2006 BASELINE RTEP REPORT

For the 2007 - 2011 Period

Issued – November 29, 2006

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INTRODUCTION

The PJM Regional Transmission Expansion Planning (RTEP) Process requires that cost responsibility for facility enhancements be established. There are three types of facility enhancements for which cost assignment must be made:

- Attachment Facilities required solely to interconnect a new generation or merchant transmission project,
- Network Facilities that are required to enhance the network solely or in part because of a proposed project, and
- Network Facilities required to support load growth.

In order to establish a starting point for development of Regional Transmission Expansion Plans and determine cost responsibility for expansion facilities, a 'baseline' analysis of system adequacy and security is necessary. The purpose of this analysis is threefold:

- to identify areas where the system, as planned, is not in compliance with the applicable reliability standards (for purposes of this report, "applicable reliability standards" will refer to NERC, MAAC, ECAR, SERC, MAIN, PJM and the individual transmission owner reliability standards). The baseline system will be analyzed using the same criteria and analysis methods that will be used for assessing the impact of proposed new interconnection projects. This will ensure that the need for system enhancement of the baseline system and enhancements due to interconnection projects are determined in a consistent and equitable manner.
- to bring those areas into compliance, develop and recommend facility expansion plans, including cost estimates and estimated in-service dates.
- to establish what will be included as baseline costs in the allocation of the costs of expansion for those generation and merchant transmission projects proposing to connect to the PJM system.

The system as planned is tested for its compliance with applicable reliability standards and PJM design standards to accommodate the forecast demand, committed resources, and commitments for firm transmission services for a specified time frame. Areas not in compliance with the standards are identified and enhancement plans are developed to achieve compliance.

The 'baseline' analysis and the resulting expansion plans serve as the base system for the conduct of Feasibility Studies and Impact Studies.

This report presents the results of the 'baseline' analysis from 2007 through 2011 for the PJM "footprint" as it existed in May 2006.

EXECUTIVE SUMMARY

PJM has responsibility for the development of a Regional Transmission Expansion Plan (RTEP) for the PJM system that will meet the needs of the region in a reliable, economic and environmentally acceptable manner. PJM also is responsible for recommending the assignment of any transmission expansion costs to the appropriate parties. In order to carry out these responsibilities, it is necessary to establish a starting point or 'baseline' from which the need and responsibility for enhancements can be determined.

In order to establish that baseline, PJM has defined the five (5) year period from 2007 through 2011 as the 2006 "baseline" planning period. The existing system plus any planned modifications to the transmission system scheduled to be in service prior to the 2011 summer peak period was chosen as the base system. All new generation and merchant transmission projects in Queues A through O that executed a Facility Study Agreement were also included in this baseline system along with any associated transmission enhancements as identified in the Impact Studies. Any Transmission Owner identified transmission enhancements independent of those associated with new generation or merchant transmission projects were also included. Only firm transmission service currently committed for the period was represented.

PJM has conducted a comprehensive load flow analysis of the ability of the PJM system to meet all applicable reliability planning criteria which are listed below:

- NERC Planning Standards ftp://www.nerc.com/pub/sys/all_updl/pc/pss/ps9709.pdf
- MAAC Reliability Principles and Standards (http://www.maac-rc.org/reference/princstandards.html) will be applied for all facilities included in the MAAC Compliance Facility list (http://www.maac-rc.org/reports/eia_ferc_nerc/downloads/comp-facil.pdf).
- ECAR Reliability Criteria (Document No. 1) (http://www.ecar.org/documents/document%201_6-98.pdf) will be applied to all ECAR networked transmission systems rated 100 kV or higher.
- MAIN Reliability Criteria **(http://www.maininc.org/bg/bgidx.htm)** will be applied to all MAIN networked transmission systems rated 100 kV or higher.
- SERC Reliability Criteria (http://www.serc1.org/Pages/ComplianceContentPage.aspx?ID=25) will be applied to all SERC networked transmission systems rated 100 kV and higher.
- PJM Reliability Planning Criteria as contained in Manual M14B Attachment G (http://www.pjm.com/contributions/pjm-manuals/pdf/m14bv04.pdf)
- Transmission Owner Reliability Planning Criteria as filed in their respective FERC 715 filing.

All conditions where the system was not in compliance with the applicable reliability standards were documented and system reinforcements required to bring the system into compliance were identified along with estimated cost and lead-time to implement them.

