Section 1: Executive Summary

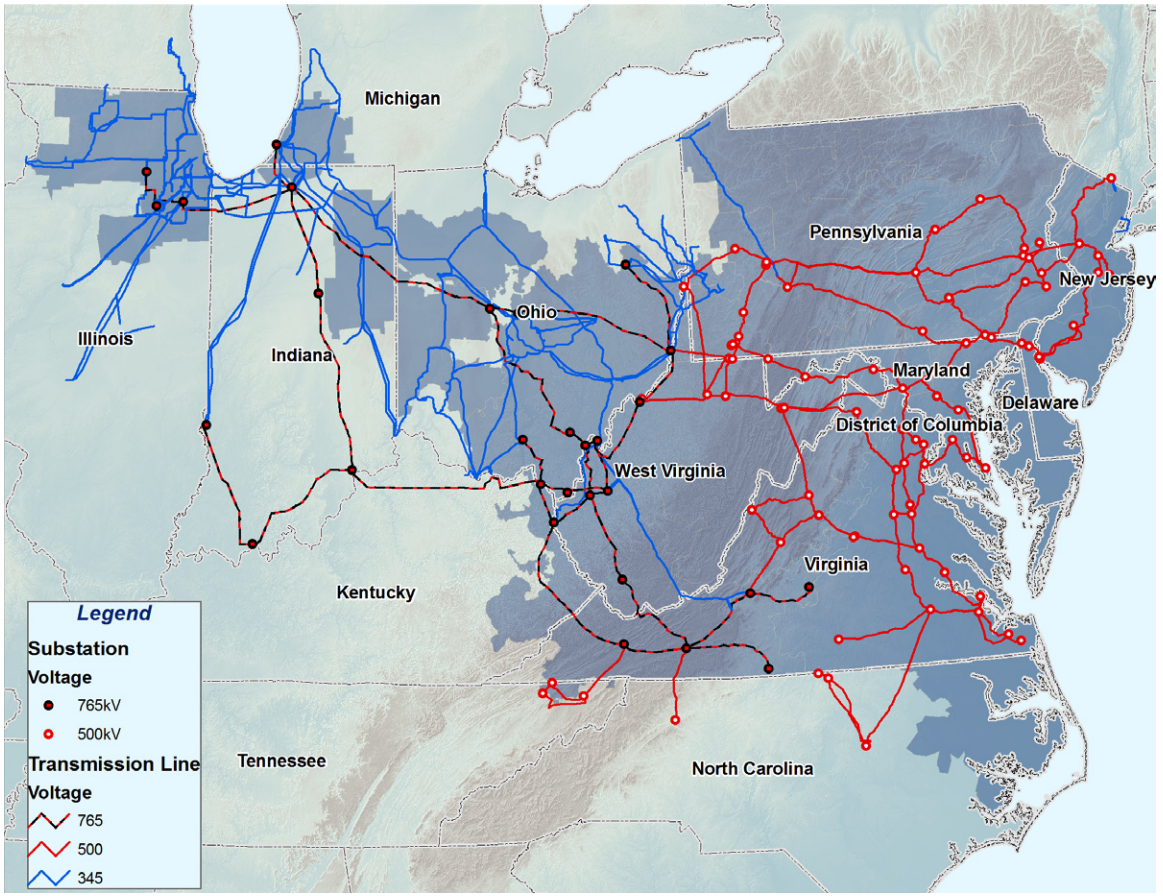
PJM | DE | DC | IL | IN | KY | MD | MI | NJ | NC | OH | PA | TN | VA | WV

1.0: Executive Summary

PJM's Regional Transmission Expansion Plan (RTEP) identifies transmission system upgrades and enhancements to preserve grid reliability, the foundation of competitive wholesale power markets. As a Federal Energy Regulatory Commission (FERC) approved Regional Transmission Organization (RTO), one of PJM's core functions encompasses regional transmission planning activities to address the reliability needs of a region that encompasses more than 164,000 square miles in 13 states and the District of Columbia, as shown on Map 1.1.

PJM's RTEP process includes both five year and 15-year dimensions. Five-year-out planning enables PJM to assess and recommend transmission upgrades to meet forecasted near-term load growth and to ensure the safe and reliable interconnection of new generation and merchant transmission projects seeking interconnection within PJM.

