

Section 9: Near-Term Analysis – 2015



9.0: Overview

PJM's Regional Transmission Expansion Plan (RTEP) process addresses system reliability issues and viable solutions from both regional and sub-regional perspectives, essentially ignoring internal Transmission Owner (TO) zonal and state boundaries. Consequently, PJM is able to analyze and discern the true nature of power flows, their

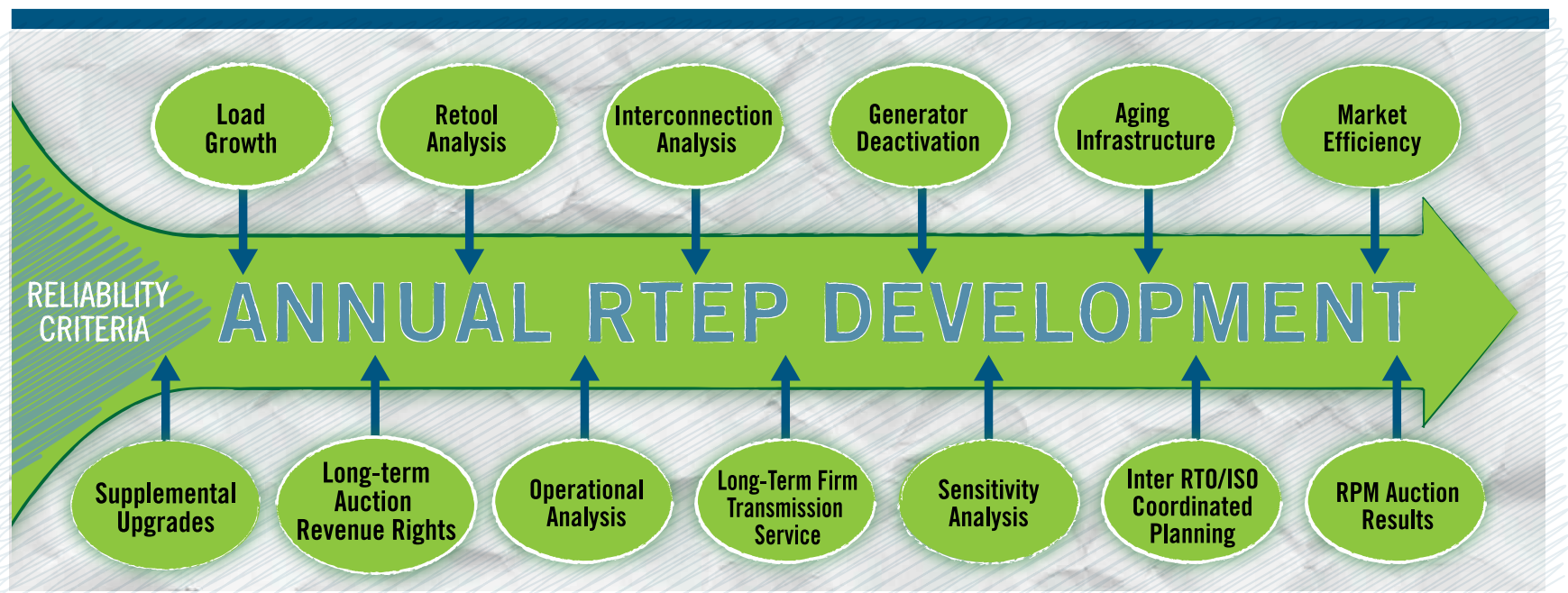
impact on reliability criteria violations and the optimal solutions within PJM to resolve them. The relationship between a reliability criteria violation and upgrade location generally takes the form of one of the following scenarios:

1. Reliability criteria violations in a given TO zone may be driven by a local issue in that same

zone. For example, local load growth may drive local transformer loadings and thus be the potential cause of a future overload on that facility.

2. Reliability criteria violations in one or more TO zones may be driven by some combination of system factors including those arising from

Figure 9.1: RTEP Development Drivers

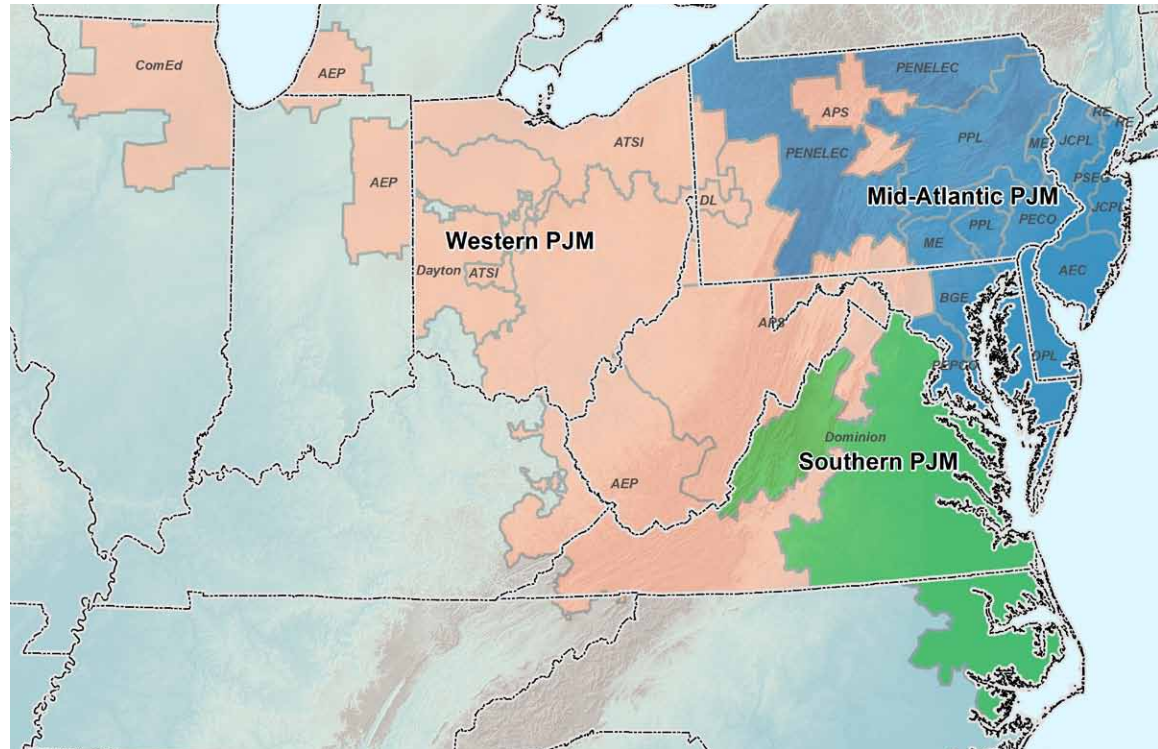


some potentially more distant, part of the PJM system. For example, voltage criteria violations in western portions of the PJM system may not be caused by a local problem but rather by heavier west-to-east transfers to more distant eastern load centers.

This perspective encompasses an RTO principle that the FERC has continued to maintain – PJM can identify more economical and optimal solutions that consider all reliability criteria violations and congestion constraints mitigated by one comprehensive set of expansion plans. Otherwise, consideration of reliability criteria violations individually, mutually exclusive of one another, can lead to economically inefficient resolutions.

The RTEP process analyzes all Bulk Electric System (BES) facilities. BES encompasses the following: all transmission facilities operated at voltages of 100 kV or higher; individual generations resources larger than 20 MVA or a generation plant with aggregate capacity higher than 75 MVA connected via step-up transformer to facilities operated at voltages of 100 kV or higher; and the associated auxiliary and protection and control system equipment that could automatically trip a BES facility, independent of the protection and control equipment's voltage level.

Map 9.1: PJM Sub Regions



9.0.1 – Order 890 Compliance

PJM expanded its stakeholder process in 2008 in compliance with FERC's Order 890 to enhance coordinated, open and transparent planning, building on a well-established planning process codified in Schedule 6 of PJM's Operating Agreement (OA). Looking to improve, valuable stakeholder discussions culminated in the establishment of three sub-regional RTEP committees – Mid-Atlantic, Western and Southern – commissioned to review proposed upgrades of more local concern. Map 9.1 depicts PJM's three sub-regions.

Stakeholder Participation

Each sub-regional RTEP committee increases the opportunity for direct stakeholder participation in the planning process from initial assumption setting stages through review of planning analyses, violations and alternative transmission expansion plans. Each sub-regional RTEP committee provides a more local forum for surfacing and considering planning issues. Interested parties can access PJM sub-regional RTEP committee planning process information from PJM's website via the following URL links:

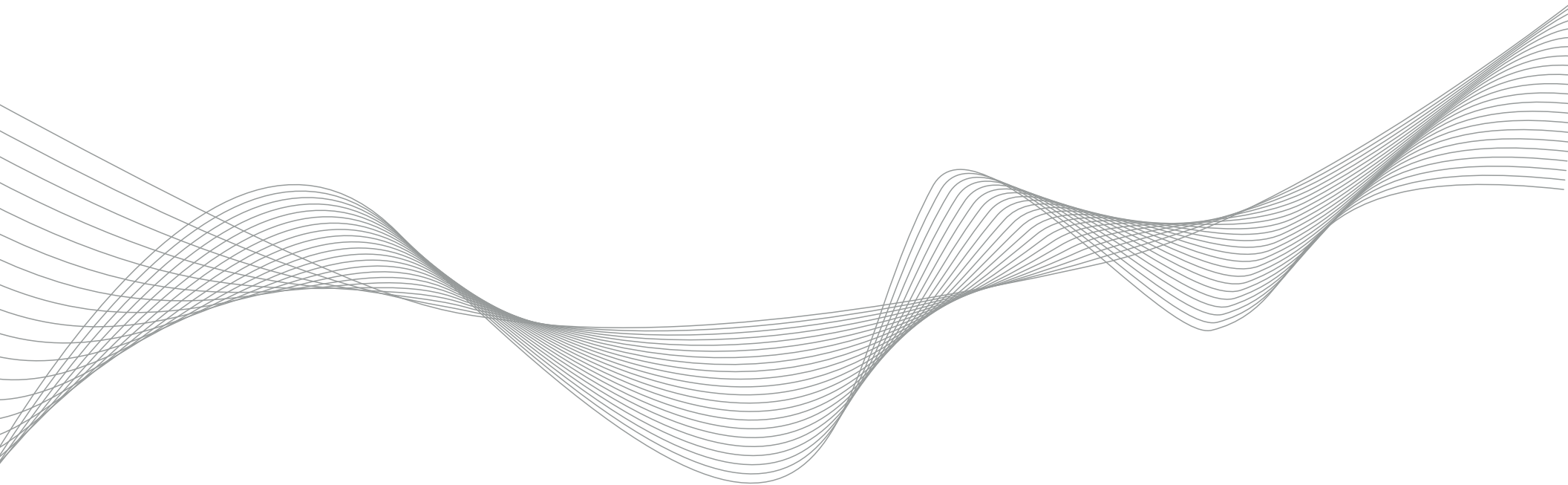
- PJM Mid-Atlantic Sub-Regional RTEP Committee: <http://www.pjm.com/committees-and-groups/committees/srstep-ma.aspx>.
- PJM Western Sub-Regional RTEP Committee: <http://www.pjm.com/committees-and-groups/committees/ssrstep-w.aspx>.
- PJM Southern Sub-Regional RTEP Committee: <http://www.pjm.com/committees-and-groups/committees/ssrstep-s.aspx>.