Those areas that were found to be non-compliant with applicable reliability standards establish the need for reinforcement in those areas independent of any future interconnection projects not included in the baseline analysis. This fact and the identified reinforcements to bring the system

into compliance will be used in evaluating the impact of the projects in Queues P & Q that qualify and elect to proceed with the impact studies. The extent to which reinforcements identified in the baseline analysis are advanced, deferred, modified or eliminated will be used in determining cost responsibility for the final plans in the RTEP.

It should be recognized that the reinforcements proposed in this baseline analysis might be modified or eliminated as a result of generation or merchant transmission projects being added to or removed from the system. The development of the RTEP for PJM is an ongoing process, which will include the conduct of impact studies and development of plans to accommodate the new interconnection projects in Queues P & Q. Upon completion of the impact studies some projects may elect not to proceed. When it is determined which projects will commit to proceed, a new baseline RTEP will be developed to meet the needs of the region, including the accommodation of all new projects committed to connect, during the next 5 year period. That RTEP will be recommended to the PJM Board of Directors for approval of proposed enhancements and will serve as the baseline for the next Queue of proposed projects.

The PJM Transmission Owners may identify the need to build additional system reinforcements that are not identified as required through the RTEP analysis.

KEY FINDINGS

The following areas of the system as planned through 2011 were found to be non-compliant with applicable reliability standards without additional reinforcement. These areas are described below along with any identified reinforcements to achieve compliance. The detailed descriptions of the conditions that result in non-compliance are reported in the Results section of this report. The cost estimates below are based on the cost estimates provided at the May 23, 2006 TEAC meeting.

1) The Mackeys – Edenton 115 kV circuit is contingency overloaded at 175% for the loss of the Everetts 230/115 kV transformer and the Earleys – Cashie – Trowbridge 230 kV circuit. The recommended solution is to install a second Everetts 230/115 kV transformer by June 2011. The estimated cost is $3 million.
2) The Remington – Brandywine 115 kV circuit is contingency overloaded at 259% for the loss of the Gordonsville – Hollymead – Charlottsville and South Anna – Louisa – North Anna 230 kV circuits. The recommended solution is to uprate/re-sag the Remington – Brandywine – Culpepper 115 kV circuit by June 2011. The estimated cost is $2.2 million.
3) The Elmont – Mt. Road 230 kV circuit is contingency overloaded at 130% for the loss of the Southwest – Walmsley – Iron Bridge – Chesterfield 230 kV and Midlothian – Trabue – Winterpock 230 kV circuits. The recommended solution is to replace the wave trap at Elmont 230 kV substation on the #231 line by June 2011. The estimated cost is $0.5 million.
4) The Halifax – Mt. Laurel 115 kV circuit is contingency overloaded at 135% for the loss of the Carson – Clover 500 kV and the Person – Halifax 230 kV circuits. The recommended solution is to build a new Chase City – Clarksville 115 kV circuit by June 2011. The estimated cost is $6 million.
5) The Shell Bank – Whealton 115 kV circuit is contingency overloaded at 137% for the loss of the Shell Bank – Magruder – Peninsula 115 kV circuit and Shell Bank 230/115 kV transformer. The recommended solution is to upgrade/re-sag the Shell Bank – Whealton 115 kV circuit by June 2011. The estimated cost is $0.5 million.

