# Transmission Expansion Advisory Committee

# Reliability Analysis Update

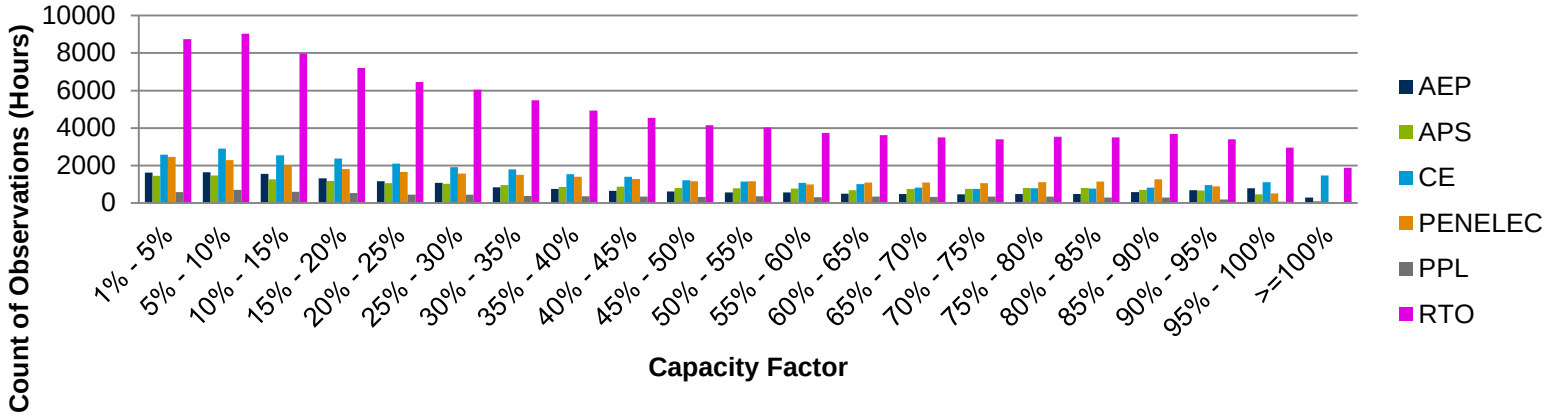
July 9, 2015

# Winter Peak Study Update

# 2015 RTEP Winter Peak Study Update

- Initial year 2020 case was sent to TOs for a winter ratings and load profile update in May.
- Received feedback from TOs
- The winter case will be finalized by the end of June
- Assumption update: Wind will be dispatched to 100% (was 80% in last year's trial test) for single contingency in generator deliverability test

**Winter Peak Capacity Factor for Wind from 2012-2015**



# 2015 RTEP Winter Peak Study Update

- The 2014 Winter study
  - N-1-1 thermal and voltage tests were not performed
  - Modeled the gas contingency outages as part of the base case assumptions then ran the load deliverability test only
    - Did not have the exact definitions, used the magnitudes of at-risk gas by TO zone
- The 2015 study will evaluate additional existing RTEP test procedures
  - Each of the 30 gas contingencies will be included in the following test procedures:
    - N-1 thermal, voltage
    - Load deliverability
    - N-1-1 (with each gas contingency as the first N-1 event)
  - This year, we will just use the gas event as a contingency that we study as part of the tests
    - Now have the specific contingency definitions (at the individual generator level)

# 2015 RTEP Winter Peak Study Update

- July 2015 Analysis Update
  - Initial generator deliverability and common mode outage analysis is complete
    - Reviewing the preliminary results with the TOs and validating line ratings
  - Baseline N-1 Gas contingency thermal and voltage analysis is in-progress
  - Winter CETO values for all LDAs under development

Preliminary Gen Deliv and Common Mode Outage Results

| | 115KV | 138/69KV | 138KV | 345/138KV | 161/138KV | 161KV | 230KV | 345KV |
|---|---|---|---|---|---|---|---|---|
| APS | | | 1 | | | | | |
| ATSI | | | 1 | | | | | |
| AEP | | | 14 | 1 | 1 | 1 | | 1 |
| ComEd | | | 7 | | | | | |
| PSEG | | | 2 | | | | | 1 |
| DPL | | 1 | | | | | | |
| EKPC | | | 1 | | | | | |
| DOM | 1 | | | | | | 1 | |
| PN | 1 | | | | | | | |
| Total | 2 | 1 | 26 | 1 | 1 | 1 | 1 | 2 |

# 2015 RTEP Winter Peak Study Update

- Development of a PJM Winter Reliability Criterion
  - 2014
    - Learned about the process of developing an updated Winter model
      - Load profile and internal PJM zonal interchange are critical
      - Initial dispatch and ramping of generation by fuel type
    - Ran initial power flow studies
    - Feedback and lessons learned
  - 2015
    - Evaluate additional test procedures
    - Evaluate detailed gas contingencies (specific units)
    - Establish high level winter peak study criteria
    - Begin to establish a method to mitigate criteria violations
    - Draft Manual 14B Winter Peak Study procedure
    - Approve Winter Peak Study procedure
  - 2016
    - Provide a 5 year out winter peak study case that is consistent with the approved procedure (for use in RTEP and TO Local Planning)
    - Implement Winter Peak Study criteria in 2016 RTEP
    - Identify reliability criteria violations resulting from the new criteria and develop solutions through the RTEP process as needed

# 2015 RTEP Winter Peak Study Update

- Next Steps
  - Review additional results with the TEAC
  - In parallel, review the development and schedule for a Winter Peak Reliability Criterion with the PJM Planning Committee
    - See posted July 2015 PC Winter Criteria presentation and corresponding PJM Manual 14B proposed changes

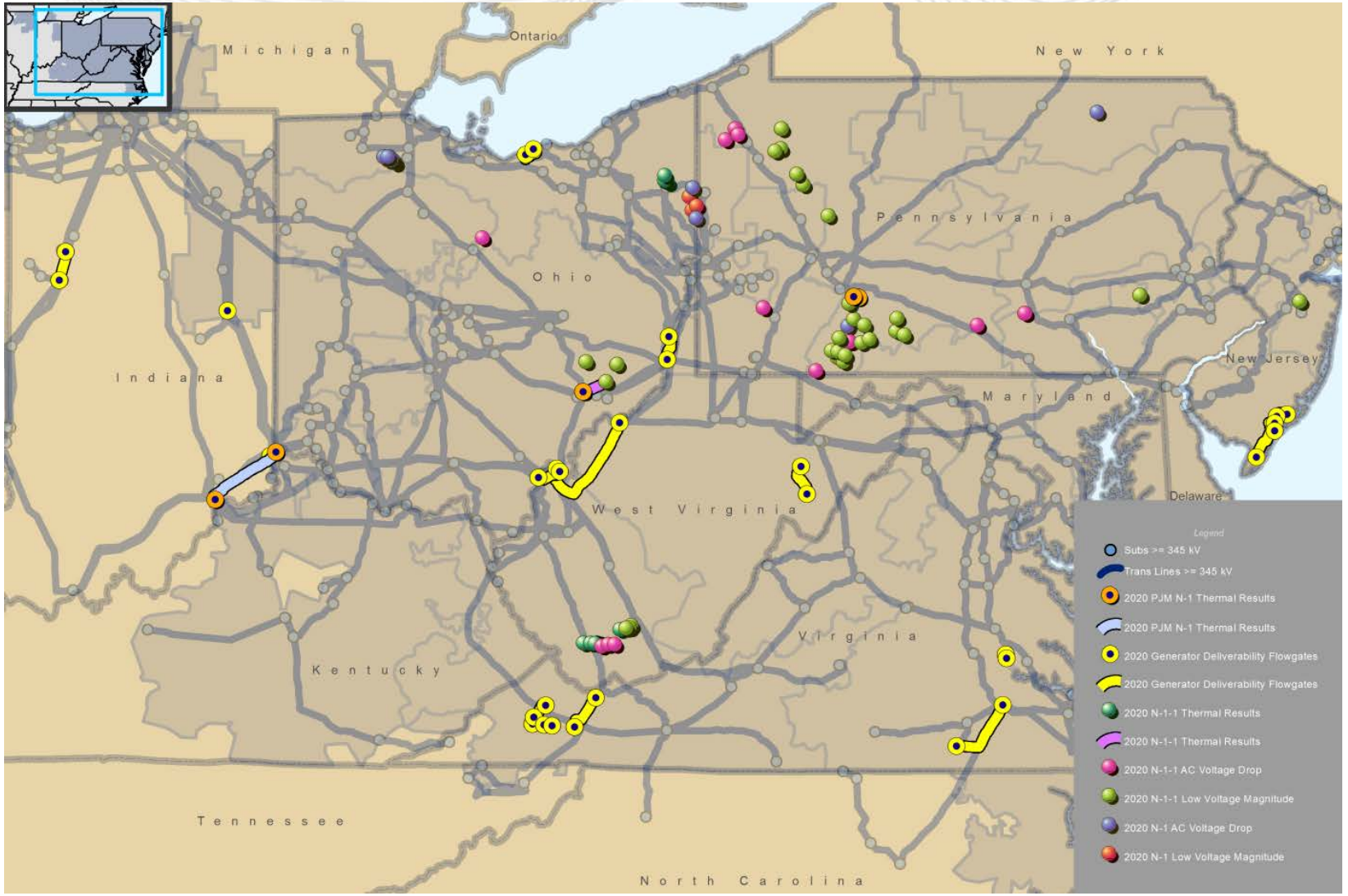
# 2015 RTEP Proposal Window #1

# 2015 RTEP Proposal Window #1

- Scope:
  - Baseline N-1 (thermal and voltage)
  - Generation Deliverability and Common Mode Outage
  - N-1-1 (thermal and voltage)
  - Load Deliverability (thermal and voltage)
- Window Opened: 6/19/2015
- Anticipated Window Close: 7/20/2015
  - Proposal definitions, simulation data and planning cost estimate due
- Detailed Cost due: 8/4/2015
  - Additional 15 days to develop and provide detailed cost data
  - See the window documentation for additional information

# 2015 RTEP Proposal Window #1 Violations

- Thermal overloads
  - Transmission lines
  - Transformers
- Voltage violations
  - Voltage Drop
  - Voltage Magnitude

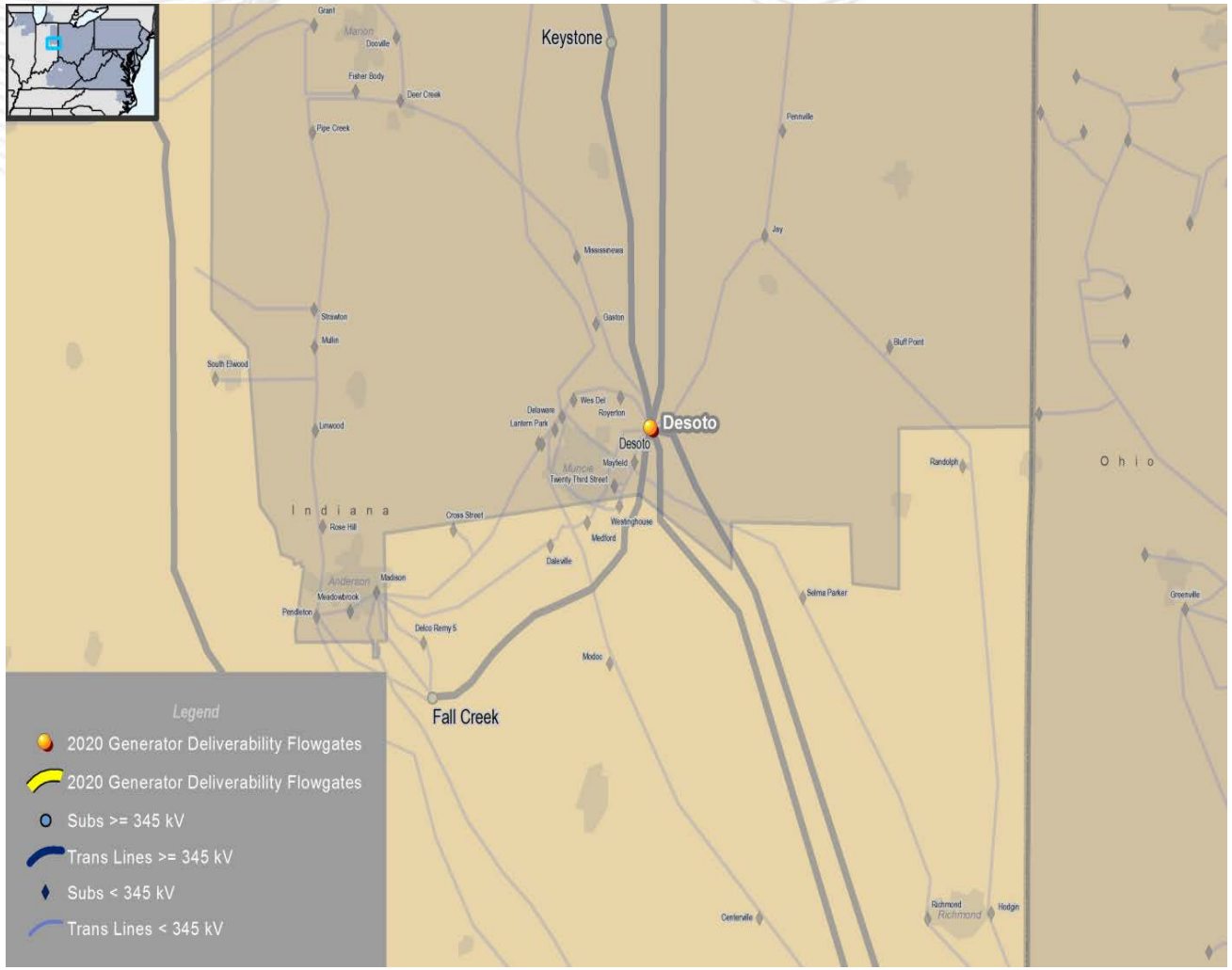


# AEP Transmission Zone

- Generation Deliverability and Common Mode Outage (FG# 59, 62, 875 and 878):
- Dequine to Meadow Lake 345 kV circuit #1 and #2 are overloaded for several contingencies.

