

# Transmission Expansion Advisory Committee

April 28, 2015

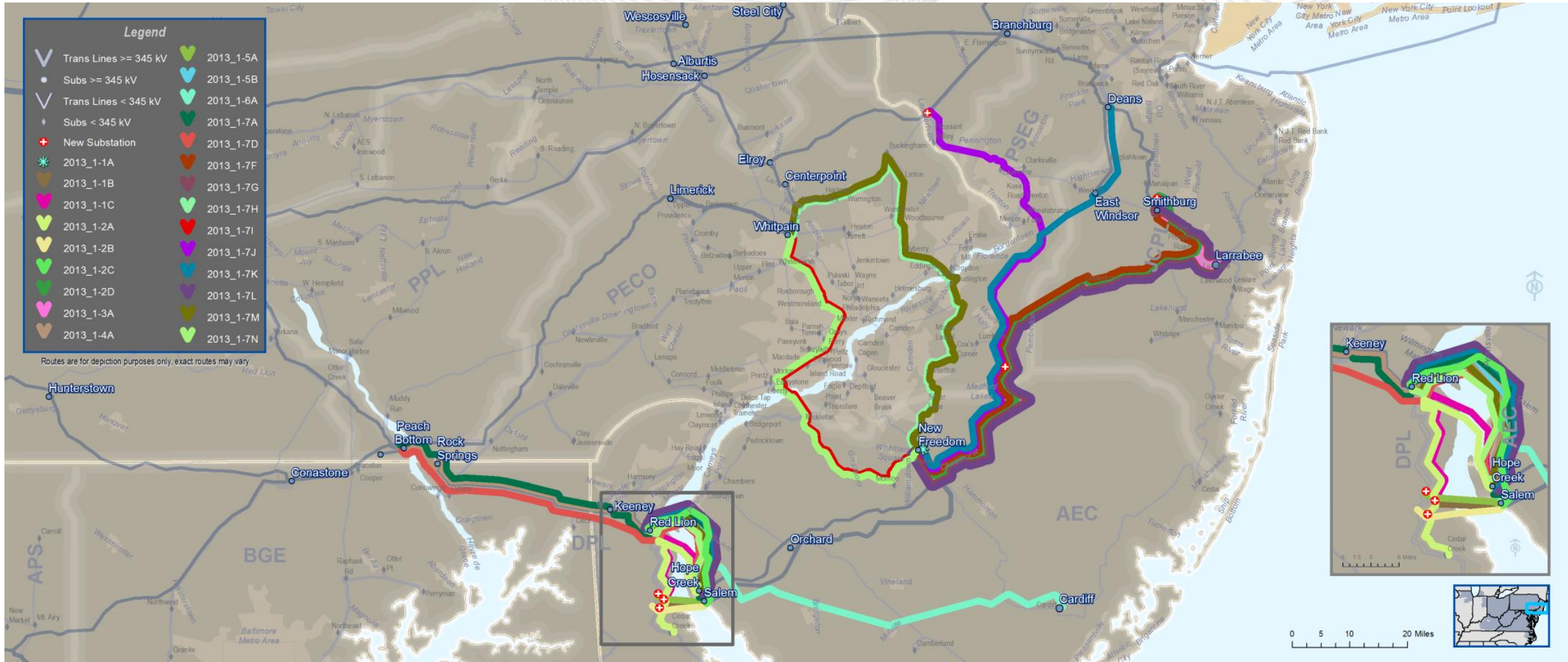
# Artificial Island

- Stakeholder Comments
- Project Evaluation
  - Performance
  - Cost
  - Constructability
- Artificial Island Project Recommendations
- Next Steps

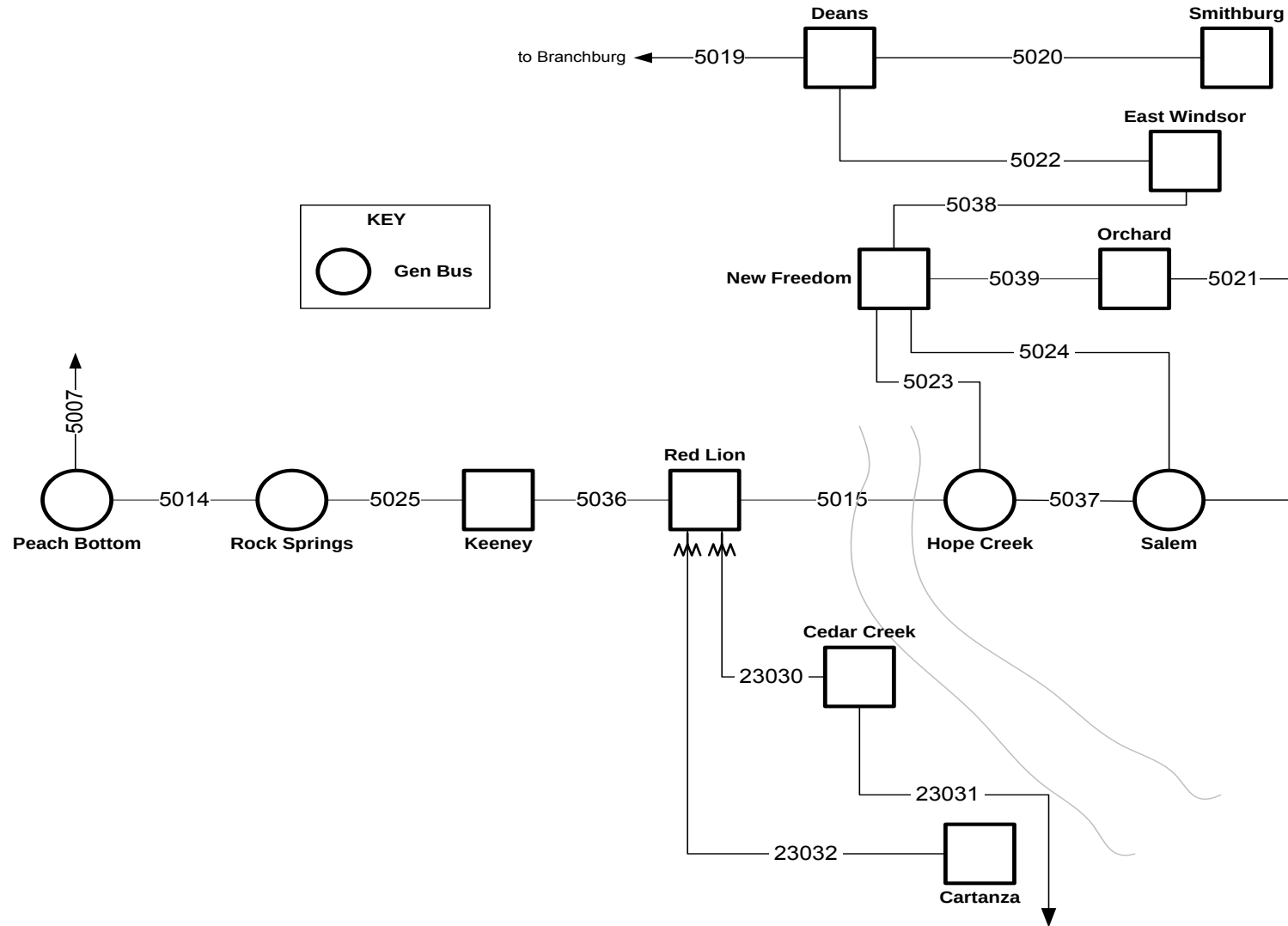
- Request from Transource and PHI:
  - Has any documentation that materially changes the supplemental information been supplied outside of what is posted on the PJM website?
    - No. Meetings were held with the FERC ALJ to clarify the supplemental information.
  - Requested project scope details for LS Power and PSE&G projects
    - December 9 PJM TEAC, Appendix slides 26 through 35
    - Included in the Appendix of this presentation