These meetings are open to all stakeholders interested in the issues under consideration. Any stakeholder can participate in any or all sub-regional activities on a voluntary basis. TOs that comprise each of the various sub regions must participate in the sub-regional meeting that includes their area.

Reviewing Upgrades

Upgrades are labeled as Regional RTEP Projects and Sub-Regional RTEP Projects, as defined in the PJM Operating Agreement, Sub-Regional RTEP Projects are those rated below 230 kV; Regional RTEP Projects are those rated at 230 kV and above. This categorization facilitates posting NERC criteria violations and the recommended upgrades to solve them and more easily enables stakeholders to focus on those RTEP matters of specific interest to each.

This **Section 9** summarizes approved RTEP Projects for each PJM sub-region.





9.1: Modeling Parameters

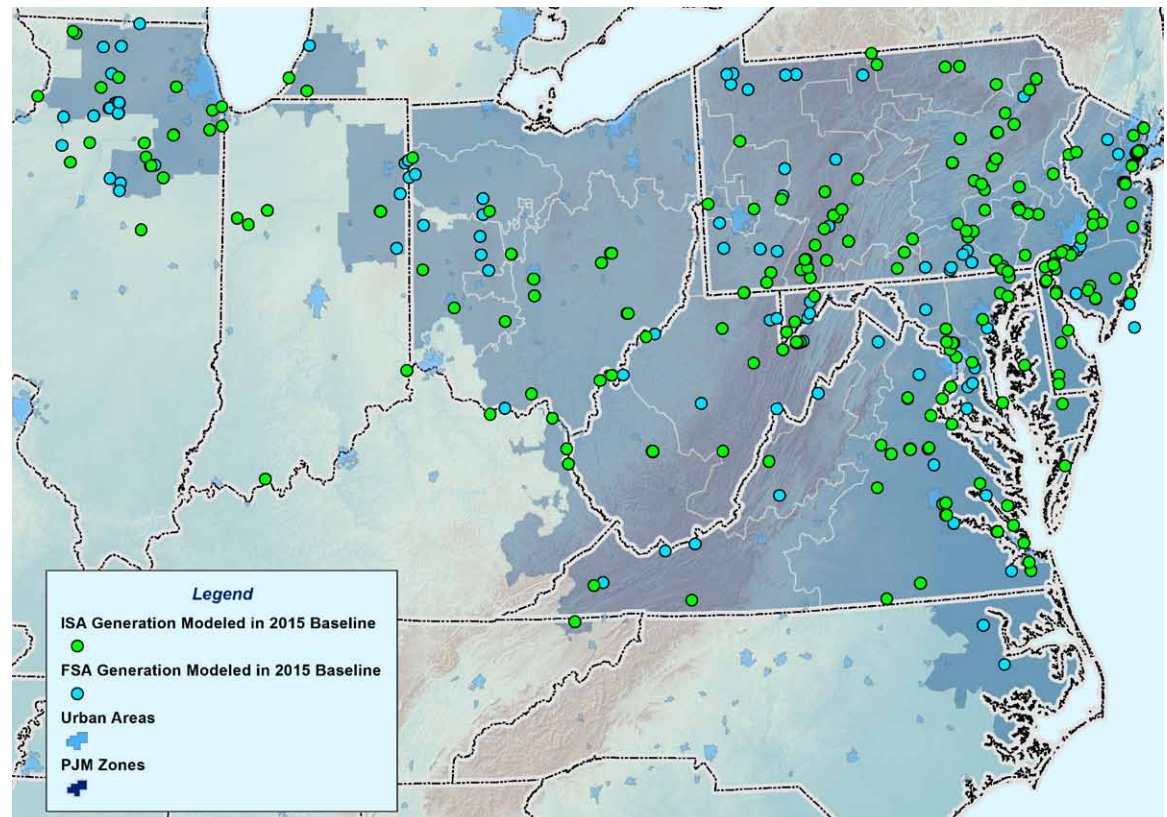
PJM's 2015 power flow cases, used throughout the 2010 Regional Transmission Expansion Plan (RTEP) process, were based on procedures and assumptions vetted with the PJM Transmission Expansion Advisory Committee (TEAC.) Inputs included the 2010 PJM Load Forecast, updated interchange information, topology changes from the 2009 RTEP, and updated generation information, as described in **Section 2**.

Generation

With respect to the 2010 RTEP analysis of the 2015 system, all generation expected to be in service by June 1, 2015 was modeled, based on PJM's RTEP methodology described in **Section 2** and **3**. Each annual RTEP process includes new generation that has executed an Interconnection Service Agreement (ISA) or signed a Facilities Study Agreement (FSA) since the previous year's RTEP.

A complete list of generators modeled in the 2015 baseline power flow case was presented at the February 10, 2010 PJM TEAC meeting. That machine list is accessible from PJM's website via the following URL link: <http://pjm.com/committees-and-groups/committees/teac.aspx>. Specific generators are depicted on maps in the respective **Section 14** state portions of this report. Specific generator status information can be found in PJM's interconnection queues, also accessible from PJM's website via the following URL link: <http://pjm.com/planning/generation-interconnection/generation-queue-active.aspx>.

Map 9.2: ISA and FSA Generation Modeled in 2015 Baseline



PJM includes generators with executed FSAs in its power flow base case model in order to allow the generators to contribute to generator deliverability problems. However, PJM does not include a generator that only has an executed FSA – i.e., one that has not yet executed an ISA – to relieve system problems, for example in an area experiencing a capacity emergency in the load deliverability test.

This approach ensures that the transmission system will be reliable whether or not the generator ultimately completes the interconnection process and goes into commercial operation. PJM uses this approach for an interconnection request that has not executed an ISA because of the remaining uncertainty as to whether that generator will ultimately go into service.

PJM uses the execution of the ISA as the indicator that a project can reasonably be expected to be placed into service and, therefore, be available to contribute to the resolution of violations of NERC Reliability Standards. Consequently, PJM has determined that those generators with an executed ISA should be modeled in all subsequent baseline analyses the same way an existing generation capacity resource is modeled, i.e., the generator is included in the baseline and is allowed to contribute to system problems and to relieve system problems.

2010 vs 2009 Load Forecast for 2015

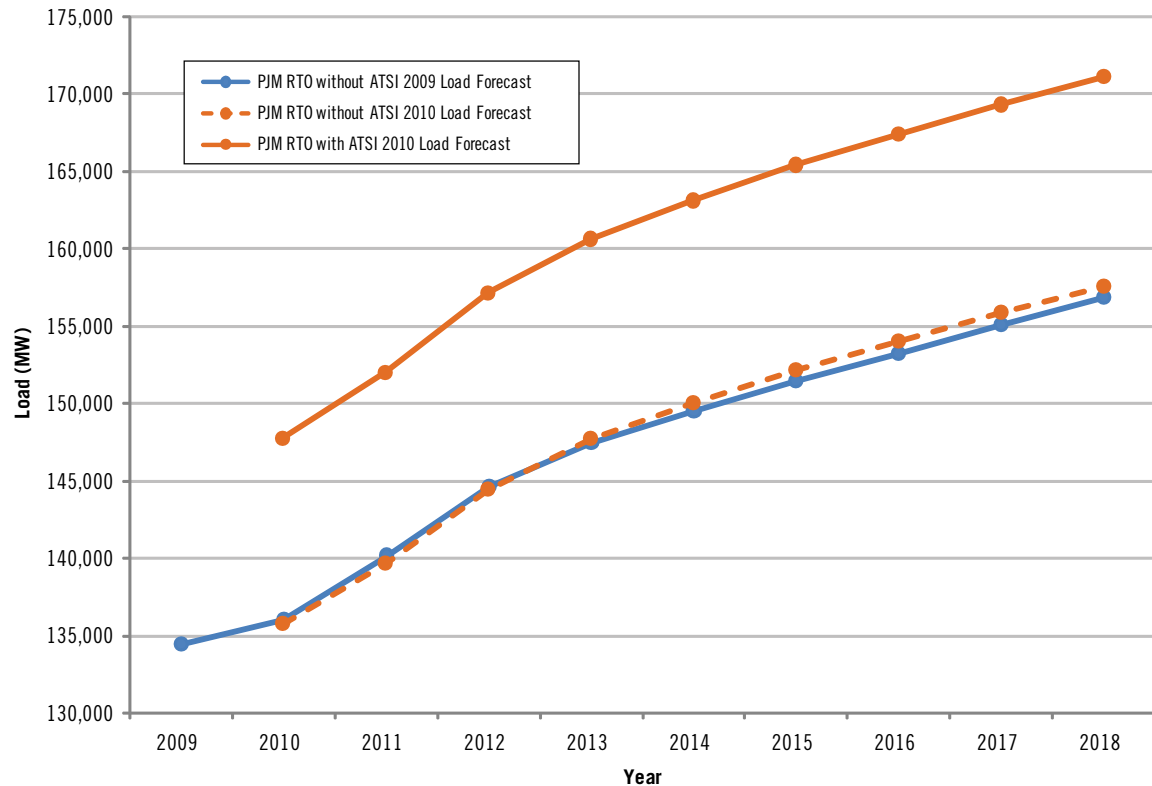
Load forecasting is a fundamental driver of resource adequacy requirements and transmission expansion plans. PJM issued a new load forecast report in January 2010 for 2010 through 2025. PJM RTO load without American Transmission Systems, Inc. (ATSI) (i.e., the current PJM footprint) for 2015 was forecasted to be 152,119 MW, 709 MW (0.5 percent) greater than the 2009 forecast for 2015. (The PJM RTO load with ATSI included for 2015 from the 2010 forecast was 165,402 MW.) ATSI is expected to be integrated on June 1, 2011. Please refer to **Section 2.1** for detailed forecast comparisons and load growth projections.

Summer peak load growth for PJM RTO (including ATSI) is projected to average 1.7 percent per year over the next 10 years, and 1.4 percent over the next 15 years. Figure 9.3 shows a 10-year load growth rate comparison by sub-region.

Load Management

The PJM Load Forecast Report is used for modeling loads, and unrestricted peak loads are adjusted to account for changes in energy efficiency (EE) and load management (LM) resources.

Figure 9.2: 10-Year Summer Load Forecast Comparison: 2009 and 2010



Demand Resources and EE initiatives are currently integrated into the RTEP based on the degree to which EE and LM programs clear PJM’s Reliability Pricing Model (RPM) three-year-forward capacity market. Those resources that clear an RPM auction are factored into reliability analyses based on the circumstances under which the programs are expected to be implemented in actual operations. Additional discussion of Demand Resource and EE concepts can be found in **Section 2.2**.

NOTE

Figure 9.2
 PJM’s January, 2011 Load Forecast shows a further decrease in projected load levels for the period 2016 through 2026. The January 2011 Load Forecast Report is accessible from PJM’s website via the following URL link:
<http://pjm.com/planning/resource-adequacy-planning/-/media/documents/reports/2011-pjm-load-report.ashx>.