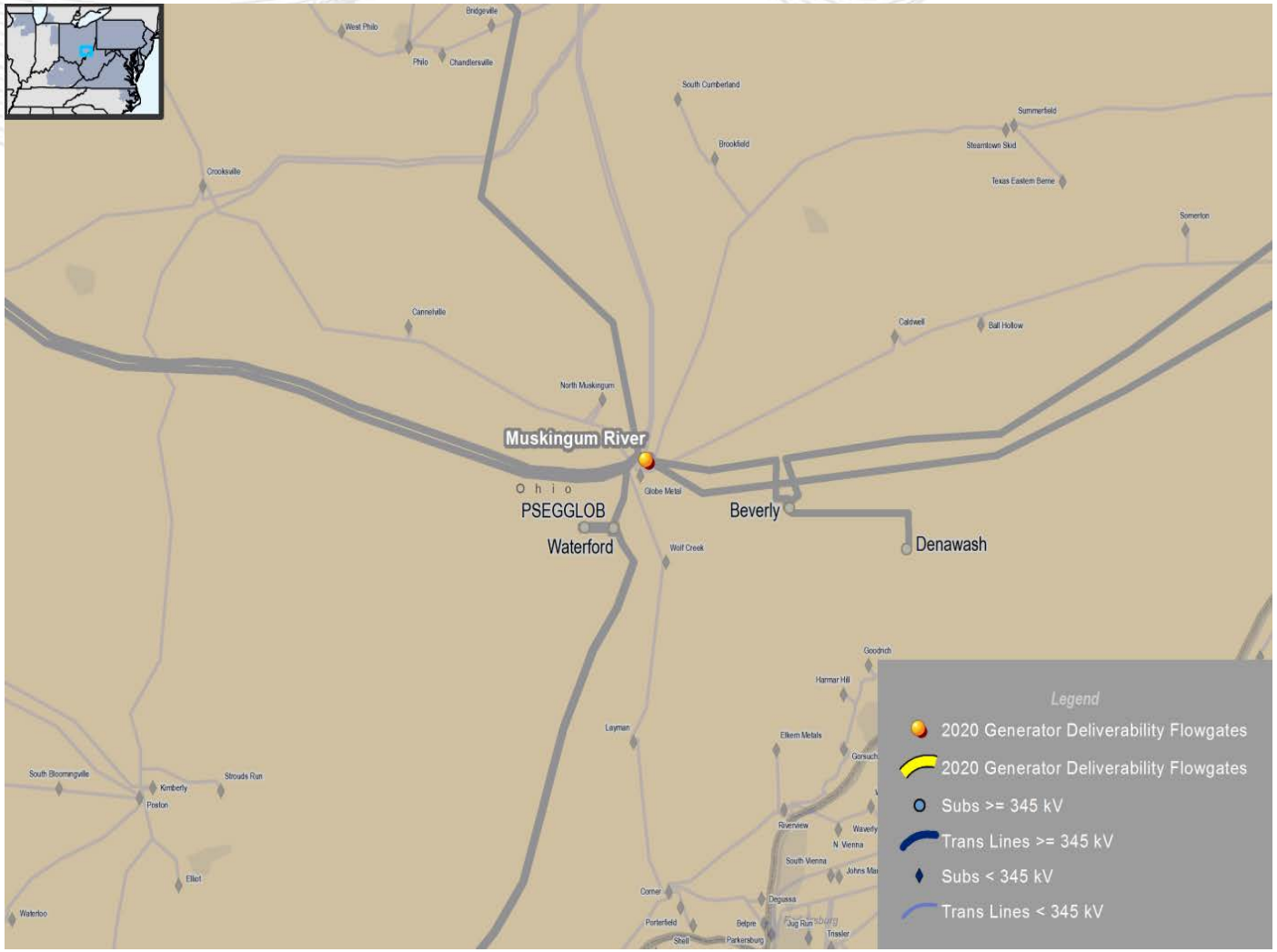
# AEP Transmission Zone

- Common Mode Outage (FG# 653):
- Desoto to 345/138 kV transformer is overloaded for tower outage loss of the Desoto – Sorenson and Keystone – Sorenson 345 kV circuits.



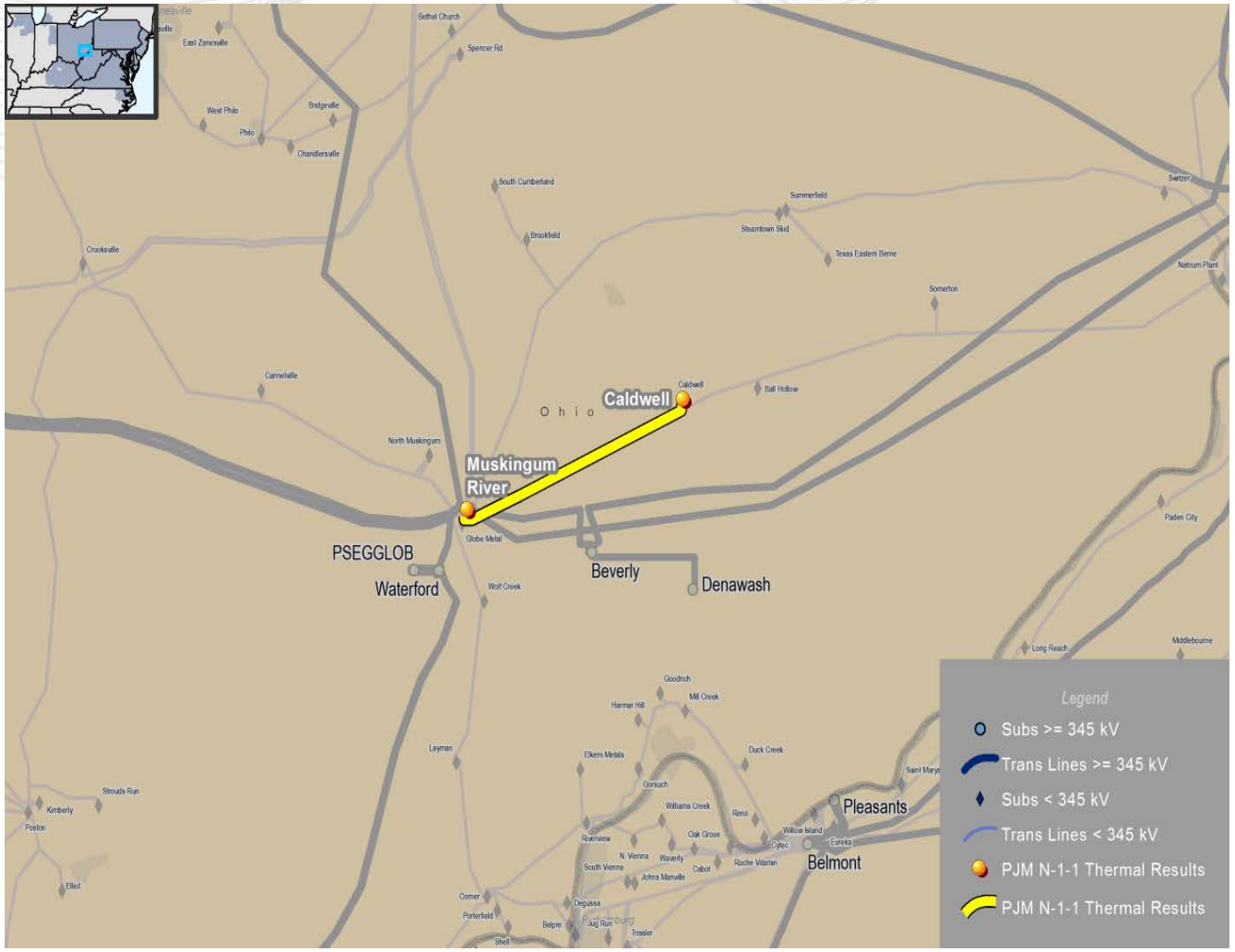
# AEP Transmission Zone

- Baseline and Common Mode Outage (FG# 152):
- Muskingum River 138 kV bus section is overloaded for line fault stuck breaker contingency loss of the Muskingum – North Muskingum and Muskingum – Globe Metal 138 kV circuits.



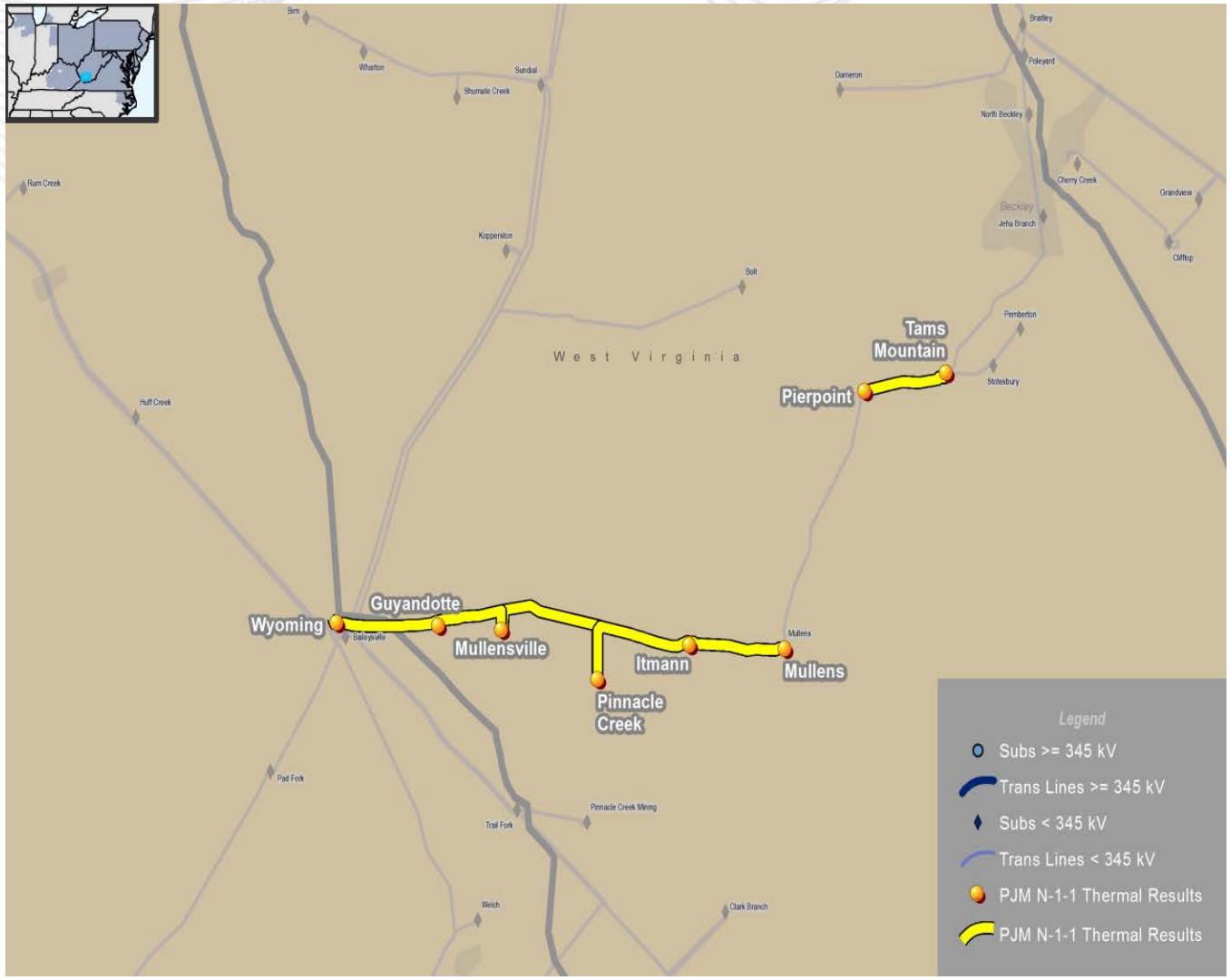
# AEP Transmission Zone

- N-1-1 Thermal Violation (FG# N2-T16 and N2-T17):
- South Caldwell – Muskingum 138 kV circuit is overloaded for several contingencies.



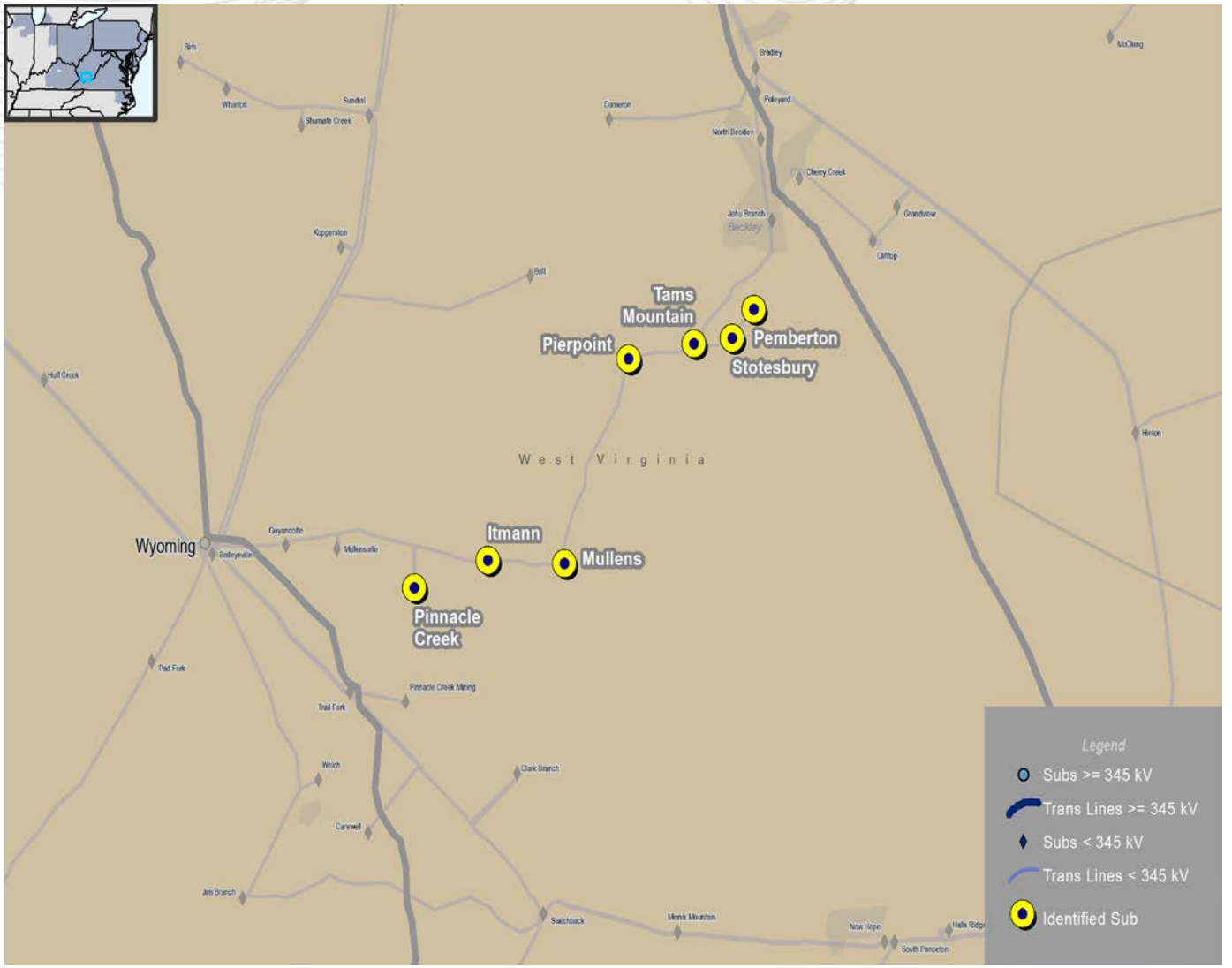
# AEP Transmission Zone

- N-1-1 Thermal Violation (FG# N2-T4 - 15):
- Wyoming – Guyandotte - Mullensville – Pinnacle Creek – Itmann -Mullens and Pierss – Tams Mountain 138 kV circuits are overloaded for N-1-1 contingency loss of the Glen Lyn – Hinton 138kV line and the loss of the Poleyard-Bradley-Grandview 138kV circuits.



