Transmission Expansion Advisory Committee

December 4, 2014

Market Efficiency Update

- 111(d) Update
  - Production cost simulations using various assumptions for input parameters (e.g. EE targets, renewable penetration)
  - Simulations will identify potential “at-risk” generation
  - Reliability analysis will assess the impact of loss of the “at-risk” generation

Interregional Planning Update

EIPC non-grant 2014 Analysis

- 2014 Scenario Analysis - update
  - Scenario A - Update rollup case - complete
  - Scenario B - Severe Heat and Drought - complete
    - Scenario complete – Report under preparation
  - Stakeholder WebEx held November 21
  - Report update for Scenarios A and B in progress

EIPC non-grant – Future Work

- Beyond 2014 discussions
  - Summer and Winter case builds and analysis
  - Ongoing review of potential scope
    - TC approved 2015/16 work plan and budget on 11-20-2014
      - Committee representation rotation
      - Contracts for consultant and web services support
      - 2025 summer and winter scenario build and analysis
      - Ground work for production cost studies – resource, data, funding Q1/Q2 - Database Q3/Q4
    - NERC model building - November 18-19 meeting

EIPC non-grant – NERC Meeting

- NERC wants better models
  - Quality of data, Fidelity in modeling, Build Database
  - Model change control process
  - TPL requires about 7 models
- Designated Entity – 7/1/15 selection target
  - Legal entity to contract with NERC
- Transition needed – project team to begin addressing

EIPC non-grant – NERC Meeting

- Transition Project Team – begin January, end June 2015?
  - NERC
  - Each Regional Entity
  - ISO/RTO (IRC)
  - Chair and vice-chair MMWG
  - Planning Coordinator
- Issues
  - What is the end state and target end date
  - Flow Chart model/database build
  - Flow Chart Designee selection
  - Need for cases / analysis
  - Funding

EIPC non-grant – NERC Meeting

- Observations:
  - Not much compliance discussion
  - Wide divergence of model needs
  - NERC plans to hold PC's accountable for models
  - Aggressive schedule
  - NERC to plan transition with DE
  - Stay tuned

North Carolina Study

- NCTPC - update
  - Study requested by NCUC
  - Reliability and Economic Analysis – complete
  - Report drafting underway
  - Discussions on draft could extend to Q1 2015
- Examine PJM Annual 2016/17 Base Residual Auction External Resources
  - Potential Reliability and Economic Effects on North Carolina

North Carolina Study

- Study Area

Area Num	Area Name	Generation (MW)	Load (MW)	Scheduled Interchange (MW)	Actual Interchange (MW)	Area Control Error (MW)	Losses (MW)
340	CPLE	11,798	12,533	-956	-956.47	-0.47	221
341	CPLW	766	908	-151	-151.01	-0.01	9
342	DUKE	21,907	21,299	-37	-42.95	-5.95	651
NC Total:		34,471	34,740	-1,144	-1,150.43	-6.43	881

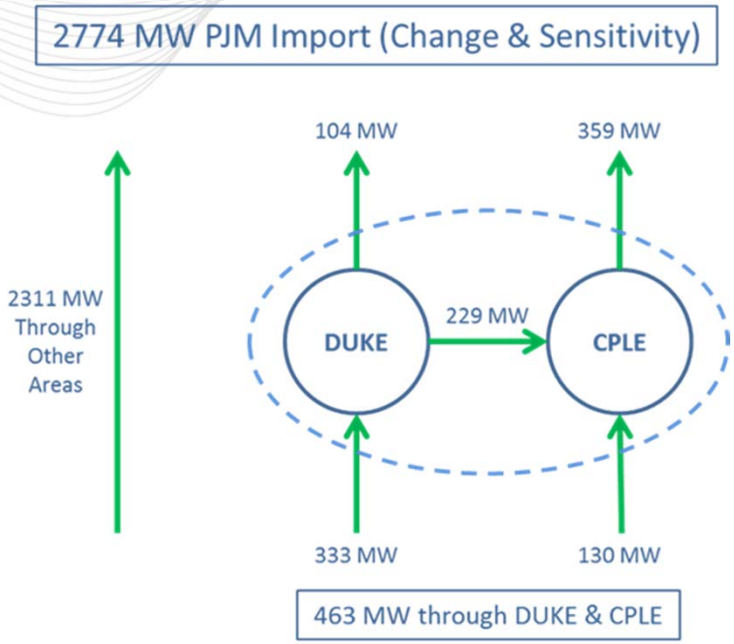
North Carolina Study

- PJM 2016/17 BRA Studied external resources

Region	Base Case	Change Case	Sensitivity Case
South	580	-	834
West 1	1,620	1,076	-
West 2	2,689	864	-
Total:	4,889	1,940	834

North Carolina Study

- BRA impacts preliminary observations:
  - 7663 MW total
  - 2774 MW lack firm transmission



North Carolina Study

- BRA reliability impacts preliminary observations:
  - Reliability screens include severe contingencies
  - All facilities shown on the reliability screens have high base loadings and very low BRA unit impacts
  - Aggregate impacts below 2%
  - Largest unit impact below 3%
- Economic impact preliminary observation – extremely small change in production cost

Interregional Planning Studies (not including JCM)

- PJM/MISO IPSAC
  - Metric and Process Review
    - September 11 WebEx – introduction and plan
    - October 2 In person at PJM – detailed reviews of PJM and MISO planning
    - October 24 in-person at MISO – input from stakeholders
    - November 10 JCM update
    - December 8 next IPSAC – “quick hit” agenda
- Northeast Protocol IPSAC tentative date December 12

Review of 2015 RTEP Assumptions

Overview

- Update of standard RTEP assumptions
- TEAC input & feedback

2015 RTEP Assumptions

- Load Flow Modeling
  - Power flow models for world load, capacity and topology will be based on the 2020 summer peak case from the 2014 ERAG MMWG series power flow base case
  - Update of adjacent areas with latest topology
  - PJM topology will be based on the 2019 RTEP case that was used in the 2014 RTEP
    - Include all PJM Board approved upgrades through the November 2014 PJM Board of Manager approvals as well as all anticipated February 2015 PJM Board approvals

Locational Deliverability Areas (LDAs)

- Includes the existing 27 LDAs

- Total of 27 LDAs
  - All 27 to be evaluated for the 2018/2019 delivery year RPM base residual auction planning parameters
  - Also evaluated for the 2020 Summer RTEP case

LDA	Description
EMAAC	Global area - PJM 500, JCPL, PECO, PSEG, AE, DPL, RECO
SWMAAC	Global area - BGE and PEPCO
MAAC	Global area - PJM 500, Penelec, Meted, JCPL, PPL, PECO, PSEG, BGE, Pepco, AE, DPL, UGI, RECO
PPL	PPL & UGI
PJM WEST	APS, AEP, Dayton, DUQ, Comed, ATSI, DEO&K, EKPC, Cleveland
WMAAC	PJM 500, Penelec, Meted, PPL, UGI
PENELEC	Pennsylvania Electric
METED	Metropolitan Edison
JCPL	Jersey Central Power and Light
PECO	PECO
PSEG	Public Service Electric and Gas
BGE	Baltimore Gas and Electric
PEPCO	Potomac Electric Power Company
AE	Atlantic City Electric
DPL	Delmarva Power and Light
DPLSOUTH	Southern Portion of DPL
PSNORTH	Northern Portion of PSEG
VAP	Dominion Virginia Power
APS	Allegheny Power
AEP	American Electric Power
DAYTON	Dayton Power and Light
DLCO	Duquesne Light Company
Comed	Commonwealth Edison
ATSI	American Transmission Systems, Incorporated
DEO&K	Duke Energy Ohio and Kentucky
EKPC	Eastern Kentucky Power Cooperative
Cleveland	Cleveland Area

2015 RTEP Assumptions

- New TPL-001-4 Requirement
  - 1.1. System models shall represent:
  - 1.1.1. Existing Facilities
  - **1.1.2. Known outage(s) of generation or Transmission Facility(ies) with a duration**
  - **of at least six months**.
  - 1.1.3. New planned Facilities and changes to existing Facilities
  - 1.1.4. Real and reactive Load forecasts
  - 1.1.5. Known commitments for Firm Transmission Service and Interchange
  - 1.1.6. Resources (supply or demand side) required for Load

- PJM will compile and assess (as a sensitivity) planned outages of generation or Transmission with a duration of at least six months

2015 RTEP Assumptions

- Firm Commitments
  - Long term firm transmission service will be consistent with operations
- Outage Rates
  - Generation outage rates will be based on the most recent Reserve Requirement Study (RRS) performed by PJM
  - Generation outage rates for future PJM units will be estimated based on class average rates

2015 RTEP Load Modeling

- Peak Load
  - Load will be modeled consistent with the 2015 PJM Load Forecast Report
  - The final load forecast data is expected to be available late December 2014
  - Include Demand Response (DR) and Energy Efficiency (EE) that cleared in the 2017/18 BRA

- Light Load
  - Modeled at 50% of the Peak Load forecast per M14B
  - The Light Load Reliability Criteria case will be modeled consistent with the procedure defined in M14B

- Load Management, where applicable, will be modeled consistent with the 2015 Load Forecast Report
  - Used in LDA under study in load deliverability analysis

2015 RTEP Generation Assumptions

- All existing generation expected to be in service for the year being studied will be modeled.
- Future generation with a signed Interconnection Service Agreement, or that cleared in the 2017/18 BRA, will be modeled along with any associated network upgrades.
  - Generation with a signed ISA will contribute to and be allowed to back-off problems.
- Generation with an executed Facility Study Agreement (FSA) will be modeled along with any associated network upgrades.

2015 RTEP Generation Assumptions

- Generation with an FSA will be modeled consistent with the procedures noted in manual 14B
  - Exceptions to those procedures will be vetted with stakeholders at a future TEAC
- Generation with an executed FSA will be modeled off-line but will be allowed to contribute to problems in the generation deliverability testing.
  - Generation with an executed FSA will not be allowed to back-off problems.
- Additional generation information (i.e. machine lists) will be posted to the TEAC page when developed.

Deactivation Notification Generation

- Generation that has officially notified PJM of deactivation will be modeled offline in RTEP base cases for all study years after the intended deactivation date

- RTEP baseline upgrades associated with generation deactivations will be modeled

- Retired units capacity interconnection rights are maintained in RTEP base cases for 1 year after deactivation at which point they will be removed unless claimed by a queue project

2015 RTEP Assumptions

- All PJM bulk electric system facilities, all tie lines to neighboring systems and all lower voltage facilities operated by PJM will be monitored.

- Contingency analysis will include all bulk electric system facilities, all tie lines to neighboring systems and all lower voltage facilities operated by PJM.

- Thermal and voltage limits will be consistent with those used in operations.

24 Month RTEP

- As part of the 24-month RTEP cycle, a year 7 (2022) base case will be developed and evaluated as part of the 2015 RTEP

- The year 7 case will be based on the 2022 case that was developed as part of this year's 2014 RTEP
  - The case will be updated to be consistent with the 2014 RTEP assumptions.

