Reliability Analysis Update

Transmission Expansion Advisory Committee

July 14, 2016

2016 RTEP Timeline

2016 RTEP Timeline

- Cases
  - 2021 RTEP Summer case finalized
  - 2021 RTEP Winter case nearing finalization
  - 2021 RTEP Light Load case under construction

- Analysis
  - 2016 RTEP Proposal Window 2 is open
  - Remaining 2016 RTEP Analysis
    - Winter
    - Light Load
    - TO Criteria

2016 RTEP Proposal Window 2

2016 RTEP Proposal Window 2

- 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: 6/29/2016
- Anticipated Window Close: 7/29/2016
  - Proposal definitions, simulation data and planning cost estimate due
- Detailed Cost due: 8/15/2016
  - Additional 15 days to develop and provide detailed cost data
  - See the window documentation for additional information

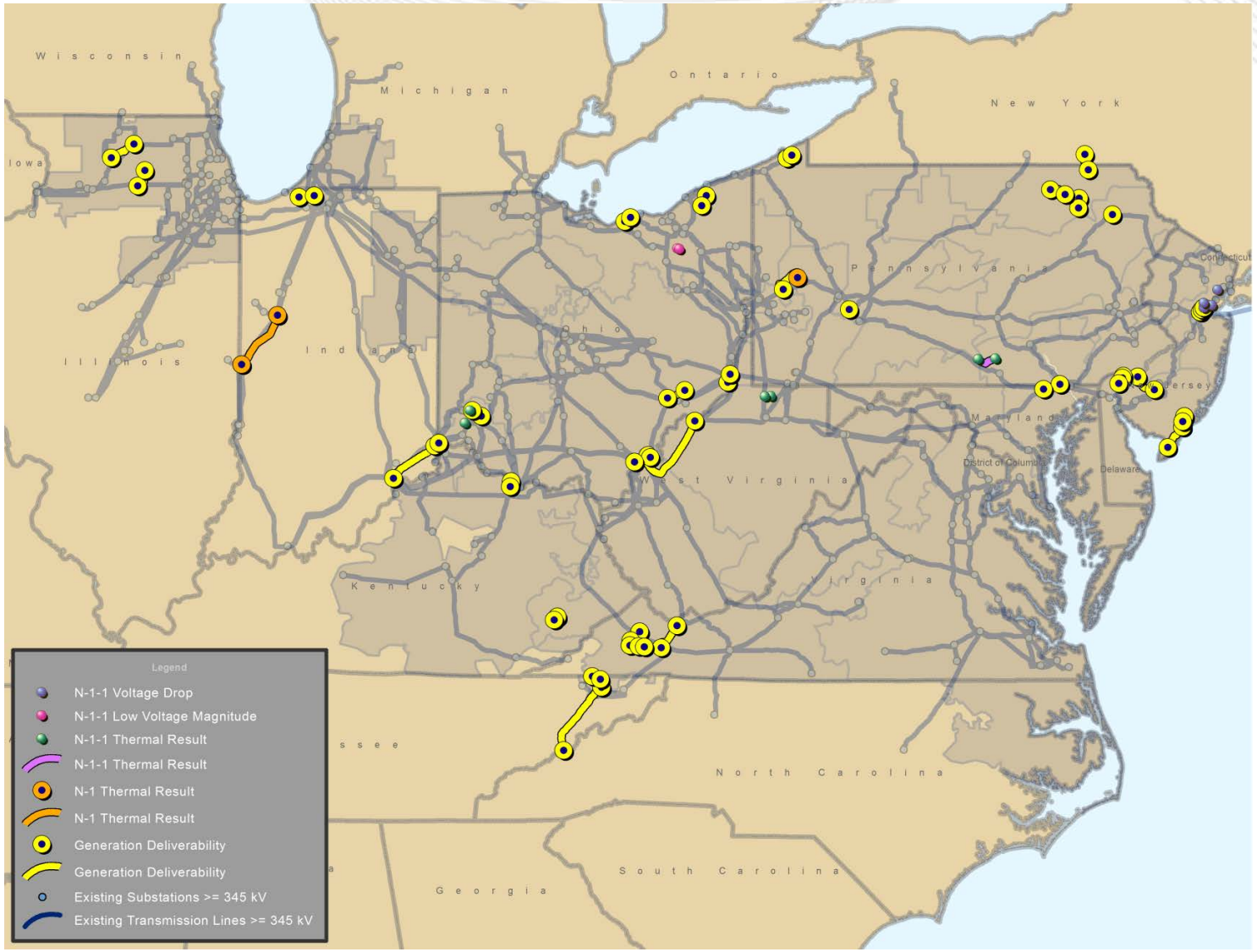
2016 RTEP Proposal Window 2

- 140 total flowgates (as of Version 3)

Test/kV Level*	100kV - 200kV	230kV	345kV	500kV	765kV	Total
N-1 Thermal	1		2			3
N-1 High Voltage						0
N-1 Low Voltage						0
N-1 Voltage Drop						0
Gen Deliv & CMO	76	9	14	3	1	103
Load Deliv Thermal						0
Load Deliv Voltage						0
N-1-1 Thermal	10					10
N-1-1 Low Voltage	2					2
N-1-1 Voltage Drop	4	18				22
N-1-1 Voltage Collapse						0
Total	93	27	16	3	1	140

