

# Transmission Expansion Advisory Committee

January 7, 2015



# Interregional Planning Update

- 2014 Scenario Analysis – Complete and report posted – comments due by 1/16/2015
  - Scenario A - Update rollup case - complete
  - Scenario B - Severe Heat and Drought – complete
- 2025 summer and winter scenario build and analysis scheduled to begin
- Ground work for production cost studies – resource, data, funding Q1/Q2

- NERC transition planning
- Designated Entity – 7/1/15 selection target
  - Legal entity to contract with NERC
- Transition model building to NERC vision – project team to begin addressing
  - January – June 2015

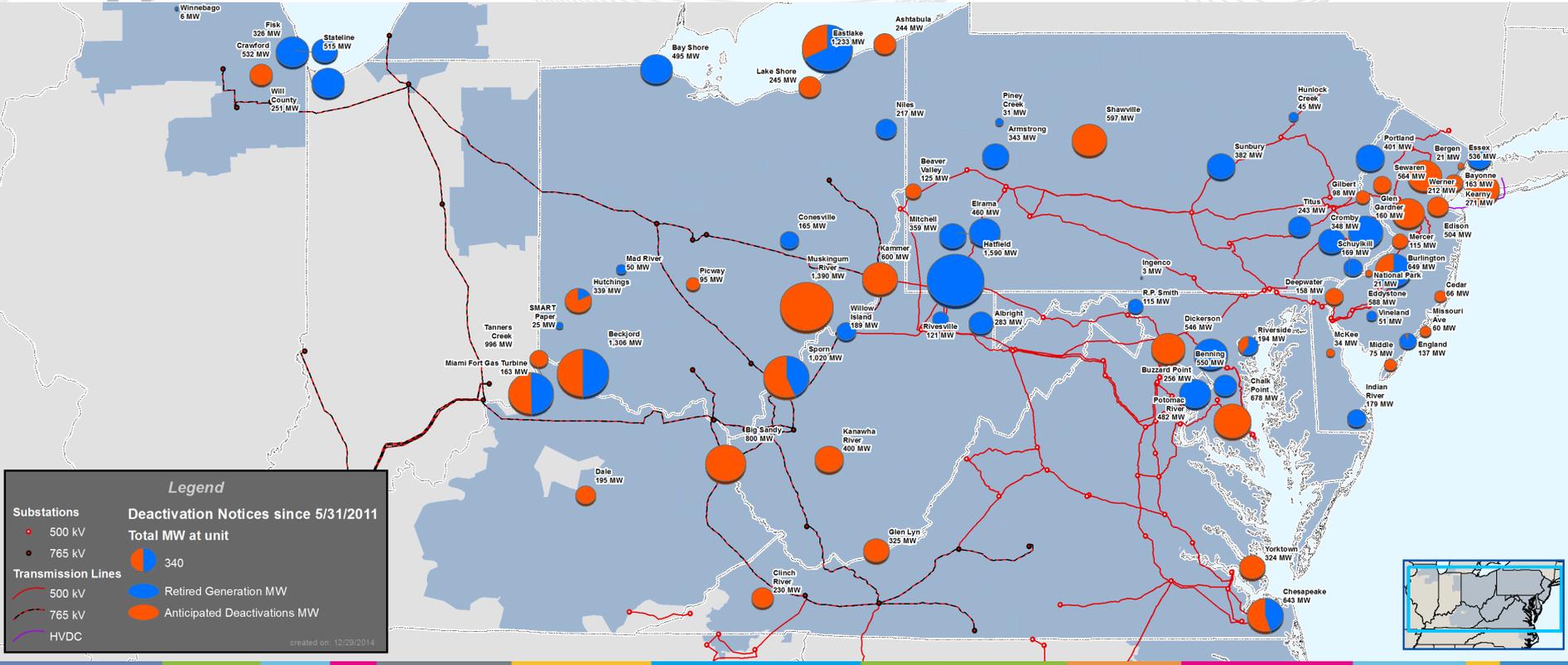
- **NC Utility Commission study**
  - Examine PJM Annual 2016/17 Base Residual Auction External Resources
  - Potential Reliability and Economic Effects on North Carolina
  - Analysis complete
  - Report draft under discussion

- 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 observation – extremely small change in production cost



- **PJM/MISO IPSAC**
  - **Metric and Process Review**
    - Three meetings held – new meeting schedule being developed
  - **“Quick hit” study**
    - Initial meeting held and stakeholder input requested – new meeting schedule being developed
    - December 8 next IPSAC – “quick hit” agenda
  - **FERC Orders related to MISO Order 1000**

# Generation Deactivation Notification (Retirements) Update



Unit(s)	Transmission Zone	Requested Deactivation Date	PJM Reliability Status
Bayonne CC (163MWs)	PSEG	11/1/2018	Reliability analysis complete. Impact identified. Upgrade expected to take approximately 4 years to complete. Generator can deactivate as scheduled on November 1, 2018. Upgrade under review (<.2% overload).
Burger EMD generator (6MWs)	ATSI	5/31/2016	Reliability analysis complete. No impacts identified.
Miami Fort Unit 6	DEOK	6/1/2015	Reliability analysis underway.

# 2015 RTEP Assumptions (Continued from December 2014 TEAC)

- Scenarios
- Machine List
- Case Build Schedule
- 24 Month Cycle

- Base Case
  - TO updates incorporated
  - Updated queued generation information incorporated
- In progress
  - Contingency update and check
  - Update interchange
  - Update generation dispatch
    - Machine list will be presented at February TEAC
  - Update load per latest 2015 load forecast

- End of January 2015
  - Incorporate final TO feedback and updates
  - Finalize case and associated files
- February 2015
  - Exercise the model using analysis, coordinate quality control check and benchmark
- February 2015 - March 2015
  - Begin formal RTEP analysis



# Year 2020 Summer RTEP Model Assumptions

- Load forecast
  - Latest 2015 load forecast for 2020 50/50 summer peak load
- Interchange
  - Based on latest reservations for 2020 in OASIS
- External topology
  - MMWG 2014 series 2020 summer peak
- Internal topology
  - 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



# Year 2020 Summer RTEP Model Assumptions

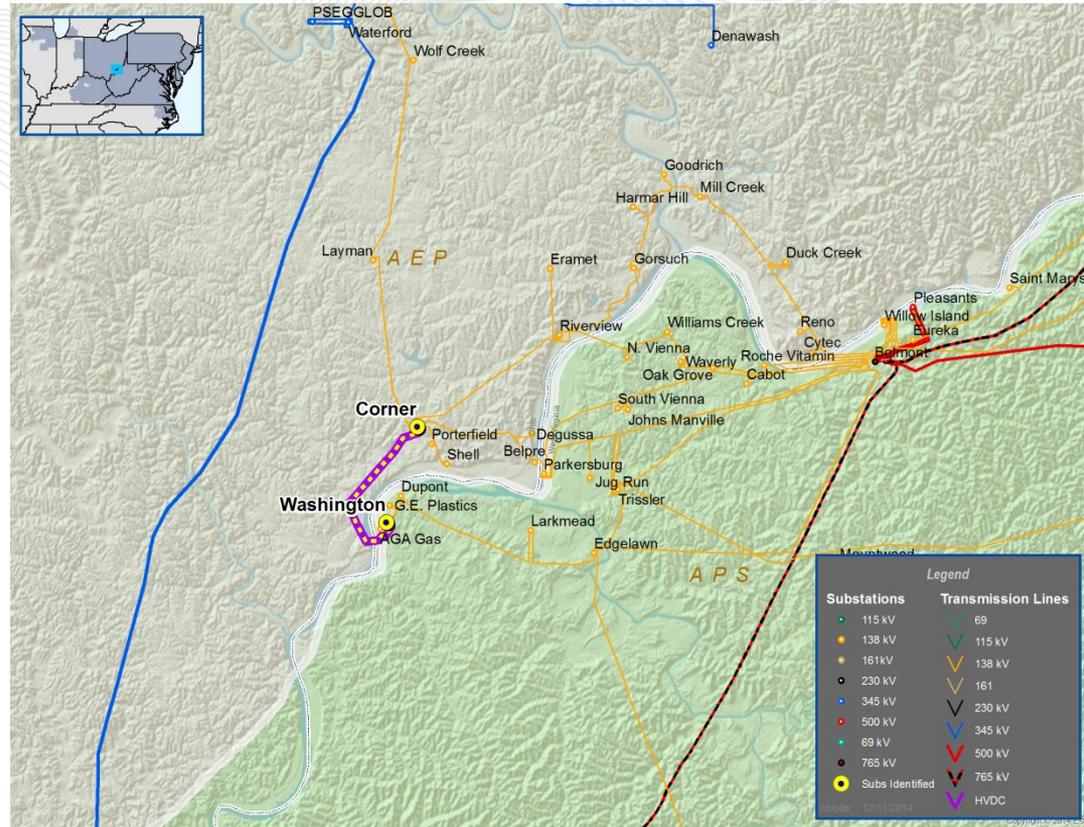
- Machine list
  - Updated Capacity Interconnection Rights (CIR's) for existing units
  - Queues with an executed FSA or higher as of 12/11/2014 will be included in the base model
    - Consult posted machine list for exact modeling assumption
    - FSA will be turned off but allowed to contribute to problems in Generator Deliverability
    - Any identified network upgrades driven by included queue projects will also be modeled
    - Any exceptions will be reviewed with TEAC
  - Units that cleared in previous RPM auctions that do not yet have an executed FSA or higher will be modeled
  - 2020 RTEP machine list will be presented at February 2015 TEAC

- MOD desk reference completed in 2013
  - Desk reference is being updated and an updated copy will be distributed to Transmission Owners in January 2015
- TO access including uploading and downloading via MOD website verified in 2014
- Currently updating Model On Demand software to latest version (v9.1) released December 2014

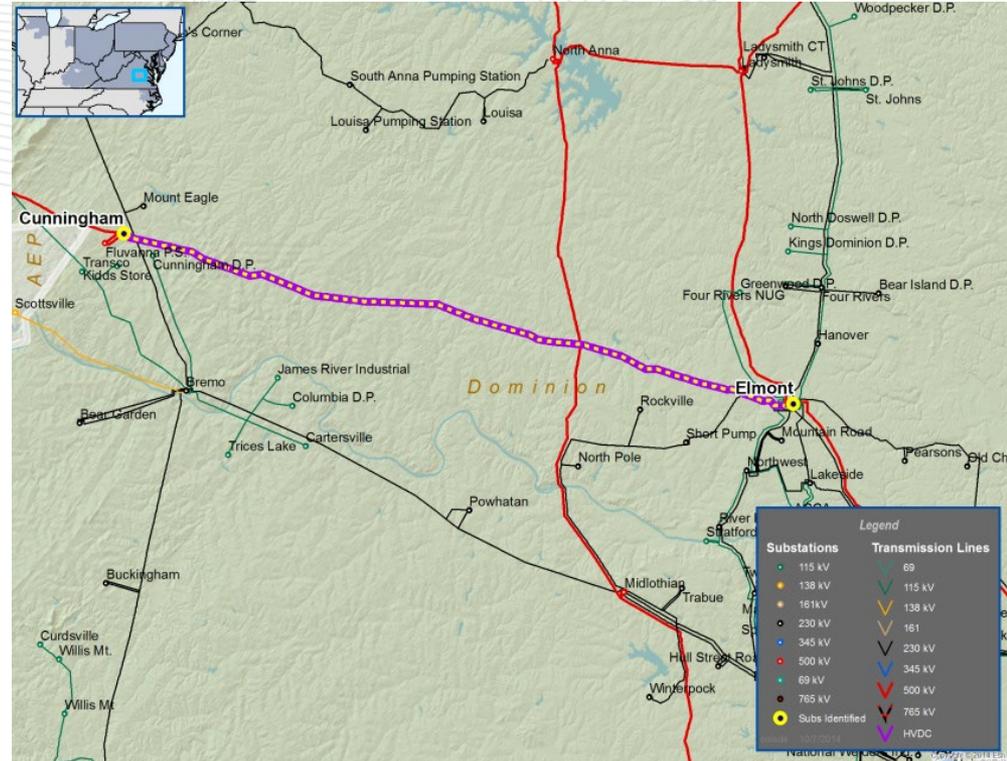
- January
  - Complete MOD v9.1 install
  - Install new schema and verify TO access
- Feb – July
  - Work with TO's to load in project files
- July – September
  - Benchmark cases built in MOD vs. vetted RTEP cases
- October – December
  - First case built in MOD anticipated 2019 RPM case

# Reliability Analysis Update

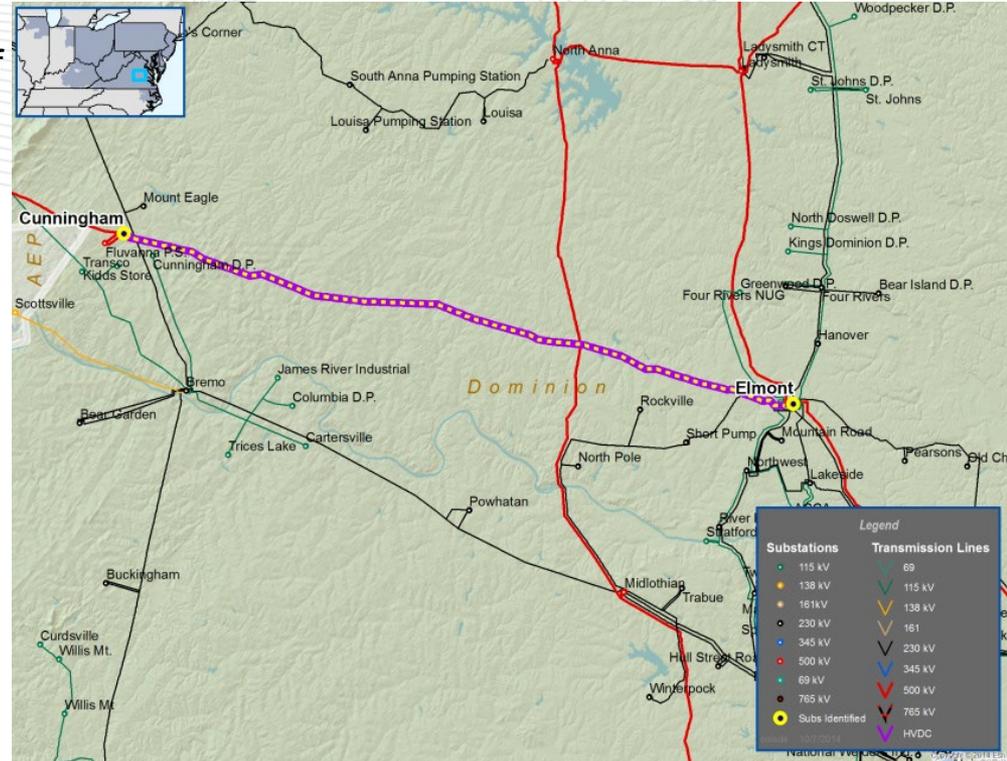
- Temporary Operating Procedure
- Immediate need due to the delay of the B1464: Corner area 138kV upgrades
- Recommended Solution: Interim Operating Procedure until B1464 is in service: Open the Corner 138 kV circuit breaker 86 for an overload of the Corner – Washington MP 138 kV line. The tower contingency loss of the Belmont – Trissler 138kV line and the Belmont – Edgelawn 138kV should be added to the Operational contingency file (B2581)
- Estimated Project Cost: \$0.0M
- Required IS Date: 6/1/2015



- Dominion Transmission Planning Criteria - End of Life Criteria Violation on the Cunningham to Elmont 500 kV Line
- Dominion 500 kV assessment by third party
  - Initiated by Dominion
  - Evaluate the condition of the 500 kV system in Dominion
    - Physical infrastructure evaluation
    - Power flow simulation
- Assessment Result
  - Due to condition, Cunningham – Elmont 500 kV has reached it's end of life
  - Facility list ranked by priority

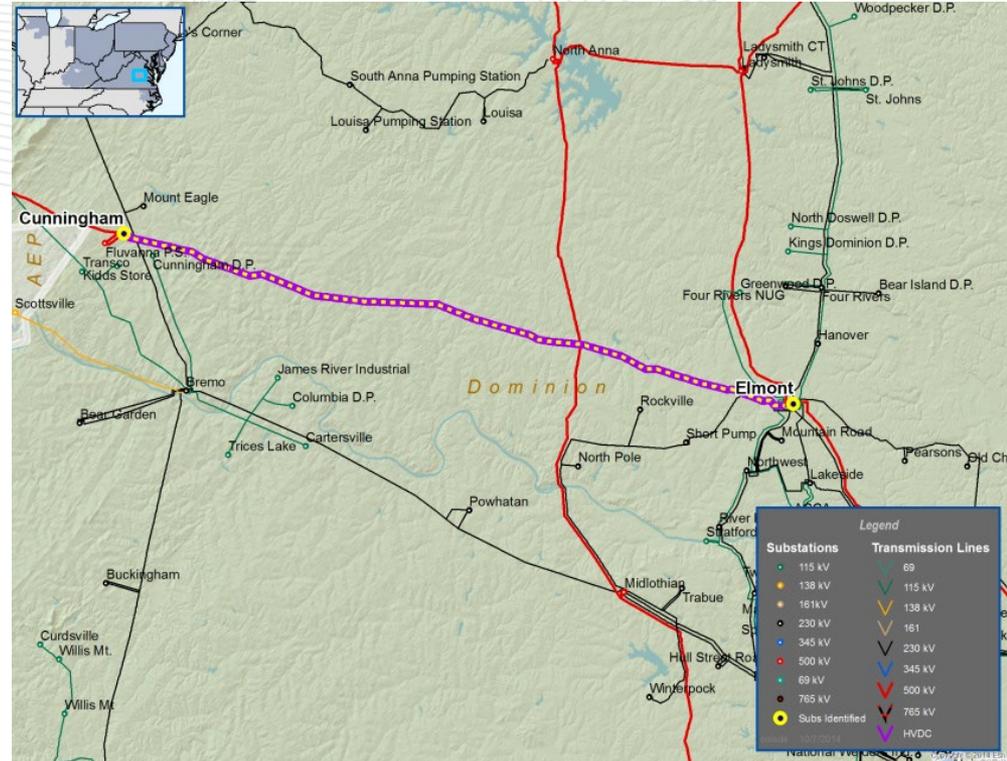


- Dominion Transmission Planning Criteria - End of Life Criteria Violation on the Cunningham to Elmont 500 kV Line
- Dominion Third party evaluation:
  - Confirmed the Cunningham to Elmont 500 kV is nearing or has reached its End of Life
  - Performed a Risk Assessment
- PJM analyses confirmed multiple category B and category C criteria violations including voltage and thermal violations on 230 kV and 138 kV systems without the line

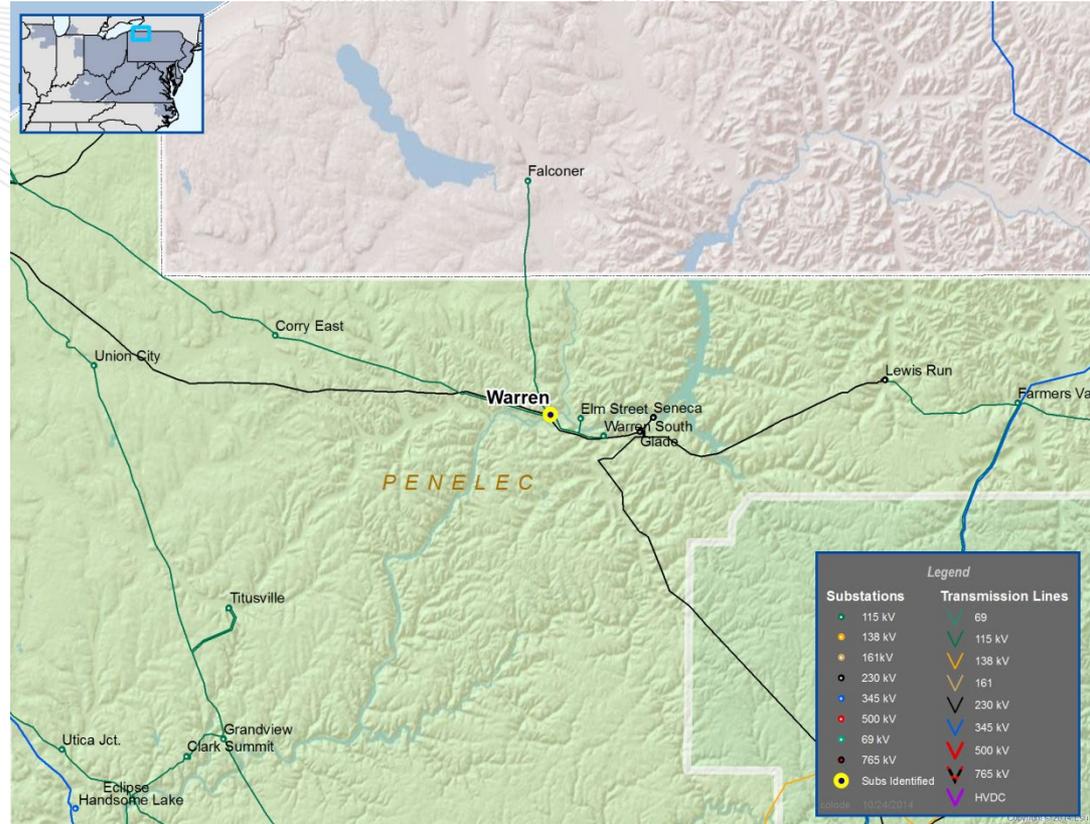


## Dominion Transmission Planning Criteria - End of Life Criteria Violation on the Cunningham to Elmont 500 kV Line

- PJM reviewed the condition assessment and a PJM Power Flow Assessment validated the power flow simulation results
- Recommended Solution: Rebuild the Elmont to Cunningham 500 kV line as a PJM baseline upgrade (b2582)
- Estimated Project Cost: \$106.1 M
- Expected In Service Date: 6/1/2018
  - PJM requests that the construction designee complete the project as soon as practical given the condition of the facility
- Construction Designation: Local TO (Dominion)



- The Warren 115kV breaker 'B12' is overstressed
- Proposed Solution: Replace the Warren 115kV breaker 'B12' with a 40kA breaker (B2573)
- Estimated Project Cost: \$250K
- Required IS Date: 6/1/2016



# 2014 RTEP Proposal Window #2 – Analytical Update

- Overview of Proposals
- Preliminary Recommendations
- [http://mediastream.pjm.com/2014/1218/teac/12182014-TEAC-Recording-Proposal-Window-n232-Update\\_/index.htm](http://mediastream.pjm.com/2014/1218/teac/12182014-TEAC-Recording-Proposal-Window-n232-Update_/index.htm)

## Transmission Expansion Advisory Committee

The Transmission Expansion Advisory Committee (TEAC) provides advice and recommendations to aid in the development of the [Regional Transmission Expansion Plan \(RTEP\)](#).

Chair: [Paul McGlynn](#)

Secretary: [Mike Herman](#)

### Postings

[Charter \(PDF\)](#)

Date

3.25.2011

[Behind the Meter Business Rules \(PDF\)](#)

1.11.2006

### Webcasts

[TEAC Webcast for 2014/15 RTEP Long Term Proposal Window](#)

[TEAC Webcast for 2014 RTEP Proposal Window 2](#)

[TEAC Webcast for 2014 RTEP Proposal Window 2 - Preliminary Recommendations - 12.18.2014](#)

- Light Load Reliability Criteria
  - Light Load Generator Deliverability Analysis identified 11 potential Reliability Criteria Violations
    - Nine (9) are related to PJM queued generators with an ISA but suspended status
    - One (1) is related to a retired unit
    - The one (1) remaining issue is a 138 kV line in the Comed Zone
  - Light Load N-1 Voltage Analysis identified 54 potential Reliability Criteria Violations
    - Five (5) 345 kV violations in the Penelec zone
    - Eleven (11) 230 kV violations in the PSE&G and Penelec zones
    - Thirty eight (38) 115 and 161 kV violations in the Penelec and EKPC zones

- N-1 Voltage Analysis
  - N-1 Low Voltage magnitude analysis identified one 138 kV violation in the APS zone.
  - N-1 Voltage Drop analysis identified one 138 kV violation in the EKPC zone and one 230 kV violation in the APS zone.
  