# Artificial Island Proposals



# Artificial Island Area Network





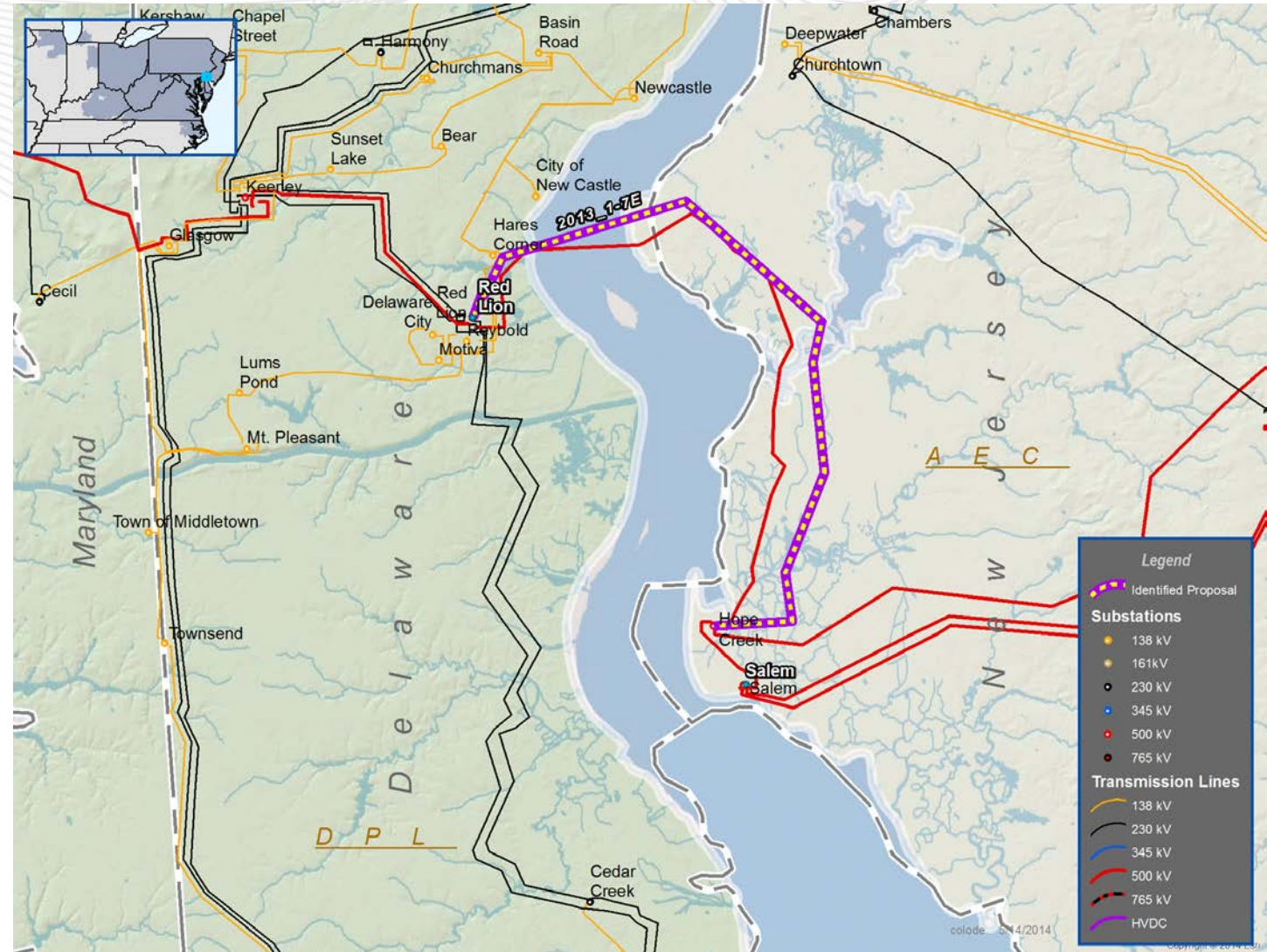
# Dominion Virginia Power (DVP) 1A

- New switching station cutting the 5023 and 5024 lines near New Freedom substation that includes
  - 500kV SVC (+750 to -375 MVAR)
  - Two Thyristor Controlled Series Compensation (TCSC) devices





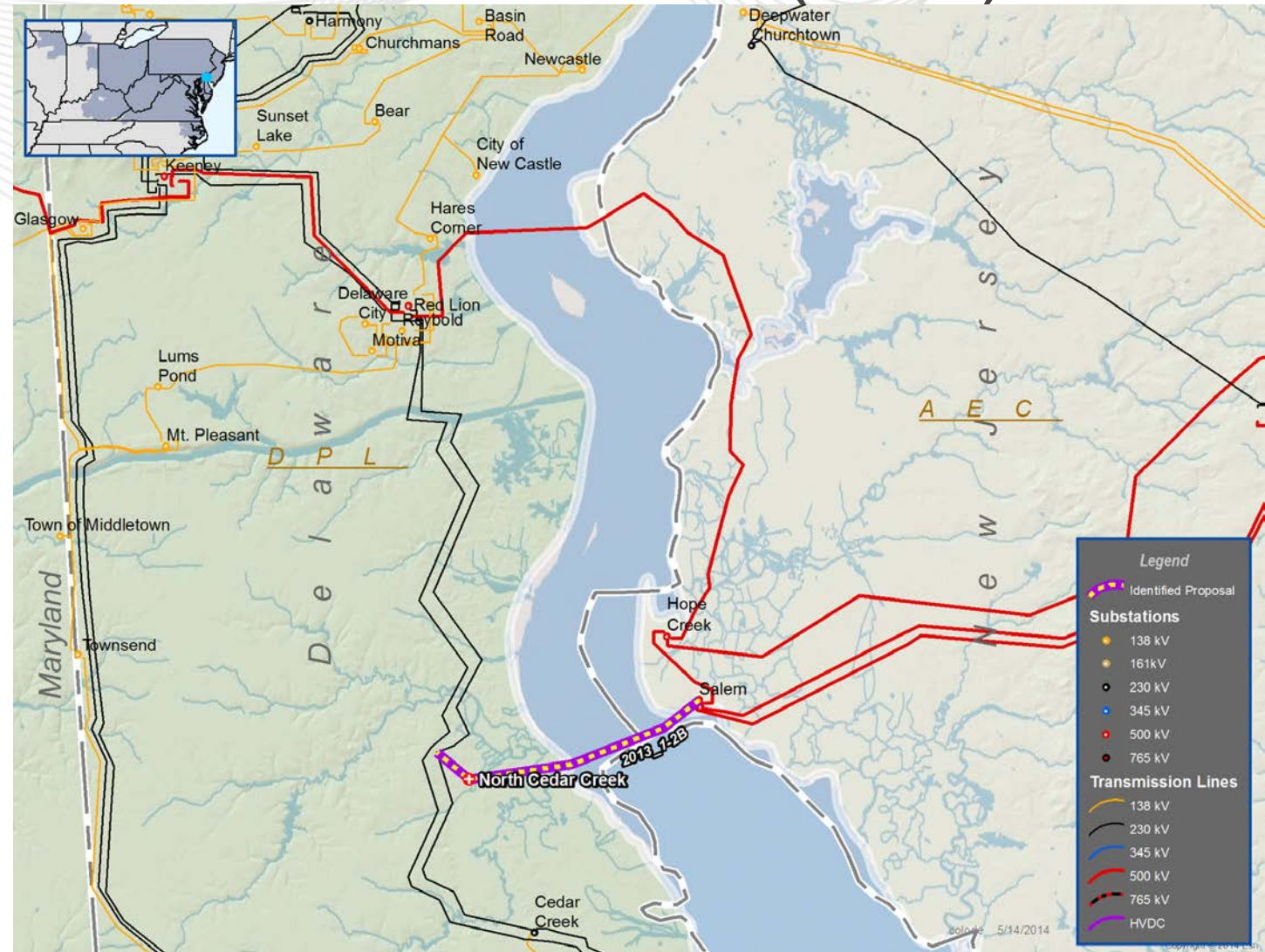
- Expansion of Hope Creek substation
- 500kV line from Hope Creek to Red Lion
  - Parallels existing 5015 Red Lion to Hope Creek 500 kV line
- Reconfigure Red Lion substation to accommodate new line