6) The Jetersville – Moran 115 kV circuit is contingency overloaded at 103% for the loss of a generation at Jetersville 115 kVsubstation. The recommended solution is to install a breaker at Crewe 115 kV substation and shift load from circuit 158 to circuit 98 by June 2011. The estimated cost is $0.5 million.
7) The Chesapeake – Cradock 115 kV circuit is contingency overloaded at 100% for the loss of the Chesapeake – Reeves 115 kV circuit. The recommended solution is to uprate/re-sag the Chesapeake – Cradock 115 kV circuit by June 2011. The estimated cost is $0.7 million.
8) The Chesapeake – Dozier 115 kV circuit is contingency overloaded at 108% for the loss of a generator at Thompsons Corner 115 kV substation. The recommended solution is to reconductor one span of the Chesapeake – Dozier 115 kV circuit by June 2011. The estimated cost is $0.05 million.
9) The Gordonsville 230/115 kV transformer #1 is contingency overloaded at 108% for the loss of the Gordonsville 230/115 kV transformer #2. The recommended solution is to replace the Gordonsville 230/115 transformer #1 by June 2011. The estimated cost is $3 million.
10) The Iron Bridge – Walmsley 230 kV circuit is contingency overloaded at 130% for the loss of the Midlothian – Trabue – Winterpock and Elmont – Mt. Road – North West 230 kV circuits. The recommended solution is to uprate/re-sag the Iron Bridge – Walmsley – Southwest 230 kV circuit by June 2011. The estimated cost is $0.6 million.
11) The Dayton – Harrisonburg 230 kV circuit and the Valley 500/230 kV transformer are contingency overloaded at 135% and 140% respectively, for the loss of the Dooms – Valley 500 kV circuit and Dooms 500/230 kV transformer #2. The recommended solution is to install a breaker at Dooms 230 kV substation by June 2009. The estimated cost is $1.0 million.
12) Voltage violation identified in the Norfolk/Virginia Beach area 230 kV buses and the Surry – Smithfield – Crittendon 230 kV circuit overloaded at 134% for N-2 contingency involving the loss of the Yadkin – Septa 500 kV circuit along with the Yadkin – Suffolk or Yadkin – Surry 500 kV circuit. The recommended solution is to build a new Carson – Suffolk 500 kV circuit, install second Suffolk 500/230 kV transformer and build new Suffolk – Fentress 230 kV circuit by June 2011. The estimated cost is $160 million.
13) The Rolling Meadows – Gore Junction 115 kV circuit is pre-contingency overloaded at 102%. The recommended solution is to upgrade the Rolling Meadow – Gore Junction 115 kV circuit by June 2011. No cost associated with this project.
14) The Portland – Pequest 115 kV circuit is contingency overloaded at 101% for the loss of the Gilbert – Morris Park 230 kV circuit. The recommended solution is to implement an operating procedure to close the Glendon – Gilbert 115 kV circuit by June 2011. No cost associated with this project.
15) The Grays Ferry – Tunnel – Parrish 230 kV circuit is contingency overloaded at 110% for the loss of the Windsor – Alloway 500 kV circuit. The recommended solution is to reconductor the overloaded circuit by June 2011. The cost is estimated at $4 million.
16) Either one of the Eddystone – Llanerch 138 kV circuit is contingency overloaded at 105% for the loss of the other Eddystone – Llanerch 138 kV circuit. The recommended solution is to install 2% reactor on both Eddystone – Llanerch 138 kV circuits and install a new 230/138 kV transformer at Plymouth Meeting by June 2011. The estimated cost is $4 million.
17) The Eddystone – Island Road 230 kV circuit is contingency overloaded at 105% for the loss of the MacDade – Morton 230 kV circuit. The recommended solution is to upgrade terminal equipments by June 2011. The estimated cost is $1.4 million.

18) The Portland – Greystone 230 kV circuit is contingency overloaded at 105% for tower outage involving the loss of the Gilbert – Morristown and Glen Gardner – West Wharton 230 kV circuits. The recommended solution is to upgrade terminal equipments by June 2011. The estimated cost is $0.8 million.
19) The Buckingham – Pleasant Valley 230 kV circuit is contingency overloaded at 112% for N-2 contingency involving the loss of the Alburtis – Branchburg and Elroy – Branchburg 500 kV circuit. The recommended solution is to reconductor the Buckingham – Pleasant Valley 230 kV circuit by June 2011. The estimated cost is $8 million.
20) The North Philadelphia – Waneeta 230 kV circuit is contingency overloaded at 126% for the loss of the Whitpain 230 kV bus #3 and Plymouth – Whitemarsh – Pulaski 230 kV circuit. The recommended solution is to reconductor the North Philadelphia – Waneeta 230 kV circuit by June 2011. The estimated cost is $4.1 million.
21) The Master – North Philadelphia 230 kV circuit is pre-contingency overloaded at 112%. The recommended solution is to reconductor the Master – North Philadelphia 230 kV circuit by June 2011. The estimated cost is $4.2 million.
22) A few thermal overloads identified in the Penelec region for numerous N-2 contingencies. The recommended solution is to change various tap settings in the Penelec region by June 2011. The estimated cost is $0.1 million.
23) The Alburtis – Hosensack 230 kV is overloaded at 105% for the N-2 contingency involving the loss of the Alburtis – Branchburg and Elroy – Branchburg 500 kV circuits. The recommended solution is to replace a 3000A disconnect switch at the Alburtis 230 kV substation. The estimated cost is $0.075 million.
24) The Oak Grove – Richie 230 kV is overloaded for N-2 contingency involving the loss of the Dickerson – Quince Orchard and Station H – Quince Orchard 230 kV circuits. The recommended solution is to install a 4th 230/69 kV transformer at Richie substation by June 2011. The estimated cost is $11.5 million.
25) The Dickerson – Quince Orchard “23033” 230 kV circuit is overloaded for N-2 contingency involving the loss of the Dickerson – Quince Orchard and Station H – Quince Orchard 230 kV circuits. The recommended solution is to upgrade the Dickerson – Quince Orchard “23033” 230 kV circuit by June 2011. The estimated cist is $3.75 million.
26) The Portland – Martins Creek 230 kV circuit is contingency overloaded at 102% for the loss of the Gilbert – Martins Creek 230 kV circuit. The recommended solution is to upgrade terminal equipment on Martins Creek and raise the operating temperature of the Portland – Martins Creek 230 kV circuit by June 2011. The estimated cost is $0.26 million.
27) The Kittatiny – Newton 230 kV circuit is overloaded at 112% for tower contingency involving the loss of the Portland – Greystone and Kittatiny – Pogatcong 230 kV circuits. The recommended solution is to reconductor the overloaded portion of the Kittatiny – Newton 230 kV circuit by June 2011. The estimated cost is $1.25 million.
28) The Gilbert – Glen Gardner 230 kV circuit is contingency overloaded at 110% for the Gilbert – Martins Creek 230 kV circuit. The recommended solution is to reconductor the 8 miles Gilbert – Glen Gardner 230 kV circuit by June 2011. The estimated cost is $7 million.
29) The Tosco – G22_MTX 230 kV circuit is contingency overloaded at 102% for the loss of the Deans – New Dover – Westfield 230 kV circuit. The recommended solution is to reconductor the Tosco – G22_MTX 230 kV circuit with 1033 bundled ACSS conductor by June 2011. The estimated cost is $0.62 miles.
30) The Portland – Kittatiny 230 kV circuit is overloaded at 110% for tower contingency involving the loss of the Portland – Greystone and Gilbert – Morristown 230 kV