*xfmr are categorized based on low side kV

2016 RTEP Proposal Window 2

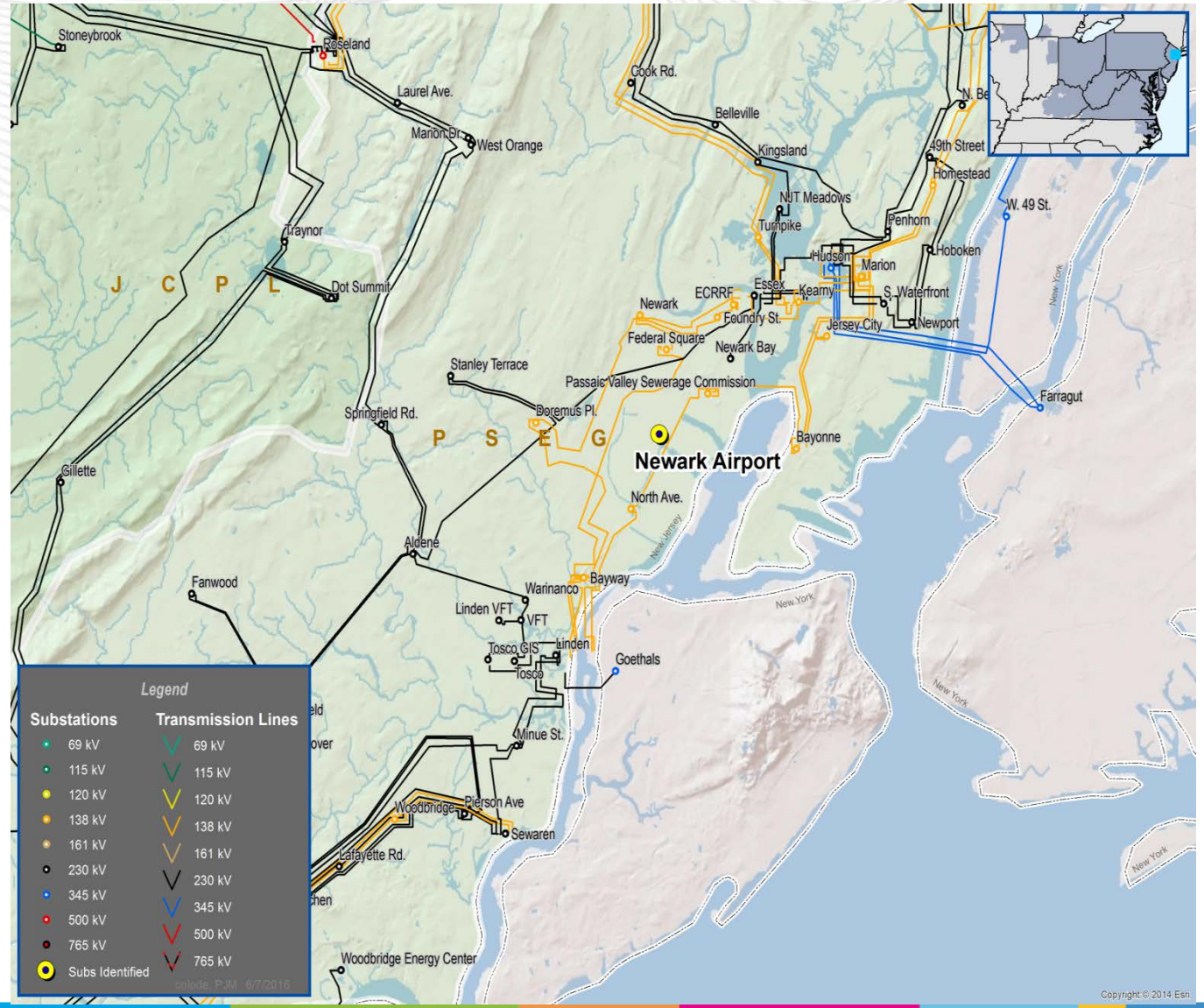


Newark Airport Additional Source Need

PSE&G Transmission Zone

Newark Airport Loads

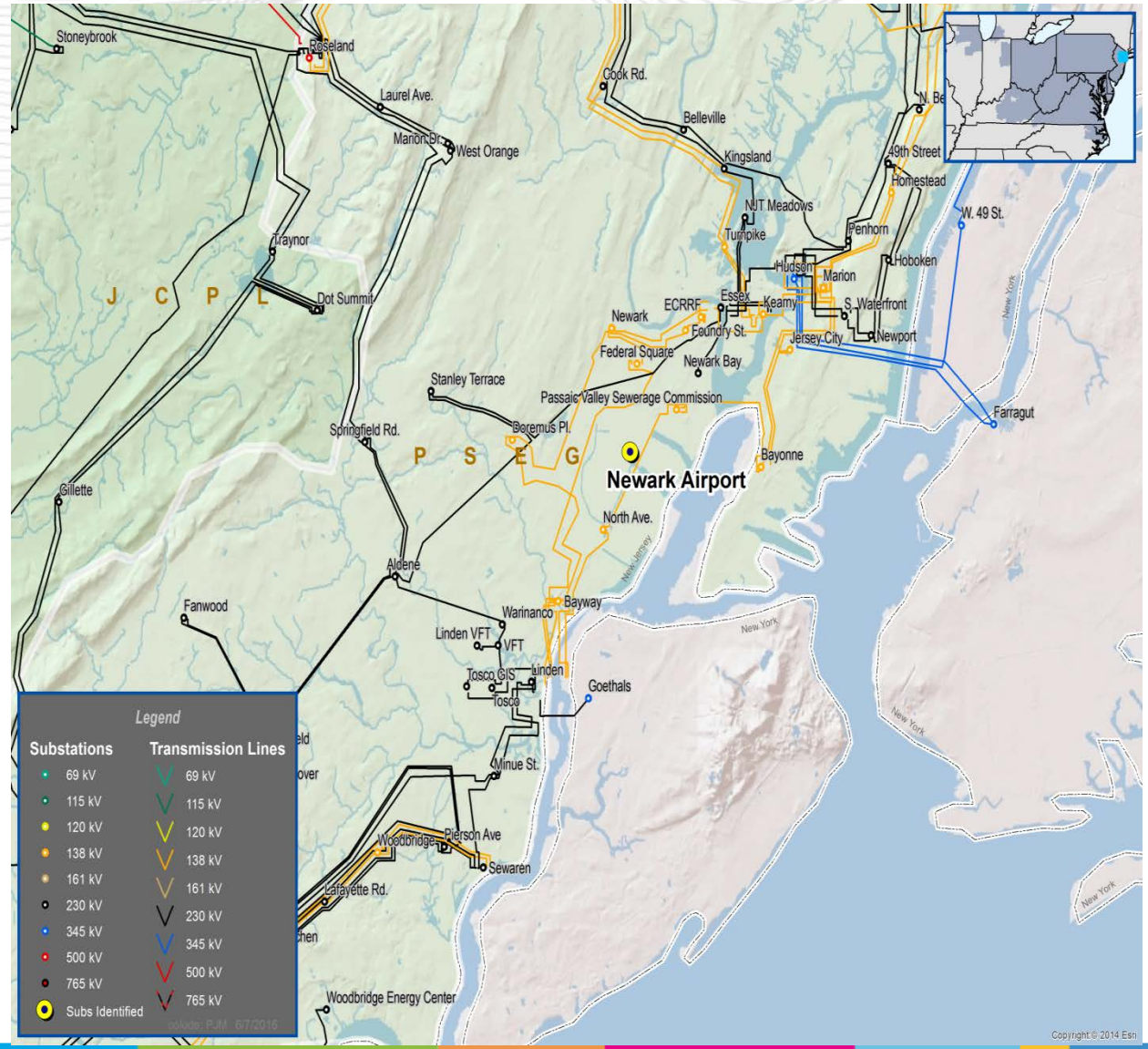
- Current Newark Airport load is ~40MVA.
- A new Terminal A is planned in 2018 and will increase the current load by another ~33MVA.
- The current Terminal A will remain in-service.



PSE&G Transmission Zone

Newark Airport Loads

- Future Port Authority plans for PATH are anticipated to add another ~8MVA to the total airport load.
- With the planned projects in terminal A and existing load the total load at the Airport is expected to exceed 80MVA
- Anticipated future Terminal B and Terminal C upgrades will increase the load further.



PSE&G Transmission Zone

- **Potential TO criteria violation:**
  - Under the existing planned configuration the Newark Airport load will be primarily served from two new 345 kV underground cable circuits that are part of the Bergen to Linden Corridor project. In addition several existing 26 kV circuits will be used for back up.
  - Based on PSEG's N-1-1 criteria, load of more than 20MVA cannot be dropped for more than 24 hours.
    - If one cable is out for maintenance/repair and a second cable trips, it will take more than 24 hours to energize the cables to restore feed to Newark Airport. third source will be needed.
  - For the loss of two 345 kV underground cable circuits (TO criteria) serving the Newark Airport, the load would need to be served from the 26 kV circuits
    - A portion of the 26 kV station property is owned by the Newark Airport and the Airport requested that the use of the property be returned back to them
    - The 26 kV facilities are aging, and will be thermally overloaded with anticipated airport demand increase under the 345 kV N-1-1 condition

PSE&G Transmission Zone

Problem: PSE&G FERC 715 Transmission Owner Criteria

- Acceptable load drop levels and durations.
- An N-1-1 outage of the 345 kV cables serving Newark Airport would outage the facility for more than 24 hours

Immediate Need:

- Due to the immediate need, the timing required for an RTEP proposal window is infeasible. As a result, the local Transmission Owner will be the Designated Entity.

Alternatives Considered:

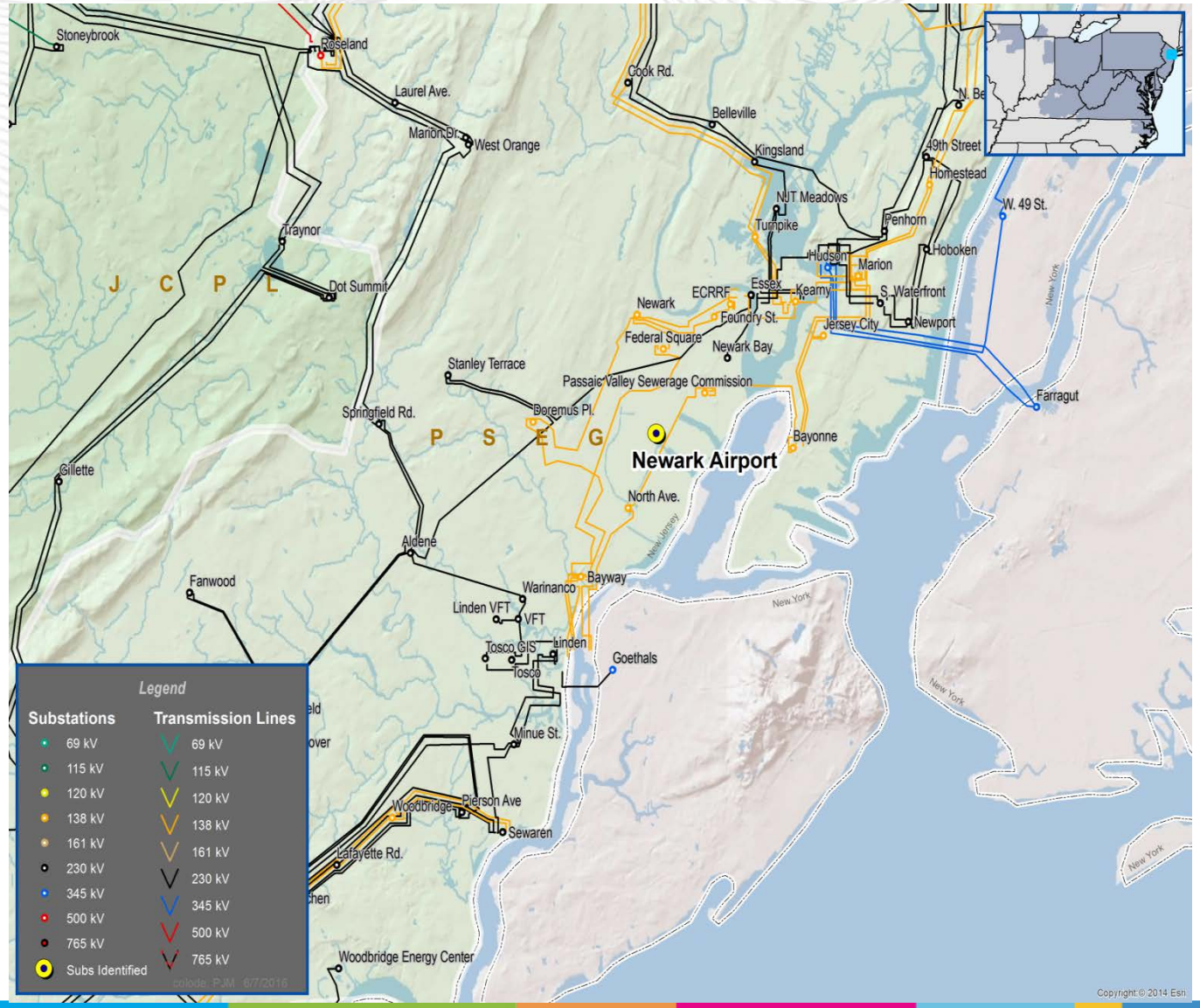
- 345 kV third source
- 138 kV supply
- 26 kV supply
- 69kV third source