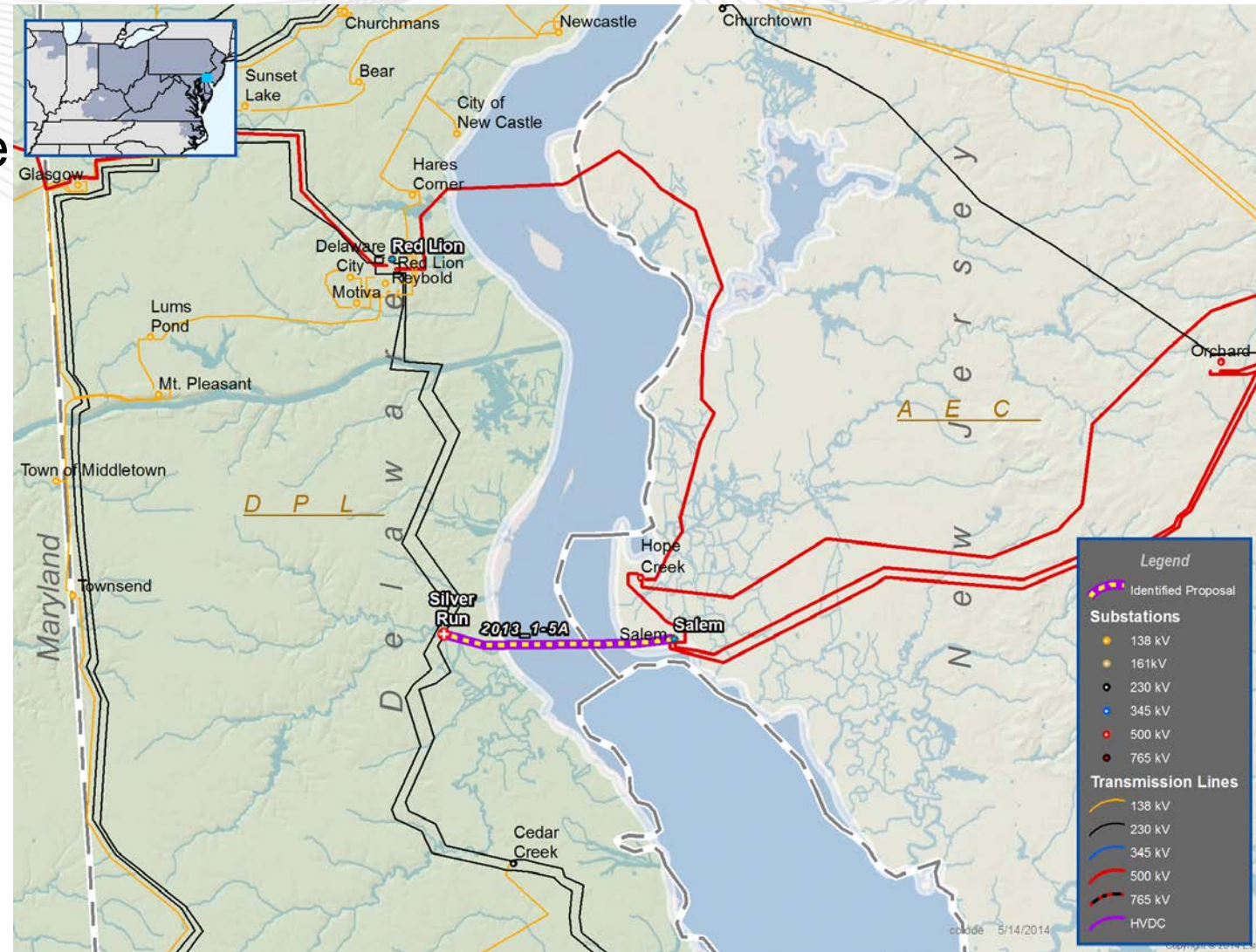
# Transource (AEP) 2B

- Expansion of the Salem substation
- New substation near Artificial Island with two 500/230 kV autotransformers
- Submarine line under the Delaware river
- New substation in Delaware that taps the existing Red Lion to Cartanza 230 kV and Red Lion to Cedar Creek 230 kV lines





- Expansion of the Salem substation to the south to include a new 500/230kV auto-transformer
- Submarine line under the Delaware
- New substation in Delaware that taps the existing Red Lion to Cartanza 230 kV and Red Lion to Cedar Creek 230 kV lines



# Performance



- Siemens Power Technologies International (Siemens PTI) was contracted to perform a Sub Synchronous Resonance screening study of the Dominion 1A proposal
- Siemens SSR Screening Study
  - Available Data
    - Mass moment of inertia and torsional modes
  - Assumptions
    - Approximate two-mass modeling approach
    - Critical conditions (including system configuration and critical faults)
  - Analysis
    - PSCAD simulation and frequency scan
  - Result
    - Negative damping at the Artificial Island for several resonant frequencies

- Exponent's report summary:
  - Determined Siemens SSR study is inconclusive based on the study assumptions
  - The 90% post contingency TCSC compensation level is very high leaving little margin to avoid resonance
    - Identifies that 70-80% compensation is highest in general industry practice
  - To be credible, additional study should consider simulations in a real time digital power system simulation such as RTDS

- Dominion provided a timeline of studies required to design the TCSC controller that estimates 26 weeks for completion
  - Assumptions:
    - All required study data has been acquired
      - This includes the machine data for the nuclear units at Artificial Island
    - Does not include review time between study stages



- Assessment of the impact of reduced fault clearing times and Artificial Island generator step-up transformer tap optimizations on the performance of the proposals:
  - Faster fault clearing times will be realized by installing new line relaying and high speed fiber optic communication channels on several lines
  - PJM analysis quantified the improved stability margins from the relay and GSU tap setting changes

# OPGW and GSU Tap Settings

- High speed relaying utilizing OPGW to be implemented on the following existing lines:

5037 Salem – Hope Creek

5015 Hope Creek – Red Lion

5023 Hope Creek – NF

5021 Salem - Orchard

5022 East Windsor - Deans

5038 New Freedom – East Windsor

5024 Salem – New Freedom

5039 New Freedom – Orchard

- Tap setting optimization for the three Artificial Island generator step-up transformers

- Pushed each project to failure
  - Determined the longest duration fault clearing time (cycles) for which a project remained stable
- PJM Manual 14B
  - Add a  $\frac{1}{4}$  and  $\frac{1}{2}$  cycle of fault clearing time and re-test
  - Margin test accounts for uncertainty in actual clearing times



