Section 1: Executive Summary

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

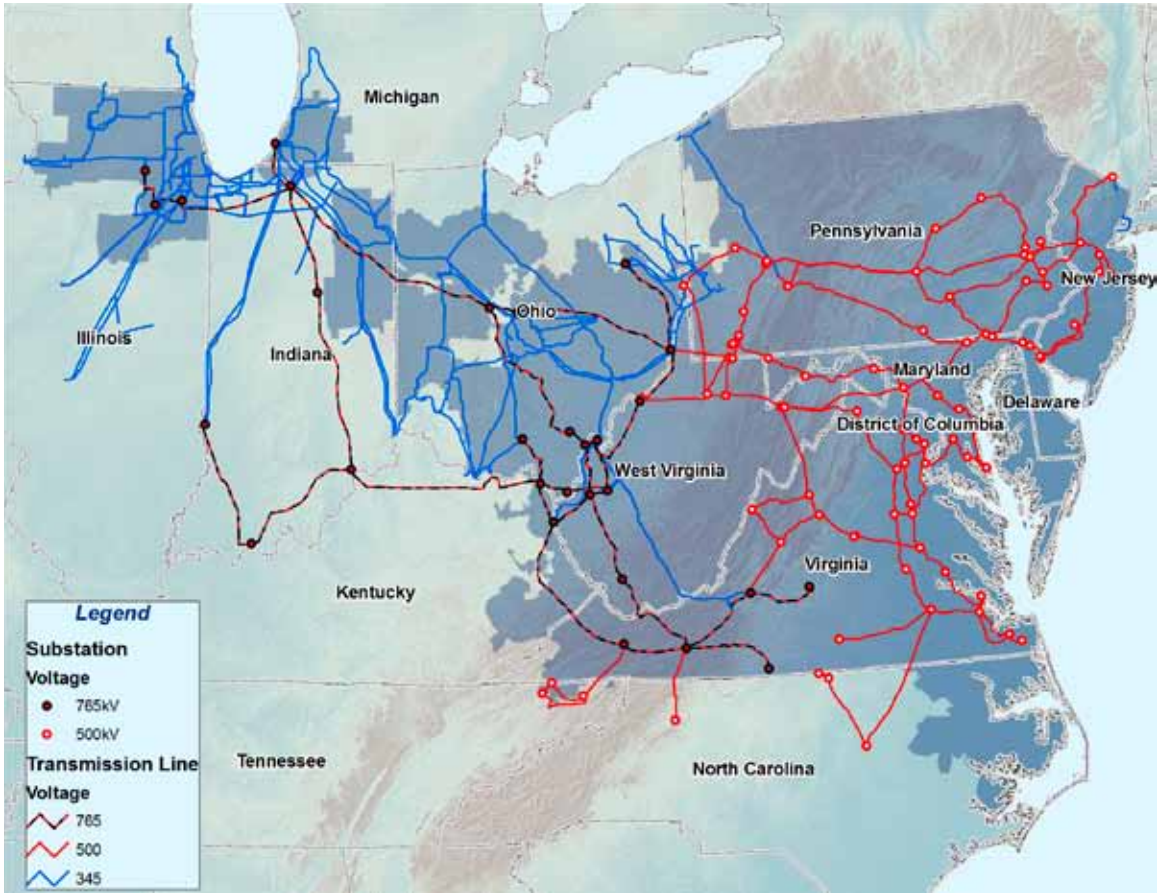
1.0: Executive Summary

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.

PJM's 15-year planning 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

Map 1.1: PJM Backbone Transmission System



load growth, impacts of generation deactivation and broader generation development patterns across PJM.

New RTEP BES 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.

The Bulk Electric System (BES) includes all transmission facilities operated at 100 kV and above, as defined by NERC. PJM itself includes BES facilities, as well as transmission system facilities turned over to PJM Operations by Transmission Owners.

Emerging RTEP Trends

1. To a significant extent, PJM's 2009 RTEP Process focused on retool studies driven by lower, short-term 2009 load forecast trends. Indeed, when assessed over a 10 year period, while annual peak load forecasts are somewhat reduced growth rates are seen to rebound to pre-recession levels.