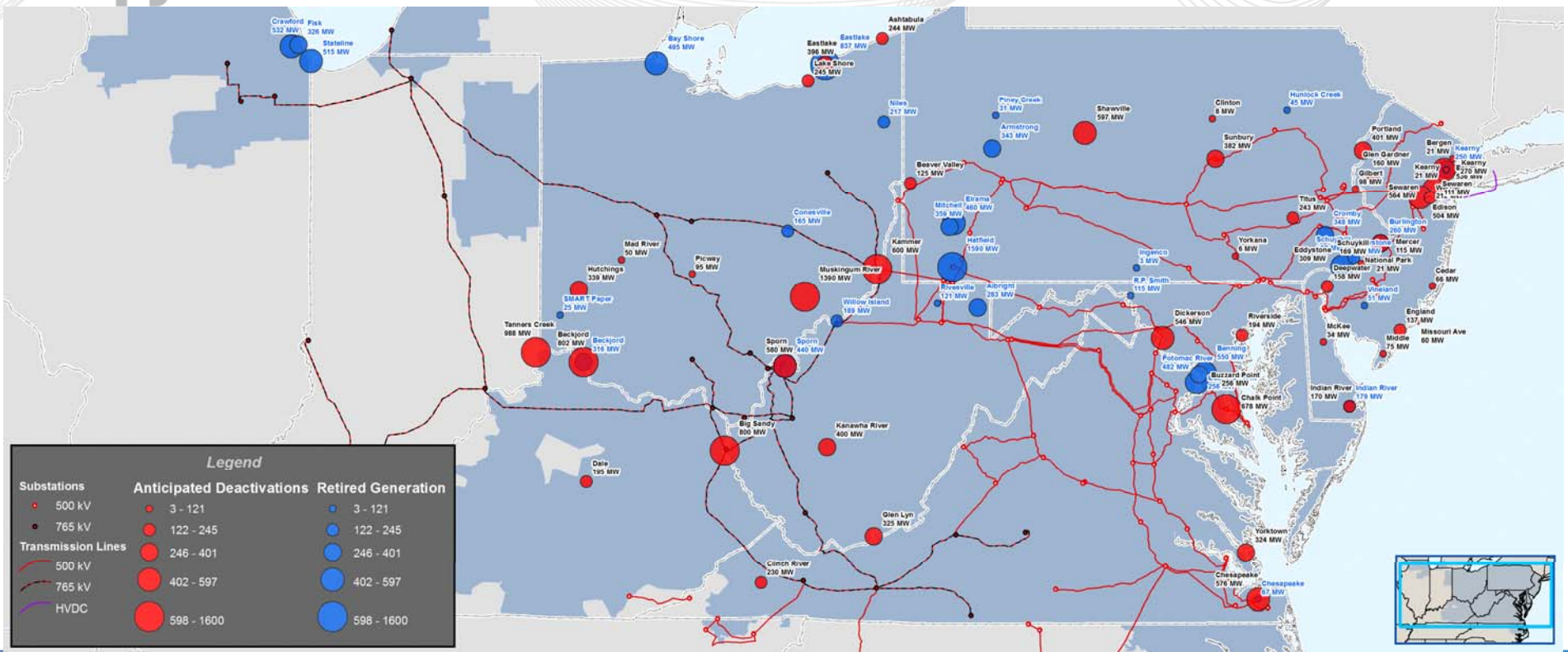
- Purpose: To identify and develop longer lead time transmission upgrades

Questions, input or suggestions

– Email RTEP@pjm.com

Generation Deactivation Notification (Retirements) Update

Generation Retirements



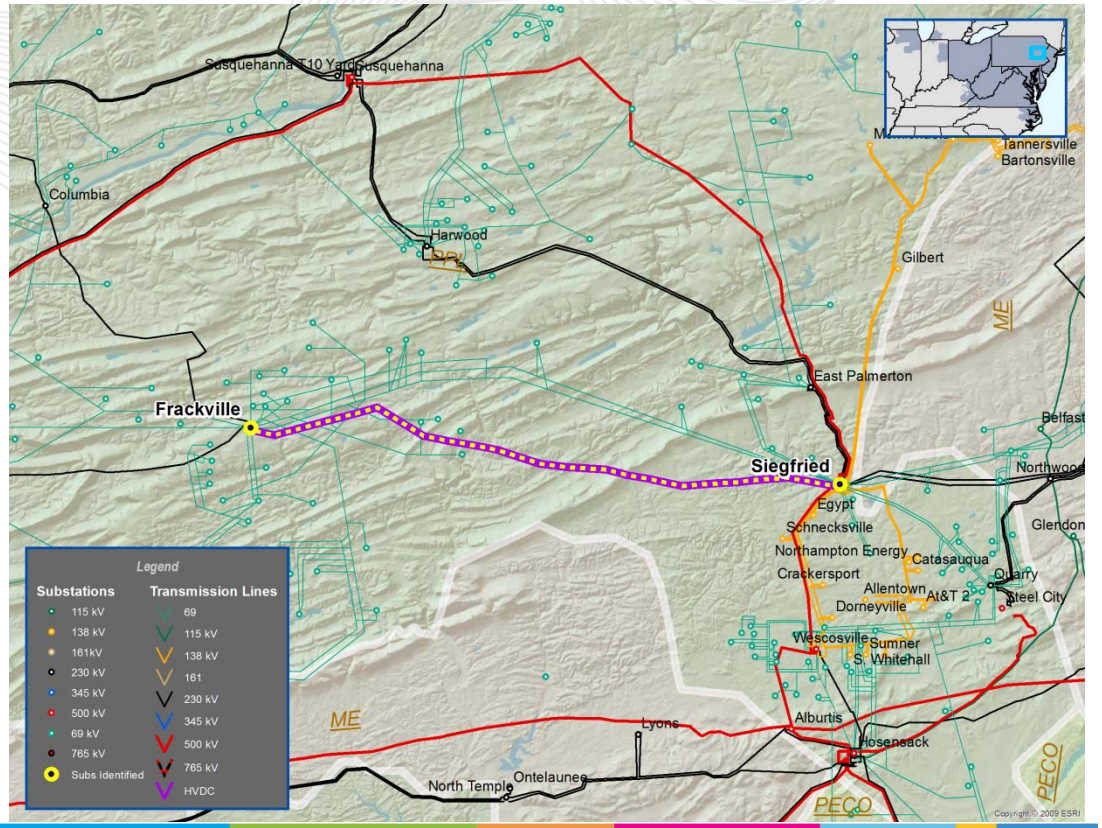
Deactivation Status

Unit(s)	Transmission Zone	Requested Deactivation Date	PJM Reliability Status
Bayonne CC (163MWs)	PSEG	11/1/2018	Reliability analysis underway
Burger EMD generator (6MWs)	ATSI	5/31/2016	Reliability analysis underway

Reliability Analysis Update

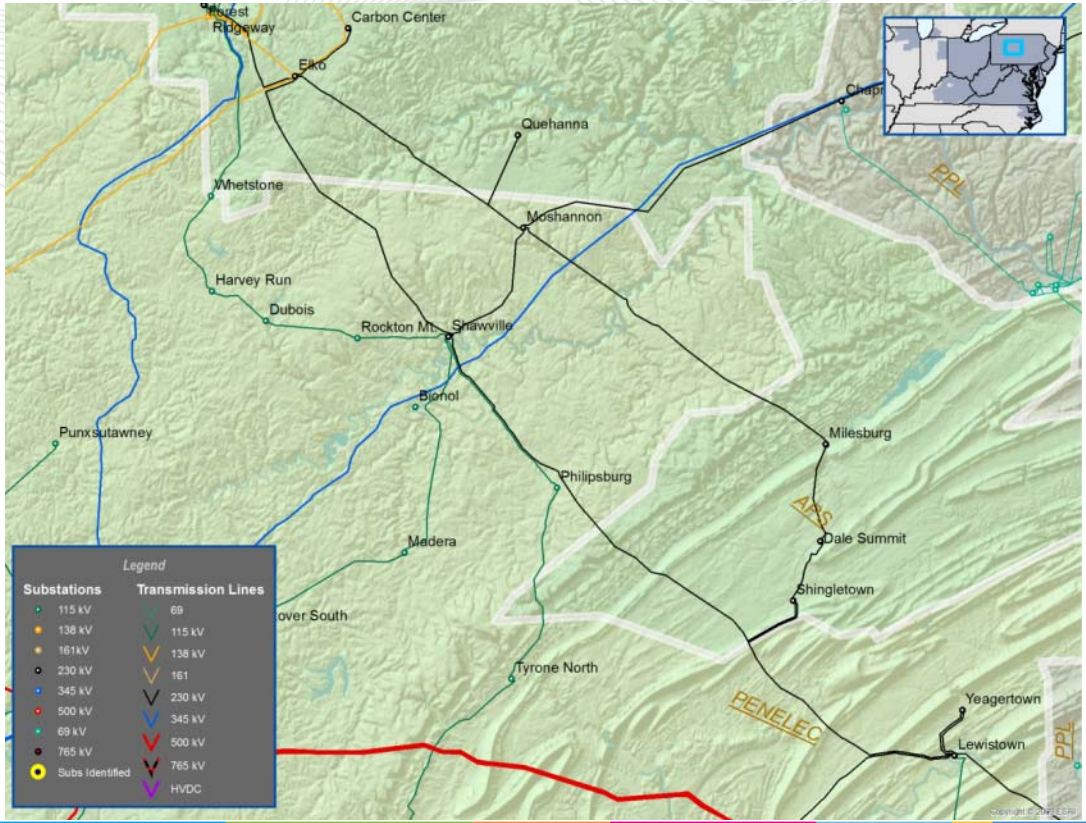
PPL Transmission Zone

- Cancel B2282 Upgrade
  - The B2282 (Rebuild the Siegfried - Frackville 230 kV line) upgrade is no longer needed for reliability in 2019 and will be canceled
  - The main driver for this change is due to the withdrawal of queued generation in the Frackville vicinity



APS Transmission Zone

- **Basecase Analysis Violation**
- Voltage drop violation at Squab Hollow 230kV bus for the loss of the Squab Hollow – Forrest 230KV line and the Squab Hollow SVC due to the stuck breaker
- Install a 230KV breaker at Squab Hollow 230 kV substation. (B2362.1)
- Estimated Project Cost: $0.75M
- Expected IS Date: 06/01/2015



2014 RTEP Proposal Window 2

2014 RTEP Proposal Window #2 Proposal Overview

- Scope: Transmission Owner Criteria, 2019 Baseline N-1 Voltage, 2019 N-1-1 Voltage and 2018 Light Load Reliability Criteria
  - Opened Friday, October 17, 2014
  - Closed Monday, November 17, 2014
  - Pratt's area violations extended to December 5, 2014

- Approximately 118 individual facilities with reliability criteria violations (49 Thermal and 69 Voltage)
  - Approximately 311 flow gates are identified
- 12 proposing entities
- 63 proposals
  - 43 Transmission Owner Upgrades
    - Cost range of $0.2M to $71M
  - 20 Greenfield Projects
    - Cost range of $6.1M to $450M
- 9 target TO zones