# Margin Testing Results – Cycles to Fail

| Project   | Project ID | Proposing Entity | OPGW Wire | GSU Tap Optimization | TCSC Compensation (Normal/ Transient) | SVC     | Outage | Limiting Contingency (redacted) | Maximum Angle Swing | Fault Clearing Time (Tcl) (cycles) | CCT <sup>(1)</sup> (cycles) | Margin to CCT (cycles) (CCT – Tcl) |
|-----------|------------|------------------|-----------|----------------------|---------------------------------------|---------|--------|---------------------------------|---------------------|------------------------------------|-----------------------------|------------------------------------|
| 230kV     | P2013_1-5A | LS Power         | Yes       |                      | N/A                                   | No      | 5015   |                                 | 114                 | 9.06 <sup>(5)</sup>                | 9.31                        | 0.25                               |
|           |            |                  |           | 300MVar              |                                       | 5015    |        | 91                              | 9.06                | 10.31                              | 1.25                        |                                    |
|           | P2013_1-2B | Transource       | No        |                      |                                       | 650MVAR | 5015   |                                 | 112                 | 10.4                               | 10.65                       | 0.25                               |
|           |            |                  | Yes       |                      |                                       | No      | 5015   |                                 | 107                 | 9.06                               | 9.56                        | 0.50                               |
|           |            |                  |           |                      |                                       | 300MVar | 5015   |                                 | 88                  | 9.06                               | 10.56                       | 1.50                               |
|           |            |                  | No        |                      |                                       | 650MVAR | 5015   |                                 | 109                 | 10.14                              | 10.64                       | .5                                 |
| 500kV     | P2013_1-7K | PSE&G            | Yes       |                      |                                       | No      | 5015   |                                 | 100                 | 9.06                               | 9.81                        | 0.75                               |
|           |            |                  |           |                      |                                       | 300MVar | 5015   |                                 | 83                  | 9.06                               | 10.81                       | 1.75                               |
|           |            |                  | No        |                      |                                       | 650MVAR | 5021   |                                 | 107                 | 4.02                               | 4.27                        | .25                                |
|           | P2013_1-1C | DVP              | Yes       |                      |                                       | No      | 5015   |                                 | 100                 | 9.06                               | 10.06                       | 0.75                               |
|           |            |                  |           |                      |                                       | 300MVar | 5015   |                                 | 83                  | 9.06                               | 10.81                       | 1.75                               |
|           |            |                  | No        |                      |                                       | 650MVAR | 5021   |                                 | 107                 | 4.02                               | 4.27                        | 0.25                               |
| TCSC only | P2013_1-1A | DVP              | Yes       |                      | 40,45/90%                             | No      | 5038   |                                 | Unstable            | 2.90                               | < 2.90                      | -                                  |
| 40,45/90% |            |                  |           |                      | 500MVar                               | 5038    |        | 93                              | 2.90                | 3.15                               | 0.25                        |                                    |
| 0/50%     |            |                  |           |                      | 750MVar                               | 5038    |        | 99                              | 2.90                | 2.90                               | 0.00                        |                                    |
| 0/70%     |            |                  |           |                      | 750MVar                               | 5038    |        | 81                              | 2.90                | 3.40                               | 0.50                        |                                    |

(1) CCT: critical clearing time – maximum fault clearing time for which a system remains transiently stable. In this study CCT resolution is ¼ cycle.

(2) (redacted)

(3) (redacted)

(4) (redacted)

(5) For a SLG fault w/ delayed clearing contingency, back-up clearing time is increased in CCT calculation. Primary clearing time is fixed to 2.90 cycle during the CCT calculation.

# Margin Testing Results – M14B Margin Test

| Project   | Project ID | Proposing Entity | FOG Wire | GSU Tap Optimization | TCSC Compensation (Normal/ Transient) | SVC     | Outage | Limiting Contingency (redacted) | Maximum Angle Swing | Margin to CCT (CCTM) (cycles) | M14B Margin (M14B) (cycles) | Margin Results (CCTM-M14B) (cycles) |
|-----------|------------|------------------|----------|----------------------|---------------------------------------|---------|--------|---------------------------------|---------------------|-------------------------------|-----------------------------|-------------------------------------|
| 230kV     | P2013_1-5A | LS Power         | Yes      |                      | N/A                                   | No      | 5015   |                                 | 114                 | 0.25                          | 0.5                         | -0.25                               |
|           |            |                  | No       |                      |                                       | 300MVar | 5015   |                                 | 91                  | 1.25                          | 0.5                         | 0.75                                |
|           | P2013_1-2B | Transource       | No       |                      |                                       | 650MVar | 5015   |                                 | 112                 | 0.25                          | 0.5                         | -0.25                               |
|           |            |                  | Yes      |                      |                                       | No      | 5015   |                                 | 107                 | 0.50                          | 0.5                         | 0.0                                 |
|           |            |                  | No       |                      |                                       | 300MVar | 5015   |                                 | 88                  | 1.50                          | 0.5                         | 1.0                                 |
|           |            |                  | No       |                      |                                       | 650MVar | 5015   |                                 | 109                 | 0.50                          | 0.5                         | 0.0                                 |
| 500kV     | P2013_1-7K | PSE&G            | Yes      |                      |                                       | No      | 5015   |                                 | 100                 | 0.75                          | 0.5                         | 0.25                                |
|           |            |                  | No       |                      |                                       | 300MVar | 5015   |                                 | 83                  | 1.75                          | 0.5                         | 1.25                                |
|           | P2013_1-1C | DVP              | No       |                      |                                       | 650MVar | 5021   |                                 | 107                 | 0.25                          | 0.25                        | 0.0                                 |
|           |            |                  | Yes      |                      |                                       | No      | 5015   |                                 | 100                 | 1.00                          | 0.5                         | 0.25                                |
|           |            |                  | No       |                      |                                       | 300MVar | 5015   |                                 | 83                  | 1.75                          | 0.5                         | 1.25                                |
|           |            |                  | No       |                      |                                       | 650MVar | 5021   |                                 | 107                 | 0.25                          | 0.25                        | 0.0                                 |
| TCSC only | P2013_1-1A | DVP              | Yes      | 40,45/90%            | No                                    | 5038    |        | Unstable                        |                     |                               |                             |                                     |
| 40,45/90% |            |                  |          | 500MVar              | 5038                                  |         | 93     | 0.25                            | 0.25                | 0.0                           |                             |                                     |
| 0/50%     |            |                  |          | 750MVar              | 5038                                  |         | 99     | 0.00                            | 0.25                | -0.25                         |                             |                                     |
| 0/70%     |            |                  |          | 750MVar              | 5038                                  |         | 81     | 0.50                            | 0.25                | 0.25                          |                             |                                     |

(1) CCT: critical clearing time – maximum fault clearing time for which a system remains transiently stable. In this study CCT resolution is ¼ cycle.

(2) (redacted)

(3) (redacted)

(4) (redacted)

(5) For a SLG fault w/ delayed clearing contingency, back-up clearing time is increased in CCT calculation. Primary clearing time is fixed to 2.90 cycle during the CCT calculation.

- SSR and control interaction study duration
  - Six month study duration does not account for data acquisition time
  - If measured data required, acquisition timeframe tied to Artificial Island unit outages
- Compensation
  - Proposed 90% compensation level well above industry norms of 70-80%
- Performance
  - Baseline performance with 90% compensation level and very large SVC is in line with other projects
  - Performance at lower compensation levels not as good as line solutions
  - Performance under margin testing is less robust than line solutions
- Due to the above, the TCSC project is not recommended



# Proposed Cost Commitments and Project Cost Estimates



# Cost Commitment / Containment Mechanism Summary

| Proposing Entity                                                       | LS Power                                                                                                                                                                                                                                                                                                                | PSE&G                                                                                                                                                                                                                                                                    | Transource                                                                                                                                                                                                                                                             | Dominion                           |
|------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| Summary of Terms and Conditions (as specified by the Proposing Entity) | <p>Includes all project costs; exceptions below:</p> <ol style="list-style-type: none"><li>1. PJM scope changes</li><li>2. Breach/default of DEA/ICA by PJM</li><li>3. Breach / Default / interference or failure to cooperate with ICA Terms by TO</li><li>4. Costs caused by changes in laws or regulations</li></ol> | <p>Includes all project costs; exceptions below:</p> <ol style="list-style-type: none"><li>1. PJM scope changes</li><li>2. Non-construction project cost changes deemed outside of the control of PSE&amp;G</li><li>3. Commitment includes all escalation cost</li></ol> | <p>Includes all project costs; no exceptions</p> <ol style="list-style-type: none"><li>1. Up to \$203 million: all ROE / incentives</li><li>2. \$243 to \$299.8 million: half ROE / incentives</li><li>3. Above \$299.8 million: forego all ROE / incentives</li></ol> | <p>No cost commitment proposed</p> |

- Total cost estimates combine Proposing Entity cost commitment numbers with PJM cost estimates
  - Costs estimates provided by Proposing Entities for project components within their cost commitment
  - PJM cost estimates used for project components outside of proposed cost commitment