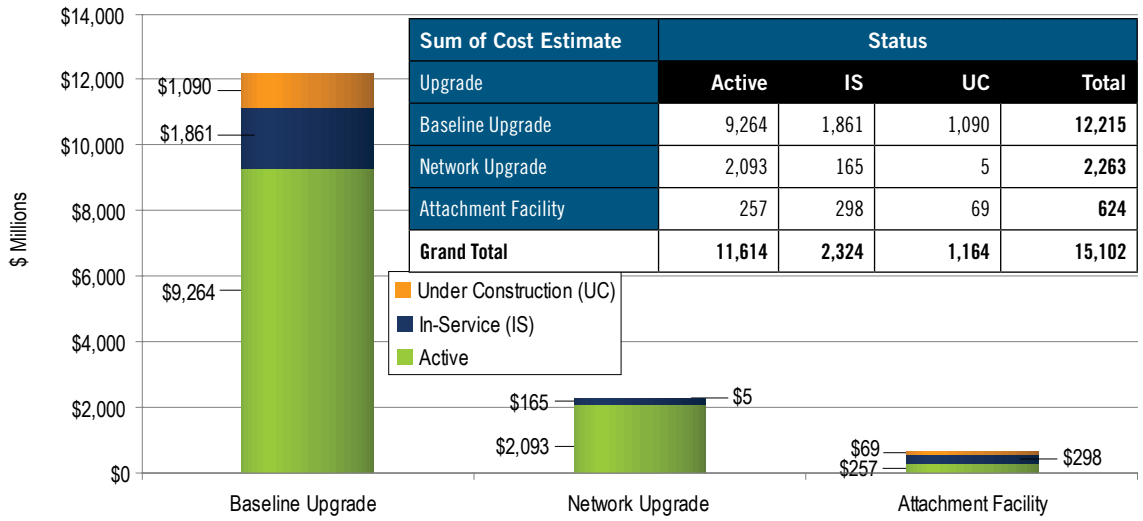
   Retool studies in 2009 helped PJM to confirm the need for previously approved RTEP backbone upgrades and to refine required in-service dates: some for the in-service dates originally determined and some deferred by a year or more.

   A limited number of other projects have been deferred indefinitely and removed from the RTEP. Equally important, retool results also revealed that no need existed for any backbone upgrade earlier than already identified.

2. More recently, PJM has completed sensitivity analyses on existing 2014 power flow cases, performed at the request of Virginia's Hearing Examiner in the PATH proceeding. Several scenarios that included increased levels of demand response revealed the potential to defer PATH beyond the originally identified 2014 in-service date. PJM will examine PATH, as well as other backbone projects, as part of its 2010 annual RTEP process analyses.

3. The growing impacts of renewable resources on generation mix and demand response initiatives on load growth will continue to shape the scope and type of BES transmission expansion plans that PJM's RTEP process is expected to identify in 2010 and beyond. Spurred by unfolding federal and state public policy decisions, the location and magnitude of these resources and initiatives will impact future transmission expansion decisions. Not least of these is the emergence of substantial wind powered generating facilities often located far from the load centers they serve. PJM continues to remain engaged in many stakeholder forums in which these trends and decisions are discussed.

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



Sum of Cost Estimate	Status			
Upgrade	Active	IS	UC	Total
Baseline Upgrade	9,264	1,861	1,090	**12,215**
Network Upgrade	2,093	165	5	**2,263**
Attachment Facility	257	298	69	**624**
Grand Total	**11,614**	**2,324**	**1,164**	**15,102**

1.0.1 – Approved Upgrades to Enhance System Total $15 Billion

The PJM Board has approved more than $15 billion of BES transmission enhancements since the inception of PJM's RTEP process in 1999, through December 31, 2009, ensuring that PJM is compliant with NERC reliability criteria. This includes over $12 billion of baseline transmission upgrades across PJM and nearly $3 billion of additional BES transmission upgrades to enable the interconnection of nearly 50,000 MW of new generating resources and merchant transmission projects. A summary of upgrades by status appears in Figure 1.1. In 2009 alone, the PJM Board approved over 420 individual BES baseline upgrades. Larger scale projects are discussed in this report.