The EE and LM projections in the 2010 Load Forecast Report reflect the May 2009 RPM results. PJM's 2009 load forecast for the PJM RTO contained no energy efficiency programs for 2015 but did contain 3,456 MW of load management. By contrast, the 2010 Load Forecast Report shows projected PJM RTO EE programs of 549 MW and LM resources of 6,823 MW.

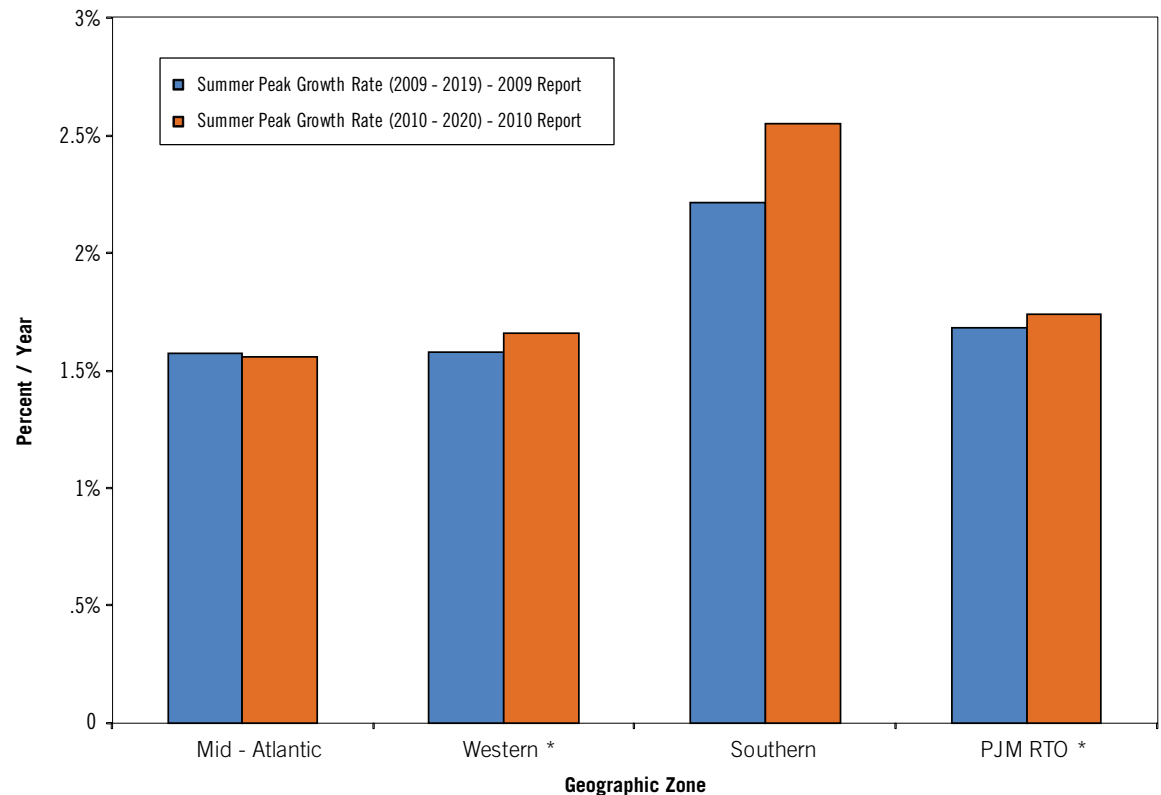
Network Topology

Upgrades approved by the PJM Board along with merchant transmission projects expected to be in service by June 1, 2015 were modeled in PJM's 2015 power flow case. The TrAIL project, with an expected in-service date of June 1, 2011, was modeled in-service. Interchange values were consistent with approved long term firm transmission service requests in PJM's OASIS system. Power flow cases also included upgrades to interconnect new generation for which System Impact Studies have been completed.

Modeling Impacts

As a possible outcome, and consistent with sound, forward-looking planning practices, baseline reinforcements may be modified, advanced or deferred if anticipated system conditions do not materialize including for example, changes in load forecasts or status of generation and merchant transmission interconnection requests.

Figure 9.3: 10-Year Summer Load Forecast Sub-Regional Growth Rate Comparison: 2009 and 2010



Preliminary 2011 PJM RTEP process analysis suggests that the need for the PATH line has moved several years beyond 2015. The outlook for a slower economic recovery – reflected in the reduced load growth rates in PJM's January 2011 published forecast – has led the PJM Board to direct transmission owners to suspend efforts on the PATH line pending a more complete analysis in 2011 of all RTEP upgrades, including MAPP. **Section 5** of this report discusses the PATH suspension.



* NOTE

PJM's 2010 Load Forecast incorporates the impact of ATSI: <http://www.pjm.com/planning/resource-adequacy-planning/load-forecast-dev-process.aspx>.

Table 9.1: 10-Year Summer Load Forecast Comparison: 2007 through 2010

TO	2007 Load Forecast Report Summer Peak (MW)			2008 Load Forecast Report Summer Peak (MW)			2009 Load Forecast Report Summer Peak (MW)			2010 Load Forecast Report Summer Peak (MW)		
	2007	2017	Growth Rate (%)	2008	2018	Growth Rate (%)	2009	2019	Growth Rate (%)	2010	2020	Growth Rate (%)
Atlantic City Electric Company	2,758	3,373	2.0	2,829	3,673	2.6	2,692	3,533	2.8	2,734	3,443	2.3
Baltimore Gas and Electric Company	7,303	8,198	1.2	7,344	8,118	1.0	7,303	8,745	1.8	7,456	8,919	1.8
Delmarva Power and Light	4,076	4,919	1.9	4,192	5,047	1.9	3,972	4,882	2.1	4,023	4,601	1.4
Jersey Central Power and Light	6,333	7,688	2.0	6,478	7,897	2.0	6,357	7,621	1.8	6,440	7,611	1.7
Metropolitan Edison Company	2,853	3,349	1.6	2,929	3,432	1.6	2,866	3,334	1.5	2,920	3,444	1.7
PECO Energy Company	8,554	9,847	1.4	8,759	10,085	1.4	8,455	9,538	1.2	8,528	9,821	1.4
Pennsylvania Electric Company	2,824	3,248	1.4	2,850	3,157	1.0	2,786	3,305	1.7	2,843	3,420	1.9
PPL Electric Utilities Corporation	7,196	8,333	1.5	7,292	8,379	1.4	7,106	7,985	1.2	7,161	8,213	1.4
Potomac Electric Power Company	6,972	8,032	1.4	7,057	8,046	1.3	6,960	7,823	1.2	7,048	7,909	1.2
Public Service Electric and Gas Company	10,801	12,451	1.4	10,967	12,622	1.4	10,858	12,470	1.4	10,921	12,428	1.3
Rockland Electric Company	423	446	0.5	435	486	1.1	435	496	1.3	435	493	1.3
UGI	195	222	1.3	197	219	1.1	190	207	0.9	190	210	1.0
Diversity - Mid-Atlantic	-568	-659		-594	-689		-359	-427		-530	-385	
Mid-Atlantic	59,720	69,447	1.5	60,735	70,472	1.5	59,621	69,512	1.5	60,169	70,127	1.5
American Electric Power Company	24,206	27,464	1.3	23,939	26,736	1.1	23,682	26,554	1.2	23,287	26,631	1.4
Allegheny Power	8,630	9,427	0.9	8,688	9,475	0.9	8,538	9,889	1.5	8,661	9,909	1.4
American Transmission Systems, Inc.										13,040	14,888	1.3
Commonwealth Edison Company	23,076	28,159	2.0	23,654	28,524	1.9	22,472	27,722	2.1	22,536	27,965	2.2
Dayton Power and Light	3,524	4,035	1.4	3,597	3,962	1.0	3,399	3,945	1.5	3,368	3,835	1.3
Duquesne Light Company	2,949	3,282	1.1	2,942	3,241	1.0	2,862	3,257	1.3	2,883	3,318	1.4
Diversity - Western (Including ATSI)	-1,504	-1,745		-1,413	-1,618		-1,252	-1,646		-1,684	-2,192	
Western (Including ATSI)	60,881	70,622	1.5	61,407	70,320	1.4	59,701	69,721	1.6	72,091	84,354	1.6
Dominion Virginia Power	19,167	23,222	1.9	19,353	23,157	1.8	18,982	23,603	2.2	19,779	25,387	2.5
Southern	19,167	23,222	1.9	19,353	23,157	1.8	18,982	23,603	2.2	19,779	25,387	2.5
Diversity - RTO (Including ATSI)	-2,807	-3,469		-3,547	-3,842		-3,876	-4,219		-4,248	-5,144	
PJM RTO (Including ATSI)	136,961	159,822	1.6	137,948	160,107	1.5	134,428	158,617	1.7	147,791	174,724	1.7



9.2: PJM Mid-Atlantic Sub-Region – 2015

PJM operates the Bulk Electric System (BES) transmission facilities (and others monitored at lower voltage levels) throughout the Mid-Atlantic Sub-Region footprint shown in Map 9.1, including those of Atlantic City Electric Company (AEC), Baltimore Gas and Electric (BGE), Delmarva Power and Light (DPL), Jersey Central Power and Light (JCPL), Metropolitan Edison Company (METED), Neptune, Old Dominion Electric Corporation (ODEC), PECO Energy (PECO), Pennsylvania Electric Company (PENELEC), PEPCo Holdings (PEPCo), PPL Electric Utilities Corporation (PPL), Public Service Electric and Gas (PSEG), Rockland Electric (Rockland) and UGI Corporation (UGI). The Neptune Regional Transmission System interconnects with the Mid-Atlantic PJM transmission system at Sayreville substation in northern New Jersey. The Linden variable frequency transformer (VFT) interconnects with the PJM transmission system at the Linden 230 kV substation in New Jersey.

Compounding Factors Drive Need for New Backbone Upgrades

A number of factors have continued collectively and progressively to impact system reliability in Mid-Atlantic PJM:

- Load growth
- Deactivation/retirement of generation resources
- Sluggish development of new generating facilities

- Continued reliance on transmission to meet load deliverability requirements and to obtain access to more economical sources of power from sources to the west

This situation is compounded by 1,120 MW of recently completed export capability to New York City and Long Island by way of new merchant transmission facilities with terminals in New Jersey. More than 1,600 MW of additional merchant transmission interconnection requests are also active in PJM's queue (through January 31, 2011).

Until 2008, trends indicated that reliability criteria violations would continue to be identified in the PJM Mid-Atlantic sub region and elsewhere in PJM where similar conditions exist. However, as a result of the economic recession since the Fall of 2008, some reliability criteria violations are now not being observed until later in PJM's planning horizon.

Delivering Energy from Western and Southwestern PJM Generating Resources

In general, the location of generation on which PJM Mid-Atlantic markets rely is increasingly shifting to the west, due both to retirements of eastern units and the location of new generation capacity in western areas, i.e., western Pennsylvania, West Virginia, eastern Ohio and beyond. Eastern PJM relies on transmission across Pennsylvania and up from southwestern PJM to import power from sources west and southwest. PJM expects eastern PJM to continue to rely on transmission capability to replace retired generation and to meet growth in demand. This trend will also inevitably worsen

congestion on bulk transmission facilities.

