



Transmission Expansion Advisory Committee

February 12, 2015



Interregional Planning Update

- 2025 summer and winter scenario build
 - Initial SSMLFWG kickoff – February 4
 - Modeling begins March
 - Target complete models late summer
- Ground work for production cost studies
 - February 17th task force call
 - Information for March 11 TC discussion
 - July 9th TC targeted for recommendation

- **NC Utility Commission study**
 - Examine PJM Annual 2016/17 Base Residual Auction External Resources
 - Potential Reliability and Economic Effects on North Carolina
 - Final draft report posted – provide any comments to the RTEP email

- BRA reliability impacts PJM observations:
 - PJM external auction units not the cause of North Carolina reliability issues
 - 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 – extremely small change in production cost

- PJM will continue to enhance coordinated planning with North Carolina
 - Improve data exchange
 - Implement enhanced Order No. 1000 planning
- PJM and North Carolina coordinated operations
 - March 18 meeting at Charlotte, NC
 - NC operational readiness

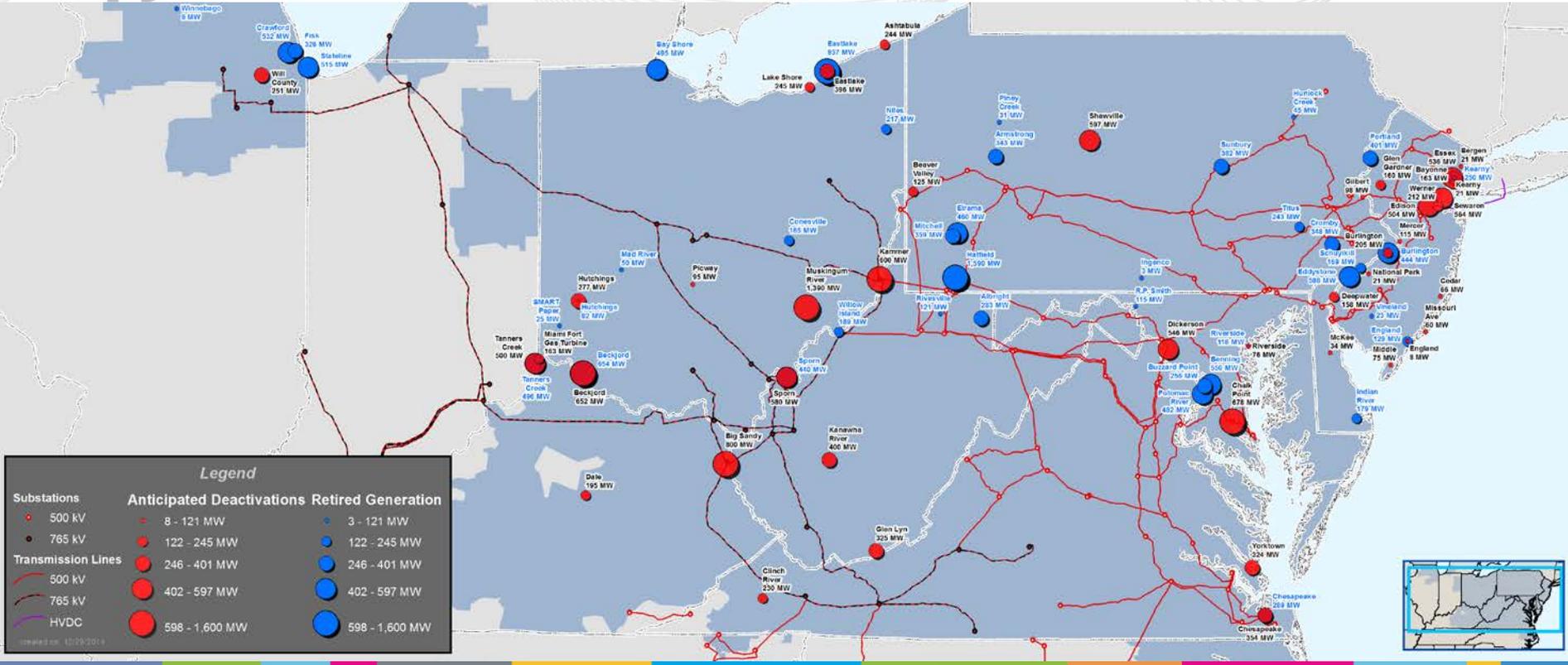


Interregional Planning Studies (not including JCM)

- **PJM/MISO IPSAC**
 - Order No. 1000 Interregional Compliance
 - June 16, 2015
 - IPSAC reviews March-May timeframe
 - “Quick hit” study – M2M congestion 2013-2014
 - PJM list of top 30
 - MISO list of top 16 (7 overlap with PJM)
 - Review of congestion cause and remedy is underway
 - Currently evaluating which limits may have potential for quick hit upgrade
 - IPSAC reviews target start in March
 - Targeted completion end 2nd quarter 2015

- “Quick Hit” reviews
 - Ability to implement in near term
 - Apparent economic or operational performance drivers
 - Evaluations of remedies considered:
 - Reliability analysis
 - Market efficiency beneficiaries
- Potential longer term focus area – Michigan interface
- Metric and Process review restart 3rd quarter
- SERTP compliance filing under review

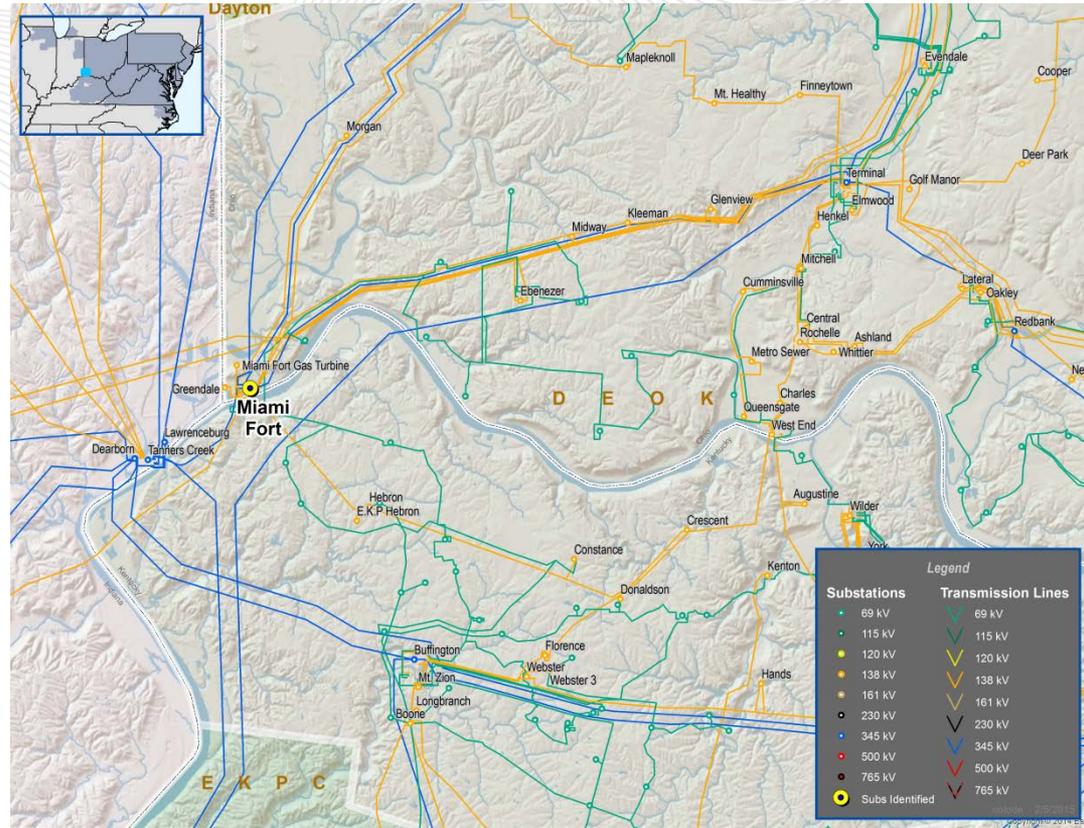
Generation Deactivation Notification (Retirements) Update



Unit(s)	Transmission Zone	Requested Deactivation Date	PJM Reliability Status
Miami Fort Unit 6 (163 MWs)	DEOK	6/1/2015	Reliability analysis complete.
Lake Kingman units A and B	DVP	05/31/2015	Reliability analysis underway.