Market Efficiency

Completion of RTEP process market efficiency studies in 2009 identified upgrades economically justified based on application of the cost/benefit analysis procedures described in Section 1.5.7 of Schedule 6 of the PJM Operating Agreement. Vetted through PJM's TEAC stakeholder process in December 2009, the following facilities will be recommended to the PJM board in January 2010: the addition of a 500/230 kV transformer at Conemaugh and a new 230 kV line between Conemaugh and Seward.

1.0.2 – 2009 Compliance with NERC Criteria

PJM's 2009 RTEP process validated compliance with NERC standards for Category A (TPL-001), Category B (TPL-002) and Category C (TPL-003) events for the period 2010 through 2024. Baseline assessment included thermal and voltage analysis, load deliverability thermal and voltage analyses, generation deliverability thermal and voltage analyses, and common mode contingency analysis.

Contingency analysis included all PJM BES, all other facilities turned over to PJM by transmission owners, and critical facilities in systems adjoining PJM, including tie lines. Thermal and voltage limits employed are 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.

*** NOTE**

Totals for "Active" Baseline Upgrades are dollars for those baseline facilities which have been approved by the PJM Board but for which construction has not started.

1.0.3 – 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, PJM's RTEP is the outcome of a sophisticated process that examines many drivers over a 15-year horizon, as described more fully in **Section 2** and summarized in Figure 1.2.

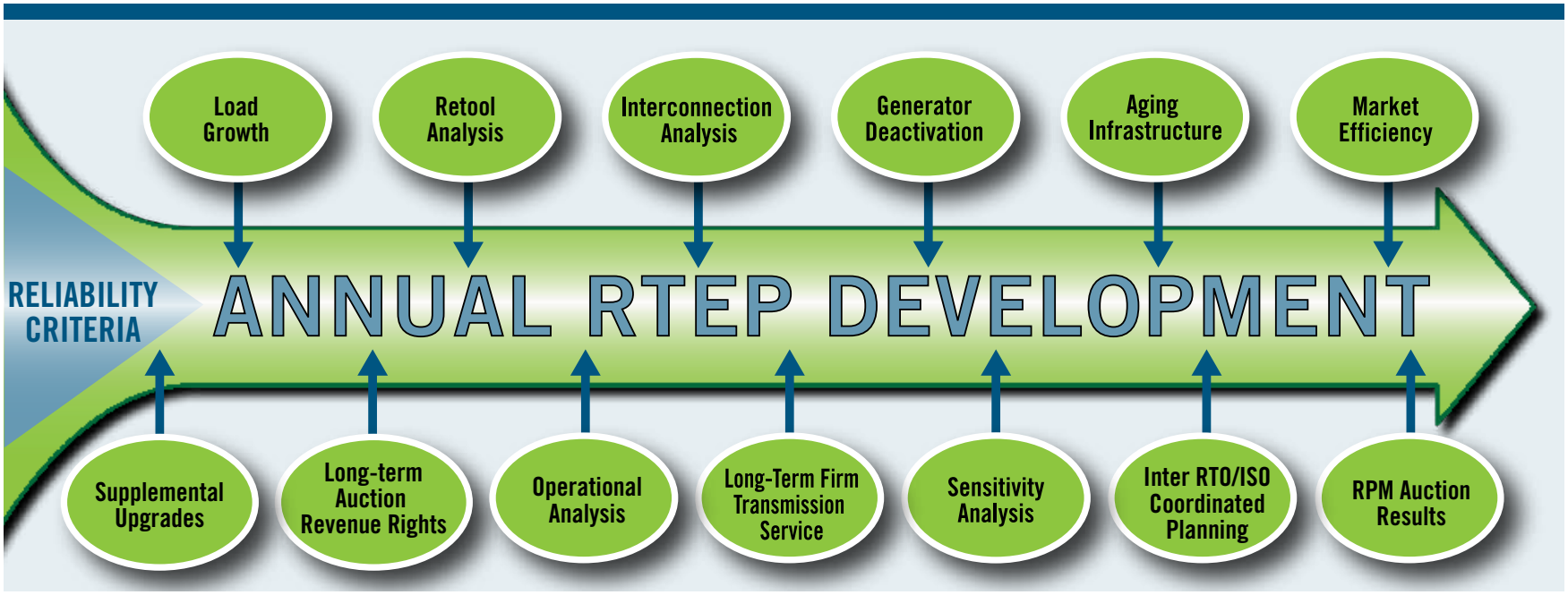
PJM's RTEP process throughout 2009 culminated in a series of upgrades approved by the PJM Board. PJM identified and recommended these upgrades to resolve reliability criteria violations identified through 2024. Now part of PJM's RTEP, 2009 upgrade plans have been integrated with those RTEP upgrades which were approved by PJM's Board between 1999 and December 31, 2008. Consistent with findings in prior years, 2009 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.

