- PJM dispatcher notifies ISO-NE when off-cost operations are no longer required to provide assistance and logs the event.

Midwest Independent System Operator (MISO)

	Type of Operating Procedure	Transmission Operations Manual Section Ref
Midwest Independent System Operator (MISO)		
MISO – PJM Joint Operating Guide: Safe Operating Mode	Conservative Operations / Contingency Control	Section 5 MISO
MISO – PJM Manual Shadow Price Override Procedure	Conservative Operations / Contingency Control	Section 5 MISO
Back To Index		

MISO and PJM Safe Operating Mode

PURPOSE/BACKGROUND:

MISO and PJM have extensive joint operating procedures per the MISO and PJM Joint Operating Agreement. These procedures define agreed upon coordination for normal and emergency conditions. Under normal conditions, Reciprocally Coordinated Flowgates are pre-defined and joint procedures are established to manage these facilities. Under emergency conditions, procedures define required actions by MISO and PJM up to including all available controlling actions.

The time frame this standing operating guide addresses is when an abnormal operating condition is encountered or forecasted to be encountered in the next several hours where there is not a defined operating procedure or Reciprocally Coordinated Flowgate to manage the condition and both parties' operations have an impact on the abnormal operating condition. The purpose of this operating guide is to have agreed upon steps MISO and PJM will jointly and immediately take to prevent the abnormal operating condition from degrading into an emergency condition while more formal procedures can be established. This mode of operation will be known as “Safe Operating Mode” and will be declared when required by either party to prevent going into an emergency condition. This joint operating guide commits the MISO and PJM operators to work together and take actions to prevent the emergency condition just as if MISO and PJM were in the same RTO, under the same management, and using the same procedures. It is expected the impacted party or party declaring the Safe Operating Mode, known as “Declaring Entity”, will take all appropriate normal operating steps to manage the abnormal condition, time permitting, prior to declaring Safe Operating Mode (SOM). Normal operating steps include obtaining relief via TLR Levels 1 through 5, market redispatch, and market to market redispatch. These steps would include use of proxy flowgates to manage market flows impacting the abnormal condition. The counter party will be known as the “Impacting Entity”.

Safe Operating Mode steps:

1. **Notification** - In the event PJM or MISO needs to declare SOM, the declaring entity will notify the other party via phone of the declaration including:
    a. Facility or facilities that are or expected to be experiencing the abnormal operating condition,
    b. Location of facilities,
    c. The abnormal problem and associated system conditions,
    d. How the Declaring Entity believes the other party is impacting the facilities,
    e. What actions the declaring Entity is taking to remedy the problem, and
    f. What specific actions the Declaring Entity is requesting of the Impacting Entity.

    If at all possible, the Declaring Entity will provide as much advance notice as possible to allow the Impacting Entity to analyze the situation and develop appropriate mitigating actions.

2. **Requirements**
    a. The Declaring Entity must take all effective operating steps, time permitting, including reconfiguration, redispatch, holding market flow impacts to existing levels, and issuing TLR Levels 1 – 5 prior to requesting same actions of Impacting Entity.
        i. For MISO, the steps will include reconfiguration, implementation of operating guides and procedures, generation redispatch in accordance with the Congestion Management Procedure and TLR Levels 1-5.
        ii. For PJM, the steps will include reconfiguration, implementation of operating guides and procedures, generation redispatch in accordance with the Congestion Management Procedure, and TLR Levels 1-5.

    If the condition is so critical as to require the interruption of customer load, then the customer load restoration must take first priority as the system is adjusted back to normal conditions by both parties.

b. The Impacting Entity must take all effective operating steps, time permitting, including reconfiguration, redispatch, holding market flow impacts to existing levels, and TLR Levels 1 – 5 as soon as possible following request by Declaring Entity.

c. While an effort will be made by the parties to quickly arrive at the set of required actions and fairly share in actions taken to relieve the abnormal conditions, including sharing economical impacts, it is not expected or required to have a prorated sharing of relief requirements. The priority will be to quickly mitigate the abnormal operating condition. The secondary concern is an exact fair sharing of relief requirements.

d. Emergency will be declared as needed including if load shedding is required to manage the condition.

e. The Declaring Entity will terminate the SOM as soon as practical.