circuits. The recommended solution is to replace terminal equipments on both Portland and Kittatiny 230 kV substations by 2011. The estimated cost is $1.38 million.

31) Various voltage violations identified across Mid Atlantic region for loss of several 500 kV circuits and generators under the 2011 load deliverability test for Mid Atlantic region. The recommended solution is to install 500 MVAR reactive device at Airydale 500 kV substation by June 2011. The estimated cost is $22 million.
32) Various voltage violations identified across Mid Atlantic region for the loss of the Keystone - Airydale 500 kV circuit under the 2011 load deliverability test for Mid Atlantic region. The recommended solution is to install 300 MVAR capacitors at Conemaugh 500 kV substation by June 2011. The estimated cost is $2 million.
33) The Pleasant View – Dickerson 230 kV circuit is contingency overloaded for the loss of the Possum Point – Burches Hill 500 kV circuit. The recommended solution is to install 0.5% reactor at Dickerson 230 kV substation on the Pleasant View – Dickerson 230 kV circuit by June 2011. The estimated cost is $5.0 million.
34) The Dickerson – Quince Orchard "23035" 230 kV circuit is contingency overloaded at 104% for the loss of the Station H – Quince Orchard "23033" 230 kV circuit. The recommended solution is to upgrade the Dickerson – Quince Orchard "23035" 230 kV circuit by June 2011. The estimated cost is $3.75 million.
35) The Burches Hill 500/230 kV transformer is pre-contingency overloaded at 101%. The recommended solution is to add a second Burches Hill 500/230 kV 1000 MVA transformer by June 2011. The estimated cost is $32 million.
36) Voltage violation identified at Altoona 230kV substation for N-2 contingency involving the loss of the Conastone – Hunterstown 500 kV and Johnstown – Altoona 230 kV ciruits. The recommended solution is to install two 50 MVAR capacitors at Altoona 230 kV substation by June 2011. The estimated cost is $1.0 million.
37) The Carroll 230/138 kV transformer #4 is contingency overloaded at 117% and numerous overloads were identified on the non PJM monitored facilities for the loss of the Doubs – Montgomery – Monocacy 230 kV circuit. The recommended solution is to extend 230 kV service to the existing Lime Kiln substation by December 2006 and to convert the Doubs – Monocacy 138 kV facilities to 230 kV operation by June 2011. The estimated cost is $13.6 million.
38) The North Shenandoah 138/115 kV transformer is contingency overloaded at 130% for the loss of the Meadow Brook – Greenland Gap 500 kV circuit and the Meadow Brook 500/138 kV transformers. The recommended solution is to replace the North Shenandoah 138/115 kV transformer by June 2011. The estimated cost is $2.0 million.
39) The Inwood – Stonewall 138 kV circuit is contingency overloaded at 103% for the loss of the Bedington – Black Oak 500 kV circuit and Bedington 500/138 kV transformers #1 and #3. The recommended solution is to upgrade the Inwood – Stonewall 138 kV circuit with 954 ACSR conductor by June 2011. The estimated cost is $1.6 million.
40) The Doubs 500/230 kV transformers #2, #3 and #4 are contingency overloaded for the loss of the Doubs – Brighton 500kV circuit under the 2011 load deliverability test for the Mid Atlantic region. The recommended solution is to replace the three overloaded Doubs transformers by June 2011. The estimated cost is $15.7 million.
41) Several voltage violations and thermal overloads identified across PJM system under the 2011 various tests. The recommended solution is to build a new 500 kV circuit from 502 Junction – Mt. Storm – Meadow Brook – Loudoun by June 2011. The estimated cost is $850 million.