Recommended Solution:

- Build a third 345 kV source into Newark Airport

Estimated Cost: $43 M

Required IS Date: 6/1/2018

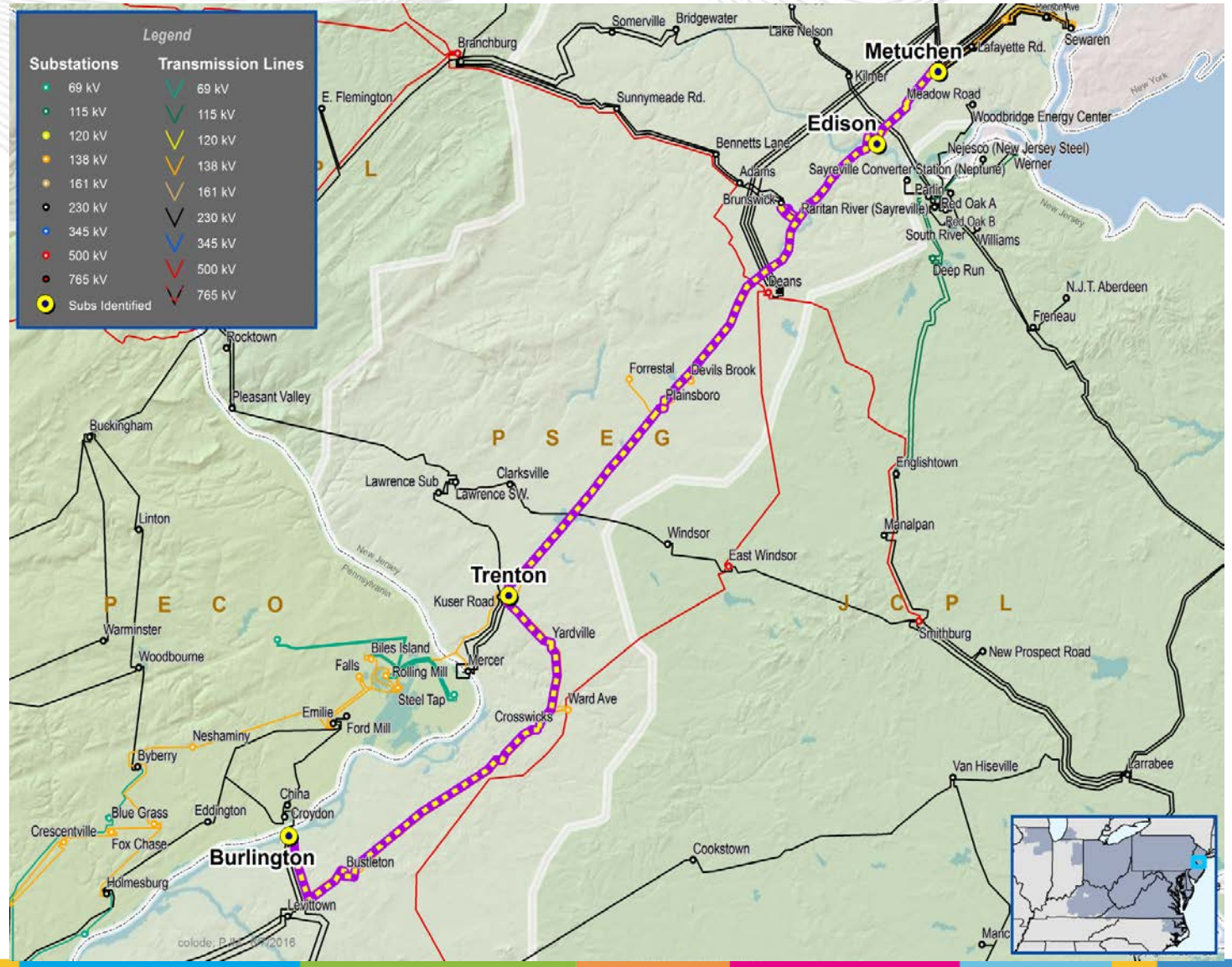


PSE&G End Of Life Assessment

Metuchen – Edison – Trenton – Burlington Corridor

PSE&G Transmission Zone

- PSE&G's FERC 715 Transmission Owner criterion addresses equipment condition assessments
  - PSE&G assessed the condition of the Metuchen to Trenton (MT-T) and Trenton to Burlington (T-BU)138 kV circuits.



PSE&G Transmission Zone

- Refer to PSE&G criteria:

  VII. EQUIPMENT ASSESSMENT AND STORM HARDENING

  http://www.pjm.com/~/media/planning/planning-criteria/PSE&G-planning-criteria.ashx

  - Metuchen to Trenton is approximately 30 miles of 138 kV circuit and the average structure age is 86 years.
  - Trenton to Burlington is approximately 22 miles of 138 kV circuit and the average structure age is 75 years.

- Assessment Result:
  - Consultant - Foundation assessment
    - 23% and 30% of structures for MT-T and T-BU respectively will require extensive foundation rehabilitation or total foundation replacement.
  - Consultant – Tower line assessment
    - 25 % of the tower structures exceed the tower load carrying design capability
    - 35% of the towers are at 99-100% of the tower's load bearing capability, and 81% of the towers at 95-100% of the tower's capability.