# Cost Estimates Incorporating Cost Commitments

## Line Projects Coupled with SVC and OPGW/GSU TAP Projects

In Current Year Dollars

| <b>Dominion 1C</b>                       |                   |
|------------------------------------------|-------------------|
| <b>500kV Line Hope Creek to Red Lion</b> |                   |
| Cost Containment                         | \$0               |
| Project Cost Estimate                    | \$211 - \$257     |
| OPGW/GSU Taps                            | \$20 <sup>1</sup> |
| SVC Cost Estimate                        | \$31 - \$38       |
|                                          |                   |
| Project Total                            | \$263 - \$316     |

| <b>PSE&amp;G 7K</b>                      |                   |
|------------------------------------------|-------------------|
| <b>500kV Line Hope Creek to Red Lion</b> |                   |
| Cost Containment                         | \$221             |
| Red Lion Expansion                       | \$4 - \$6         |
| OPGW/GSU Taps                            | \$20 <sup>1</sup> |
| SVC Cost Estimate                        | \$31 - \$38       |
|                                          |                   |
| Project Total                            | \$277 - \$285     |

| <b>Transource 2B</b>   |               |
|------------------------|---------------|
| <b>230kV Submarine</b> |               |
| Cost Containment       | \$203 - \$259 |
| New Salem Substation   | \$41          |
| Salem Expansion        | \$14 - \$17   |
| OPGW/GSU Taps          | \$25          |
| SVC Cost Estimate      | \$31 - \$38   |
|                        |               |
| Project Total          | \$313 - \$380 |

| <b>LS Power 5A</b>     |               |
|------------------------|---------------|
| <b>230kV Submarine</b> |               |
| Cost Containment       | \$146         |
| Salem Expansion        | \$61 - \$74   |
| OPGW/GSU Taps          | \$25          |
| SVC Cost Estimate      | \$31 - \$38   |
|                        |               |
| Project Total          | \$263 - \$283 |

<sup>1</sup> Cost for OPGW upgrade work is reduced for 1C and 7K because new line construction includes OPGW





# Cost Estimates Incorporating Cost Commitments

Line Projects Coupled with SVC and OPGW/GSU TAP Projects

In-Service Year Dollar Costs (2.5% per year escalation)

| <b>Dominion 1C</b><br><b>500kV Line Hope Creek to Red Lion</b> |  |
|----------------------------------------------------------------|--|
| Capital Cost (current year \$)                                 |  |

|               |               |
|---------------|---------------|
| Project Total | \$263 - \$316 |
|---------------|---------------|

|                                |  |
|--------------------------------|--|
| Capital Cost (with escalation) |  |
|--------------------------------|--|

|               |               |
|---------------|---------------|
| Project Total | \$284 - \$341 |
|---------------|---------------|

| <b>PSE&amp;G 7K</b><br><b>500kV Line Hope Creek to Red Lion</b> |  |
|-----------------------------------------------------------------|--|
| Capital Cost (current year \$)                                  |  |

|               |                            |
|---------------|----------------------------|
| Project Total | \$277 - \$285 <sup>1</sup> |
|---------------|----------------------------|

|                                |  |
|--------------------------------|--|
| Capital Cost (with escalation) |  |
|--------------------------------|--|

|               |                            |
|---------------|----------------------------|
| Project Total | \$281 - \$290 <sup>1</sup> |
|---------------|----------------------------|

| <b>Transource 2B</b><br><b>230kV Submarine</b> |  |
|------------------------------------------------|--|
| Capital Cost (current year \$)                 |  |

|               |               |
|---------------|---------------|
| Project Total | \$313 - \$380 |
|---------------|---------------|

|                                |  |
|--------------------------------|--|
| Capital Cost (with escalation) |  |
|--------------------------------|--|

|               |               |
|---------------|---------------|
| Project Total | \$346 - \$411 |
|---------------|---------------|

| <b>LS Power 5A</b><br><b>230kV Submarine</b> |  |
|----------------------------------------------|--|
| Capital Cost (current year \$)               |  |

|               |                            |
|---------------|----------------------------|
| Project Total | \$263 - \$283 <sup>1</sup> |
|---------------|----------------------------|

|                                |  |
|--------------------------------|--|
| Capital Cost (with escalation) |  |
|--------------------------------|--|

|               |                            |
|---------------|----------------------------|
| Project Total | \$284 - \$306 <sup>1</sup> |
|---------------|----------------------------|

# Transource 2B and Dominion 1C

## Project Evaluations

### Transource 2B

- Due to the high estimated cost relative to the other projects under consideration, the Transource 2B project is not recommended at this time

### Dominion 1C

- Due to the high estimated cost relative to the other projects under consideration and the lack of a cost commitment the Dominion 1C project is not recommended at this time

# Cost Containment Comparison

| Proposing Entity                  | LS Power                                                                                                                                                                                                                                                                                        | PSE&G                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cost Containment Provision        |                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Escalation                        | Costs would be escalated against an industry standard index                                                                                                                                                                                                                                     | Commitment includes all escalation cost                                                                                                                                                                                                                                                                                                                                                                                                  |
| Exclusions to the cost commitment | <ul style="list-style-type: none"> <li>• PJM project scope changes</li> <li>• Costs caused by changes in laws or regulations</li> <li>• Cost caused by PJM's breach or default</li> <li>• Cost caused by any Transmission Owner breach, default interference or failure to cooperate</li> </ul> | <ul style="list-style-type: none"> <li>• PJM project scope changes</li> <li>• Costs caused by changes in laws or regulations</li> <li>• Greater than anticipated environmental mitigation costs</li> <li>• Costs caused by route changes driven from permitting or land acquisition</li> <li>• Costs incurred due to delays in permit issuance</li> <li>• Cost incurred due to delays incurred due to a court order or action</li> </ul> |

- Current Year Dollars
  - LS Power 5A project cost commitment, which is based on current year dollars and tied to an industry escalation index, has lower cost in current year dollars
- In Service Year Dollars
  - PSE&G 7K project cost commitment, which is based on a guaranteed maximum price with escalation included, may have lower cost based on in-service year dollars
- Cost Cap Terms and Conditions
  - Entities will collect revenues based on actual costs
  - LS Power terms and conditions provide fewer exclusions in comparison to the PSE&G terms and conditions
  - Greater potential for increased costs with the PSE&G proposal due to cost containment exceptions



# Constructability Analysis

- PJM met with permitting agencies
  - U.S. Army Corps of Engineers (USACE)
  - Delaware Department of Natural Resource and Environmental Control (DNREC)
  - New Jersey DEP
  - U.S. Fish and Wildlife Service (USFWS)
  - National Marine Fisheries
  - National Oceanic and Atmospheric Administration (NOAA)

- Feedback is based on preliminary information
  - Without detailed design and route, agencies will not state likelihood of permitting success of any of the projects
  - Various permitting agencies will be involved in review of the project proposals based on the preliminary project information
- Various entities will coordinate review through the lead agency
  - USACE is likely to be the lead agency

## Meetings with Permitting Agencies

- River Crossing will be major challenge for all projects
  - Type of construction will impact permitting
    - Overhead
    - Jet-plow
    - Horizontal directional drilling
  - Issues will include:
    - View shed
    - Navigational impacts
    - Burial depth
    - Use of existing RoW
    - Construction time
- Permitting through the sensitive environmental areas may be difficult
  - Supawna Meadows National Wildlife Refuge
  - Augustine Wildlife Area



- Primary Considerations

- Technical Analysis

- Thermal
    - Stability
    - Short-circuit
    - Voltage
    - NERC Cat-D Contingencies

- Secondary Considerations

- Schedule

- Permitting
    - Construction
    - Long lead time equipment

- Project Complexity

- Line crossings
    - Outage requirements
    - Modifications to other transmission facilities
    - Modification to Artificial Island substations
    - Modifications to Red Lion substation

- Cost Factors

- Cost Commitments
    - Cost effectiveness
    - Market efficiency
    - PJM estimated costs

- Right of Way and Land Acquisition

- New right of way required
    - Substation land required

- Siting and Permitting

- Wetlands impact
    - Public opposition risk
    - Delaware river crossing
    - Land permitting
    - Historic and scenic highway

- Operational Impact

- Artificial island facility requirements
    - Ongoing maintenance
    - Blackstart
    - Route diversity
    - Operational Robustness