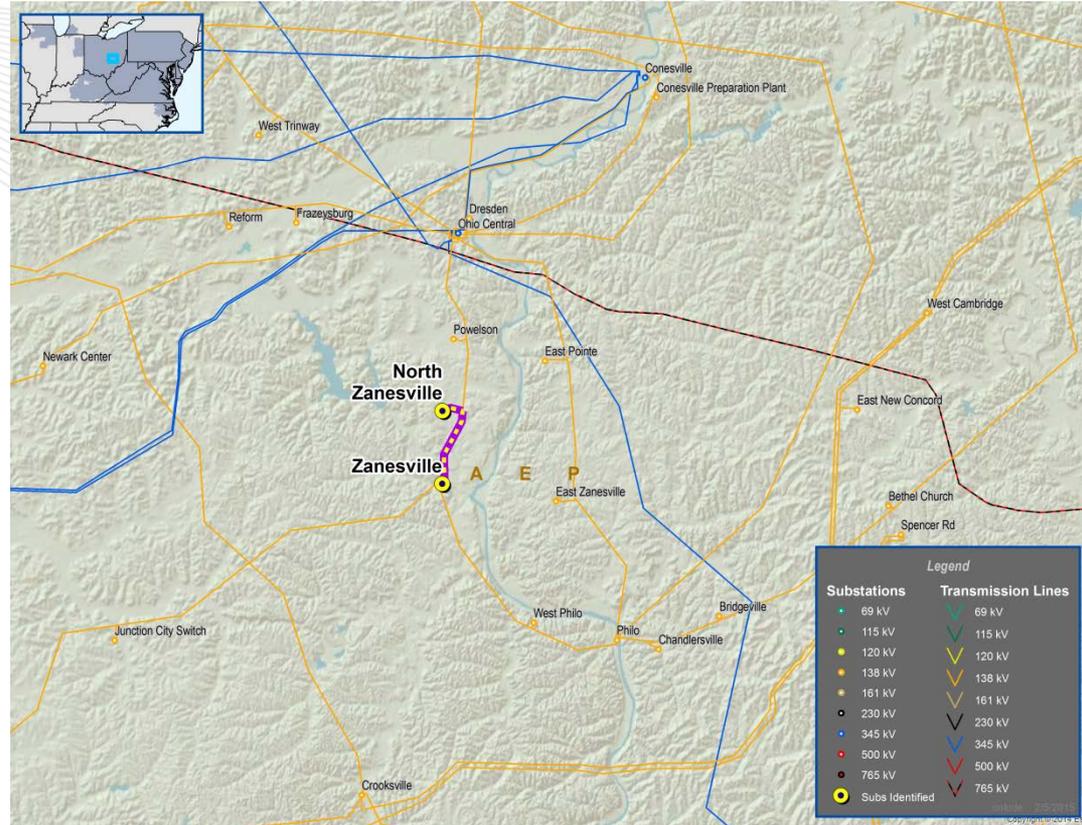
Miami Fort Unit 6

- DEOK Transmission Zone
- 163 MW
- Deactivation date: 05/1/2015





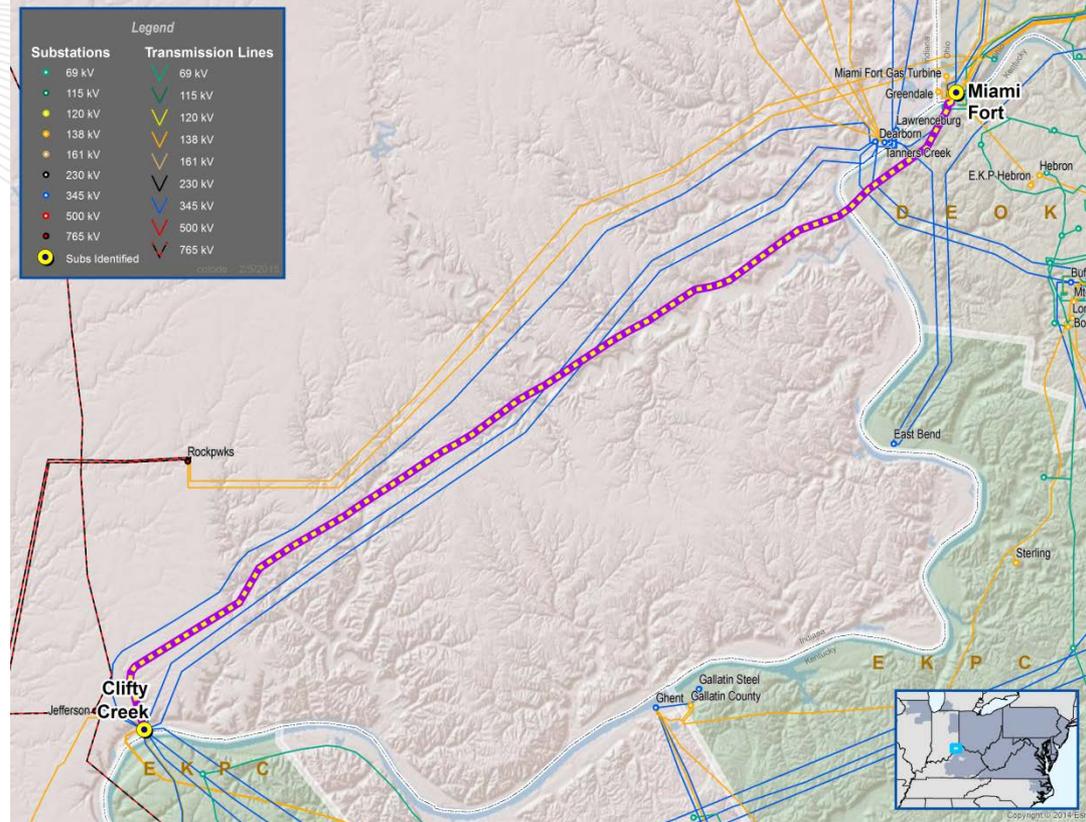
AEP Transmission Zone



- N-1-1 Violation due to the Miami Fort Unit 6 deactivation notification
- The North Zanesville – Zanesville 138 kV line is overloaded for the loss of Ohio Central to East Point to East Zanesville 138 kV line, Philo to East Zanesville 138 kV line, East Zanesville 138/69 kV transformers 1 and 2, East Point 138/12 kV transformer and East Zanesville – Oakland 69 kV line ('5163_B2_TOR739_WOMOAB').
- Proposed Upgrade: Build an Ohio Central 138 kV loop
- Construction Designation: AEP (the local Transmission Owner)
- Cost estimate: \$4.5 M
- Required IS date: 6/1/2015 (immediate need)

DEOK Transmission Zone

- N-1-1 Violation due to the deactivation notification of Miami Fort Unit 6
- The Clifty-Miami Fort 138 kV line is overloaded for the loss of Miami Fort-Glendale 138 kV line ('B2 MIAMI FORT-GRENDALE 1681') followed by the loss off Miami Fort-Tanner 138 kV line and Miami Fort transformers 9 and 10 ('B3 MIAMI FORT 345/138 TB9/TB10').
- Proposed Upgrade: Fix the 'B3 MIAMI FORT 345/138 TB9/TB10' contingency through station reconfiguration
- Required IS date: 6/1/2015 (immediate need):
- Expected IS date: 05/2017
- Construction Designation: DEOK (the local Transmission Owner)
- Interim Solution: The operating procedure is to open Clifty to Miami Fort 138 kV branch and to open the tie 251579 08HEBRON to 341726 2HEBRON after the first contingency.





Byron, Quad Cities and Clinton Deactivation Scenario Study



Generation Information

- Byron Nuclear Units 1 and 2
 - ComEd Transmission Zone
 - Unit 1: 1168.5 MW
 - Unit 2: 1142.0 MW
 - Deactivation date: 06/01/2019
- Quad Cities Nuclear Units 1 and 2
 - ComEd Transmission Zone
 - Unit 1: 964.0 MW
 - Unit 2: 964.0 MW
 - Deactivation date: 06/01/2019
- Clinton Nuclear Unit
 - AMIL Transmission Zone
 - 1099.0 MW
 - Deactivation date: 06/01/2019



Thermal Circuit Violations

Transmission Owner Zone	138kV	345kV
ATSI	1	0
AEP	5	2
AEP/AMIL	0	1
AEP/NIPSCO	0	1
ComEd	13	6
ComEd/AMIL	0	1

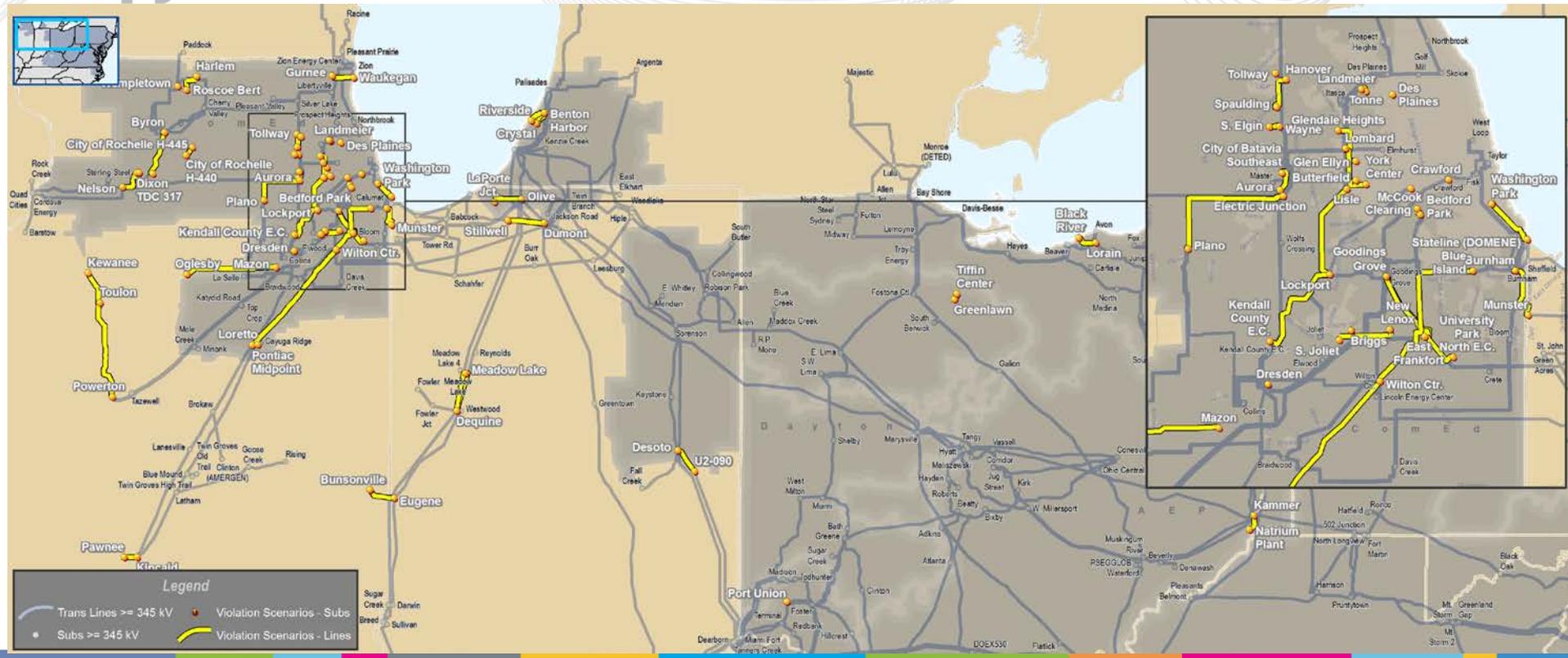


Thermal Transformer Violations

Transmission Owner	345/138kV	345/138/34.5kV	138/138kV Phase Angle Regulator
AEP	1	0	0
ComEd	8	1	8