3. **Management Notification** – MISO and PJM

   a. When either party invokes this operating guide, the MISO and PJM Operations Management Staff will be notified as soon as practical.

4. **Review of Actions and Follow Up–** MISO and PJM

   a. Immediately after being notified, MISO and PJM designated Operations Management representatives will discuss appropriateness of actions taken under the declared SOM and agree on whether actions should continue or some other mitigation actions should occur. If both parties cannot agree on alternative mitigation actions at this time, both parties will continue actions taken under step two of this operating guide as appropriate.

   b. Within fifteen business days after ending a SOM event, MISO and PJM Operations' Management representatives will review the event, determine any lessons learned, and agree on a set of action items as appropriate to prevent the abnormal system condition from occurring again. Any new operating guides or Reciprocally Coordinated Flowgates required to prevent the abnormal condition from reoccurring will be implemented within the fifteen business days after ending the SOM event.

   c. This operating Guide will be updated as appropriate by MISO and PJM.

Note1: When using the M2M tool during Safe Operating Mode, the Declaring Entity must first notify the Impacting Entity that Safe Operating Mode is in effect prior to implementing control on a substitute or proxy flowgate.

Note2: The actual constraint shall be used in the system when it is available for use in the M2M tool. Use of a proxy or substitute flowgate shall be logged in SmartLog so they can be tracked for adjustments to M2M settlements.

SOM Event Review Form

Date:

Time:

Party declaring the SOM:

Abnormal Operating Conditions:

Constraint Name:

Related Constraint(s):

Actions Requested:

Actions Taken:

Summary

Detailed Analysis

1.) What actions were taken prior to declaring the SOM to prevent the emergency condition?

2.) Was there a Reciprocally Coordinated Flowgate to manage this constraint?

3.) Was manual re-dispatch initiated?

4.) Was additional generation available to manage this constraint?

Lessons Learned

1.) Is development of an operating guide appropriate as a result of this event?

References

- MISO-PJM Joint Operating Agreement
- Safe Operating Mode Procedure (RTO-AOP-012-R0)

PJM and MISO Manual Shadow Price Override Procedure Purpose/Background:

When the Monitoring RTO has no effective control (3% or greater) on an internal flowgate, the shadow price of the flowgate can be zero. According to the revised M2M procedure, the Non-monitoring RTO will then automatically control the flowgate to the current shadow price limit of the Monitoring RTO, via the Constraint Relaxation logic. However, there may be times when manual intervention may be required. The following procedure has been developed to provide a method for the Monitoring RTO to inform the Non-monitoring RTO to dispatch generation by manually entering a shadow price limit override that the Monitoring RTO is willing to dispatch to under their SCED solution (assuming there will be no adverse impact on reliability).

Because the shadow price limit over-ride may result in the Non-monitoring RTO binding no matter what the Monitoring RTO is doing, it is preferred that this procedure only be used when there are problems with the automatic M2M process. Those circumstances when the shadow price over-ride procedure should be used:

- The Monitoring RTO is unable to bind and send a shadow price to the Non-monitoring RTO. This could be due to SCED problems or M2M communication problems.
- The shadow price over-ride procedure could be implemented as a last step to avoid calling Safe Operating Mode.
- There may be circumstances where the Monitoring RTO is binding on one flowgate and calling for M2M on a different flowgate. This could occur during times of forced or unplanned outages where a Reciprocal Coordinated Flowgate (RCF) does not exist for the most limiting constraint. The Monitoring RTO will bind on the most limiting constraint and put the proxy RCF in M2M.

A list of known Flowgates with minimal controlling actions available to the Monitoring RTO are included below. This list is based on historical data as well as seasonal projections. This list is meant to serve as a guide only. Additional Flowgates eligible for the Shadow Price Override procedure may be determined in Real Time as indicated in Section 2.1.