- Outage Requirements
  - Artificial Island to Red Lion solutions would require outages to the 5015 line
    - 5015 line outages are challenging to schedule
  - All projects would require coordination of 500kV and 230kV facility outages
  - PJM operational analysis to manage impact to system configuration to support any outage required to support construction
    - Reactive devices
    - Coordination with planned generation and transmission outages
- A solution that minimizes outage requirements during construction is preferred

- Land Permitting
  - All projects will face challenges
    - Red Lion to Artificial Island
      - State wildlife management areas
      - Supawna Meadows National Wildlife Refuge
        - » Permitting may be made more difficult with the availability of a viable alternative
    - Southern crossing lines
      - Augustine Wildlife Area
        - » Permitting may be made more difficult with the availability of a viable alternative
        - » Potentially mitigated through HDD and route selection
- A solution that can mitigate land permitting is preferred

- Delaware River Crossing

- Type of construction will impact permitting
  - Overhead
  - Jet-plow
  - Horizontal directional drilling (HDD)
- Issues will include:
  - View shed
  - Navigational impacts
  - Burial depth
  - Use of existing RoW
  - Construction time

- Siting and permitting for a new river crossing will be a major component in the project schedule for all projects under consideration, but there appears to be a lower risk for a NEPA EIS being required for a solution utilizing HDD



# Additional Evaluation Considerations

- Blackstart
  - LS Power 5A provides access to additional blackstart resources
- Historic and scenic highway
  - LS Power 5A line parallels Delaware state route 9
- Market efficiency
  - LS Power 5A: \$92M over 15 years
  - PSE&G 7K: \$57M over 15 years
- Route diversity
  - LS Power 5A project is a new, diverse route
- Salem expansion
  - Constrained with limited space
- Operational robustness
  - PSE&G 7K project improves voltage drop for loss of 500kV facilities
- Wetlands impact
  - PSE&G 7K project potentially impacts approximately 16 acres of forested wetlands
  - LS Power 5A project potentially impacts approximately 8 to 11 acres of forested wetlands
- Construction and long lead time equipment
  - LS Power 5A project construction involves specialized equipment and transmission cable and auto-transformers are long lead time equipment

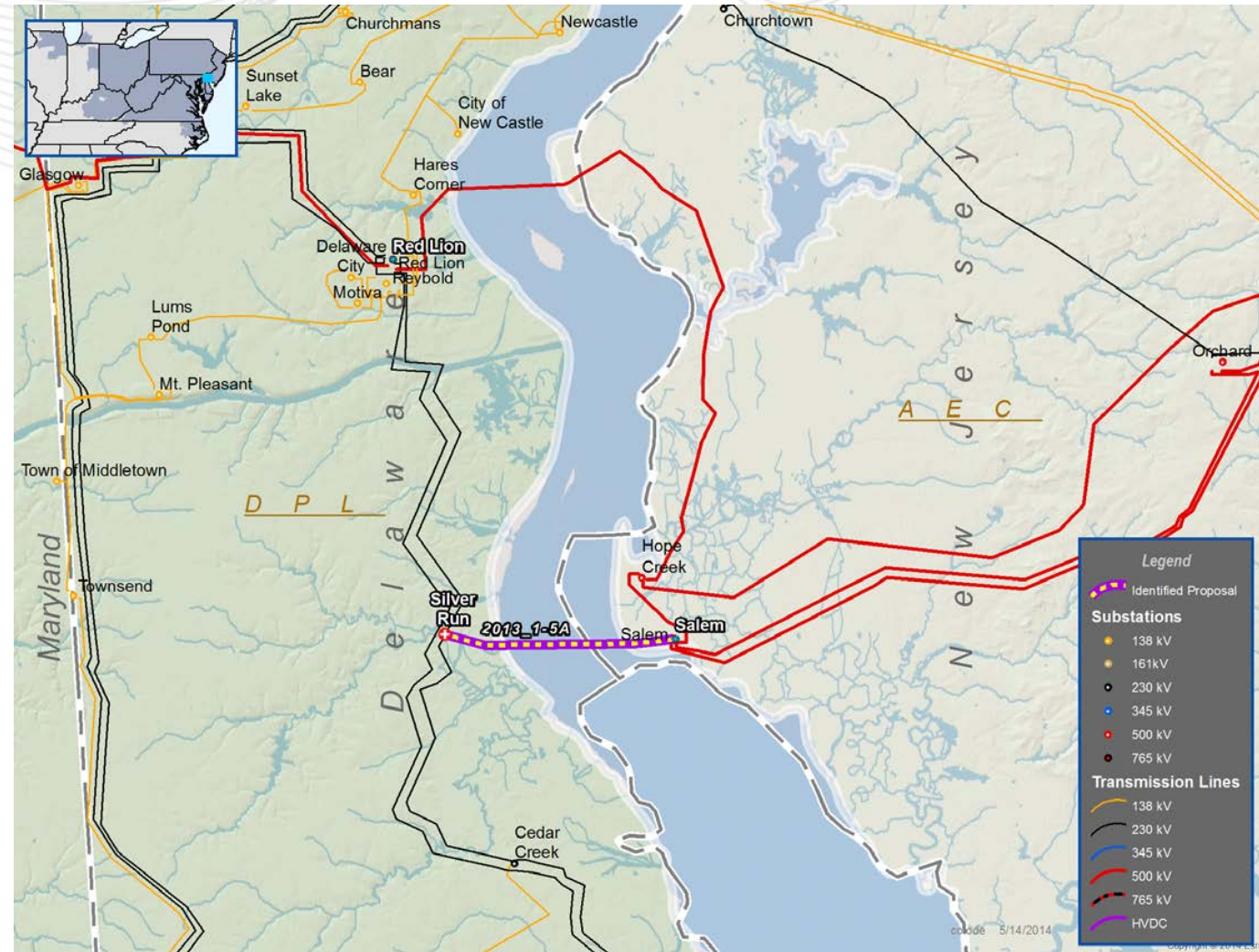
- Performance
  - The line proposals along with a 300MVAR SVC at New Freedom and the protective relay improvements satisfy all requirements of the request for proposal
- Cost
  - The LS Power proposal and the PSE&G proposal are the lowest cost alternatives
  - PJM's evaluation of the cost commitments finds that the LS Power proposal provides greater cost certainty with fewer exclusions to the cost commitment
- Constructability
  - Siting will be challenging for both line proposals however the LS Power proposal through the use of horizontal directional drilling technology provides greater flexibility to mitigate permitting risk

# Artificial Island Recommendation

- At the July 27 PJM Board meeting, PJM staff will recommend for inclusion in the RTEP:
  - 230kV transmission line under the Delaware river from Salem to a new substation near the 230kV transmission RoW in Delaware utilizing HDD under the river designated to LS Power
    - Associated substation work at Salem designated to PSE&G
    - Associated work on the 230kV RoW designated to PHI
  - SVC at New Freedom designated to PSE&G
  - OPGW upgrades designated to PSE&G and PHI
  - Artificial Island GSU tap settings upgrade designated to PSEG Power