Thermal Violations

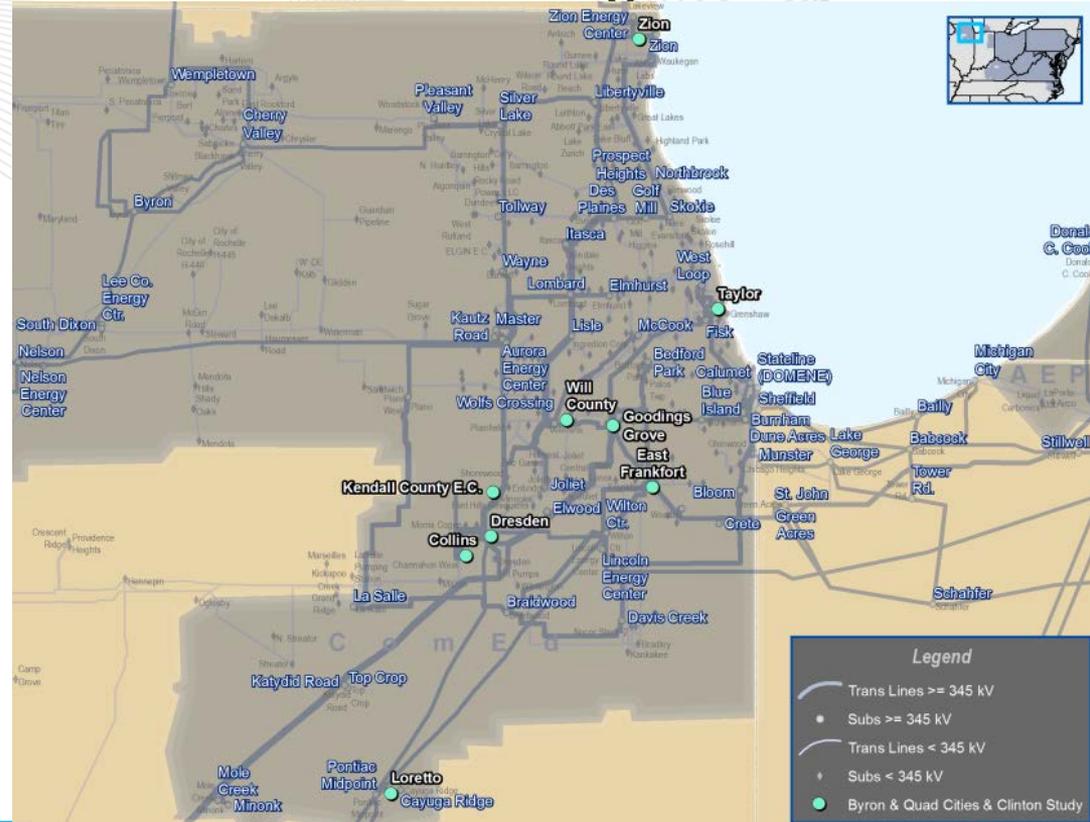




Voltage Violations

- Several voltage collapse violations have been identified in the Load deliverability voltage study for ComEd and PJM West LDAs.
- Scenario Analysis Potential Solutions:
 - Install 200 MVAR capacitor at Collins 345 kV substation
 - 600 MVAR capacitor at Loretto 345 kV substation
 - 200 MVAR capacitor at Dresden 345 kV substation
 - 150 MVAR capacitor at East Frankfort 345 kV substation
 - 150 MVAR at Goodings Grove 345 kV substation
 - 100 MVAR capacitor at Will County 3U 20 kV substation
 - 50 MVAR capacitor at Kendall 345 kV substation
 - 100 MVAR capacitor at Zion 18 kV substation
 - 200 MVAR capacitor at Taylor 138 kV substation
 - 500 MVAR capacitor at Wilton 345 kV substation
 - 500 MVAR SVC at Wilton 765 kV substation

* Note that these upgrades were developed by PJM for this scenario study and are not recommended at this time





Appendix

(Potential violations outside of PJM)



NIPSCo Transmission Zone

- The Aetna Substation - PRAXAIR-3 LAKE SIDE ckt 1 138 kV line is overloaded for the GD test for the tower contingency '630'. The overload on this line was also identified for the N-1 test.
 - Scenario Analysis Potential Solution: Reconductor 7.41 miles of the line.
 - Cost: \$11.12M.
 - Required IS Date: 6/1/2019
- The Miller Substation - US STEEL-TIN MILL ckt 1 138 kV line is overloaded for the GD test for the tower contingency '630'. The overload on this line was also identified for the N-1 test.
 - Scenario Analysis Potential Solution: Reconductor 4.87 miles of the line.
 - Cost: \$7.31M.
 - Required IS Date: 6/1/2019
- The LAKE GEORGE - MUNSTER ckt 1 345 kV line is overloaded for the LD test for the Single contingency '695_B2'.
 - Scenario Analysis Potential Solution: Reconductor 18.15 miles of the line.
 - Cost: \$36.29M.
 - Required IS Date: 6/1/2019
- The Aetna Substation - US STEEL-WEST MILL ckt 1 138 kV line is overloaded for the N-1 test for the Tower contingency 630. The overload on this line was also identified for the GD test.
 - Scenario Analysis Potential Solution: Reconductor 3.82 miles of the line.
 - Cost: \$5.73M.
 - Required IS Date: 6/1/2019
- The Miller Substation - US STEEL-COKE PLANT ckt 1 138 kV line is overloaded for the N-1 test for the Tower contingency 630. The overload on this line was also identified for the GD test.
 - Scenario Analysis Potential Solution: Reconductor 2.34 miles of the line.
 - Cost: \$3.51M.
 - Required IS Date: 6/1/2019
- The US STEEL-WEST MILL - HENDRICKS ckt 1 138 kV line is overloaded for the N-1 test for the Tower contingency 630. The overload on this line was also identified for the GD test.
 - Scenario Analysis Potential Solution: Reconductor 2.49 miles of the line.
 - Cost: \$3.74M.
 - Required IS Date: 6/1/2019

* Note that these upgrades were developed by PJM for this scenario study and are not recommended at this time



AMIL Transmission Zone

- The Mount Zion 345 kV Bus 1 345/138 kV transformer is overloaded for the N-1-1 test for the '345-L2101____-S' single contingency, followed by 'SPS-2102&2106_'.
 - Scenario Analysis Potential Solution: Replace the transformer.
 - Cost: \$15M.
 - Required IS Date: 6/1/2019
- The Lanesville 345 kV Bus 3586-3587 (KNC-LNVL-2101) 345/138 kV transformer is overloaded for the N-1-1 test for the 'SPS-2102&2106_' single contingency, followed by '345-L9201____-S'.
 - Scenario Analysis Potential Solution: Replace the transformer.
 - Cost: \$15M.
 - Required IS Date: 6/1/2019
- The Ramsey East 345 kV Bus 1 345/138 kV transformer is overloaded for the N-1-1 test for the 'SPS-2105&U1____' single contingency, followed by '1111_B2'.
 - Scenario Analysis Potential Solution: Replace the transformer.
 - Cost: \$15M.
 - Required IS Date: 6/1/2019
- The Effingham 138 138 kV North Bus - Effingham Northwest 138 kV Bus 1 ckt 1 138 kV line is overloaded for the GD test for the single contingency '1112_B2'.
 - Scenario Analysis Potential Solution: Reconductor 2.72 miles of the line.
 - Cost: \$4.08M.
 - Required IS Date: 6/1/2019
- The Mount Zion PPG 138 kV Bus 1 - Mount Zion Route 121 138 kV Bus 1 ckt 1 138 kV line is overloaded for the GD test for the single contingency 'SPS-2106&02&U2'. The overload on this line was also identified for the N-1-1 test.
 - Scenario Analysis Potential Solution: Reconductor 2.37 miles of the line.
 - Cost: \$3.56M.
 - Required IS Date: 6/1/2019
- The Ramsey East 138 kV Bus 1 - Pana North 138 kV East Bus ckt 1 138 kV line is overloaded for the GD test for the single contingency 'SPS-2105&U1____'. The overload on this line was also identified for the N-1 test.
 - Scenario Analysis Potential Solution: Reconductor 18.43 miles of the line.
 - Cost: \$27.65M.
 - Required IS Date: 6/1/2019

* Note that these upgrades were developed by PJM for this scenario study and are not recommended at this time



AMIL Transmission Zone

- The Mount Zion PPG Tap 138 kV PANN-R51D-1462 Tap Point - Route 51 Decatur 138 kV North Bus ckt 1 138 kV line is overloaded for the GD test for the single contingency '345-L2101___-S'. The overload on this line was also identified for the N-1 test.
 - Scenario Analysis Potential Solution: Reconductor 1.43 miles of the line.
 - Cost: \$2.15M.
 - Required IS Date: 6/1/2019
- The Route 51 Decatur 138 kV North Bus - East Main Street 138 kV Bus 1 ckt 1 138 kV line is overloaded for the GD test for the single contingency '345-L2101___-S'. The overload on this line was also identified for the N-1-1 test.
 - Scenario Analysis Potential Solution: Reconductor 2.44 miles of the line.
 - Cost: \$3.66M.
 - Required IS Date: 6/1/2019
- The Casey West 345 kV East Bus - Kansas West 345 kV Bus 2 ckt 1 345 kV line is overloaded for the LD test for the Single contingency 'SPS-2105&U1___'.
 - Scenario Analysis Potential Solution: Reconductor 21.16 miles of the line.
 - Cost: \$42.32M.
 - Required IS Date: 6/1/2019
- The Midway 138 kV Bus 1408-1409 (MDWY-SCNT-1542) - Schram City Tap 138 kV PANN-MDWY-1466 Tap Point ckt 1 138 kV line is overloaded for the N-1 test for the Single contingency SPS-2105&U1___. The overload on this line was also identified for the GD test.
 - Scenario Analysis Potential Solution: Reconductor 5.19 miles of the line.
 - Cost: \$7.79M.
 - Required IS Date: 6/1/2019
- The Mount Zion Route 121 138 kV Bus 1 - Mount Zion PPG 138 kV Bus 1 ckt 1 138 kV line is overloaded for the N-1 test for the Single contingency BASE CASE. The overload on this line was also identified for the N-1-1 test.
 - Scenario Analysis Potential Solution: Reconductor 2.37 miles of the line.
 - Cost: \$3.56M.
 - Required IS Date: 6/1/2019
- The Newton 138 kV Bus 1856-1868 (XFMR 2) - Robinson Marathon 138 kV Bus 1737-1747 (ROBM-ROMN-1) ckt 1 138 kV line is overloaded for the N-1 test for the Single contingency 1112_B2. The overload on this line was also identified for the GD test.
 - Scenario Analysis Potential Solution: Reconductor 34.20 miles of the line.
 - Cost: \$51.30M.
 - Required IS Date: 6/1/2019
- The ADM North 138 kV Bus 1324-1328 (OREA-ADMN-1610) - Mount Zion Route 121 138 kV Bus 1 ckt 1 138 kV line is overloaded for the N-1-1 test for the 'SPS-2106&02&U2' single contingency, followed by the 'BASE CASE'.
 - Scenario Analysis Potential Solution: Reconductor 7.34 miles of the line.
 - Cost: \$11.01M.
 - Required IS Date: 6/1/2019