Load Forecasts: Comparing 2009 with 2008

One of the core principles of PJM's planning process is the consideration of all drivers that impact grid infrastructure planning needs and integration of all solutions available to meet those needs. Load forecasting is one such fundamental, key driver of transmission expansion plans and resource adequacy requirements.

PJM's planning process identifies future system transmission needs based on power flow studies that reveal NERC criteria violations. These power flow models incorporate the effect of many system expansion drivers. Load growth remains a fundamental driver of transmission expansion plans. Over time, experience has demonstrated that load growth in eastern PJM load centers, if not coupled with increases in new generation and demand response, leads to increased west-to-east flows on transmission facilities, potentially aggravating an already heavily-loaded system.

Figure 1.2: RTEP Development Drivers



PJM's 2014 Baseline model incorporated PJM's 2009 load forecast for the planning horizon through 2014. PJM's 2014 RTO Summer Peak was modeled at 149,497 MW, less than the 2008 forecast for 2014 of 151,675 MW by 2,178 MW, or about 1.4 percent lower. The 2009 forecast reflects the impacts of the economic downturn in the US since the Fall of 2008.

Just as important, PJM's forecasted 15-year RTO load growth rate increased from 1.5 percent per year in the 2008 Forecast to 1.7 percent per year in the 2009 Forecast following a drop due to recessionary pressures.

Generation

In addition to existing in-service generation, 2009 RTEP process power flow cases incorporated the impacts of various generation status changes including the following: generation with signed ISAs, generation with signed ISAs that withdrew and generation deactivations (e.g., retirement).

- Mid-Atlantic PJM included 500 MW of new generation with a signed ISA and 3,500 MW of new generation with a signed FSA. In addition, the following units, previously identified for potential deactivation, as discussed in previous RTEP reports, – were modeled in-service: Indian River 3 & 4, Potomac River, Bergen and Sewaren.

- Western PJM included 1,000 MW of new generation with a signed ISA and 900 MW of new generation with a signed FSA. In addition, Catoctin generation was modeled as having an FSA due to the suspension of its ISA.

- Southern PJM included 500 MW of new generation with a signed ISA and 650 MW of new generation with a signed FSA.

Prior to the beginning of each retool analysis – 2010, 2011, 2012 and 2013 – PJM updated its power flow generation model to include the impact of the most current ISA status of queued generation projects.

In addition, queued generation interconnection requests with a signed Facilities Study Agreement (FSA) were modeled online in generator deliverability and common mode base cases but offline in load deliverability studies in the specific area under study.

1.0.4 – PJM Baseline Backbone Facilities

Since 2006, the PJM Board has approved six new major 500 kV and 765 kV backbone upgrades, as shown on Map 1.2:

1. 502 Junction - Loudoun 500 kV line, also known as TrAIL (2006 RTEP)

2. Carson - Suffolk 500 kV line (2006 RTEP)

3. Susquehanna - Roseland 500 kV line (2007 RTEP)

4. Amos - Kemptown 765 kV line, also known as the PATH line (2007 RTEP)

5. Possum Point - Indian River 500 kV line, also known as the MAPP line (2007 RTEP)

6. Branchburg - Roseland - Hudson 500 kV line (2008 RTEP)

1.0.5 – 502 Junction - Loudoun 500 kV line (TrAIL)