# Artificial Island Project Recommendation

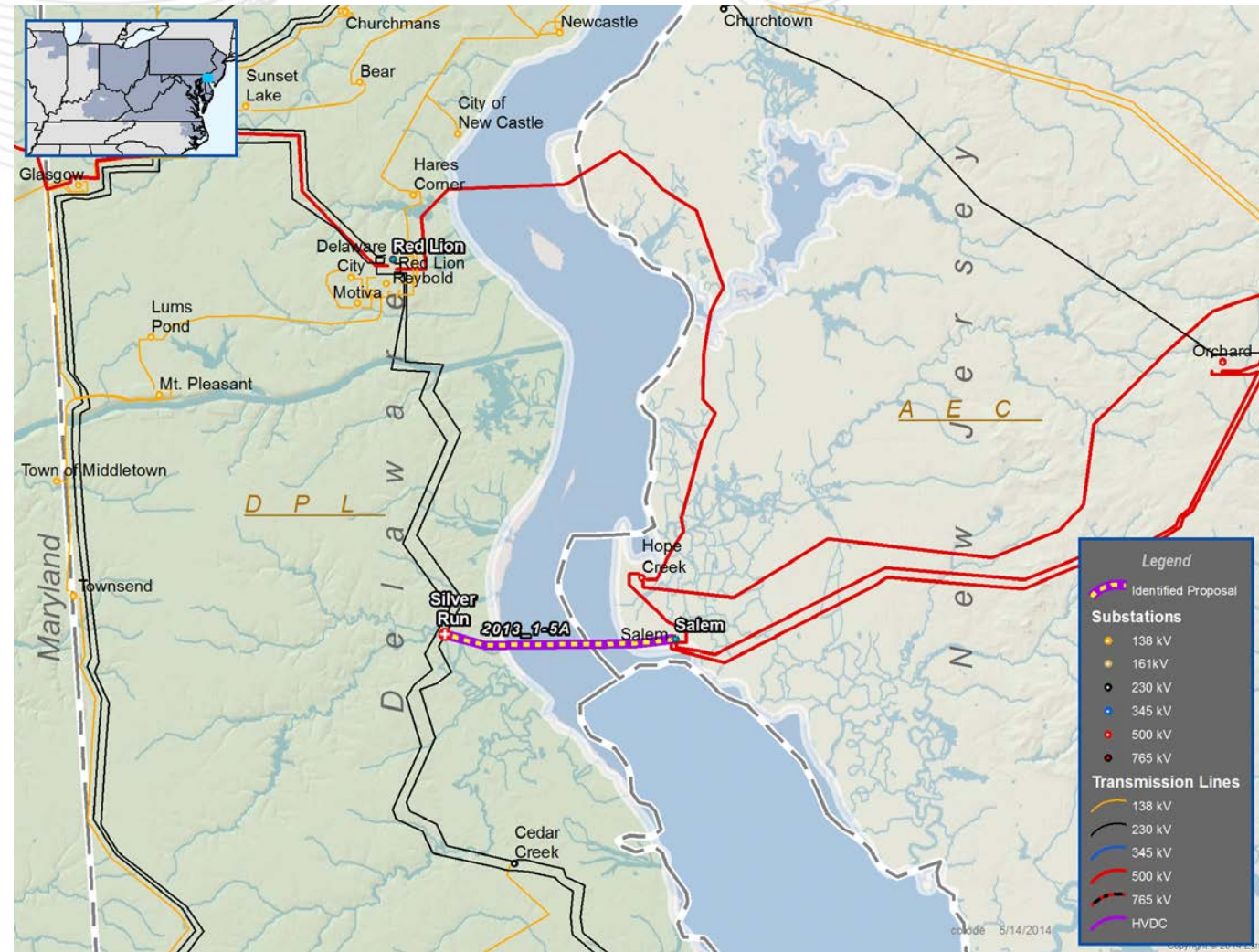
- In consideration of all factors, PJM staff will recommend for inclusion in the RTEP:
  - A new 230kV circuit from Salem to a new substation near the 230kV corridor in Delaware tapping the existing Red Lion to Cartanza and Red Lion to Cedar Creek 230 kV lines, utilizing HDD under the river (b2633.1)
  - Designate transmission line to LS Power





# Artificial Island Project Recommendation

- Required connection facilities to accommodate the new transmission facilities:
  - Expansion of the Salem substation (b2633.2)
    - Designate to PSE&G
  - Interconnecting to the existing Red Lion to Cartanza and Red Lion to Cedar Creek 230 kV lines into the new substation (b2633.3)
    - Designate to PHI





# SVC Upgrade Project Recommendation

- Construct an SVC at New Freedom 500 kV substation
  - Facilities design will determine the final technical parameters (b2633.4)
- Project cost estimate:
  - \$31M to \$38M
- Designate SVC upgrade at New Freedom to PSE&G



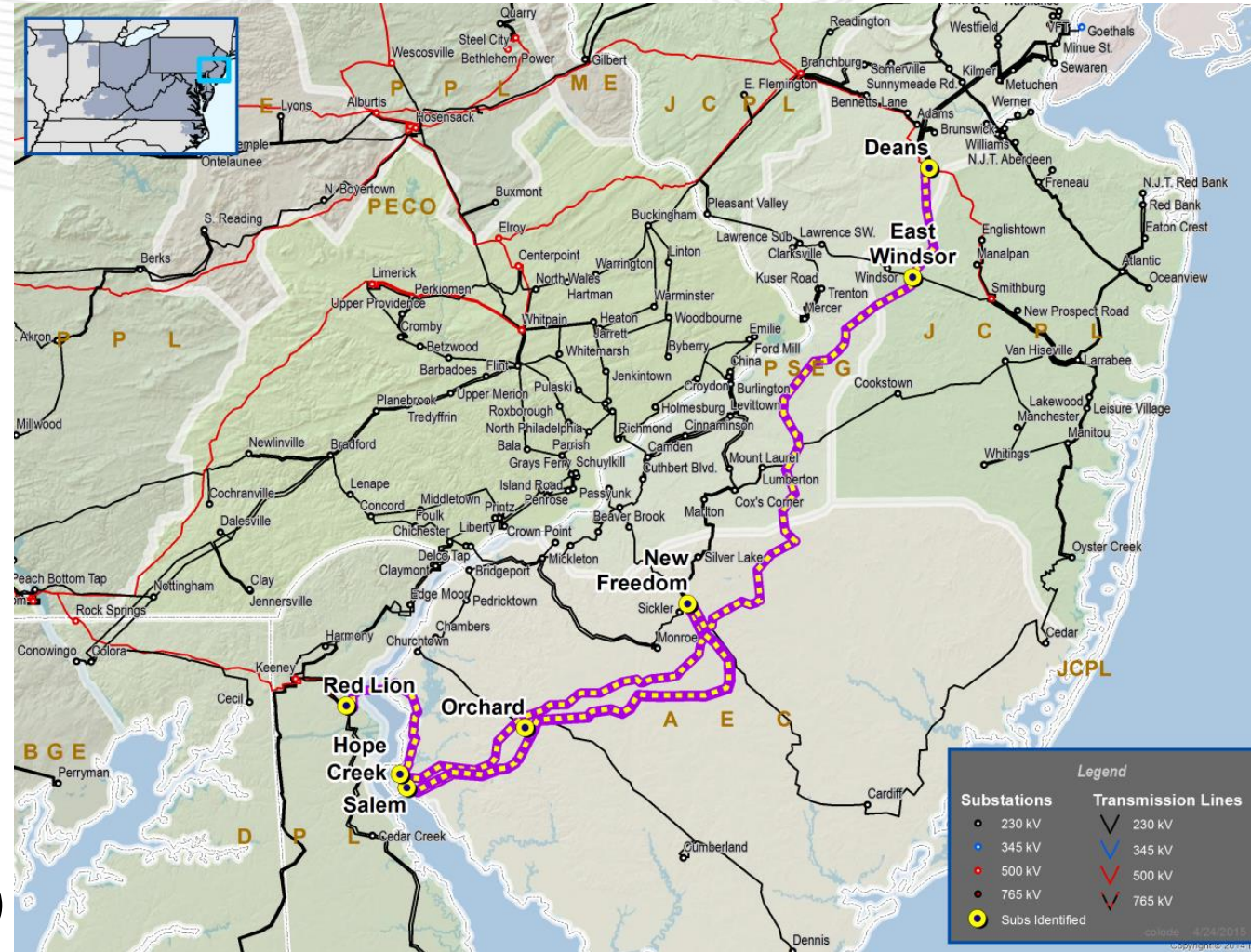


# OPGW Upgrade Project Recommendation

- Implement high speed relaying utilizing OPGW on the following existing lines (b2633.5 and b2633.6):

|      |      |
|------|------|
| 5037 | 5022 |
| 5015 | 5038 |
| 5023 | 5024 |
| 5021 | 5039 |