* Note that these upgrades were developed by PJM for this scenario study and are not recommended at this time



AMIL Transmission Zone

- The East Main Street 138 kV Bus 1 - Decatur Junction (Decatur 27th Street Tap) 138 kV NDEC-EMST-1522 Tap Point ckt 1 138 kV line is overloaded for the N-1-1 test for the '345-L2101___-S' single contingency, followed by the 'SPS-2102&2106_'.
 - Scenario Analysis Potential Solution: Reconductor 2.54 miles of the line.
 - Cost: \$3.81M.
 - Required IS Date: 6/1/2019
 - The Latham South Tap 138 kV NDEC-LATM-1342 Tap Point - Latham 138 kV Bus 1 ckt 1 138 kV line is overloaded for the N-1-1 test for the 'SPS-2102&2106_' single contingency, followed by the '345-L2107___-S'.
 - Scenario Analysis Potential Solution: Reconductor 0.38 miles of the line.
 - Cost: \$0.57M.
 - Required IS Date: 6/1/2019
 - The Mount Zion Route 121 138 kV Bus 1 - ADM North 138 kV Bus 1324-1328 (OREA-ADMN-1610) ckt 1 138 kV line is overloaded for the N-1-1 test for the '345-L2101___-S' single contingency, followed by the 'SPS-2102&2106_'. The overload on this line was also identified for the GD test.
 - Scenario Analysis Potential Solution: Reconductor 7.34 miles of the line.
 - Cost: \$11.01M.
 - Required IS Date: 6/1/2019
 - The Mount Zion PPG 138 kV Bus 1 - Mount Zion PPG Tap 138 kV PANN-R51D-1462 Tap Point ckt 1 138 kV line is overloaded for the N-1-1 test for the '345-L2101___-S' single contingency, followed by the 'SPS-2102&2106_'.
 - Scenario Analysis Potential Solution: Reconductor 5.86 miles of the line.
 - Cost: \$8.79M.
 - Required IS Date: 6/1/2019
 - The Pana North 138 kV East Bus - Schram City Tap 138 kV PANN-MDWY-1466 Tap Point ckt 1 138 kV line is overloaded for the N-1-1 test for the 'SPS-2102&U1___' single contingency, followed by the 'BASE CASE'.
 - Scenario Analysis Potential Solution: Reconductor 28.61 miles of the line.
 - Cost: \$42.92M.
 - Required IS Date: 6/1/2019
 - The Pawnee West 138 kV East Bus - Auburn North 138 kV Bus 1 ckt 1 138 kV line is overloaded for the N-1-1 test for the '345-L2101___-S' single contingency, followed by the '345-L2102___-S'.
 - Scenario Analysis Potential Solution: Reconductor 7.90 miles of the line.
 - Cost: \$11.85M.
 - Required IS Date: 6/1/2019
 - The Mount Vernon West 138 kV Bus 1408-1409 (MTVW-ASHL-1486) - South Centralia 138 kV Bus 1543-1544 (MDWY-SCNT-1542) ckt 1 138 kV line is overloaded for the N-1-1 test for the '1112_B2' single contingency, followed by the 'KN-1U_____S'.
 - Scenario Analysis Potential Solution: Reconductor 15.80 miles of the line.
 - Cost: \$23.70M.
 - Required IS Date: 6/1/2019
- * Note that these upgrades were developed by PJM for this scenario study and are not recommended at this time

2015 RTEP Assumptions (Continued from January 2015 TEAC)

- All TO's provided feedback for final case review
- PJM finalizing case and will exercise the case for quality control and benchmarking
- Final contingency file review
- Machine List
 - 2020 RTEP machine list is posted with today's TEAC materials
 - Stakeholders are encouraged to examine the list and provide PJM feedback

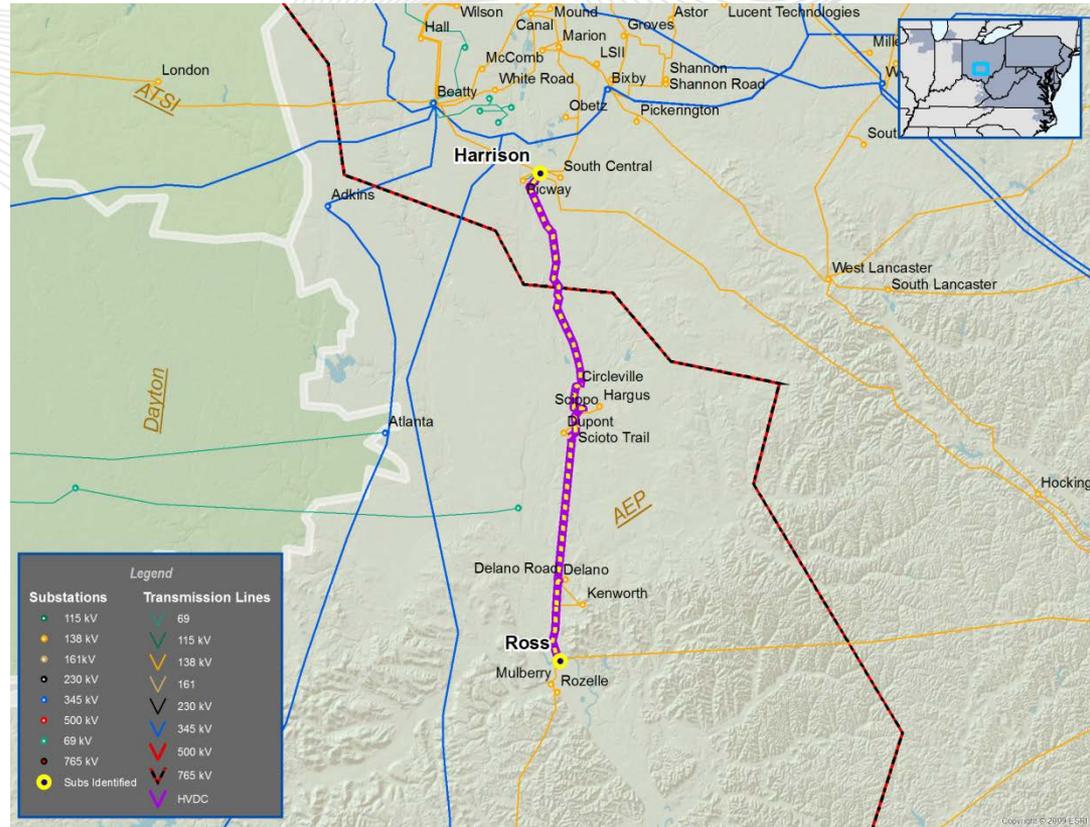
- FSA generation modeled with any associated network upgrades
- Units in suspension are not used to back-off problems
- One existing and one ISA project not modeled

Queue Projects NOT included in 2020 RTEP

- Queue projects with an FSA or ISA but are not included in 2020 RTEP case
 - Q65 (Gen) North Anna Nuclear 1594 MW
 - S57/S58 and U3-026 (MTX) Collins “Rock Island Clean Line” 3500 MW
 - 3,500 MW total
 - 2,308 non-firm and 1,192 firm
 - X3-028 (MTX) Breed 345 kV “Grain Belt Express” 3500 MW
- Existing Units not included in the 2020 RTEP case
 - Oyster Creek Nuclear (Existing Generator) – 645 MW

Reliability Analysis Update

- **Project Update – B2256**
- B2256: Upgrade approximately 36 miles of 138 kV through path facilities between Harrison 138kV station and Ross 138KV station in Ohio.
- The outages of this line jeopardize a large pocket of load and a de-energized rebuild may take much longer than the required in-service. AEP has determined to rebuild the line while it is energized. This increases the cost.
- Previous Estimated Project Cost: \$40.5M
- New Estimated Project Cost: \$130M
- Required IS Date: 6/1/2017



2014 RTEP Proposal Window #2 – Analytical Update Pratts Area Proposals



2014 RTEP Proposal Window #2 Pratts Area Proposals

- Scope: Transmission Owner Criteria, 2019 N-1-1 Thermal, Voltage Drop, Voltage Magnitude and Non-Converged
 - Opened Friday, October 17, 2014
 - Pratts area violations extended to December 5, 2014
- 4 proposing entities
- 16 proposals
 - 2 Transmission Owner Upgrades
 - Cost range of \$91.47M to \$103.7M
 - 14 Greenfield Projects
 - Cost range of \$60.9M to \$201.2M