Map 1.1: PJM Backbone Transmission System



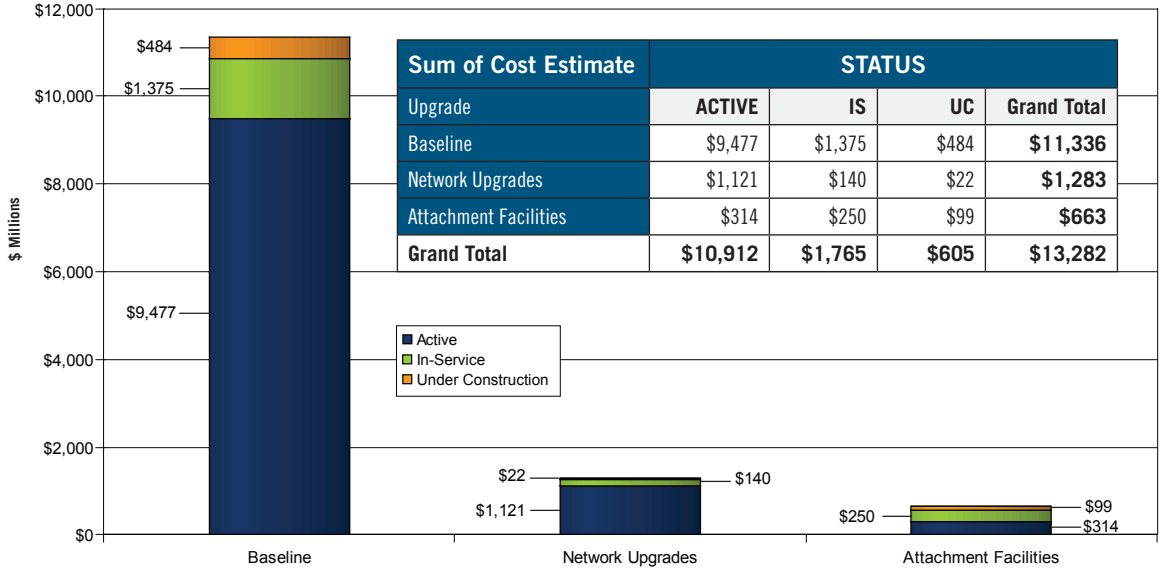
The 15-year horizon permits consideration of many long-lead-time transmission options. These options often comprise larger magnitude transmission facilities that more efficiently and globally address reliability issues. Typically, these are higher voltage upgrades that simultaneously address multiple NERC reliability criteria violations at all voltage levels. A 15-year horizon also allows PJM to consider the aggregate effects of many system trends including long-term load growth, impacts of generation deactivation and broader generation development patterns across PJM. This could include reliability issues posed by clusters of development based on innovative coal or nuclear technologies, renewable energy sources, or proximity to fuel sources.

New RTEP recommendations are submitted to PJM's independent Board of Managers (PJM Board) periodically throughout the year to resolve identified reliability criteria violations. Once approved, they become part of PJM's overall RTEP.

Approved Upgrades to Enhance System Total $13.2 Billion

More than $13.2 billion of transmission upgrades and additions, representing over 1,400 distinct transmission projects ranging from 69 kV to 765 kV, have been authorized by the PJM Board since the inception of the RTEP process in 1999, through December 2008. About $11.3 billion of baseline transmission network upgrades across PJM ensure that established reliability criteria will continue to be met. At the same time, $1.9 billion of additional transmission upgrades will enable the interconnection of more than 45,000 MW of new generating resources and merchant transmission projects. A summary of upgrades by status appears in Figure 1.1.