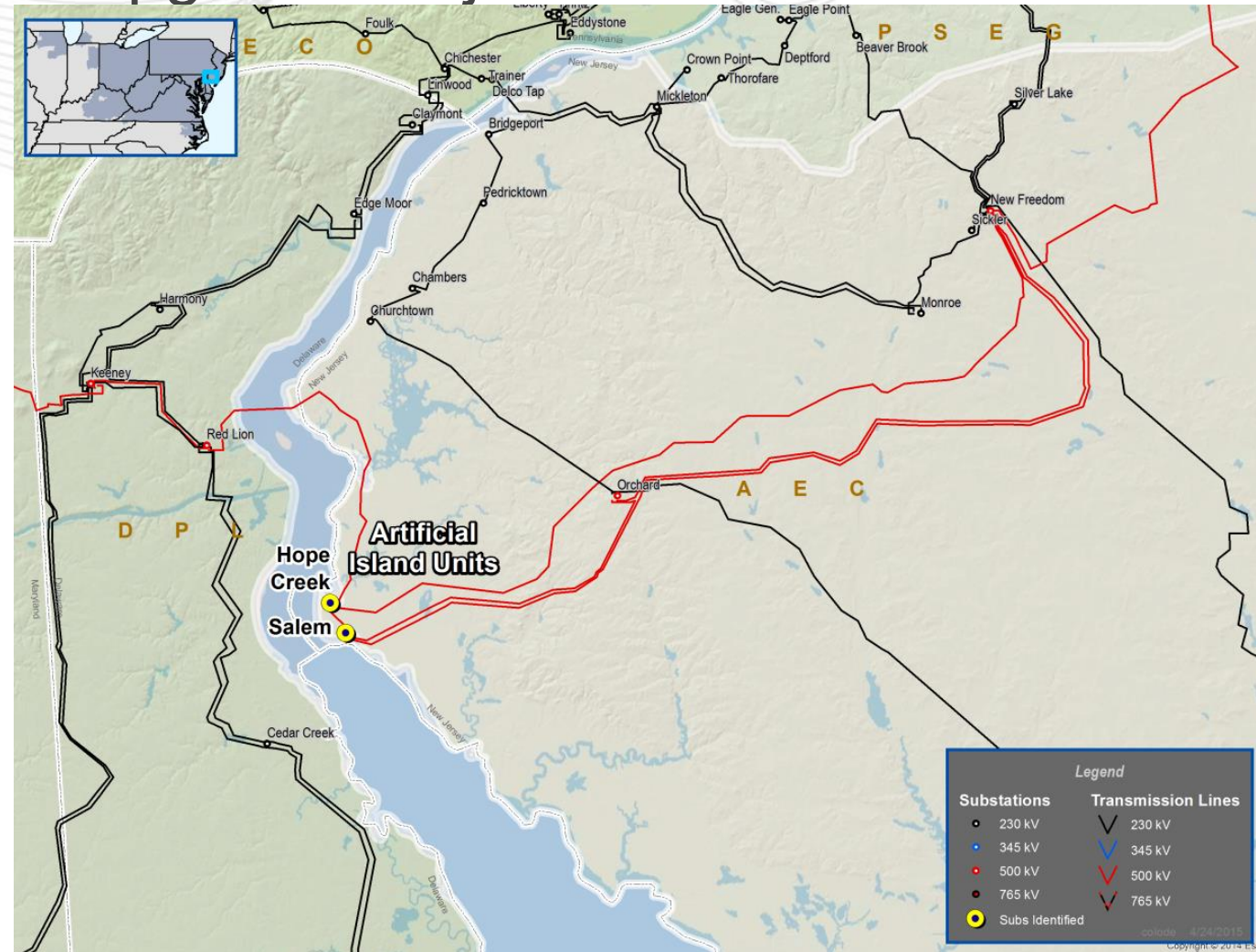
- Project cost estimate:
  - \$25M
- Designate OPGW upgrades to PSE&G and PHI (5015 remote end)





# Artificial Island Unit GSU Tap Settings Upgrade Project Recommendation

- Implement changes to the tap settings for the three Artificial Island unit's step-up transformers(b2633.7)
- Designate GSU tap settings change upgrade to PSEG Power



- All stakeholder comments for the PJM Board must be sent no later than close of business on May 29
- If the PJM Board approves these recommendations, PJM staff will proceed to draft the Designated Entity Agreement
  - Recommendation is based upon PJM's understanding of the cost commitment terms and conditions, which will be finalized and incorporated into the Designated Entity Agreement
  - The first required milestone will be related to engineering feasibility of the river crossing utilizing horizontal directional drilling installation



# Appendix

# Supplemental Information Summary

- 08/12 – Letter sent to Proposing Entity ‘finalists’ to provide opportunity to supplement their proposals
- 09/12 – Supplemental information submitted to PJM by all ‘finalists’
- 09/18 – Redacted versions of the supplemental information is posted to PJM.com
- Oct 22 through Nov 3 – Meetings with FERC Administrative Law Judge and finalists to review and confirm information

- \$146 Million
- Physical scope of work included under proposed mechanism
  - Aerial or submarine line
  - New substation located near the existing 230kV right-of-way in Delaware
- Physical scope of work not included under proposed mechanism
  - Salem substation modifications
    - New bay position
    - New 500/230kV transformer
  - 230kV turning poles cutting the two Delaware transmission lines



- Costs included under the containment mechanism
  - Permits and government approvals
  - Land acquisition
  - Environmental assessment and mitigation
  - Engineering
  - Equipment, supplies and other material procurement
  - All development and construction activities

- Costs not included under the containment mechanism
  - Financing costs
  - AFUDC
  - Additions and modifications to the project scope due to
    - “any material change in the enforcement, interpretation of application of any statute, rule, regulation, order or other applicable law existing..”
    - “any Breach or Default by PJM of its obligations under the DEA or any request by PJM to delay or suspend any activities associated with the Project”.
    - “any breach, default, interference or failure to cooperate by any Transmission Owner in connection with the Interconnection Coordination Agreement or interconnection agreement”

- Proposed tiered cost containment mechanism
  - Up to \$203 Million: entitled to recover all FERC approved ROE plus incentives
  - Portion from \$243 to \$299.8 million: forego 50% of any FERC approved ROE incentives
  - Above \$299.8 million: forego 100% of any FERC approved ROE incentives
- Physical scope of work included under proposed mechanism
  - 230kV submarine cable from Salem substation to new substation in Delaware
  - New substation located near the existing 230kV right-of-way in Delaware
  - New 500/230kV substation adjacent to Salem substation
- Physical scope of work not included under proposed mechanism
  - Modifications in and near Salem substation
    - New bay position at Salem
  - 230kV turning poles cutting the two Delaware transmission lines

- Transource provided a contingency amount of \$52.3 million which is included in the second tier of their cost containment mechanism
  - Some specific contingency items identified (redacted)
  - General 10% project contingency



- \$221 Million
- Physical scope of work included under proposed mechanism
  - Aerial 500kV line from Hope Creek to Red Lion substations
  - Upgrade work at Hope Creek to create the new line bay
- Physical scope of work not included under proposed mechanism
  - Upgrade work at Red Lion to create the new line bay

- Costs included under the containment mechanism
  - All project costs with exceptions as noted below
- Costs not included under the containment mechanism
  - Costs associated with PJM modifications or additions to the scope of work
  - Costs incurred from the following events deemed outside of the control of PSE&G:
    - Changes in applicable laws and regulations
    - Obtaining governmental approvals and permits
    - Obtaining necessary property rights to construct the Project
    - Environmental permitting, remediation and mitigation
    - Orders of courts or action or inaction by governmental agencies

- Dominion did not provide a cost containment mechanism, but rather provided reasons for confidence in their ability to meet cost estimates and elaborated on project management approach and past experience with transmission projects
  - Red Lion to Hope Creek: agreed with PJM's cost estimate of \$242 to \$292 million
  - FACTS based solution: provided a revised cost estimate of \$174.1 million
    - \$86.4 million based upon vendor not-to-exceed budget prices

- V1 4/28/2015 – Original Presentation Posted
- V2 4/28/2015 – Slide 45 updated to reflect May 29<sup>th</sup> comment date
- V3 05/06/2015 – Slide 39 updated to reflect the July 27 PJM Board meeting