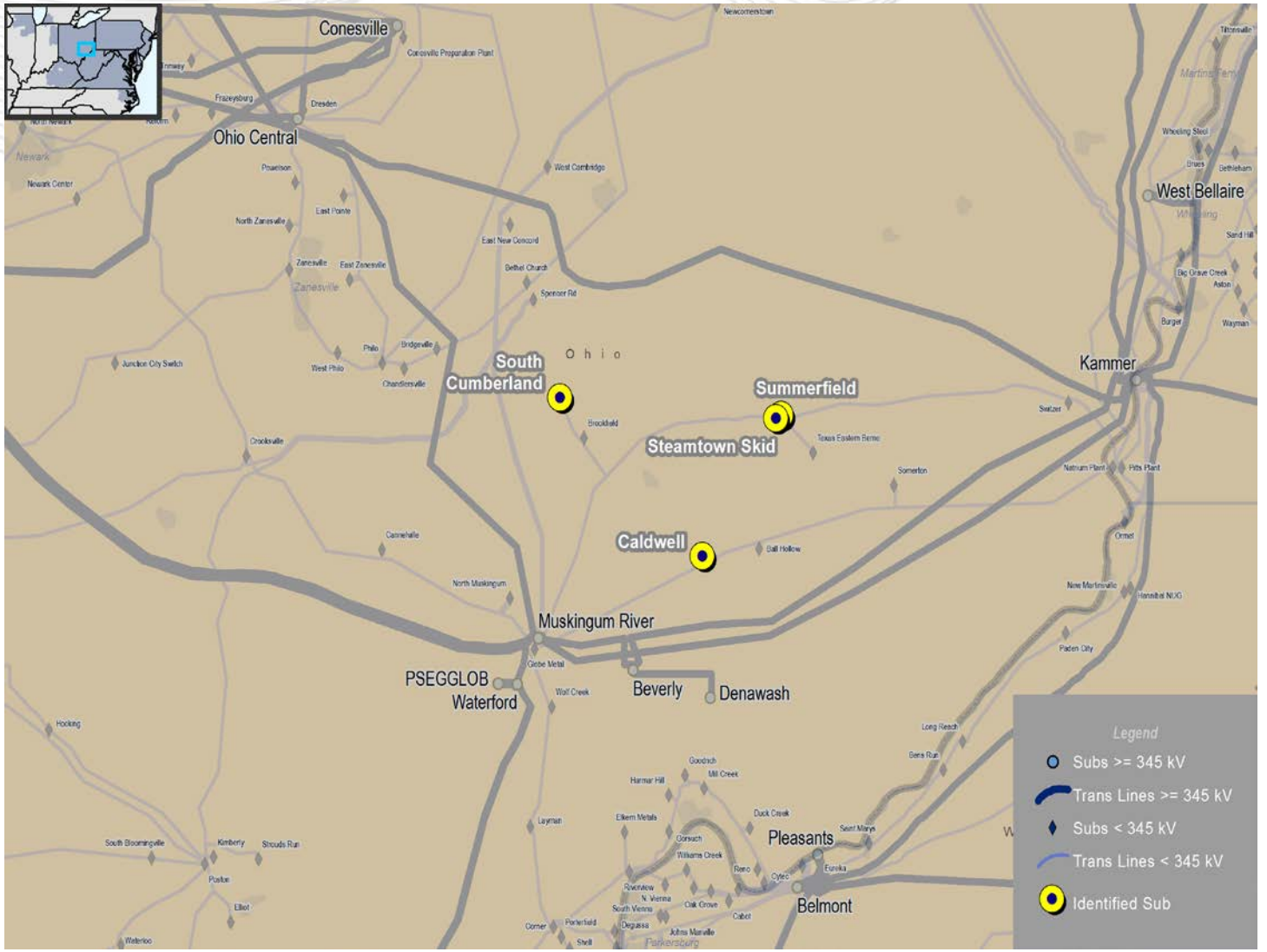
# AEP Transmission Zone

- N-1-1 Voltage (FG# N2-VM65 – 69, N2-VD75 – 90):
- Low voltage at Pemberton, Stotesbury, Tams Mountain, and Pierss 138KV buses and Voltage drop at Pemberton, Stotesbury, Tams Mountain, Mullens, Itmann, Pinnacle Creek and Pierss 138KV buses for the loss of the Glen Lyn – Hinton 138kV line and the loss of the Poleyard-Bradley-Grandview 138kV line
- Voltage drop at Pemberton, Stotesbury, Tams Mountain 138kV buses for the loss of the Poleyard-Bradley-Grandview 138kV line and the loss of the Wyoming - Guyandotte- Mullensville –Tams Mountain 138kV line



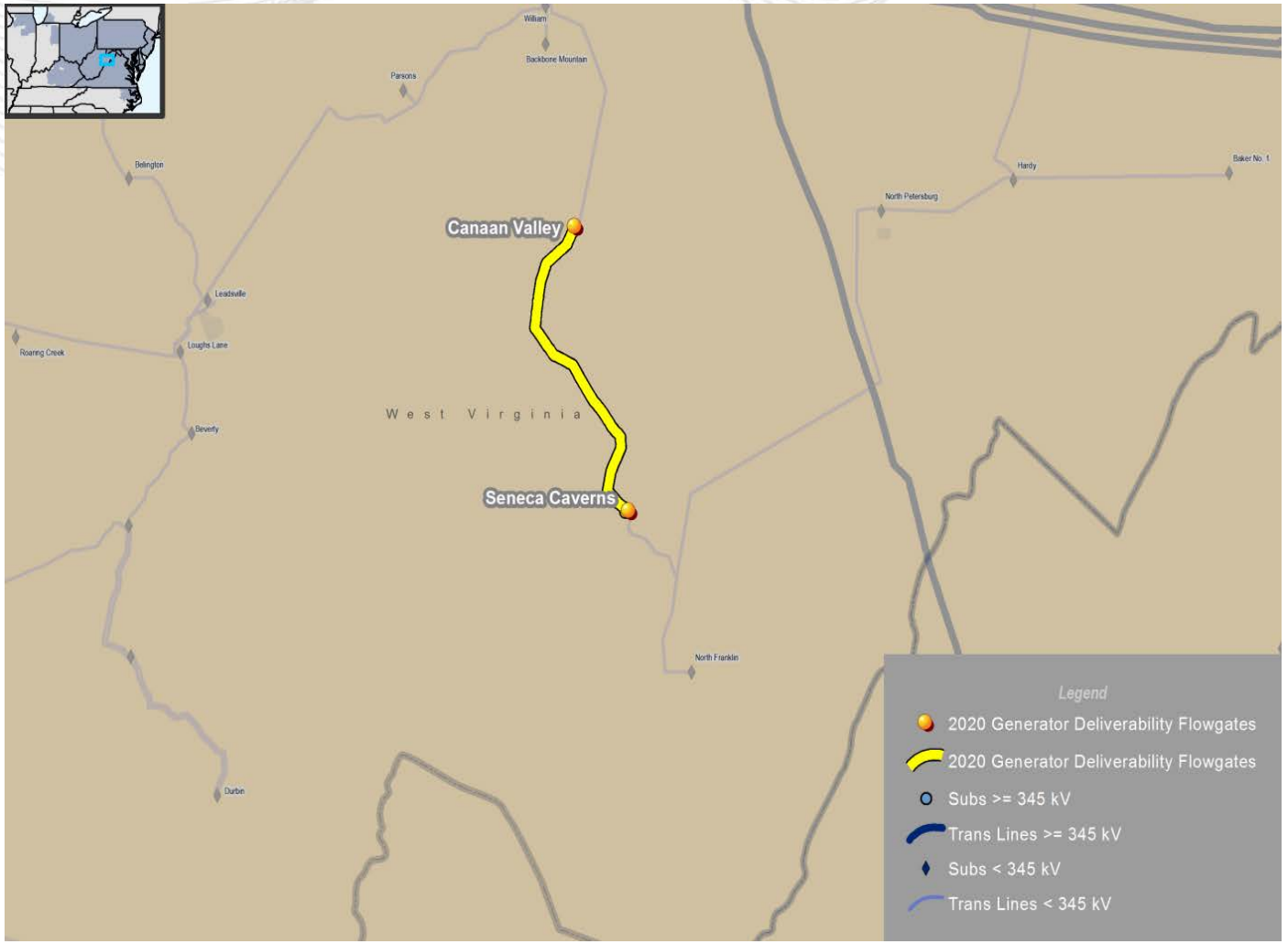
# AEP Transmission Zone

- N-1-1 Voltage (FG#: N2-VM70 – 76, N2-VD73 – 74):
- Low voltage at South Cumberland, Summerfield 138kV buses for several contingency pairs
- Low voltage at South Caldwell and Steamtown 138kV buses and voltage drop at South Caldwell and South Cumberland 138kV buses for the loss of the Muskingum – South Caldwell 138kV line and the loss of the Muskingum –East New Concord-West Cambridge 138kV line



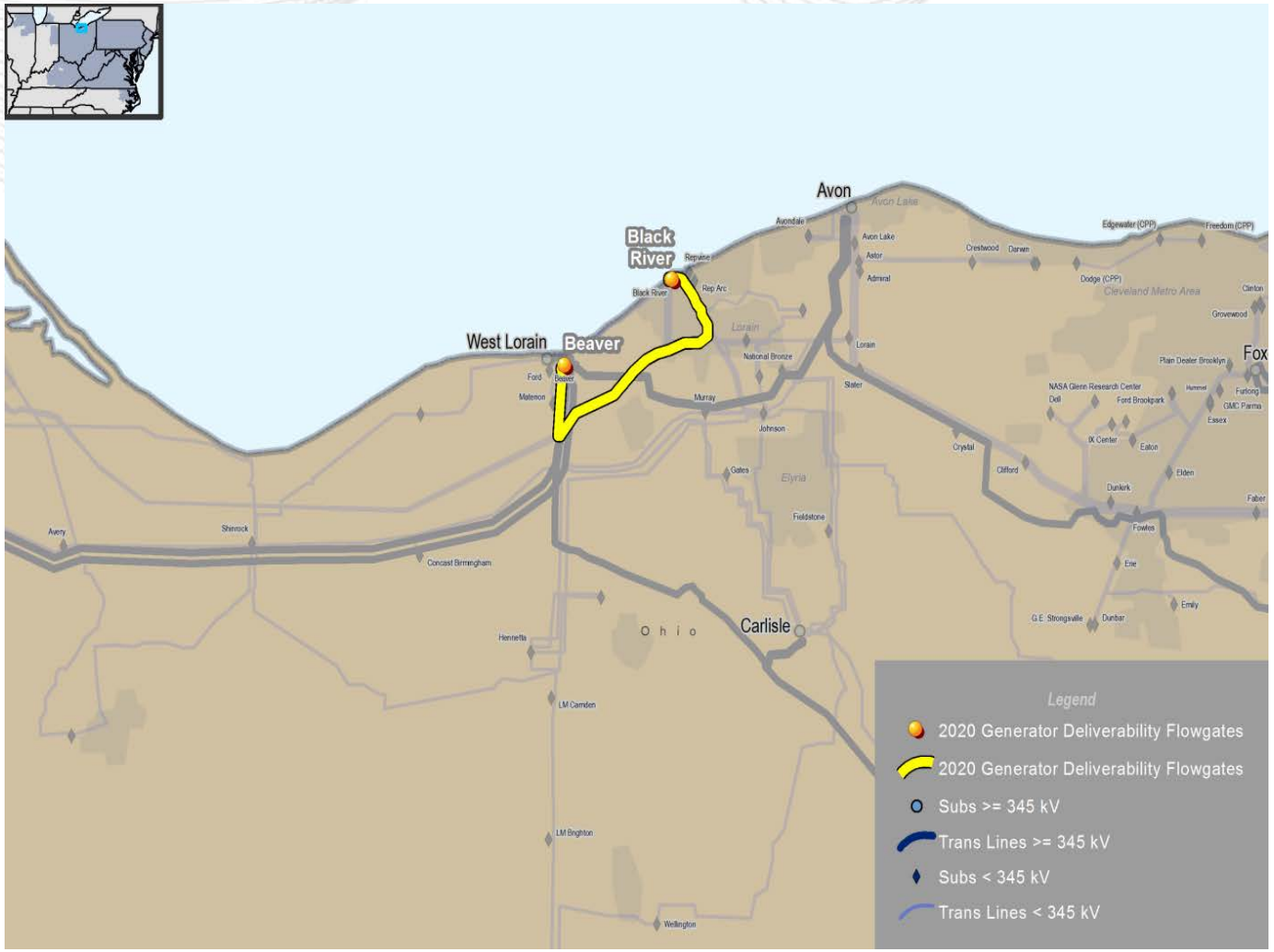
# APS Transmission Zone

- Common Mode Outage (FG# 589, 859, 860, 861):
- Canaan Valley to Seneca Caverns 138 kV circuit is overloaded for several contingencies.



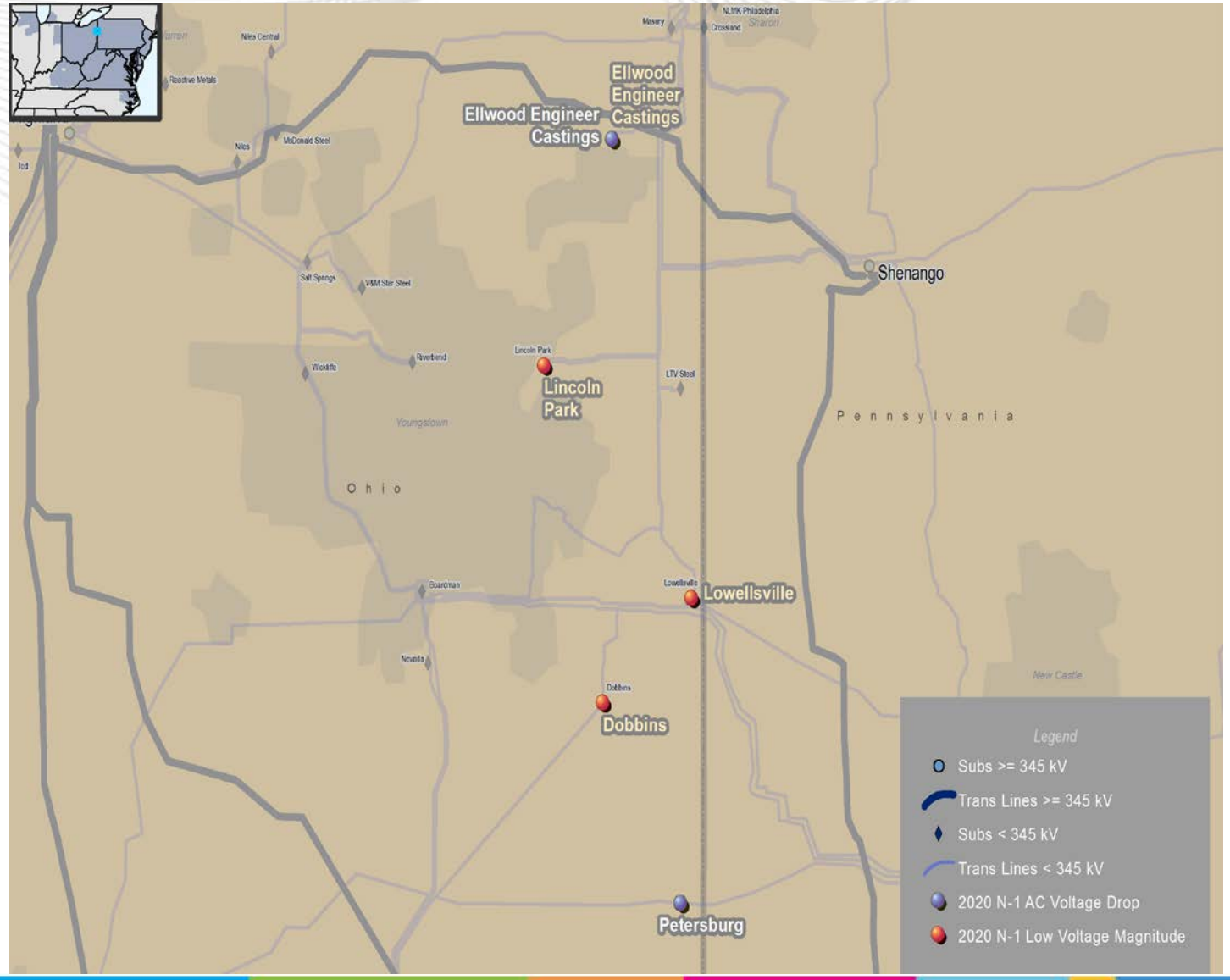
# ATSI Transmission Zone

- Common Mode Outage (FG# 664):
- Beaver to Black River 138 kV circuit is overloaded for tower outage loss of the Beaver – Lake Ave #1 & #2 345 kV circuits.