- N-1-1 Voltage Analysis
  - N-1-1 Voltage Drop analysis identified:
    - Twenty seven (27) 230 kV violations in the PSE&G zone and one (1) in the APS zone
    - Five (5) 138 kV violations in the APS zone and one (1) in the EKPC zone
    - Fourteen (14) 115 kV violations in the Meted zone
  
  - N-1-1 Low Voltage Magnitude analysis identified two (2) 115 kV violations in the Meted zone

- Transmission Owner Criteria
  - Thermal Transmission Owner Criteria potential violations include:
    - Four (4) 23 kV violations in the AEP zone
    - Thirteen (13) 34.5 kV violations in the AEP zone
    - Thirteen (13) 46 kV violations in the AEP zone
    - Nineteen (19) 69 kV violations in the AEP zone
    - Two (2) 138/69 kV violations in the AEP zone
    - Two (2) 23/69 kV violations in the AEP zone
    - One (1) 26/69 kV violations in the AEP Zone
    - Two (2) 69/161 kV violations in the EKPC zone
    - Two (2) 35 kV violations in the JCPL zone
    - Four (4) 345 kV violations in the Dominion zone
  - Voltage Transmission Owner Criteria potential violations include:
    - Sixty Four (64) 46 kV violations in the AEP zone
    - Two (2) 69 kV violations in the AEP zone

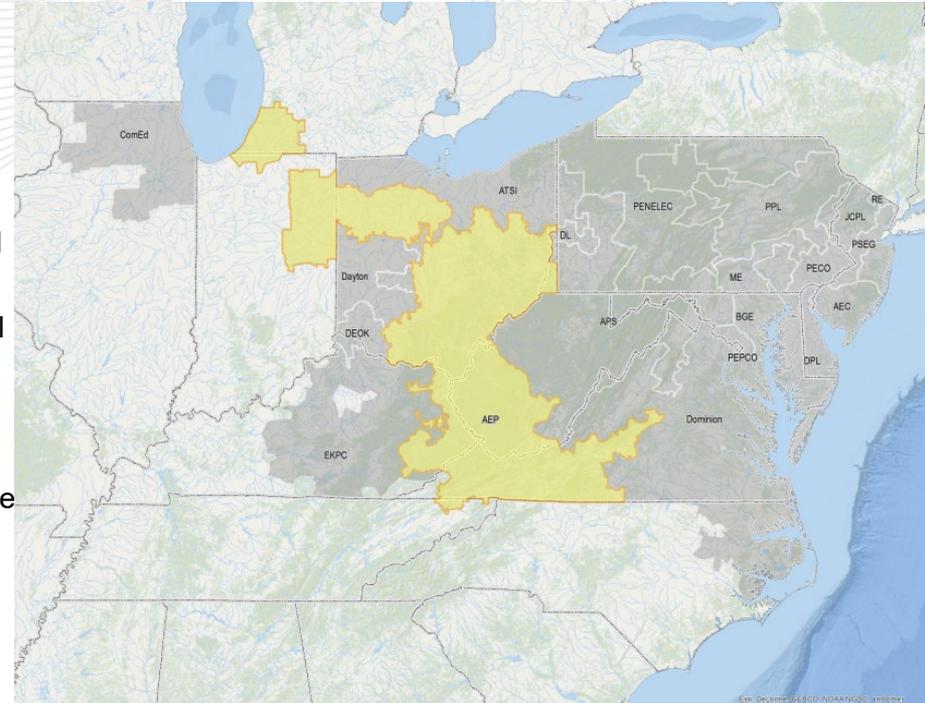


# 2014 RTEP Proposal Window #2 Proposals

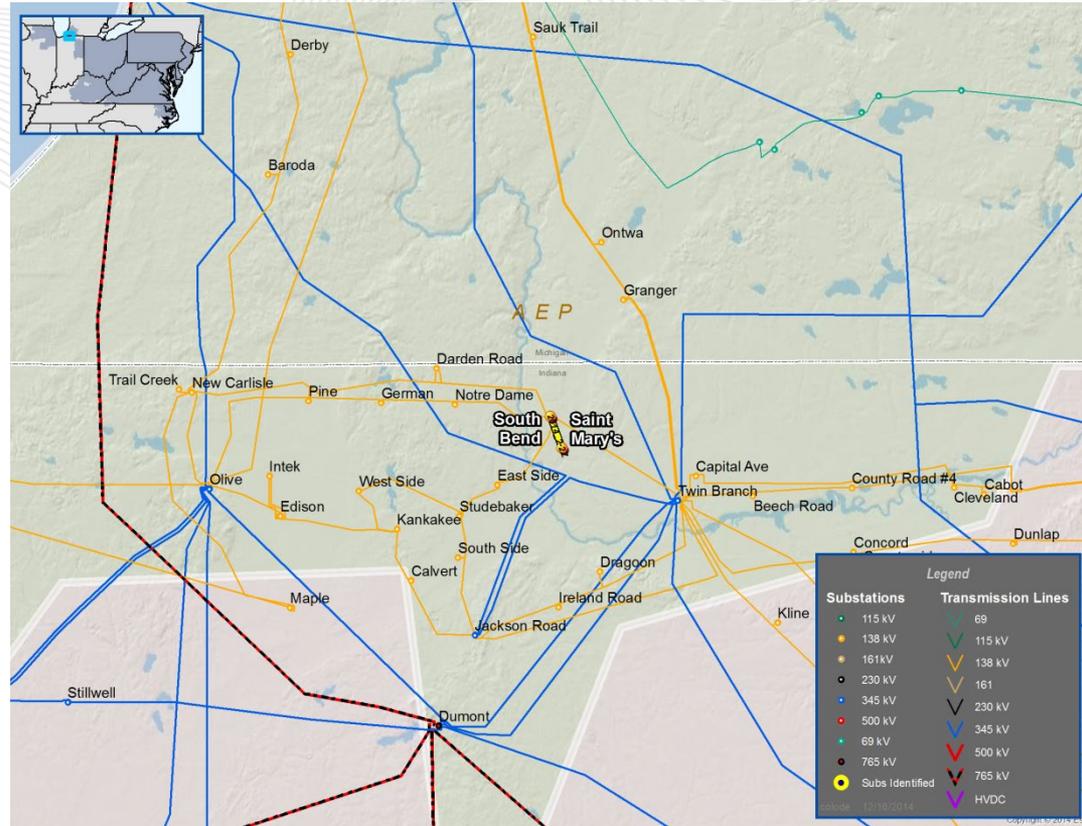
- PJM continues to evaluate the proposed projects
- Based on the work done to date proposals fall into the following high level categories
  1. Recommended solutions
  2. Retirement/At Risk related (reliability violations will be re-evaluated pending the status of the retirement/at risk generation)
  3. FSA generation related (reliability violations will be re-evaluated pending the status of the planned generation)
  4. Technical evaluation is on-going as necessary to develop a preliminary recommended solution

- As part of the evaluation, PJM considered the 15-year analysis results when making preliminary recommendations to check if a more robust solution would be needed due to that test
- The 15-year analysis results did not indicate a need for more robust preliminary recommendation solutions

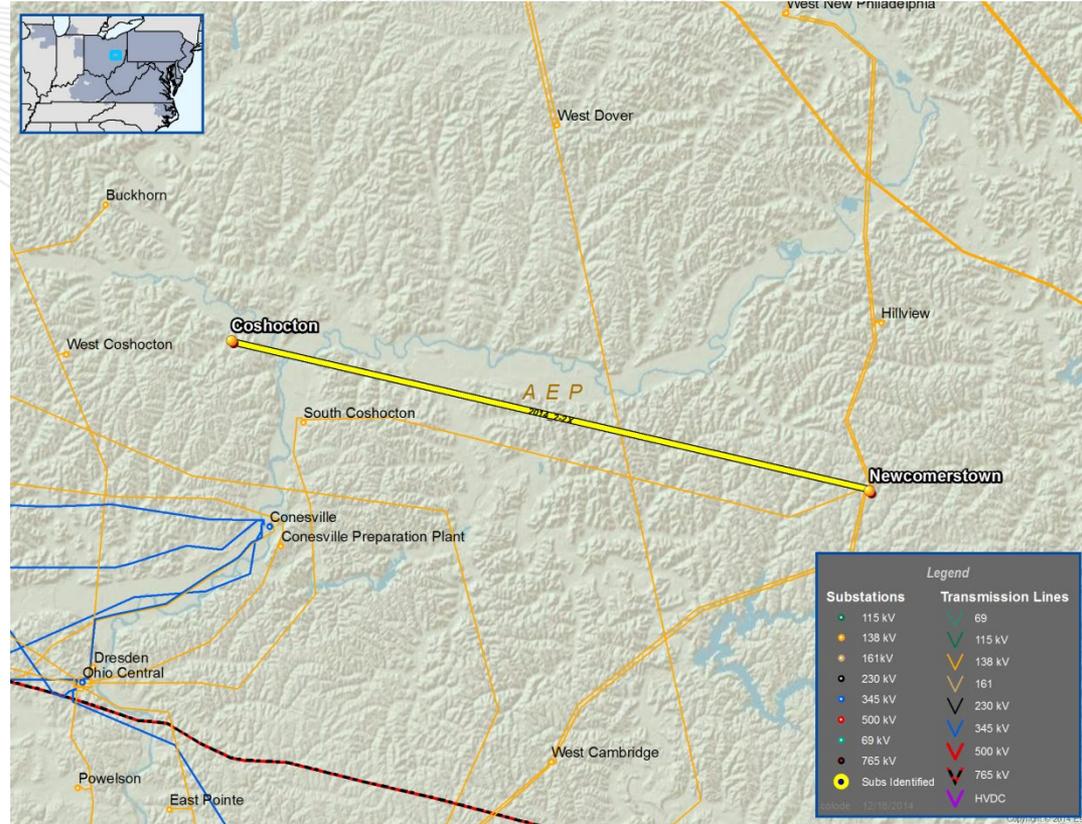
- 2014 RTEP Window #2 Violations by zone:
  - AEP
    - Four (4) 23 kV violations – TO Criteria, thermal
    - Thirteen (6) 34.5 kV violations – TO Criteria, thermal
    - Thirteen (13) 46 kV violations – TO Criteria, thermal
    - Nineteen (18) 69 kV violations – TO Criteria, thermal
    - Two (2) 138/69 kV violations – TO Criteria, thermal
    - Two (2) 23/69 kV violations – TO Criteria, thermal
    - One (1) 26/69 kV violations – TO Criteria, thermal
    - Sixty Four (64) 46 kV violations – TO Criteria, voltage
    - Two (2) 69 kV violations – TO Criteria, voltage



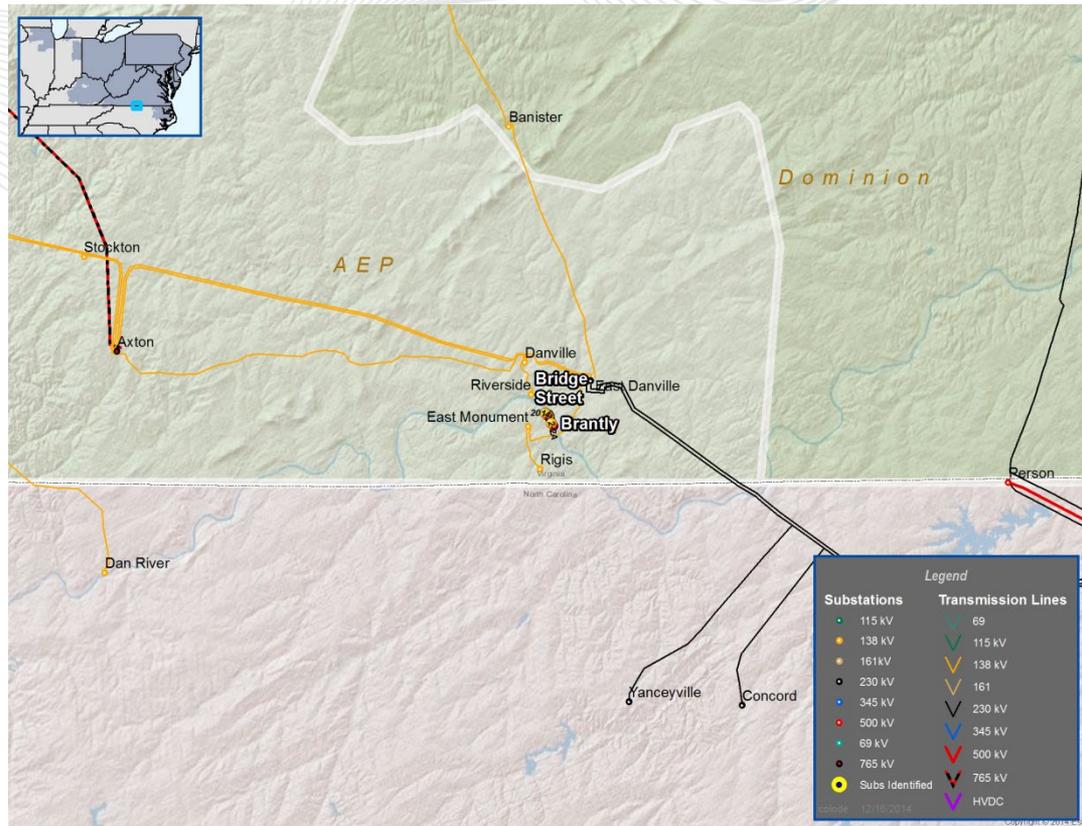
- **AEP Criteria Thermal Violation (FG # AEP-T32)**
- The South Bend – St. Marys 34.5KV branch is overloaded for the loss the W Side – Goodland – Drewrey’s 34.5KV line.
- **Alternatives considered:**
  - P2014\_2-2Y (\$7.922M)
  - P2014\_2-2Z (\$8.588M)
- **Recommended Solution:**
  - Construct a new 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. (P2014\_2-2Y)
- **Estimated Project Cost:** \$ 7.922 M
- **Required IS Date:** 6/1/2019



- **AEP Criteria Thermal Violation (FG # AEP-T33)**
- The Coshocton– North Coshocton 34.5KV branch is overloaded for the loss of the NEWCOM 138/69KV transformer
- **Alternatives considered:**
  - P2014\_2-2X (\$5.09M)
- **Recommended Solution:**
  - Rebuild existing East Coshocton – North Coshocton double circuit line which contains Newcomerstown - N. Coshocton 34.5kV Circuit and Coshocton – North Coshocton 69kV circuit . (P2014\_2-2X)
- **Estimated Project Cost:** \$ 5.09 M
- **Required IS Date:** 6/1/2019



- **AEP Criteria Thermal Violation (FG # AEP-T17)**
- The Brantly – Bridge S 69KV line is overloaded for the loss of Danville – Riverside 138kV line
- **Alternatives considered:**
  - P2014\_2-2A (\$1.5M)
- **Recommended Solution:**
  - Rebuild 1.0 mile of Brantley-Bridge Street 69 kV Line with 1033 ACSR overhead conductor. (P2014\_2-2A)
- **Estimated Project Cost: \$1.5 M**
- **Required IS Date: 6/1/2019**



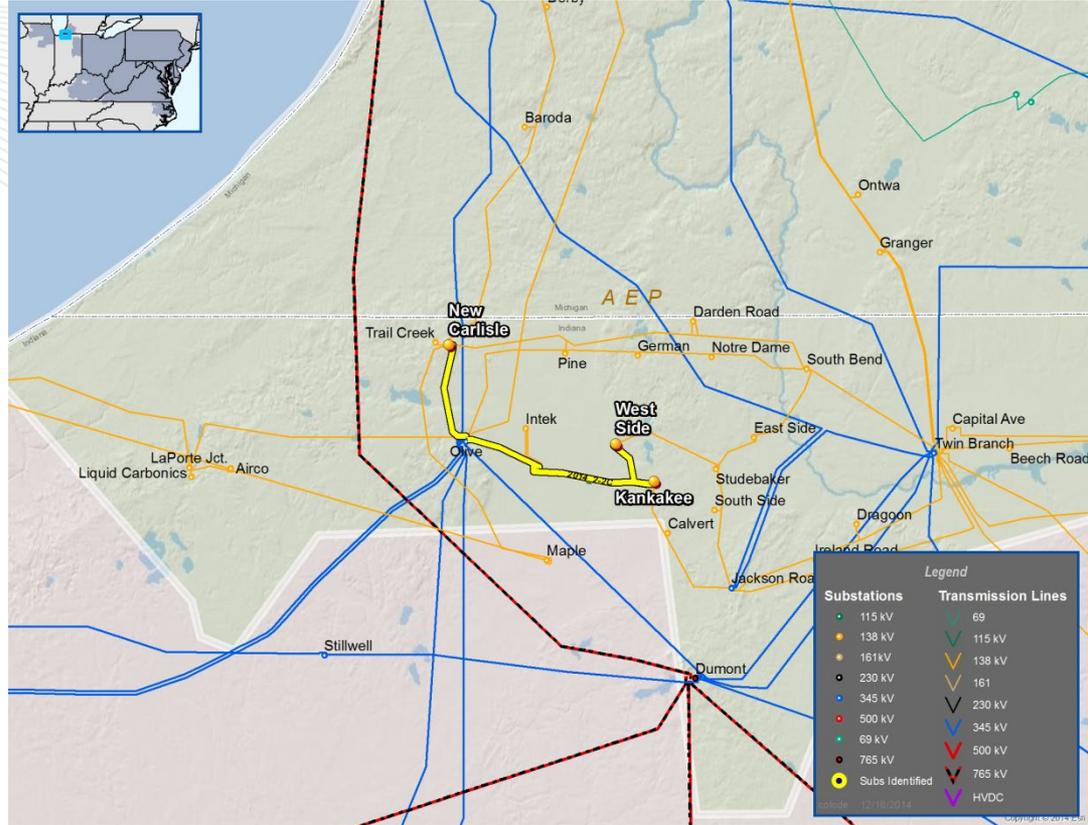
- **AEP Criteria Thermal Violation (FG # AEP-T13, AEP-T19)**
- The Haysi SS – Moss 69KV line is overloaded for the loss of Fletch – Skeggb – Gardec 138kV line; The Elkhorn – Haysi SS 69kV line is overloaded for the loss of the Big Sandy- Inez 138kV circuits
- **Alternatives considered:**
  - P2014\_2-2B(\$31.86M)
- **Recommended Solution:**
  - Rebuild 7.82 mile Elkhorn City - Haysi S.S 69 kV line utilizing 1033 ACSR built to 138 kV standards; Rebuild 5.18 mile Moss - Haysi SS 69 kVline utilizing 1033 ACSR built to 138 kV standards. (P2014\_2-2B)
- **Estimated Project Cost: \$31.86 M**
- **Required IS Date: 6/1/2019**



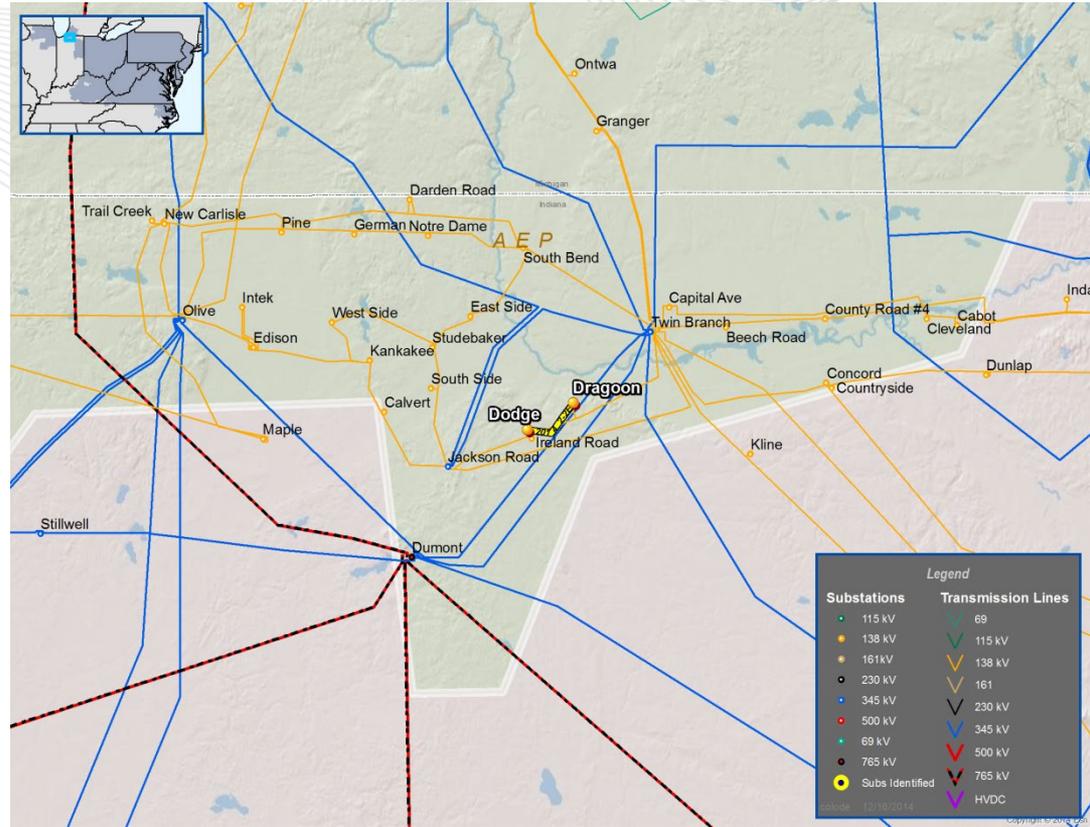


# AEP Transmission Zone

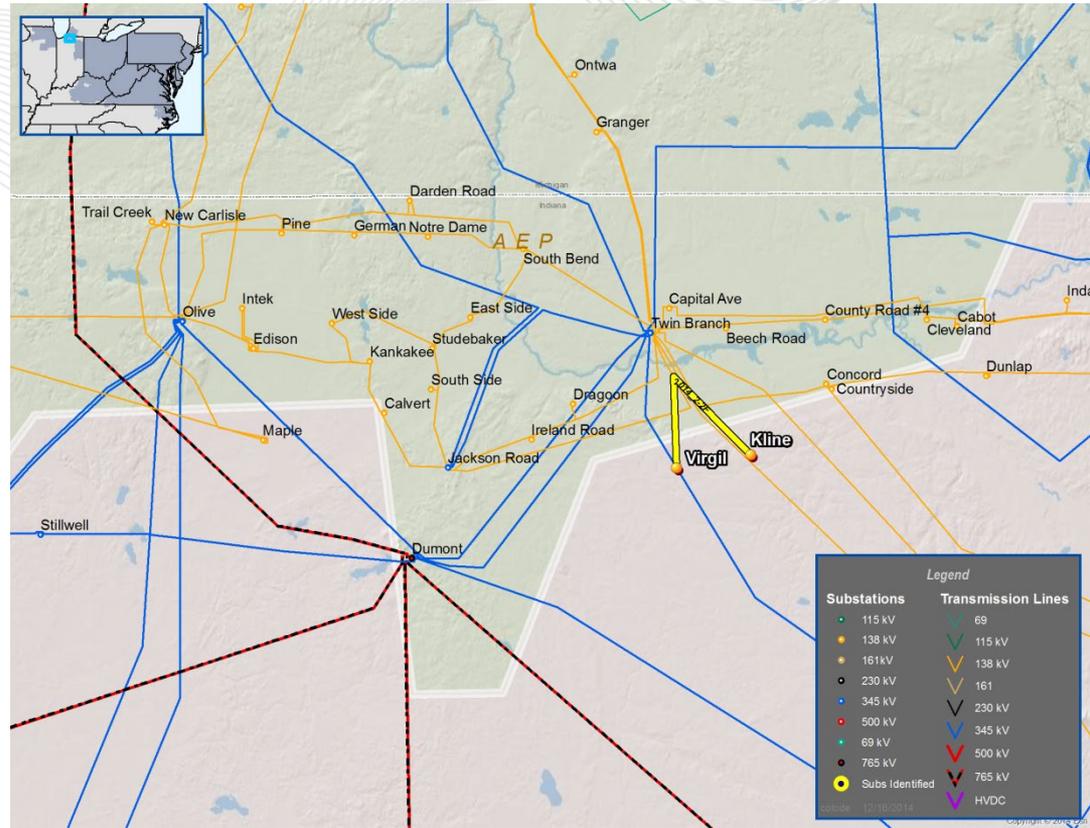
- **AEP Criteria Thermal Violation (FG # AEP-T28)**
- The Lydick– West Side 34.5KV line is overloaded for the loss of the New Carlisle 138/34.5kV transformer
- Alternatives considered:
  - P2014\_2-2C (\$8.778M)
  - P2014\_2-2D (\$2.025M)
- Recommended Solution:
  - Move load from the 34.5 kV bus to the 138 kV bus by installing a new 138/12 kV XF at New Carlisle station in Indiana. (P2014\_2-2D)
- Estimated Project Cost: \$2.025 M
- Required IS Date: 6/1/2019



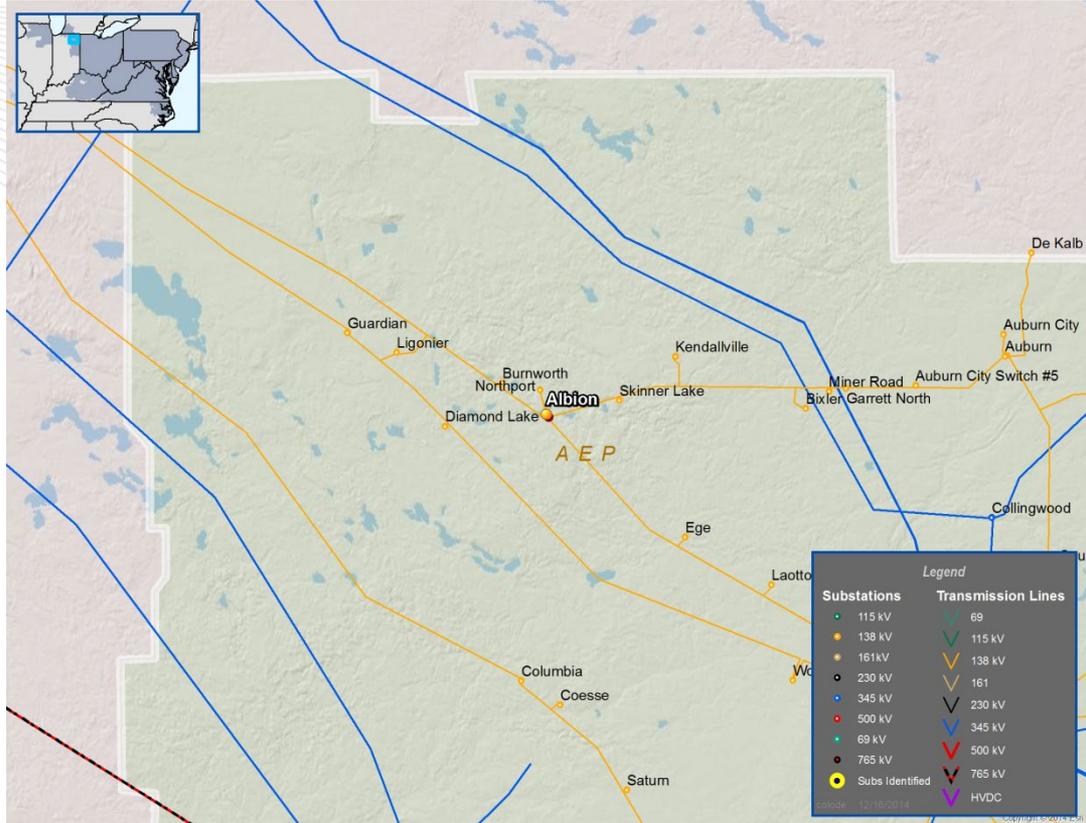
- **AEP Criteria Thermal Violation (FG # AEP-T29)**
- The Dodge Tap– Dagoon 34.5KV line is overloaded for the loss of the Kline 138/34.5kV transformer
- Alternatives considered:
  - P2014\_2-2E (\$2.154M)
- Recommended Solution:
  - Rebuild approximately 1 mile section of the Dagoon-Virgil Street 34.5 kV line between Dagoon and Dodge Tap switch and replace Dodge switch MOAB to increase thermal capability of the Dagoon-Dodge Tap branch. (P2014\_2-2E)
- Estimated Project Cost: \$2.154 M
- Required IS Date: 6/1/2019



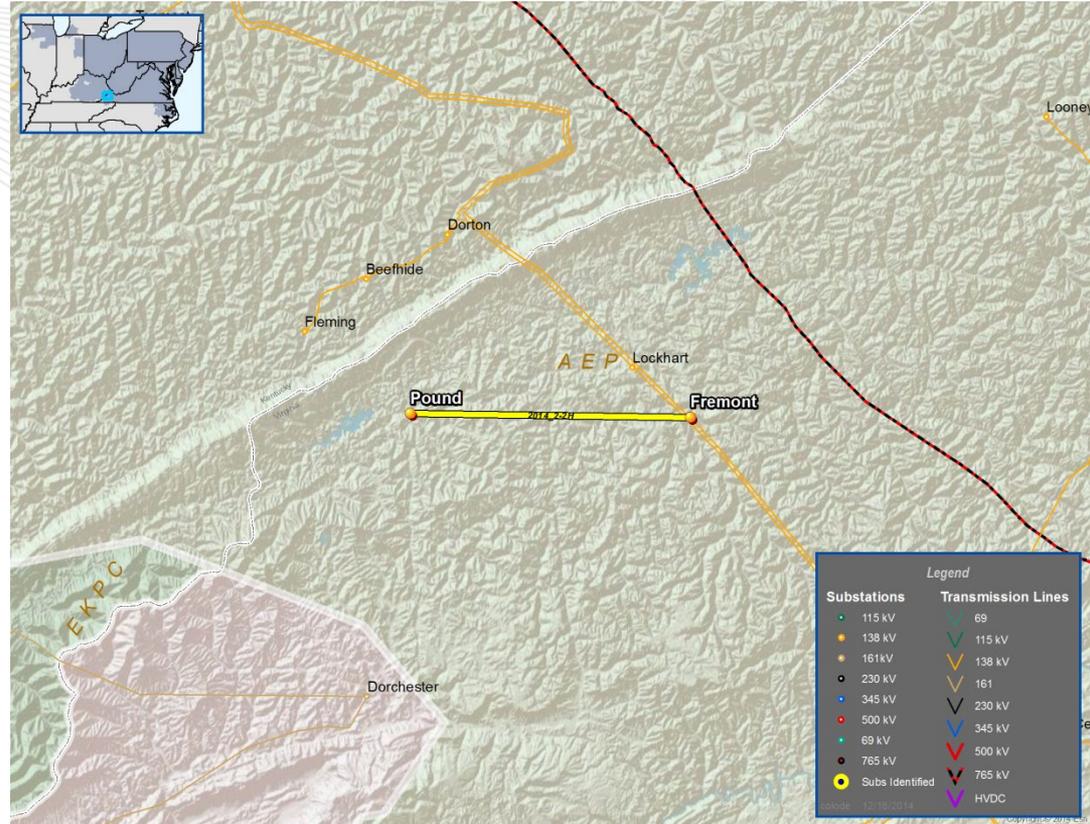
- **AEP Criteria Thermal Violation (FG # AEP-T30, AEP-T31)**
- The Kline – Bieger – Virgil S 34.5KV line is overloaded for the loss of the Dagoon 138/34.5kV line
- Alternatives considered:
  - P2014\_2-2F(\$1.689M)
- Recommended Solution:
  - Rebuild approximately 1 mile section of the Kline-Virgil Street 34.5 kV line between Kline and Virgil Street tap. Replace MOAB switches at Bieger, risers at Kline, switches and bus at Virgil Street. (P2014\_2-2F)
- Estimated Project Cost: \$1.689 M
- Required IS Date: 6/1/2019