Pratts Area Proposal Summary

Project ID	Upgrade/Greenfield	Proposing Entity	Proposed Cost (\$M)	Major Components
2014_2-6B	Greenfield	ITC Mid Atlantic	142.00	Rebuild the existing Gordonsville to Pratts 115kV line to 230kV and tie in to new 230/115kV Fairground station near Pratts. Build a new 230kV line from Fairground to Remington CT. Expand existing Gordonsville and Remington CT substations.
2014_2-7D	Greenfield	Northeast Transmission Development	93.10	Approximately 51-mile 230 kV Line from Gordonsville to Pratts to Remington with a 230/115 kV substation at Pratts
2014_2-7E	Greenfield	Northeast Transmission Development	60.9*	Rebuild/Reconductor existing 18 mile (approx) line from Gordonsville to Pratts 115 kV line to 230 kV line, an approximately 33 miles 230 kV line from Pratts to Remington, and a 230/115 kV substation at Pratts.
2014_2-7F	Greenfield	Northeast Transmission Development	109.90	Approximately 51-mile 230 kV Line from Gordonsville to Pratts to Remington, 230/115 kV substation at Pratts, and a new 230/115 kV substation on the Pratts-Remington 230 kV Line ("Brook Run").
2014_2-7G	Greenfield	Northeast Transmission Development	77.7*	Rebuild/Reconductor existing approximately 18-mile Gordonsville to Pratts 115 kV Line to 230 kV Line, an approximately 33-mile 230 kV Line from Pratts to Remington, a 230/115 kV substation at Pratts, and a new 230/115 kV substation on the Pratts-Remington 230 kV Line ("Brook Run")
2014_2-7H	Greenfield	Northeast Transmission Development	68.70	Approximately 38-mile 230 kV Line from Gordonsville to Remington
2014_2-7I	Greenfield	Northeast Transmission Development	85.50	Approximately 38-mile 230 kV Line from Gordonsville to Remington with a new 230/115 kV substation on the Gordonsville-Remington 230 kV Line ("Brook Run").
2014_2-7J	Greenfield	Northeast Transmission Development	90.40	Approximately 38-mile 230 kV Line from Gordonsville to Remington with a new approximately 14-mile 115 kV Line from Pratts to a new 115 kV switchyard on the Orange Tap-Oak Green 115 kV Line ("Rapidan River").
2014_2-7K	Greenfield	Northeast Transmission Development	107.20	Approximately 38-mile 230 kV Line from Gordonsville to Remington with a new 230/115 kV substation on the Gordonsville-Remington 230 kV Line ("Brook Run") and a new approximately 14-mile 115 kV Line from Pratts to a new 115 kV switchyard on the Orange Tap-Oak Green 115 kV Line ("Rapidan River").

* = Cost does not include significant TO Upgrade estimated cost



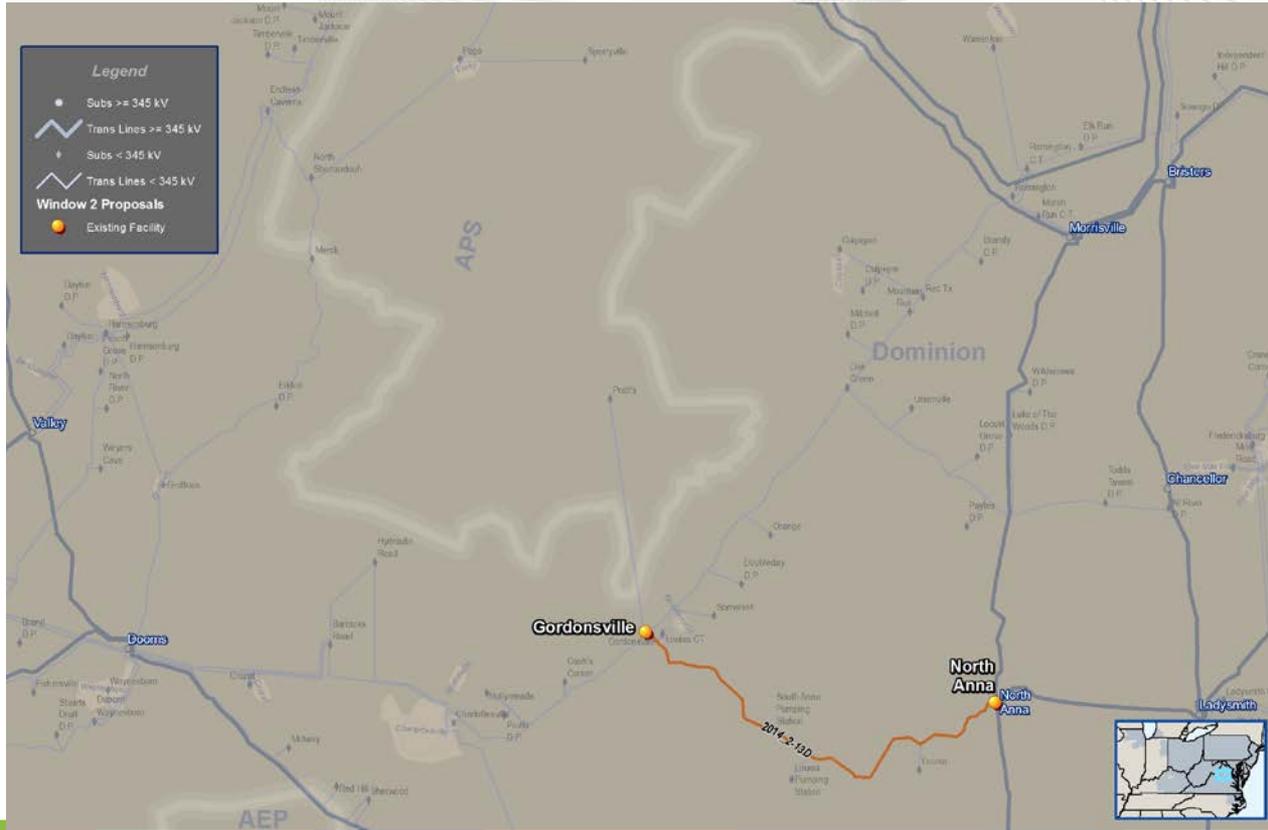
Pratts Area Proposal Summary

Project ID	Upgrade/Greenfield	Proposing Entity	Proposed Cost (\$M)	Major Components
2014_2-13A	Greenfield	Dominion/First Energy	149.30	<ol style="list-style-type: none"> 1. Remington – Oneals Road (Pratts) 230 kV line: Construct a new 230 kV transmission line from Dominion's existing Remington substation to FirstEnergy's upgraded Oneals Road(Pratts) 230 kV switching station. Included in this work will be an uprate of one existing 115 kV line segment between Mountain Run and Mitchell for the length of right-of-way it shares with new structures for the new 230 kV line. This work segment is the responsibility of Dominion. 2. Gordonsville – Oneals Road (Pratts) 230 kV line: Convert the existing FirstEnergy radial Gordonsville to Pratts 115 kV line to 230 kV and terminate in the new Oneals Road (Pratts) 230 kV switching station creating a new Gordonsville to Oneals Road (Pratts) 230 kV line. This work segment is the responsibility of FirstEnergy. 3. Oneals Road (Pratts) substation: Upgrade/expand the existing Pratts substation and install a 230 kV ring bus with a 230/115 kV transformer to connect to the existing Rappahannock Electric Cooperative (REC) Pratts distribution station. This work segment is the responsibility of FirstEnergy. 4. Remington substation: Upgrade the 230 kV bus to a ring configuration. This work segment is the responsibility of Dominion. 5. Gordonsville substation: Upgrade the 230 kV bus to a breaker-and-a-half configuration. This work segment is the responsibility of Dominion.
2014_2-13B	Greenfield	Dominion/First Energy	201.20	<ol style="list-style-type: none"> 1. Remington – Oneals Road (Pratts) 230 kV line: Construct a new 230 kV transmission line from Dominion's existing Remington substation to FirstEnergy's upgraded Oneals Road(Pratts) 230 kV switching station. Included in this work will be an uprate of one existing 115 kV line segment between Mountain Run and Mitchell for the length of right-of-way it shares with new structures for the new 230 kV line. This work segment is the responsibility of Dominion. 2. Gordonsville – Oneals Road (Pratts) 230 kV line: Convert the existing FirstEnergy radial Gordonsville to Pratts 115 kV line to 230 kV and terminate in the new Oneals Road (Pratts) 230 kV switching station creating a new Gordonsville to Oneals Road (Pratts) 230 kV line. This work segment is the responsibility of FirstEnergy. 3. Oneals Road (Pratts) substation: Upgrade/expand the existing Pratts substation and install a 230 kV ring bus with a 230/115 kV transformer to connect to the existing Rappahannock Electric Cooperative (REC) Pratts distribution station. This work segment is the responsibility of FirstEnergy. 4. Remington substation: Upgrade the 230 kV bus to a ring configuration. This work segment is the responsibility of Dominion. 5. Gordonsville substation: Upgrade the 230 kV bus to a breaker-and-a-half configuration. This work segment is the responsibility of Dominion. 6. Oneals Road (Pratts) – Sperryville 230 kV line: Construct a new 230 kV transmission line from FirstEnergy's upgraded Oneals Road (Pratts) 230 kV switching station to FirstEnergy's upgraded Sperryville 138 kV station. This work segment is the responsibility of FirstEnergy. 7. Sperryville substation: Upgrade/expand the existing Sperryville substation and install a 138 kV ring bus with a 230/138 kV transformer. This work segment is the responsibility of First Energy.