2014 RTEP Proposal Window #2 Criteria Violations

- Unique Monitored Elements by TO Zone

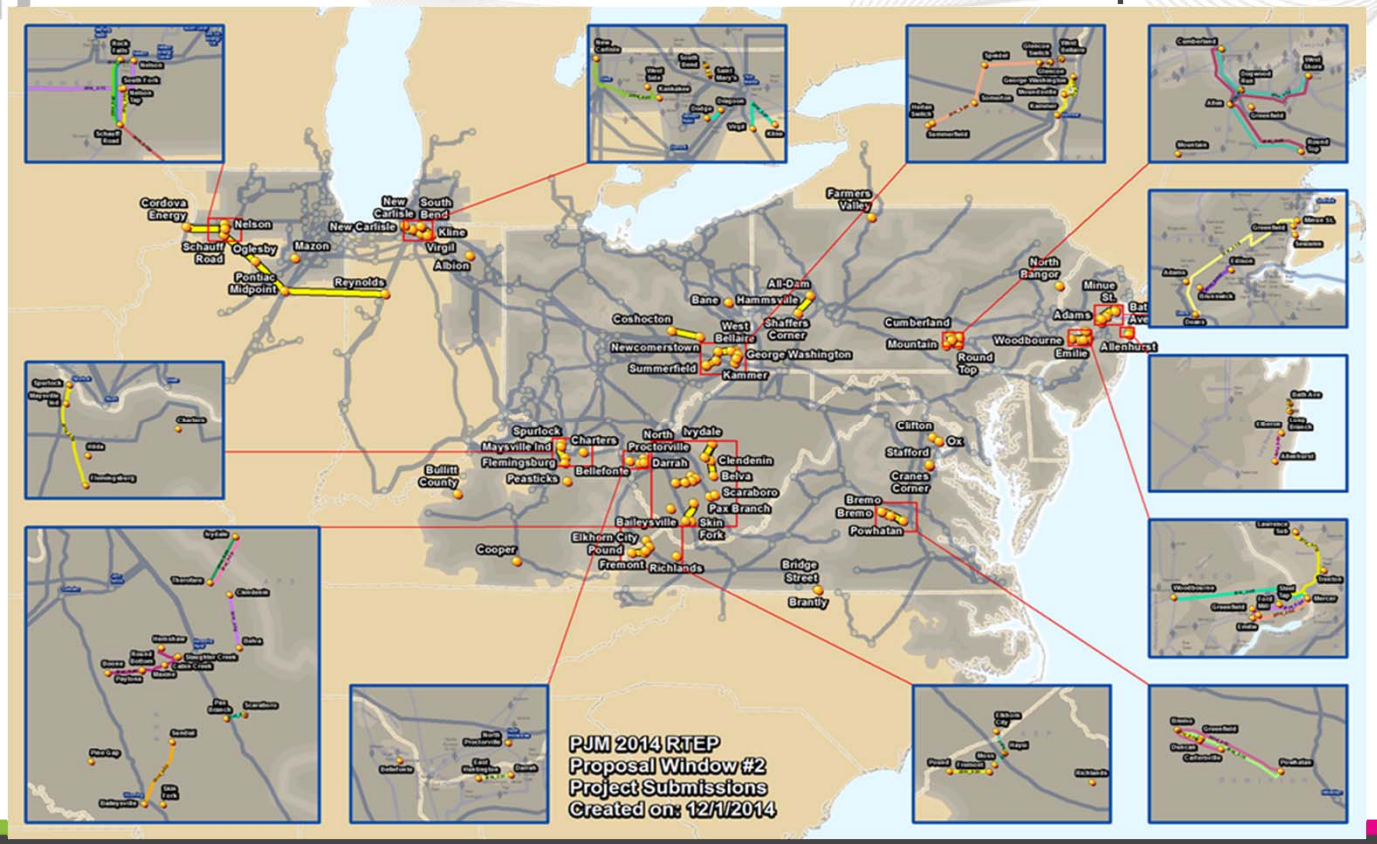
TO Zone	Thermal Violations	Voltage Violations
APS	0	2
AEP	35	18
ComEd	4	0
PENELEC	0	5
METED	0	7
JCP&L	2	0
PSE&G	0	18
EKPC	1	8
DVP	7	11
TOTAL	**49**	**69**

- Unique Monitored Elements by Voltage

Thermal Violations	
Voltage	Total
230	2
138	4
115	4
69	16
46	6
35	2
34.5	9
23	5
Dominion Loss of Load Criterion	1
Grand Total	**49**

Voltage Violations	
Voltage	Total
345	1
230	21
161	7
138	2
115	20
69	1
46	17
Grand Total	**69**

2014 RTEP Proposal Window 2



Tracking Spreadsheet

- The full spreadsheet tracking all proposal can be found with the Meeting materials for the 12/4/2014 TEAC at:
  - http://pjm.com/~/media/committees-groups/committees/teac/20141204/20141204-2014-rtep-proposal-window-2-tracking.ashx

AEP Target Zone

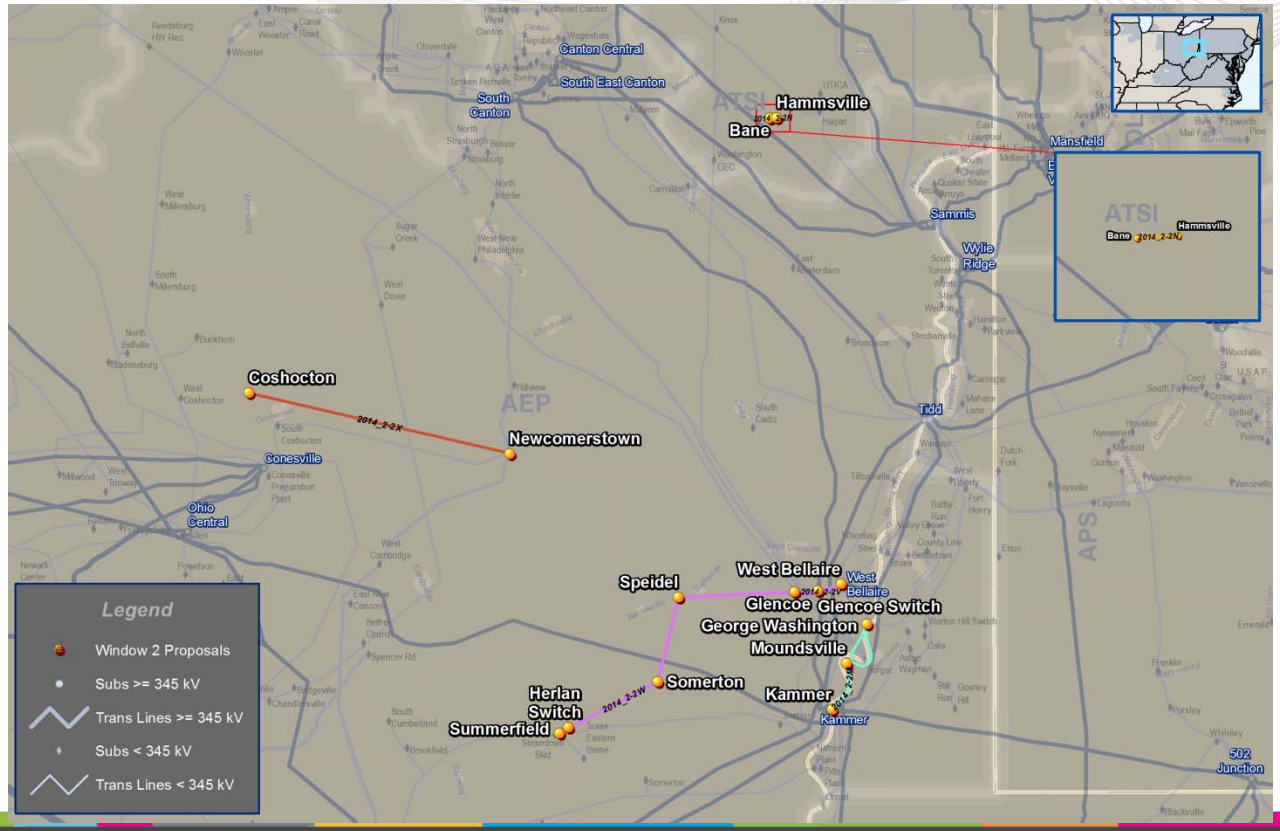
Project ID	Upgrade/Greenfield	Proposing Entity	Cost ($M)	kV Level	Analysis Type	Major Components
2014_2-2Z	Upgrade	AEP	8.588	34.5	AEP Thermal TO Criteria	Rebuild approximately 5 miles of South Bend-West Side 34.5 kV line between South Bend and Saint Mary's stations. Replace risers and bus at South Bend station. Also, replace risers and switches at Saint Mary's station.
2014_2-2Y	Greenfield	AEP	7.922	69	AEP Thermal TO Criteria	Construct a new line approximately 2.5 miles from Colfax to Drewry's. Construct a new Drewry's station and install a new circuit breaker at Colfax station.
2014_2-2X	Upgrade	AEP	5.09	69	AEP Thermal TO Criteria	Rebuild existing East Coshocton – North Coshocton double circuit line which contains Newcomerstown - N. Coshocton 34.5kV Circuit and Coshocton – North Coshocton 69kV circuit
2014_2-2W	Upgrade	AEP	110	138	AEP Thermal TO Criteria	Rebuild / reconductor existing West Bellaire-Glencoe 69 kV line with 138 kV & 69 kV circuits and install 138/69 kV transformer at Glencoe Switch. Rebuild / reconductor / convert Glencoe-Speidel line and taps to 138 kV. Re-energize Speidel-Somerton as 138 kV. Rebuild / reconductor / convert Speidel-Summerfield line and taps to 138 kV. Construct Herlan Switch.
2014_2-2A	Upgrade	AEP	1.5	69	AEP Thermal TO Criteria	Rebuild 1.0 mile of Brantley-Bridge Street 69 kV Line with 1033 ACSR overhead condutor.
2014_2-2B	Upgrade	AEP	31.86	138	AEP Thermal TO Criteria	Rebuild 7.82 mile Elkhorn City - Haysi S.S 69 kV line utlizing 1033 ACSR built to 138 kV standards; Rebuild 5.18 mile Moss - Haysi SS 69 kVline utlizing 1033 ACSR built to 138 kV standards
2014_2-2C	Upgrade	AEP	8.778	34.5	AEP Thermal TO Criteria	Rebuild approximately 4 mile section of the New Carlisle – West Side/Kankakee 34.5 kV line between West Side
2014_2-2D	Upgrade	AEP	2.025	138	AEP Thermal TO Criteria	Move load from the 34.5 kV bus to the 138 kV bus by installing a new 138/12 kV XF at New Carlisle station in Indiana.
2014_2-2E	Upgrade	AEP	2.154	34.5	AEP Thermal TO Criteria	Rebuild approximately 1 mile section of the Dragoon-Virgil Street 34.5 kV line between Dragoon and Dodge Tap switch and replace Dodge switch MOAB to increase thermal capability of the Dragoon-Dodge Tap branch.
2014_2-2F	Upgrade	AEP	1.689	34.5	AEP Thermal TO Criteria	Rebuild approximately 1 mile section of the Kline-Virgil Street 34.5 kV line between Kline and Virgil Street tap. Replace MOAB switches at Beiger, risers at Kline, switches and bus at Virgil Street.
2014_2-2G	Upgrade	AEP	0.2	69	AEP Thermal TO Criteria	Rebuild approximately 0.1 miles of 69 kV line between Albion and Albion tap.
2014_2-2H	Upgrade	AEP	14.5	138	AEP Thermal TO Criteria	Fremont - Pound Rebuild as 138 kV
2014_2-2I	Upgrade	AEP	2.5	138	AEP Thermal TO Criteria	Freemont Station improvements: Replace MOAB towards Beaver Creek with 138kV breaker, Replace MOAB towards Clinch River with 138kV breaker, Replace 138kV breaker A with new bus-tie breaker. Reuse Breaker A as highside protection on transformer #1, Install two (2) circuit switchers on highside of transformers # 2 and 3 at Fremont Station
2014_2-2J	Upgrade	AEP	12.56	138	AEP Thermal TO Criteria	Install 138 kV breaker E2 at North Proctorville' Construct 2.5 Miles of 138 kV 1033 ACSR from East Huntington to Darrah 138 kV substations; Install breaker on new line exit at Darrah towards East Huntington; Instal 138 kV breaker on new line at East Huntington towards Darrah, Install 138 kV breaker at East Huntington towards North Proctorville
2014_2-2K	Greenfield	AEP	43.18	138	AEP Thermal TO Criteria; AEP Voltage TO Criteria	Boone Area Improvements: Purchase approximately a 200X300 station site near Slaughter Creek 46 kV station (Wilbur Station). Install 3 138 kV circuit breakers, Cabin Creek to Hernshaw 138 kV circuit: Construct one mile of double circuit 138 kV line with 1590 ACSS 54/19 conductor @ 482 Degree design temperature conductor and 1-159 12/7 ACSR and one 86 Sq.MM. 0.646" OPGW Static wires. Wilbur to Boone 138 and 46 kV double circuit: Construct 15.86 miles of 138 kV double circuit line using 1033 ACSR 54/7 conductor and 1-2#8 alumoweld and one 86 Sq.MM. 0.646" OPGW Static wires with one conductor side insulated at 138 kV and one side insulated at 69 kV. Connect 46 kV line insulated to 69 kV to Slauter Creek, Maxine, Peytona, Round Bottum and Boone Stations Boone Station: Add 138-69/46 kV 130 MVA Transformer and circuit switcher to Boone Station. Add 69 kV 40 kA 3000 amp circuit breaker operated at 46 kV.
2014_2-2L	Upgrade	AEP	31.65	138	AEP Thermal TO Criteria	Bellefonte Transformer Addition
2014_2-2M	Upgrade	AEP	26	138	AEP Thermal TO Criteria	Rebuild & Reconductor Kammer-George Washington 69kV circuit and George Washington-Moundsville Ckt #1, designed for 138kV. Upgrade limiting equipment at remote ends and at tap stations.
2014_2-2N	Upgrade	AEP	9.3	69	AEP Thermal TO Criteria	Convert Bane-Hammondsville from 23kV to 69kV operation. Due to a large load addition at Bane, the networked 23kV system is overloaded for normal and contingency conditions.
2014_2-2O	Upgrade	AEP	N/A	46	AEP Thermal TO Criteria	Pine Gap Relay Limit Increase
2014_2-2P	Upgrade	AEP	0.2	69	AEP Thermal TO Criteria	Richlands Relay Upgrade
2014_2-2Q	Upgrade	AEP	75.5	138	AEP Thermal TO Criteria	Belva - Clendenin Rebuild
2014_2-2R	Upgrade	AEP	57.5	138	AEP Thermal TO Criteria	Therofare - Ivydale Area Build
2014_2-2S	Upgrade	AEP	53	138	AEP Thermal TO Criteria	Therofare - Ivydale Area Build
2014_2-2T	Upgrade	AEP	11.3	138	AEP Thermal TO Criteria	Pax Branch - Scaraboro Rebuild as 138 kV
2014_2-2U	Greenfield	AEP	25.98	138	AEP Thermal TO Criteria; AEP Voltage TO Criteria	Skinfork Area improvements, including New 138/46 kV station near Skin Fork, 3.2 miles of 1033 ACSR double ckt from New Station to cut into Sundial-Baileysville 138 kV line, and other componenets
2014_2-2V	Upgrade	AEP	30	138	AEP Thermal TO Criteria	Rebuild existing West Bellaire-Glencoe 69 kV line with 138 kV & 69 kV circuits and install 138/69 kV transformer at Glencoe Switch.