Figure 1.1: Status of Baseline, Network, and Attachment Facility Connection Upgrades



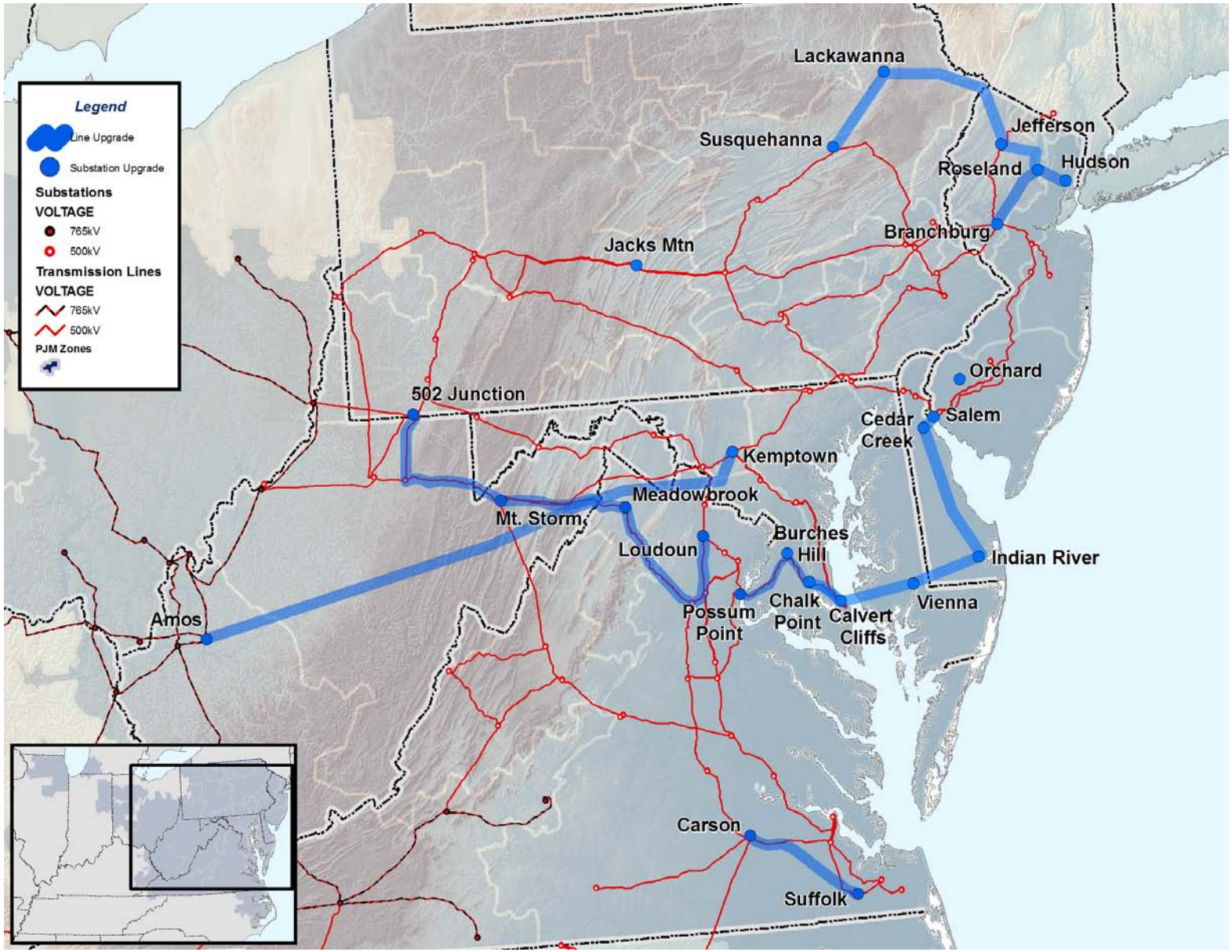
Sum of Cost Estimate	STATUS			
Upgrade	ACTIVE	IS	UC	Grand Total
Baseline	$9,477	$1,375	$484	**$11,336**
Network Upgrades	$1,121	$140	$22	**$1,283**
Attachment Facilities	$314	$250	$99	**$663**
Grand Total	**$10,912**	**$1,765**	**$605**	**$13,282**

Baseline Key Backbone Facilities

In June 2006, the PJM Board approved the 502 Junction - Loudoun 500 kV line, referred to as TrAIL (Trans-Allegheny Interstate Line). In June 2007, the PJM Board approved two new backbone transmission network facilities – the 500 kV Susquehanna - Roseland project between northeastern Pennsylvania and northern New Jersey, and the Amos - Kemptown line (referred to as the Potomac-Appalachian Transmission Highline or PATH). In October 2007, the PJM Board approved one additional backbone transmission facility: Possum Point – Calvert Cliffs – Vienna – Indian River – Cedar Creek – Salem line, also known as the MAPP (Mid-Atlantic Power Path) Project. Taken together, these four projects will substantially enhance the reliability and economic performance of the transmission system in the Mid-Atlantic region of PJM, which includes Delaware, the District of Columbia, New Jersey, and parts of Maryland, Pennsylvania, and Virginia. Map 1.2 depicts the location of these backbone facilities.