Congestion on the eastern interface also constrains power flows from Washington D.C., Baltimore and northern Virginia to New Jersey, Delmarva Peninsula and Philadelphia load centers.

The high-voltage, bulk power transmission pathway within portions of the states of Pennsylvania, West Virginia, Virginia and Maryland serve the densely populated load centers of northern Virginia and further east. The electricity needs of this area are supplied not only by local generation, but also by significant energy transfers into those areas. The dependence of the Washington - Baltimore - Northern Virginia area and Eastern PJM on bulk power transfers from western sources has been growing steadily since the integration of western markets into PJM began in 2002 with the integration of Allegheny Power.

Approved Mid-Atlantic Sub-Region BES Upgrades

Upgrades listed in Table 9.2 and shown in Map 9.3 have an estimated cost of \$5 million or more approved by PJM's Board in 2010 to solve NERC reliability criteria violations.

The extent to which Mid-Atlantic PJM continues to rely on transfers into the area to meet load-serving needs also has a quantifiable, negative impact on the high voltage backbone transmission system west of the Baltimore / Washington metro area. In addition to the TrAIL project already under construction, 2015 baseline analysis indicated that the PATH project and MAPP project will resolve identified reliability criteria violations, as discussed in **Section 5** and **Section 6**, respectively.

Map 9.3: PJM Mid-Atlantic Sub-Region Transmission Upgrades

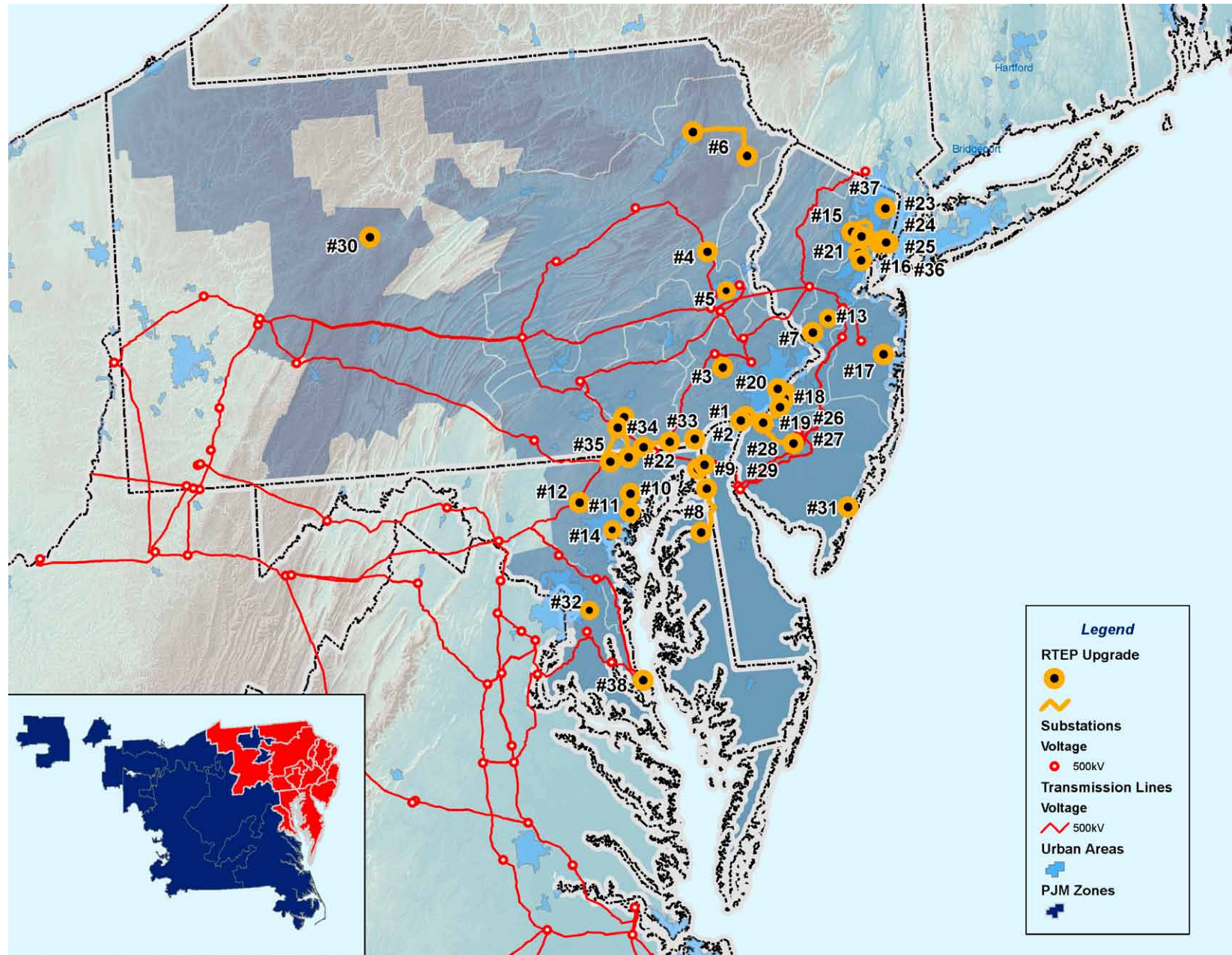


Table 9.2: PJM Mid-Atlantic Sub-Region Transmission Upgrades

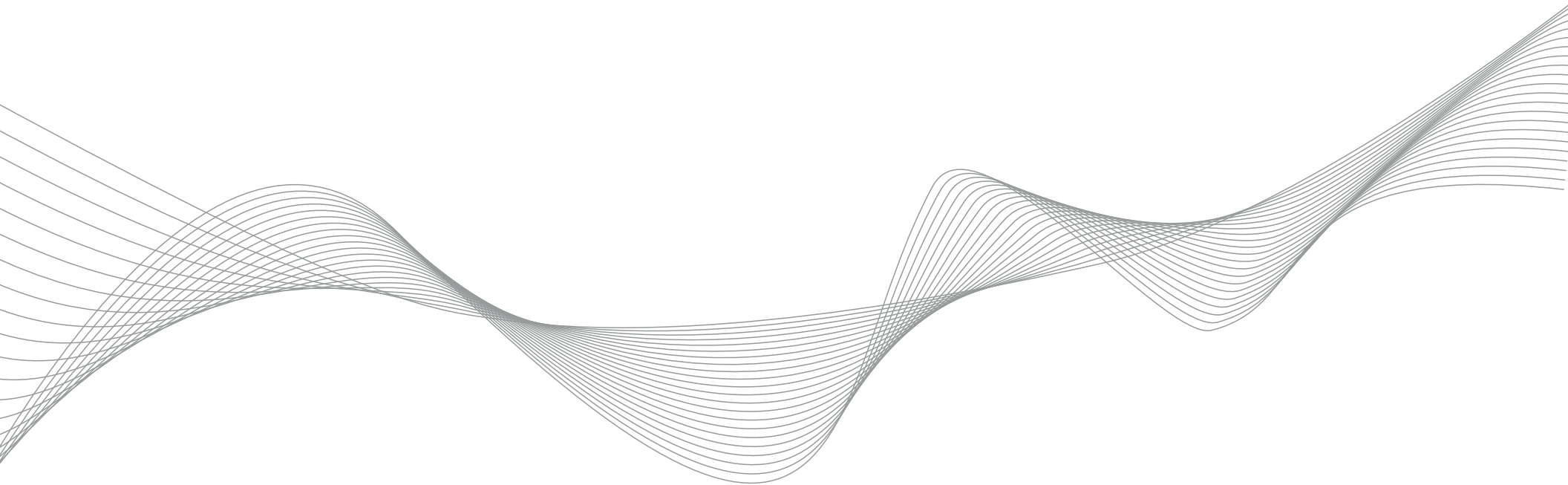
		System Upgrade Drivers										Date	Cost (M)	TO Zone(s)	2010 TEAC Review
		Baseline Upgrades					Network Upgrades			Supplemental Upgrade					
Upgrade		Baseline Load Growth / Deliverability & Reliability	Congestion Relief - Economic	Operational Performance	Generator Deactivation	TO Criteria Violation	Generation Interconnection	Merchant Transmission Interconnection	Long-term Firm Transmission Service	Criteria Compliance other than for Baseline					
1	Add a second 230/138 kV transformer at Chichester. Add an inductor in series with the parallel transformers				▲						December 2011	5.908	PECO	3/10/2010	
2	Reconductor Chichester - Saville 138 kV line and upgrade terminal equipment				▲						June 2012	8.5	PECO	3/10/2010	
3	Replace 230/69 kV transformer #6 at Cromby. Add two 50 MVar 230 kV banks at Cromby				▲						December 2011	6.142	PECO	3/10/2010	
4	Add the 2nd Circuit to the East Palmerton-Wagners-Lake Naomi 138/69 kV Tap					▲					November 2014	12.3	PPL	6/2/2010	
5	Install a new 230-69 kV Substation at New Breinigsville					▲					May 2015	34.65	PPL	6/2/2010	
6	Reconductor and rebuild Peckville-Varden 69 kV line and Blooming Grove-Honesdale 69 kV line					▲					November 2014	22.4	PPL	6/2/2010	
7	Re-configure the Lawrence 230 kV substation	▲									June 2014	9	PSEG	9/8/2010	
8	Re-build the Townsend - Church 138 kV circuit	▲									June 2015	5.96	DPL	9/8/2010	
9	Re-build the Glasgow - Cecil 138 kV circuit	▲									June 2015	16	DPL	9/8/2010	
10	Build a second Raphael - Bagley 230 kV and re-build the existing Raphael - Bagley 230 kV line	▲									June 2015	18	BGE	8/11/2010	
11	Replace the existing Northeast 230/115 kV transformer #3 with 500 MVA transformer	▲									June 2015	10.1	BGE	9/8/2010	
12	Build a new 500/230 kV substation at Emory Grove and rebuild the Emory - North West 230 kV circuits	▲									June 2015	71	BGE	9/8/2010	
13	Build a new 69 kV substation at Ridge Road and build new 69 kV circuits from Montgomery – Ridge Road – Penns Neck/Dow Jones	▲									June 2015	22.5	PSEG	8/24/2010	
14	Rebuild existing Erdman 115 kV substation and construct 115 kV double circuit underground line from existing Coldspring to Erdman substation	▲									June 2015	139.6	BGE	8/24/2010	

Table 9.2: PJM Mid-Atlantic Sub-Region Transmission Upgrades (Continued)