OBJECTIVE AND SCOPE

The objectives of this study were as follows:

- To identify areas where the system as planned for the period 2007 through 2011 would not be in compliance with applicable reliability standards.
- To develop and recommend preliminary facility expansion plans, including cost estimates and estimated in service dates, to bring those areas into compliance.
- To establish what will be included as baseline expansion costs for the allocation of the costs of expansion for those projects included in Queues P & Q.

The scope of this study included analysis for the period 2007 through 2011 to determine compliance with the all applicable reliability planning criteria.

Other than as required for the PJM Reliability Planning Criteria or an individual transmission owner criteria, the system was not analyzed under non-peak load flow conditions on the basis that the system can and will be dispatched to remain within first contingency operating limits. Transmission constraints on market dispatch are economic constraints. Economic constraints are not considered violations of reliability criteria as long as the system can be adjusted to remain within reliability limits on a pre-contingency basis.

The necessity of all system reinforcements previously identified in the previous RTEP Baseline Reports and the Queue A through O Impact Studies were evaluated. Any previously identified reinforcements that are no longer required were documented and removed from the list of RTEP Reinforcements.

ANALYSIS METHODOLOGY

Load flow simulation was based on a representation of the 2011 forecast peak load, existing capacity resources, and all proposed interconnection projects in Queues A through O that executed a Facility Study Agreement. All firm transmission services committed for the 2011 period were represented in the base case (see below). In addition, any transmission reinforcements planned to be placed in service by 2011 summer were represented.

RTEP 2010 – INTERCHANGE		
FROM	**TO**	**MW**
PJM	AMRN	70
PJM	CIN	408
PJM	EKPC	0
PJM	FE	1676
PJM	IP	-1233
PJM	LGEE	-66
PJM	OVEC	-1853
PJM	ALTW	264
PJM	ALTE	155
PJM	CPLE	65
PJM	CPLW	0
PJM	DUK	263
PJM	MEC	1370
PJM	MECS	979
PJM	NIPS	400
PJM	NYIS	1342
PJM	WEC	1230
Total		**5070**

A load flow base case was developed for 2011 representing projected non diversified summer peak loads across the PJM Control Area. All in-service PJM capacity resources were dispatched at approximately 94% of the installed capacity value. All remaining Queue A through O generators were initially modeled at 0 MW.

Study of all voltage limits was completed using this base system. For analysis pertaining to thermal limits including Generator Deliverability and Load Deliverability a multitude of dispatch patterns were analyzed. A complete description of the Generator and Load Deliverability procedures is contained in Attachment E of PJM Manual M14B.

The 2011 base case was also used to analyze network transfer capability. To maintain reliability in a competitive capacity market, resources must contribute to the deliverability of electricity in the Control Area in two ways: 1) energy must be deliverable from the aggregate of resources available to the Control Area to load in portions of the Control Area experiencing a localized capacity emergency, or deficiency, 2) capacity resources within a given electrical area must, in aggregate, be able to be exported to other areas of the Control Area within some bounds that separate the reliability requirements of the Control Area from the reasonable economic function of the market place. PJM has developed two methods for evaluating the adequacy of network transfer capability for each of these deliverability requirements. These methods are described in

more detail in Attachment E of PJM Manual M14B.

The CETO/CETL method will be used to determine if the Capacity Emergency Transfer Limit (CETL) to each of the various electrical areas of PJM is sufficient to deliver each respective area's Capacity Emergency Transfer Objective (CETO).

The PJM Generation Deliverability procedure was used to determine if Network Transfer Capability was adequate to deliver all capacity resources out of defined areas to the network.