2.0 <u>M2M Shadow Price Override steps:</u>

1. The Monitoring RTO realizes that it does not have effective control for an internal flowgate constraint and that the Constraint Relaxation Logic has not been activated. This condition is indicated by SCED violating the desired rating % of the constraint but the shadow price of the constraint remains at zero.
2. The Monitoring RTO determines the marginal limit for this constraint which is available on the “Active Constraints” tab in DMT.
3. The Monitoring RTO calls the Non-monitoring RTO and requests to use the Marginal Limit determined in Section 2.2 as the Shadow Price Override for the flowgate. The Monitoring and Non-monitoring RTO will log this request in their respective logging application.
    a. When the Monitoring RTO requests that the shadow price over-ride procedure be used, the Monitoring RTO will specify a Marginal Limit that is identical to the

Marginal Limit being used to manage congestion on the flowgate by the Monitoring RTO.

b. It may be necessary to increase the Marginal Limit. The Monitoring RTO shall follow their internal procedures for raising the Marginal Limit and communicate the new limit to the Non-Monitoring RTO for use as the new Shadow Price Override.

c. The Monitoring RTO should review the Request Relief MW periodically when the Shadow Price Override is in effect to make sure the request is appropriate for the current operation.

4. Upon receiving the request from the Monitoring RTO, the Non-monitoring RTO will manually enter the Shadow Price Override on the “M2M Flowgate” tab of DMT. The

   Non-monitoring RTO will log this action in their respective logging application.

5. The Monitoring RTO will closely monitor the loading of the flowgate when the Shadow Price Override is in effect. Because the Non-monitoring RTO will bind whenever its shadow price is below the Marginal Limit, it is important that the monitoring RTO specify the relief requested and keep this value up-to-date while the shadow price over-ride procedure is being used.

6. When the relief from the Non-monitoring is no longer needed, The Monitoring RTO will inform the Non-monitoring to cancel the manual shadow price override. The Monitoring RTO will log this cancellation in their respective logging application.

7. The Non-monitoring RTO will remove the manual shadow price for the flowgate from DMT and make sure the normal flag is re-checked after the removal. The Non-monitoring RTO will log this cancellation in their respective logging application

Known Flowgates with limited control by the Monitoring RTO.

The Monitoring RTO should use the normal M2M procedure to make sure all available native dispatchable generation has been dispatched before asking the Non-Monitoring RTO to enter into the manual shadow price override operation.

**This list is meant to serve as a guide and is not all encompassing. There may be additional Flowgates that qualify for the Shadow Price Override procedure based on Real Time conditions as indicated above in Section 2.1.*

PJM Flowgates:

#506 – Nelson 345/138 kV xfmr 84 l/o Nelson 345/138 xfmr 82

#507 – Nelson 345/138 kV xfmr 82 l/o Nelson 345/138 xfmr 84

#3245 – 15616 Cher – Silv l/o 15502 Nels-EJ

#3250 – 15502 Nels-EJ l/o 15616 Cher-Silv

#3263 – Nelson-Dixon(15507) 138 kV l/o Nelson-Dixon (15508)

#3264 – Nelson-Nelson RT l/o Nelson-Dixon B

#3265 – OTDF ChV-Bel Red l/o ChV-SilvLk

Attachment A: SPS Listing

TO	ERO	SPS Name	Planning or Operational	Telem. (Y/N)	Year of Installation	Default Status
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
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						

TO	ERO	SPS Name	Planning or Operational	Telem. (Y/N)	Year of Installation	Default Status
Description						
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.						
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
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
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
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.						
COMED	RFC	**Dresden Unit 2 Trip Scheme**	Operational	N	2004	Armed

TO	ERO	SPS Name	Planning or Operational	Telem. (Y/N)	Year of Installation	Default Status
Description						
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.						
COMED	RFC	**Kincaid Unit Stability Trip Scheme**	Operational	N	Pre-1995	Armed
To prevent first swing and/or oscillatory instability of either unit, a Multi-Phase Fault High-Speed Sectionalizing Scheme and Multiple Line						