PSE&G Transmission Zone

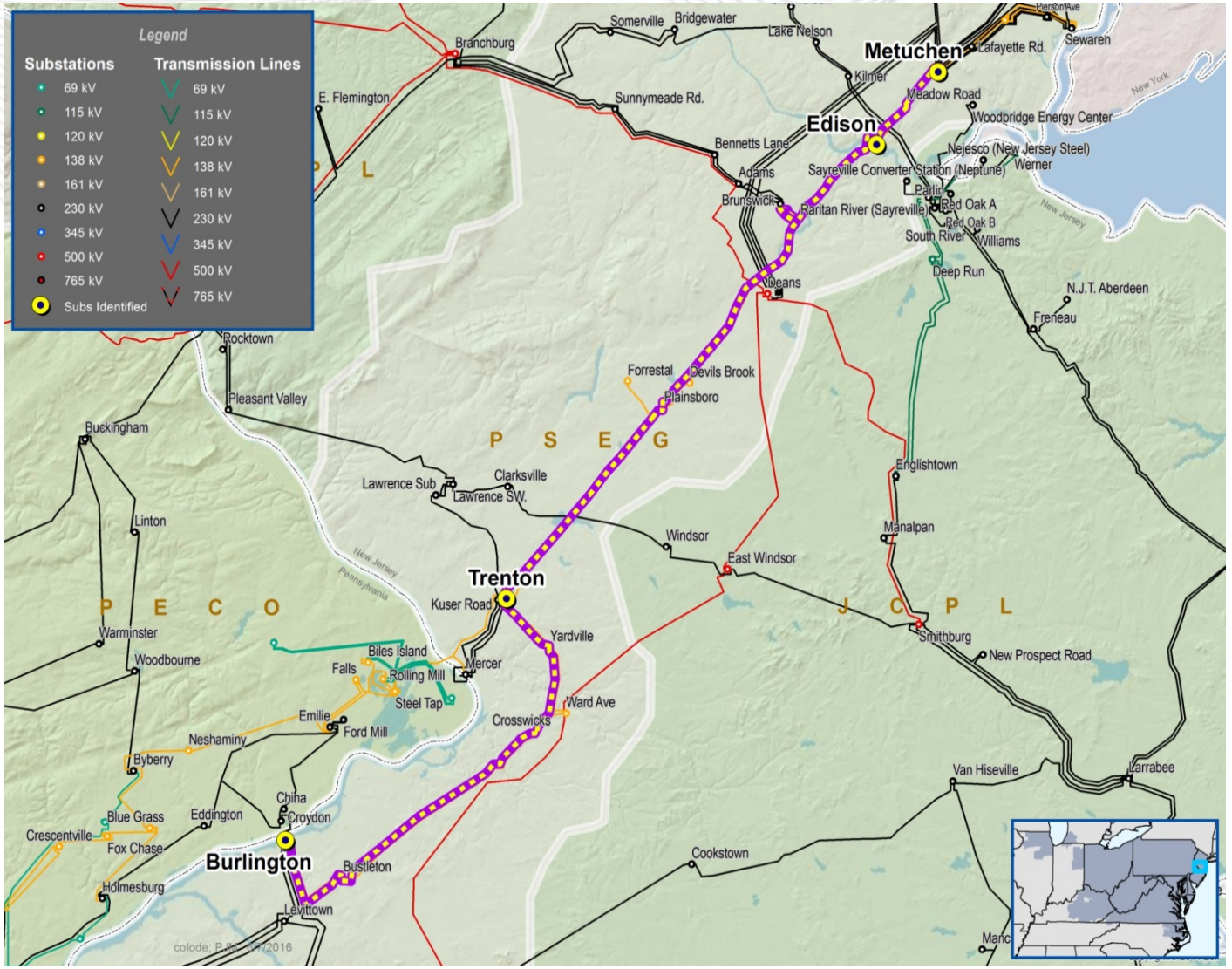
Problem: Metuchen – Edison – Trenton – Burlington Corridor

PSE&G FERC 715 Transmission Owner Criteria

- Equipment condition assessment for the entire corridor
- Equipment has reached its end of life

NERC Reliability Criteria

- N-1-1 voltage violations in the Metuchen vicinity in the 2016 RTEP Window #2



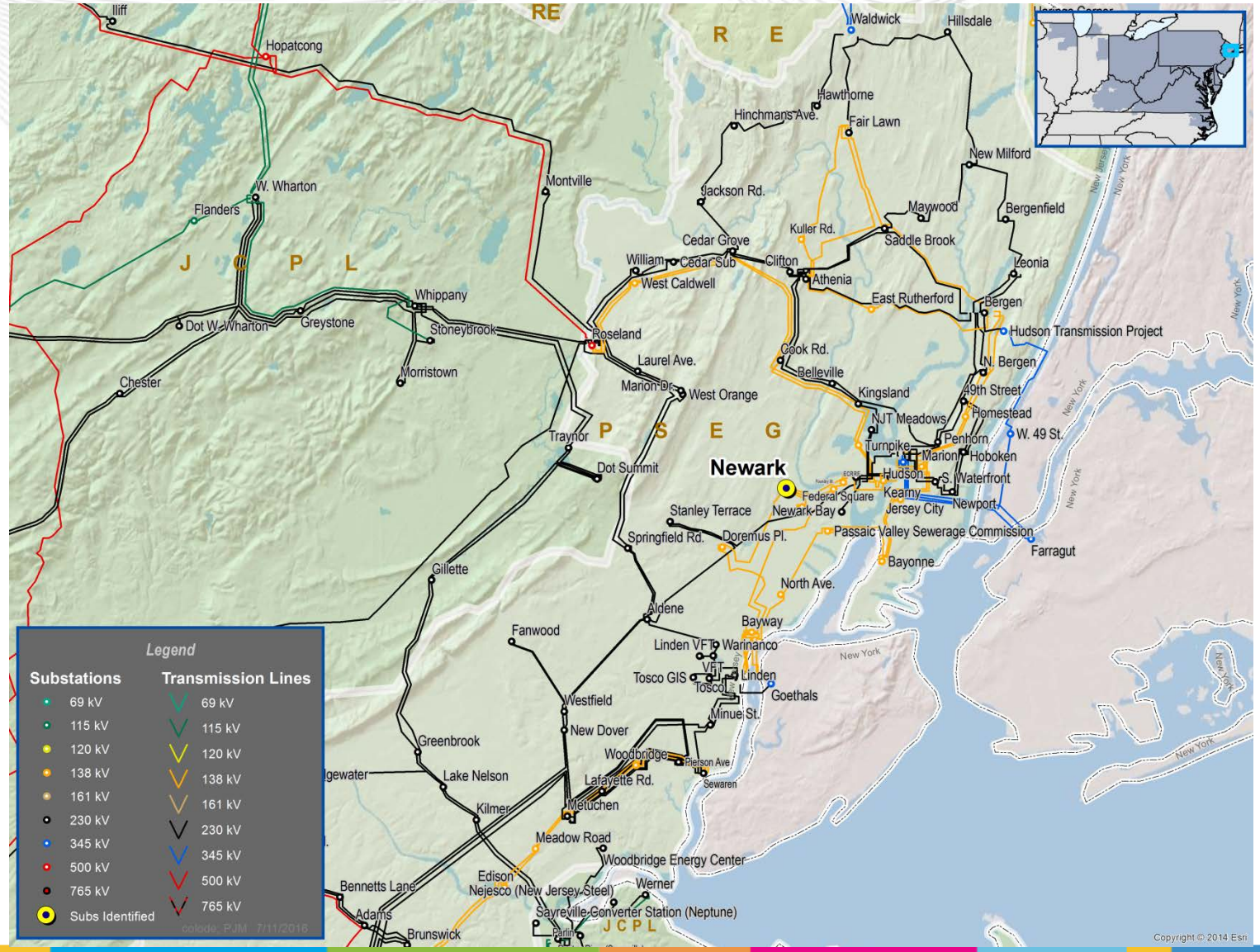
PSE&G End Of Life Assessment
Newark Switch

PSE&G Transmission Zone

Problem: Newark Switch Aging Infrastructure

PSE&G FERC 715 Transmission Owner Criteria

- Age
  - Substation: 1953
  - Transformer 1: 1927
  - Transformer 2&3: 1958
  - Spare: 1992
- Housed in an urban building
- Equipment condition assessment
- Equipment has reached its end of life