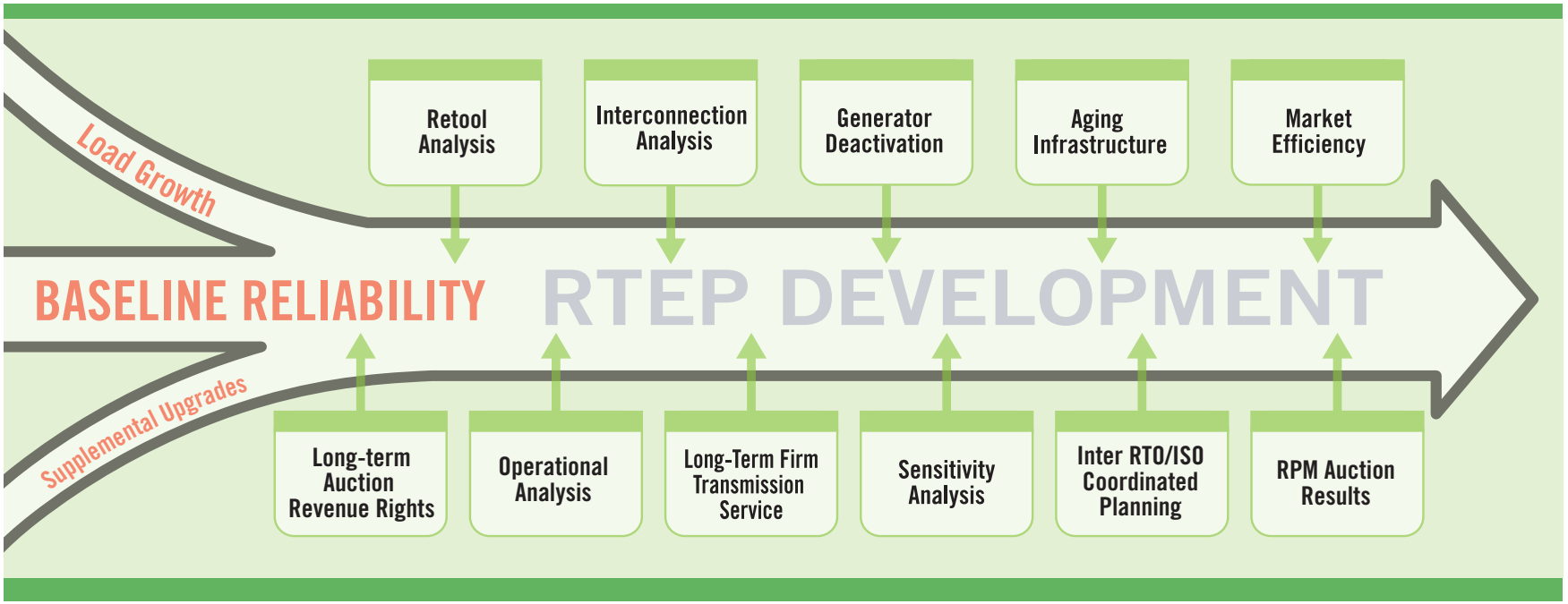
As more fully discussed in this report, the PJM Board approved 450 additional transmission upgrade projects in 2008, including a reconfiguration of the MAPP Project to include the use of direct current (DC) technology for the Chesapeake Bay crossing, from Calvert Cliffs to Vienna and Indian River. These transmission projects are valued at approximately $3.4 billion and are designed to address transmission system criteria violations. This set of upgrades approved in 2008 also includes a new 500 kV facility from Branchburg to Roseland to Hudson to resolve a number of reliability criteria violations identified in Northern New Jersey. This facility is also depicted in Map 1.2.