Note that multiple projects may be needed to address all violations in a target zone

AEP Target Zone

AEP Target Zone continued

AEP Target Zone continued

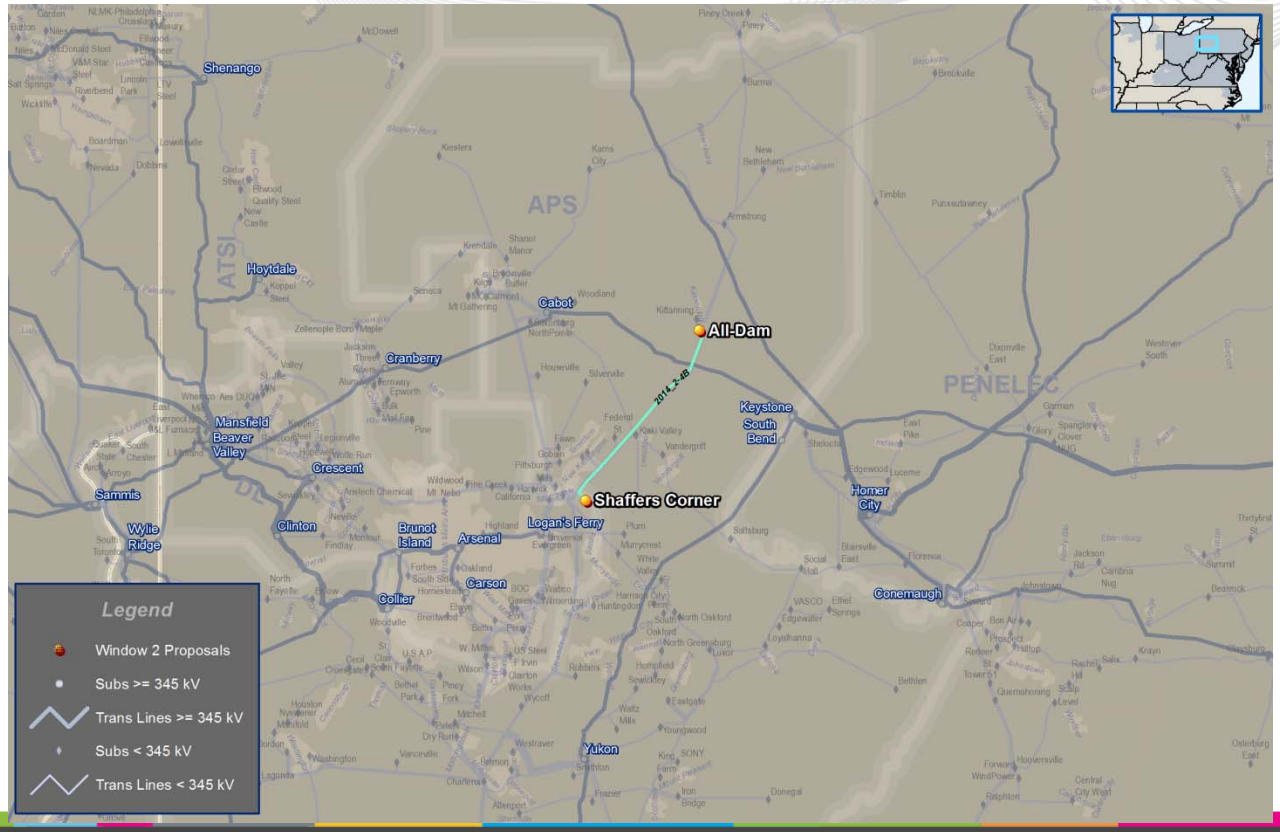


APS Target Zone

Project ID	Upgrade/Greenfield	Proposing Entity	Cost ($M)	kV Level	Analysis Type	Major Components
2014_2-4B	Upgrade	First Energy	0.93	138	N1-VM	Relocate All Dam 6 138 kV line and the 138 kV line to AE units 1&2. Install 138kV, 3000A bus-tie breaker in the open bus-tie position next to the Shaffers corner 138 kV line install a 6-pole manual switch, foundation, control cable, and all associated facilities

Note that multiple projects may be needed to address all violations in a target zone

APS Target Zone

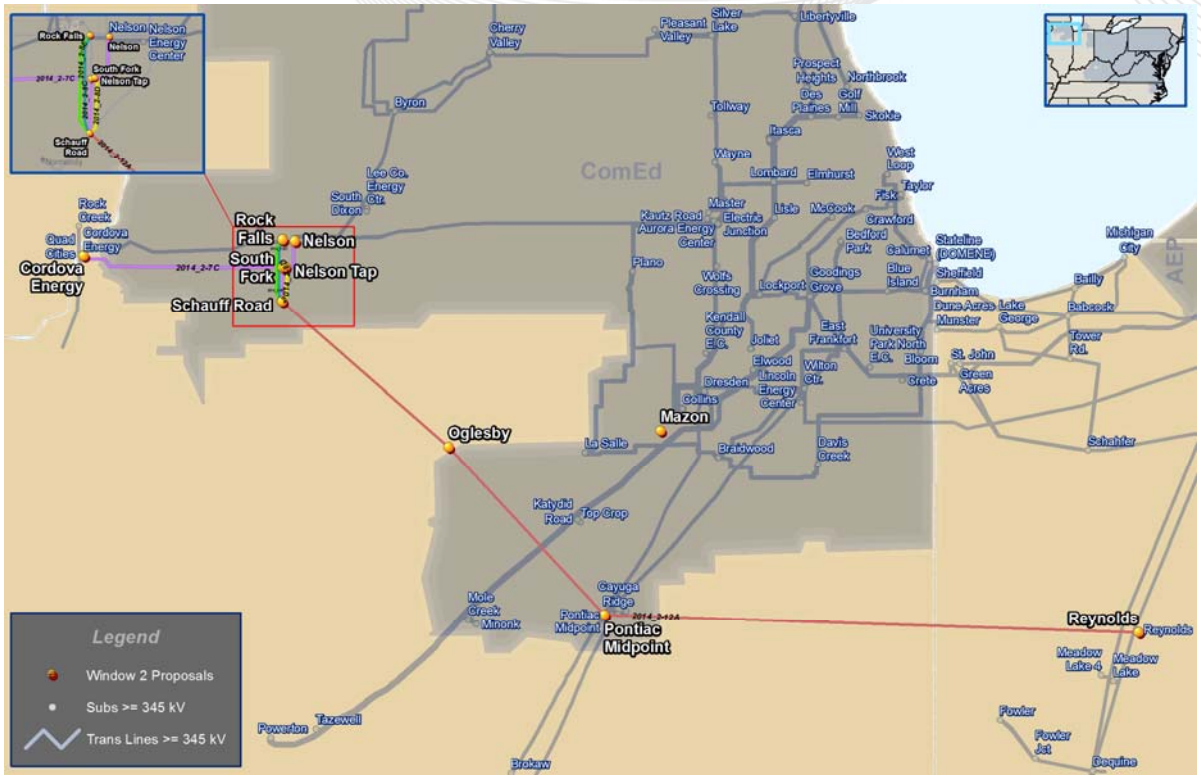


ComEd Target Zone

Project ID	Upgrade/Greenfield	Proposing Entity	Cost ($M)	kV Level	Analysis Type	Major Components
2014_2-12A	Greenfield	NIPSCO	450	345	LL	O09-Oglesby-Pontiac Single Circuit 345 kV and Pontiac-Reynolds Double Circuit 345
2014_2-8E	Greenfield	ComEd	16.1	138	LL	Install new 138 kV line from O29 (Schauff Road) to Rock Falls
2014_2-8D	Upgrade	ComEd	12.2	138	LL	Reconductor 12.3 miles of 138 kV line 15508 from O29 to Nelson tap
2014_2-8C	Upgrade	ComEd	10.5	138	LL	Reconductor 138 kV line 13311 from O9 to Rock Falls (assumes completion of N0610)
2014_2-8B	Upgrade	ComEd	0.53	138	LL	Station Upgrades at Rock Falls substation
2014_2-8A	Upgrade	ComEd	0.7	138	LL	Replace relays at Mazon substation
2014_2-7C	Greenfield	Northeast Transmission Development	33.7	345	LL	Approximately 5-mile 138 kV transmission line from Schauff Road 138 kV switching station to a new 345/138 kV substation on the Cordova-Nelson 345 kV Line ("South Fork").

Note that multiple projects may be needed to address all violations in a target zone