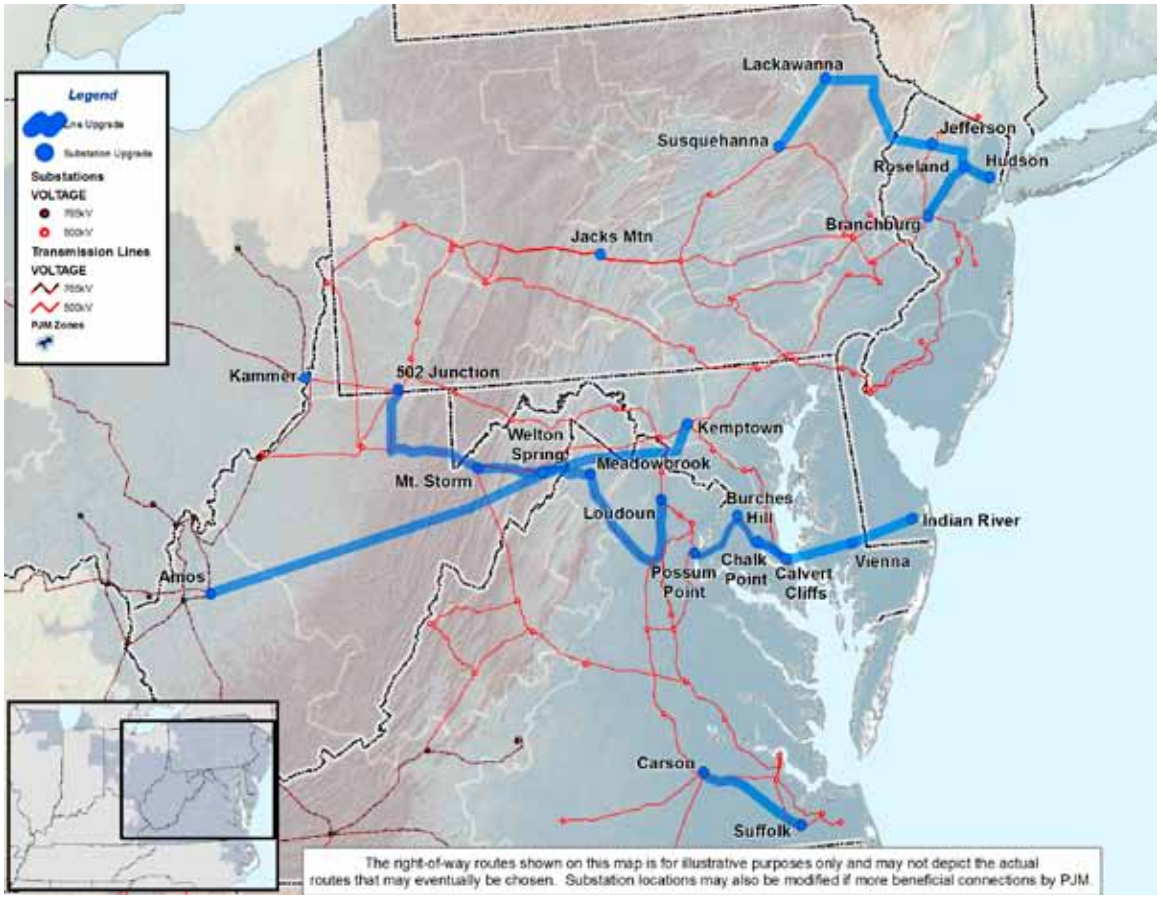
PJM 2009 RTEP process 2011 retool analysis confirmed the need for the 502 Junction - Loudoun 500 kV line (TrAIL Project) in 2011. The 2009 RTEP Retool analysis identified reliability criteria violations on the Mt. Storm - Doubs 500 kV line without TrAIL. The required in-service date for TrAIL remains June 1, 2011. The 502 Junction - Loudoun portion of the TrAIL Line has been approved by the regulatory commissions in Pennsylvania, Virginia and West Virginia and is presently under construction with a June 1, 2011 required in-service date.