Pratts Area Proposal Summary

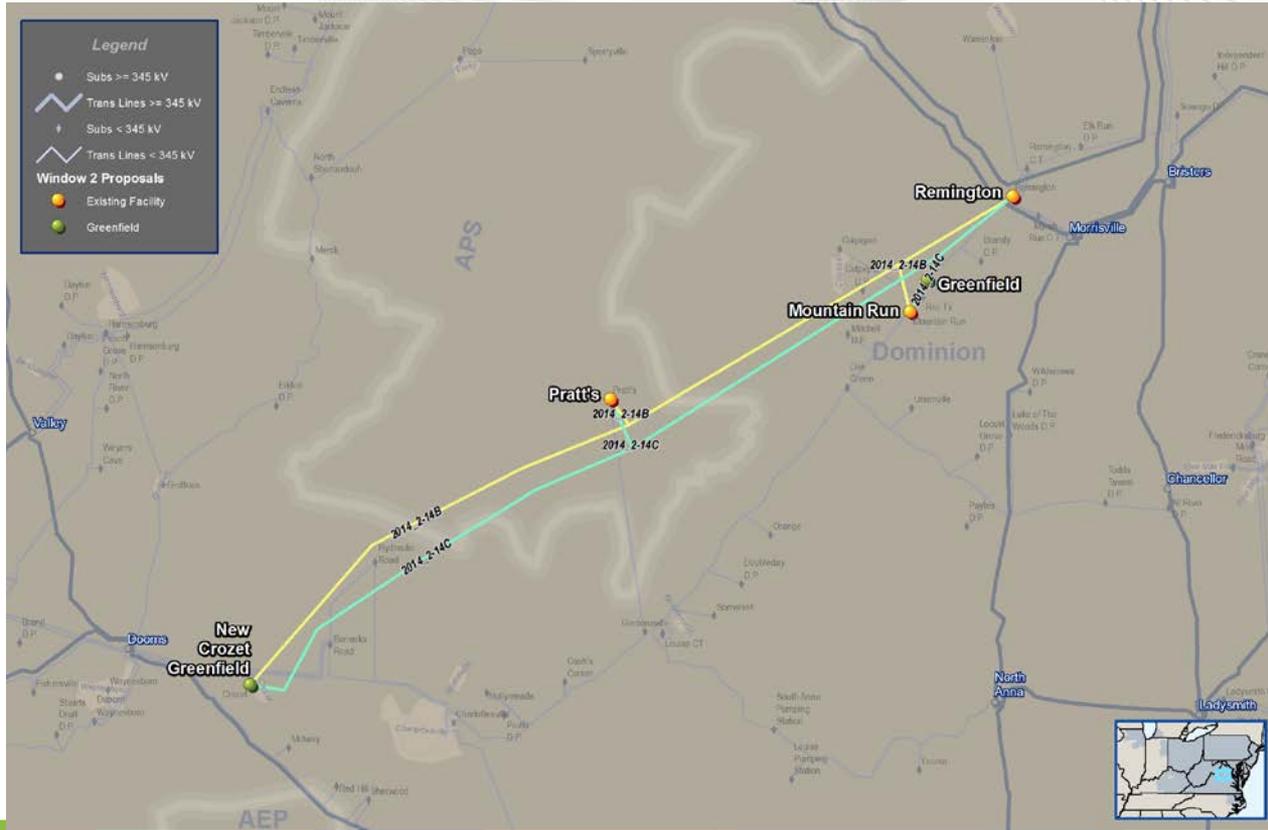
Project ID	Upgrade/Greenfield	Proposing Entity	Proposed Cost (\$M)	Major Components
2014_2-13C	Upgrade	Dominion/First Energy	103.70	Build a 230kV Line from Remington Substation to Gordonsville Substation utilizing existing ROW. Install a 3rd 230-115kV Tx at Gordonsville Substation
2014_2-13D	Upgrade	Dominion/First Energy	91.47	Build a 230kV Line from North Anna Substation to Gordonsville Substation utilizing existing ROW. Install a 3rd 230-115kV Tx at Gordonsville Substation.
2014_2-14A	Greenfield	Ameren	139.35	Build Gordonsville - Remington CT 230 kV line with two 230/115 kV connections near existing Pratts and Mountain Run substations
2014_2-14B	Greenfield	Ameren	169.23	Build from a new substation constructed near Crozet Substation (Sub A) - Remington CT 230 kV line with two 230/115 kV connections near existing Pratt's and Mountain Run substations. Supply Crozet Substation directly from Sub A
2014_2-14C	Greenfield	Ameren	198.57	Build from a new substation constructed near Crozet Substation (Sub A) - Remington CT 230 kV line with two 230/115 kV connections near existing Pratt's and Mountain Run substations. Supply Crozet Substation directly from Sub A + Build a new 230 kV line between Substation C (located near existing Mountain Run substation) and Remington CT substation. Install a new 230 KV breaker at Remington CT substation





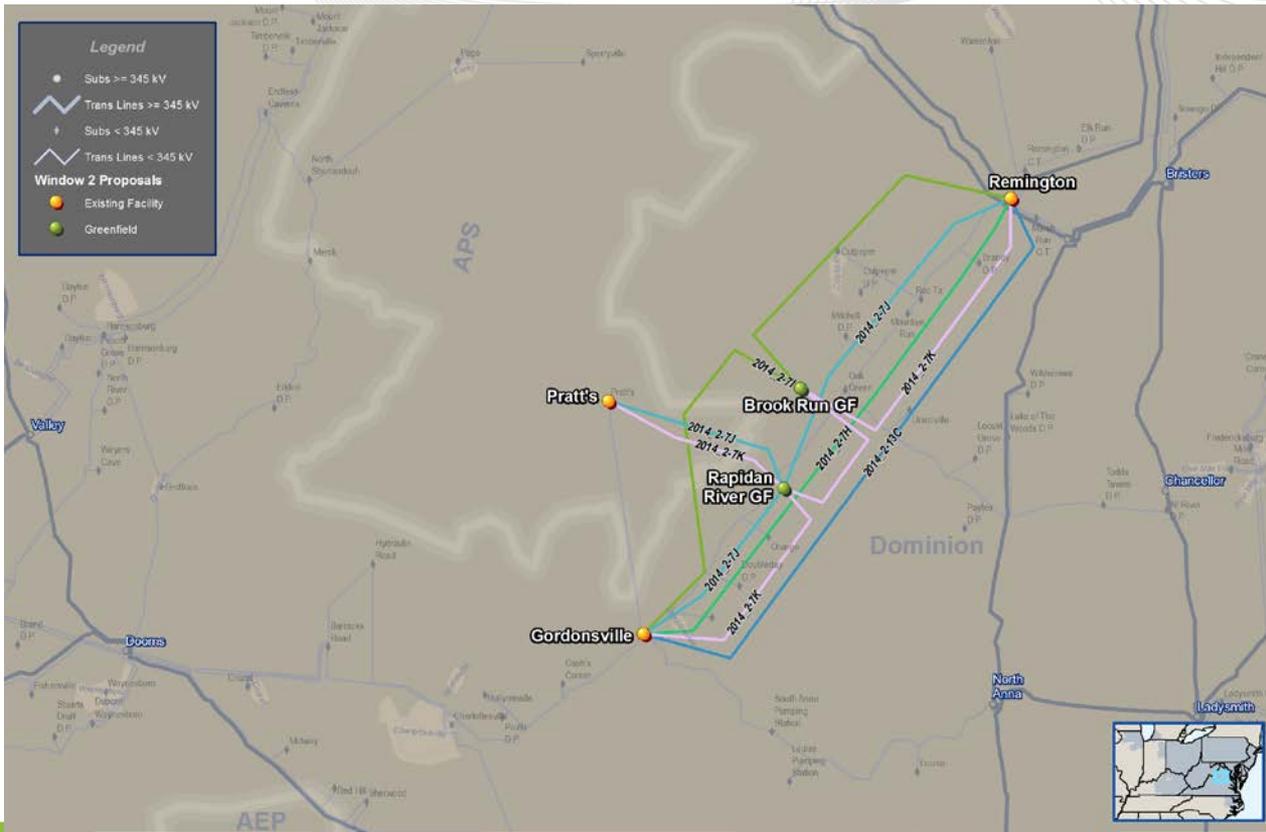
Gordonsville-North Anna Project

Project ID	Upgrade/ Greenfield	Proposing Entity	Proposed Cost (\$M)	Major Components
2014_2-13D	Upgrade	Dominion/First Energy	91.47	Build a 230kV Line from North Anna Substation to Gordonsville Substation utilizing existing ROW. Install a 3rd 230-115kV Tx at Gordonsville Substation.



Project ID	Upgrade/ Greenfield	Proposing Entity	Proposed Cost (\$M)	Major Components
2014_2-14B	Greenfield	Ameren	169.23	Build from a new substation constructed near Crozet Substation (Sub A) - Remington CT 230 kV line with two 230/115 kV connections near existing Pratt's and Mountain Run substations. Supply Crozet Substation directly from Sub A
2014_2-14C	Greenfield	Ameren	198.57	Build from a new substation constructed near Crozet Substation (Sub A) - Remington CT 230 kV line with two 230/115 kV connections near existing Pratt's and Mountain Run substations. Supply Crozet Substation directly from Sub A + Build a new 230 kV line between Substation C (located near existing Mountain Run substation) and Remington CT substation. Install a new 230 KV breaker at Remington CT substation

Gordonsville-Remington Projects





Gordonsville-Remington Projects

Project ID	Upgrade/ Greenfield	Proposing Entity	Proposed Cost (\$M)	Major Components
2014_2-7H	Greenfield	Northeast Transmission Development	68.70	Approximately 38-mile 230 kV Line from Gordonsville to Remington
2014_2-7I	Greenfield	Northeast Transmission Development	85.50	Approximately 38-mile 230 kV Line from Gordonsville to Remington with a new 230/115 kV substation on the Gordonsville-Remington 230 kV Line ("Brook Run").
2014_2-7J	Greenfield	Northeast Transmission Development	90.40	Approximately 38-mile 230 kV Line from Gordonsville to Remington with a new approximately 14-mile 115 kV Line from Pratts to a new 115 kV switchyard on the Orange Tap-Oak Green 115 kV Line ("Rapidan River").
2014_2-7K	Greenfield	Northeast Transmission Development	107.20	Approximately 38-mile 230 kV Line from Gordonsville to Remington with a new 230/115 kV substation on the Gordonsville-Remington 230 kV Line ("Brook Run") and a new approximately 14-mile 115 kV Line from Pratts to a new 115 kV switchyard on the Orange Tap-Oak Green 115 kV Line ("Rapidan River").
2014_2-13C	Upgrade	Dominion/First Energy	103.70	Build a 230kV Line from Remington Substation to Gordonsville Substation utilizing existing ROW. Install a 3rd 230-115kV Tx at Gordonsville Substation