TO	ERO	SPS Name	Planning or Operational	Telem. (Y/N)	Year of Installation	Default Status
Description						
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
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
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
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
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.						
COME	RFC	**Waukegan 138kV Auto-Closing Scheme**	Operational	N	2004	Armed

TO	ERO	SPS Name	Planning or Operational	Telem. (Y/N)	Year of Installation	Default Status
Description						
D						
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
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.						
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						

TO	ERO	SPS Name	Planning or Operational	Telem. (Y/N)	Year of Installation	Default Status
Description						
Carolina end of the ‘54’ line if the line rating is being exceeded.						
DOM	SERC	**Clover Unit 2 Stability Trip Scheme**	Operational	Y	?	Disarmed
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 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.						

TO	ERO	SPS Name	Planning or Operational	Telem. (Y/N)	Year of Installation	Default Status
Description						
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, PJM does not operate to this SPS.						
PPL	RFC	**Montour Runback Scheme**	Operational	Y	2013	Armed

TO	ERO	SPS Name	Planning or Operational	Telem. (Y/N)	Year of Installation	Default Status
Description						
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
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
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
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
To mitigate overloads on the Warren – Falconer 115kV line, an inverse time overcurrent relay trips the line if flow exceeds the emergency rating.						

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

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**
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
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

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**
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
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

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**
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
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

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**
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
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

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**
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
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

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 - 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

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 – PHIPPS BEND TIE		14		26.9	500.2	0.2	29.7	525.2	0.2	32.5	550.2	0.2
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
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

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**
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
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

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**
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 - Kammer		126		595.4	790.9	25.9	635.0	816.7	26.7	675.8	842.6	27.6
Maliszewski - Marysville		25		117.4	766.0	1.0	125.2	791.1	1.1	133.2	816.1	1.1
Rockport – Sullivan		97		461.4	780.4	15.4	492.0	805.9	15.9	523.7	831.4	16.4

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

Allegheny Power (AP)

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.

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. **<u>Maliszewski 765/138 kV T-1 Sectionalized</u>** – 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. **<u>Belmont 765/500 kV T-5 Sectionalized</u>** – Restores Kammer-Belmont 765 kV and Mountaineer-Belmont 765 kV following a fault on the Belmont 765/500 kV T-5 transformer.
8. **<u>Kammer 345/138 kV T300 Sectionalized</u>** – 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. **<u>Kammer 345/138 kV Transformer 100A/100B Sectionalized</u>** – 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. **<u>Kirk 345/138 T4 Sectionalized</u>** – 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. **<u>Hyatt OP-Hyatt CSP (S) 345 kV Bus Tie Sectionalized</u>** - Restores Hyatt OP-W Millersport 345 kV following a fault on the Hyatt OP-Hyatt CSP (S) 345 kV Bus Tie.
12. **<u>Hyatt OP-W Millersport 345 kV Sectionalized</u>** – Restores Hyatt OP-Hyatt CSP (S) 345 kV following a fault on the Hyatt OP-W Millersport 345 kV line.
13. **<u>Hyatt OP-Hyatt CSP (N) 345 kV Bus Tie Sectionalized</u>** – Restores Hyatt OP-Tangy 345 kV line following a fault on the Hyatt OP-Hyatt CSP (N) 345 kV Bus Tie.
14. **<u>Hyatt OP-Tangy FE 345 kV Sectionalized</u>** – Restores Hyatt OP-Hyatt CSP (N) 345 kV following a fault on the Hyatt OP-Tangy FE 345 kV line.
15. **<u>Bixby 345/138 kV T2 Sectionalized</u>** – Restores Bixby- Marquis 345 kV following a fault on the Bixby 345/138 kV T2 transformer.
16. **<u>Bixby-Marquis 345 kV Sectionalized</u>** – Restores Bixby 345/138 kV T2 transformer following a fault on the Bixby-Marquis 345 kV line.
17. **<u>Jackson Road 345/138 kv T-3 Sectionalized</u>** – 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. **<u>Benton Harbor 345/138 kv T-1A/1B Sectionalized</u>** - 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. **<u>Kenzie Creek 345/138 kv T-1 Sectionalized</u>** – 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. **<u>East Elkhart 345/138 kv T-2 Sectionalized</u>** – 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. **<u>Robison Park 345/138 kv T-5 Sectionalized</u>** – Restores Robison Park-R P Mone 345kv line following a fault on the Robison Park 345/138 kv T-5 transformer.