		System Upgrade Drivers									Date	Cost (M)	TO Zone(s)	2010 TEAC Review
		Baseline Upgrades					Network Upgrades			Supplemental Upgrade				
Upgrade		Baseline Load Growth / Deliverability & Reliability	Congestion Relief - Economic	Operational Performance	Generator Deactivation	TO Criteria Violation	Generation Interconnection	Merchant Transmission Interconnection	Long-term Firm Transmission Service	Criteria Compliance other than for Baseline				
14	Rebuild existing Erdman 115 kV substation and construct 115 kV double circuit underground line from existing Coldspring to Erdman substation	▲									June 2015	139.6	BGE	8/24/2010
15	Convert the existing 'D1304' and 'G1307' 138 kV circuits between Roseland - Kearny - Hudson to 230 kV operation, expand the existing Bergen 230 kV substation, reconfigure the Athenia 230 kV substation, and build a second 230 kV underground cable from Bergen to Athenia	▲									June 2015	650	PSEG	9/8/2010
16	Build second 230 kV underground cable from Hudson to South Waterfront	▲									June 2015	50	PSEG	9/8/2010
17	Build a new 34.5 kV line from Larrabee – Howell					▲					June 2013	9.483	JCPL	10/28/2010
18	Build two new parallel underground circuits from Gloucester to Camden via Cuthbert Blvd., install shunt reactor at Gloucester, reconfigure the Cuthbert station, build a second 230 kV parallel overhead circuit from Mickleton - Gloucester, and reconductor the existing Mickleton - Gloucester 230 kV circuit (PSEG portion)	▲									June 2015	230	PSEG	10/28/2010
19	Reconductor the existing Mickleton – Gloucester 230 kV circuit (AE portion)	▲									June 2015	5.9	AEC	10/28/2010
20	Reconductor the Camden – Richmond 230 kV circuit (PSEG portion) and upgrade terminal equipment at Camden substation	▲									June 2015	8	PSEG	10/28/2010
21	Convert the 138 kV line from Aldene –Springfield Rd. - West Orange to 230 kV	▲									June 2014	75	PSEG	10/28/2010
22	Nottingham - Peach Bottom - Reconductor the 220-08 line						U2-074				October 2012	10	PECO	7/14/2010
23	Hudson - South Waterfront - Add second 230kV underground cable						T107				June 2012	41.9	PSEG	7/14/2010
24	Hudson - Essex - Construct new 230kV circuit and add new terminations at each end						T107				June 2012	50.5	PSEG	7/14/2010

Table 9.2: PJM Mid-Atlantic Sub-Region Transmission Upgrades (Continued)

		System Upgrade Drivers										Date	Cost (M)	TO Zone(s)	2010 TEAC Review
Upgrade	Baseline Load Growth / Deliverability & Reliability	Baseline Upgrades					Network Upgrades			Supplemental Upgrade					
		Congestion Relief - Economic	Operational Performance	Generator Deactivation	TO Criteria Violation	Generation Interconnection	Merchant Transmission Interconnection	Long-term Firm Transmission Service	Criteria Compliance other than for Baseline						
25	Hudson - Replace the 230kV autotransformer						T107				June 2012	9	PSEG	7/14/2010	
26	Gloucester - Replace the 230/138 kV XFMR and terminal equipment						S107				June 2011	8.25	PSEG	7/14/2010	
27	Gloucester - Cuthbert - Reconductor 138kV line and replace Cuthbert terminal equipment						S107				June 2011	20	PSEG	7/14/2010	
28	Mickelton - Monroe - Reconductor 230kV line #1						S107				June 2011	7	AEC	7/14/2010	
29	Mickelton - Monroe - Reconductor 230kV line #2						S107				June 2011	7	AEC	7/14/2010	
30	Shawville - Install new 3 breaker 230kV ring bus and a new 3 breaker 115kV ring bus and a 168MVA transformer adjacent to Shawville						R92				June 2009	12.04	PENELEC	7/14/2010	
31	BL England 0 Scull #2 - Rebuild and reconductor the 138kV line section						T146, V2-021				November 2012	10.5	AEC	7/14/2010	
32	Oak Grove - Upgrade conductors between Talbert and Oak Grove						V3-017				June 2012	14	PEPCO	7/14/2010	
33	Extend a second 230 kV transmission supply to Clay Substation									▲	June 2013	21	PECO	4/14/2010	
34	Rebuild Manor – Graceton 230 kV line									▲	December 2012	33	PPL	6/2/2010	
35	Rebuild Otter Creek – Conastone 230 kV line									▲	December 2012	20	PPL	6/2/2010	
36	Reconfigure the Newport substation									▲	June 2011	20	PSEG	10/28/2010	
37	Raise the New Milford yard and control house									▲	June 2015	70	PSEG	10/28/2010	
38	Clavert Cliffs - Construct transmission line, move 5072 to CC3, Loop 5042 in and out of CC3 and new tie line between CC1 & 2 and CC3						V2-042				June 2017	10.5	BGE	7/14/2010	



PJM

DE

DC

IL

IN

KY

MD

MI

NJ

NC

OH

PA

TN

VA

WV

9.3: PJM Western Sub-Region – 2015

PJM operates the Bulk Electric System (BES) transmission facilities (and others monitored at lower voltage levels) throughout the Western Sub-Region footprint shown in Map 9.1, including those of Allegheny Power (AP), American Electric Power (AEP), American Transmission Systems, Inc. (ATSI), Commonwealth Edison (ComED), Dayton Power and Light (Dayton) and Duquesne Light Company (DLCO).

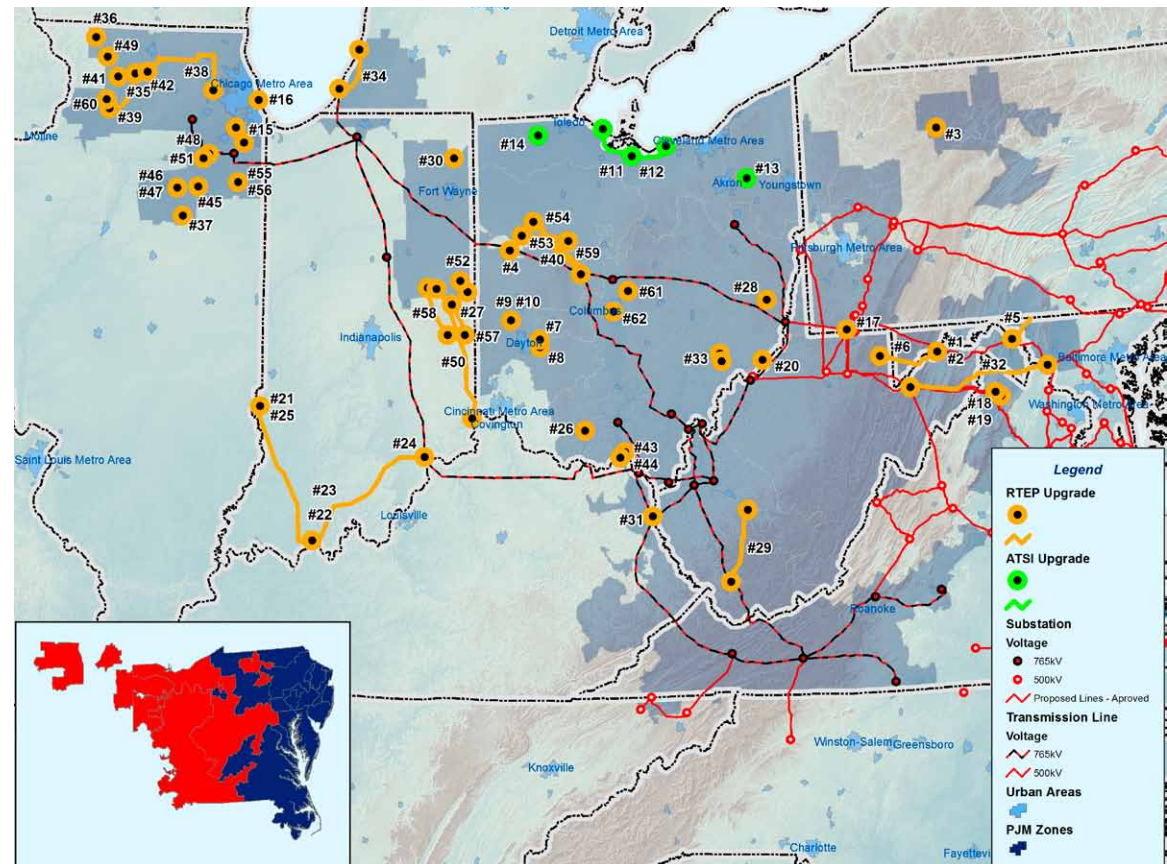
PJM serves a number of major metropolitan areas over BES facilities in the western part of its system, including Chicago, Dayton, Columbus and Pittsburgh, and, following the integration of ATSI, Cleveland and Toledo as well.

In addition, high-voltage BES transmission facilities in western PJM serve the densely populated load centers of northern Virginia and further east, from power sources in western PJM.



Preliminary 2011 PJM RTEP process analysis suggests that the need for the PATH line has moved several years beyond 2015. The outlook for a slower economic recovery – reflected in the reduced load growth rates in PJM's January 2011 published forecast – has led the PJM Board to direct transmission owners to suspend efforts on the PATH line pending a more complete analysis in 2011 of all RTEP upgrades, including MAPP. **Section 5** of this report discusses the PATH suspension.

Map 9.4: PJM Western Sub-Region Transmission Upgrades



Upgrades listed in Table 9.3 and shown in Map 9.4 have an estimated cost of \$5 million or more approved by PJM's Board in 2010 to eliminate NERC reliability criteria violations.

In addition to the TrAIL project already under construction, 2010 RTEP process baseline analysis identified the need for the PATH project in 2015 to resolve NERC reliability criteria violations, as discussed in **Section 5**.

American Transmission System, Inc. (ATSI)

Based on FirstEnergy's integration filing submitted to FERC on August 17, 2009, ATSI transmission assets will be integrated into PJM effective June 1, 2011. ATSI is a wholly owned subsidiary of FirstEnergy and owns the transmission assets of its electric utility operating companies - The Toledo Edison Company (Toledo Edison), The Cleveland Electric Illuminating Company (The Illuminating Company), Ohio Edison Company (Ohio Edison), and Pennsylvania Power Company (Penn Power). PJM has completed all required studies to incorporate ATSI into the Regional Transmission Expansion Plan (RTEP) process beginning in 2011, as discussed in **Section 11**.

As part of the 2010 RTEP, a number of baseline upgrades were identified in the ATSI zone. Given the ATSI zone will not formally be integrated into PJM until June 1, 2011, these upgrades have not been approved by the PJM Board. The PJM Board will be requested to approve the upgrades following the June 1, 2011 integration of ATSI. As part of the 2010 RTEP, a number of baseline upgrades were identified in the ATSI zone. Given the ATSI zone will not formally be integrated into PJM until June 1, 2011, these upgrades have not been approved by the PJM Board. The PJM Board will be requested to approve the upgrades following the June 1, 2011, integration of ATSI.