Map 1.2: PJM Board-Approved Backbone Transmission Lines



The right-of-way routes shown on this map is for illustrative purposes only and may not depict the actual routes that may eventually be chosen. Substation locations may also be modified if more beneficial connections are determined by PJM.

Figure 1.2: RTEP Development Drivers



Expansion Planning Drivers

Since its inception in 1997, PJM's RTEP Process has continued to adapt to the needs of RTO constituencies – end-use customers, generation and merchant transmission developers and Transmission Owners, to name a few. Initially, PJM's RTEP consisted mainly of upgrades driven by load growth and generating resource interconnection requests. Today, many other drivers are also considered. PJM's RTEP is the outcome of a sophisticated process that examines these drivers over a 15-year horizon, as described more fully in **Section 2** and summarized in Figure 1.2.

PJM's RTEP process throughout 2008 culminated in a series of upgrades approved by the PJM Board of Managers (PJM Board). PJM identified and recommended these upgrades to resolve reliability criteria violations identified through 2023. Now part of PJM's RTEP, the 2008 upgrade plans have been integrated with those RTEP upgrades, approved by PJM's Board between 1999 and December 31, 2007. As this report demonstrates, and consistent with findings in prior years, 2008 RTEP transmission upgrades and enhancements cover a range of power system elements: circuit breaker replacements to accommodate increased current interrupting duty cycles, new capacitors to increase reactive power support, new lines, line reconductoring, new transformers to accommodate increased power flows and other circuit reconfigurations and upgrades to accommodate power system changes.

2008 Compliance with NERC Criteria

The 2009 – 2023 baseline assessments included base case thermal and voltage analysis, load deliverability thermal and voltage analyses, generation deliverability thermal and voltage analyses and baseline stability analysis. Contingency analysis included all bulk electric system facilities 100 kV and greater, all tie lines to neighboring systems and all lower voltage facilities operated by PJM. Thermal and voltage limits employed were those specified by PJM Operations, as described in PJM Transmission Operations Manual M-3, available on PJM's Web site via the following URL: http://www.pjm.com/documents/manuals.aspx.

Baseline thermal and voltage analysis encompasses an exhaustive analysis of all Bulk Electric System (BES) facilities for compliance with NERC Category A (TPL-001), Category B (TPL-002) and Category C (TPL-003) events. In addition, consistent with NERC standard TPL-004, a number of extreme events including those judged to be critical from an operational perspective as well as those defined in Table I of TPL-004 were evaluated for risk and consequences to the system.

2008 Reactive Analysis

PJM's 2008 RTEP process included completion of a series of reactive studies begun in 2007 looking 10 years out – 2017 – in keeping with the Planning Committee's 2006 direction to include reactive planning analysis in year 10 of each 15 year planning horizon. The scope of PJM's 2017 voltage analysis comprised areas of the PJM system where thermal overload criteria violations were identified in the 6 -15 year load deliverability analysis. Determination of this scope for voltage analysis was based on the rationale that operationally PJM typically experiences system voltage issues when the transmission system is stressed, as under the high load conditions modeled in load deliverability studies. The 2017 voltage analysis focused on the 765 kV, 500 kV and 345 kV portions of the transmission system to determine reactive limitations and requirements. Given that the 2007 RTEP identified thermal problems in the Eastern Mid-Atlantic, Southwest Mid-Atlantic and Mid-Atlantic areas of PJM, the load deliverability voltage analysis for 2017 was performed for those same Mid-Atlantic, Southwest Mid-Atlantic and Eastern Mid-Atlantic areas.

1. PJM identified the need for approximately 3,000 MVAR of reactive devices by 2017 in order to provide for acceptable voltage profiles under N-0 and N-1 conditions.
2. PJM 2008 RTEP analysis also included sensitivity analysis of zonal power factors to determine the magnitude of the reactive reinforcements that would be required if all zones were at unity power factor. Results revealed that with all transmission owner zones at unity power factor, PJM needs approximately 750 MVAR of reactive support by 2017 to alleviate N-0 and N-1 contingency voltage criteria violations.
3. Addition of the backbone transmission lines identified approved by the PJM Board as part of PJM's 2007 RTEP have mitigated the need for a significant portion of the nearly 10,000 MVAR of reactive reinforcements required by 2016 as originally identified in PJM's 2006 RTEP analysis.