Originally also part of TrAIL, the 502 Junction-Prexy 500 kV line segment, as part of a settlement with the Commonwealth of Pennsylvania was removed from the RTEP. An alternative solution was approved by PJM's Board that included a set of local 138 kV transmission upgrades to resolve identified Category B and Category C thermal and voltage criteria violations. *(PA-PUC approval remains pending as of February 15, 2010.)*

1.0.6 – Carson - Suffolk 500 kV line

PJM analysis has not identified any reason to advance or defer the June 1, 2011 required in-service date for the Carson - Suffolk 500 kV line. Most facility design has been completed with construction expected to begin in early 2010.

Map 1.2: Approved PJM Backbone 765 kV and 500 kV Facilities



1.0.7 – Susquehanna - Roseland 500 kV line

The PJM Board of Managers approved the Susquehanna - Roseland 500 kV line in 2007 to resolve numerous overloads on critical 230 kV circuits across Eastern Pennsylvania and Northern New Jersey beginning in 2012. In its 2008 RTEP Retool, PJM validated the required June 1, 2012 in-service date. During the 2008 RTEP analysis, 23 single contingency reliability criteria thermal violations were identified in Eastern Pennsylvania and New Jersey beginning in 2012 as well as 27 NERC Category C double-circuit tower line contingency thermal violations.

The 2009 RTEP Retool analysis for 2012 included an assessment of the continued need for the Susquehanna - Roseland 500 kV line. Based on the identification of 13 single contingency thermal overloads and 10 double circuit tower line outage overloads, PJM re-validated the line's June 1, 2012 in-service date. *(On February 11, 2010, the New Jersey Board of Public Utilities approved PSE&G's portion of the line. In a binding poll on January 14, 2010, the Pennsylvania Public Utility Commission indicated it would approve PPL's portion of the line.)*

1.0.8 – Amos - Welton Springs - Kemptown 765 kV line

Also known as the Potomac Appalachian Transmission Highline (PATH) line, this backbone transmission line was approved by the PJM Board of Managers in June 2007 to resolve reliability criteria violations throughout the 15-year planning horizon, including those identified by PJM on the following 500 kV lines across Central Pennsylvania and the Allegheny Mountains beginning in 2012:

- Mt. Storm - Doubs 500 kV line
- Keystone - Jack's Mountain 500 kV line
- Jack's Mountain - Juniata 500 kV lines #1 and #2

Based on the 2007 RTEP, a June 1, 2012 in-service date for PATH was established.

PJM's 2008 RTEP process included a retool analysis for 2012 incorporating a number of modeling updates since the 2007 analysis and revealed 500 kV overloads in the region beginning in 2013 and continuing through 2023. Based on these results, PJM recommended a deferral of the in-service date by one year to 2013. While PJM's 2009 RTEP process retool of 2013 subsequently revealed no reliability criteria violations, 2014 baseline deliverability analysis identified widespread thermal and reactive problems beginning in 2014. As a result, the in-service date

for PATH was deferred by one additional year to June 1, 2014.

Transmission owners also addressed siting issues associated with the Bedington substation and the Bedington to Kemptown line segment, revealing the need for a configuration change. The new configuration now comprises a 765 kV line from the Amos station in West Virginia to a new mid-point station located at Welton Spring along TrAIL in West Virginia, continuing to Kemptown, Maryland.

Reactive Criteria Violations Driving PATH

PJM draws particular attention to the severe, widespread reactive criteria violations identified beginning in 2014. These not only included voltage magnitude and voltage drop limit violations, but the potential for voltage collapse events as well. Given the severity of the voltage violations, PJM conducted "PV Curve" analysis for voltage collapse conditions in 2014 for the loss of numerous 500 kV lines including Bedington - Black Oak, Black Oak - Hatfield, Conemaugh - Hunterstown, Mt. Storm - Doubs, Keystone - Jacks Mountain, Doubs - Brighton, and Hunterstown - Conastone. PV curve analysis revealed voltage collapse at power transfer levels as much as 1,650 MW below the 8,190 MW CETO required for the Mid-Atlantic load deliverability test compliance.

PATH HVDC Conceptual Study

Following discussions with states, transmission owners and other stakeholders, PJM engaged industry consultant expertise to consider two HVDC options in addition to the single circuit 765 kV AC overhead transmission line base design, as part of a conceptual study:

- Concept 1: Bipolar ±600 kV HVDC, 2×2000 MW overhead through transmission from Amos to Kemptown with a Bipolar ±600 kV HVDC, 2×1000 MW tap at Welton Spring.