Finally, a short circuit analysis will be performed to determine if any of the 230 kV, 345 kV, or 500 kV breakers are overdutied. Calculated single phase to ground and three phase fault currents will be compared to breaker interrupting capability provided by the transmission owners for each breaker. All breakers having ratings less than the calculated fault currents will be identified.

RESULTS

The results of the baseline analysis for the 2007 – 2011 period are presented below. The cost estimates below are based on the cost estimates provided at the May 23, 2006 TEAC meeting.

The PJM generator and load deliverability analysis were completed as defined in the procedures of Manual M14B. In general these tests involve n-0 (pre-contingency) and n-1 (single contingency) analysis to determine the sufficiency of transfer capability between generation resources and load within the PJM system. The Load Deliverability test assures that there is adequate import capability to serve load pockets experiencing a capacity emergency condition while the Generator Deliverability test assures that PJM capacity resources will not be bottled at peak load conditions.

The 2011 system was also tested for compliance with PJM, Transmission Owner, and Regional Reliability council application of all NERC category A & B contingencies. In addition, NERC Category C contingencies were examined. Where the physical design of connections or breaker arrangements resulted in the outage of more than the faulted facility when the fault was cleared, such additional facilities were also outaged in the load flow. For example, if a transformer is tapped off a line without a breaker, both the line and transformer were outaged as a single contingency event.

Facilities with pre-contingency flows equal to or higher than 100% of the normal rating and facilities with post contingency flows equal to or higher than 100% of the 4-hour emergency rating were identified. In addition, voltages were monitored based on the existing voltage limits used in PJM Operations.

The following areas of the PJM system were found to not be in compliance for the 2007 – 2011 study period.

1) The Mackeys – Edenton 115 kV circuit is contingency overloaded at 175% for the loss of the Everetts 230/115 kV transformer and the Earleys – Cashie – Trowbridge 230 kV circuit. The recommended solution is to install a second Everetts 230/115 kV transformer by June 2011. The estimated cost is $3 million.
2) The Remington – Brandywine 115 kV circuit is contingency overloaded at 259% for the loss of the Gordonsville – Hollymead – Charlottsville and South Anna – Louisa – North Anna 230 kV circuits. The recommended solution is to uprate/re-sag the Remington – Brandywine – Culpepper 115 kV circuit by June 2011. The estimated cost is $2.2 million.
3) The Elmont – Mt. Road 230 kV circuit is contingency overloaded at 130% for the loss of the Southwest – Walmsley – Iron Bridge – Chesterfield 230 kV and Midlothian – Trabue – Winterpock 230 kV circuits. The recommended solution is to replace the wave trap at Elmont 230 kV substation on the #231 line by June 2011. The estimated cost is $0.5 million.
4) The Halifax – Mt. Laurel 115 kV circuit is contingency overloaded at 135% for the loss of the Carson – Clover 500 kV and the Person – Halifax 230 kV circuits. The recommended solution is to build a new Chase City – Clarksville 115 kV circuit by June 2011. The estimated cost is $6 million.