Specific MAAC and EMAAC deliverability tests revealed several significant voltage limitations that absent a backbone solution could otherwise lead to voltage collapse. Given the severity of the reliability criteria violations – including voltage collapse – MAAC and EMAAC deliverability voltage studies and results, the efficacy of the MAPP project was validated as the most effective solution among a number of alternatives examined.

Mid-Atlantic Power Pathway (MAPP)

As proposed, the PHI MAPP 500 kV line will run from Possum Point 500 Kv substation in Virginia to the Salem 500 kV substation in New Jersey, as shown on MAP 1.2. The 220 mile long line is expected to be built primarily along existing rights of way and is intended to pass through Burches Hill, Chalk Point, Calvert Cliffs, Vienna, Indian River and Cedar Creek stations. The line is expected to be overhead construction with the exception of the Chesapeake Bay crossing which is expected to be HVDC submarine cable construction. The line is currently estimated to cost $1.4 billion, based on more detailed engineering estimates developed in 2008, including that for employing HVDC technology. As part of PJM's 2008 RTEP process, PJM engineering staff in collaboration with Transmission Owner PHI has validated the need for MAPP and has refined the scope of the project itself in light of available industry technologies.

PJM's 2008 RTEP process examined and refined a number of aspects of the MAPP project:

1. Confirmation of need for MAPP in 2013, per the voltage criteria violations.
2. Ability of MAPP to alleviate the Rock Springs – Keeney 500 kV line thermal overload in year 15
3. Preference of MAPP as a solution to identified reliability criteria violations in 2013 and beyond, including a comparison with a new Conastone - Peach Bottom 500 kV line and a new Peach Bottom – Keeney 500 kV line
4. Preference for DC over AC technology for the portion of the MAPP line that crosses the Chesapeake Bay particularly in light of voltage rise concerns, operability, construction/ engineering issues and environmental concerns.

After due consideration of the additional information and insights gained from examination of the aforementioned, the PJM Board approved several PJM recommendations in 2008 regarding the MAPP project:

1. Proceed with the engineering and construction of the portion of the MAPP project from Possum Point to Burches Hill to Chalk Point to Calvert Cliffs with a DC link from Calvert Cliffs to Vienna and a DC link from Calvert Cliffs to Indian River.
2. Update the expected in-service date of the MAPP project to June 1, 2013
3. Continue to evaluate the timing of the need for the Indian River - Salem portion of the MAPP project.
4. Continue to follow the disposition of the Indian River consent decree to determine if additional interim solutions are required.

PJM will continue to work with transmission owner PHI throughout 2009 to refine plans for the MAPP facility in light of these 2008 studies and additional feasibility assessments.

2008 RTEP: 2011 and 2012 Retool Analyses

Planning is a dynamic process. System conditions change over time, driving the need to adjust modeling assumptions used in planning studies in order to evaluate the efficacy of previously identified expansion plans. PJM's RTEP process provides such flexibility so that existing expansion plans can be modified as required and to determine whether upgrades are still required in the year originally identified.

This type of planning analysis – known as a retool - is the means PJM uses to ensure the planning process reflects the most current forecasted conditions. The timing and nature of future criteria violations as well as the progress of construction of previously identified transmission upgrades have a bearing on whether all such upgrades may need to be accelerated, deferred or modified. As a result, the transmission plan is adjusted accordingly.

PJM's RTEP process 2008 RTEP analysis encompassed validation of existing upgrade plans and recommendation of much-needed new ones to eliminate identified reliability criteria violations.

- 2008 RTEP retool analysis of 2011 system conditions validated the need for the 502 Junction – MeadowBrook Loudoun (TrAIL) 500 kV line in 2011.
- 2008 RTEP retool analysis of 2012 system conditions confirmed the need for the Susquehanna - Roseland 500 kV Line in 2012 and revealed that the Amos - Kemptown 765 kV line could be deferred, but only for one year.