Table 9.3: PJM Western Sub-Region Transmission Upgrades

		System Upgrade Drivers										Date	Cost (M)	TO Zone(s)	2010 TEAC Review
		Baseline Upgrades					Network Upgrades			Supplemental Upgrade					
Upgrade		Baseline Load Growth / Deliverability & Reliability	Congestion Relief - Economic	Operational Performance	Generator Deactivation	TO Criteria Violation	Generation Interconnection	Merchant Transmission Interconnection	Long-term Firm Transmission Service	Criteria Compliance other than for Baseline					
1	Install the second Black Oak 500/138kV transformer, two 138kV breaker, and related substation work	▲									June 2013	9.11	APS	2/10/2010	
2	Install six 500 kV breakers and remove BOL1 500 kV breaker at Black Oak	▲									June 2013	9.17	APS	2/10/2010	
3	Construct Bear Run 230 kV substation with 230/138 kV transformer	▲									June 2014	6	APS	8/11/2010	
4	Replace the existing 138/69-12 kV transformer at West Moulton Station with a 138/69 kV transformer and a 69/12 kV transformer. Reconductor the 7.23 miles of 69 kV line from Wapakoneta to West Moulton					▲					June 2012	11.9	AEP	8/24/2010	
5	Reconductor Nipetown - Reid 138 kV with 1033 ACCR	▲									June 2015	15	APS	9/8/2010	
6	Reconductor the Albright - Black Oak AFA 138 kV line with 795 ACSS/ TW	▲									June 2013	55	APS	9/8/2010	
7	Add 2nd Bath 345/138kV Xfr	▲									June 2015	7	Dayton	8/24/2010	
8	Add 2nd Trebien 138/69kV Xfr	▲									June 2015	5.3	Dayton	8/24/2010	
9	Add 2nd W. Milton 138/69kV Xfr	▲									June 2015	8.8	Dayton	8/24/2010	
10	Add 2nd W. Milton 345/138 kV Xfr	▲									June 2015	5.5	Dayton	8/24/2010	
11	Build new Hayes 345/138 kV substation with new 138 kV lines to: Greenfield #1, Greenfield #2, and Avery.	▲									June 2015	33	ATSI	9/8/2010	
12	Build Beaver - Hayes - Davis - Besse #2 345 kV line	▲									June 2015	34.65	ATSI	9/8/2010	
13	Loop the Chamberlin - Mansfield 345 kV line into the Hanna 345 kV substation	▲									June 2015	9.075	ATSI	9/8/2010	
14	Install a new Fulton 345/138 kV substation	▲									June 2015	23	ATSI	9/8/2010	
15	Reconductor the East Frankfort - Goodings Grove 345 kV 11601 line	▲									June 2015	22	ComEd	9/8/2010	

Table 9.3: PJM Western Sub-Region Transmission Upgrades (Continued)

Upgrade	System Upgrade Drivers									Date	Cost (M)	TO Zone(s)	2010 TEAC Review
	Baseline Load Growth / Deliverability & Reliability	Baseline Upgrades			Network Upgrades			Supplemental Upgrade					
		Congestion Relief - Economic	Operational Performance	Generator Deactivation	TO Criteria Violation	Generation Interconnection	Merchant Transmission Interconnection	Long-term Firm Transmission Service	Criteria Compliance other than for Baseline				
16	Upgrade both Garfield - Taylor 345 kV lines (17723 and 17724)	▲								June 2015	150	ComEd	9/8/2010
17	Install 2nd 500/138 kV transformer at 502 Junction	▲								June 2015	15	APS	10/6/2010
18	Reconductor Double Tollgate – Meadow Brook 138 kV ckt 2 with 1033 ACCR	▲								June 2015	9	APS	10/6/2010
19	Reconductor Double Tollgate – Meadow Brook 138 kV ckt 1 with 1033 ACCR	▲								June 2015	9	APS	10/6/2010
20	Reconductor Bens Run – St. Mary's 138 kV with 954 ACSR	▲								June 2015	5.8	APS	10/6/2010
21	Add a 3rd 2250 MVA 765/345 kV transformer at Sullivan station and 345 kV switching changes at Sullivan/Breed	▲								June 2015	37	AEP	10/28/2010
22	Replace the 100 MVar 765 kV shunt reactor bank on Rockport - Jefferson 765 kV line with a 300 MVar bank at Rockport Station	▲								June 2015	16	AEP	10/28/2010
23	Transpose the Rockport - Sullivan 765 kV line and the Rockport - Jefferson 765 kV line	▲								June 2015	10	AEP	10/28/2010
24	Make switching changes at Jefferson 765 kV station	▲								June 2015	7.5	AEP	10/28/2010
25	Make switching changes at Sullivan 765 kV station	▲								June 2015	29.5	AEP	10/28/2010
26	Create an in and out loop at Adams Station, upgrade the Adams transformer to 90 MVA, install a new 138 kV bus and two new 138 kV circuit breakers at Seaman Station, convert South Central Co-op's New Market 69 kV Station to 138 kV, increase the operation of the Seaman - Highland circuit to 138 kV, install a new 138 kV bus at Highland Station, install three new 138 kV circuit breakers at Highland Station, install a new 138/69 kV 90 MVA transformer at Highland Station, and build a 138 kV circuit from Hillsboro - Highland 138 kV	▲								June 2015	13.5	AEP	10/28/2010
27	Expand Selma Parker Station and install a 138/69/34.5 kV transformer, rebuild and convert 34.5 kV line to Winchester to 69 kV, including Farmland Station, and retire the 34.5 kV line from Haymond to Selma Wire	▲								June 2015	8	AEP	10/28/2010

Table 9.3: PJM Western Sub-Region Transmission Upgrades (Continued)

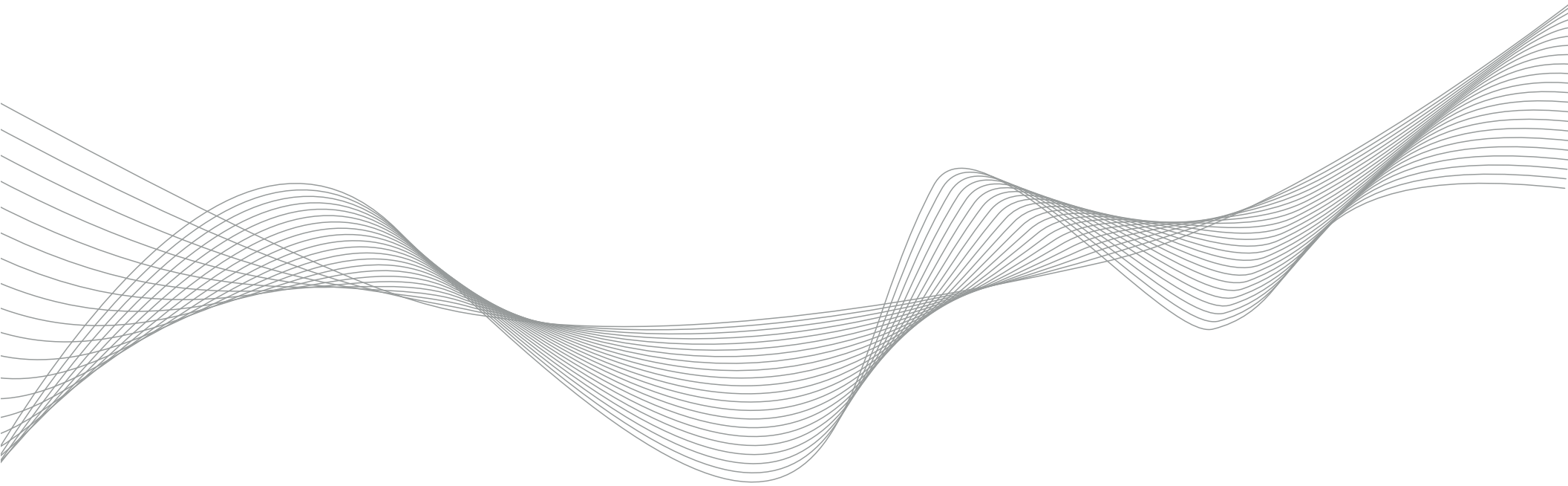
		System Upgrade Drivers										Date	Cost (M)	TO Zone(s)	2010 TEAC Review
		Baseline Upgrades					Network Upgrades			Supplemental Upgrade					
Upgrade		Baseline Load Growth / Deliverability & Reliability	Congestion Relief - Economic	Operational Performance	Generator Deactivation	TO Criteria Violation	Generation Interconnection	Merchant Transmission Interconnection	Long-term Firm Transmission Service	Criteria Compliance other than for Baseline					
28	Convert the Newcomerstown – Cambridge 34.5 kV system to 69 kV operation, expand the Derwent 69 kV Station (including reconfiguration of the 69 kV system), and rebuild 11.8 miles of 69 kV line, and convert additional 34.5 kV stations to 69 kV operation	▲									December 2012	23	AEP	10/28/2010	
29	Build a new 138 kV double circuit to Skin Fork Station, install a new 138/46 kV transformer at Skin Fork, and replace 5 Moab's on the Kanawha – Baileysville line with breakers at the Sundial 138 kV station	▲									June 2015	8.5	AEP	10/28/2010	
30	Establish a new 138/69 kV Butler Center station, build a new 138 kV line from Auburn station to Woods Road station VIA Butler Center station, replace the existing 40 MVA 138/69 kV transformer at Auburn station with a 90 MVA 138/69 kV transformer, and improve the switching arrangement at Kendallville station	▲									June 2015	25	AEP	10/28/2010	
31	Add an Additional 765/345 kV transformer at Baker Station			▲							June 2015	46	AEP	10/28/2010	
32	Terminal Equipment upgrade at Doubs substation and Mt Storm - Doubs transmission line rebuild in Maryland			▲							June 2020	370	AEP	10/28/2010	
33	Muskingum - Wolf Creek - Reconductor 138kV line 4.69 miles with 2 conductor bundles of 795 ACSR(Drake)						T32				March 2010	6	AEP	7/14/2010	
34	Construct new 345kV Switching Station connecting to the Cooks - Palisades circuits, including 5-345kV CB, Relays, meterig, SCADA and asso equipment						T94				March 2010	10	AEP	7/14/2010	
35	Byron Station 6 - Wayne TSS144 - Build new 345kV line						R16				December 2009	250	ComEd	7/14/2010	
36	Lena TSS180 - Build new 3 breaker 138kV ring but to interconnect to TSS180						R16				December 2009	7.4	ComEd	7/14/2010	
37	Pontiac Midpoint TSS80 - Install extra breaker to connect R30 to Pontiac Midpoint TSS80						R30				December 2009	6	ComEd	7/14/2010	
38	Byron Station 6 - Wayne - Build second 345kV line						R33				December 2009	48	ComEd	7/14/2010	

Table 9.3: PJM Western Sub-Region Transmission Upgrades (Continued)