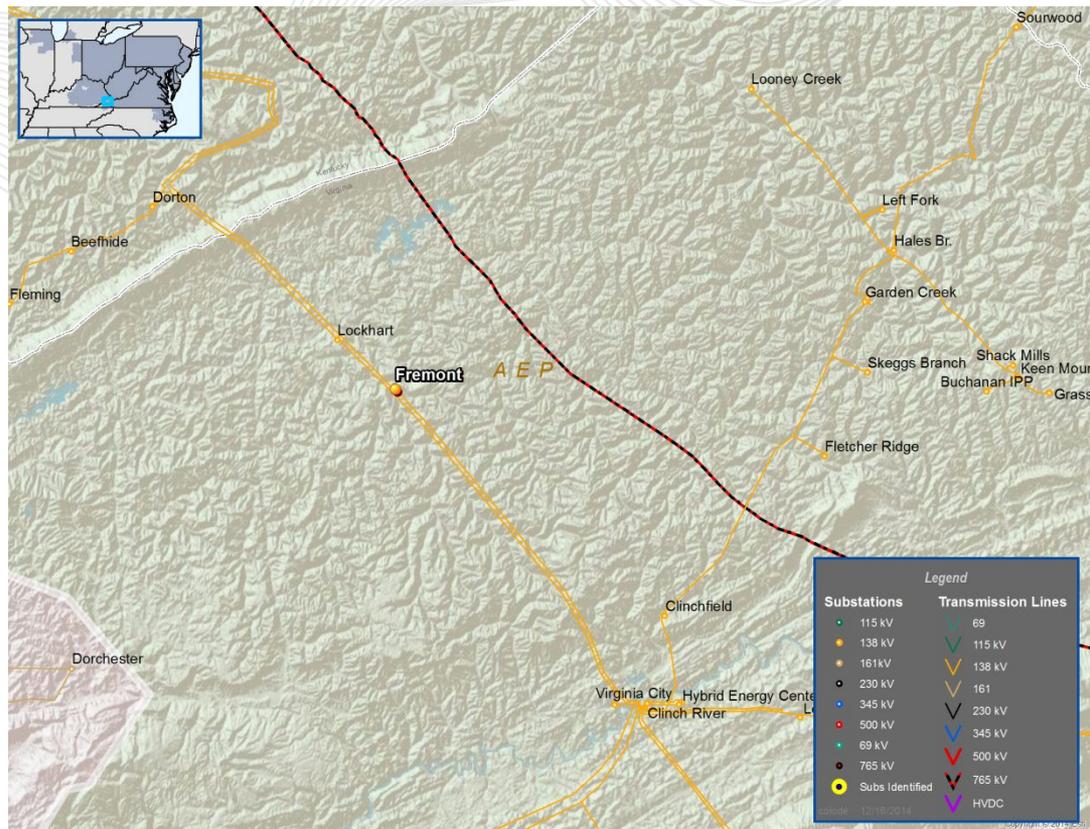
- **AEP Criteria Thermal Violation (FG # AEP-T54)**
- The Albion– Albion Z 69KV line is overloaded for the loss the Bixler – Kendallville 138kV line
- Alternatives considered:
  - P2014\_2-2G (\$0.2M)
- Recommended Solution:
  - Rebuild approximately 0.1 miles of 69 kV line between Albion and Albion tap. (P2014\_2-2G)
- Estimated Project Cost: \$0.2 M
- Required IS Date: 6/1/2018



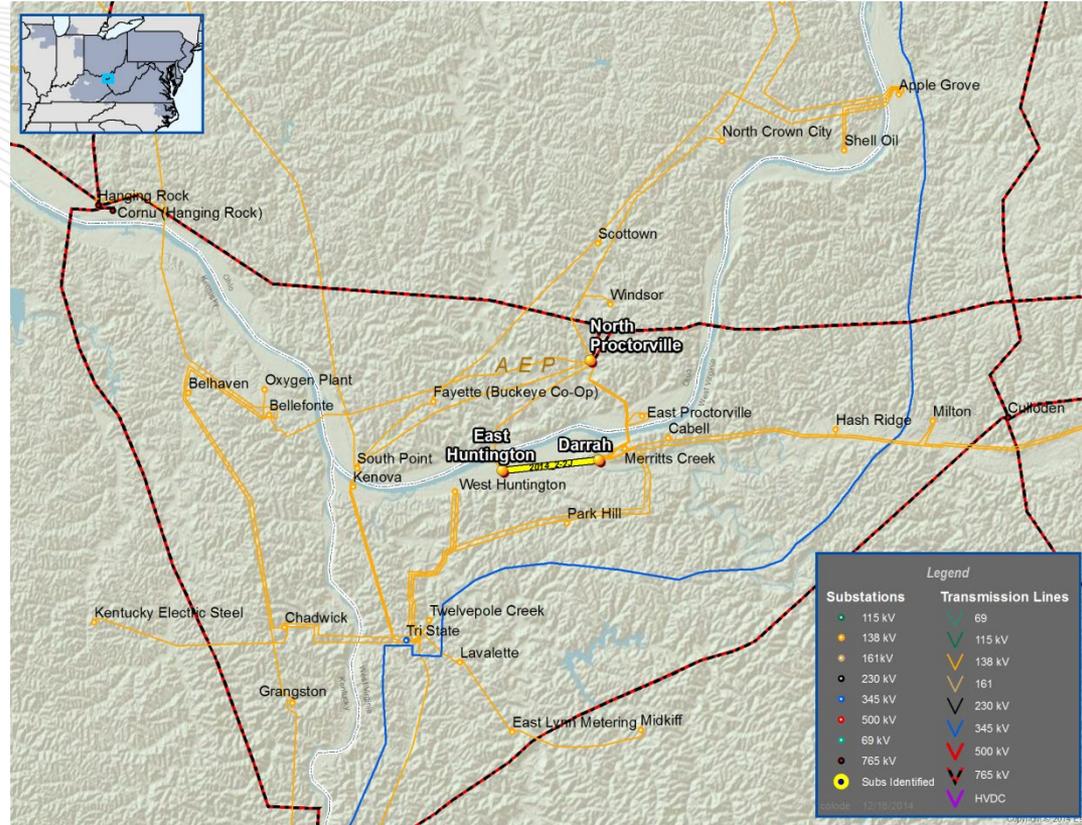
- **AEP Criteria Thermal Violation (FG # AEP-T23, AEP-T26)**
- The Lick Fork S.S. – Clintwood S.S. 69KV line is overloaded for the loss of the Clinch River – Lockhart 138kV line
- Alternatives considered:
  - P2014\_2-2H (\$14.5M)
- Recommended Solution:
  - Fremont - Pound Rebuild as 138 kV. (P2014\_2-2H)
- Estimated Project Cost: \$14.5 M
- Required IS Date: 6/1/2019



- **AEP Criteria Thermal Violation (FG # AEP-T9)**
- The Fremont 138/69kV XF1 transformer is overloaded for the loss of the Beaver Creek – Fremont 138kV line
- Alternatives considered:
  - P2014\_2-2I (\$2.5M)
- **Recommended Solution:**
  - Fremont 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. (P2014\_2-2I)
- Estimated Project Cost: \$2.5 M
- Required IS Date: 6/1/2019



- **AEP Criteria Thermal Violation (FG # AEP-T10)**
- The 23<sup>rd</sup> Street – 24<sup>th</sup> Street 34.5KV line is overloaded for the loss of East Huntington – North Proctorville – South Point 138kV line
- **Alternatives considered:**
  - P2014\_2-2J (\$12.56M)
- **Recommended Solution:**
  - 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 (P2014\_2-2J)
- **Estimated Project Cost: \$12.56 M**
- **Required IS Date: 6/1/2019**



**AEP Criteria Thermal/Voltage Violation (FG # AEP-T6, AEP-T7, AEP-T24; AEP-V8, AEP-V9, AEP-V11, AEP-V13, AEP-V14, AEP-V15, AEP-V16, AEP-V17, AEP-V18, AEP-V19, AEP-V20, AEP-V21, AEP-V22, AEP-V23, AEP-V24, AEP-V27, AEP-V28, AEP-V29, AEP-V32, AEP-V41, AEP-V42, AEP-V44, AEP-V46, AEP-V47, AEP-V48, AEP-V49, AEP-V50, AEP-V51, AEP-V52, AEP-V53, AEP-V54, AEP-V55, AEP-V56, AEP-V57, AEP-V60, AEP-V61, AEP-V62, AEP-V65)**

The Slaughter Creek –Winifrede 46kV line is overloaded for multiple contingencies. Low voltage at the Emmons, Roundbottom, Peytona, Penn VA Coal, Mikes Run, Shabdue, Hopkins Fork, Boone, Maxine S. S., Camp Creek 46kV buses for multiple contingencies

**Alternatives considered:**

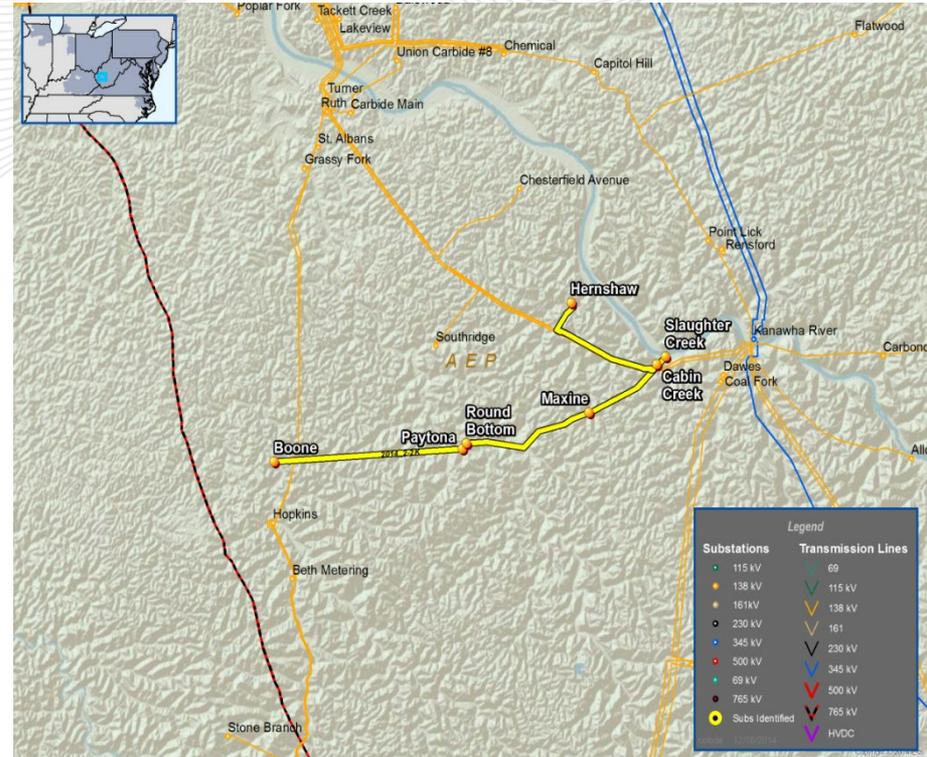
- P2014\_2-2K (\$43.18M)

**Recommended Solution:**

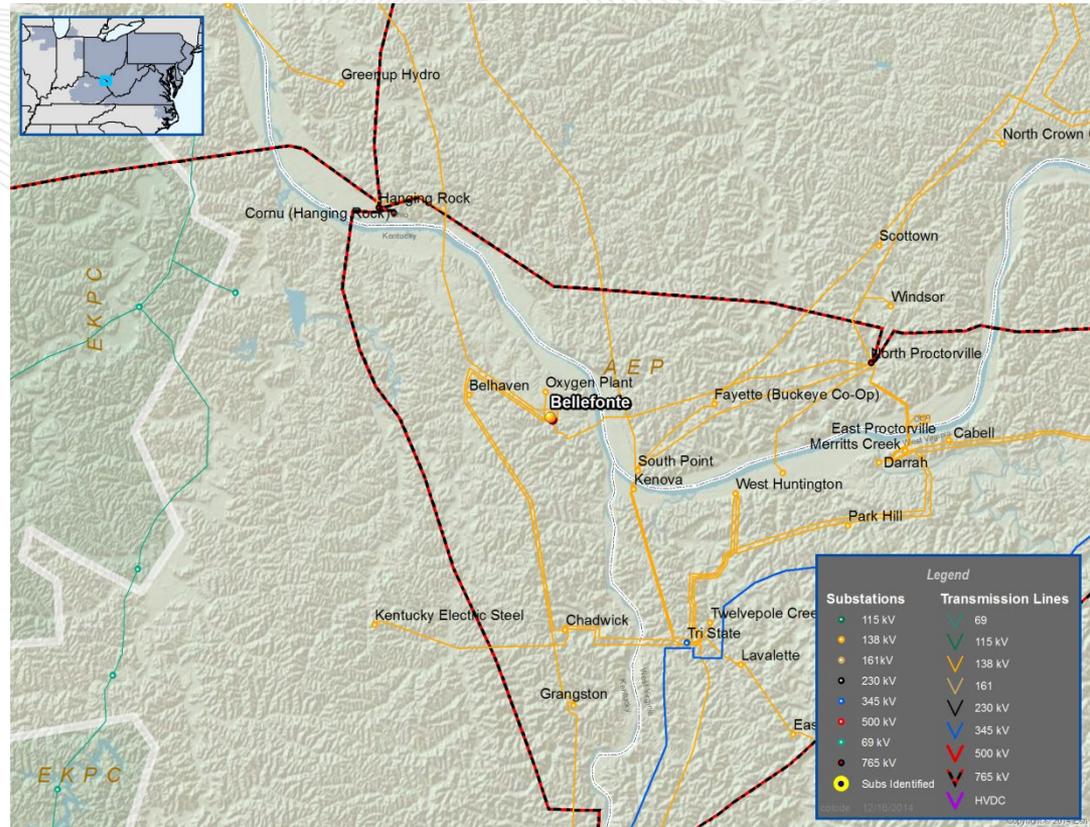
Boone Area Improvements: Purchase approximately a 200X300 station site near Slaughter Creek 46 kV station (to establish a greenfield 138kV Wilbur Station). Install 3 138 kV circuit breakers. Loop the Cabin Creek to Harnshaw 138 kV circuit into the new station by constructing ~1mile double circuit 138kV line extending north from the station. 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 Slaughter Creek, Maxine, Peytona, Round Bottom and Boone Stations. 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 (P2014\_2-2K)

**Estimated Project Cost: \$43.18 M**

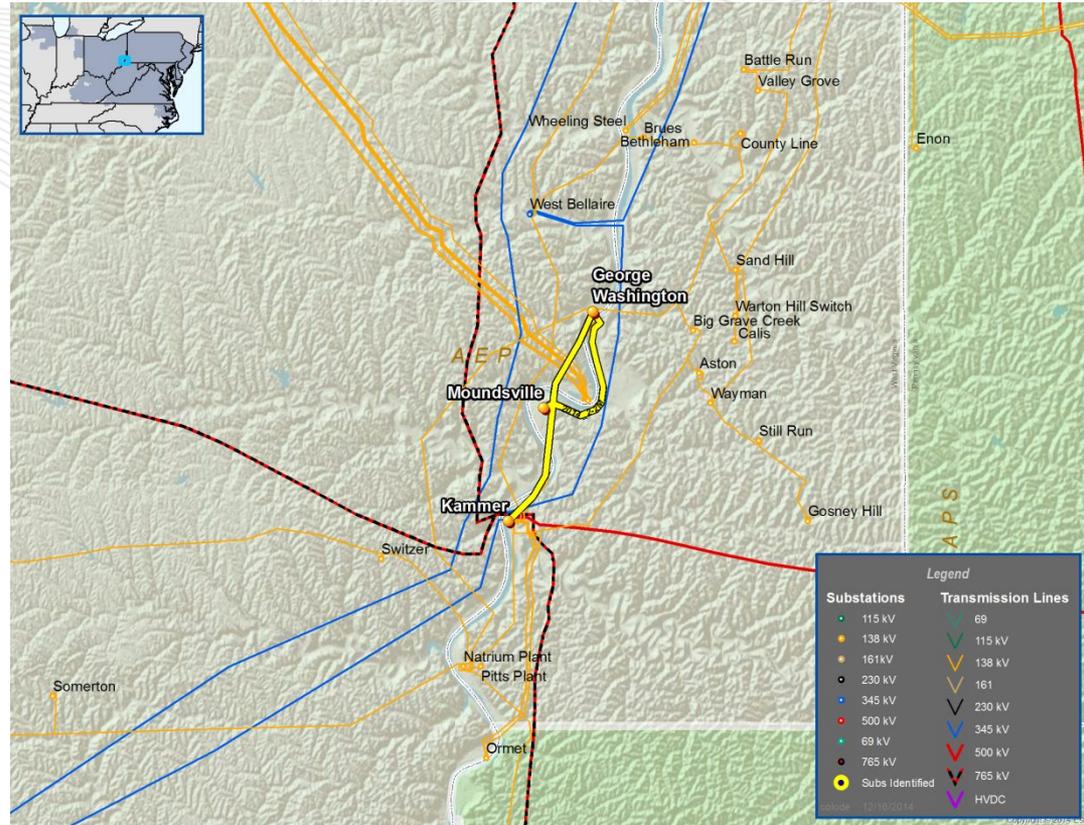
**Required IS Date: 6/1/2019**



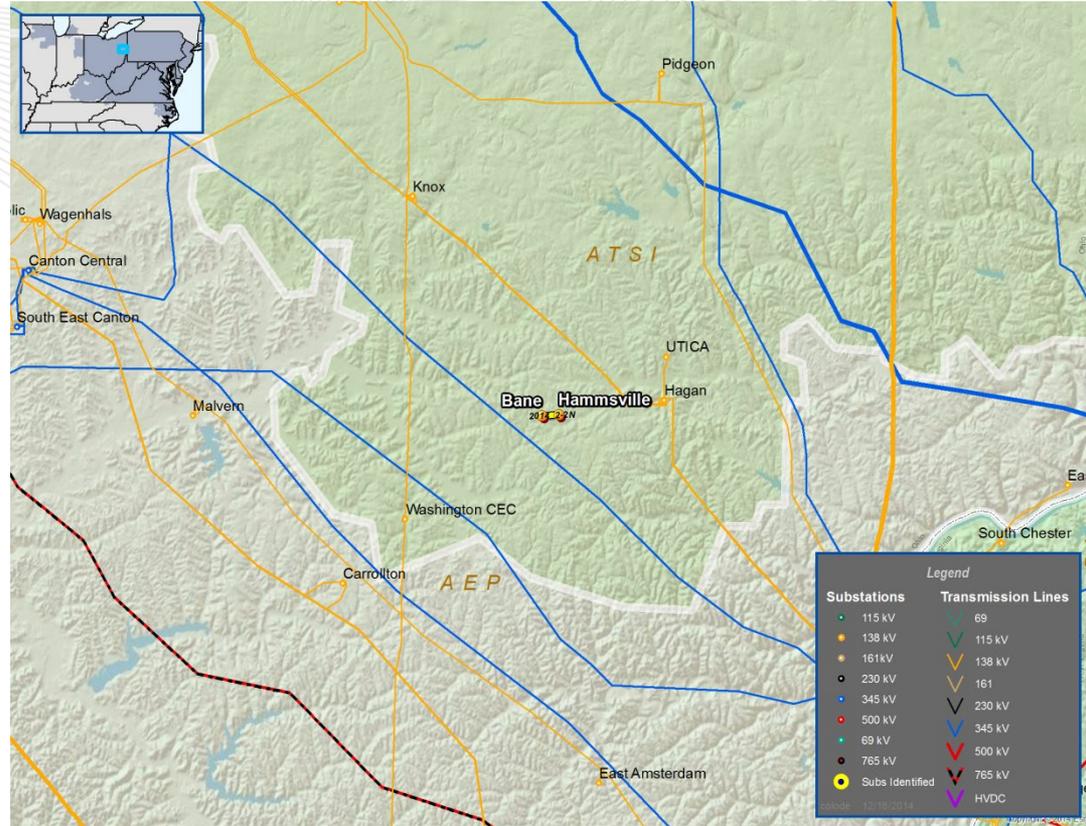
- **AEP Criteria Thermal Violation (FG # AEP-T53)**
- The Bellefonte 138/69/34 XF5 transformer is overloaded for the loss of Bellefonte – Hanging Rock 138kV line
- Alternatives considered:
  - P2014\_2-2L (\$31.65M)
- Recommended Solution:
  - Bellefonte Transformer Addition (P2014\_2-2L)
- Estimated Project Cost: \$31.65 M
- Required IS Date: 6/1/2019



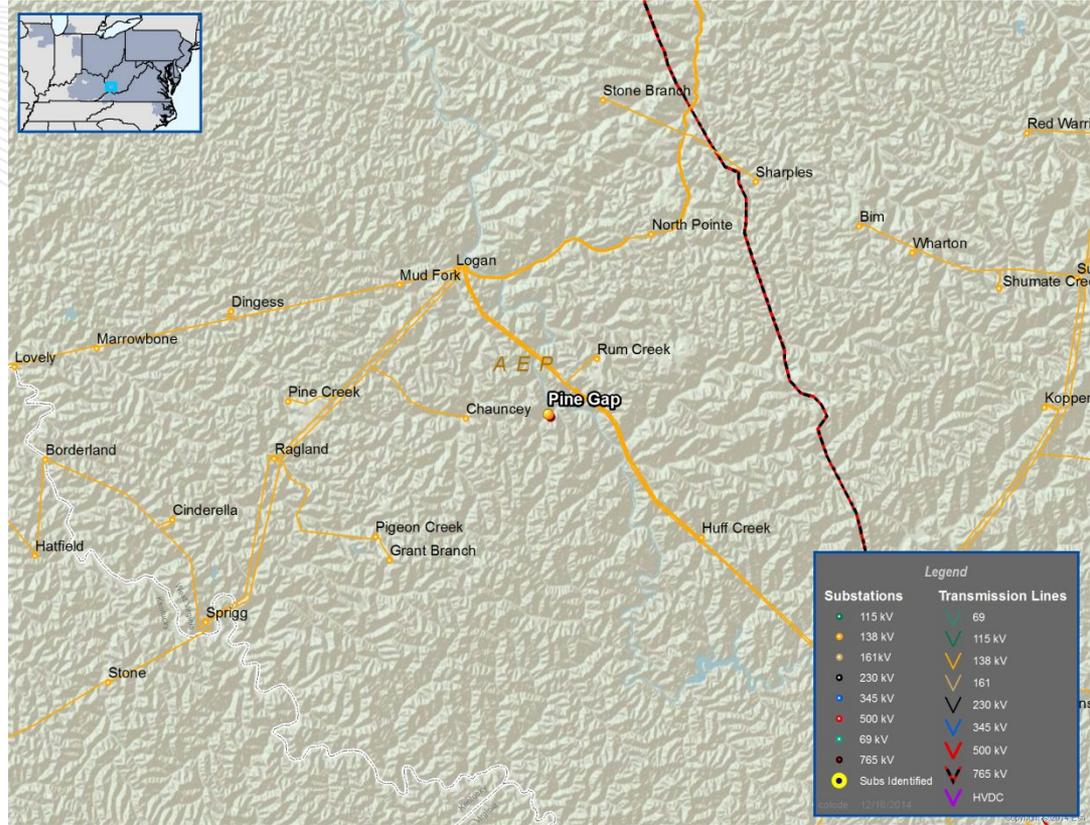
- **AEP Criteria Thermal Violation (FG # AEP-T38, AEP-T39, AEP-T40, AEP-T41, AEP-T42, AEP-T43, AEP-T44)**
- The Lockwood– Moundsville 69KV line, Consol Coal IR –Kammer 69KV line is overloaded for multiple contingencies
- Alternatives considered:
  - P2014\_2-2M (\$26M)
- Recommended Solution:
  - Rebuild & 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. (P2014\_2-2M)
- Estimated Project Cost: \$26 M
- Required IS Date: 6/1/2019



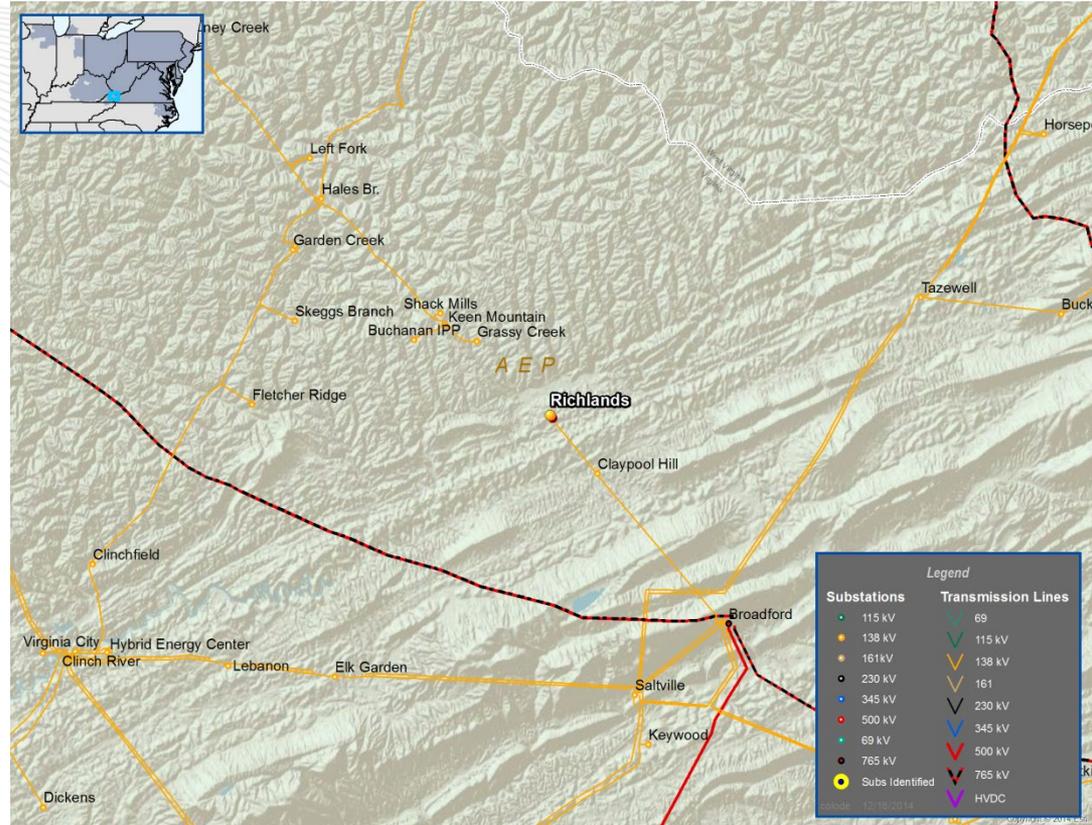
- **AEP Criteria Thermal Violation (FG # AEP-T46, AEP-T47, AEP-T48, AEP-T49, AEP-T50, AEP-T51, AEP-T52)**
- The Pekin–Bane S.S. 23kV line and Bane S.S. 69/23 KV transformer are overloaded in base case and the loss of the Hammondsville –Salinville 23kV line ; Hammondsville 69/23kV transformer, Augusta- Bane S.S. 23KV line and Summitville – West Summitville 23kV line for the loss of the Pekin –Bane 23kV line
- **Alternatives considered:**
  - P2014\_2-2N (\$9.3M)
- **Recommended Solution:**
  - Convert Bane-Hammondsville from 23kV to 69kV operation. (P2014\_2-2N)
- **Estimated Project Cost:** \$9.3 M
- **Required IS Date:** 6/1/2019