DOM Existing Projects Update

Dominion Transmission Area

Existing B1696 Cost Increase and Scope Addition

Problem: N-1 and N-1-1 Thermal Violations

- For various contingencies, the Idylwood 230kV bus is overloaded

Proposed Solution

- Install a Breaker and Half Scheme at Idylwood 230 kV

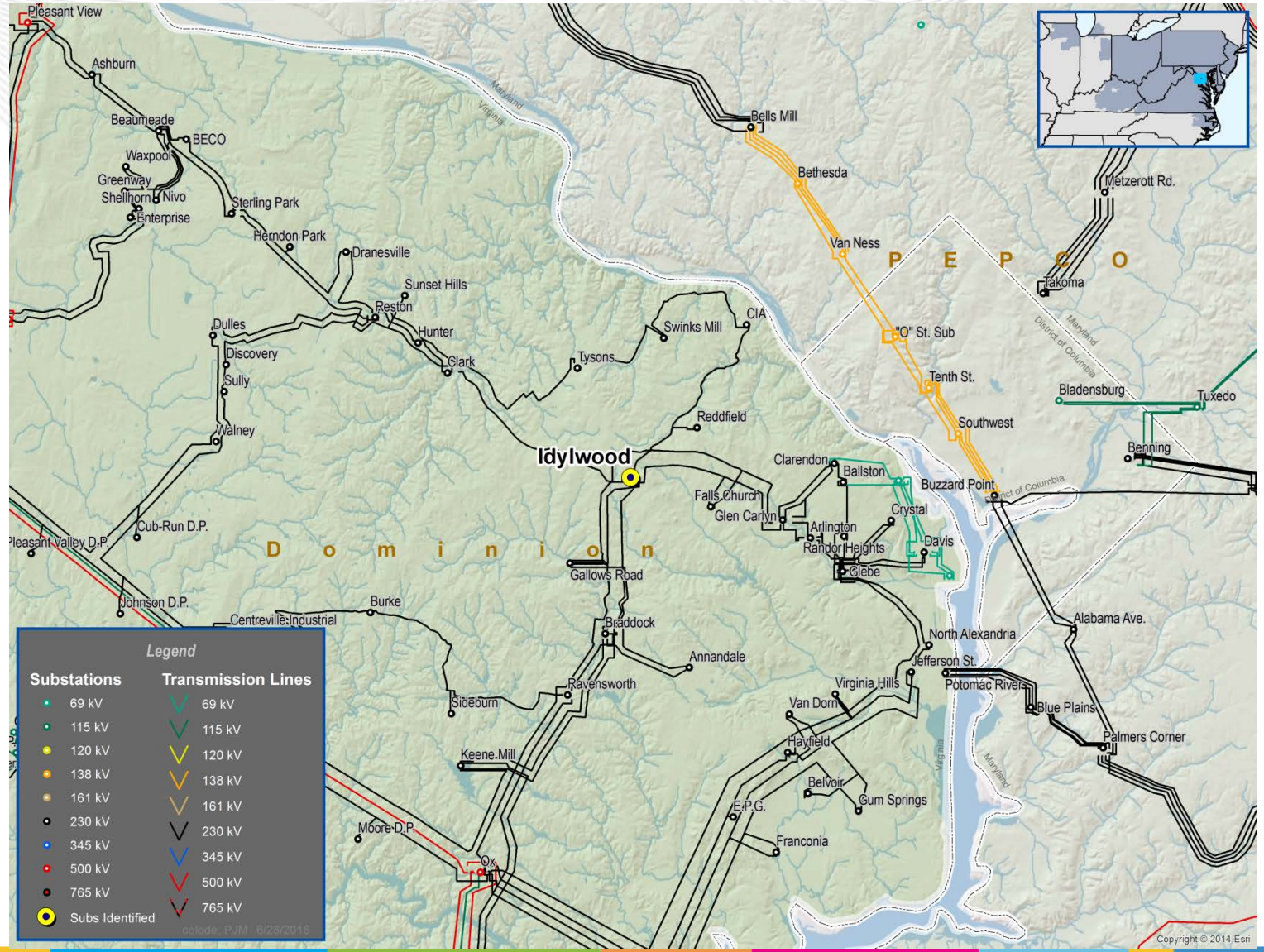
Reason for cost increase:

- Detailed cost estimate included additional cost due to GIS breakers, security wall, transmission structures, labor, and permitting.

Previous Cost Estimate: $55 M

Revised Cost Estimate: $80 M

Projected IS Date: 02/01/2020



Dominion Transmission Area

Existing B1792 Cost Increase and Scope Modification

Problem: N-1 and N-1-1 Thermal Violations

- For several contingencies, the Halifax- Chase City 115kV line is overloaded

Proposed Solution

- Rebuild line #33 Halifax to Chase City 26 miles and install a 230kV four breaker ring bus at Halifax to eliminate the motor operator schemes.

Reason for Revision:

- The original plan was to expand Halifax substation. Halifax substation cannot be expanded because it is located in a flood plain.

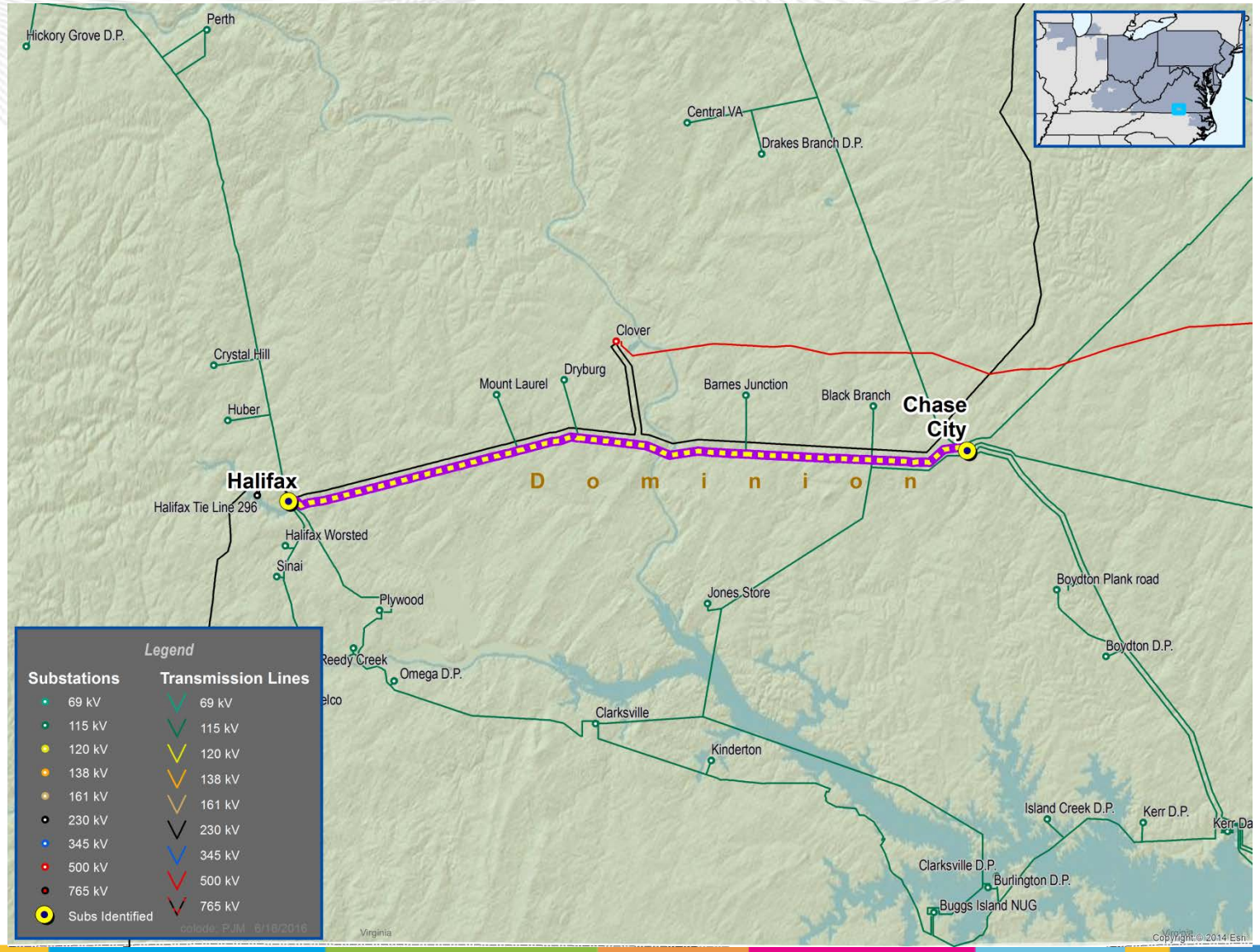
Proposed Revised Solution:

- Rebuild Line #33 Chase City – Halifax 230kV to a minimum summer emergency rating of 300 MVA.
- Relocate Halifax switching station out of the flood plain
- Build a new switching station, to be called Sedge Hill, with 230kV four breaker ring and a 115kV breaker and a half scheme with seven breakers.

Previous Estimated Cost: $26.0 M

Revised Estimated Cost: $43.6 M

Projected IS Date: 12/15/2016



Dominion Transmission Area

Existing B2186 Cost Increase and Scope Modification

Problem: N-1-1 Thermal Violation

- For the loss of Line # 54 Carolina – Earleys and the Earleys 230-115kV transformer, the #108 line Boykins – Tunis 115kV is overloaded

Proposed Solution:

- Install a 2nd 230-115kV transformer at Earleys connected to the existing 115kV and 230kV ring busses. Add a 115kV breaker and 230kV breaker to the ring busses. (B2186)