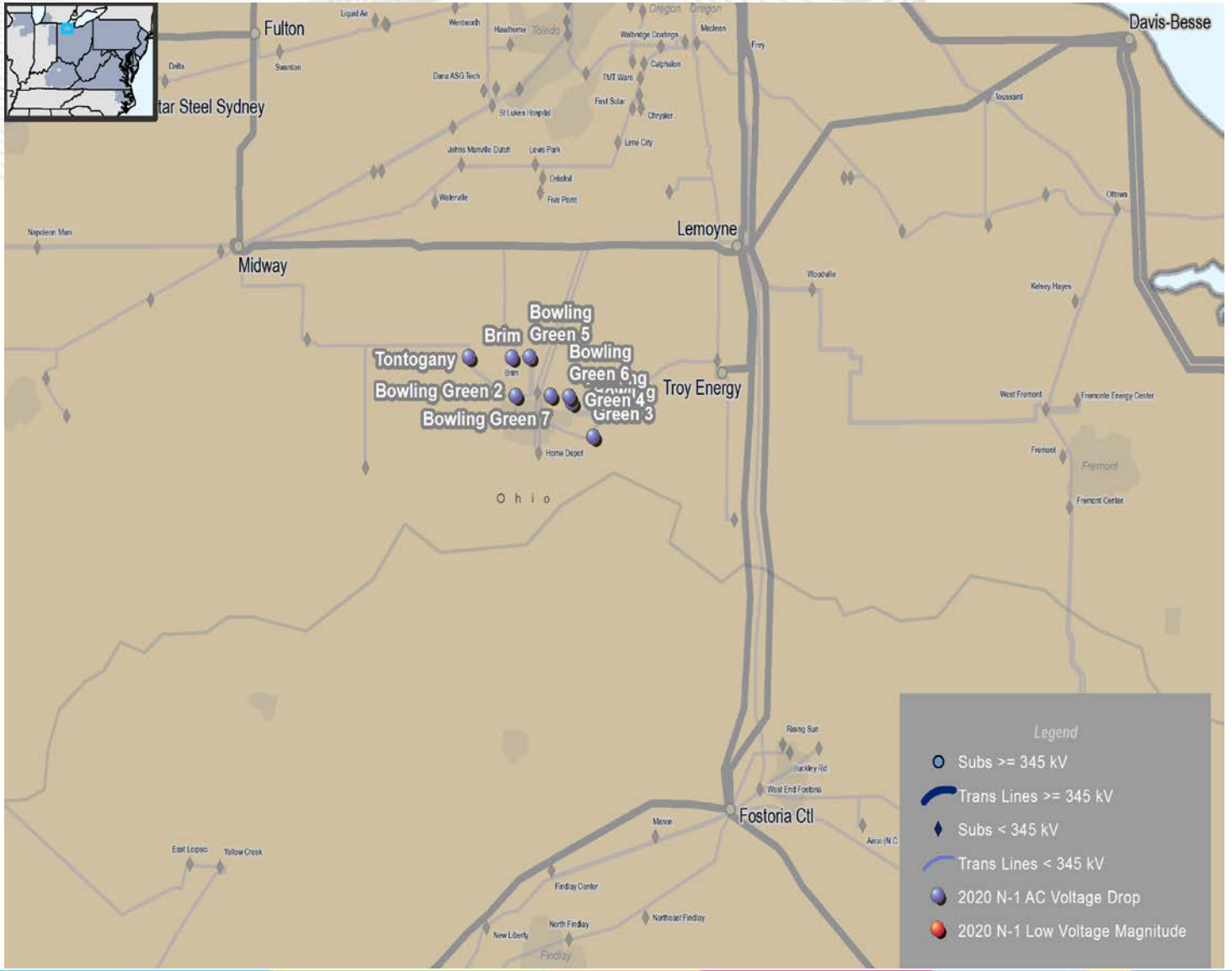
# ATSI Transmission Zone

- Baseline Voltage Violation (FG# N1-VM2 - VM13, N1-VD2 and VD3):
- Voltage magnitude violation on the Dobbins, Ellwood, Lincoln Park, Lowellsville and Pennant 138 kV substations for several contingencies.



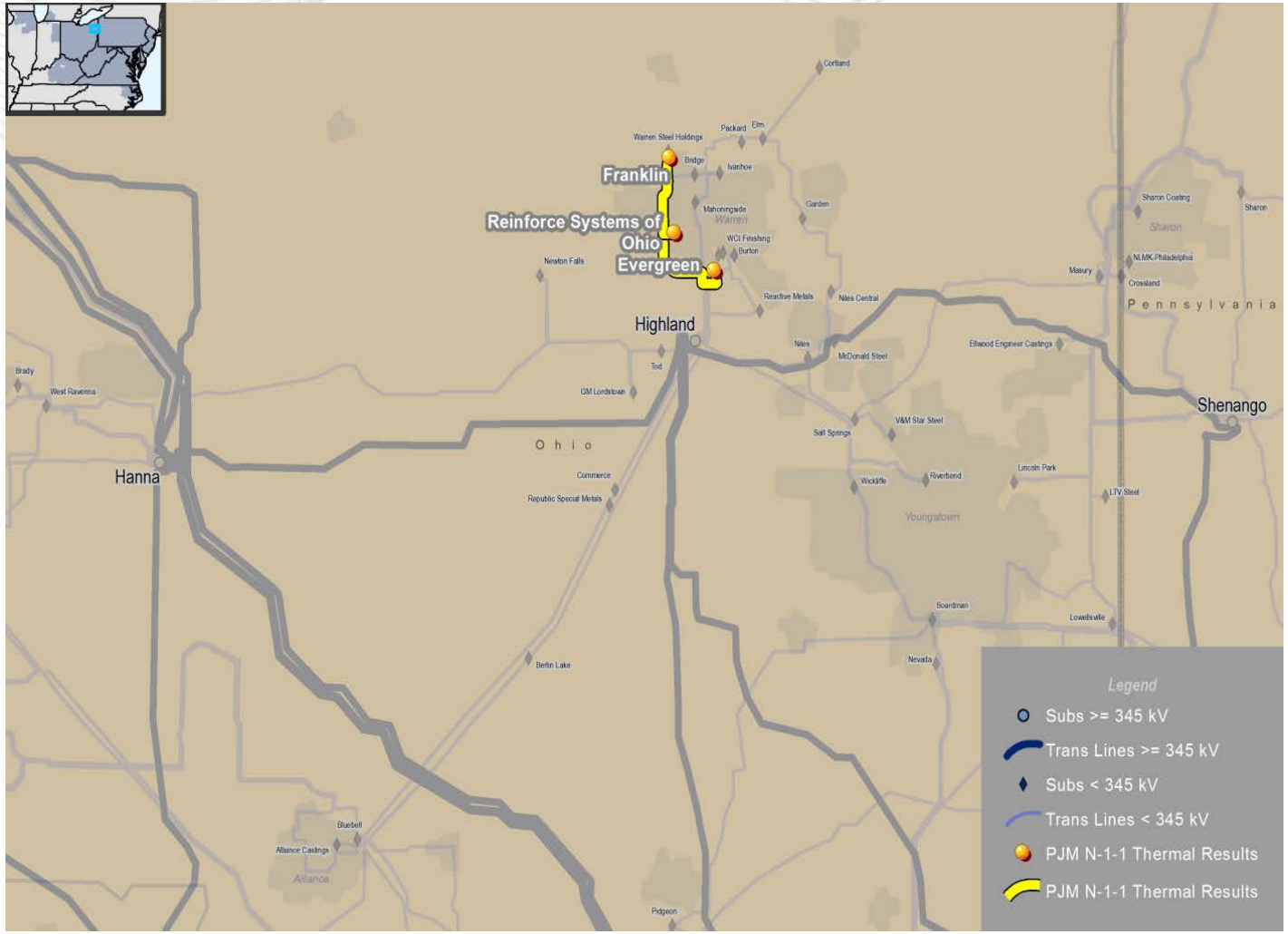
# ATSI Transmission Zone

- Baseline Voltage Violation:
- Voltage drop violation on the Brim, Page 72, Tontogany and Bowling Green 2, 3,4,5,6,7 69 kV substations for several contingencies.



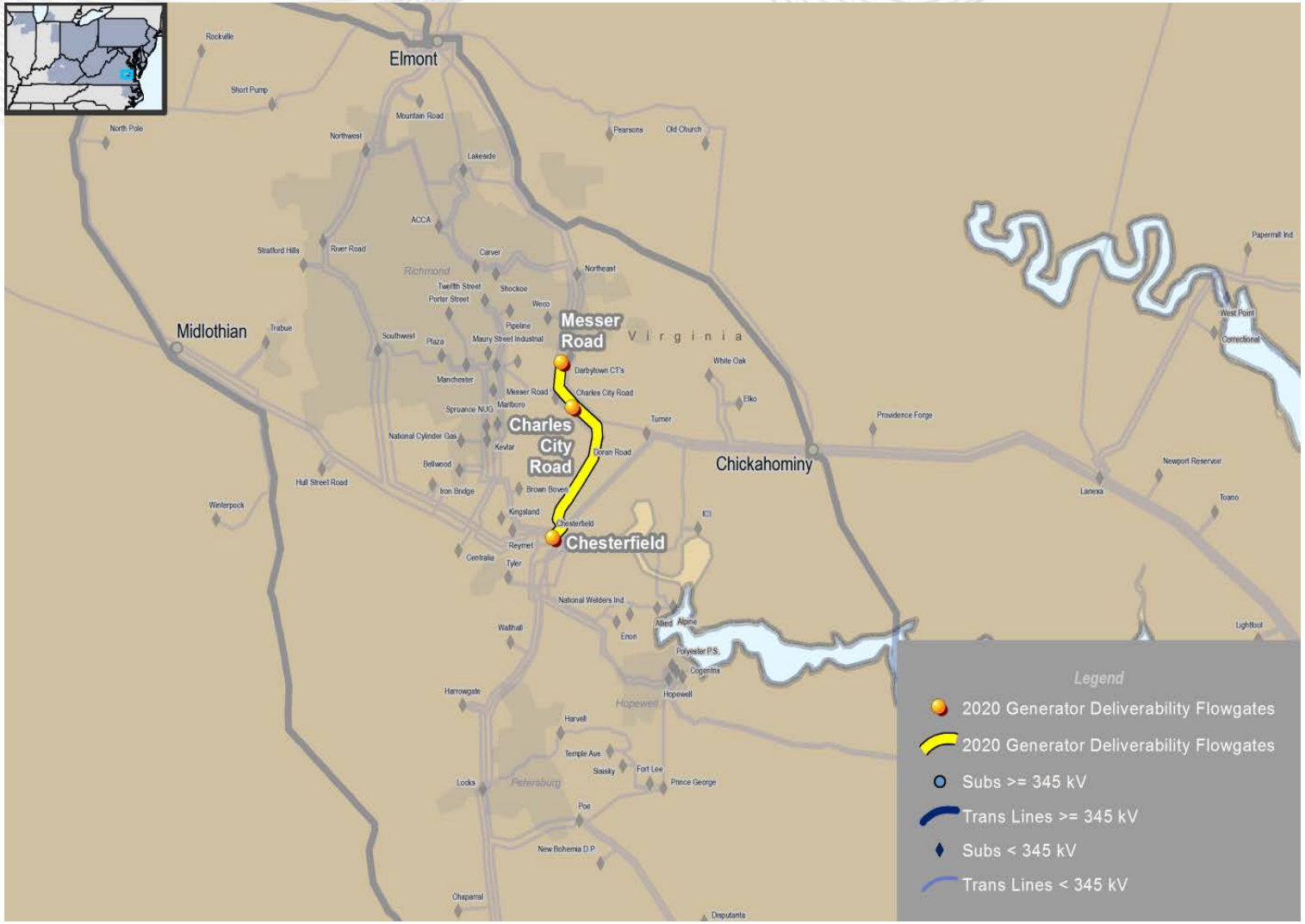
# ATSI Transmission Zone

- N-1-1 Thermal Violation (FG# N2-T1 – T3):
- Evergreen – RSYSOH – Franklin 138 kV circuit is overloaded for N-1-1 contingency loss of the Niles – Niles Central and Mahoningside – Ivanhoe 138 kV circuits.



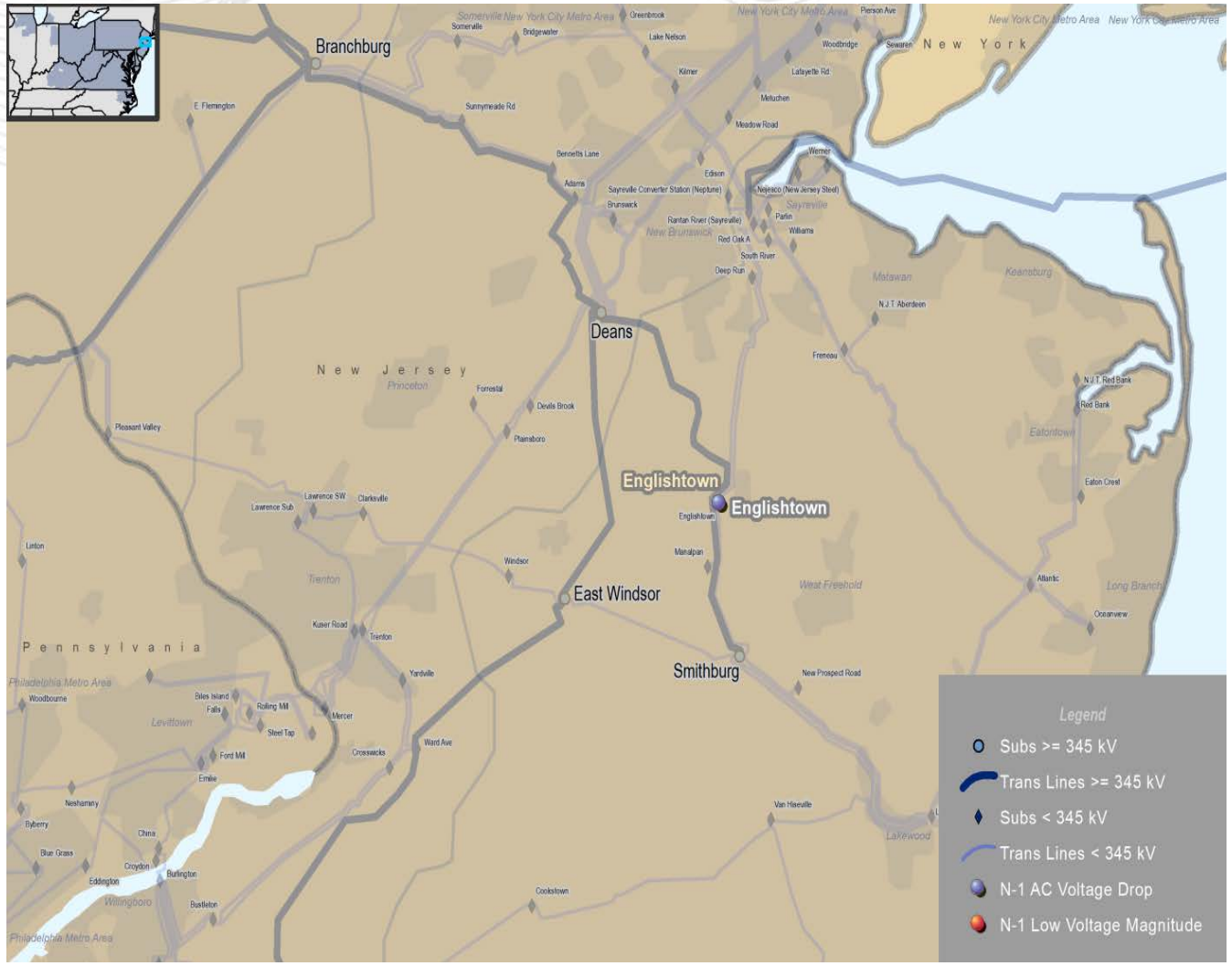
# DOM Transmission Zone

- Generation Deliverability Violation
- The Chesterfield – Messer Road – Charles City Road 230kV circuit is overloaded for several contingencies