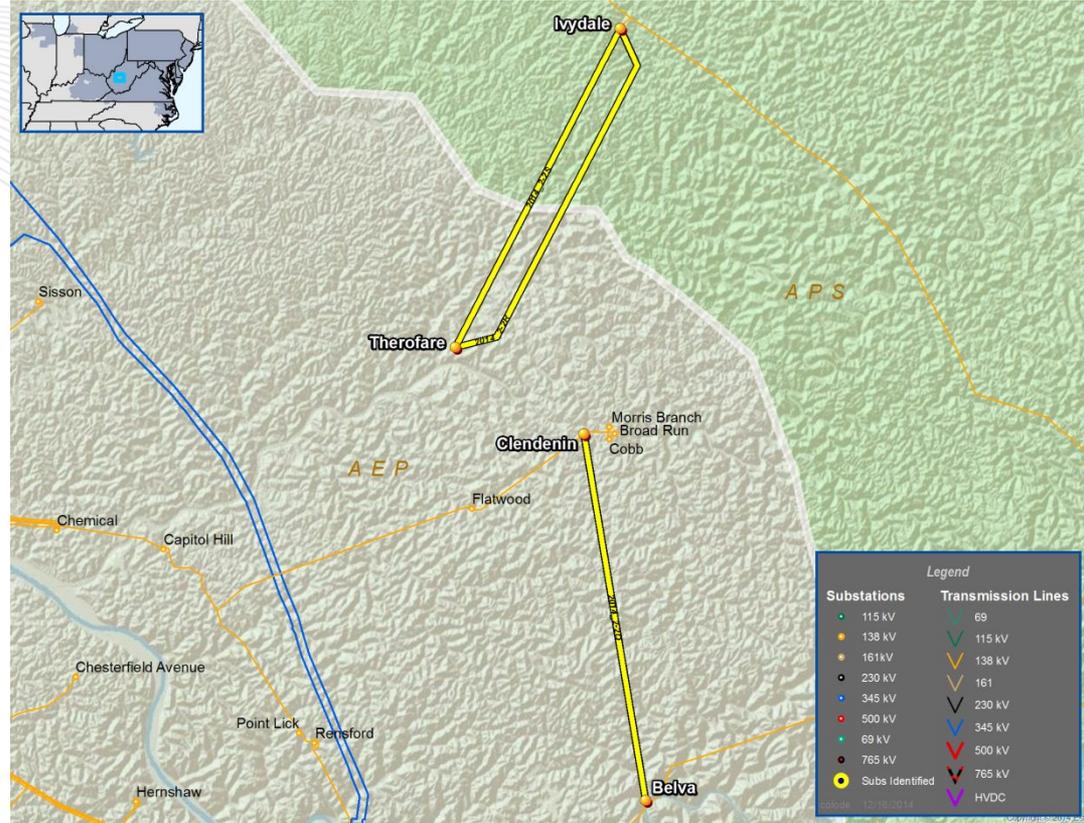
- **AEP Criteria Thermal Violation (FG # AEP-T14)**
- The Chauncey– Pine Gap 46KV line is overloaded for the loss of the Becco – Braeholm – Huff Creek 46kV line
- Alternatives considered:
  - P2014\_2-20 (\$0.0M)
- Recommended Solution:
  - Pine Gap Relay Limit Increase. (P2014\_2-20)
- Estimated Project Cost: \$0.0 M
- Required IS Date: 6/1/2019



- **AEP Criteria Thermal Violation (FG # AEP-T21)**
- The Richlands– Town of Richlands 69KV line is overloaded for the loss of Saltville – Tazewell 138KV line
- Alternatives considered:
  - P2014\_2-2P (\$0.2M)
- Recommended Solution:
  - Richlands Relay Upgrade (P2014\_2-2P)
- Estimated Project Cost: \$0.2 M
- Required IS Date: 6/1/2019



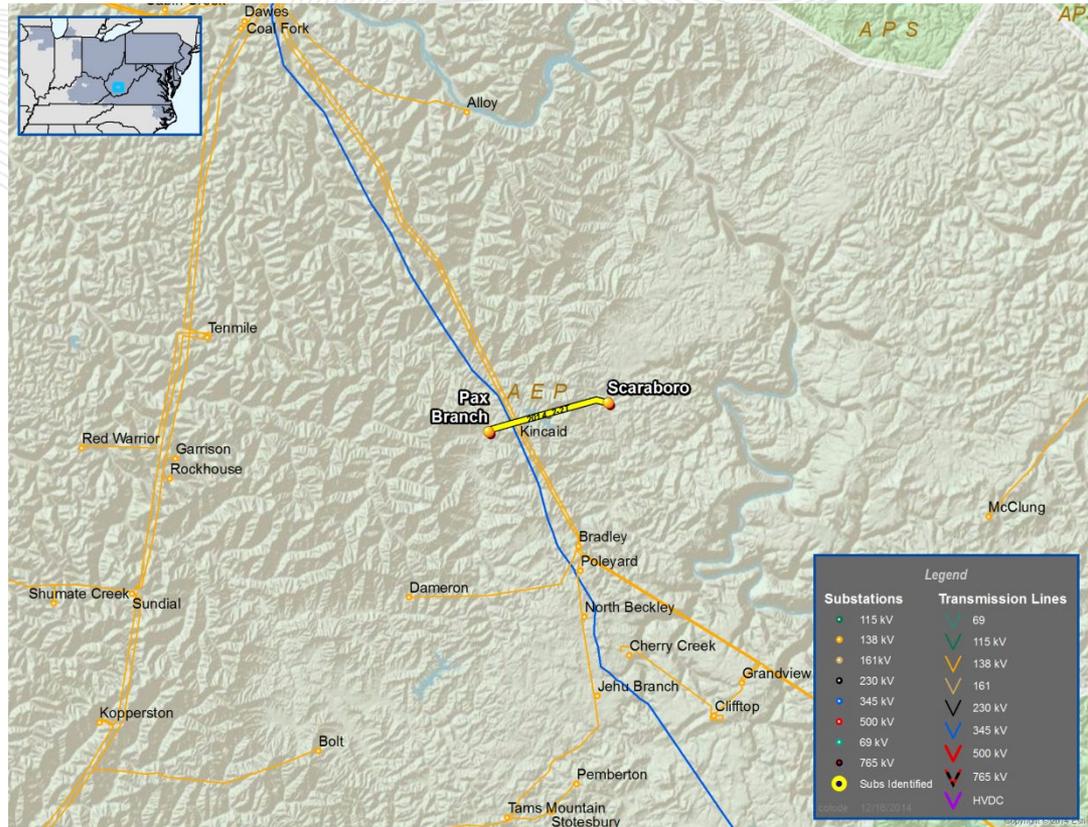
- **AEP Criteria Thermal Violation (FG # AEP-T18, AEP-T22)**
- The Clendenin– Hartland 46KV branch is overloaded for the loss of the Belva – Carbondale 138kV line
- Alternatives considered:
  - P2014\_2-2Q (\$75.5M)
  - P2014\_2-2R (\$57.5M)
  - P2014\_2-2S (\$53.0M)
- Recommended Solution:
  - Therofare - Ivydale Area Build (P2014\_2-2S)
- Estimated Project Cost: \$53.0 M
- Required IS Date: 6/1/2019



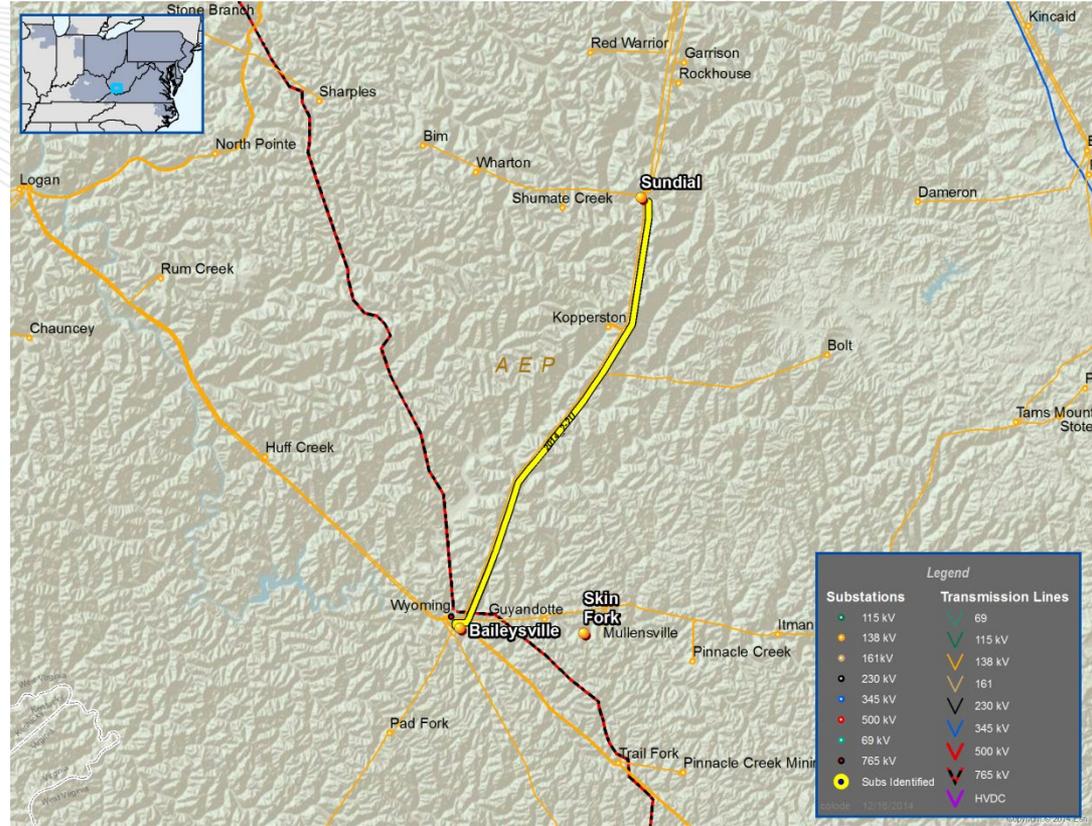


# AEP Transmission Zone

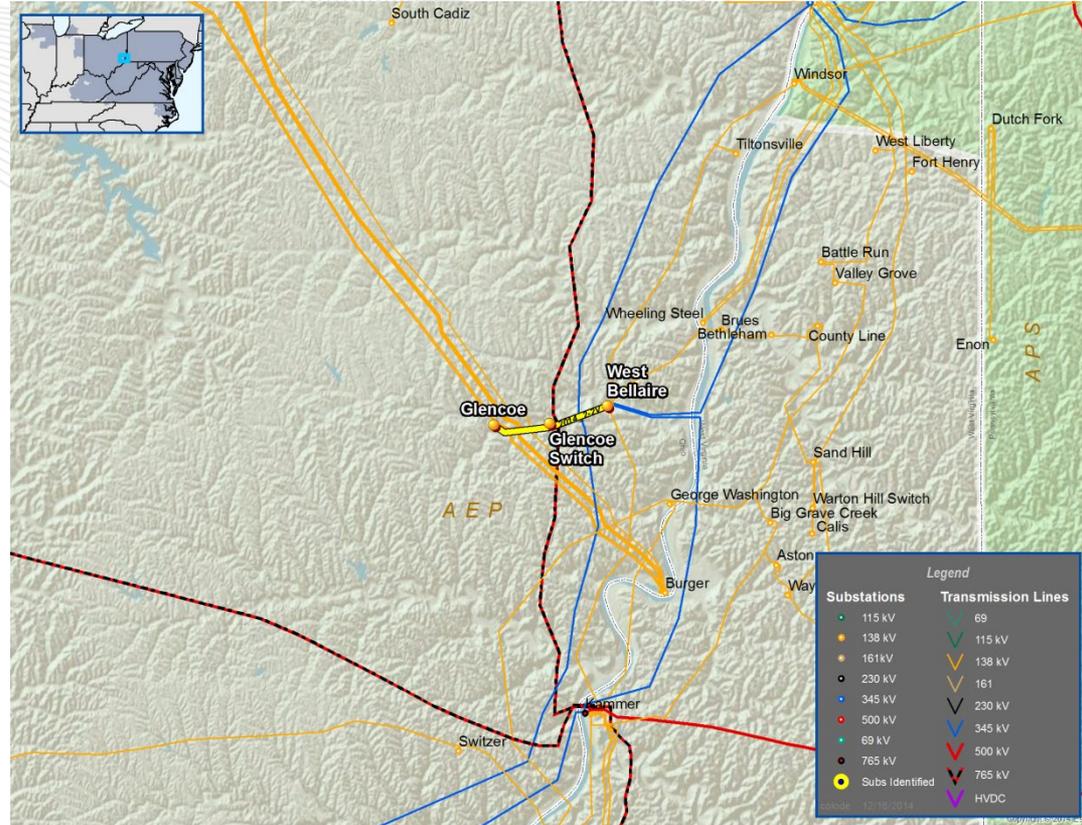
- **AEP Criteria Thermal Violation (FG # AEP-T20)**
- The Scarboro– Pax Branch 46KV line is overloaded for the loss of the Bradley – Pax Branch 138kV line
- **Alternatives considered:**
  - P2014\_2-2T (\$11.3M)
- **Recommended Solution:**
  - Pax Branch - Scarboro Rebuild as 138 kV (P2014\_2-2T)
- **Estimated Project Cost: \$11.3 M**
- **Required IS Date: 6/1/2019**



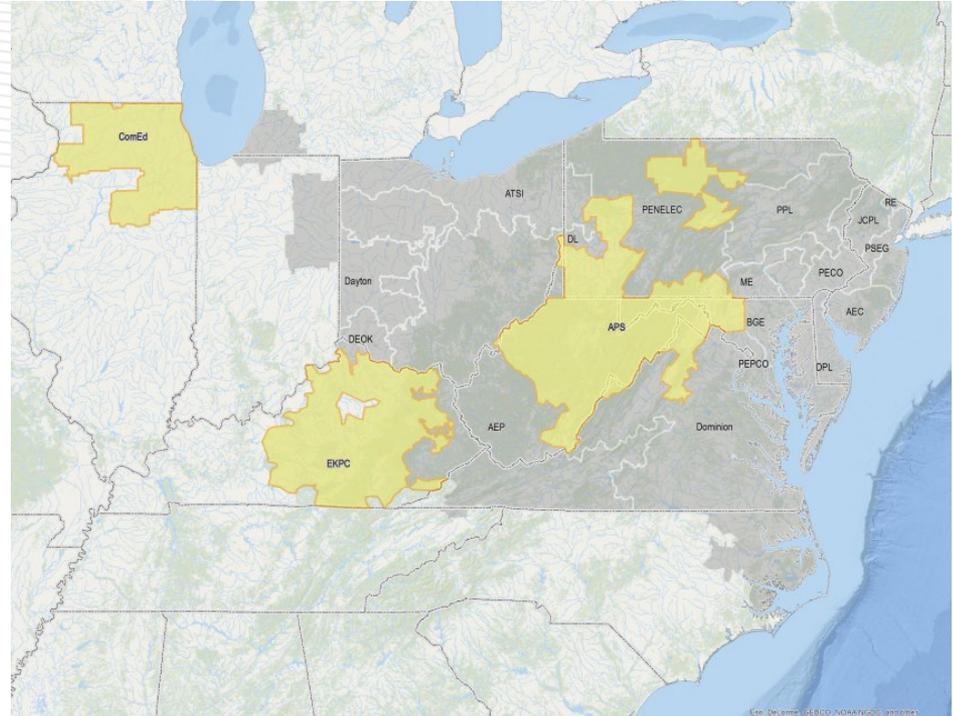
- **AEP Criteria Thermal/Voltage Violation (FG # AEP-T8, AEP-T11, AEP-T12, AEP-T15, AEP-T16, AEP-T25; AEP-V1, AEP-V2, AEP-V3, AEP-V4, AEP-V5, AEP-V6, AEP-V7, AEP-V10, AEP-V12, AEP-V25, AEP-V26, AEP-V30, AEP-V31, AEP-V33, AEP-V34, AEP-V35, AEP-V36, AEP-V37, AEP-V38, AEP-V39, AEP-V40, AEP-V43, AEP-V45, AEP-V58, AEP-V59, AEP-V63, AEP-V64, AEP-V66)**
- The Becco – Latrobe 46KV line is overloaded for multiple contingencies; The Skinfork – Three forks 46kV line for the loss of the Braeholm – Becco –Latrobe 46kV line; The low voltage at the Toney Fork, Cyclone, Latrobe, Craneco S. S. 1, Craneco S. S. 2, Pardee S.S., Three Forks, 46kV buses and Chap 69kV bus for multiple contingencies
- **Alternatives considered:**
  - P2014\_2-2U (\$25.98M)
- **Recommended Solution:**
  - 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(P2014\_2-2U)
- **Estimated Project Cost:** \$25.98 M
- **Required IS Date:** 6/1/2019



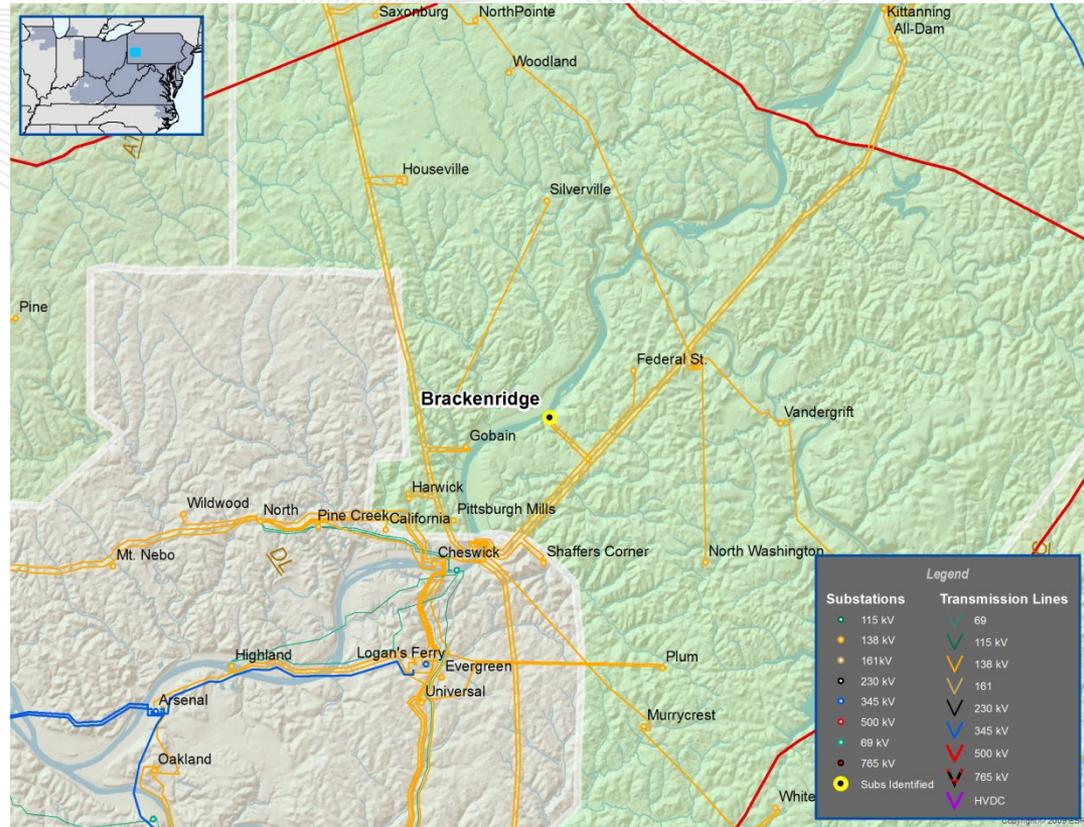
- **AEP Criteria Thermal Violation (FG # AEP-T34, AEP-T35, AEP-T36, AEP-T37)**
- The Speidel – Glencoe 69KV line and DTE Coal – Robywill 69KV line and Somerton 139/69kV transformer is overloaded for the loss of Kammer – West Bellaire 138kV line
- **Alternatives considered:**
  - P2014\_2-2V (\$30M)
  - P2014\_2-2W (\$110M)
- **Recommended Solution:**
  - Rebuild existing West Bellaire–Glencoe 69 kV line with 138 kV & 69 kV circuits and install 138/69 kV transformer at Glencoe Switch. (P2014\_2-2V)
- **Estimated Project Cost:** \$30 M
- **Required IS Date:** 6/1/2019



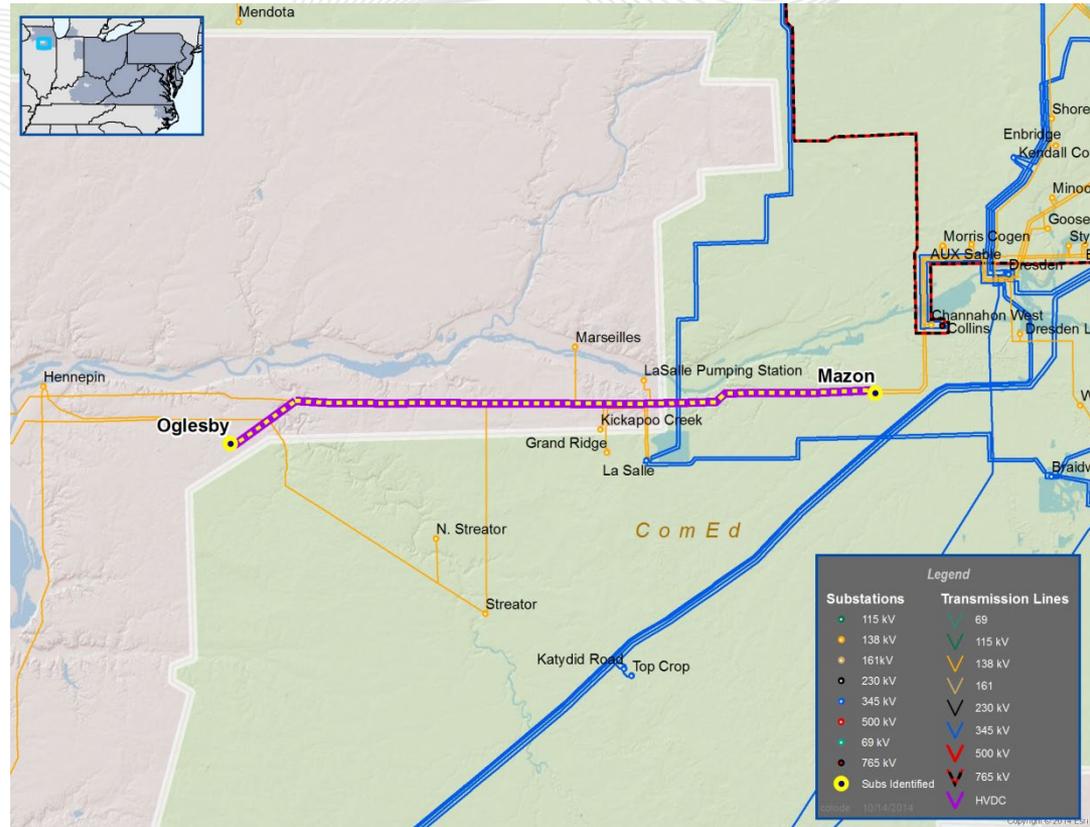
- 2014 RTEP Window #2 Violations by zone:
  - ComEd
    - Ten (10) 138 kV violation – Light Load Generator Deliverability
  - APS
    - One (1) 138 kV violations – N-1 Low Voltage
  - EKPC
    - One (1) 138 kV violation – N-1 Voltage Drop
    - Two (2) 69/161 kV violations – TO Criteria, thermal



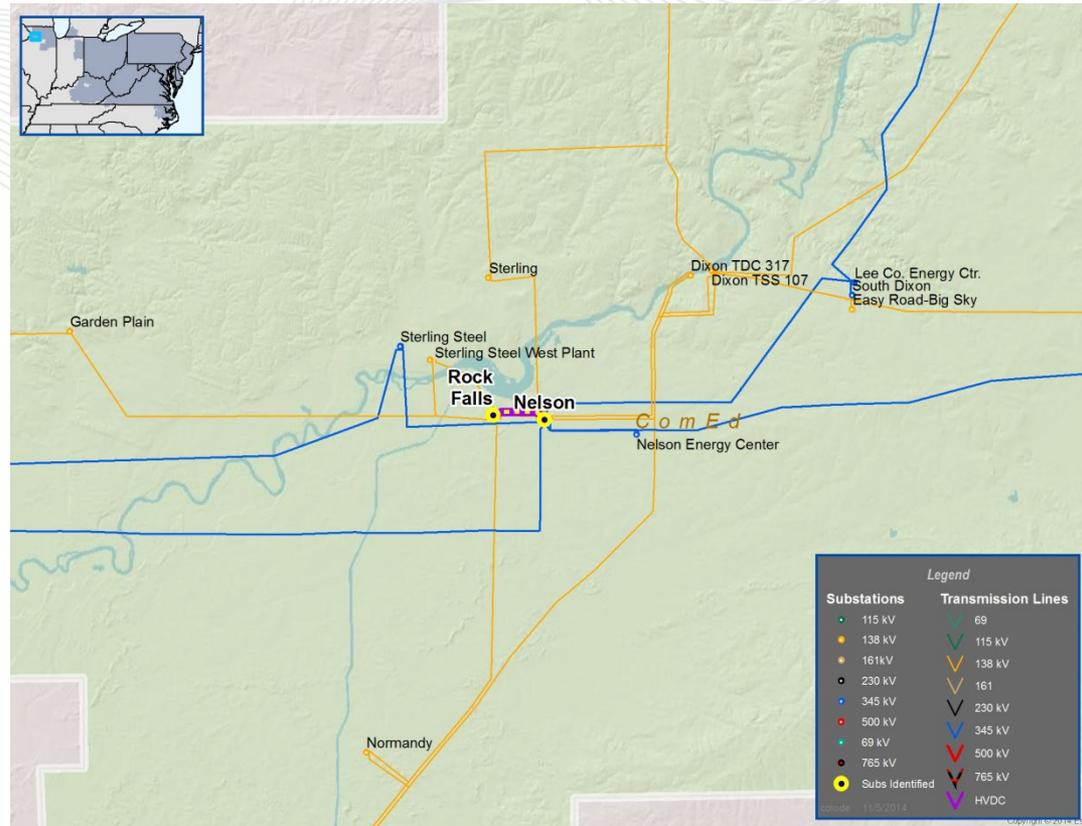
- **N-1 Voltage Violation (FG # N1-VM1)**
- Low voltage at Brackenridge 138kV bus for the tie breaker failure at Springdale
- Alternatives considered:
  - P2014\_2-4B (\$0.93M)
- Recommended Solution:
  - Relocate All Dam 6 138 kV line and the 138 kV line to AE units 1&2. Install 138kV, 3000A bus-tie 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 (P2014\_2-4B)
- Estimated Project Cost: \$0.93 M
- Required IS Date: 6/1/2019