ComEd Target Zone

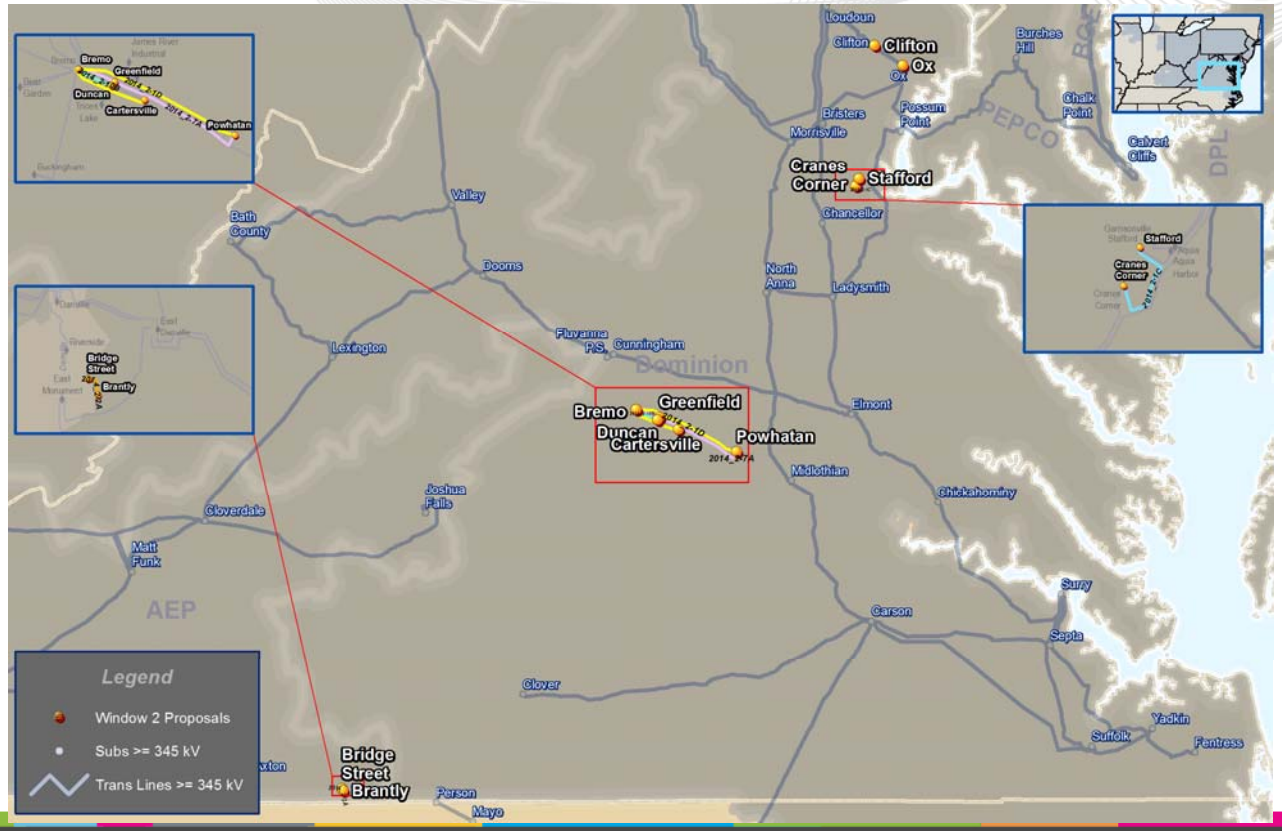


Dominion Target Zone

Project ID	Upgrade/Greenfield	Proposing Entity	Cost ($M)	kV Level	Analysis Type	Major Components
2014_2-1A	Upgrade	Dominion	7.25	500	Dominion Thermal TO Criteria	Install 500kV ring bus at Clifton Substation to remove Tx #2 from the 561 Line.
2014_2-1B	Upgrade	Dominion	1.24	500	Dominion Thermal TO Criteria	Install 500kV breaker at Ox Substation to remove Ox Tx #1 from H1T561 breaker failure outage.
2014_2-1C	Upgrade	Dominion	7.12	230	Dominion Thermal TO Criteria	Reconductor 7.63 miles of existing line between Cranes and Stafford and upgrade associated line switches at Stafford.
2014_2-1D	Upgrade	Dominion	1.67	230	Dominion Thermal TO Criteria	Winter loading on line #4 begins to exceed Dominion's 100 MW Radial Load Planning Criteria beginning in the 2018/19 time frame. Transfering existing distribution loads at both Bremo and Cartersville stations to adjacent 230kV lines reduces Line #4 loading below Dominion's 100MW Radial Line Planning Criteria
2014_2-10B	Greenfield	Nextera Energy Transmission	6.1	115	Dominion Thermal TO Criteria	Build a new 4.5 mile 115 kV line from Bremo Bluff to the four-way tap that serves the James River, Trices Lake, and Cartersville 115 kV substations. Reconfigure the four-way tap so that Trices Lake and Cartersville is served off of NEET's new line.
2014_2-10A	Greenfield	Nextera Energy Transmission	12.71	230	Dominion Thermal TO Criteria	Build a new Duncan 230/115 kV substation, tapping the existing Bremo Bluff - Powhatan 230 kV lines, and reconfiguring the 115 kV four-way tap serving James River, Trices Lake and Cartersville 115 kV substations.
2014_2-7A	Greenfield	Northeast Transmission Development	23	230	Dominion Thermal TO Criteria	Build 230/115 kV Substation (Cedar Plains) Interconnecting Bremo-Powhatan 230 kV Line to Bremo, James River, Cartersville, and Trices Lake 115 kV Lines

Note that multiple projects may be needed to address all violations in a target zone

Dominion Target Zone



EKPC Target Zone

Project ID	Upgrade/Greenfield	Proposing Entity	Cost ($M)	kV Level	Analysis Type	Major Components
2014_2-9D	Upgrade	EKPC	N/A	161	LL-V	Reduce voltage schedule at Cooper plant units by 2% under light load conditions.
2014_2-9C	Upgrade	EKPC	N/A	69	N2-VD	Switch on 69-kV capacitor banks (Charters, Peasticks, Hilda) in the Fleming-Mason area after first contingency.
2014_2-9B	Upgrade	EKPC	0.76	138	N1-VD	Decouple the double-circuited Spurlock - Maysville Industrial Tap 138-kV & Spurlock - Flemingsburg 138-kV line segments.
2014_2-9A	Upgrade	EKPC	1.29	161	EKPC Thermal TO Criteria	Upgrade the Bullitt County 161/69 kV transformer facility.

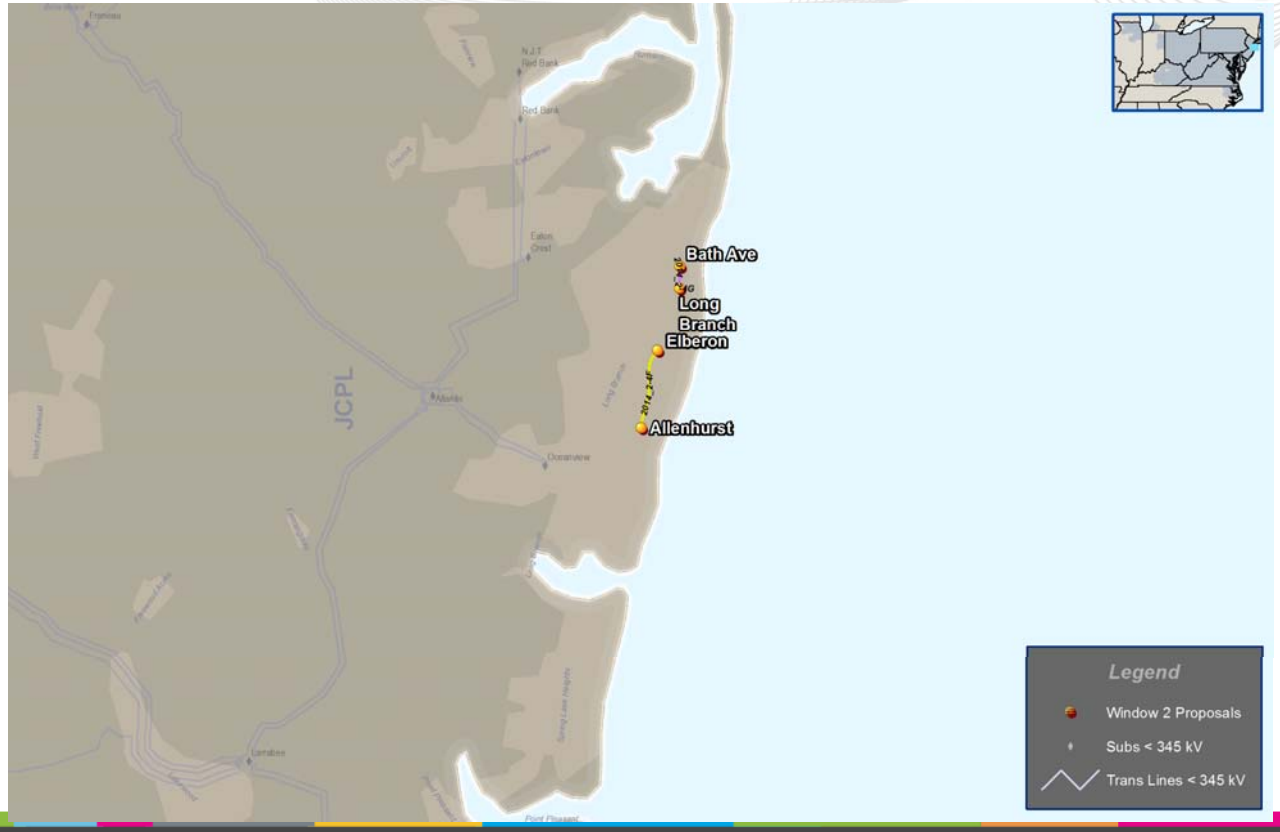
Note that multiple projects may be needed to address all violations in a target zone

EKPC Target Zone

JCPL Target Zone

Project ID	Upgrade/ Greenfield	Proposing Entity	Cost ($M)	kV Level	Analysis Type	Major Components
2014_2-4G	Upgrade	First Energy	1.3	34.5	JCPL Thermal TO Criteria	Reconductor/Replace the limiting facilities on both the Long Branch to Bath Avenue line section and the Allenhurst to Elberon line section.
2014_2-4F	Upgrade	First Energy	14.76	34.5	JCPL Thermal TO Criteria	Upgrade the V74 34.5 kV transmission line between Allenhurst and Elberon Substations.

JCPL Target Zone



Meted Target Zone

Project ID	Upgrade/ Greenfield	Proposing Entity	Cost ($M)	kV Level	Analysis Type	Major Components
2014_2-7B	Greenfield	Northeast Transmission Development	22	230	N2-VD	Approximately 2-mile 115 kV transmission line from Allen 115 kV switching station to a new 230/115 kV substation on the Cumberland-West Shore 230 kV Line ("Dogwood Run").
2014_2-4E	Greenfield	First Energy	19.33	230	N2-VD	Expand the existing Allen substation: The Allen substation and remote terminal work is an upgrade to existing facilities. Expansion of Existing Facilities - Scope of work: Install a 230kV and 115kV ring bus at Allen substation; Install a 224 MVA 230/115 kV Transformer; Upgrade relays at PPGI 115 kV (Allen Terminal); Upgrade relays at Roundtop 115 kV (Allen Terminal) Greenfield - Scope of work: - Loop the PPL Cumberland-West Shore 230 kV line into Allen Substation (~2 miles)
2014_2-4D	Upgrade	First Energy	0.96	115	N2-VD	Install a 28.8 MVAR 115 kV capacitor at the Mountain substation. Capacitor should be on pre-contingency.
2014_2-4C	Upgrade	First Energy	0.98	115	N2-VD, N2-VM	Install a 36.6 MVAR 115kV capacitor at North Bangor substation. Capacitor should be on pre-contingency
2014_2-3A	Greenfield	Transource	16.13	230	N2-VD; N2-VM	Cumberland Tap Project includes approximately two miles of new double circuit 115 kV line which will cut into the existing Allen – Roundtop 115 kV and connect it to a new 230/115 kV station. The new station will also cut into the Cumberland – West Shore 230 kV line, creating a new 230 kV source into the 115 kV system. Two 230 kV breakers and two 115 kV breakers will be added at the new station, along with a new 230/115 kV 300 MVA transformer.