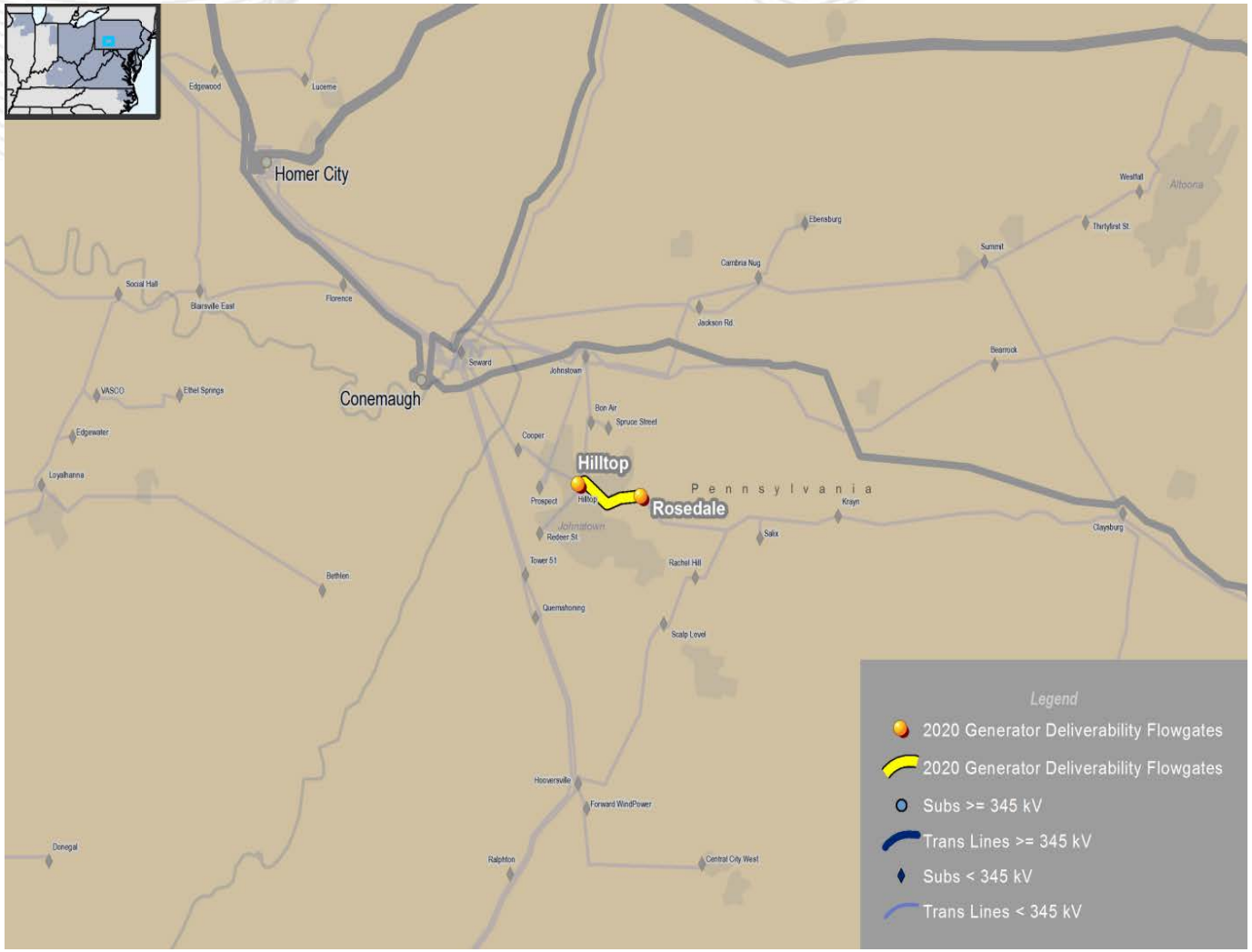
# JCPL Transmission Zone

- Baseline and N-1-1 Voltage Violation (FG# N1-VD1, N2-VM5 to N2-VM8, N2-VM10, N2-VM12, N2-VM13, N2-VD2, N2-VDV3 and N2-VD4):
- Voltage magnitude and drop violation at the Englishtown 230 kV substation for several N-1-1 contingency pairs.



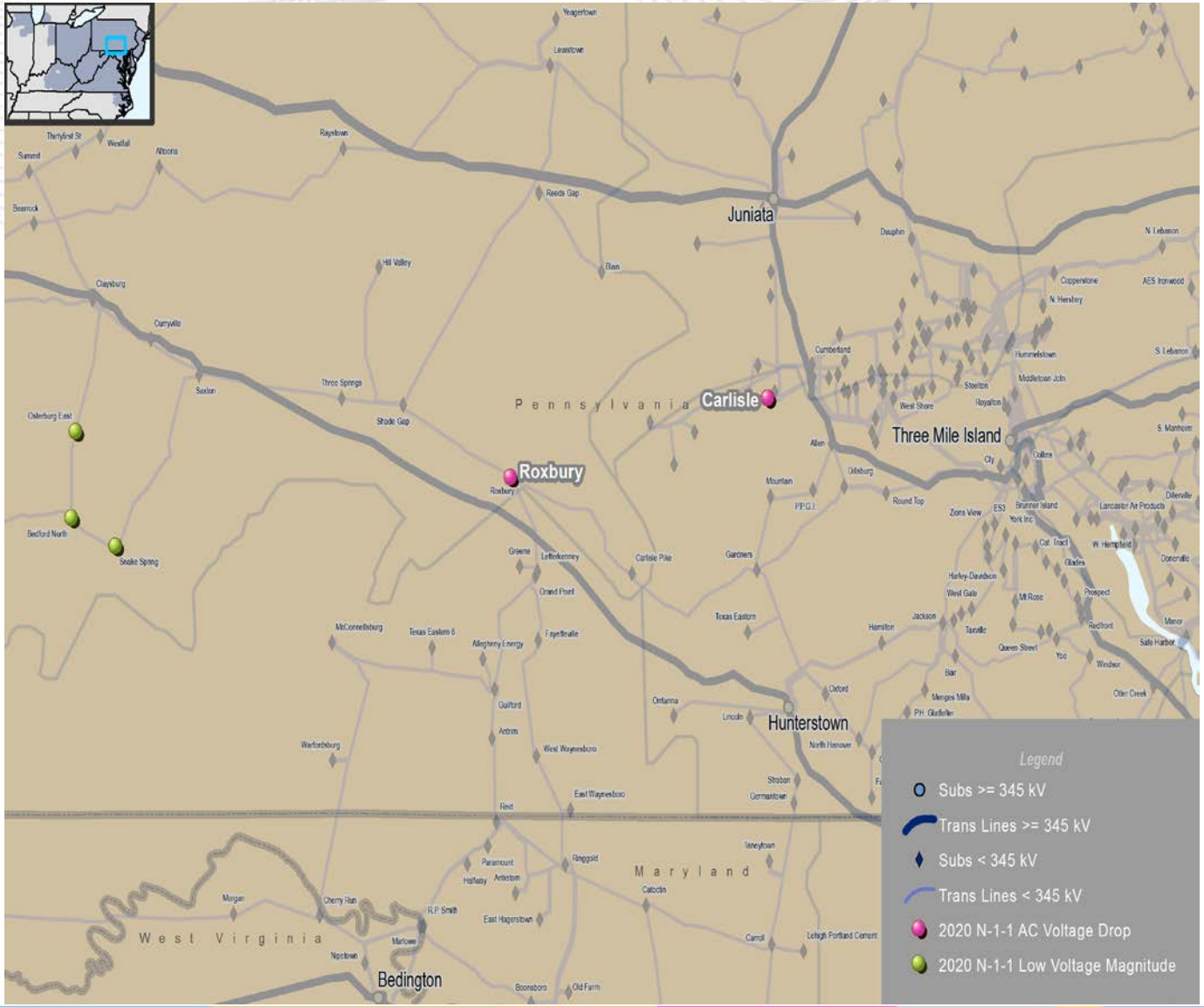
# PenElec Transmission Zone

- Baseline and Common Mode Outage (FG # 204 and 674):
- Rosedale – Hill top 115 kV circuit is overloaded for tower line outage of Homer City – Hooversville 230 kV and Seward – Tower 115 kV circuits.



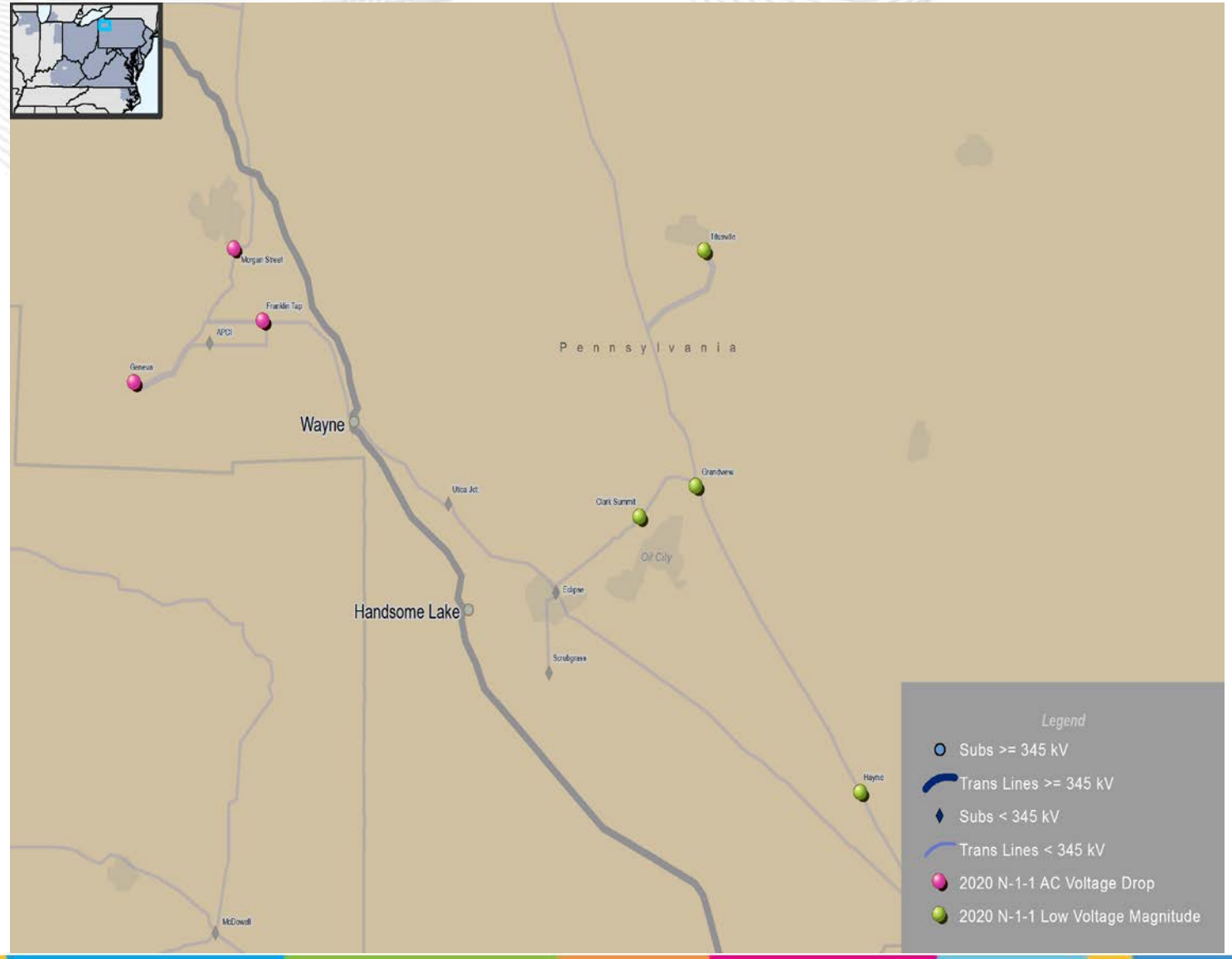
# PenElec Transmission Zone

- N-1-1 Voltage Violation (FG# N2-VD6, N2-VD7, N2-VD53, N2-VD60, N2-VD61 and N2-V72):
- Voltage magnitude and drop violation on the Carlisle Pike and Roxbury115 kV substations for several N-1-1 contingency pairs.