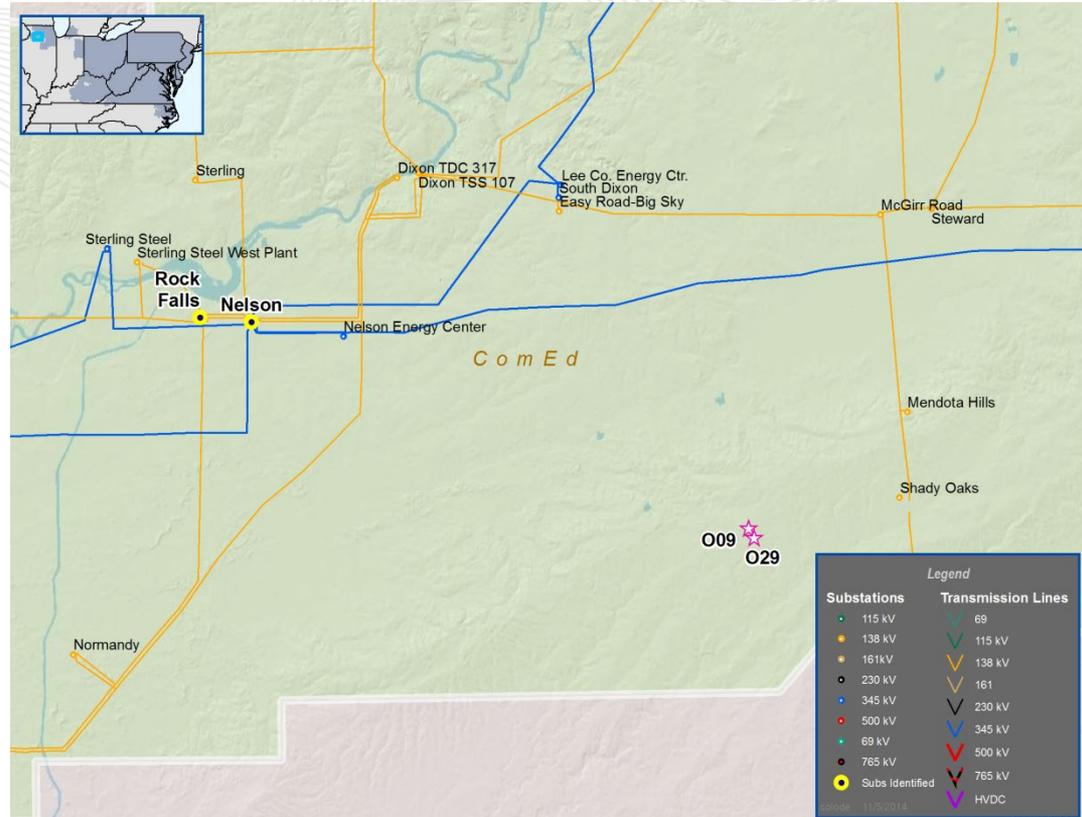
- **Light Load Reliability Criteria Thermal Violation (FG # LL-1)**
- Ogelsby – Mazon is overloaded for the loss of the Kickapoo Creek – LaSalle 138Kv blue line (L0112)
- Alternatives considered:
  - P2014\_2-8A (\$0.7M)
  - P2014\_2-12A (\$450M)
- Recommended Solution:
  - Replace relays at Mazon substation (P2014\_2-8A)
- Estimated Project Cost: \$0.7 M
- Required IS Date: 3/1/2019



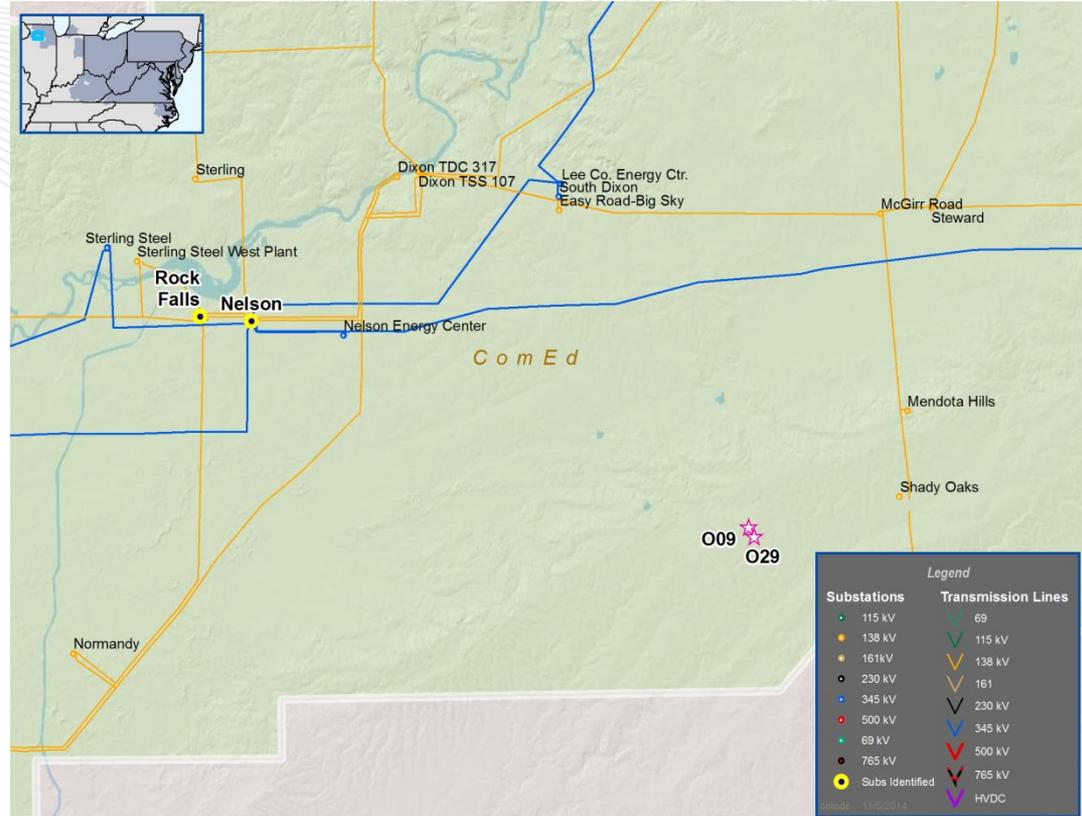
- Light Load Reliability Criteria Thermal Violation (FG# LL-28, LL-30, LL-34)
- The Rock Fall– Nelson 138kV red line is overloaded for all facility in service and several contingencies
- Alternatives considered:
  - P2014\_2-8B (\$0.53M)
  - P2014\_2-12A (\$450M)
  - P2014\_2-8E (\$16.1M)
  - P2014\_2-7C (\$33.7M)
- Status: FSA evaluation is in progress
- FSA generation related (reliability violations will be re-evaluated pending the status of the planned generation)



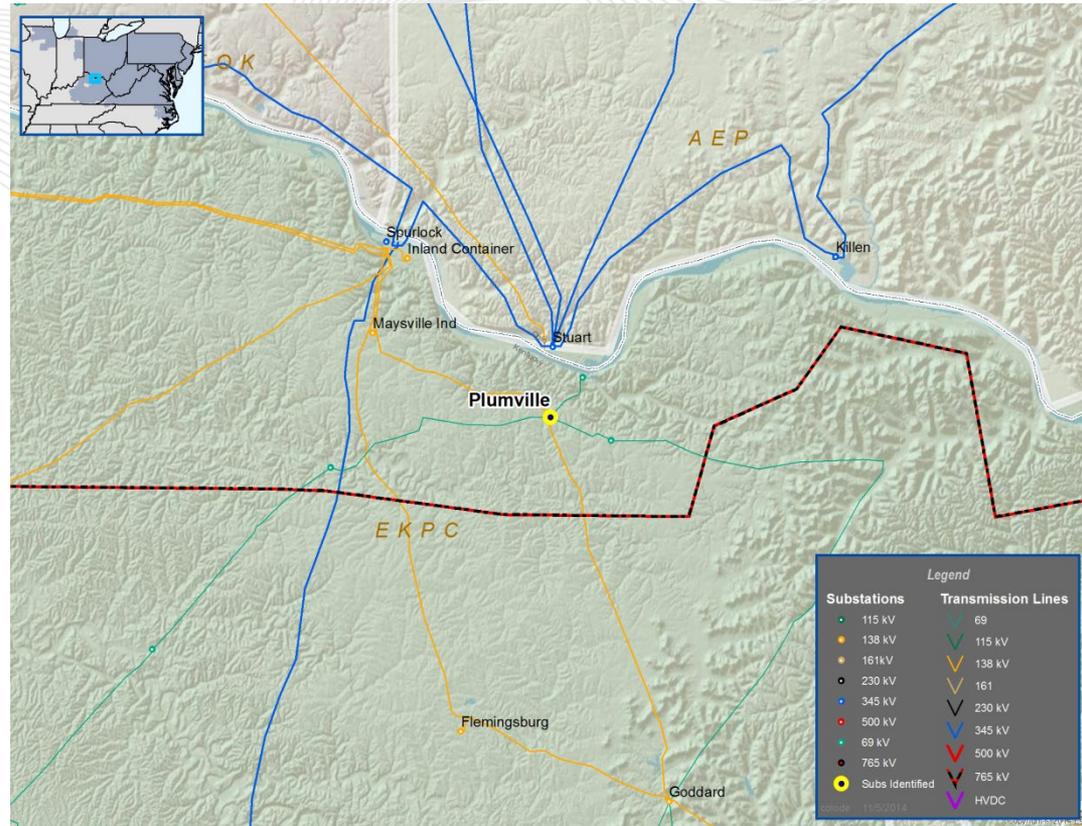
- Light Load Reliability Criteria Thermal Violation(FG# LL-40, LL-42, LL-45)
- The O09 - Rock Falls 138kV red line is overloaded for all facility in service and several contingencies
- Alternatives considered:
  - P2014\_2-8C (\$10.5M)
  - P2014\_2-12A (\$450M)
  - P2014\_2-8E (\$16.1M)
  - P2014\_2-7C (\$33.7M)
- Status: FSA evaluation is in progress
- Queued generation related (reliability violations will be re-evaluated pending the status of the planned generation)



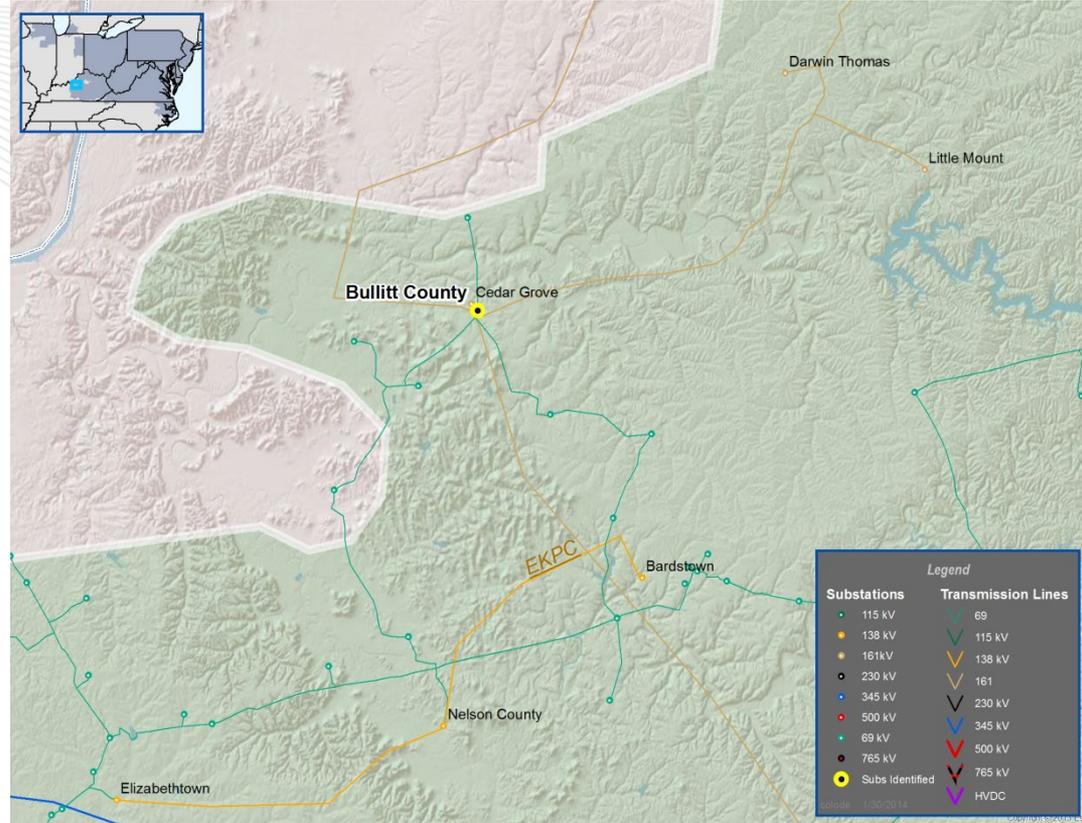
- Light Load Reliability Criteria Thermal Violation(FG# LL-61, LL-63, LL-69)
- The Nelson –O29 138kV red line is overloaded for all facility in service and several contingencies
- Alternatives considered:
  - P2014\_2-8D (\$12.2M)
  - P2014\_2-12A (\$450M)
  - P2014\_2-8E (\$16.1M)
  - P2014\_2-7C (\$33.7M)
- Status: FSA evaluation is in progress
- Queued generation related (reliability violations will be re-evaluated pending the status of the planned generation)



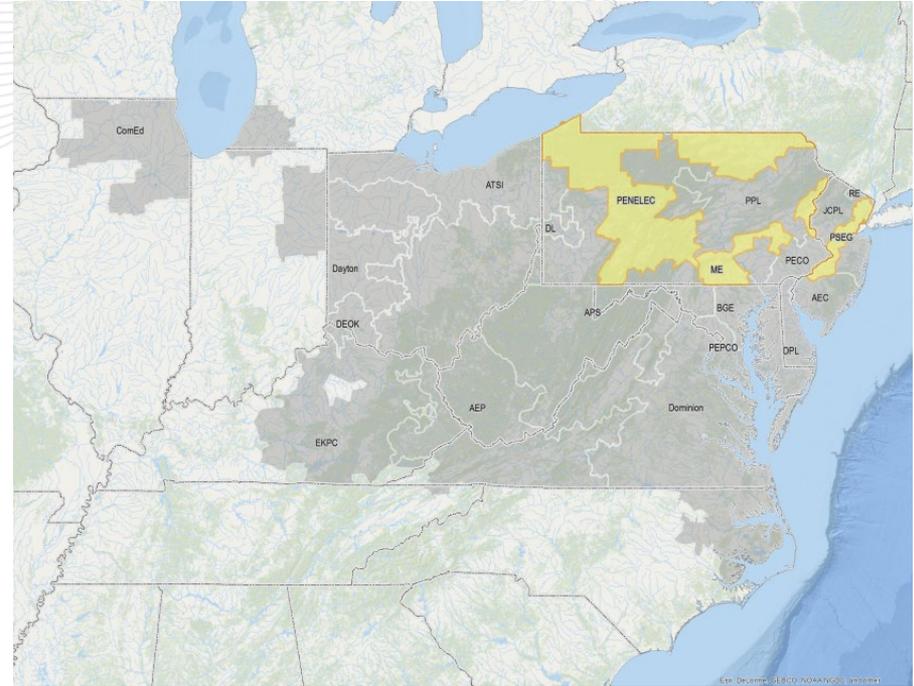
- N-1 Voltage Violation (FG#: N1-VD1)
- Voltage drop violation at Plumville 138kV for the tower outage of the Godard – Flemingsburg – Spurlock 138kV line and the Plumville – Maysville – Spurlock 138kV line
- Alternatives considered:
  - P2014\_2-9B (\$0.76M)
- Recommended Solution:
  - Decouple the double-circuited Spurlock - Maysville Industrial Tap 138-kV & Spurlock - Flemingsburg 138-kV line segments. (P2014\_2-9B)
- Estimated Project Cost: \$0.76 M
- Required IS Date: 6/1/2019



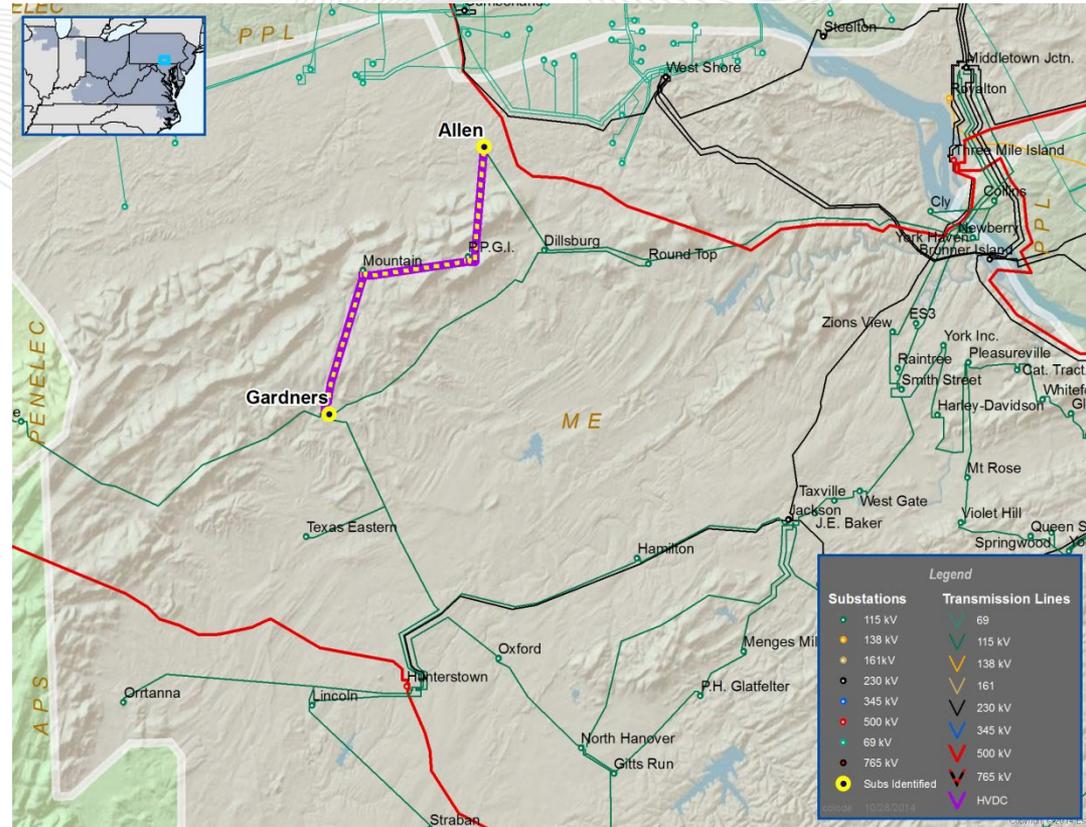
- EKPC Criteria Violation (FG #: EKPC-T1, EKPC-T2)
- The Bullitt County 161/69kV transformer is overloaded during an outage of LGE/KU's Hardin County 345/138kV transformer with LGE/KU's Brown Unit #3 off
- Alternatives considered:
  - P2014\_2-9A (\$1.29M)
- Recommended Solution:
  - Upgrade the Bullitt County 161/69 kV transformer facility. (P2014\_2-9A)
- Estimated Project Cost: \$1.29 M
- Required IS Date: 6/1/2019

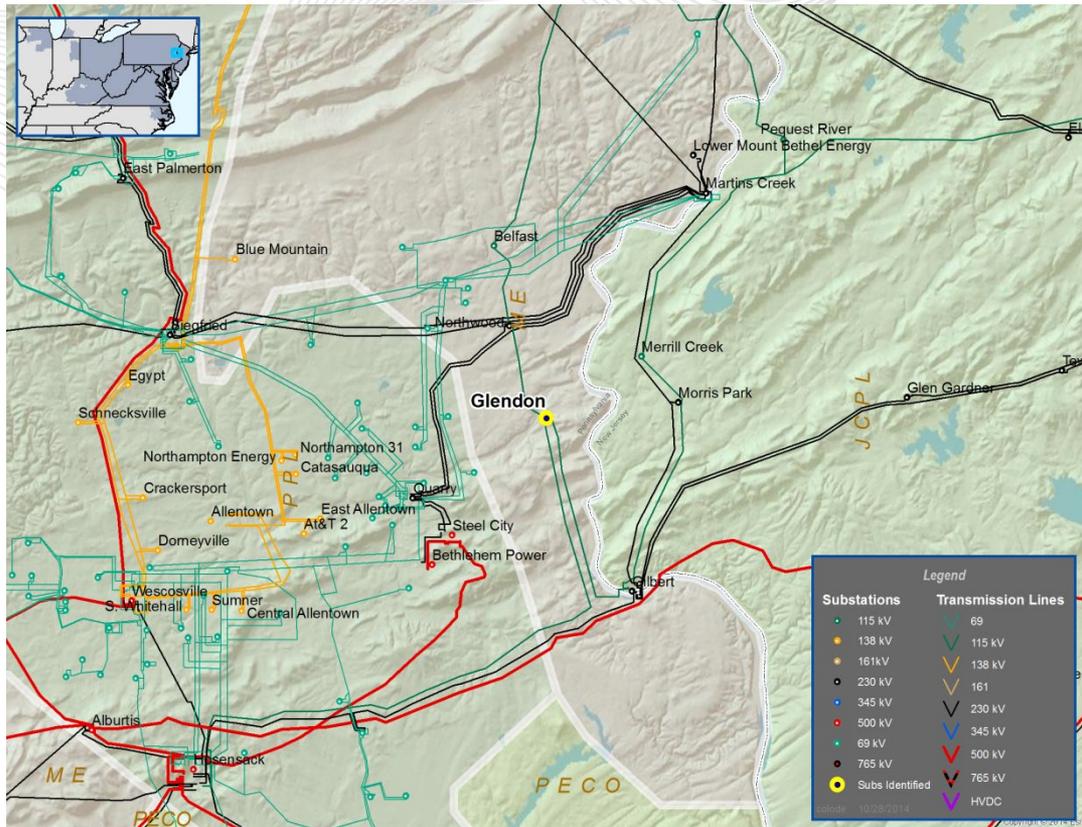


- 2014 RTEP Window #2 Violations by zone
  - Meted
    - Fourteen (14) 115 kV violations – N-1-1 Voltage Drop
    - Two (2) 115 kV violations – N-1-1 Low Voltage Magnitude
  - Penelec
    - Five (5) 345 kV violations – Light Load N-1 Low Voltage
    - Three (3) 230 kV violations – Light Load N-1 Low Voltage
    - Eleven (11) 115 kV violations – Light Load N-1 Low Voltage
  - PSEG
    - Eight (8) 230 kV violations – Light Load N-1 Low Voltage
    - Twenty Seven (27) 230 kV violations – N-1-1 Voltage Drop



- **N-1-1 Voltage Violation:**
- Voltage drop violation in the Allen and Gardner vicinity for the N-1-1 contingency loss of the Hunterstown – Texas Eastern – Gardner and Middletown Jct. – Collins – Newberry – Round Top 115 kV circuits.
- **Alternatives Considered:**
  - 2014\_2-7B (\$22 M)
  - 2014\_2-4E (\$19.33 M)
  - 2014\_2-3A (\$16.13 M)
  - 2014\_2-4D(\$1.96 M)
- Still evaluating the upgrades due to assumption changes in the area





## N-1-1 Voltage Violation:

Voltage drop and voltage magnitude violations at the Glendon 115 kV station for the N-1-1 contingency loss of the Northwood – Quarry 230 kV circuit, Northwood 230/115 kV transformer, and Portland – North Bangor 115 kV circuit.