Upgrade	System Upgrade Drivers									Date	Cost (M)	TO Zone(s)	2010 TEAC Review
	Baseline Load Growth / Deliverability & Reliability	Baseline Upgrades		Network Upgrades			Supplemental Upgrade						
		Congestion Relief - Economic	Operational Performance	Generator Deactivation	TO Criteria Violation	Generation Interconnection	Merchant Transmission Interconnection	Long-term Firm Transmission Service	Criteria Compliance other than for Baseline				
39	Byron Station 6 - Nelson 155 - Build second 345kV line					R33				December 2009	70	ComEd	7/14/2010
40	East Lima - Marysville - Construct new switching station, including 3 345kV circuit breakers, relays, metering, SCADA and associated equip.					U2-041				January 2010	8	AEP	7/14/2010
41	Pine Rock TSS 97 - Build three breaker 138kV transmission substation					R54				December 2009	7.505	ComEd	7/14/2010
42	White Pines TSS 99 - Build three breaker 138kV interconnection substation					R55				December 2009	7.275	ComEd	7/14/2010
43	Millbrook Park - South Portsmouth - Add 3 ring breaker 138kV ring bus interconnection substation					U2-080				July 2011	5	AEP	7/14/2010
44	Millbrook Park - South Portsmouth - Construct double circuit 138kV line facilities to loop in and out of new switching station					U2-080				July 2011	14.3	AEP	7/14/2010
45	Gooseberry Creek TSS 878 - Build new 3 breaker substation					R78				December 2010	12.299	ComEd	7/14/2010
46	Otter Creek TSS 873 - Build new 3 breaker substation					R79				December 2010	13.193	ComEd	7/14/2010
47	Otter Creek TSS 873 - Engineer, labor and material for fiber communication					R79				December 2010	5.311	ComEd	7/14/2010
48	Dresden Station 12 - Reconductor 32 miles of line 1202					R79				December 2010	26	ComEd	7/14/2010
49	Town Line Road TSS 189 - Build new 3 breaker substation					R96				July 2009	7.5	ComEd	7/14/2010
50	Desoto - Tanners Creek - Construct new switching station connecting to the 345kV line, including 3 345kV circuit breakers, relays, metering, SCADA and associated equipment					U2-090				December 2011	8.5	AEP	7/14/2010
51	Collins Station 23 - Install 2 765kV circuit breakers, two line positions and two revenue meters					S57-S58				December 2011	10	AEP	7/14/2010
52	Bluff Point - Randolph - Add 3 breaker 138kV ring bus interconnection station to circuit					U2-062				December 2010	5.3	AEP	7/14/2010

Table 9.3: PJM Western Sub-Region Transmission Upgrades (Continued)

Upgrade		System Upgrade Drivers										Date	Cost (M)	TO Zone(s)	2010 TEAC Review
		Baseline Upgrades					Network Upgrades			Supplemental Upgrade					
		Baseline Load Growth / Deliverability & Reliability	Congestion Relief - Economic	Operational Performance	Generator Deactivation	TO Criteria Violation	Generation Interconnection	Merchant Transmission Interconnection	Long-term Firm Transmission Service	Criteria Compliance other than for Baseline					
53	Marysville - Southwest Lima - Add 3 breaker 345kV ring bus to substation						U2-066				September 2012	8	AEP	7/14/2010	
54	East Lima - Marysville - Add 3 breaker 345kV ring bus interconnection substation to the 345kV line						U2-072				October 2010	8	AEP	7/14/2010	
55	Kensington Ave TSS199 - Build new six breaker interconnection substation						S36				December 2009	10.9	ComEd	7/14/2010	
56	Kensington Ave TSS199 - Install 138kV transmission line tie in						S36				December 2009	7	ComEd	7/14/2010	
57	Delaware - Richmond - Construct a new switching station connecting to 138kV line, including 3 138kV circuit breakers, relays, metering, SCADA and asso. Equip						U2-091				December 2011	5.3	AEP	7/14/2010	
58	Delaware - Centerville - Construct new switching station connecting to 138kV line, including 3 138kV circuit breakers, relays, metering, SCADA and asso equip						U2-092				December 2011	5.3	AEP	7/14/2010	
59	East Lima - South Kenton - Construct a new switching station connecting to the 138kV line, including three 138kV circuit breakers, relays, metering, SCADA and associated equipment						U1-060				April 2011	5.1	AEP	7/14/2010	
60	U1-060 - Sterling - Construct a new 17 mile 138kV circuit. Add a new bay, breaker						U1-060				April 2011	17.9	AEP	7/14/2010	
61	Build a new "Vassell" 765/345/138 kV Station to the North of Columbus, OH at the intersection of the Kammer - Maliszewski 765 kV line and the Hyatt - Corridor 345 kV line									▲	May 2014	181	AEP	10/28/2010	
62	Install two 84 MVA transformers at West Campus. The Roberts - OSU underground 138 kV Line (presently approved, power sited and in the ROW acquisition stage) will be routed into West Campus									▲	September 2011	8.309	AEP	10/28/2010	



PJM

DE

DC

IL

IN

KY

MD

MI

NJ

NC

OH

PA

TN

VA

WV

9.4: PJM Southern Sub-Region – 2015

PJM operates the Bulk Electric System (BES) transmission facilities (and others monitored at lower voltage levels) throughout the Southern Sub-Region footprint shown in Map 9.1, including those of Dominion Virginia Power (Dominion) which operates in Virginia and Northeastern North Carolina.

The electricity needs of northern Virginia area are supplied not only by local generation, but also by energy transfers across the interstate transmission systems of northern West Virginia, northern Virginia, Maryland, eastern Ohio and central-southwestern Pennsylvania. This dependence on bulk power transfers from western sources has been growing steadily since the integration of western and southern markets into PJM.

Upgrades listed in Table 9.4 and shown in Map 9.5 have an estimated cost of \$5 million or more approved by PJM's Board in 2010 to eliminate NERC reliability criteria violations.

In addition to the TrAIL and Carson - Suffolk projects already under construction, 2010 RTEP process baseline analysis identified the need for the PATH project in 2015 to resolve NERC reliability criteria violations, as discussed in **Section 5**.

Map 9.5: PJM Southern Sub-Region Transmission Upgrades

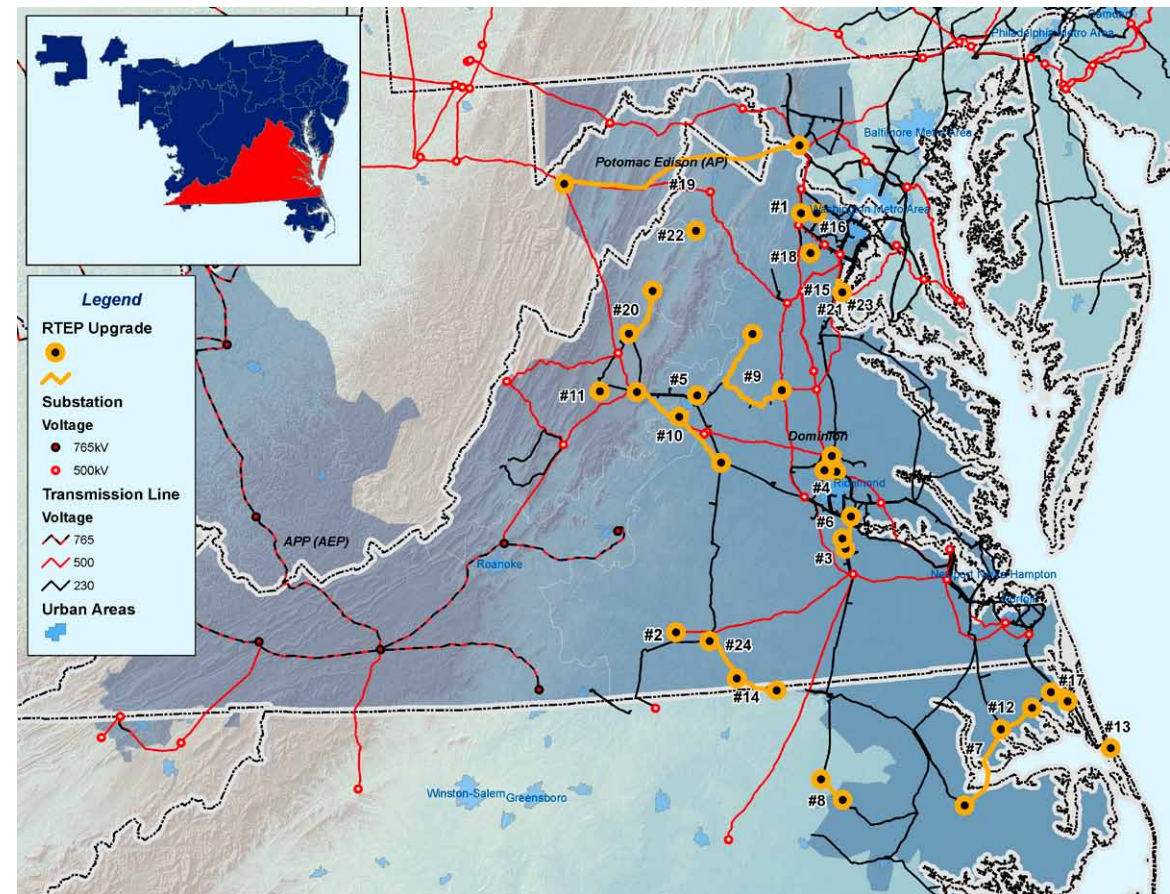
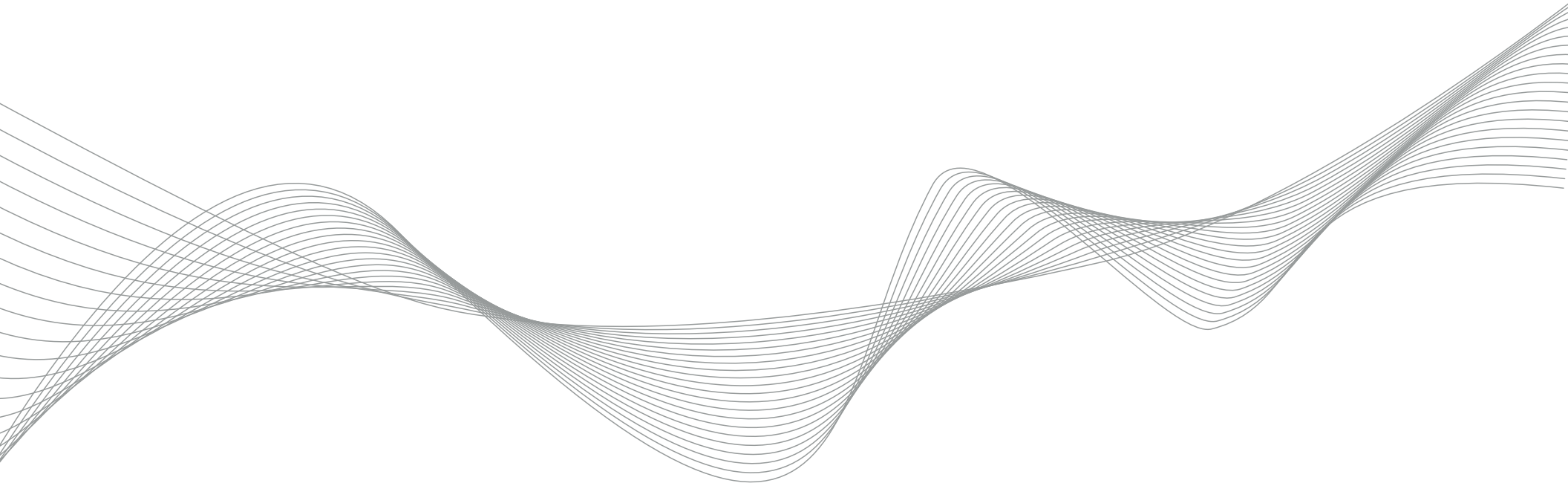