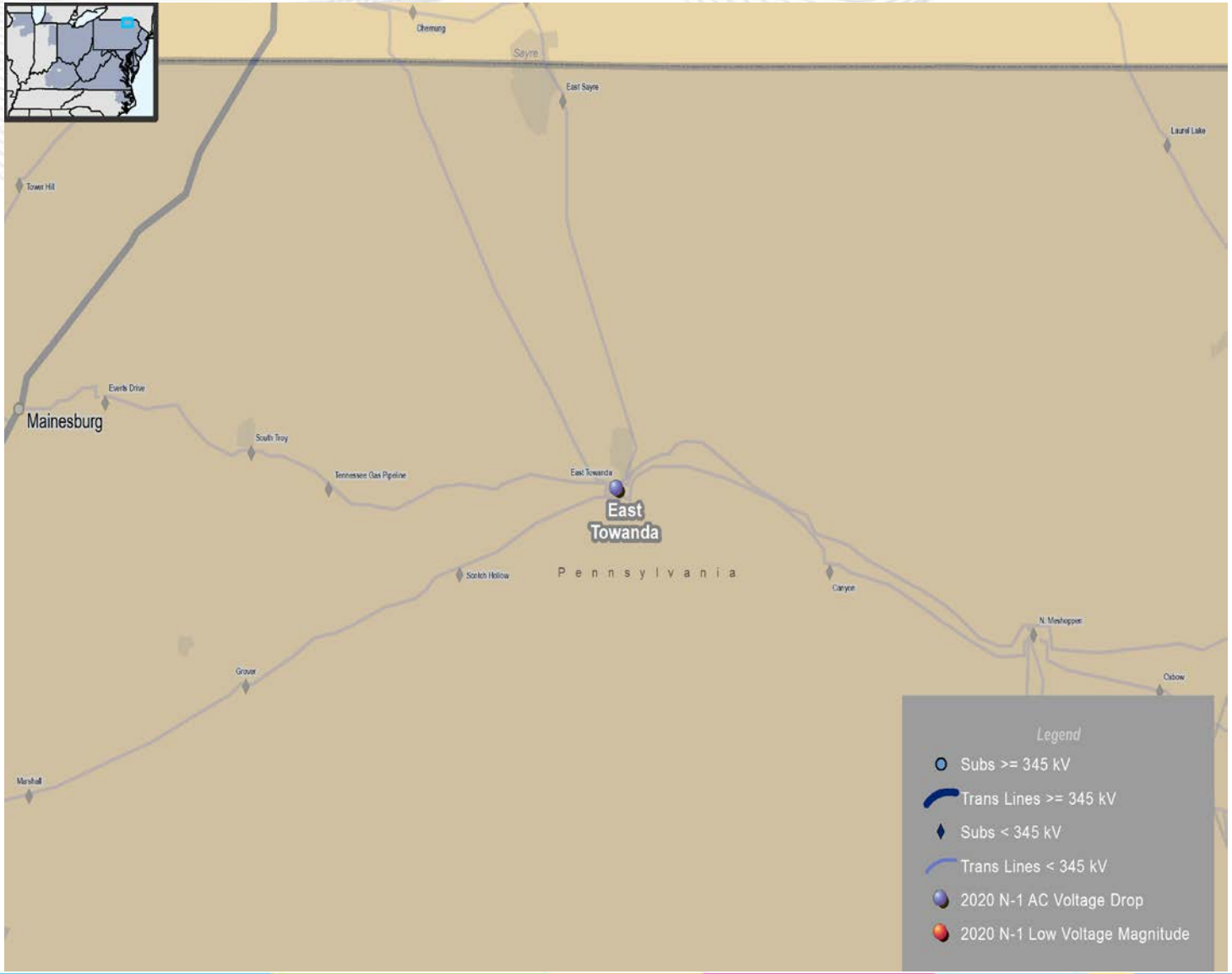
# PenElec Transmission Zone

- N-1-1 Voltage Violation (FG# N2-VD5 - 9):
- Voltage drop  violation on the Morgan St., Geneva, PPGAPI, Frankline115 kV kV substations for N-1-1 contingencies loss of Wayne 345-115 kV transformer and Morgan St. – Springboro – Edinboro South 115 kV circuit.



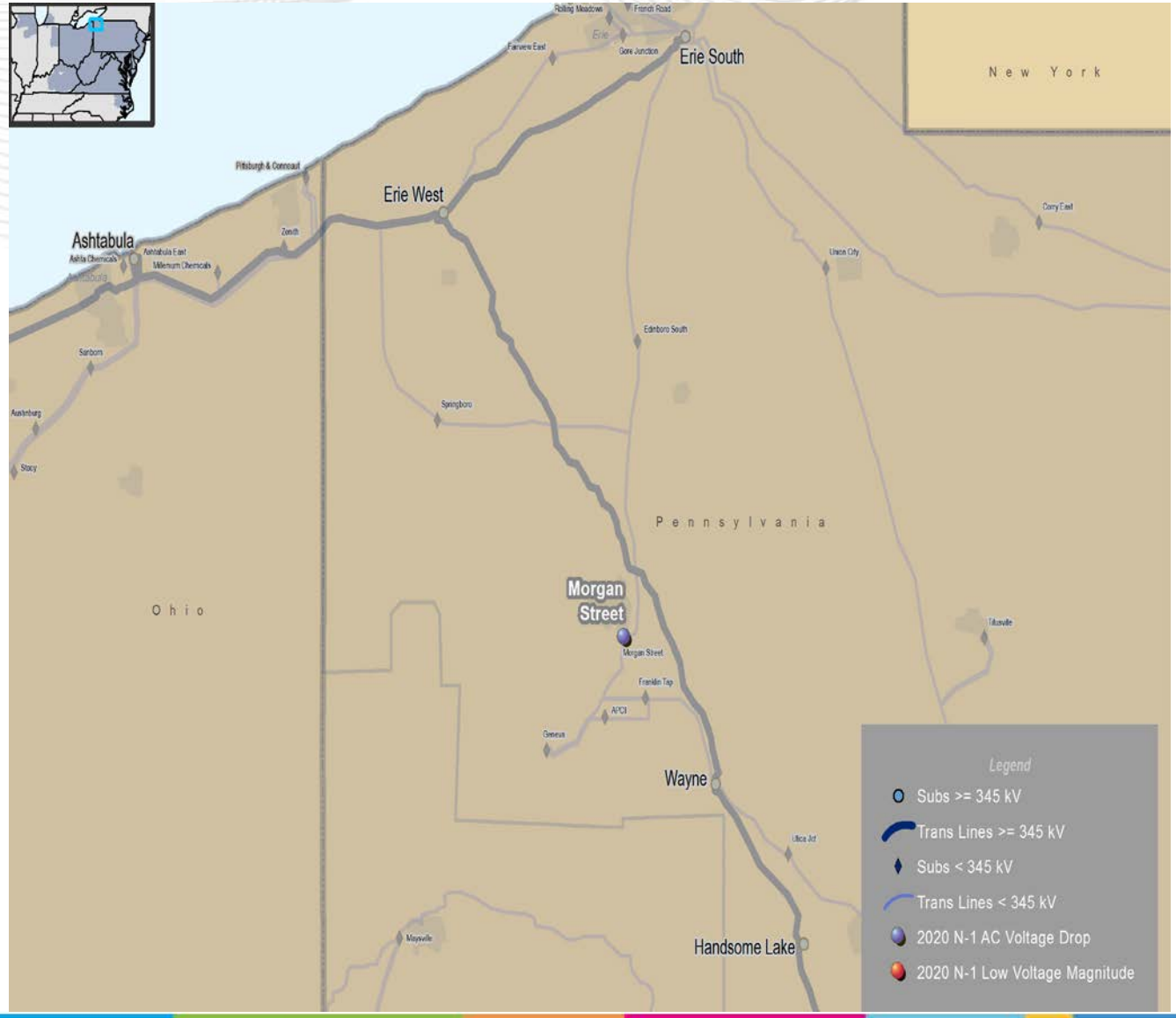
# PenElec Transmission Zone

- Baseline Voltage Violation (FG# N1-VD4):
- Voltage drop violation at Towanda 115 kV bus section for line fault stuck breaker contingencies loss of another Towanda 115 kV bus section.



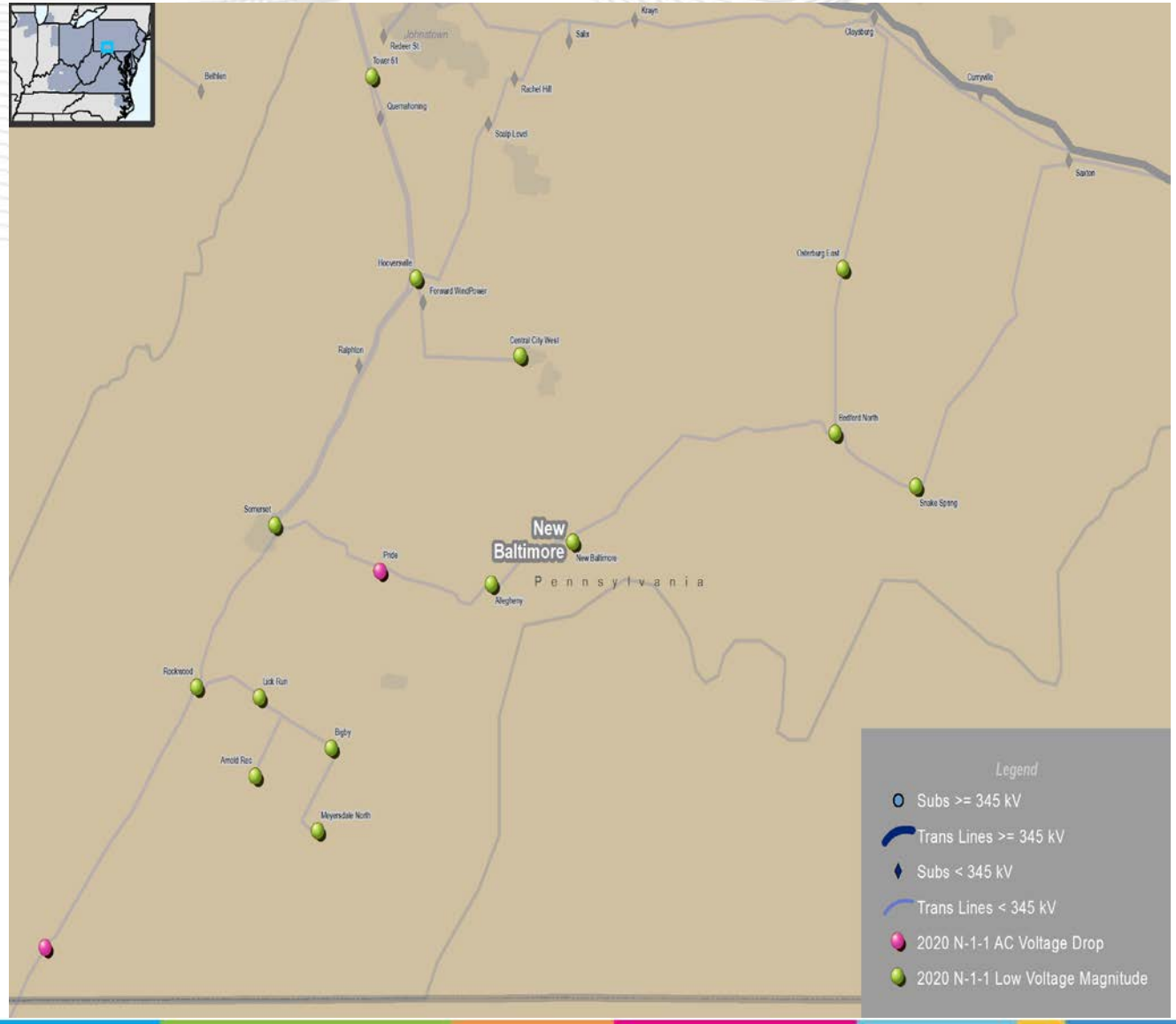
# PenElec Transmission Zone

- Baseline Voltage Violation (FG# N1-VD7):
- Voltage drop violation at Morgan St. 115 kV bus substation for line fault stuck breaker contingencies loss of Morgan St – Edinboro South – Erie South 115 kV circuit.



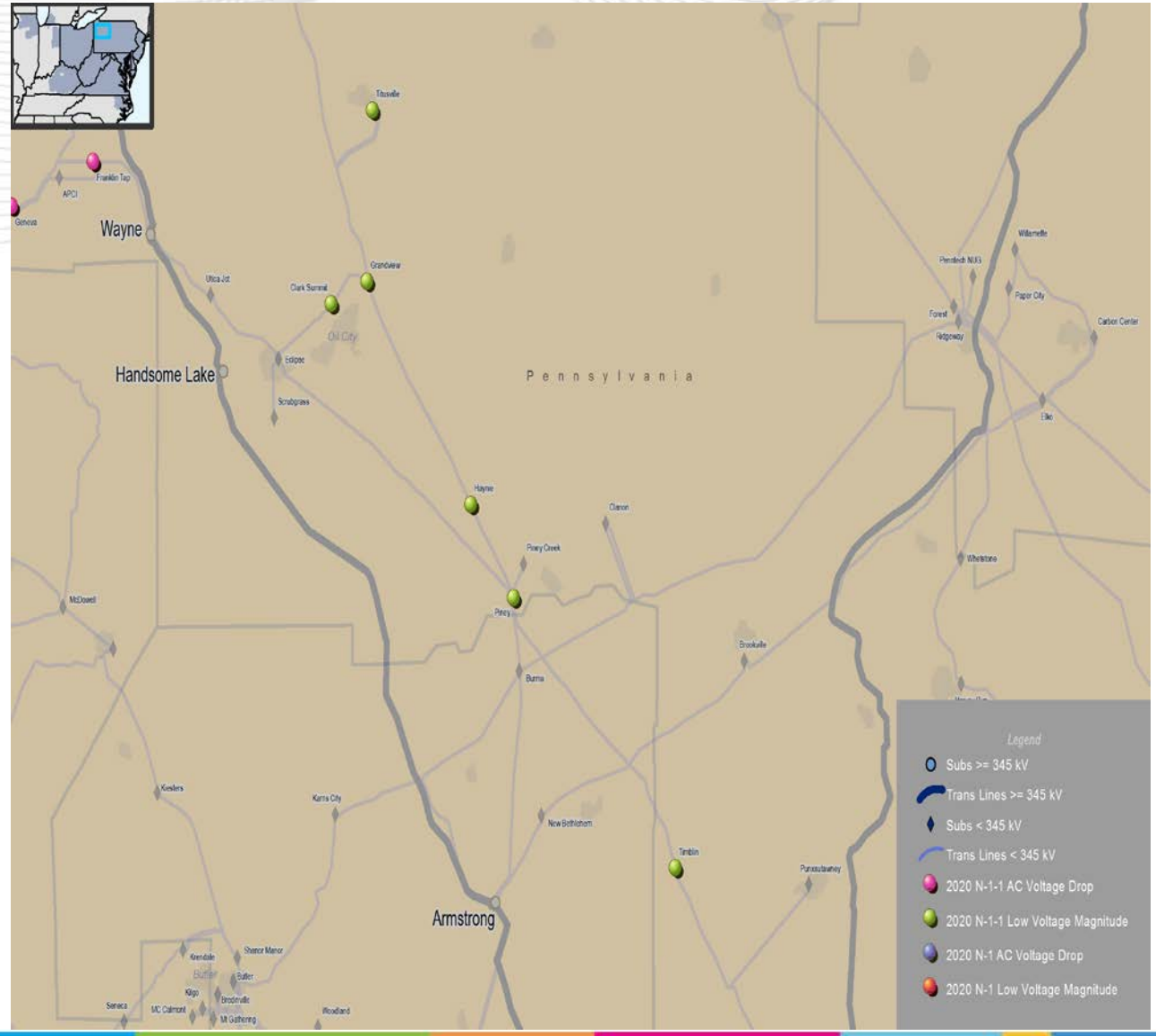
# PenElec Transmission Zone

- N-1-1 Voltage Violation :
- Voltage magnitude and drop violation on several 115 kV substations along the Hooversville-Somerset – New Baltimore – Bedford North circuit for several N-1-1 contingencies.



# PenElec Transmission Zone

- N-1-1 Voltage Violation:
- Voltage magnitude and drop violation on the Grandview, Clark Summit, Titusville, Haynie, Piney and Timblin 115 kV substations for several N-1-1 contingency pairs.