## Alternatives Considered:

- 2014\_2-3A (\$16.13 M)
- 2014\_2-4C (\$0.98 M)

## Recommended Solution:

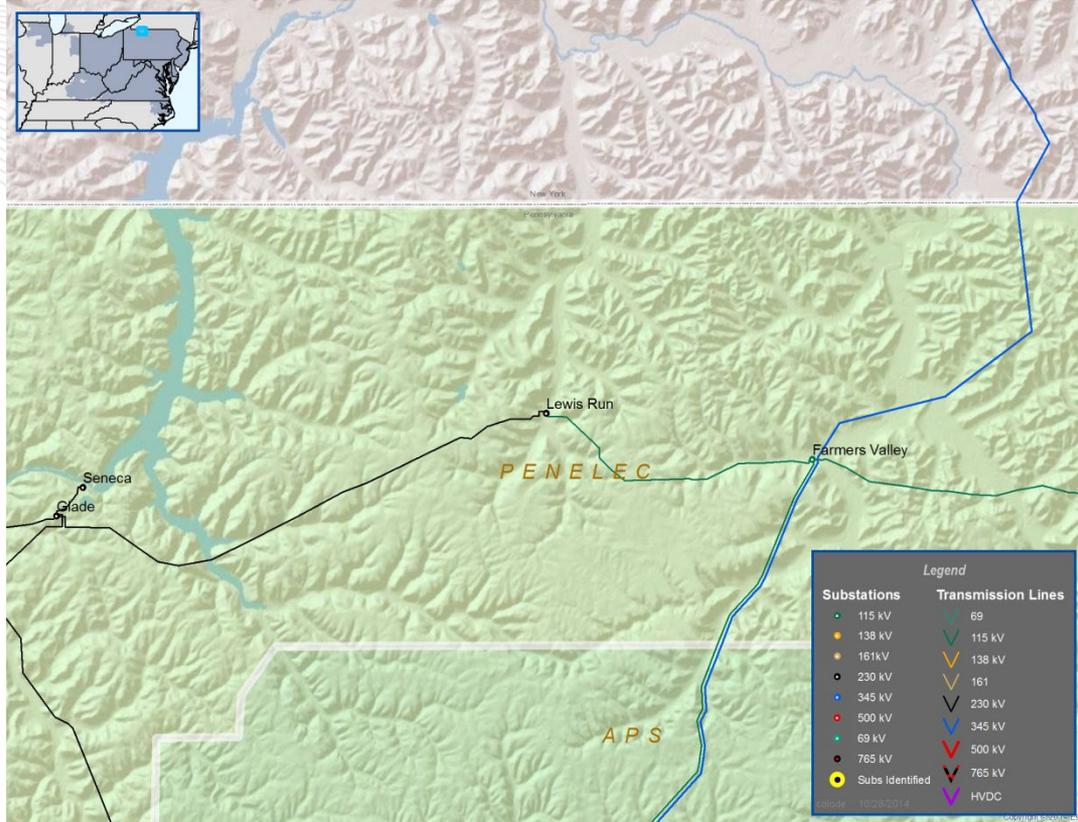
Install a 36.6 MVAR 115 kV capacitor at the North Bangor substation. (2014\_2-4C)

## Estimated Project Cost:

\$0.98 M

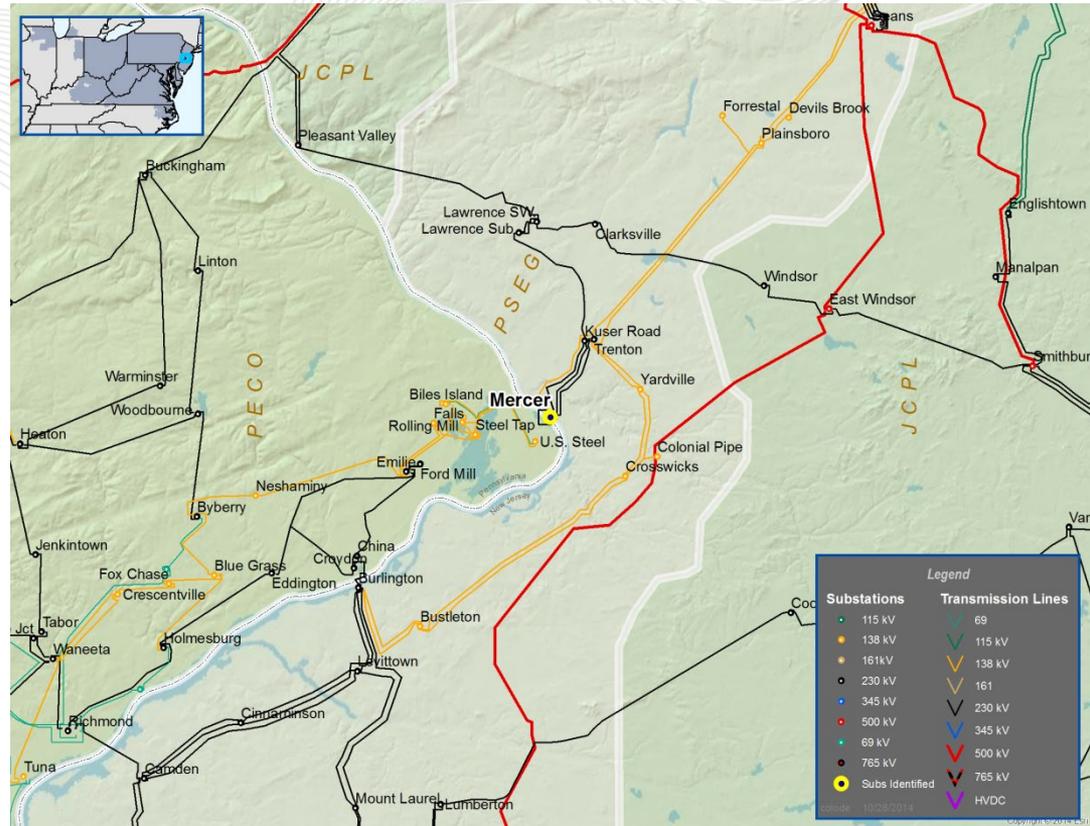
## Required IS Date:

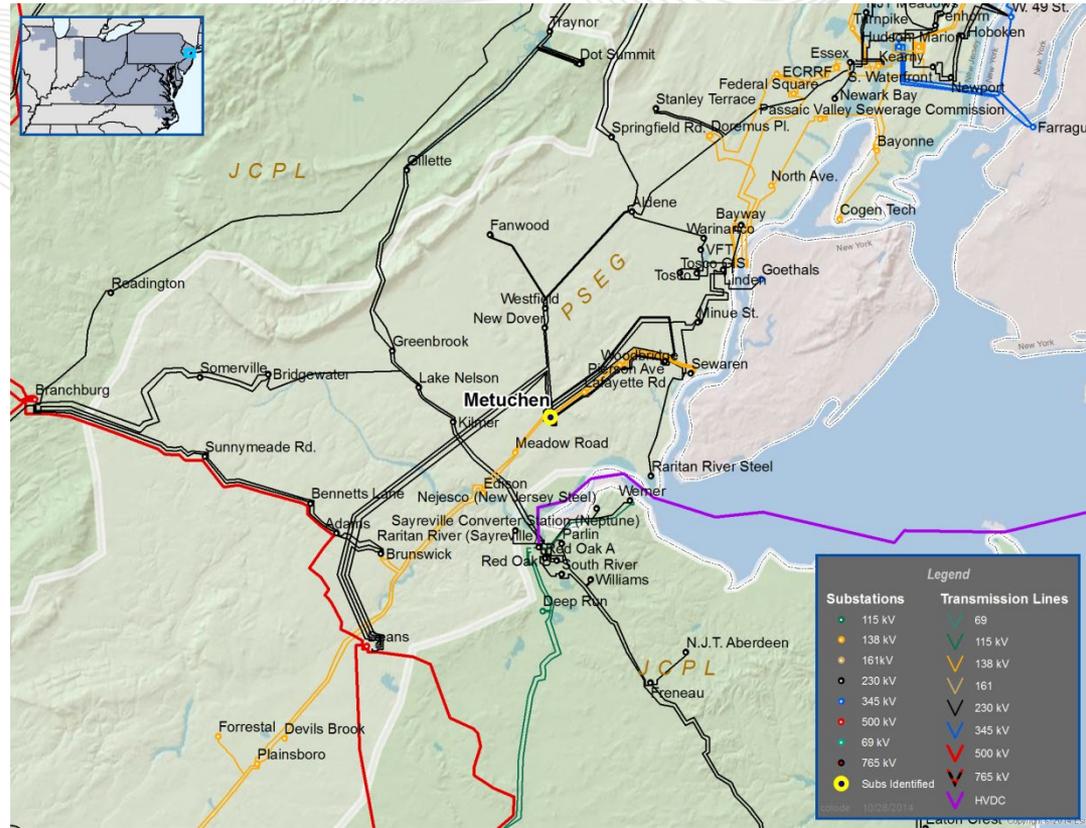
6/1/2019



- Light Load Reliability Criteria Voltage Violation:
- High voltage violations in the PierceBrook vicinity for several contingencies.
- Alternatives Considered:  
2014\_2-4A (\$5.53 M)
- Recommended Solution:  
Reconfigure the PierceBrook 345 kV station to a ring bus and install a 125 MVAR shunt reactor at the station. (2014\_2-4A)
- Estimated Project Cost:  
\$5.53 M
- Required IS Date:  
9/1/2018

- Light Load Reliability Criteria Voltage Violation:
- High voltage violations in the Mercer vicinity for the loss of the Mercer – Kuser Rd. – Lawrence 230 kV circuit (A2201).
- Alternatives Considered:
  - 2014\_2-11F (\$13.4 M)
  - 2014\_2-11E (\$7.2 M)
  - 2014\_2-11B (\$47 M)
  - 2014\_2-5B (\$35.5 M)
  - 2014\_2-5A (\$20.5 M)
  - 2014\_2-6A (\$56-97 M)
  - 2014\_2-11D (\$7.2 M)
- Recommended Solution:
  - Install 100 MVAR 230 kV shunt reactor at Mercer station. (2014\_2-11D)
- Estimated Project Cost:
  - \$7.2 M
- Required IS Date:
  - 9/1/2018



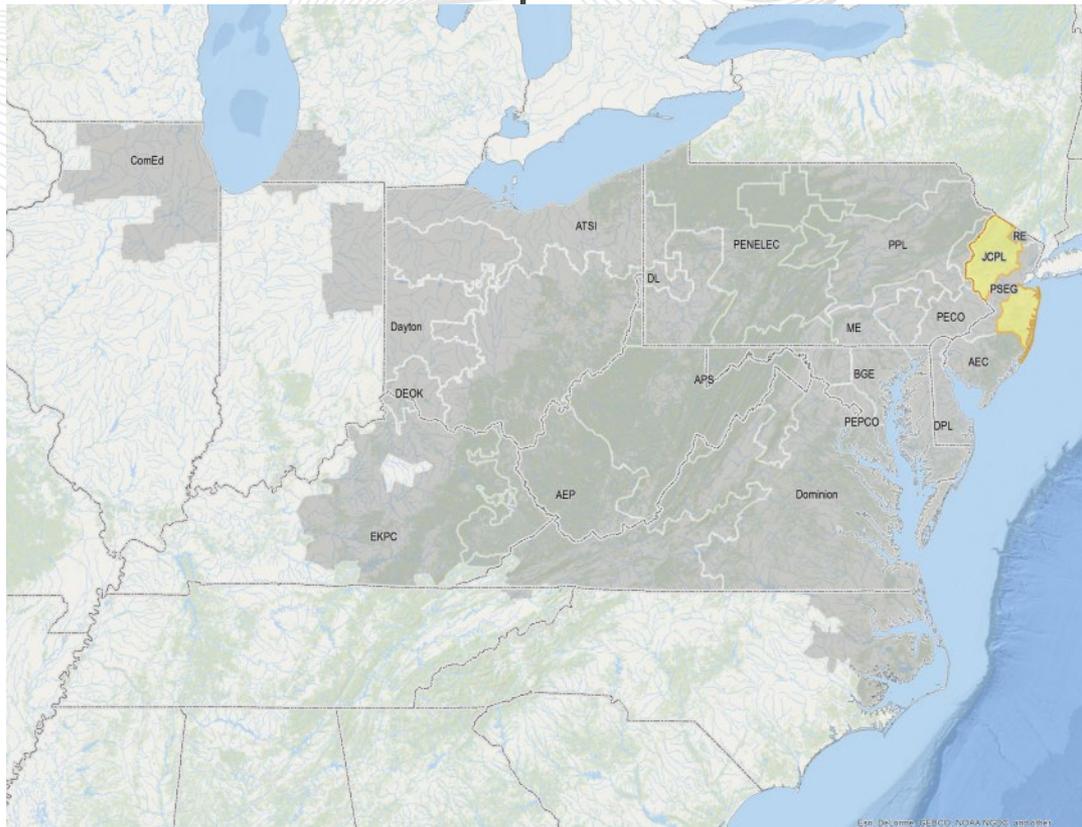


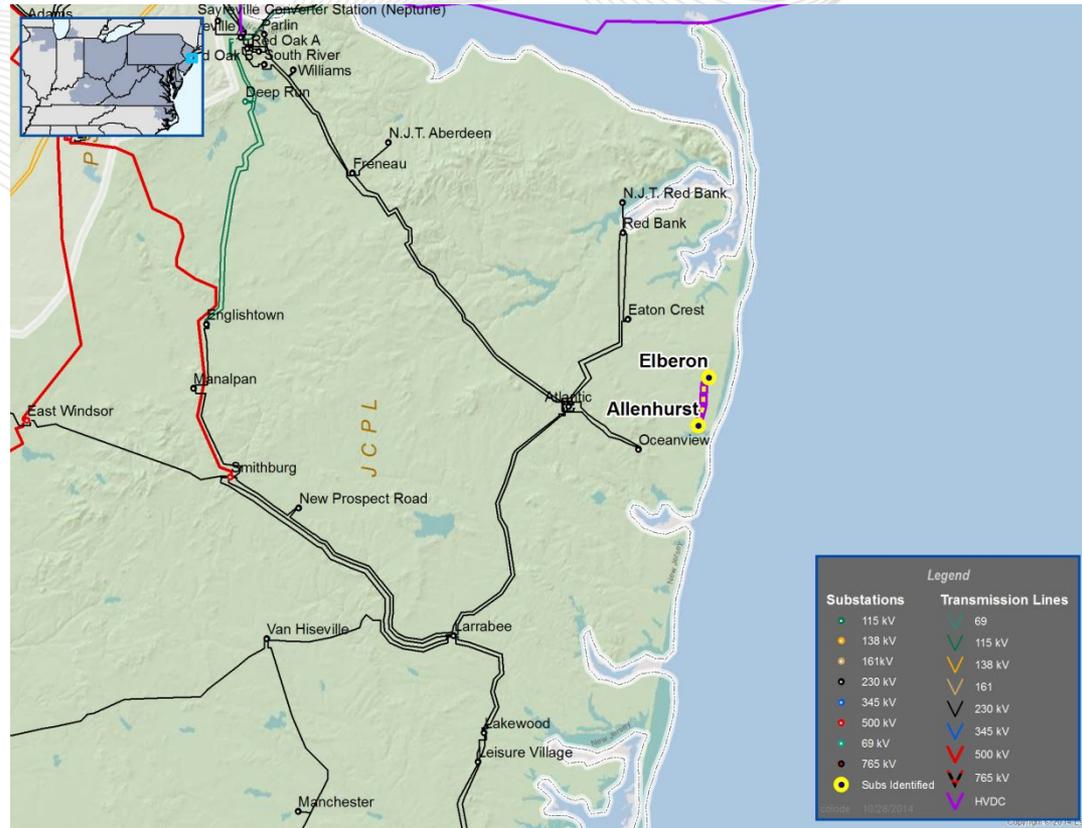
- N-1-1 Voltage Violation:
- Voltage drop violations in the Metuchen vicinity for several N-1-1 contingencies.
- Alternatives Considered:
  - 2014\_2-11C (\$71 M)
  - 2014\_2-3B (\$13.6 M)
  - 2014\_2-11A (\$8.4 M)
- Recommended Solution:
  - Install two 75 MVAR 230 kV capacitors at Sewaren station. (2014\_2-11A)
- Estimated Project Cost:
  - \$8.4 M
- Required IS Date:
  - 6/1/2019



# 2014 RTEP Proposal Window #2

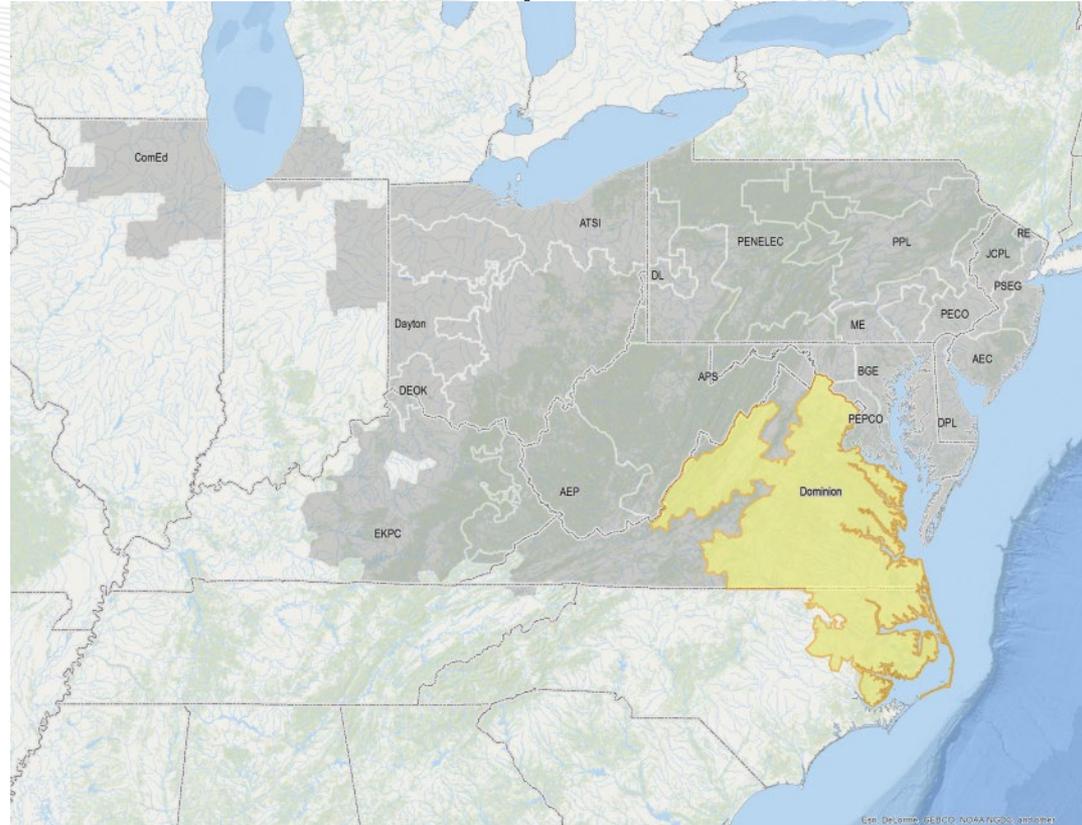
- 2014 RTEP Window #2 Violations by zone:
  - JCPL
    - Two (2) 35 kV violations – TO Criteria, thermal





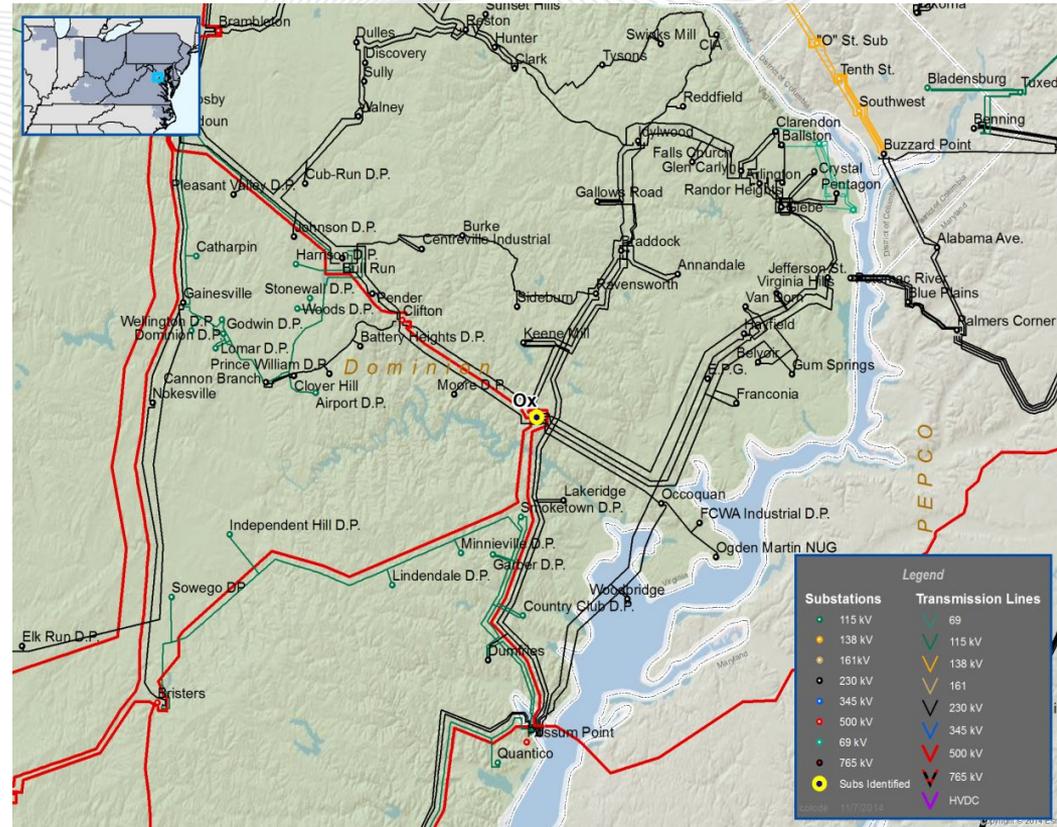
- FE Planning Criteria Violation (FG # JCPL-T1, JCPL-T2):
- The Allenhurst to Elberon (V74) 34.5 kV circuit is overloaded for the loss of the Bath Avenue – Long Branch (V74) 34.5 kV circuit.
- The Bath Avenue – Long Branch (V74) 34.5 kV circuit is overloaded for the loss of the Allenhurst to Elberon (V74) 34.5 kV circuit.
- Alternatives Considered:
  - 2014\_2-4F (\$14.76 M)
  - 2014\_2-4G (\$1.3 M)
- Recommended Solution:
  - Upgrade the V74 34.5 kV transmission line between Allenhurst and Elberon Substations. (2014\_2-4F)
- Estimated Project Cost:
  - \$14.76 M
- Required IS Date:
  - 6/1/2018

- 2014 RTEP Window #2 Violations by zone:
  - Dominion
    - Four (4) 345 kV violations – TO Criteria, thermal
    - Pratts area violations (next section)

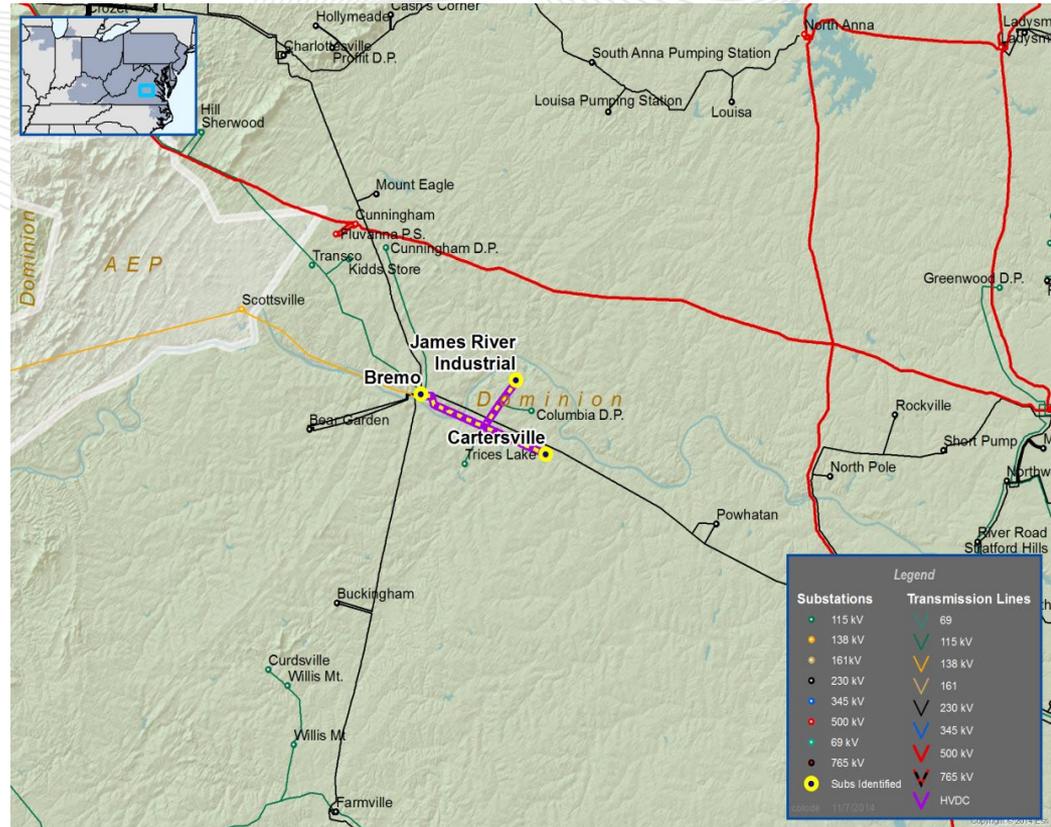


# Dominion Transmission Zone

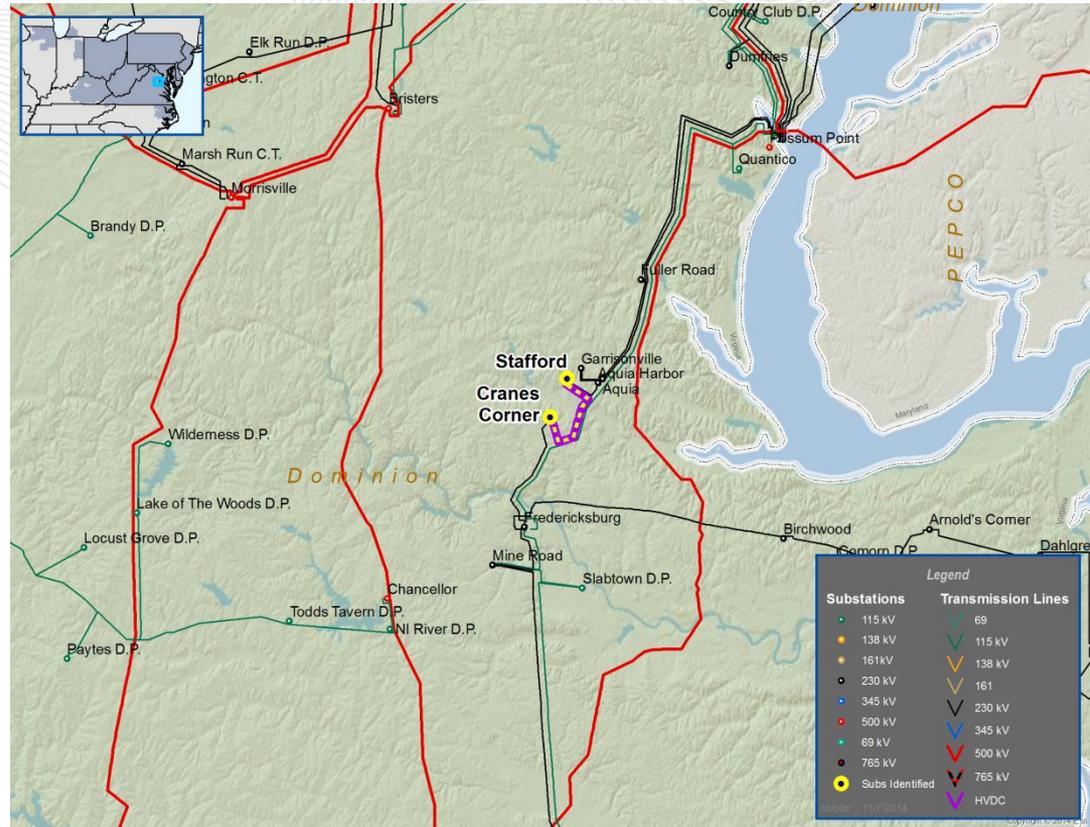
- Dominion Planning Criteria Violation (FG # DOM-1)
- The Ox 500/230 transformer #2 is overloaded for line fault stuck breaker contingency loss of the Ox – Clifton 500 kV circuit, Ox 500/230 kV #1 and Clifton 500/230 #2 kV. transformers.
- Alternatives Considered:
  - 2014\_2-1A (\$7.25 M)
  - 2014\_2-1B (\$1.24 M)
- Recommended Solution:
  - Install 500 kV circuit breaker at Ox substation to remove Ox transformer #1 form H1T561 breaker failure outage. (2014\_2-1B)
- Estimated Project Cost: \$1.24 M
- Required IS Date: 6/1/2019



- Dominion Planning Criteria Violation (FG # DOM-5):
- Loss of more than 100 MW load for the loss of the Bremono - James River - Cartersville 115 kV circuit.
- Alternatives Considered:
  - 2014\_2-10B (\$6.1 M)
  - 2014\_2-10A (\$12.71 M)
  - 2014\_2-7A (\$23 M)
  - 2014\_2-1D (1.67 M)
- Recommended Solution:
  - Relocate the Bremono load (transformer #5) to #2028 (Bremono- Charlottesville 230 kV) line and Cartersville distribution station to #2027 (Bremono-Midlothian 230 kV) line. (2014\_2-1D)
- Estimated Project Cost: \$1.67 M
- Required IS Date: Winter 2018/19