Note that multiple projects may be needed to address all violations in a target zone

Meted Target Zone

Penelec Target Zone

Project ID	Upgrade/ Greenfield	Proposing Entity	Cost ($M)	kV Level	Analysis Type	Major Components
2014_2-4A	Upgrade	First Energy	5.53	345	Light Load - Voltage	Pierce Brook Substation (Formerly Farmers Valley):Install a 125 MVAR 345kV shunt reactor; Install a 345 kV shunt reactor breaker; Install a 345kV breaker to create a 4 breaker 345kV ring bus

Note that multiple projects may be needed to address all violations in a target zone

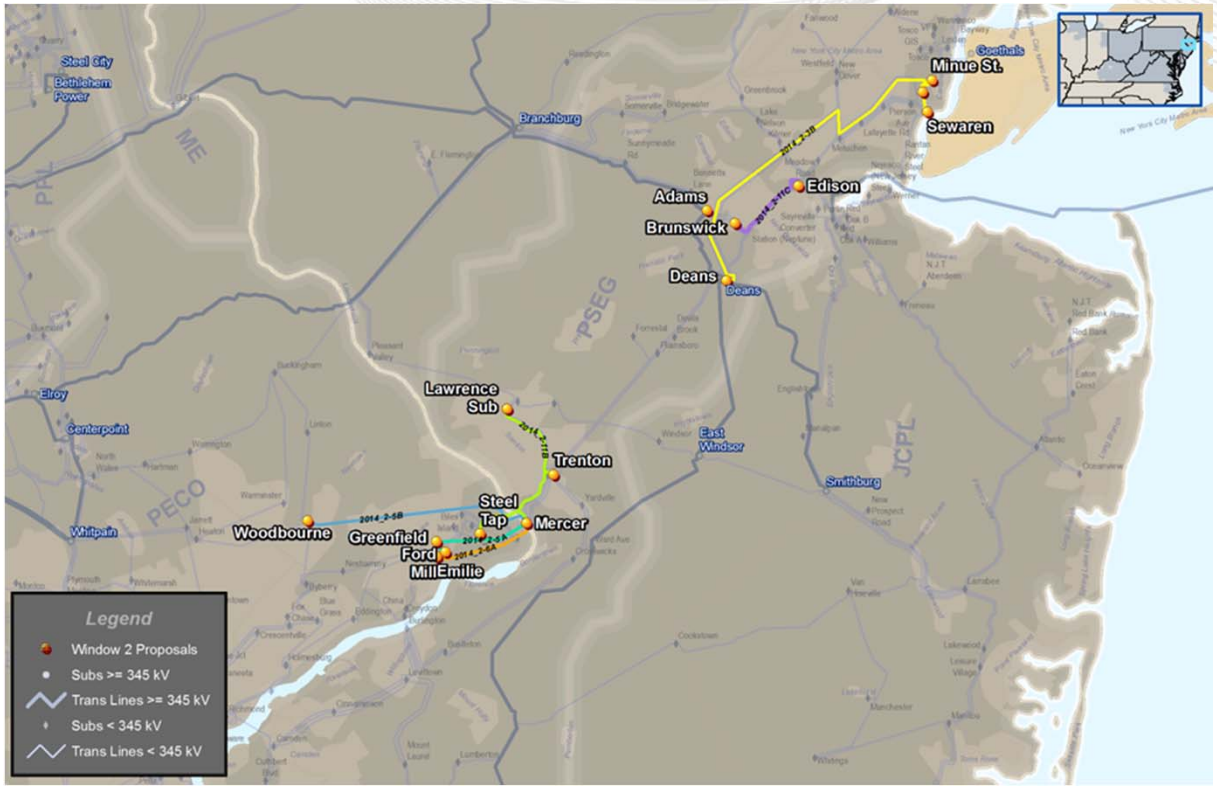
Penelec Target Zone

PSE&G Target Zone

Project ID	Upgrade/ Greenfield	Proposing Entity	Cost ($M)	kV Level	Analysis Type	Major Components
2014_2-11F	Upgrade	PSEG	13.4	230	LL-V	Install 230 kV Reactors at Mercer and Lawrence
2014_2-11E	Upgrade	PSEG	7.2	230	LL-V	Install 230 kV Reactors at Lawrence
2014_2-11D	Upgrade	PSEG	7.2	230	LL-V	Install 230 kV Reactors and Mercer
2014_2-11C	Upgrade	PSEG	71	230	N2-VD	Convert two 138kV lines from Edison to Brunswick to one 230kV line from Edison to Brunswick
2014_2-11B	Upgrade	PSEG	47	230	LL-V	Terminate existing US Steel to Trenton 138 kV at Mercer, and use the old position of the US Steel to Trenton line to create a Mercer to Lawrence 230kV line
2014_2-11A	Upgrade	PSEG	8.4	230	N2-VD	Add 230 kV Capacitor at Sewaren Switching Station
2014_2-5B	Greenfield	PECO	35.5	230	Light Load - Voltage	Build new 230 kV transmission line connecting Mercer and Woodbourne substations
2014_2-5A	Greenfield	PECO	20.5	230	Light Load - Voltage	Build new 230 kV substation and transmission line connecting Mercer and 230 kV line from Emilie to Ford Mill
2014_2-3B	Greenfield	Transource	13.6	230	N2-VD	Tie together the Sewaren – Minue St Adams 230 kV line and the Minue St Adams – Deans 230 kV line at a new station location that is adjacent to the existing line cooridor. The new station to tie these lines together will be built as a breaker-and-a-half station with six 230 kV breakers and four line exits: one to Sewaren, one to Deans (via Pierson Avenue), and two to Linden via Minue St Adams.
2014_2-6A	Greenfield	ITC Mid Atlantic	56-97	230	Light Load - Voltage	Build a new 230 kV line from Mercer (PSEG) to Emilie (PECO).

Note that multiple projects may be needed to address all violations in a target zone

PSE&G Target Zone



2014 RTEP Proposal Window 3 (Long Term Window)

2014 RTEP Proposal Window 3

- Reliability
- Market Efficiency

Supplemental Projects

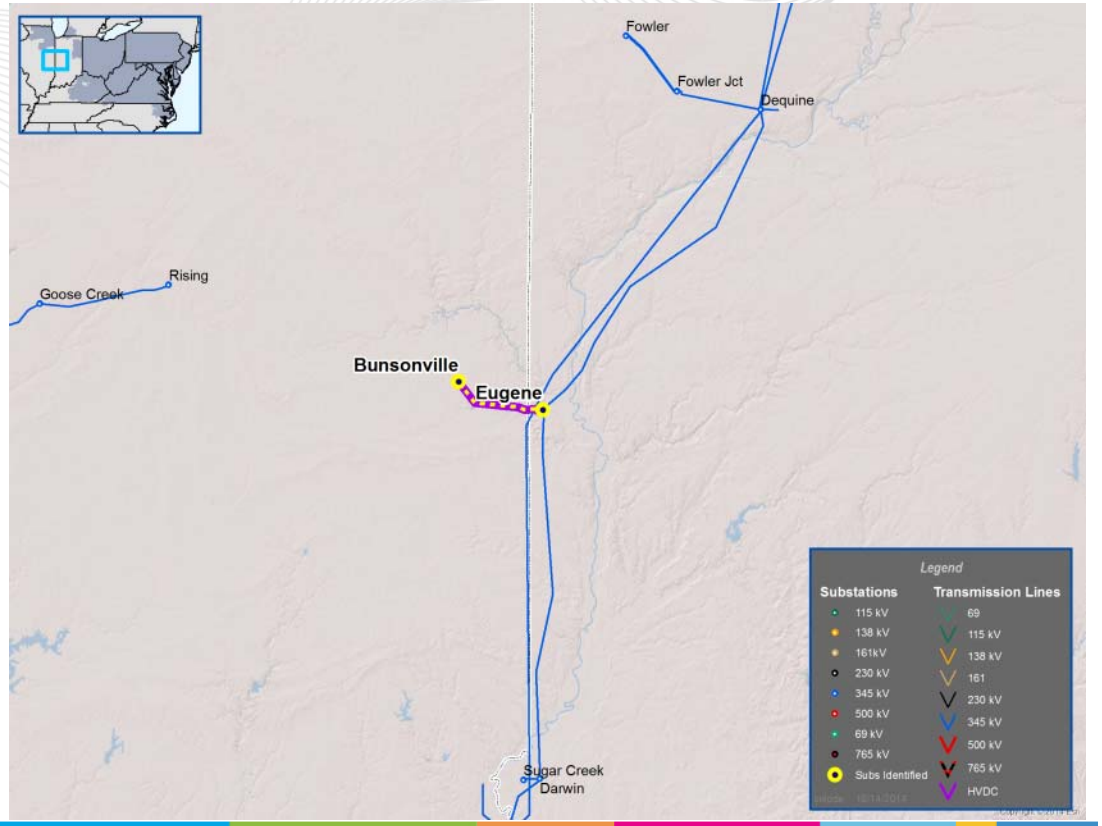
AEP Transmission Zone

- Supplemental Project

- Rebuild AEP's portion (less than 2 miles) of Bunsonville - Eugene 345 kV tie line with Ameren (S0855)

- Estimated Project Cost: $3M

- Projected IS Date: 12/1/2015

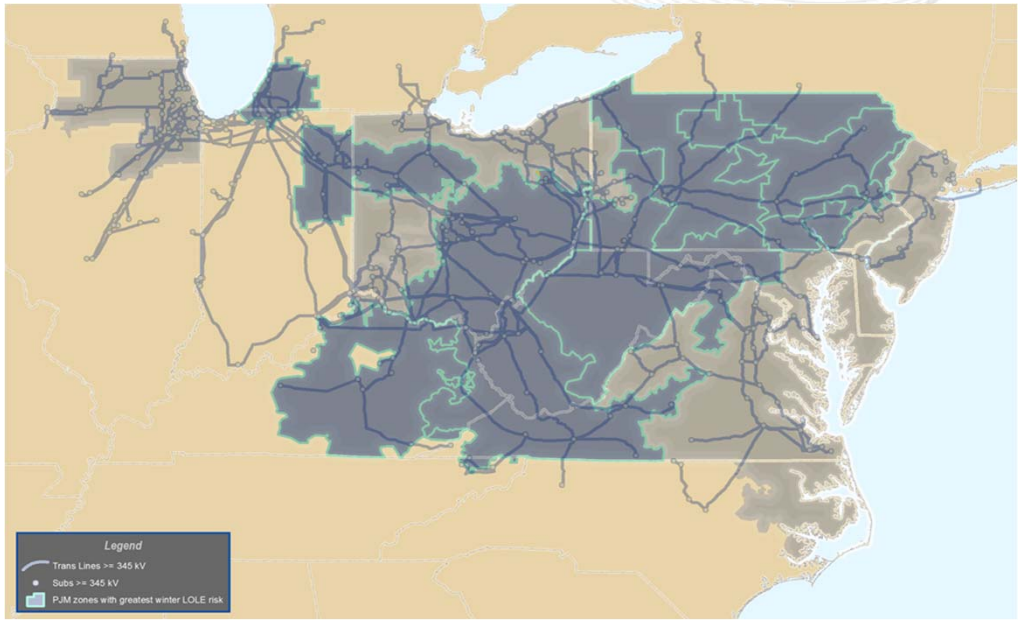


Winter Peak Study Update

Progressive Approach – Anticipated 2019 System

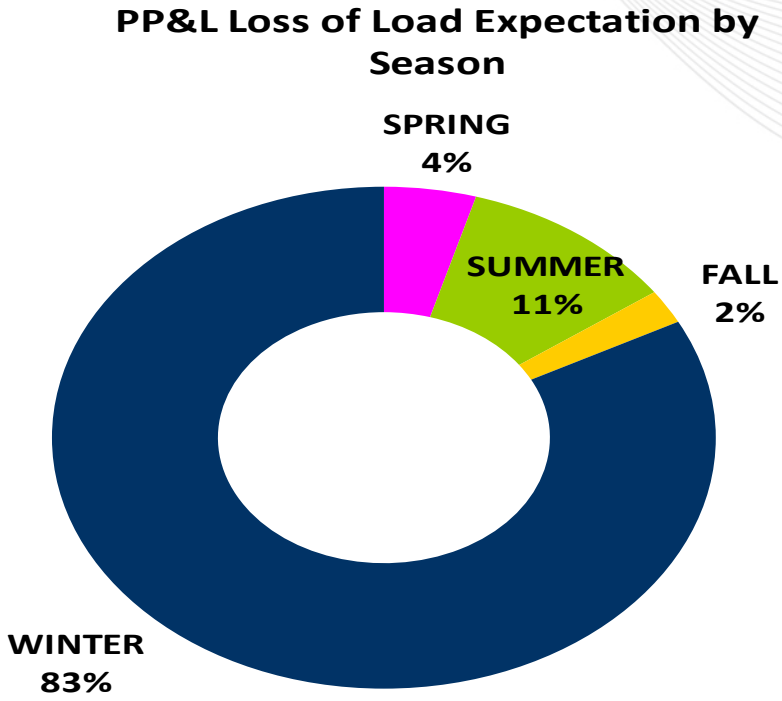
- Stressed the winter risk LDAs
  - Gas scenario generation outages
  - No transmission issues
- Targeted Specific LDAs
  - Gas scenario generation outages
  - PSE&G North, PSE&G, EMAAC, SWMAAC
    - Feedback from PJM Operations
  - 90/10 load in all of PJM
  - No transmission issues
- Polar vortex scenario
    - 90/10 load
    - Gas scenario generation outages
  - Internal TO zone interchanges
    - All 27 LDAs
  - Interface interchange
  - No major transmission issues