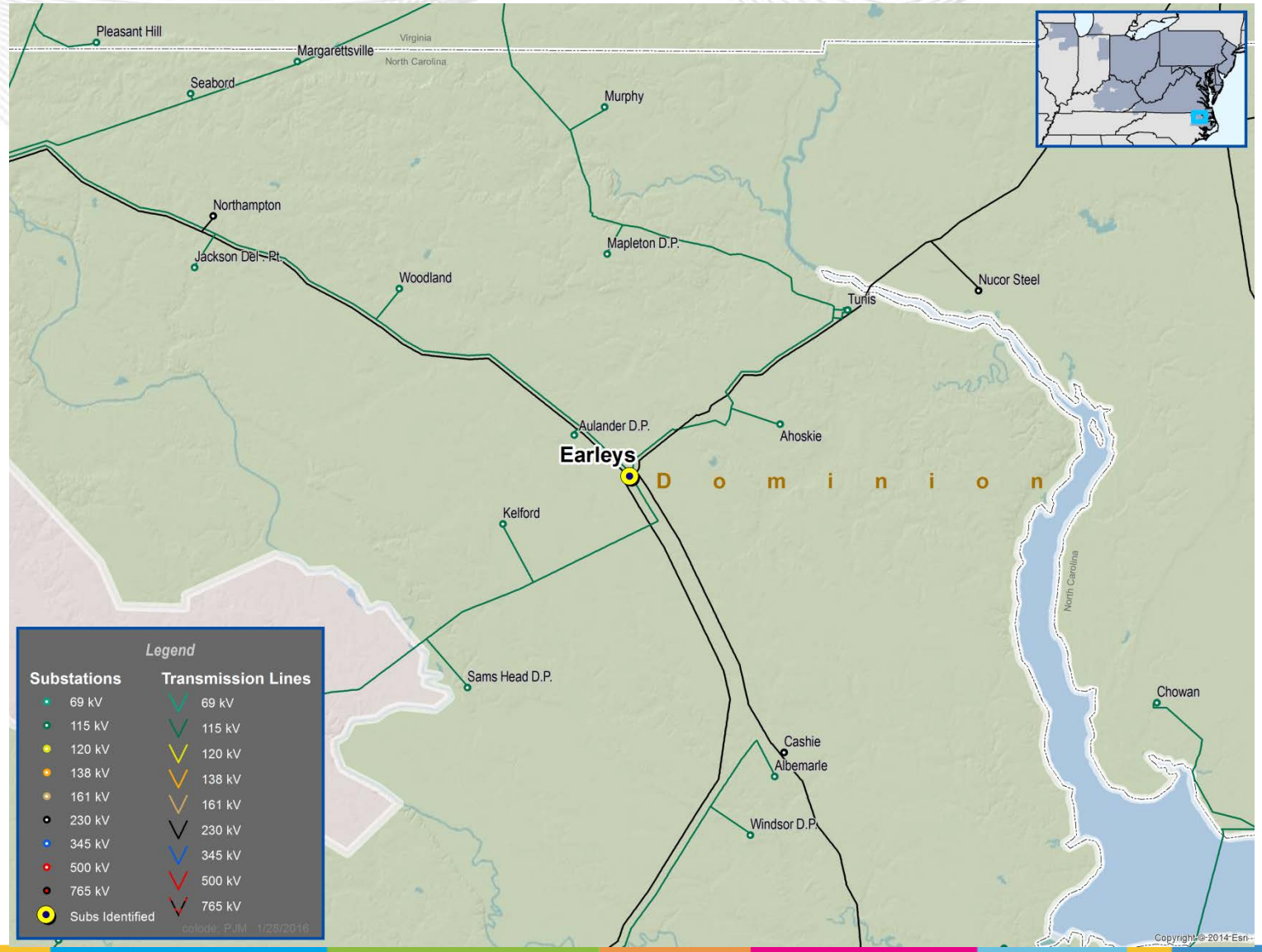
Reason for cost increase:

- Dominion design guidelines require that wood pole structures inside the station be replaced when there is a project at a substation.
- Therefore, four wood pole structures need to be replaced at Earleys.
- Two spans of conductor will be replaced on line #2012 Earleys- Roanoke Valley 230kV at Earley's substation that will increase the summer STE rating from 595 to 608 MVA.
- Due to additional DC load requirements from this project and previous projects and no room for expansion in the existing control house, a new battery enclosure is required.

Previous Estimated Cost: $ 11.5 M

Revised Estimated Cost: $ 13 M

Projected IS Date: 06/01/2017



Short Circuit Upgrades

Dominion Transmission Area

Problem: Short Circuit

- The Idylwood 230kV breakers “25112” and “209712” are overstressed.

Significant Driver:

- Install a breaker and a half scheme for five existing lines at Idylwood 230 kV

Immediate Need:

- Due to the immediate need, the timing required for an RTEP proposal window is infeasible. As a result, the local Transmission Owner will be the Designated Entity.

Alternatives Considered:

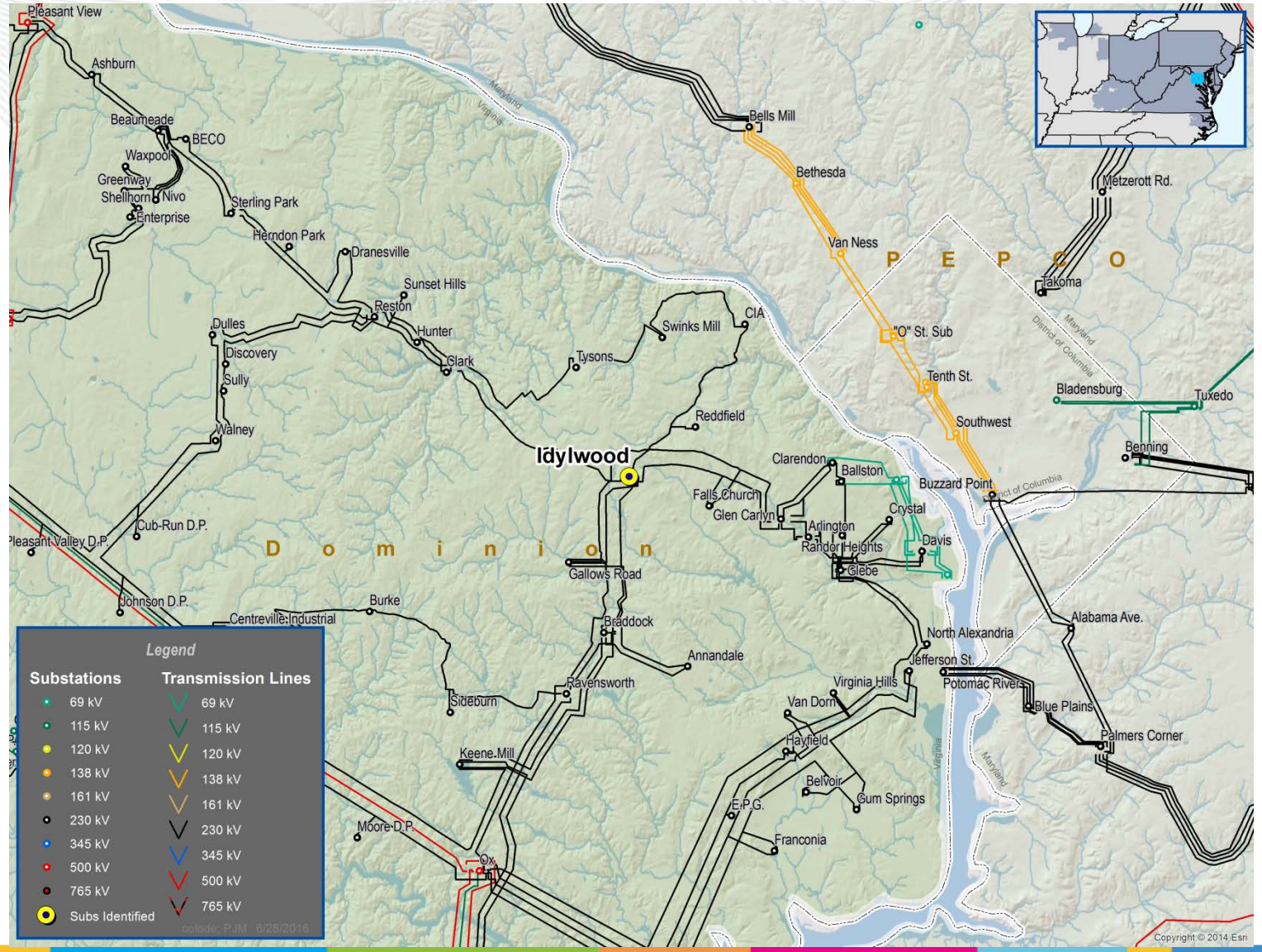
- Due to the immediate need of the project no alternatives were considered

Proposed Solution:

- Replace Idylwood 230kV breakers “25112” and “209712” with 50kA breakers (b1696.1-b1696.2)