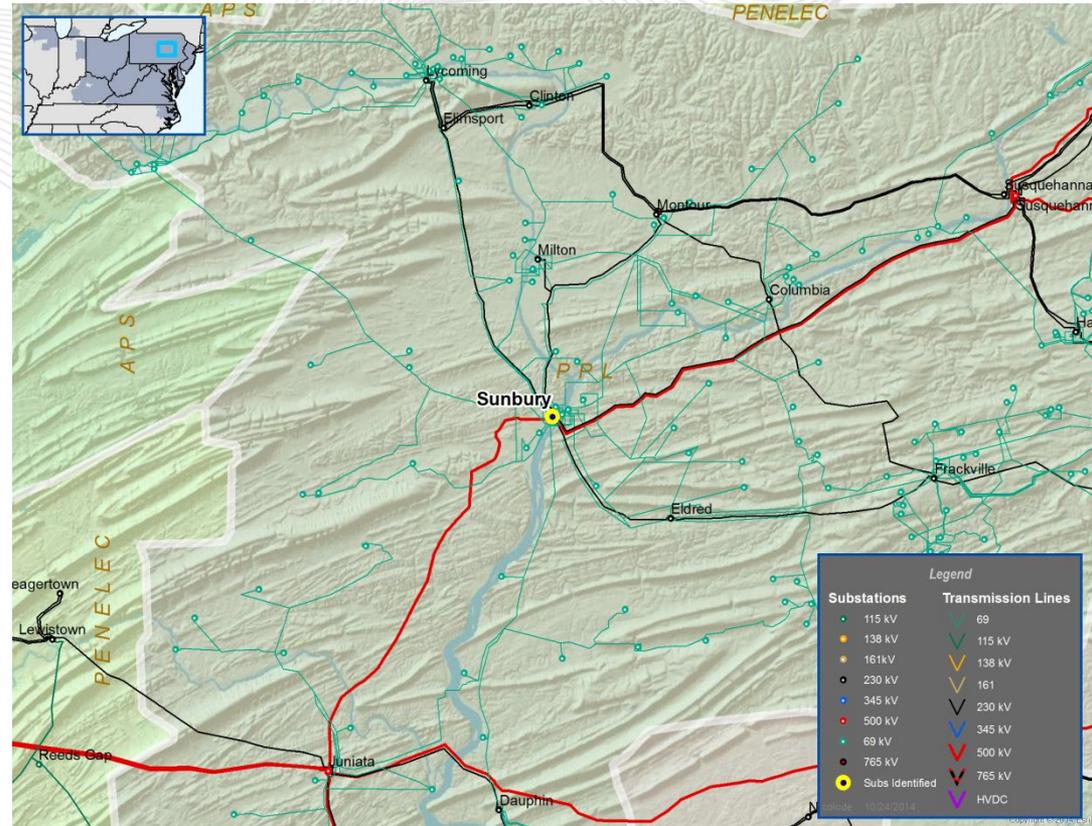
- Dominion Planning Criteria Violation:
- The Cranes – Stafford 230 kV is overloaded for single contingency loss of the Ladysmith – Possum Point 500 kV circuit.
- Alternatives Considered:  
2014\_2-1C (\$7.12 M)
- Recommended Solution:  
Reconductor 7.63 miles of existing line between Cranes and Stafford and upgrade associated line switches at Stafford. (2014\_2-1C)
- Estimated Project Cost:  
\$7.12 M
- Required IS Date:  
6/1/2019



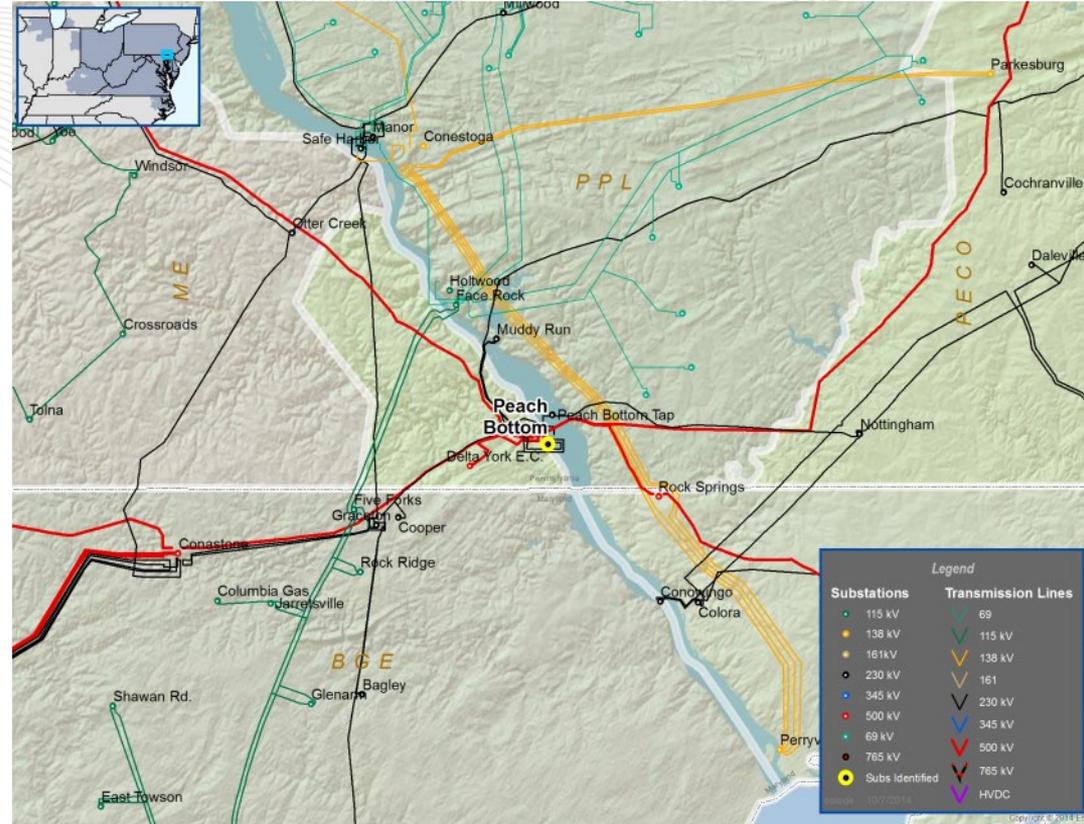


# Additional Recommendations to PJM Board in February 2015 (Presented at Previous 2014 TEAC Meetings)

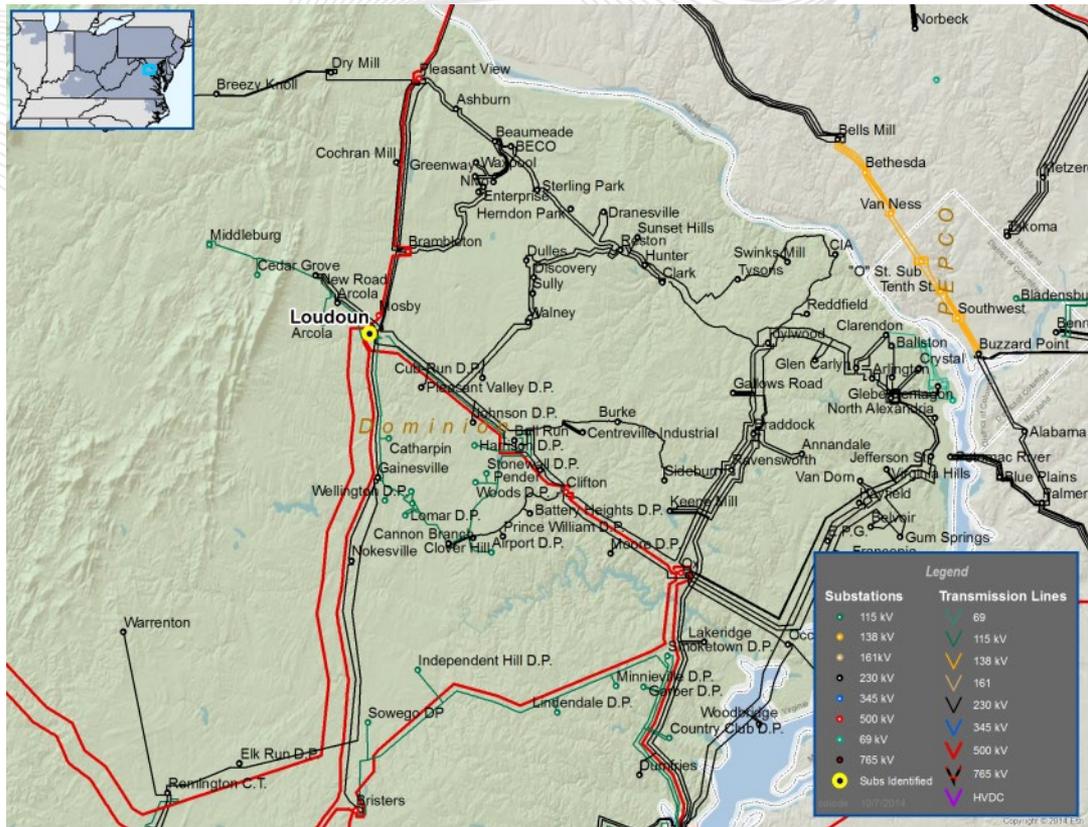
- The Sunbury 230 kV breaker ‘MONTOUR NORT’ is overstressed
- Proposed Solution: Replace the Sunbury 230 kV breaker ‘MONTOUR NORT’ with a 63kA breaker (B2574)
- Estimated Project Cost: \$750K
- Required IS Date: 6/1/2019



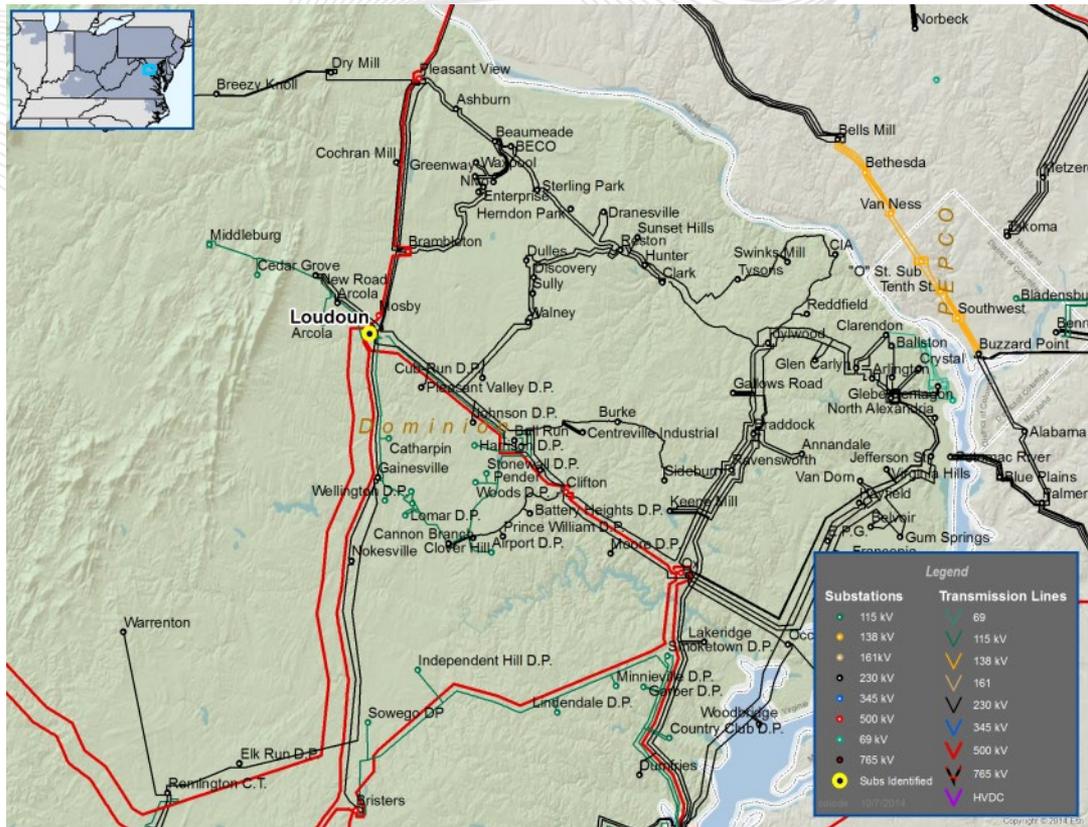
- The Peach Bottom 500kV breaker '#225' is overstressed
- Proposed Solution: Replace the Peach Bottom 500kV breaker '#225' with a 63 kA breaker (B2572)
- Estimated Project Cost: \$1.5M
- Required IS Date: 6/1/2019



- The Loudoun 230kV breaker '203052' is overstressed
- Proposed Solution: Replace the Loudoun 230kV breaker '203052' with a 63kA breaker (B1698.7)
- Estimated Project Cost: \$313K
- Required IS Date: 6/1/2016



- The Loudoun 500kV breakers 'H2T502' and 'H2T584' are overstressed
- Proposed Solution: Replace the Loudoun 500kV breakers 'H2T502' and 'H2T584' with 50kA breakers (B2542 and B2543)
- Estimated Project Cost: \$790K per breaker
- Required IS Date: 6/1/2019



# ATSI Transmission Zone Reinforcement

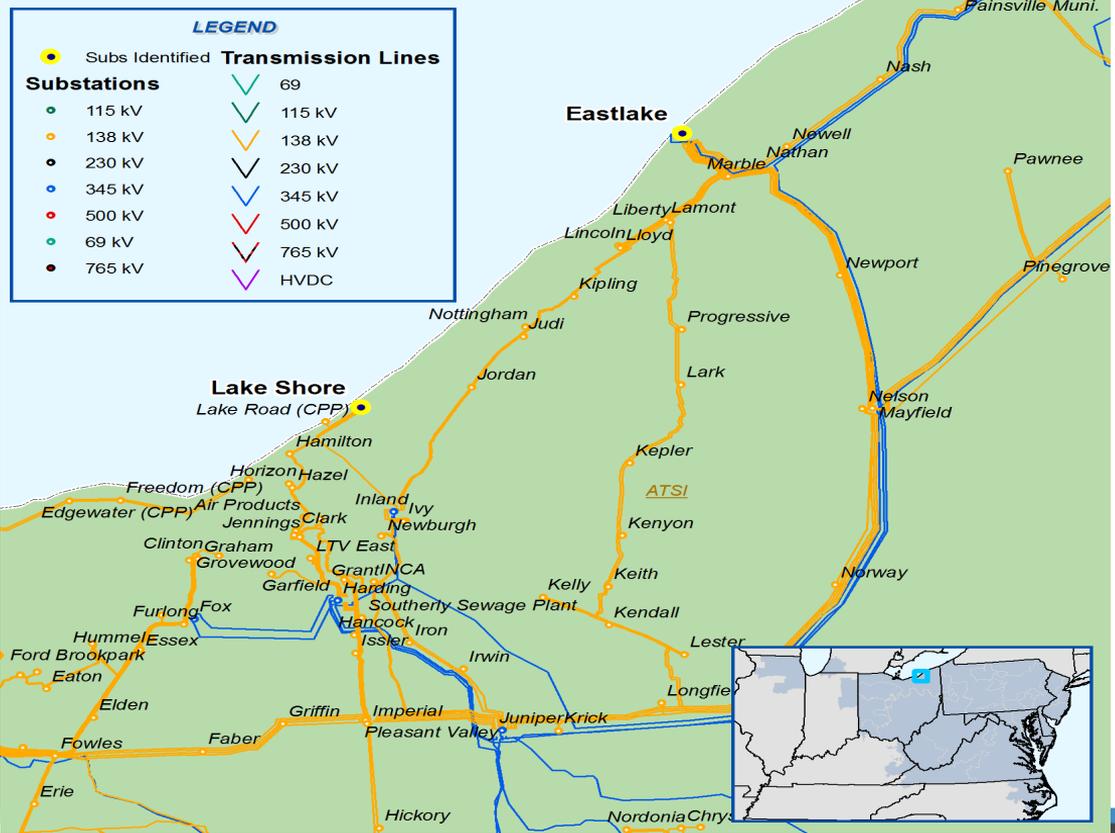


- **Original upgrade:**
  - B1914 - Convert Lake Shore unit 18 to a synchronous condenser
  - Original Estimated Project Cost: \$20M
- **New Upgrade:**
  - Install SVC at Lake Shore
  - Estimated Project Cost: \$34.7M

Reason for the recommend scope change to the reinforcement:

The conceptual synchronous condenser costs now exceed that of an SVC due to significantly increased physical structure, lubrication/cooling systems and staffing requirements identified while establishing firm scope and pricing for the synchronous condenser

- Projected in-service date: 6/1/2015



- Next Steps
  - Recommend all final recommendations reviewed at today's TEAC to the PJM Board in February 2015 for approval and inclusion in the RTEP

# Pratts Area Project 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
- 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



- **Next Steps**
  - Continue the analytical evaluation.
  - Reviewing cost estimates and construction feasibility.



# 2014/15 Long Term RTEP Proposal Window

- **Reliability Criteria**

- 15 Year Reliability Analysis
- Long Term Transmission Owner Criteria
- Based on the current result no new transmission facilities are required at this time

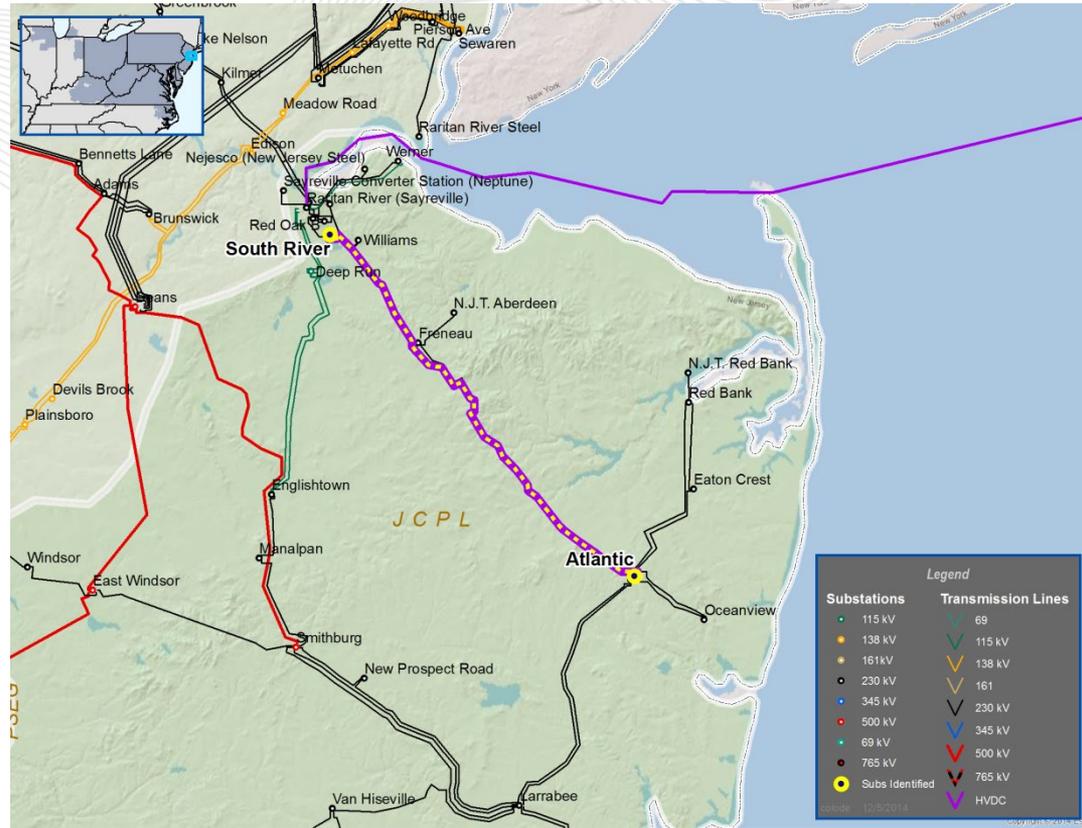
- **Market Efficiency Criteria**

- Window closes on 2/27/2015

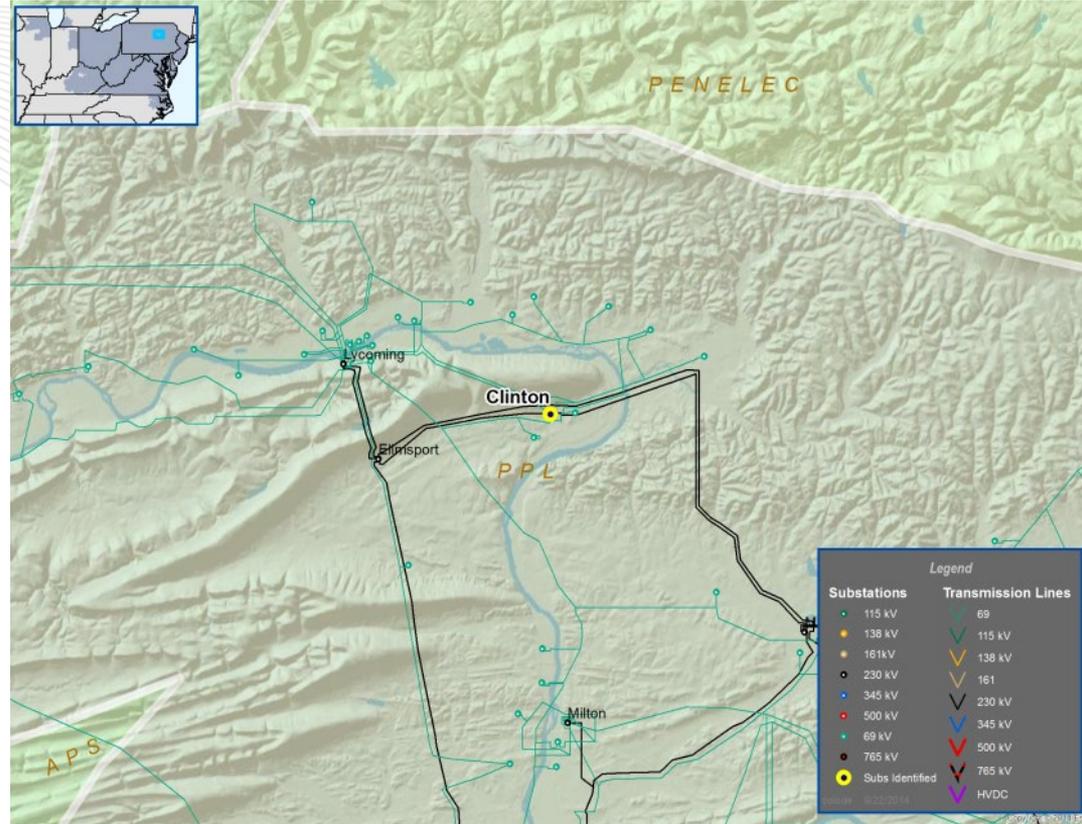
- <http://pjm.com/planning/rtep-development/expansion-plan-process/ferc-order-1000/rtep-proposal-windows.aspx>

# Supplemental Projects

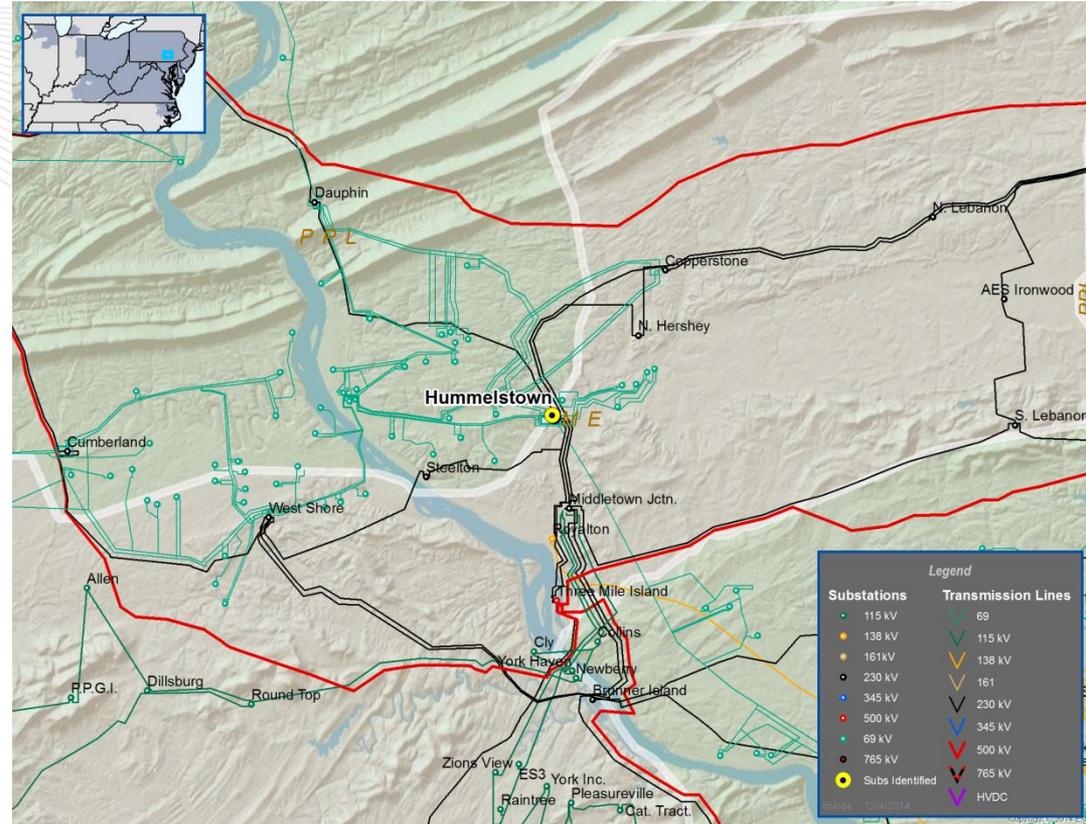
- Supplemental Upgrade:
- Adds Operational flexibility and enables planned bus outages.
- Proposed Solution:
  - Install 2000 Amp disconnect switch on the Atlantic – South River 230 kV (P1030) circuit. (S0875)
- Estimated Project Cost: \$ 0.1 M
- Projected IS Date: 1/30/2015