Table 9.4: PJM Southern Sub-Region Transmission Upgrades

		System Upgrade Drivers									Date	Cost (M)	TO Zone(s)	2010 TEAC Review
		Baseline Upgrades					Network Upgrades			Supplemental Upgrade				
Upgrade		Baseline Load Growth / Deliverability & Reliability	Congestion Relief - Economic	Operational Performance	Generator Deactivation	TO Criteria Violation	Generation Interconnection	Merchant Transmission Interconnection	Long-term Firm Transmission Service	Criteria Compliance other than for Baseline				
1	Install one 500/230 kV transformer and two 230 kV breakers at Brambleton	▲									June 2014	14.5	Dominion	9/8/2010
2	Install 2nd 500/230 kV transformer and a 150 MVar capacitor at Clover	▲									June 2015	16	Dominion	5/12/2010
3	Increase rating on Locks - Purdy 115 kV line	▲									June 2014	9.4	Dominion	8/25/2010
4	Install a 230 kV line from Lakeside to Northwest and reconductor the existing 221 line between Elmont and Northwest	▲									June 2013	12.5	Dominion	8/25/2010
5	Loop the 2054 line in and out of Hollymeade and place a 230 kV breaker at Hollymeade					▲					June 2014	30.5	Dominion	8/25/2010
6	Rebuild line #100 from Chesterfield to Harrowgate 115 kV for a minimum 300 MVA rating	▲									June 2014	8	Dominion	8/25/2010
7	Convert line #64 Trowbridge to Winfall to 230 kV and install a 230 kV capacitor bank at Winfall.	▲									June 2014	23	Dominion	8/25/2010
8	Rebuild 115 kV line #80, Battleboro - Heartsease DP	▲									June 2014	11	Dominion	8/25/2010
9	Build a new 230 kV line North Anna - Oak Green and install a 224 MVA 230/115 kV transformer at Oak Green	▲									June 2015	70	Dominion	8/25/2010
10	Rebuild the 39 Line (Dooms - Sherwood) and the 91 Line (Sherwood - Bremo)	▲									June 2015	100	Dominion	8/25/2010
11	Install a 224 MVA 230/115 kV transformer at Staunton. Rebuild the 115 kV line #43 section Staunton - Verona	▲									June 2013	16.5	Dominion	8/25/2010
12	Rebuild 15 miles of line #2020 Winfall - Elizabeth City with a minimum 900 MVA rating	▲									June 2015	18	Dominion	8/25/2010
13	Install a third 168 MVA 230/115 kV transformer at Kitty Hawk with a normally open 230 kV breaker and a low side 115 kV breaker.	▲									June 2015	6	Dominion	8/25/2010
14	Rebuild the section of line #22 between Kerr Dam - Eatons Ferry substations	▲									June 2015	20	Dominion	8/25/2010

Table 9.4: PJM Southern Sub-Region Transmission Upgrades (Continued)

		System Upgrade Drivers										Date	Cost (M)	TO Zone(s)	2010 TEAC Review
		Baseline Upgrades					Network Upgrades			Supplemental Upgrade					
Upgrade		Baseline Load Growth / Deliverability & Reliability	Congestion Relief - Economic	Operational Performance	Generator Deactivation	TO Criteria Violation	Generation Interconnection	Merchant Transmission Interconnection	Long-term Firm Transmission Service	Criteria Compliance other than for Baseline					
15	Upgrade the 3.63 mile line section between Possum and Dumfries substations, replace the 1600 amp wave trap at Possum Point	▲									June 2015	5.5	Dominion	8/25/2010	
16	Install a five breaker ring bus at the expanded Dulles substation	▲									June 2014	6	Dominion	8/25/2010	
17	Build a 230 kV line from Shawboro to Aydlett tap and connect Aydlett to the new line	▲									June 2015	22	Dominion	8/25/2010	
18	Build Cannon Branch to Nokesville 230 kV line	▲									May 2018	40	Dominion	8/25/2010	
19	Terminal Equipment upgrade at Mt Storm substation and Mt Storm - Doubs transmission line rebuild in both West Virginia and Virginia			▲							June 2020	370	Dominion	10/28/2010	
20	Build a 2nd 230kV Line Harrisonburg to Endless Caverns, install a 3rd 230-115kV Tx at Endless Caverns, and upgrade 115kV shunt capacitor banks at Merck and Edinburg	▲									June 2015	70	Dominion	10/28/2010	
21	Possum Point - Reconductor the engineering proving grounds 230kV line and replace 2 in-line switches						V1-031				April 2016	9.2	Dominion	7/14/2010	
22	Front Royal - Construct loop in line 508 to a new 3-breaker ring bus substation						V2-030				April 2015	10	Dominion	7/14/2010	
23	Possum Point - Reconductor the 230kV transmission line #237 (Possum Point to Lake Ridge)						V1-031				June 2016	6	Dominion	7/14/2010	
24	Split 115kV Line 38 (Chase City – Kerr Dam) and build double circuit tap 1.5 miles (new ROW) to BPRI Park. Build substation in BPRI Park with 115kV four breaker ring bus									▲	April 2011	15.6	Dominion	10/28/2010	





9.5: PJM System Stability

PJM performs a series of analyses to ensure Bulk Electric System (BES) stability and satisfactory dynamic performance. Disturbances are applied that have a reasonable possibility of occurring in operations, consistent with NERC TPL standards. Studies performed assess system dynamic performance over a wide range of load levels.

Whenever system dynamic performance is deemed inadequate, PJM identifies appropriate transmission and generation reinforcements and mitigation measures. These can include Power System Stabilizers, excitation system refinements, dynamic or static reactive supports for wind generation plants, relaying and breaker configuration modifications, among others. PJM's 2010 RTEP process stability assessment confirmed compliance with NERC system stability standards through 2015.

PJM uses full Eastern Interconnection Reliability Assessment Group (ERAG) Multi-Region Modeling Working Group (MMWG) models as a starting point for system model development coupled with all known transmission system and generation model changes from PJM transmission owners

Next, step response simulations are conducted to detect and correct any modeling errors. Case initialization results are carefully analyzed to make sure that all initial conditions are satisfactory. A 20 second no-fault simulation is performed to validate model input parameters.

PJM performs these stability studies in a three tiered approach. The first tier contains PJM system

wide analysis as described in **Section 9.5.1**; the second tier is Interconnection Requests as described in **Section 9.5.2** and the third tier is operational performance issues as described in **Section 9.5.3**. By employing this approach, PJM ensures its compliance to all applicable standards including the assessments required by NERC TPL standards Table 1.

9.5.1 – PJM System-Wide Analysis

A first tier of this analysis includes PJM's annual comprehensive transient stability assessment of existing generating stations in the system. The annual analysis is performed for one third of the generating stations each year, so that every PJM generating station is analyzed every three years. In addition to the standard 95 stability studies performed each year, for 2010 PJM performed stability analysis for an additional 18 plants due to the integration of ATSI. Since every existing PJM unit has undergone rigorous testing including stability, new violations are not anticipated in these studies. This review, however, ensures that the existing system has not experienced gradual system changes that could affect system stability. The analysis includes an evaluation of the system under light load conditions as well as peak load conditions. PJM's reason for choosing a light load case is that the light load system conditions are found to be the most challenging and severe from a transient stability perspective. The analysis also includes an evaluation of the system under summer peak loading (50/50) conditions. All PJM stability

studies start by testing the system for a major transmission line switching operation. This examines the system under system normal conditions, as specified in TPL-001 and applicable disturbances for NERC TPL-002 (Category B) and NERC TPL-003 (Category C). The system is verified to settle to a steady flat response by monitoring several generating unit angle curves over a 20 second time frame. This test also provides the information to verify that all dynamic parameters are correctly initiating and responding properly. Existing Special Protection Systems and their controlling actions are also evaluated to ensure their effectiveness.

9.5.2 – Interconnection Request System Studies

A second tier of PJM's stability assessment includes stability analysis for all proposed generator interconnections that exceed 20 MWs. New generator interconnections represent a significant modification to the system that could affect stability. In 2010, as part of the generation interconnection process, PJM completed transient stability analysis for 34 proposed generator interconnections within the PJM footprint. In this analysis category A, B and C conditions were analyzed for disturbances on all generating plant outlets as well as on transmission lines at a minimum, one bus away and more than one bus away from the point of interconnection if warranted by the system topology. In general, the analysis associated with proposed generation additions identifies any potential transient stability concerns

among the generators electrically close to the portion of the system being modified. The proposed generation interconnections span all transmission system voltage levels and are widespread throughout PJM's footprint. Hence, the resulting stability analysis covers fairly large sections of PJM's bulk electric system. Solutions to the identified problems are developed and implemented prior to the proposed generation being placed in service.

In addition to monitoring the stability of the proposed generation, existing generation within several layers of the interconnection bus are also monitored. The transient stability analysis that is run for proposed generation interconnections not only ensures that the proposed unit will remain stable but also ensures that the transient stability of existing generation at nearby buses will not be compromised. It is important to note that the relative interconnection queue position is respected for this analysis so that potential transient stability concerns are identified for the proposed unit and nearby existing generation. This ensures that violations will be allocated to the correct project based on queue order. The results of this analysis and any required upgrades or other mitigation measures needed, are identified in the System Impact Study for each interconnection and are posted on the PJM website at the following address: <http://www.pjm.com/planning/generation-interconnection/generation-queue-active.aspx>.

9.5.3 – Operational Performance Issues

The third tier of the stability assessment is the additional stability analysis PJM conducts on an as needed basis. This analysis provides critical feedback to PJM operations and complements the two tiers above. This analysis is performed when

major transmission changes are proposed or due to near term changes to the topology of the transmission system (less than the five-year planning horizon) in areas that have limited transient stability margin or for planned / unplanned outage conditions.

PJM also completed other special stability studies to update PJM operating guidelines, the result of such system changes such as generator step up (GSU) transformer replacement, transformer tap changes and other factors. Operation/special studies conducted in 2010 included the following:

- Beaver Valley stability analysis for unusual outage condition.
- Conemaugh operating guidelines update.
- Homer City operation guideline study.
- Orchard No Load Tap (NLT) tap sensitivity study (Artificial Island).
- Review of Artificial Island Operating Guide (AIOG) Rev. 10 made by PSEG (Artificial Island).

- Montour operation memo review.
- Bath County unstable case review.
- Yorktown operation restriction review.
- Pleasants and Willow Island operating restrictions review due to Belmont 2nd transformer.
- Stability analysis due to GSU replacements (Piney Creek, Limerick, Morgantown, Chalk Point).

PJM is also required to incorporate the Nuclear Plant Interface Requirements (NPIRs) into its planning processes according to the applicable NERC standards (effective date is April 1, 2010). For each nuclear power plants PJM scheduled NPIR stability studies consistent with the NPIR planning requirements and its Regional Transmission Planning requirements. The NPIR stability studies for Limerick and Oyster Creek were performed in 2010.

MAAC Stability Analysis

As a part of PJM Load Deliverability study, Mid-Atlantic stability analysis is conducted annually to ensure that the PJM system meets performance criteria under the critical stressed power transfer scenario for the MAAC area. In 2010, a 2014 Load Deliverability case which has 90/10 summer peak load condition is tested for NERC TPL standard Category B.

9.5.4 – Conclusion

The transient stability analysis PJM performs employ forward looking cases in order to represent the system as planned in future years. Given the continued load growth within the PJM footprint and the on-going transmission system reinforcements that are identified as part of the regional transmission expansion plan, the transient stability of the system is expected to continue to improve.