Estimated Cost: $350 K

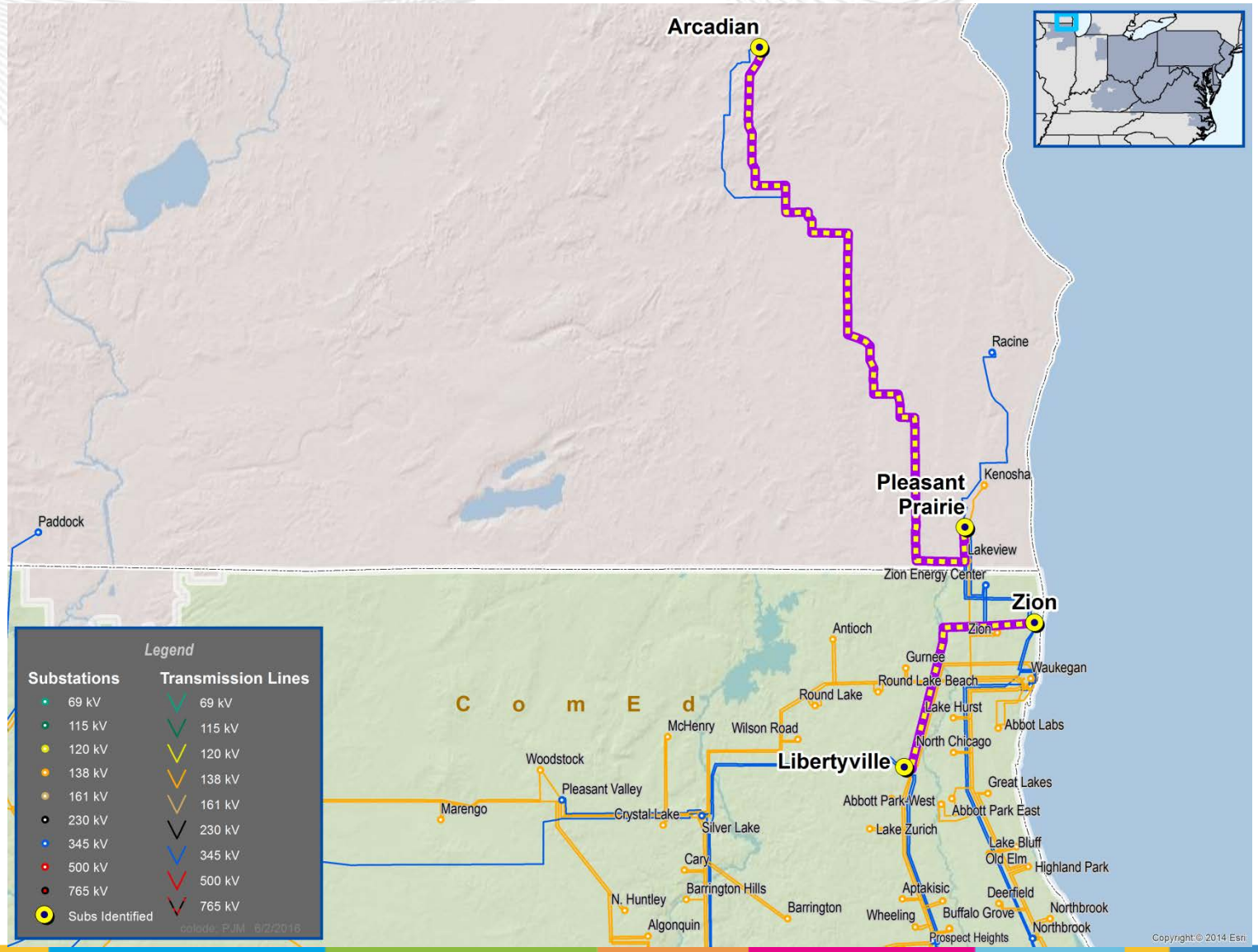
Required IS Date: 06/01/2017



Supplemental Projects

ComEd Transmission Area

- **Supplemental Project**
- ComEd's portion for MISO project (MTEP 8065:
  - Connect 345 kV line 2224 (Zion - Libertyville 345 kV) into the new Rosecrans substation
  - Create a new switching station "ROSECRANS" at the junction where 2224 turns south after passing Zion Energy Center. Reconfigure line PLPL81 Pleasant Prairie - Arcadian 345kV and ComEd line 2224 Zion - Libertyville 345 kV circuits to loop into the new 4 position (ring bus) 345 kV Switching Station. Use new double circuit structures to extend existing line circuits to new switching station. (S1146)
- Part of the MISO Transmission Expansion Plan (MTEP)
- Estimated Project Cost: $0M for ComEd
- Projected IS Date: 12/15/2020



Dominion Transmission Area

Supplemental Project

Problem:

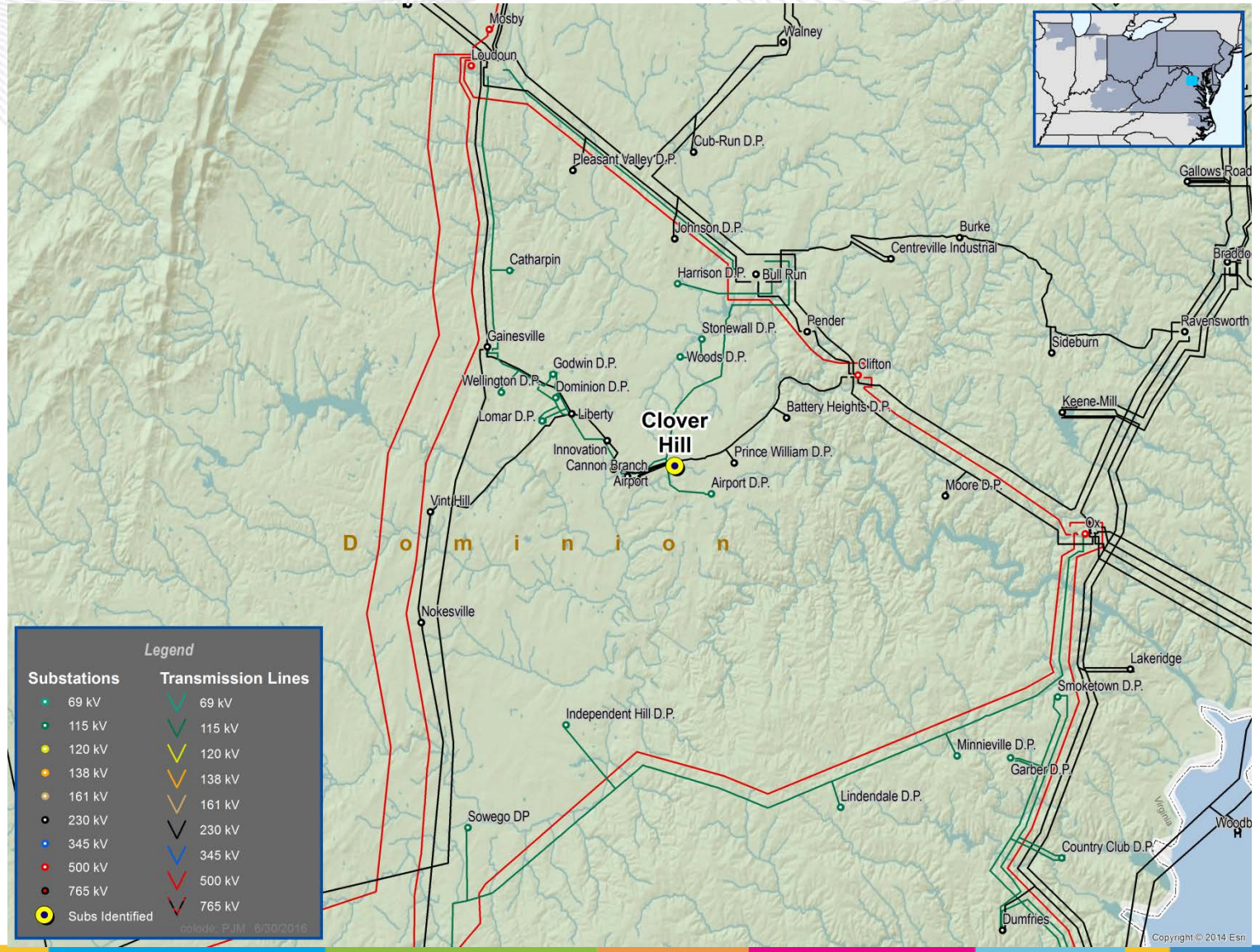
- Dominion Distribution is installing an 84MVA 230-34.5kV transformer at Clover Hill to serve a new data center.