- Concept 2: A hybrid of single circuit 765 kV AC overhead transmission from Amos to Welton Spring with symmetrical 800 kV (±400 kV) HVDC, 3×1333 MW solid-dielectric underground transmission from Welton Spring to Kemptown.

Following completion of the study, PJM decided to remain with the base design in light of cost, construction issues and operability concerns of a DC facility within the networked electrical topology of that area.

Regulatory Status – January 6, 2010

Regulatory action throughout 2009 culminated in a December 21, 2009 motion by PATH-VA to withdraw application for the line and suspend proceedings in light of the following:

1. Results of PJM sensitivity studies against the 2014 PJM model (per January 4, 2010 PATH-VA submittal) – per scenarios requested by the Hearing Examiner – which suggested additional deferral of PATH beyond 2014.

2. Results from PJM's 2010 annual RTEP process.

Only PJM's comprehensive 2010 annual RTEP process analysis will provide results that can be used to determine and support a definitive assessment of the future need and in-service date for PATH. *(On January 6, 2010, the December 21, 2009, PATH Motion was approved by the Virginia SCC and the related proceeding was terminated.)*

1.0.9 – Possum Point - Indian River (MAPP) 500 kV line

PJM's 2009 retool analysis of 2013 revealed that the Possum Point to Indian River segment of the project is not needed in 2013. However, PJM 2009 baseline analysis of 2014 system conditions revealed reliability criteria violations in 2014. Consequently, the required in service date for the Possum Point to Indian River portion of the MAPP project was deferred by one year to June 1, 2014.

Without the MAPP project, voltage collapse was also observed in 2014 for the loss of the Keeney to Rock Springs 500 kV line and, separately, for the loss of the Peach Bottom to Rock Springs 500 kV line. In addition to the reliability criteria violations associated with the voltage collapse scenarios identified in 2014, 17 thermal reliability criteria violations were identified between 2014 and 2023.

2009 RTEP 2014 baseline analysis also revealed that the Indian River to Salem portion of the line is not required through 2024 and has been formally removed from the PJM RTEP. The capability and operational flexibility afforded by the HVDC segment of the MAPP project has resolved the need for the Indian River - Salem segment through 2024. PJM will continue to evaluate the need for the Indian River to Salem portion of the line as part of annual RTEP process 15-year analyses to be performed in 2010 and subsequent years.

Regulatory Status – January 8, 2010

Pepco Holdings, Inc. (PHI), the transmission owner responsible for the MAPP project construction, filed a request on January 8, 2010 with Maryland PSC to suspend until June 2010 the procedural schedule on its application, pending PJM's completion of its 2010 annual RTEP process analyses of overall PJM transmission needs.

While the preliminary sensitivity studies performed by PJM in response to the Virginia Hearing Examiner's directive regarding PATH indicated that it may not be needed by 2014, those sensitivity studies made no specific assessment of MAPP. However, all RTEP analyses forming the basis for the MAPP project assumed the PATH project to be in-service. As with the PATH project, only the results of a comprehensive analysis – PJM's 2010 annual RTEP process – can be used to determine and support a definitive re-assessment as to the future need and in-service date for MAPP.

1.0.10 – 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 violations. Each alternative resolved the reactive issues. The 500 kV alternative resolved all near term thermal violations as well and did not require upgrades to existing underground kV circuits, a significant disruption to system operations. The PJM Board approved the Branchburg - Roseland - Hudson 500 kV line in December 2008 provided that no fatal flaws with this alternative were identified.

PJM's experience with each retool analysis – as conducted sequentially during PJM's 2009 annual RTEP process – revealed a number of input parameters significantly in flux throughout the year, impacting Northern New Jersey and Eastern Pennsylvania. As a result, PJM has deferred more definitive reassessment of the Branchburg - Roseland - Hudson project until the 2010 annual RTEP process in order to more fully incorporate the scope of all identified system changes.

1.0.11 – Reactive Planning

PJM's 2009 Baseline analysis identified numerous voltage-related NERC Reliability Standard violations, widespread and severe.