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7) The Chesapeake – Cradock 115 kV circuit is contingency overloaded at 100% for the loss of the Chesapeake – Reeves 115 kV circuit. The recommended solution is to uprate/re-sag the Chesapeake – Cradock 115 kV circuit by June 2011. The estimated cost is $0.7 million.
8) The Chesapeake – Dozier 115 kV circuit is contingency overloaded at 108% for the loss of a generator at Thompsons Corner 115 kV substation. The recommended solution is to reconductor one span of the Chesapeake – Dozier 115 kV circuit by June 2011. The estimated cost is $0.05 million.
9) The Gordonsville 230/115 kV transformer #1 is contingency overloaded at 108% for the loss of the Gordonsville 230/115 kV transformer #2. The recommended solution is to replace the Gordonsville 230/115 transformer #1 by June 2011. The estimated cost is $3 million.
10) The Iron Bridge – Walmsley 230 kV circuit is contingency overloaded at 130% for the loss of the Midlothian – Trabue – Winterpock and Elmont – Mt. Road – North West 230 kV circuits. The recommended solution is to uprate/re-sag the Iron Bridge – Walmsley – Southwest 230 kV circuit by June 2011. The estimated cost is $0.6 million.
11) The Dayton – Harrisonburg 230 kV circuit and the Valley 500/230 kV transformer are contingency overloaded at 135% and 140% respectively, for the loss of the Dooms – Valley 500 kV circuit and Dooms 500/230 kV transformer #2. The recommended solution is to install a breaker at Dooms 230 kV substation by June 2009. The estimated cost is $1.0 million.
12) Voltage violation identified in the Norfolk/Virginia Beach area 230 kV buses and the Surry – Smithfield – Crittendon 230 kV circuit overloaded at 134% for N-2 contingency involving the loss of the Yadkin – Septa 500 kV circuit along with the Yadkin – Suffolk or Yadkin – Surry 500 kV circuit. The recommended solution is to build a new Carson – Suffolk 500 kV circuit, install second Suffolk 500/230 kV transformer and build new Suffolk – Fentress 230 kV circuit by June 2011. The estimated cost is $160 million.
13) The Rolling Meadows – Gore Junction 115 kV circuit is pre-contingency overloaded at 102%. The recommended solution is to upgrade the Rolling Meadow – Gore Junction 115 kV circuit by June 2011. No cost associated with this project.
14) The Portland – Pequest 115 kV circuit is contingency overloaded at 101% for the loss of the Gilbert – Morris Park 230 kV circuit. The recommended solution is to implement an operating procedure to close the Glendon – Gilbert 115 kV circuit by June 2011. No cost associated with this project.
15) The Grays Ferry – Tunnel – Parrish 230 kV circuit is contingency overloaded at 110% for the loss of the Windsor – Alloway 500 kV circuit. The recommended solution is to reconductor the overloaded circuit by June 2011. The cost is estimated at $4 million.
16) Either one of the Eddystone – Llanerch 138 kV circuit is contingency overloaded at 105% for the loss of the other Eddystone – Llanerch 138 kV circuit. The recommended solution is to install 2% reactor on both Eddystone – Llanerch 138 kV circuits and install a new 230/138 kV transformer at Plymouth Meeting by June 2011. The estimated cost is $4 million.

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19) The Buckingham – Pleasant Valley 230 kV circuit is contingency overloaded at 112% for N-2 contingency involving the loss of the Alburtis – Branchburg and Elroy – Branchburg 500 kV circuit. The recommended solution is to reconductor the Buckingham – Pleasant Valley 230 kV circuit by June 2011. The estimated cost is $8 million.
20) The North Philadelphia – Waneeta 230 kV circuit is contingency overloaded at 126% for the loss of the Whitpain 230 kV bus #3 and Plymouth – Whitemarsh – Pulaski 230 kV circuit. The recommended solution is to reconductor the North Philadelphia – Waneeta 230 kV circuit by June 2011. The estimated cost is $4.1 million.
21) The Master – North Philadelphia 230 kV circuit is pre-contingency overloaded at 112%. The recommended solution is to reconductor the Master – North Philadelphia 230 kV circuit by June 2011. The estimated cost is $4.2 million.
22) A few thermal overloads identified in the Penelec region for numerous N-2 contingencies. The recommended solution is to change various tap settings in the Penelec region by June 2011. The estimated cost is $0.1 million.
23) The Alburtis – Hosensack 230 kV is overloaded at 105% for the N-2 contingency involving the loss of the Alburtis – Branchburg and Elroy – Branchburg 500 kV circuits. The recommended solution is to replace a 3000A disconnect switch at the Alburtis 230 kV substation. The estimated cost is $0.075 million.
24) The Oak Grove – Richie 230 kV is overloaded for N-2 contingency involving the loss of the Dickerson – Quince Orchard and Station H – Quince Orchard 230 kV circuits. The recommended solution is to install a 4th 230/69 kV transformer at Richie substation by June 2011. The estimated cost is $11.5 million.
25) The Dickerson – Quince Orchard “23033” 230 kV circuit is overloaded for N-2 contingency involving the loss of the Dickerson – Quince Orchard and Station H – Quince Orchard 230 kV circuits. The recommended solution is to upgrade the Dickerson – Quince Orchard “23033” 230 kV circuit by June 2011. The estimated cist is $3.75 million.
26) The Portland – Martins Creek 230 kV circuit is contingency overloaded at 102% for the loss of the Gilbert – Martins Creek 230 kV circuit. The recommended solution is to upgrade terminal equipment on Martins Creek and raise the operating temperature of the Portland – Martins Creek 230 kV circuit by June 2011. The estimated cost is $0.26 million.
27) The Kittatiny – Newton 230 kV circuit is overloaded at 112% for tower contingency involving the loss of the Portland – Greystone and Kittatiny – Pogatcong 230 kV circuits. The recommended solution is to reconductor the overloaded portion of the Kittatiny – Newton 230 kV circuit by June 2011. The estimated cost is $1.25 million.
28) The Gilbert – Glen Gardner 230 kV circuit is contingency overloaded at 110% for the Gilbert – Martins Creek 230 kV circuit. The recommended solution is to reconductor the 8 miles Gilbert – Glen Gardner 230 kV circuit by June 2011. The estimated cost is $7 million.
29) The Tosco – G22_MTX 230 kV circuit is contingency overloaded at 102% for the loss of the Deans – New Dover – Westfield 230 kV circuit. The recommended solution is to

reconductor the Tosco – G22_MTX 230 kV circuit with 1033 bundled ACSS conductor by June 2011. The estimated cost is $0.62 miles.