22. **<u>Robison Park-RP Mone 345kv Sectionalized</u>** – Restores Robison Park 345/138 kV transformer following a fault on the Robison Park-RP Mone 345kv line.
23. **<u>Tanners Creek 345/138 kV T-A/B Sectionalized</u>** – 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. **<u>Fall Creek 345/138 kV T-1 Sectionalized</u>** – Restores Noblesville-Fall Creek 345kV line following a fault on the Fall Creek 345/138 kv T-1 transformer.
25. **<u>Fall Creek-Noblesville 345 kV Sectionalized</u>** – Restores Fall Creek 345/138 kV T-1 transformer following a fault on the Fall Creek-Noblesville 345 kV line.
26. **<u>Desoto 345/138 kV T-1 Sectionalized</u>** – Restores Desoto #2 345 kV bus following a fault on the Desoto 345/138 kV T-1 transformer.
27. **<u>East Lima-Southwest Lima 345 kV Sectionalized</u>** – Restores East Lima 345 kV ring bus following a fault on the East Lima-Southwest Lima 345 kV line.
28. **<u>East Lima-Maddox Creek 345 kV Sectionalized</u>** – Restores East Lima 345 kV ring bus following a fault on the East Lima-Maddox Creek 345 kV line.
29. **<u>Sorenson 345/138 kV T-1 Sectionalized</u>** – Restores the Sorenson #1 345 kV bus following a fault on the Sorenson 345/138 kV T-1 transformer.
30. **<u>Sorenson 345/138 kV T-2 Sectionalized</u>** – Restores the Sorenson #2 345 kV bus following a fault on the Sorenson 345/138 kV T-2 transformer.
31. **<u>South Berwick 345/69 kv T-1 Sectionalized</u>** – 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. **<u>Olive 345/138 kv T-2 Sectionalized</u>** – Restores Olive 345kV Bus 1 following a fault on the Olive 345/138 kv T-2 transformer.
33. **<u>Greentown 765/138 kv T-1 Sectionalized</u>** – Restores Greentown 765kV Ring Bus following a fault on the Greentown 765/138 kv T-1 transformer.
34. **<u>Greentown 765/138 kv T-2 Sectionalized</u>** – Restores Greentown 765kV Ring Bus following a fault on the Greentown 765/138 kv T-2 transformer
35. **<u>Rockport 765/138/34 kv T-3 Sectionalized</u>** – Restores Rockport 765kV Ring Bus following a fault on the Rockport 765/138/34 kv T-3 transformer.
36. **<u>Cook-East Elkhart 345 kV Sectionalized</u>** – 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. **<u>East Elkhart-Hiple 345 kV Sectionalized</u>** – 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. **<u>Benton Harbor-Cook 345 kV Sectionalized</u>** – 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.

First Energy (FE)

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.

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. **Lackawanna #1 230/69kV Transformer** – Restores the 230kV High Side CBs following a fault on the transformer.
9. **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. **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. **Quarry #2 230/69kV Transformer** – Restores the 230kV High Side CBs following a fault on the transformer.
12. **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. **Siegfried #5 230/138kV Transformer** – Restores the 230kV High Side CBs following a fault on the transformer.
14. **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. **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. **South Akron #7 230/138kV Transformer** – Restores the 230kV High Side CBs following a fault on the transformer.
17. **Steel City 500/230kV TR1 Transformer** – Restores the 500kV High Side CBs following a fault on the transformer.
18. **Susquehanna 500/230kV T21 Transformer** – Restores the 500kV High Side CBs following a fault on the transformer.
19. **Wescosville #1 138/69kV Transformer** – Restores the 138kV High Side CBs following a fault on the transformer.
20. **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 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.

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.

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.

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.

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***.