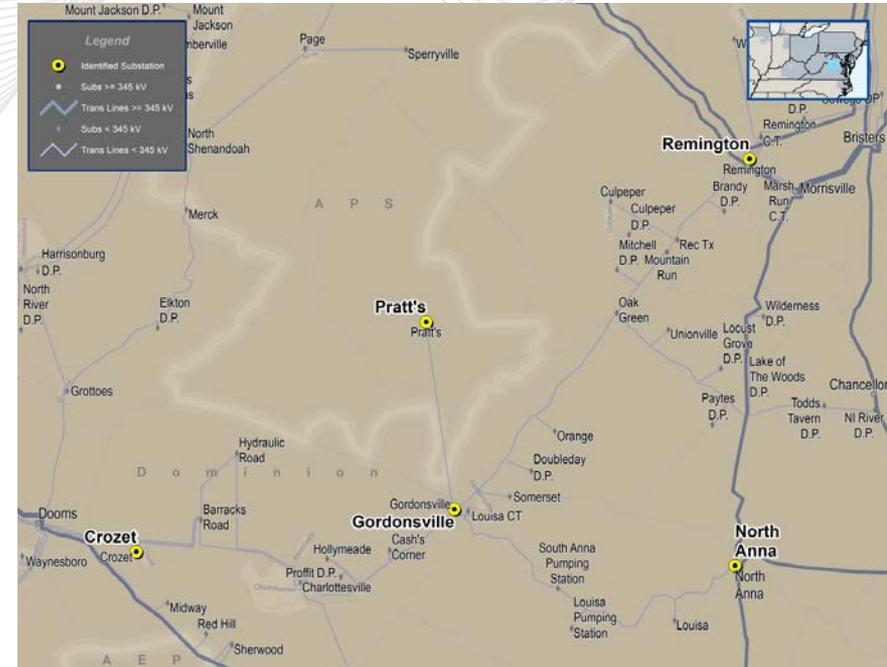
Gordonsville-Pratts-Remington Projects

Project ID	Upgrade/ Greenfield	Proposing Entity	Proposed Cost (\$M)	Major Components
2014_2-7D	Greenfield	Northeast Transmission Development	93.10	Approximately 51-mile 230 kV Line from Gordonsville to Pratts to Remington with a 230/115 kV substation at Pratts
2014_2-7E	Greenfield	Northeast Transmission Development	60.9*	Rebuild/Reconductor existing 18 mile (approx) line from Gordonsville to Pratts 115 kV line to 230 kV line, an approximately 33 miles 230 kV line from Pratts to Remington, and a 230/115 kV substation at Pratts.
2014_2-7F	Greenfield	Northeast Transmission Development	109.90	Approximately 51-mile 230 kV Line from Gordonsville to Pratts to Remington, 230/115 kV substation at Pratts, and a new 230/115 kV substation on the Pratts-Remington 230 kV Line ("Brook Run").
2014_2-7G	Greenfield	Northeast Transmission Development	77.7*	Rebuild/Reconductor existing approximately 18-mile Gordonsville to Pratts 115 kV Line to 230 kV Line, an approximately 33-mile 230 kV Line from Pratts to Remington, a 230/115 kV substation at Pratts, and a new 230/115 kV substation on the Pratts-Remington 230 kV Line ("Brook Run")
2014_2-14A	Greenfield	Ameren	139.35	Build Gordonsville - Remington CT 230 kV line with two 230/115 kV connections near existing Pratts and Mountain Run substations

* = Cost does not include significant TO Upgrade estimated cost

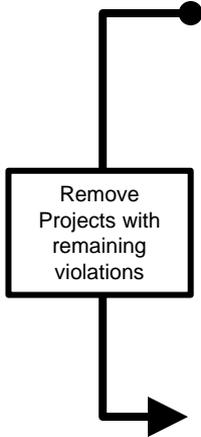
Project ID	Upgrade/ Greenfield	Proposing Entity	Propose d Cost (\$M)	Major Components
2014_2-14B	Greenfield	Ameren	169.23	Build from a new substation constructed near Crozet Substation (Sub A) - Remington CT 230 kV line with two 230/115 kV connections near existing Pratt's and Mountain Run substations. Supply Crozet Substation directly from Sub A
2014_2-14C	Greenfield	Ameren	198.57	Build from a new substation constructed near Crozet Substation (Sub A) - Remington CT 230 kV line with two 230/115 kV connections near existing Pratt's and Mountain Run substations. Supply Crozet Substation directly from Sub A + Build a new 230 kV line between Substation C (located near existing Mountain Run substation) and Remington CT substation. Install a new 230 KV breaker at Remington CT substation

- Several main routes:
 - Gordonsville – Pratts – Remington
 - Gordonsville – Remington
 - Crozet – Pratts – Remington
 - Gordonsville – North Anna



- Wide range of proposed cost estimates
- Some of the estimates do not include costs that are associated with upgrades assumed by the project sponsor to be assigned to the incumbent TO
- Several projects did not resolve the Mt. Run – Michael 115kV thermal overload
- One project had remaining 115 kV voltage violations
- Cost Commitment

- 16 Project Proposals
- 6 meet the required performance
- 8 have remaining violation(s)
- Crozet – Pratts – Remington had the highest estimated costs resulting in a lower analytical priority



	Project ID	Proposing Entity	Proposed Cost (\$M)	Performance
Gordonsville - Pratts - Remington Path	2014_2-6B	ITC Mid Atlantic	142	FAIL
	2014_2-7D	Northeast Transmission Development	93.1	FAIL
	2014_2-7E	Northeast Transmission Development	60.9 + Gordonsville-Pratts Rebuild	FAIL
	2014_2-7F	Northeast Transmission Development	109.9	PASS
	2014_2-7G	Northeast Transmission Development	77.7*	PASS
	2014_2-13A	Dominion/First Energy	149.3	PASS
	2014_2-13B	Dominion/First Energy	201.2	PASS
Gordonsville - Remington Shortcut	2014_2-14A	Ameren	139.35	PASS
	2014_2-7H	Northeast Transmission Development	68.7	FAIL
	2014_2-7I	Northeast Transmission Development	85.5	FAIL
	2014_2-7J	Northeast Transmission Development	90.4	FAIL
	2014_2-7K	Northeast Transmission Development	107.2	PASS
North Anna - Gordonsville	2014_2-13C	Dominion/First Energy	103.7	FAIL
	2014_2-13D	Dominion/First Energy	91.47	FAIL
Crozet - Pratts - Remington	2014_2-14B	Ameren	169.23	Cost
	2014_2-14C	Ameren	198.57	Cost

	Project ID	Proposing Entity	Proposed Cost (\$M)	Performance
Gordonsville - Pratts - Remington Path	2014_2-7F	Northeast Transmission Development	109.9	PASS
	2014_2-7G	Northeast Transmission Development	77.7*	PASS
	2014_2-13A	Dominion/First Energy	149.3	PASS
	2014_2-13B	Dominion/First Energy	201.2	PASS
	2014_2-14A	Ameren	139.35	PASS
Gordonsville - Remington Shortcut	2014_2-7K	Northeast Transmission Development	107.2	PASS

* = Cost does not include significant TO Upgrade estimated cost



Gordonsville – Pratts – Remington (G-P-R) Proposals

- **All G-P-R proposals share the same concept as the March 2014 Dominion proposal**
- **Gordonsville & Remington Endpoints**
 - All connect to the existing stations and require improvements at these endpoints
- **Gordonsville – Pratts**
 - All except 13A/13B require a new greenfield line or require the incumbent TO to rebuild the line
- **Pratts 115kV**
 - 7F, 7G and 14A all require a new facility near Pratts in addition to the existing facility
 - 13A/13B expands the existing Pratts 115kV facility instead of building a new Pratts 230/115kV facility
- **Pratts – Remington**
 - Greenfield required for all proposals
 - Dominion has significant ROW acquired
- **New 230/115kV Station on Pratts-Remington**
 - All except 13A/13B require an additional new station on Pratts-Remington

Project ID	Proposing Entity	Build New Gordonsville - Pratts 230kV	Rebuild Gordonsville - Pratts 115kV to 230kV	New 230/115 kV Station Near Pratts	Expand Pratts 115kV to a 230/115kV Facility	New Pratts - Remington 230 kV	New 230/115kV Station on Pratts - Remington	
Miles of New ROW		18				33		
2014_2-7F	Northeast Transmission Development	X		X		X	X	
2014_2-7G	Northeast Transmission Development		X	X		X	X	
2014_2-13A	Dominion/First Energy		X		X	X		
2014_2-13B	Dominion/First Energy		X		X	X		
2014_2-14A	Ameren	X		X		X	X	



Gordonsville – Remington (G-R) Proposals

- Only 1 of 5 G-R proposals solved all of the reliability violations
- This proposal requires:
 - 38 miles of new 230kV transmission
 - 14 miles of new 115kV transmission
 - New 230/115kV station
 - New 115kV station
- The proposal cost estimate appears to be underestimated for the scope or work.
- Cost Commitment

	Project ID	Proposing Entity	Build New Gordonsville - Remington 230 kV	New 115kV transmission from Pratts to a New Substation	New Station on Orange Tap - Oak Green 115kV	New 230/115kV Station on Gordonsville - Remington
	Miles of New ROW		38 miles new	14 miles new		
Gordonsville - Remington	2014_2-7K	Northeast Transmission Development	X	X	X	X



Proposal Comparison - Major Elements

Project ID	Proposing Entity	Build New Gordonsville - Pratts 230kV	Rebuild Gordonsville - Pratts 115kV to 230kV	New 230/115kV Station Near Pratts	Expand Pratts 115kV to a 230/115kV Facility	New Pratts - Remington 230kV	New 230/115kV Station on Pratts - Remington	New Gordonsville - Remington 230kV	New 115kV Transmission from Pratts to a New Substation	New Station on Orange Tap - Oak Green 115kV	New 230/115kV Station on Gordonsville-Remington
Miles of New ROW		18			33		38		14		
2014_2-7F	Northeast Transmission Development	X		X		X	X				
2014_2-7K	Northeast Transmission Development							X	X	X	X
2014_2-7G	Northeast Transmission Development		X	X		X	X				
2014_2-13A	Dominion/First Energy		X		X	X					
2014_2-13B	Dominion/First Energy		X		X	X					
2014_2-14A	Ameren	X		X		X	X				

- Cost commitment dollar values are proposed by Northeast Transmission Development
- PJM cost estimates exceed cost commitments
- As a result, the anticipated cost is assumed to be the cost commitment

	Project ID	Proposing Entity	Estimated Cost (\$M) by Northeast Transmission Development	Cost commitment
Gordonsville - Pratts - Remington Path	2014_2-7F	Northeast Transmission Development	109.9	138
	2014_2-7G	Northeast Transmission Development	77.7*	102.5*
Gordonsville - Remington Path	2014_2-7K	Northeast Transmission Development	107.2	134.5

* = Cost does not include significant TO Upgrade estimated cost

Cost commitment note: PJM estimates that actual costs will exceed the proposed cost commitment values

- PJM estimated project costs for were comparable to the Dominion and Ameren estimated costs and higher than the Northeast Transmission Development estimated costs and cost caps
- TO upgrade costs are added to calculate a Total Estimated Cost

	Project ID	Proposing Entity	Estimated Cost (\$M) by Proposing Entity	PJM Estimated Cost	Cost Commitment	Additional Required TO Upgrades	Total Estimated Cost
Gordonsville - Pratts - Remington Path	2014_2-7F	Northeast Transmission Development	109.9	151-192	138	15-20	153-158
	2014_2-7G	Northeast Transmission Development	77.7	151-192	102.5	46-59	148.5-161.5
Gordonsville - Remington Path	2014_2-7K	Northeast Transmission Development	107.2	146-186	134.5	15-20	149.5-154.5
	2014_2-13A	Dominion / First Energy	149.3	129-164	N/A	Included	129-164
	2014_2-13B	Dominion / First Energy	201.2	N/A	N/A	Included	201.2
	2014_2-14A	Ameren	139.35	137-174	N/A	Included	137-174



Dominion 13A/13B Work Already Completed

- Work began in 2013
- Dominion meetings with the local electric cooperative in December 2013
- Routing for 13A is complete with constructible route identified
- All cost estimates are engineering grade estimates
- TO project management is in place
- By the end of 1Q 2015, the 13A project will be ready to file a SCC in Virginia to obtain a CPCN to construct. The lead time for an SCC for a project of this magnitude takes almost a full year.