30) The Portland – Kittatiny 230 kV circuit is overloaded at 110% for tower contingency involving the loss of the Portland – Greystone and Gilbert – Morristown 230 kV circuits. The recommended solution is to replace terminal equipments on both Portland and Kittatiny 230 kV substations by 2011. The estimated cost is $1.38 million.
31) Various voltage violations identified across Mid Atlantic region for loss of several 500 kV circuits and generators under the 2011 load deliverability test for Mid Atlantic region. The recommended solution is to install 500 MVAR reactive device at Airydale 500 kV substation by June 2011. The estimated cost is $22 million.
32) Various voltage violations identified across Mid Atlantic region for the loss of the Keystone - Airydale 500 kV circuit under the 2011 load deliverability test for Mid Atlantic region. The recommended solution is to install 300 MVAR capacitors at Conemaugh 500 kV substation by June 2011. The estimated cost is $2 million.
33) The Pleasant View – Dickerson 230 kV circuit is contingency overloaded for the loss of the Possum Point – Burches Hill 500 kV circuit. The recommended solution is to install 0.5% reactor at Dickerson 230 kV substation on the Pleasant View – Dickerson 230 kV circuit by June 2011. The estimated cost is $5.0 million.
34) The Dickerson – Quince Orchard “23035” 230 kV circuit is contingency overloaded at 104% for the loss of the Station H – Quince Orchard “23033” 230 kV circuit. The recommended solution is to upgrade the Dickerson – Quince Orchard “23035” 230 kV circuit by June 2011. The estimated cost is $3.75 million.
35) The Burches Hill 500/230 kV transformer is pre-contingency overloaded at 101%. The recommended solution is to add a second Burches Hill 500/230 kV 1000 MVA transformer by June 2011. The estimated cost is $32 million.
36) Voltage violation identified at Altoona 230kV substation for N-2 contingency involving the loss of the Conastone – Hunterstown 500 kV and Johnstown – Altoona 230 kV ciruits. The recommended solution is to install two 50 MVAR capacitors at Altoona 230 kV substation by June 2011. The estimated cost is $1.0 million.
37) The Carroll 230/138 kV transformer #4 is contingency overloaded at 117% and numerous overloads were identified on the non PJM monitored facilities for the loss of the Doubs – Montgomery – Monocacy 230 kV circuit. The recommended solution is to extend 230 kV service to the existing Lime Kiln substation by December 2006 and to convert the Doubs – Monocacy 138 kV facilities to 230 kV operation by June 2011. The estimated cost is $13.6 million.
38) The North Shenandoah 138/115 kV transformer is contingency overloaded at 130% for the loss of the Meadow Brook – Greenland Gap 500 kV circuit and the Meadow Brook 500/138 kV transformers. The recommended solution is to replace the North Shenandoah 138/115 kV transformer by June 2011. The estimated cost is $2.0 million.
39) The Inwood – Stonewall 138 kV circuit is contingency overloaded at 103% for the loss of the Bedington – Black Oak 500 kV circuit and Bedington 500/138 kV transformers #1 and #3. The recommended solution is to upgrade the Inwood – Stonewall 138 kV circuit with 954 ACSR conductor by June 2011. The estimated cost is $1.6 million.
40) The Doubs 500/230 kV transformers #2, #3 and #4 are contingency overloaded for the loss of the Doubs – Brighton 500kV circuit under the 2011 load deliverability test for the Mid Atlantic region. The recommended solution is to replace the three overloaded Doubs transformers by June 2011. The estimated cost is $15.7 million.
41) Several voltage violations and thermal overloads identified across PJM system under the 2011 various tests. The recommended solution is to build a new 500 kV circuit from 502 Junction – Mt. Storm – Meadow Brook – Loudoun by June 2011. The estimated cost is $850 million.

With the addition of the above-mentioned network upgrades, all areas of the PJM system were found to be in compliance for the 2007 – 2011 study period.