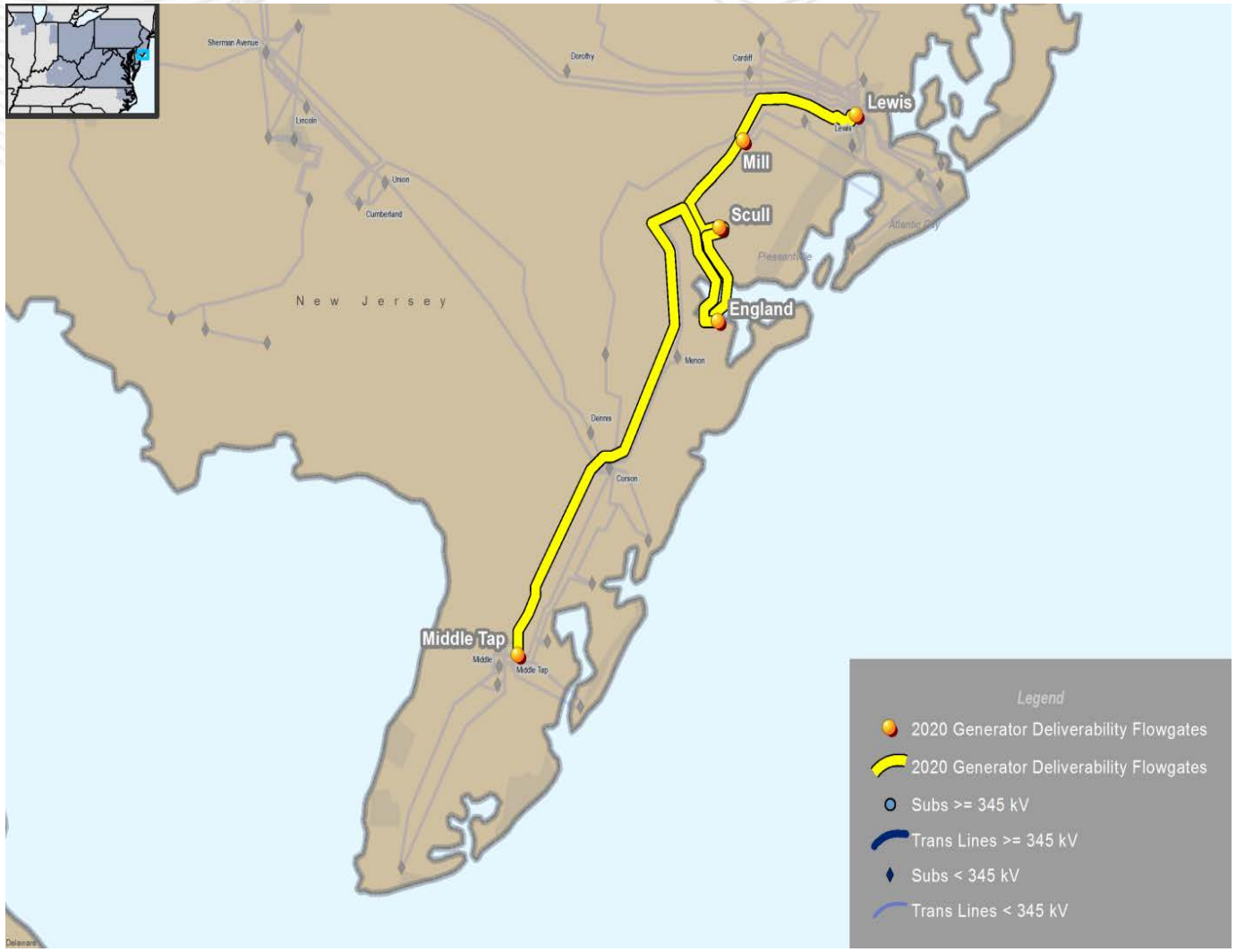


# Overloads Due to Deactivation Notification, FSA and BL England Generators

# AE Transmission Zone

- Generation Deliverability and Common Mode Outage:
- BL England related overloads.
- The following circuits are overloaded for several contingencies.

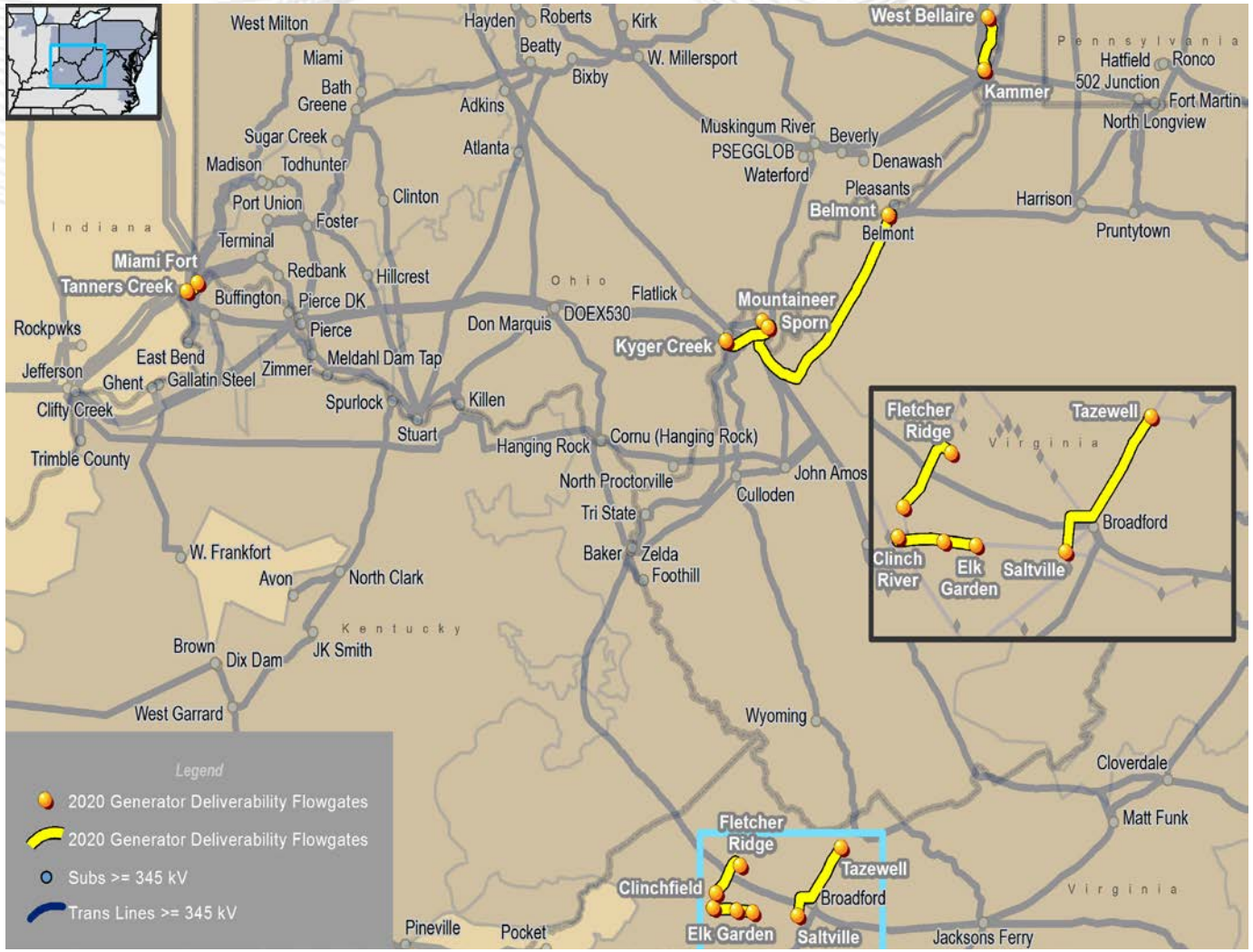
| From Name | To Name | Circuit # | KVs |
|---|---|---|---|
| SCULL | MILL | 1 | 138/138 |
| BL England | SCULL | 2 | 138/138 |
| BL England | Middle Tap | 1 | 138/138 |
| MILL | LEWIS | 1 | 138/138 |
| BLE | SCULL | 1 | 138/138 |
| SCULL | MILL | 1 | 138/138 |



# AEP Transmission Zone

- Generation Deliverability and Common Mode Outage:
- Retired generation related overloads
- The following circuits are overloaded for several contingencies.

| From Name | TO Name | CKT | KVs |
|---|---|---|---|
| Clinch River | Lebanon | 1 | 138/138 |
| Clinch Field | Fletcher Ridge | 1 | 138/138 |
| Elk Garden | Saltville | 1 | 138/138 |
| Lebanon | Elk Garden | 1 | 138/138 |
| Saltville | Tazewell | 1 | 138/138 |
| Mountaineer | Belmont | 1 | 765/765 |
| Kyger Creek | Sporn | 2 | 345/345 |
| Kyger Creek | Sporn | 1 | 345/345 |
| Tanner Creek | Miami Fort | 1 | 345/345 |



# 2015 RTEP Windows Next Steps

# Anticipated 2015 RTEP Proposal Window #2

- Anticipated window open
  - First week of August 2015
  - Advance email announcement will be provided
- Scope
  - TO criteria violations
  - Light load criteria violations
- Anticipated Window Duration
  - 30 Days

# Dominion End of Life Criteria Violation

# Dominion Transmission Zone

- Dominion End of Life Criteria Violation on the Cunningham to Dooms 500 kV Line
- Third party evaluation:
  - Confirmed the Cunningham to Doom 500 kV is nearing or has reached its End of Life
  - Performed a Risk Assessment
- Reliability Assessments without the line result in Criteria violations:
  - PJM validated the following violations
- NERC B “N-1” (New NERC TPL-001-4 P3) Violations:
  - Initial Loss of Front Royal generation followed by loss of Mt Storm- Valley 500kV line
    - Overload of Edinburg - Strasburg 138 Kv

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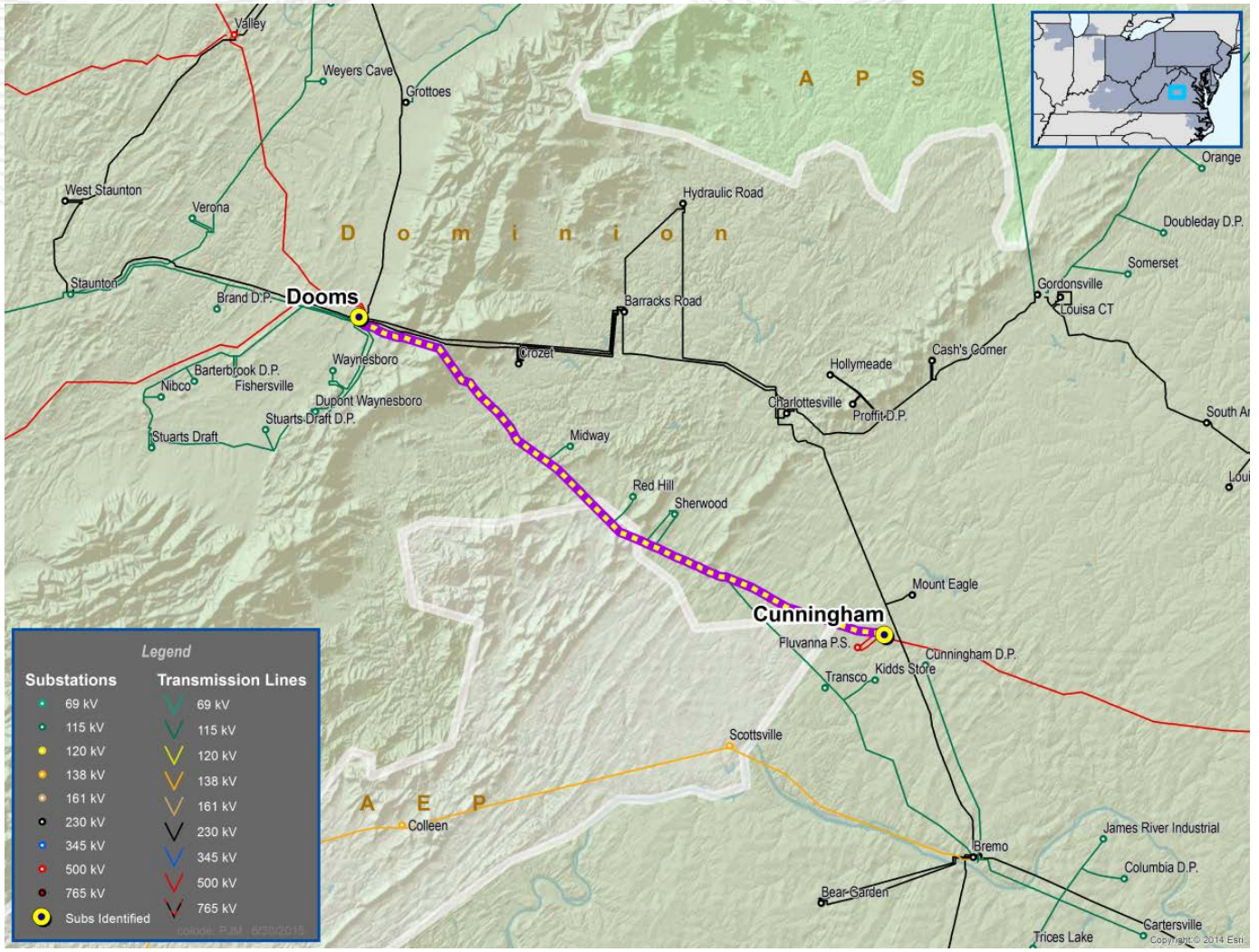
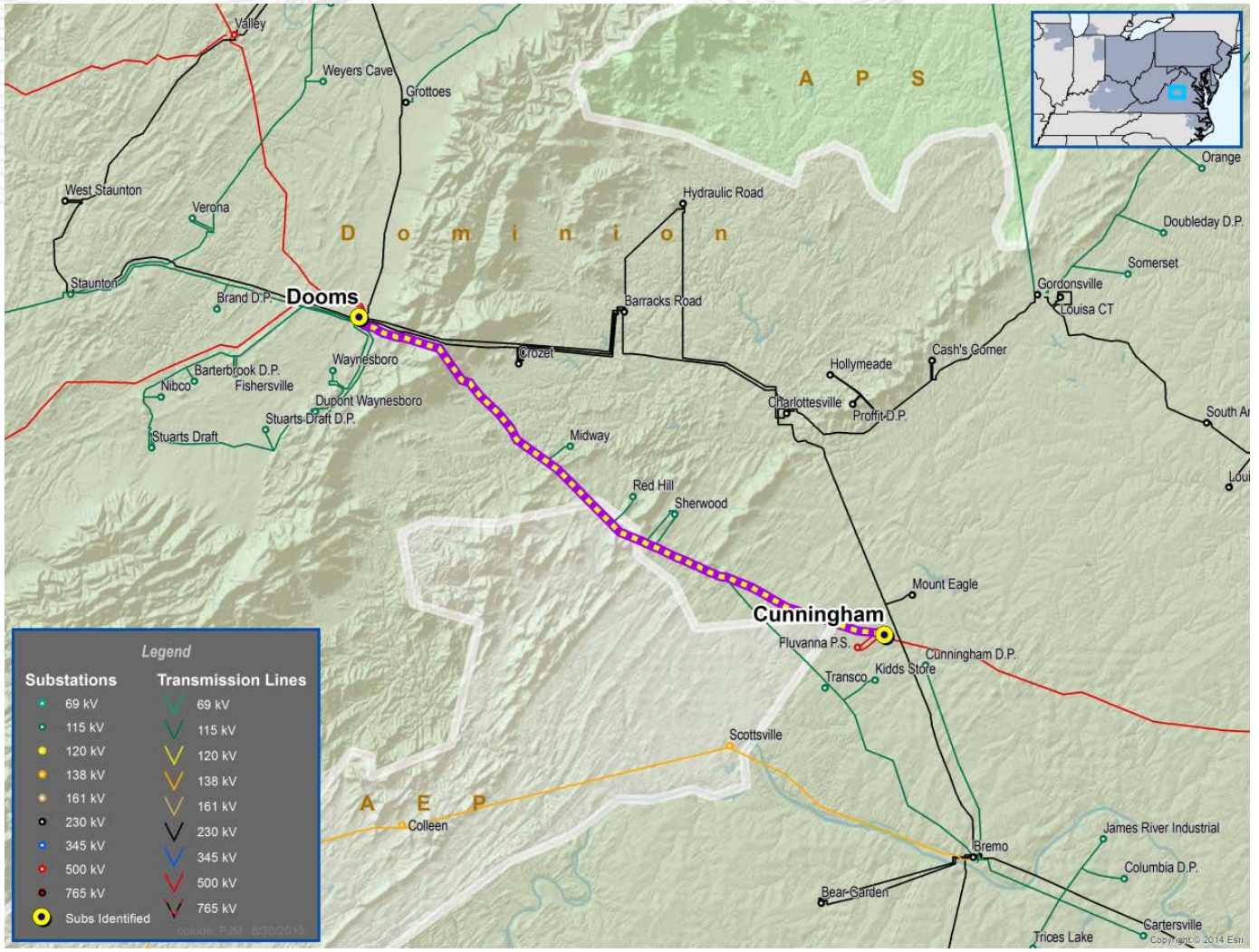