PJM reactive analysis identifies specific NERC Reliability Standard violations that fall into one of two categories:

1. Both a voltage magnitude violation and a voltage drop violation;

2. The potential for a voltage collapse event

Reactive analysis also identifies the amount of deficiency below required transfer levels.

PJM's 2009 RTEP process identified the need for the PATH project based in part on voltage violations projected to occur beginning in June 2014. RTEP analysis identified 31 contingencies that cause voltage collapse without preceding voltage drop or voltage magnitude violation. This illustrates how abruptly a voltage collapse situation can arise and how dependent portions of the PJM transmission system are on reactive power to support existing voltage levels.

Voltage collapse situations typically arise when energy transfers from one area of PJM to another are increased to serve load in the area experiencing an available generation deficiency. In certain cases, the voltage related reliability problems identified by PJM could lead to system instability, characterized by sudden and irrecoverable BES voltage collapse and loss of customer load. Such situations leave very little margin for the system operator to manage system conditions and prevent voltage collapse. The consequences of voltage violations can be severe and, as identified in 2009 studies, would be felt over a wide area including southeastern Pennsylvania, New Jersey, Delaware and Maryland.

The growing severity of thermal and reactive criteria violations over time is indicative of underlying fundamental load-to-generation imbalance and systemic weakness in the transmission system's ability to move energy in the event of system capacity emergency conditions.

1.0.12 – Baseline Stability Analysis

PJM 2009 RTEP process stability analyses confirmed compliance with established NERC system stability requirements through 2014. Results of these analyses revealed no transient stability issues, no voltage recovery performance or voltage dip issues and no small signal stability issues. All monitored damping ratios passed PJM small signal stability criteria.

1.0.13 – Operational Performance

From an operational perspective, PJM Planning staff in coordination with PJM Operations staff regularly review performance associated with specific transmission facility overloads, outages and other local facility issues as experienced in actual operations. PJM 2009 RTEP process

analysis included review of Southern PJM high voltage operating conditions and a review of operating guidelines associated with Artificial Island generation, Brunner Island generation, North East Pennsylvania (NEPA) transfer limit and Ronco generation.

1.0.14 – 2009 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.
- 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 to provide economic benefits in addition to resolving those reliability issues.

PJM's 2009 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 2008 RTEP cycle. Results have indicated that identified RTEP backbone upgrades would significantly reduce PJM constrained operations.

PJM system congestion costs fall to levels 90 percent lower than costs absent the upgrades. The majority of the congestion cost reduction is attributable to the addition of the new 765 kV and 500 kV RTEP backbone projects: TrAIL, PATH, MAPP and Susquehanna - Roseland.

PJM 2009 market efficiency analysis also suggests that the addition of a 500/230 kV transformer at Conemaugh in Western Pennsylvania coupled with a new 230 kV line between Conemaugh and Seward should also be recommended for inclusion in the PJM RTEP based on PJM's market efficiency evaluation. *(This recommendation was approved by the PJM Board in February 2010.)*

1.0.15 – Interregional Coordination

PJM continues to coordinate planning activities with each neighboring system, and beyond, as it has for many decades. PJM's interregional planning responsibilities continue to grow and evolve as organized markets continue to expand and, more recently, as FERC Order No. 890 has provided increased requirements to strengthen these responsibilities.

Recent developments in such areas as renewable energy resources are greatly expanding the scope of interregional planning efforts. Not least among these are the following:

- Eastern Interconnection Planning Collaborative (EIPC)
- Joint Coordinated System Planning Study (JCSP)
- Eastern Wind Integration Transmission Study (EWITS) resulted.
- PJM / MISO Joint Operating Agreement studies
- PJM/NYISO/ISO-NE Northeast Coordinated System Plan
- PJM-NYISO Focused Study
- North Carolina Planning Collaborative Coordination

In particular, the PJM-NYISO study is based on a more expansive scope than similar studies in prior years. The current study includes extensive reliability analysis of the northern New Jersey / southeast New York interface.

As all these interregional initiatives continue their efforts in 2010, PJM will continue to assess their impact within its existing RTEP process framework and take action accordingly.