Proposed Solution:

- Install a 230kV circuit switcher, high side switch and necessary bus work for the new transformer and additional high side switch for future transformer from same bus. (S1147)

Estimated Cost: $750 K

Projected IS Date: 09/01/2017



Dominion Transmission Area

Supplemental Project

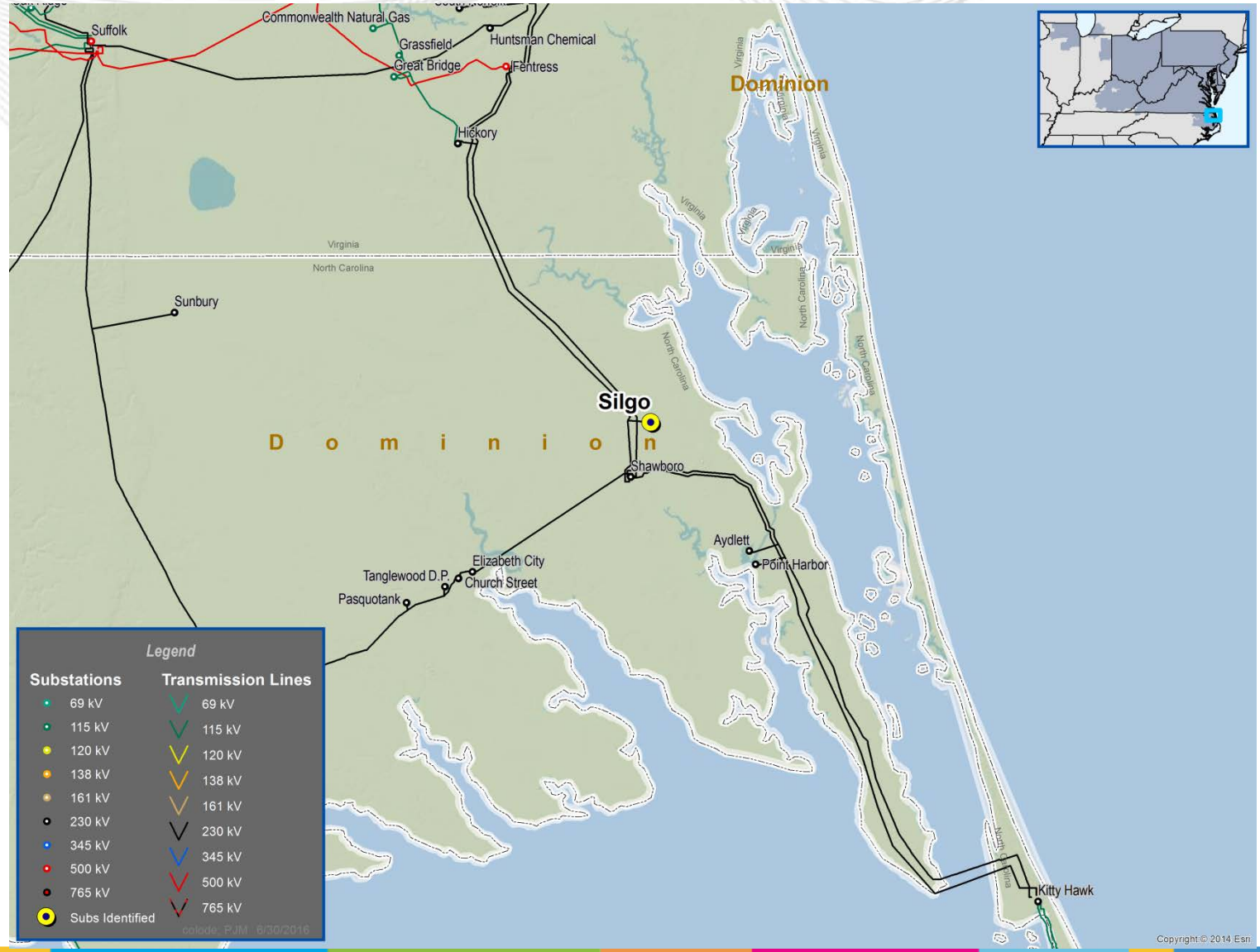
Problem:

- Dominion Distribution needs to install a second 230-34.5kV transformer at Sligo for additional support.

Proposed Solution:

- Tap Line #2192 Moyock – Shawboro 230 kV , install two line switches, a 230kV circuit switcher, high side switch and necessary bus work for the new transformer. (S1148)

- **Estimated Cost**: $1.25 M
- Projected IS Date: 11/15/2016



Dominion Transmission Area

Supplemental Project

Problem:

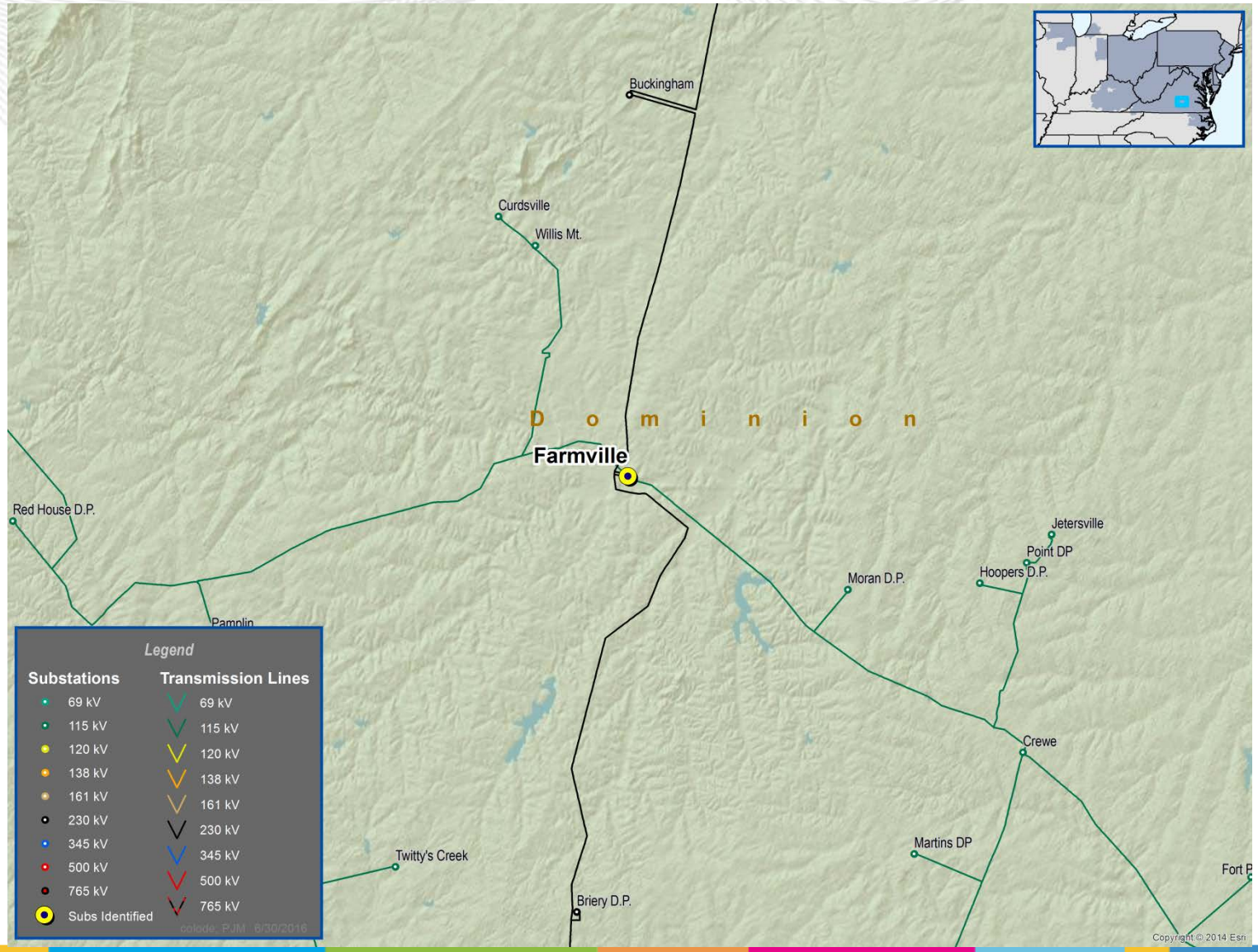
- Dominion Distribution needs to install a second 230/34.5kV transformer at Farmville for additional support.

Proposed Solution:

- Install at Farmville a 230kV circuit switcher, high side switch and necessary bus work for the new transformer. (S1149)

Estimated Cost: $500 K

Projected IS Date: 11/15/2017



RTEP Next Steps

Questions?

Email: RTEP@pjm.com

Revision History

- Revision History
  - V1 - Original version posted to PJM.com – 7/11/2016