- The Dominion 13A proposal
 - Solves the required reliability criteria violations
 - Has the least risk due to the acquisition of most of the ROW and ownership of existing local stations
 - Is the most cost effective in resolving the violations
- Recommend the Dominion 2014_2-13A proposal for inclusion in the RTEP



2014 RTEP Window 2 Addendum

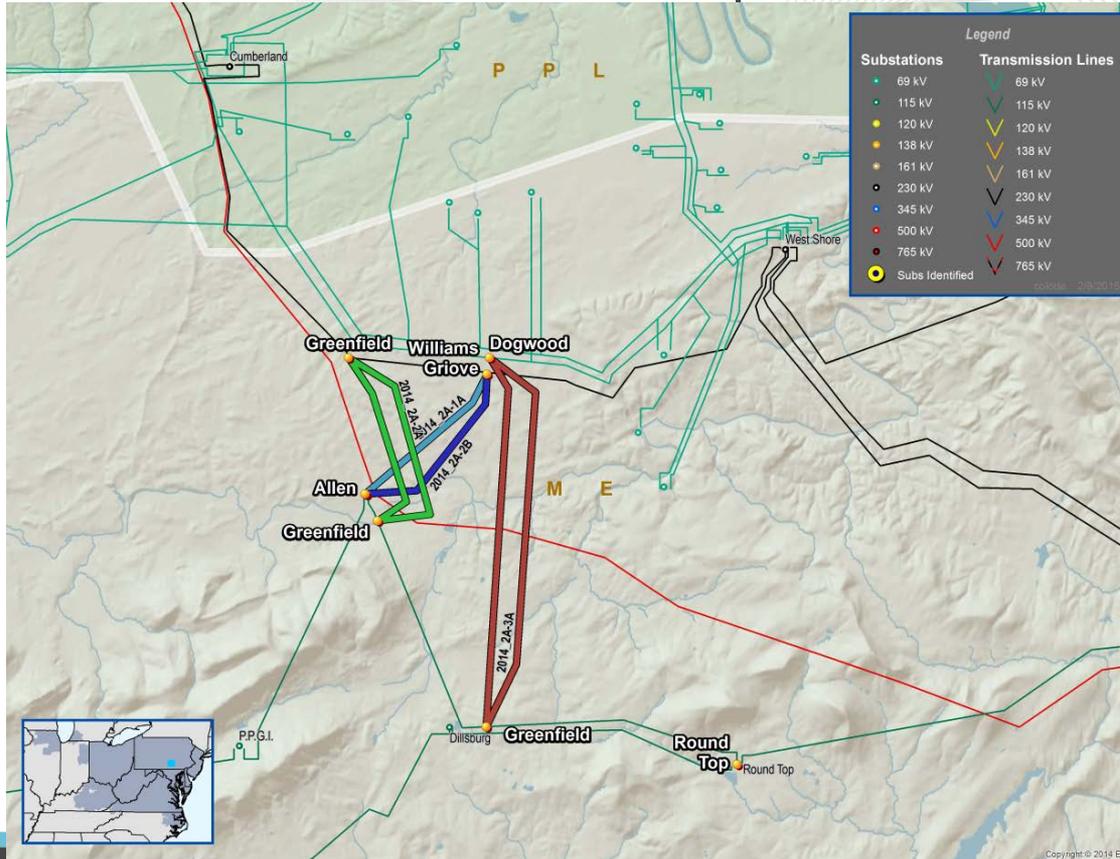
- Scope: Twelve 115 kV N-1-1 Voltage Drop violations in the vicinity of the Allen Substation in Meted
- Input assumptions changed causing proposals for these flowgates as part of window 2 to need additional consideration
 - Opened Tuesday, January 20, 2015
 - Closed Friday, February 6, 2015

- PJM received:
 - 4 Greenfield Proposals from 3 entities
 - Costs range from \$10.55M - \$16.13M

2014 Window 2 Addendum Proposals

Project ID	Upgrade/Greenfield	Proposing Entity	Cost (\$M)	Target Zone	kV Level	Analysis Type	FG #
2014_2A-1A	Greenfield	PPL/First Energy	12.41	Meted/PPL	230	N-1-1 Voltage Drop	N2-VD2, N2-VD3, N2-VD4, N2-VD5, N2-VD6, N2-VD7, N2-VD9, N2-VD10, N2-VD11, N2-VD12, N2-VD13, N2-VD14
2014_2A-2A	Greenfield	Transource	16.13	Meted/PPL	230	N-1-1 Voltage Drop	N2-VD2, N2-VD3, N2-VD4, N2-VD5, N2-VD6, N2-VD7, N2-VD9, N2-VD10, N2-VD11, N2-VD12, N2-VD13, N2-VD14
2014_2A-2B	Greenfield	Transource	10.55	Meted/PPL	230	N-1-1 Voltage Drop	N2-VD2, N2-VD3, N2-VD4, N2-VD5, N2-VD6, N2-VD7, N2-VD9, N2-VD10, N2-VD11, N2-VD12, N2-VD13, N2-VD14
2014_2A-3A	Greenfield	Northeast Transmission Development	11.9	Meted/PPL	115	N-1-1 Voltage Drop	N2-VD2, N2-VD3, N2-VD4, N2-VD5, N2-VD6, N2-VD7, N2-VD9, N2-VD10, N2-VD11, N2-VD12, N2-VD13, N2-VD14

2014 RTEP Proposal Window 2 Addendum



- 2014_2A-1A

- Expand the existing Allen substation, and connect Allen VIA new 115kV transmission to PPL's Williams Grove Substation, with transformation to 230kV at Williams Grove Substation. Construct a new Williams Grove - Allen Substation single circuit 115kV Transmission (~2.6 miles).
- Expansion of Existing Facilities: Install three 115kV breakers at Allen substation; Install a 230/115kV Transformer at Williams Grove Substation, with 115kV Breaker, and 230kV MOD, relays, and terminal work; Install a new 115kV dead-end structure at Williams Grove Substation; this structure serves as the project scope interface point between PPL and FE; Upgrade relays at PPGI 115 kV (Allen Terminal); Upgrade relays at Roundtop 115 kV (Allen Terminal)

- 2014_2A-2A

- 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.

- 2014_2A-2B
 - The Allen - Williams Grove (PPL's S0859) 115kV project proposes to build a new 115kV single ckt line from METED's Allen Station to Williams Grove station. Williams Grove station will incorporate a new 230/115kV transformer (300 MVA) and install a 115kV breaker as part of the proposed project. We assume that PPL will still cut in the 2-69kV lines between Cumberland and West Shore as well as build 69kV lines to West Carlisle and Carlisle Barack Stations. Allen Station will have to be expanded to incorporate the new 115kV line including 2-115kV breakers.
- 2014_2A-3A
 - Build an approximate 2.5-mile double-circuit 115 kV transmission line interconnecting the existing Allen-Roundtop 115 kV transmission line to a new 115/69 kV substation ("Dogwood Run") adjacent to the PPL S0859 230/69 kV substation.

- Next Steps
 - Continue analytical evaluation of these proposals



2015 RTEP Scenario Studies

- Section 111(d) of the Clean Air Act
- Analysis of critical Winter conditions
 - Gas/Electric interaction

Artificial Island Update

- **AI Generation GSU Tap Adjustment**
 - Potential to re-tap the GSU taps on the AI generation to result in a higher terminal voltage
 - Higher terminal voltage increases the stability margin
 - This change would need to be coordinated with PSE&G nuclear

- Fiber Optic Ground (FOG) a.k.a. Optical Grounding Wire (OPGW)
 - Potential to install this at several facilities on the Artificial Island to improve (decrease) relay clearing times
 - Decreased relay clearing times increase the stability margin
 - Estimated cost: approximately \$20M

Project	Project ID	Transmission Owner	FOG Wire	GSU Tap optimization	TCSC compensation (normal/transient)	SVC	Outage	Result
230kV (no SVC)	P2013_1-5A	LS Power	yes	yes	N/A	Not Modeled	5015	Stable
	P2013_1-2B	Transource	yes	yes	N/A	Not Modeled	5015	Stable
500kV (no SVC)	P2013_1-7K	PSE&G	yes	yes	N/A	Not Modeled	50151	Stable
	P2013_1-1C	DVP	yes	yes	N/A	Not Modeled	50151	Stable
TCSC (no SVC)	P2013_1-1A	DVP	yes	yes	40,45/90%	Not Modeled	5038	Unstable
TCSC + SVC	P2013_1-1A	DVP	yes	yes	40,45/90%	500MVar	5038	Stable
	P2013_1-1A	DVP	yes	yes	0/50%	750MVar	5038	Stable

• Observation

- With the additional stability margin resulting from the optical grounding wire and GSU tap optimization, the transmission alternatives do not require an SVC
- The TCSC alternative requires an SVC

- Next Steps
 - Consultant review of SSR Screening study and all previous technical results

RTEP Next Steps

- Complete 2020 Summer RTEP case quality control check
- Begin 2020 Summer RTEP Baseline Analysis

Questions?

Email: RTEP@pjm.com

- **Revision History**

- 2/11/2015 - Original version posted to the PJM TEAC
- 2/12/2014 - Added EIPC Slide 3
- 2/12/2014 – Updated slide 14 to reflect DEOK as the correct designated entity