# Dominion Transmission Zone

….. Continued from previous slide

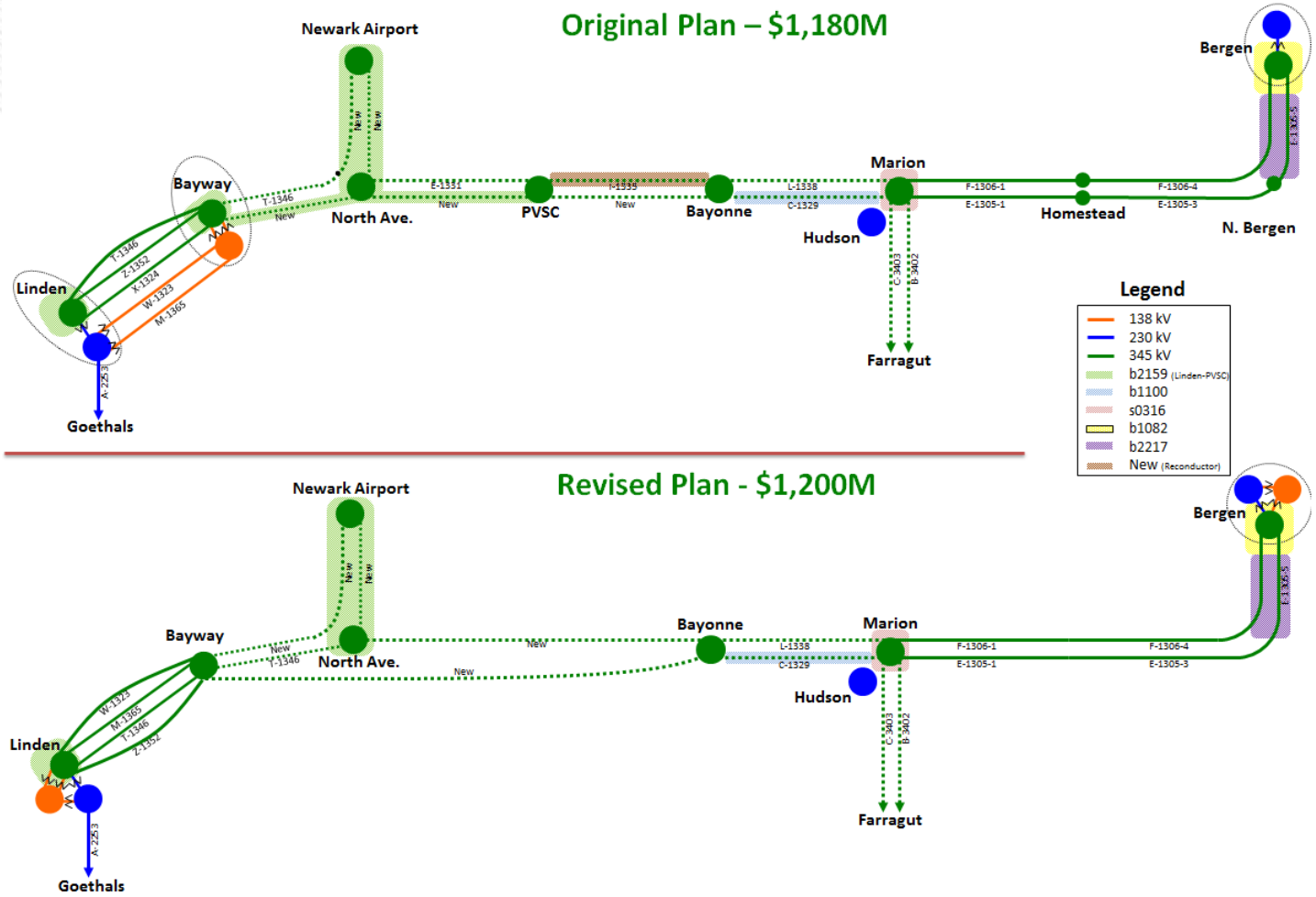
- NERC C3 “N-1-1” (New NERC TPL-001-4 P6)
  - Loss of Lexington – Cloverdale 500kV and Bath County – Valley 500kV lines:
    - Low voltage and voltage drop in the 500kV area of Bath County, Dooms, Lexington, and Valley
    - Voltage drop in the 230kV area of Lexington Low Moor, and Clifton
- Preliminary Recommended Solution: Rebuild the Cunningham – Dooms 500 kV line as a PJM baseline upgrade
- Estimated Cost: $67.95 M
- Projected In Service Date: June 2020



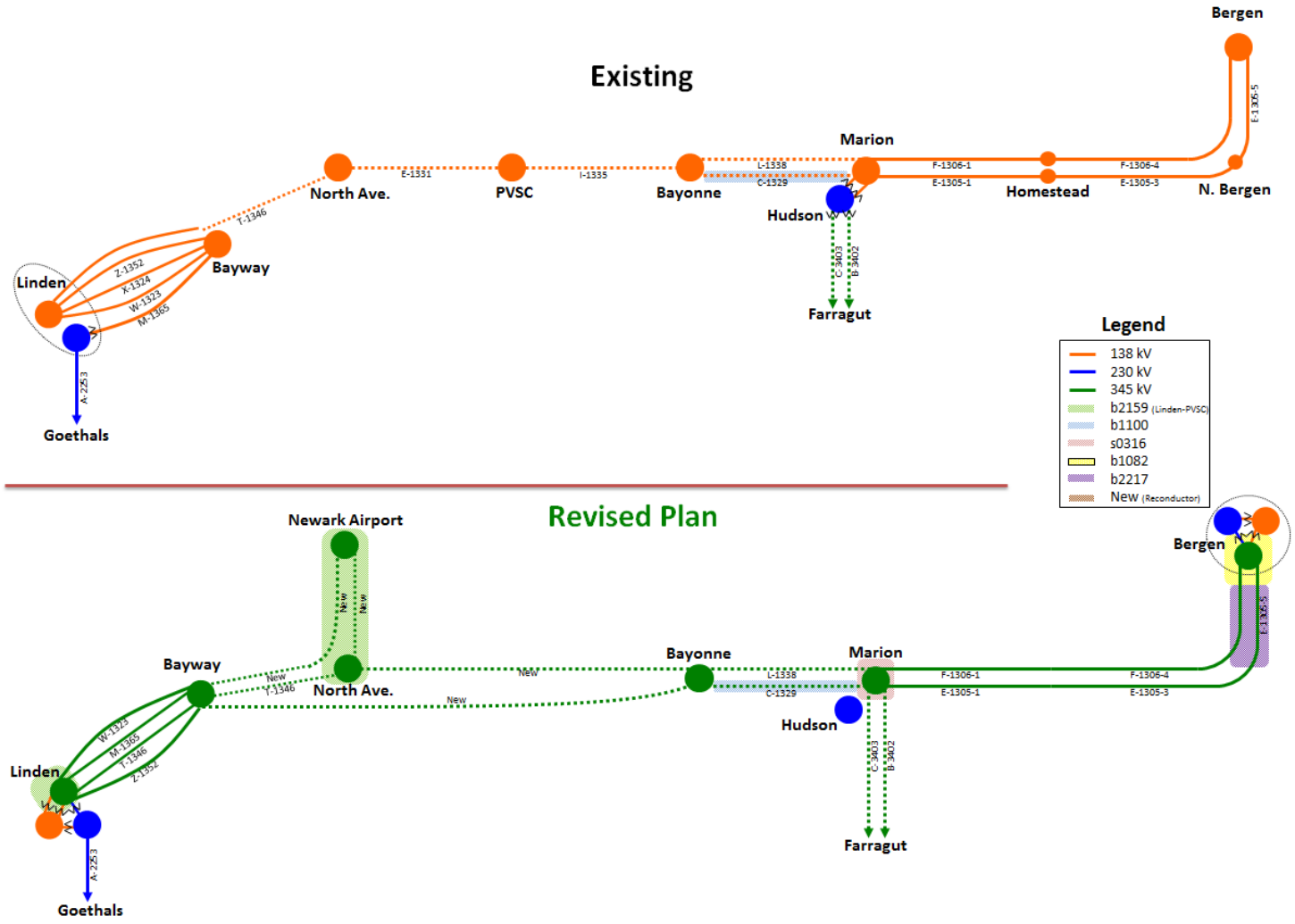
# Northern New Jersey 345 kV Configuration

# NNJ 345 kV Revised Configuration

- Reduce construction challenges between Bayway and Bayonne
  - Eliminate the Bayway 138 kV bus
    - Resolves high short circuit current at Bayway 138 kV
  - Do not convert the PVSC 138kV bus to 345 kV
- The current Linden 138 kV and Bergen 138 kV stations can remain unchanged resulting in further savings in the revised plan
- Homestead and North Bergen will not be converted to 345 kV
- A new Bayonne 345/69 kV transformer will be required
- The Bayway 138 kV bus will be eliminated
  - The Linden - Bayway 'W' 138 kV circuit will be converted to 345 kV
  - The Linden - Bayway 'M' 138 kV circuit will be converted to 345 kV
  - The Linden - Bayway 'X' 138 kV circuit will be retired instead of being converted to 345 kV
- The second Bergen 345/138 kV transformer will not be required
- A new Linden 230/138 kV transformer will not be required



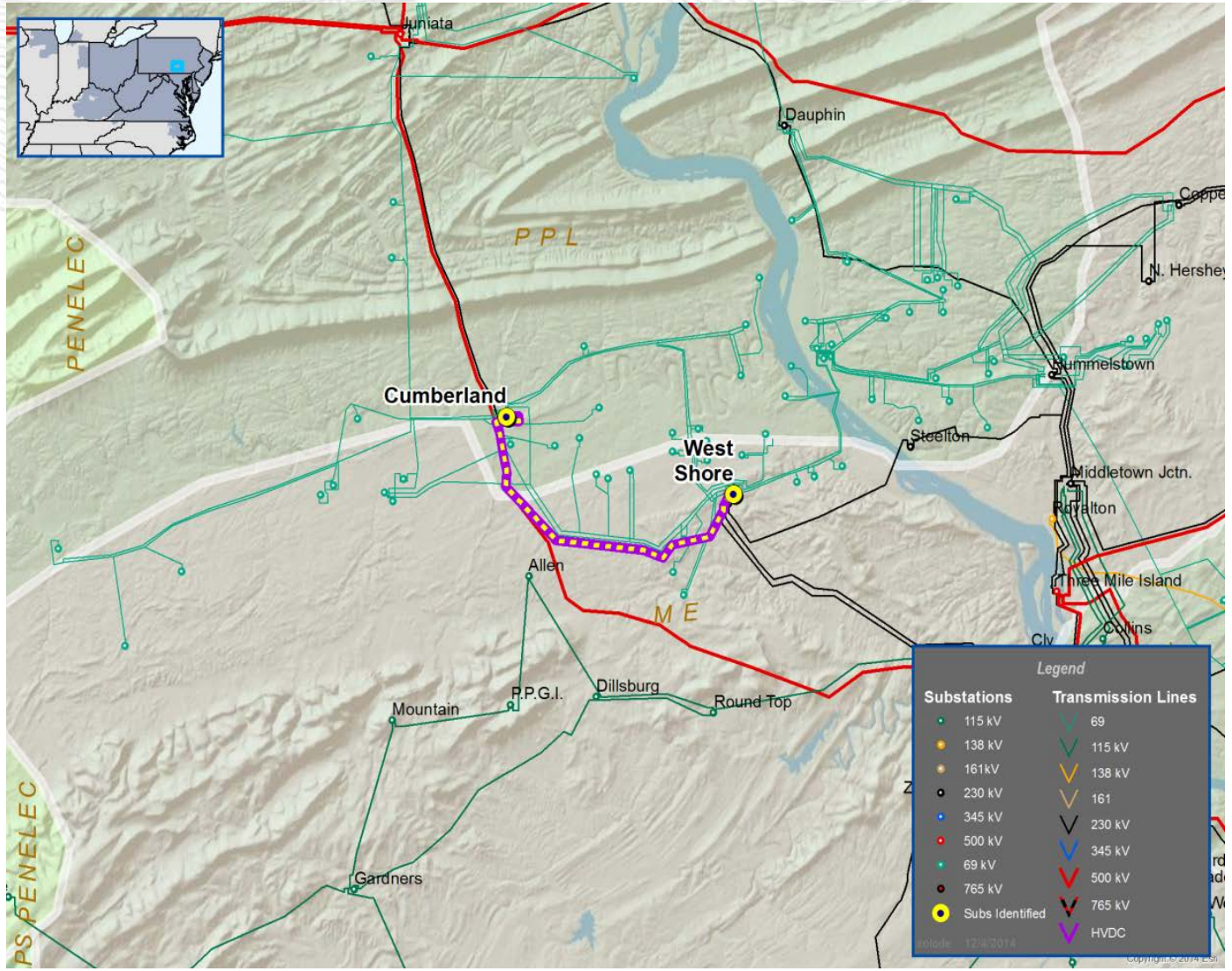
# NNJ 345 kV Revised Configuration



# Supplemental Projects

# PPL Transmission Zone

- Supplemental Upgrade:
- To reduce the potential loss of load in the Williams Grove area.
- Proposed Solution:
  - Build a new 20.2 mile Brunner Island-Williams Grove 230 kV line by breaking the existing 16 mile Brunner Island – West Shore #1 230 kV line outside of West Shore Sub, and extend it 4.2 miles to Williams Grove Sub by rebuilding the West Shore – Williams Grove 230 kV line as a double circuit tower line. (S0943)
- Estimated Project Cost:
  $ 15 M
- Projected IS Date:
  12/31/2018



# RTEP Next Steps

# RTEP Next Steps

- Complete draft Winter Reliability Criteria analysis and review with the TEAC
- Anticipate the closing of the 2015 RTEP Proposal Window #1 on 7/20/2015
  - Begin analysis of proposed solutions
- Anticipate the opening of the 2015 RTEP Proposal Window #2

# Questions?

Email: RTEP@pjm.com

# Revision History

- Revision History
  - V1 – 7/7/2015: Original version distributed to the PJM TEAC
  - V2 – 7/8/2015: Original version distributed to the PJM TEAC