Now, 2008 RTEP analysis of forecasted 2013 system conditions have revealed reliability criteria violations that validate the need for the Amos - Kemptown 765 kV line and MAPP 500 kV line in 2013.

Branchburg – Roseland – Hudson 500 kV Line

PJM's 2008 RTEP process identified more than 20 thermal and reactive reliability criteria violations in Northern New Jersey. Two alternatives – one at 500 kV and one at 230 kV – were studied for their ability to resolve these issues. Those studies revealed that for a number of reasons, the 500 kV alternative is the preferred choice. Deliverability analysis revealed that the 500 kV alternative is more effective at resolving thermal and voltage reliability criteria violations. Considering the effectiveness of each alternative at resolving thermal and reactive issues throughout the15-year planning horizon, the 500 kV alternative was selected as the preferred project.

- The two alternatives resolve many of the reactive issues identified
- Both the 500 kV and 230 kV alternatives resolve reactive issues for PS and PS North load deliverability conditions.
- For EMAAC load deliverability conditions, reactive performance is similar for each alternative with significant voltage issues for the loss of the Greystone to Whippany 230 kV line.
- For MAAC load deliverability conditions, reactive losses are approximately 1,000 MVAR higher for the 230 kV alternative.
- Common mode contingency performance is better with the 500 kV alternative.
- The 500 kV alternative is more robust resolving all near term thermal violations.

- A more robust 230 kV alternative would be required as the proposed alternative does not resolve all of the near term violations.

Recognizing the technical and operational challenges with implementing either of the projects given the size, scope and complexity of each, PJM engaged an independent engineering firm to assess the advantages and disadvantages of each alternatives from a construction and implementation perspective.

This independent engineering evaluation compared the feasibility of the 500 kV and 230 kV options based on permitting issues, constructability, schedule, and the cost of both options. While both options are technically feasibility and present no fatal flaws, when considering the higher level of system impacts, and the risks with respect to upgrading the underground circuits required for the 230 kV option, the 500 kV option is preferred. The 230 kV option would require significant system disruptions because a majority of the upgrades involve replacement of existing underground lines and substations that are presently in service.

PJM recommended the 500 kV alternative to the PJM Board of Managers who approved it in December 2008. This new 500 kV facility is also shown on Map 1.2

450 Transmission Upgrades Approved in 2008

As more fully discussed in this report, the PJM Board approved 450 additional transmission upgrade projects in 2008. Most of these upgrades spread across PJM are at voltage levels under 500 kV, smaller in scope but no less critical to reliability. These were also approved by the PJM Board in December 2008 and are also discussed throughout this report.

2008 Market Efficiency Analysis

Market efficiency analysis is performed as part of the overall Regional Transmission Expansion Plan (RTEP) Process to accomplish the following objectives:

- Determine which reliability upgrades, if any, have an economic benefit if accelerated or modified.
- Identify new transmission upgrades that may result in economic benefits.
- Identify economic benefits associated with modification to reliability-based enhancements already included in RTEP that when modified would relieve one or more economic constraints. Such upgrades resolve reliability issues but are intentionally designed in a more robust manner to provide economic benefits in addition to resolving those reliability issues.

PJM's 2008 market efficiency analysis assessed the economic impact of all upgrades identified as part of PJM's RTEP process up through and including those identified as part of the 2007 RTEP cycle. Results have indicated that approved RTEP upgrades will significantly impact PJM constrained operations reducing total PJM system congestion costs to levels 90% lower than costs expected absent the upgrades.

The majority of the congestion cost reduction is associated with the addition of the major 765 kV and 500 kV backbone projects contained in the RTEP. The backbone projects include 502 Junction – Loudoun 500 kV line, Amos – Kemptown 765 kV line, Susquehanna-Roseland 500 kV and Possum Point – Salem 500 kV line. These backbone projects are responsible for just under 90% of the total congestion cost reduction. The remainder of the congestion cost reduction is associated with non-backbone upgrades.

No economic upgrades or acceleration of reliability upgrades for economic reasons have been recommended as a result of 2008 market efficiency analysis. The 500 kV and 765 kV backbone transmission lines cannot realistically be accelerated given their scale and near-term required in-service date to resolve NERC reliability criteria violations.