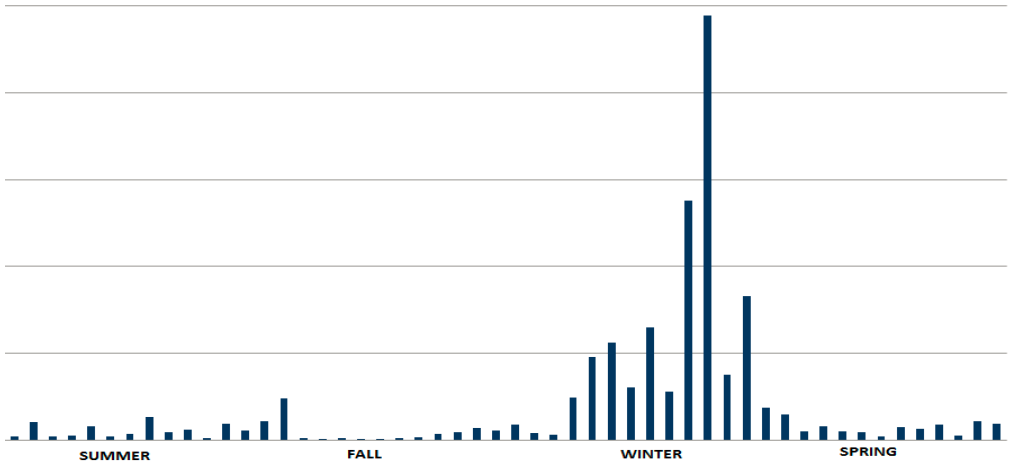
Loss of Load Expectation by PJM Zone



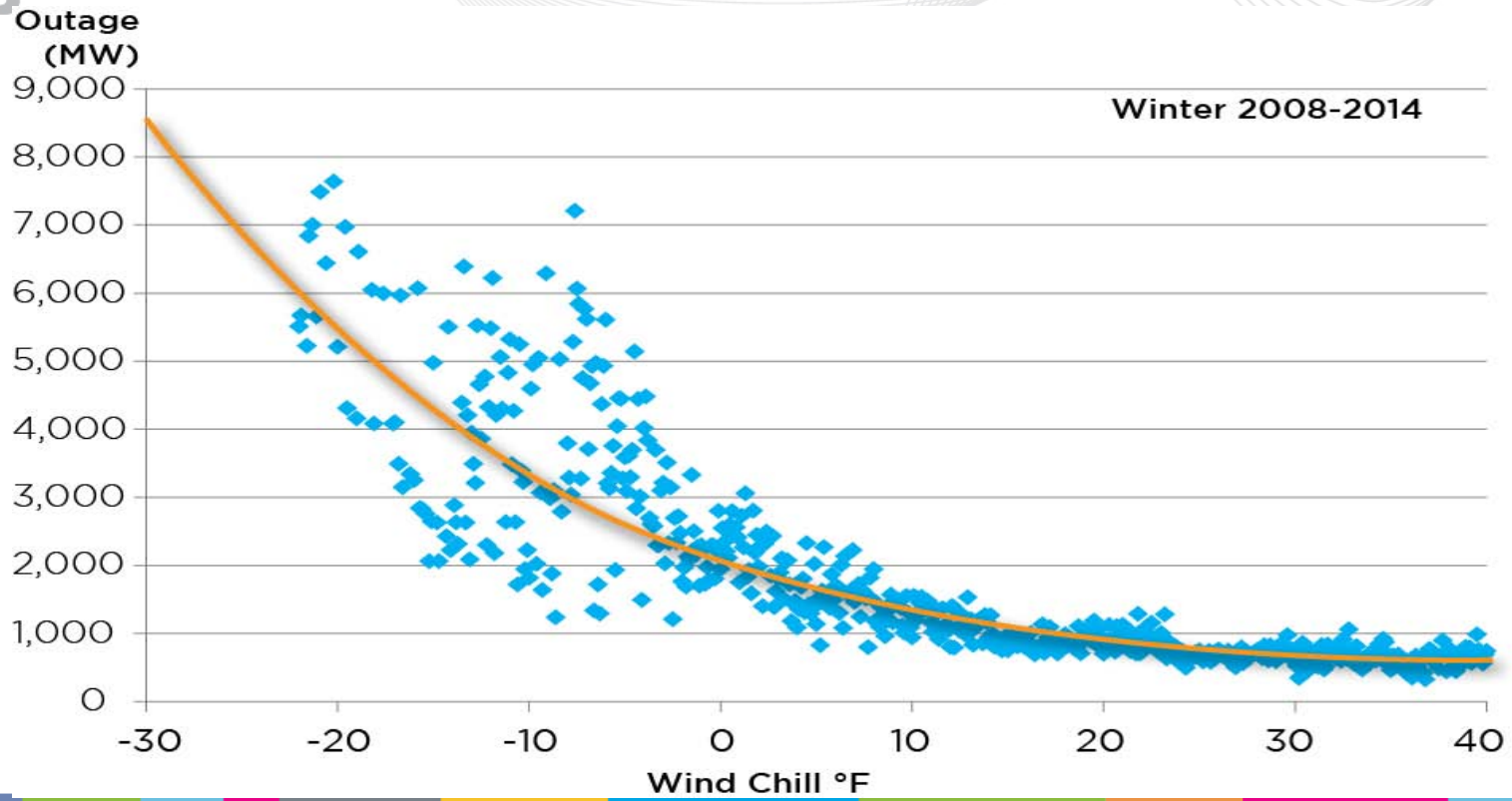
LDA	Share LOLE Winter
APS	92%
EKPC	88%
PP&L	83%
AEP	66%
WPJMMA	64%
PN	62%
METED	39%
DAY	26%
DQE	26%
BGE	10%
DOM	10%
ATSI	7%
CL	5%
DPL	5%
SPJMMA	3%
PEPCO	2%
DPLS	1%
AE	0%
COMED	0%
DUKE	0%
JCPL	0%
PECO	0%
PS	0%
PSN	0%
EPJMMA	0%
PJMWEST	0%
PJMMA	0%

Loss of Load Expectation Example: PP&L





Wind Chill vs. Forced Outage – ComEd Zone



Three Natural Gas Scenarios

Consider three different at-risk gas unit outage scenarios

- **Scenario A** – Chronically Curtailed – 7,100 MW of Gas Out
  - Chronically curtailed gas units (units that have had a minimum 12 hours per year of gas curtailments for the winters 2007- 2012; future gas interconnection projects with completed ISA that will reside on gas LDC similar to existing chronically curtailed units.

- **Scenario B** – Curtailed in last 7 years – 16,500 MW of Gas Out
  - Includes all Scenario A outages plus CTs that have had at least one curtailment in the last 7 years and gas interconnection projects with a completed ISA that are deemed as high risk due to proven record of gas curtailments on the respective gas pipeline or LDC.

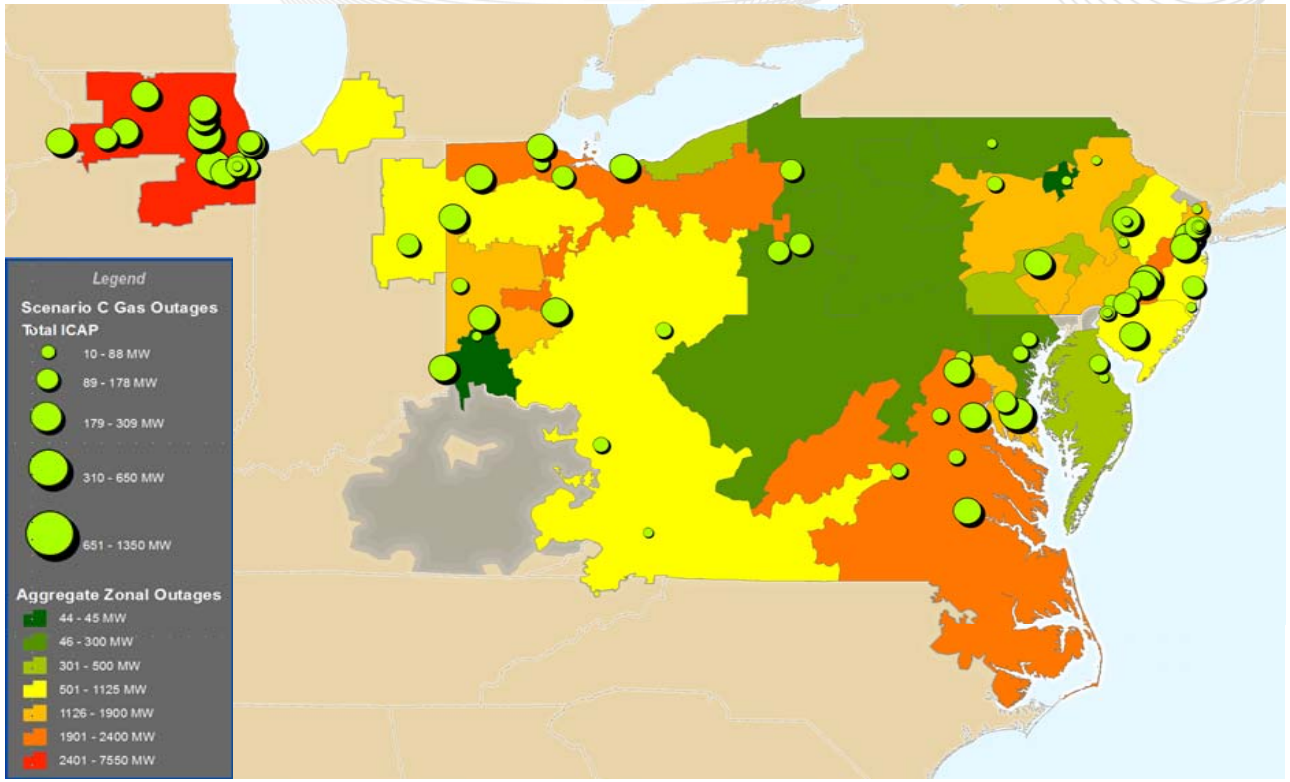
- **Scenario C** – Curtailed plus all future ISA gas – 25,700 MW of Gas Out
  - Includes all Scenario B outages plus all gas interconnection projects with a completed ISA.