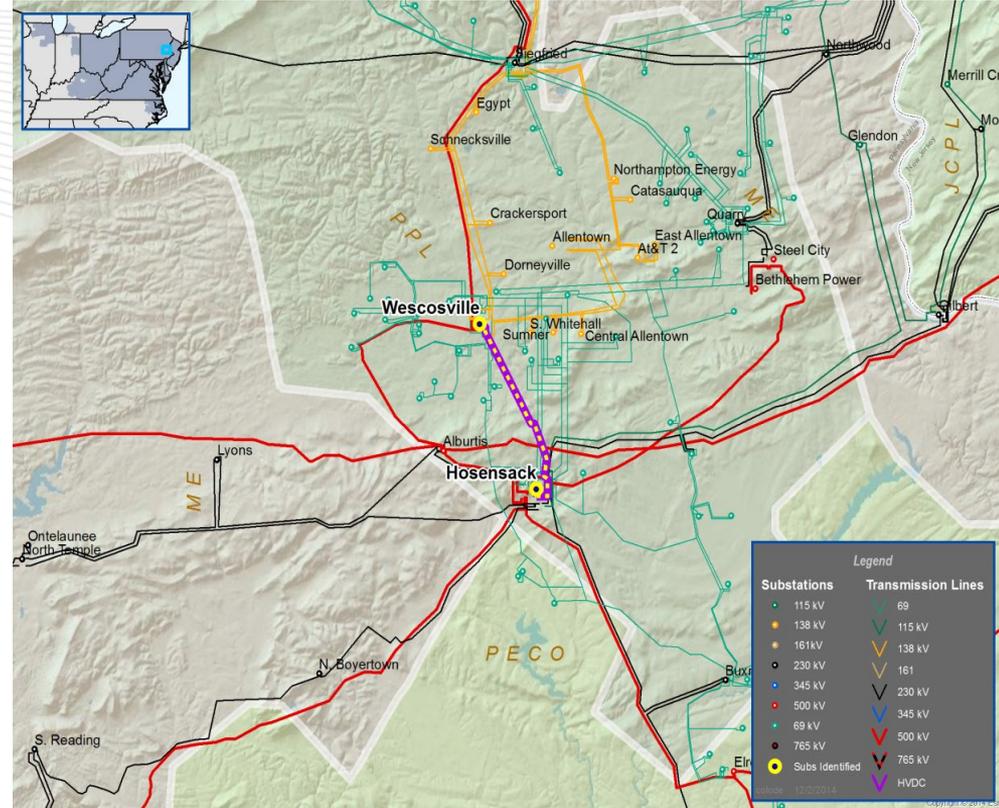
- PPL EU Reliability Principles and Practices :
- Clinton 230/69 kV T2 transformer is overloaded for tower line outage loss of the Seagers - Elimsport and Clinton – Elimsport circuits. SPS is currently in place to mitigate the overload.
- Proposed Solution:
  - Upgrade Clinton 230 kV yard. (S0858)
- Estimated Project Cost: \$ 11 M
- Projected IS Date: 12/31/2018



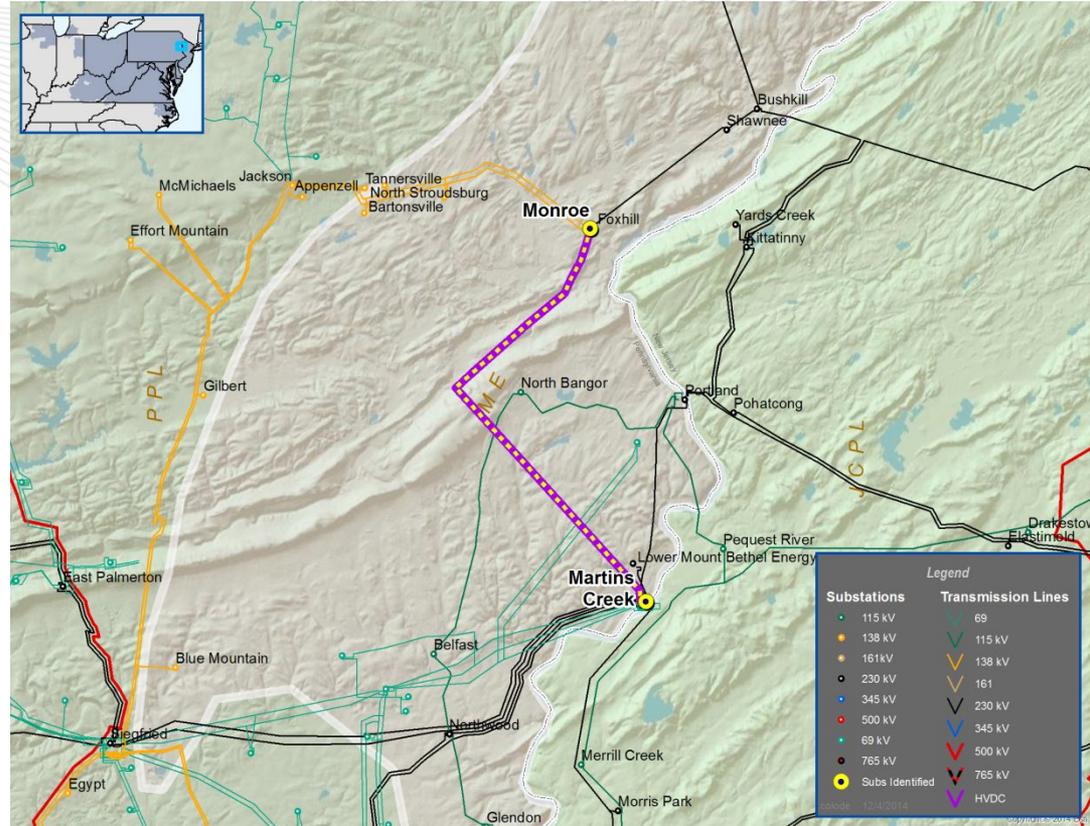
- Supplemental Upgrade:
- To eliminate line tapped transformers at Hummelstown and improve operational flexibility.
- Proposed Solution:
  - Upgrade Hummelstown 230 kV Substation to all double bus/double breaker bays. (S0862)
- Estimated Project Cost: \$ 3 M
- Projected IS Date: 12/31/2018



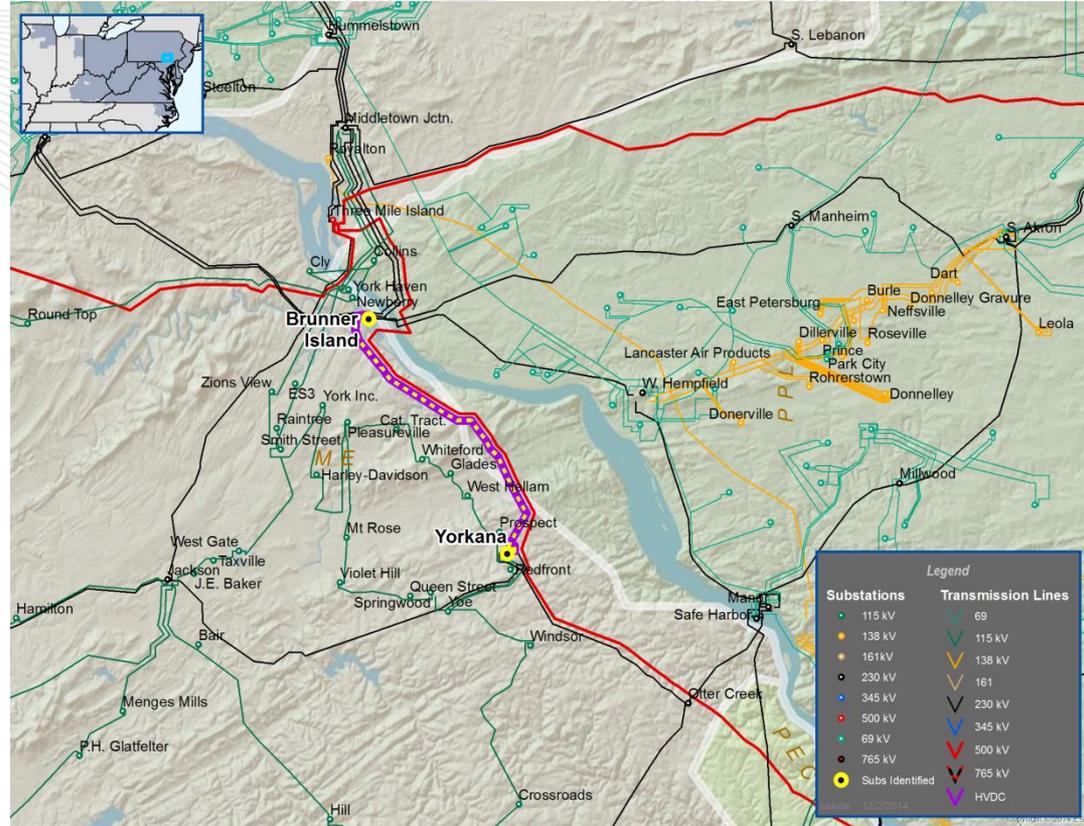
- Supplemental Upgrade:
- To replace aging infrastructure and to address operational performance issues in the Wescosville area.
- Proposed Solution:
  - Rebuild approximately 10 miles of the Hosensack-Wescosville 230 kV line and upgrade Wescosville 500-138 kV Substation. (S0864)
- Estimated Project Cost: \$ 33 M
- Projected IS Date: 12/31/2017



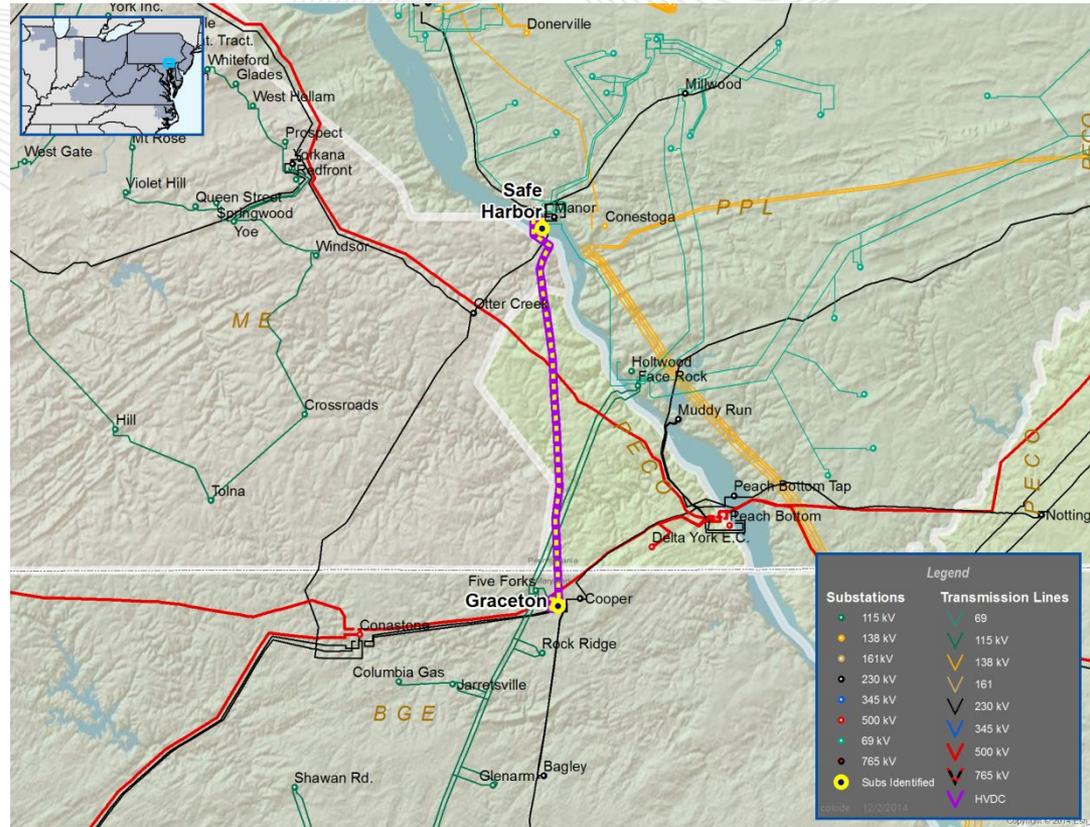
- Supplemental Upgrade:
- To improve operational flexibility out of Monroe Substation.
- Proposed Solution:
  - Build a new 230 kV circuit from Martins Creek to Monroe using existing Martins Creek-Stroudsburg 69 kV decommissioned line, and reconfigure Martins Creek and Monroe substations. (S0866)
- Estimated Project Cost: \$ 44.86M
- Projected IS Date: 5/31/2019



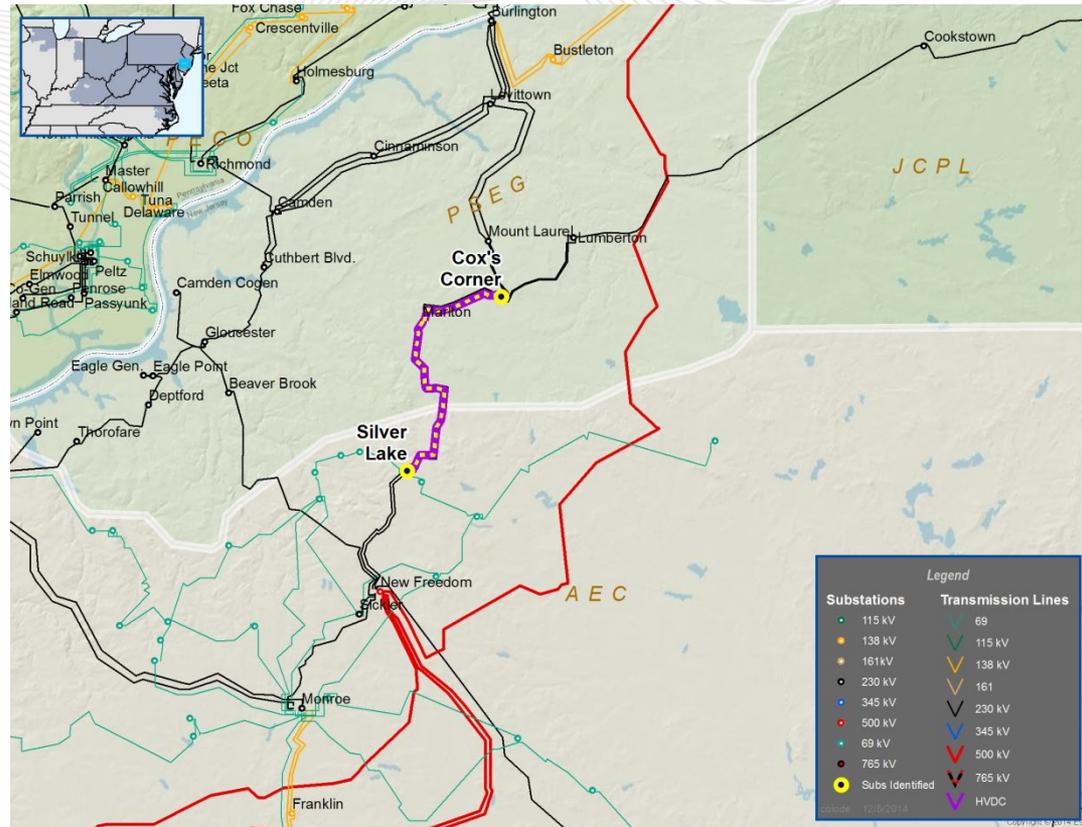
- Supplemental Upgrade:
- To improve Operational Performance.
- Proposed Solution:
  - Rebuild 0.64 mi of the Brunner Island-Yorkana 230 kV line. (S0868)
- Estimated Project Cost: \$ 1.5 M
- Projected IS Date: 12/31/2017



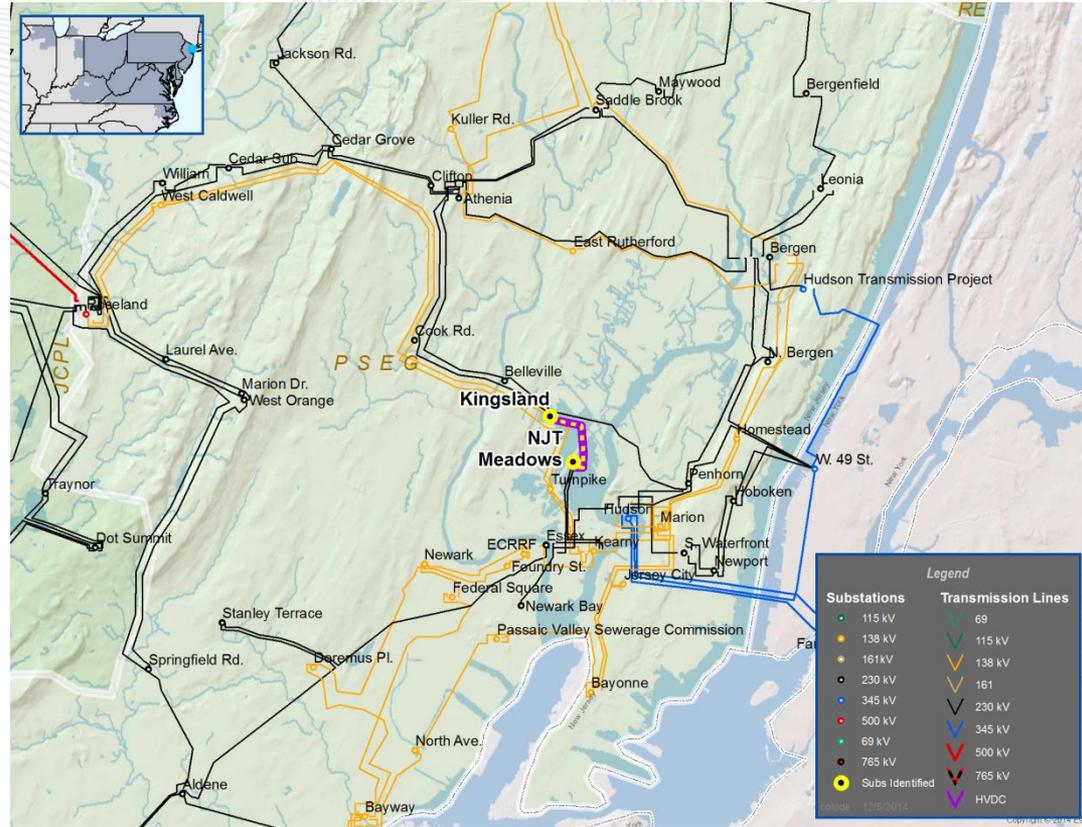
- Supplemental Upgrade:
- To improve Operational Performance.
- Proposed Solution:
  - Rebuild 1.12 mi of the Safe Harbor-Graceton 230 kV line. (S0869)
- Estimated Project Cost: \$ 4 M
- Projected IS Date: 12/31/2017



- Supplemental Upgrade:
- Install Optical Ground Wire to improve reliability. This provides strength, lightning protection and a potential communications path for high speed relaying.
- Proposed Solution:
  - Install OPGW (Optical Ground Wire) on the U-2247 (Silver Lake (ACE) to Cox Corner) 230 kV circuit. (S0852).
- Estimated Project Cost: \$ 3.5 M
- Expected IS Date: 12/31/2015



- Supplemental Upgrade:
- Install Optical Ground Wire to improve reliability. This provides strength, lightning protection and a potential communications path for high speed relaying.
- Proposed Solution:
  - Install OPGW (Optical Ground Wire) on the C-2281 (Kingsland to NJT Meadows 230 kV circuit. (S0853).
- Estimated Project Cost: \$ 1.5 M
- Expected IS Date: 12/31/2015



- **Supplemental Upgrade (S0644)**  
**Transmission Hardening Project (THP)**

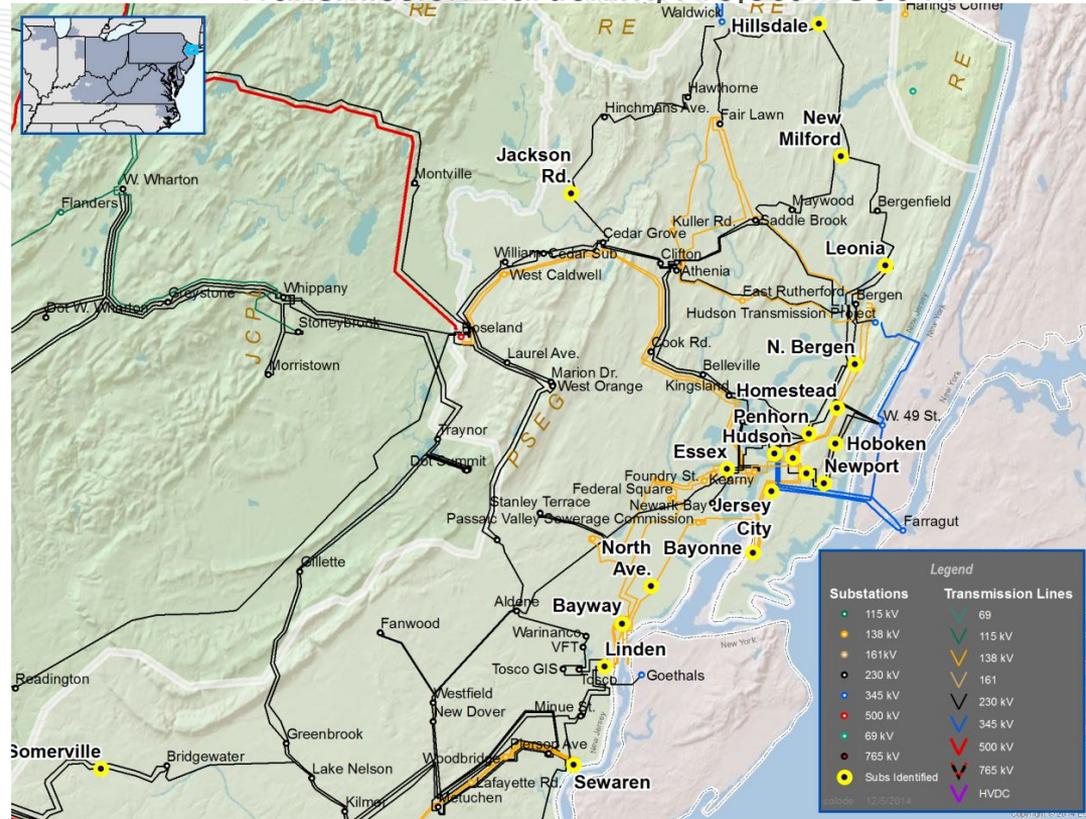
The scope of the PSE&G Transmission Hardening Program (THP) consists of improvements to PSE&G's transmission switching stations and/or associated electrical equipment in substations utilized for transmission purposes. These stations have been cross-referenced with the NJDEP Flood Hazard Limit mapping and are in the FEMA 100-year flood plain base flood elevation levels. Project scope will include raising and relocating existing new construction, installation of pumping plants, installation of a new auxiliary natural gas generators, and also raising and rebuilding existing stations with Gas Insulated Switch (GIS) gear.

- Estimated Project Cost:
  - \$ 1275 M
- Expected IS Date:
  - 12/31/2018

The following stations are already evaluated and the total estimated cost to complete the projects will be \$984 M.

## Substation Names

Bayonne 138kV	Leonia 230kV
Bayway 138kV	Linden 138/230kV
Essex 138/230kV	Marion 138kV
Hillsdale 230kV	New Milford 230kV
Hoboken 230kV	Newport 230kV
Homestead 138/230kV	North Avenue 138/345kV
Hudson 230kV	North Bergen 138/230kV
Jackson Road 69/230kV	Penhorn 230kV
Jersey City 138/230kV	Sewaren 138/230kV
Kingsland 138/230kV	Somerville 230kV
	South Waterfront 230kV



The following stations are under evaluation and the total estimated cost to complete the project will be \$292 M.

### Substation Names

Bergen/Ridgefield 69/138/230/345kV

49th St. Pothead Rack 230kV

Foundry 138kV

Cuthbert Blvd 230kV

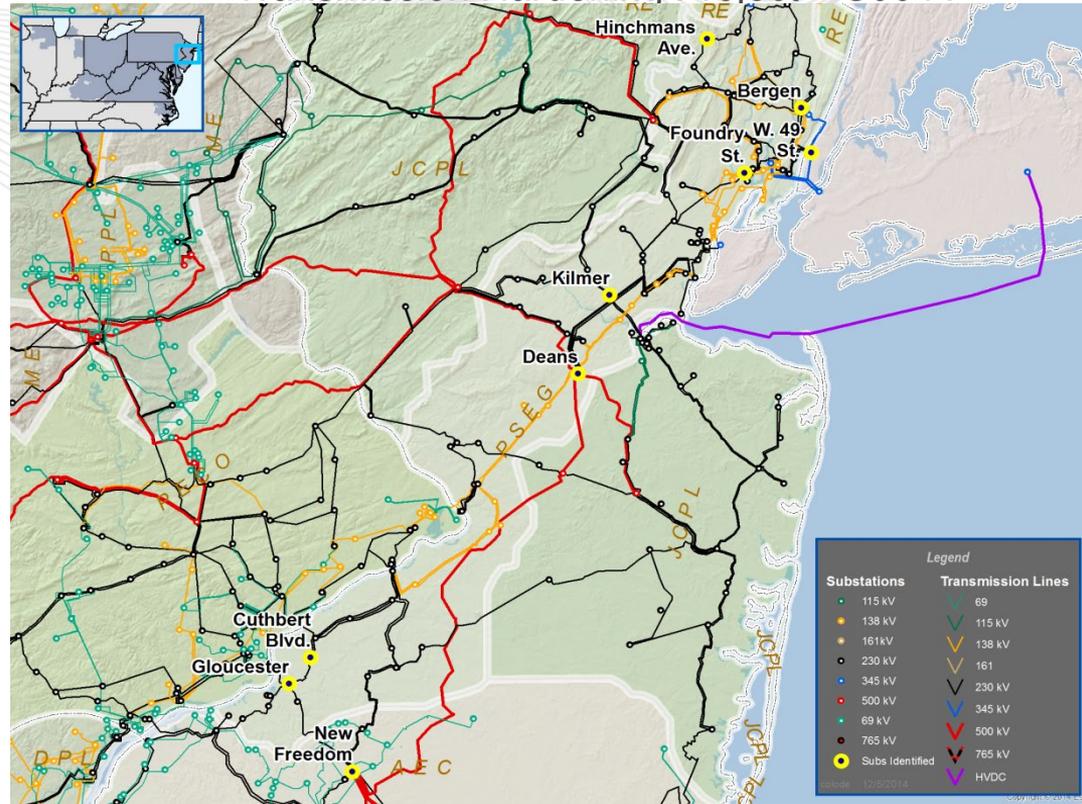
Deans 500/230kV

Gloucester 69/230kV

Hinchman's 230kV

Kilmer 230kV

New Freedom 500/230kV



# Artificial Island Update

- Sub Synchronous Resonance (SSR) study status
- Evaluation of the sensitivity of AI area assumptions
  - Fiber Optic Ground (FOG) wire installation for shorter clearing times
  - Artificial Island generation GSU tap adjustment for higher AI generation terminal voltages

- **Next Steps**

- Finalize the AI relay clearing time improvement study (Fiber Optic Ground wire study)
- Receive and finalize consultant Sub Synchronous Resonance (SSR) study
- Engagement of third party to review the issues tracking and studies for the Dominion 1A – TCSC proposal
- Cancel previously scheduled 01.21.2015 TEAC meeting to review Artificial Island, this meeting will be re-scheduled at a later date

# RTEP Next Steps

- Finalize and benchmark Summer 2020 RTEP model
- 2014 RTEP Window #2 - Continue Pratts area evaluation
- RTEP Long Term RTEP window remains open through February 2015
- Recommend all final recommendations reviewed at today's TEAC to the PJM Board in February 2015 for approval and inclusion in the RTEP

Questions?

Email: [RTEP@pjm.com](mailto:RTEP@pjm.com)

- ## Revision History

- 1/6/2015 - Original version posted to the PJM TEAC
- 1/16/2015 – remove the P2014\_2-2W (original slide #35), and it should be an alternative to P2014-2-2V (original Slide #54)
- 3/4/2015 – (Slide #56) The project “Replace relays at Mazon substation (P2014\_2-8A)” required IS date is changed from 6/1/2019 to 3/1/2019
- 6/3/2021 – (Slide #44) Added full information into recommend solution.