Generation Outage Assumptions

- Scenario C – 25,700 MW gas out
- Distribution by PJM Transmission Zone
- Overall 19% of PJM Installed Capacity

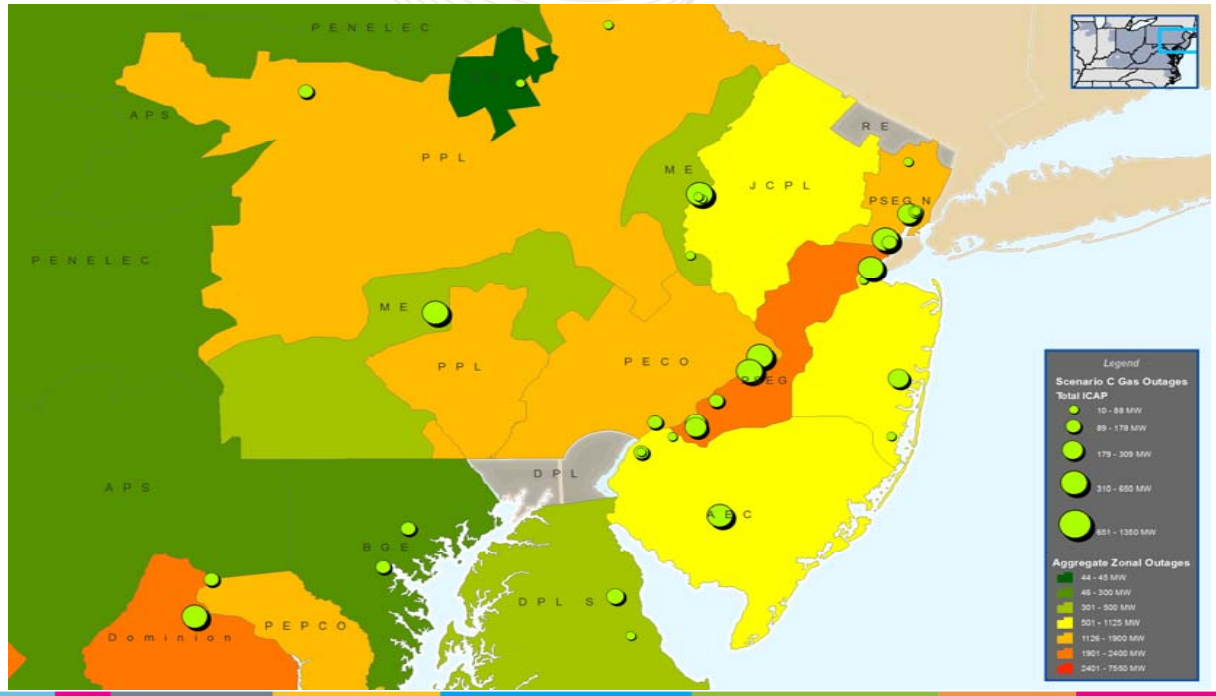
LDA	Basecase ICAP	Gas MW Out	Additional MW Out	Total MW Out	Total Outages/ICAP
AE	2,390	845	107	952	40%
AEP	27,790	1,733	2,241	3,974	14%
APS	8,120	220	648	868	11%
ATSI	11,470	1,942	581	2,523	22%
BGE	3,770	240	251	491	13%
CL	2,580	422	192	614	24%
COMED	26,620	7,519	630	8,149	31%
DAY	4,480	1,133	388	1,521	34%
DOM	26,720	1,947	1,239	3,186	12%
DPL	3,990	369	272	641	16%
DPLS	1,730	369	109	478	28%
DQE	2,750	294	113	407	15%
DUKE	4,020	44	517	561	14%
EKPC	2,600	0	177	177	7%
JCPL	3,810	1,099	163	1,262	33%
METED	2,690	440	155	595	22%
PECO	7,420	1,149	207	1,356	18%
PEPCO	3,840	1,557	233	1,790	47%
PLGRP	9,560	1,457	405	1,862	19%
PN	4,770	287	327	614	13%
PS	6,660	2,370	257	2,627	39%
PSN	4,200	1,863	166	2,029	48%
EPJMMA	32,630	6,487	1,098	7,585	23%
SPJMMA	9,330	1,797	490	2,287	25%
WPJMMA	23,740	2,645	1,160	3,805	16%
PJMWEST	87,850	12,885	5,173	18,058	21%
PJMMA	65,700	10,929	2,739	13,668	21%
Total	180,270	25,761	9,150	34,911	19%

Winter Study Scenario C Gas Outages By PJM Zone



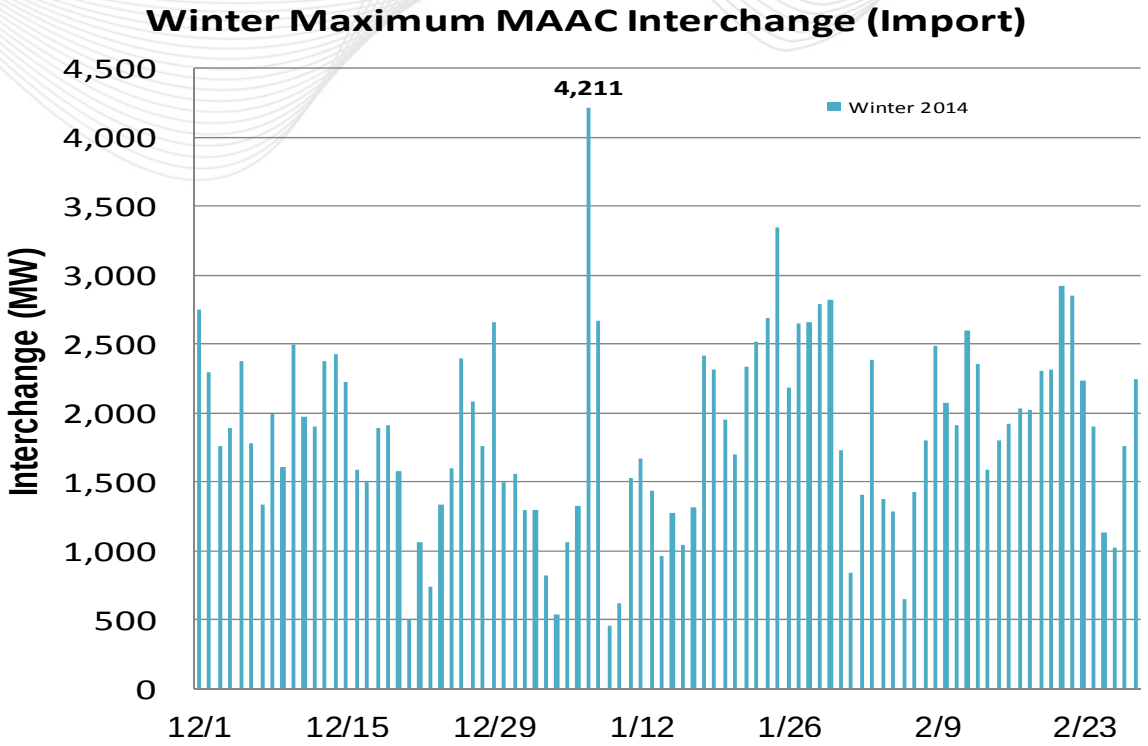
PSE&G North Scenario – All Generation Outaged

All generation of every fuel type in the PSE&G North zone was outaged (approximately 1600 MW)



PJM Winter 2014 Interchange

- Daily 2013/14 MAAC Winter Interchange Maximum (Import)
- Significant imports on 1/7/2014 during the Polar Vortex
- Modeling of operational conditions in Planning



Planning Simulations

- Scenario C – 25,700 MW gas out
- Set initial Conditions to observed Polar Vortex conditions
- CETL Analysis
  - Exceeded 1/7/2014 Observations

LDA	Operations	PLANNING					
	Polar Vortex Observation	CETO		CETL Polar Vortex Simulation			
	1/7/2014 OPS Case	Scenario C CETO Studies	90/10 Scenario C Polar Vortex Study	90/10 Scenario C CETL Studies			
				EMAAC	PSEG	PS North	SWMAAC
AE	847		850	978			
AEP	-1258	4890	-1257				
APS	2224	4100	2228				
ATSI	2248		2248				
BGE	3475		3475				4387
CL							
COMED	-3007		-3007				
DAY	627		624				
DOM	60		55				
DPL	1443		1442	1518			
DPLS	1202		1202				
DQE	934		937				
DUKE	1949		1950				
EKPC	39	440	43				
JCPL	2190		97	2575			
METED	634	1770	635				
PECO	2001		2000	3536			
PEPCO	2385		2385				4641
PLGRP	1834	2460	1835				
PN	78	890	79				
PS	4454		4450	4633	6700		
PSN	1845		1844			2507	
EPJMMA	3503		3500	8400			
SPJMMA	4014		4019				8053
WPJMMA	-3340	-2450	-3339				
PJMWEST	3756		3763				
PJMMA	4177		4181	7167			
PJM RTO	7992		8000				

Observations

- Transmission system robustness
  - Transmission system issues not expected with the transmission system as planned

- Supply / Adequacy

Artificial Island Update

12/9/2014 Artificial Island TEAC Meeting

- PJM is soliciting comments from stakeholders on the proposals under consideration
  - Stakeholders are encouraged to send their comments to RTEP@pjm.com
- Presentations from proposing entities
  - Transource Presentation
  - Dominion High Voltage MidAtlantic (DHVM) Presentation
    LS Power Presentation
  - PSE&G Presentation

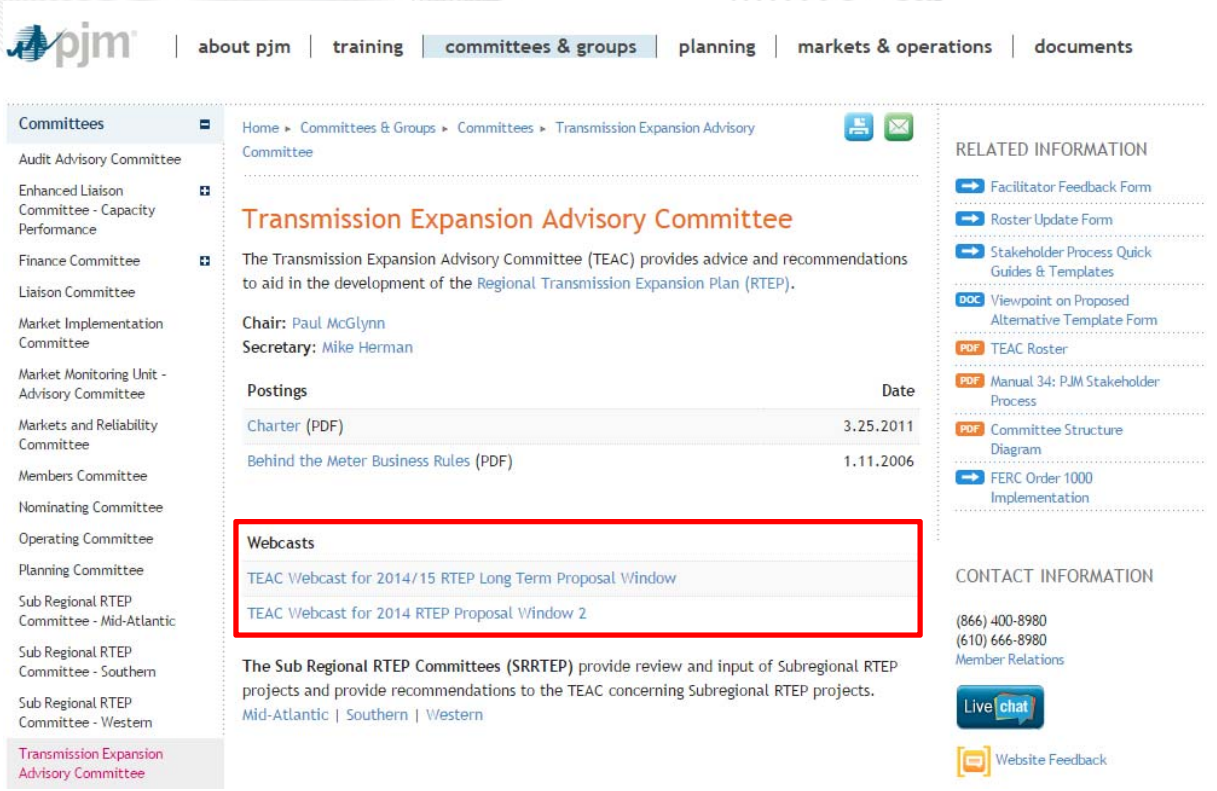
Artificial Island Next Steps

- December 9th, 2015 Artificial Island TEAC
  - Review of presentations from finalists, Q&A
- January 8th, 2015 TEAC
  - Recommend Artificial Island solution to the PJM TEAC
- February 2015 PJM Board
  - Recommend Artificial Island solution to the PJM Board

TEAC Webcasts

TEAC Webcasts

- PowerPoint slide presentation format with voice
- Email notification to the PJM TEAC list
- Posted to the PJM TEAC page on PJM.com
  - http://www.pjm.com/committees-and-groups/committees/teac.aspx



RTEP Next Steps

RTEP Next Steps

- 12/9/2014 Artificial Island TEAC Meeting
- Continue to discuss 2015 RTEP Assumptions
- Discuss 2015 RTEP Scenario Studies
- Continue to evaluate and recommend solutions for RTEP Proposal Window #2

Questions?

Email: RTEP@pjm.com

- Revision History
  - Version 1: Original version posted to the PJM TEAC on 12/3/2014