Artificial Island Timeline
Past Timeline

• 9/13/2012 – PJM discusses the trending Artificial Island operational issues with PJM Stakeholders
• March 2013 - TEAC Previewed conceptual timeline and next steps for an Artificial Island Proposal Window
• 4/29/2013 – Artificial Island Proposal Window Opened
• 6/28/2013 – Artificial Island Proposal Window Closed
• July 2013 through April 2014 – PJM discusses the details of project performance, cost and constructability
Artificial Island Timeline

- Monday, May 19th TEAC
  - 3 hour stakeholder technical meeting
  - In-person at PJM CTC
- Monday, June 2nd – Due date for stakeholder comment/feedback (14 day comment period)
- June 5th TEAC
- Monday, June 16th – PJM review of stakeholder comment/feedback and final decision meeting
  - Special TEAC Webex / Teleconference
- Comment Period to the PJM Board (36 days for comment period)
- July 10th TEAC
- Tuesday, July 22nd – PJM Board meeting
  - Artificial Island solution recommendation to the PJM Board
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<th>Project ID</th>
<th>TO</th>
<th>Cost ($)</th>
<th>Major Components</th>
<th>Supporting info</th>
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<tbody>
<tr>
<td>P2013_1-1A</td>
<td>Virginia Electric and Power Com</td>
<td>$133</td>
<td>500 MVAR SVC near New Freedom</td>
<td>Two (2) Thyristor Controlled Series Compensation (TCSC) Devices near New Freedom</td>
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<td>Virginia Electric and Power Com</td>
<td>$126</td>
<td>New 500 kV from Salem - a new station in Delaware</td>
<td>New 500/230 kV station in Delaware that taps existing Cedar Creek - Red Lion 230kV and Catanza - Red Lion 230kV</td>
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<td>Install a new 500kV line from Hope Creek - Red Lion; New Salem - Hope Creek 500 kV line</td>
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<td>Two (2) 500/230 Transformers near Salem; Loop in Red Lion - Cartanza 230 to Cedar Creek</td>
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<td>Salem - North Cedar Creek (new) 230 kV</td>
<td>Two (2) 500/230 Transformers near Salem and loop in Red Lion - Cartanza 230 and Red Lion - Cedar Creek 500 kV line</td>
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<td>New Salem - Hope Creek 500 kV line and new 500/230 station east of Lumberton</td>
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<td>$788 - $994</td>
<td>New Freedom - Lumberton - North Smithburg (New) 500 kV line</td>
<td>New Salem - Hope Creek 500 kV line and new 500/230 station east of Lumberton</td>
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<td>First Energy</td>
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<td>New Freedom-Smithburg 500 kV line with a loop into Larrabee</td>
<td>Hope Creek - Red Lion 500 kV line</td>
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<td>P2013_1-4A</td>
<td>PHI Exelon</td>
<td>$475</td>
<td>Peach Bottom - Keeneqy - Red Lion - Salem 500 kV</td>
<td>Remove Keeneqy - Red Lion 230 kV; Reconfigure 230 around Hay Road, Reconductor Harmony-Chapel St 138 kV</td>
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<td>P2013_1-5A</td>
<td>LS Power</td>
<td>$116.3M - $148.3M</td>
<td>Salem - Silver Run (new) 230 kV; Salem 500/230 kV Transformer</td>
<td>New 230 kV station that taps existing Cedar Creek - Red Lion 230kV and Catanza - Red Lion 230kV</td>
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<td>P2013_1-6A</td>
<td>Atlantic Wind</td>
<td>$170</td>
<td>Salem - Red Lion 500 kV</td>
<td>SVC at Salem/ Hope Creek; New HVDC Stations at Cardiff and Salem</td>
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<tr>
<td>P2013_1-7A</td>
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<td>320 kV HVDC Salem/Hope Creek - Cardiff</td>
<td>Existing ROV</td>
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<td>Salem-Hope Creek to Peach Bottom 500 kV</td>
<td>Same as 7A with Loop into Keeneqy</td>
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<td>P2013_1-7C</td>
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<td>P2013_1-7D</td>
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<td>P2013_1-7E</td>
<td>PSE&amp;G</td>
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<td>New Freedom - Deans 500 &amp; Salem - Hope Creek 500 kV lines</td>
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<td>P2013_1-7F</td>
<td>PSE&amp;G</td>
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<td>New Freedom - Smithburg and Salem-Hope Creek 500 kV lines</td>
<td>Existing ROV</td>
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<td>P2013_1-7G</td>
<td>PSE&amp;G</td>
<td>$1,034</td>
<td>New Freedom - Smithburg and Salem-Hope Creek 500 kV lines</td>
<td>Same as 7F with a Loop into a new Larrabee 500 kV station</td>
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<td>P2013_1-7H</td>
<td>PSE&amp;G</td>
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<td>New Freedom - Whiptail and Salem - Hope Creek 500 kV lines</td>
<td>Northern Route</td>
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<td>P2013_1-7I</td>
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<td>$1,353</td>
<td>New Freedom - Whiptail and Salem - Hope Creek 500 kV lines</td>
<td>Same as 7H with the Southern Route</td>
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<td>P2013_1-7J</td>
<td>PSE&amp;G</td>
<td>$915</td>
<td>New Freedom - New Station on Branchburg-Eltrog 500 kV line (&quot;5017 Junction&quot;) and Salem - Hope Creek 500 kV line</td>
<td>Existing ROV</td>
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<td>P2013_1-7K</td>
<td>PSE&amp;G</td>
<td>$1,086</td>
<td>New Freedom - Deans &amp; Salem - Hope Creek - Red Lion 500 kV lines w/ Hope Creek - Red Lion (new)</td>
<td>Same as 7E with Hope Creek - Red Lion</td>
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<tr>
<td>P2013_1-7L</td>
<td>PSE&amp;G</td>
<td>$1,250</td>
<td>New Freedom - Smithburg &amp; Salem - Hope Creek - Red Lion 500 kV lines w/ Hope Creek - Red Lion (new)</td>
<td>Same as 7F with Hope Creek - Red Lion</td>
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<tr>
<td>P2013_1-7M</td>
<td>PSE&amp;G</td>
<td>$1,548</td>
<td>New Freedom - Whiptail (North) &amp; Salem - Hope Creek - Red Lion 500 kV lines w/ Hope Creek - Red Lion (new)</td>
<td>Same as 7H with Hope Creek - Red Lion</td>
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<tr>
<td>P2013_1-7N</td>
<td>PSE&amp;G</td>
<td>$1,289</td>
<td>New Freedom - a new Station on the Branchburg-Eltrog 500 kV line (&quot;5017 Junction&quot;) &amp; Salem-Hope Creek - Red Lion 500 kV lines w/ Hope Creek - Red Lion (new)</td>
<td></td>
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Artificial Island Feedback Received from 5/19/2014 Technical Review
Comments submitted by:

- Delaware PSC
- Dominion Virginia Power
- LS Power
- New Jersey BPU
- Atlantic Wind Connection
- PHI Exelon

- PSE&G
- PSE&G Nuclear
- State of Delaware Public Advocate
- Transource
Topics Raised by Commenters

• Alternative proposed which included a neutral reactor and a 500kV CB

• Benefits of TCSC to resolve operational performance issues

• Right of way acquisition: Impact of LDV ownership, private land vs non-private and new versus expansion

• PJM cost estimates: Incorporation of EoC estimates and missing cost components

• Constructability concerns: Submarine cable installation, salt spray, modifications to existing transmission facilities
Topics Raised by Commenters

- Environmental impact and permitting concerns: Supawna Meadows NWR, environmental management areas, Reedy Island dike, Sunken Ship Cove (NRHP), essential fish habitats and wetlands impacts

- Concerns with Delaware river crossing permitting

- Concerns with NRC review of FACTS devices impacting cost and schedule

- Concerns with cost allocation for the 230 kV solutions

- Non-incumbent ability to build transmission facilities in New Jersey and Delaware
• PHI/Exelon: Eliminate the need (and cost) for an SVC by:
  – Alternative # 1 - Install a 2% reactor in the neutral of the 500kV (wye grounded) side of the two Salem generator-step-up transformers (GSU) or Install a 1% neutral reactor to the 500kV side of the two Salem and the Hope Creek GSUs
  – Alternative # 2 - Employ a back-to-back circuit breaker scheme to interconnect the PHI/Exelon proposed 500kV line to the Salem Substation.

• PJM determined that the suggested modifications would only address phase to ground faults and there are three phase faults that would still be unstable and not improved by the back-to-back breakers or neutral reactors

• Reactors also have additional negative impacts that would need be considered
• Feedback at the 5/19/2014 AI Technical Review regarding the potential Hope Creek – Red Lion proposal

  – Transource was concerned that the potential Hope Creek – Red Lion transmission solution would not solve all stability requirements
  – Resolution: PJM worked with Transource to update their technical assumptions and this concern was found to not be an issue
Artificial Island Recommendation
Evaluation Considerations

• Performed extensive technical analysis
  – Stability, thermal, voltage, short circuit, market efficiency
  – Studied all solutions as is and with modifications

  *Initial analysis showed only two of the highest cost solutions worked as submitted*

• Engaged outside engineers to perform constructability review
  – focus on physical, cost, schedule, RoW, siting, permitting

• Met with all proposers for clarification as needed
• Met with AI nuclear plant representatives
• PJM Operations review
• PJM independent cost evaluation
• Met with equipment manufacturers
Evaluation Considerations

- **Primary Considerations**
  - Technical Analysis
    - Thermal
    - Stability
    - Short-circuit
    - Voltage
    - NERC Cat-D Contingencies
  - Permitting
  - Construction
  - Long lead time equipment
  - Line crossings
  - Outage requirements
  - Modifications to other transmission facilities
  - Modification to Artificial Island substations
  - Modifications to Red Lion substation

- **Secondary Considerations**
  - Schedule
    - Permitting
    - Construction
  - Project Complexity
    - Long lead time equipment
    - No eminent domain in Delaware
    - New right of way required
    - Substation land required

- **Cost Factors**
  - Cost effectiveness
  - Market efficiency
  - PJM estimated costs

- **Right of Way and Land Acquisition**
  - Wetlands impact
  - Public opposition risk
  - Delaware river crossing
  - Land permitting
  - Historic and scenic highway

- **Siting and Permitting**
  - Artificial island facility requirements
  - Ongoing maintenance
  - Blackstart
  - Route diversity
  - Performance
Determination of Proposal Short List

• Overall, there were 26 proposals
  – 2 projects passed the initial analytical screen without modification
  – Through evaluation of the various proposals, PJM staff found that many of the proposals could be made more effective and efficient with some modification and the addition of other components
  – Screened proposals (with the PJM modifications) based on performance and cost
Determination of Proposal Short List

- PJM focused on a short list of evaluations that included several projects in each of these four categories:
  - Southern Crossing – Submarine
  - Southern Crossing – Overhead
  - Salem to Red Lion 500 kV
  - Hope Creek to Red Lion 500 kV
AI Final Project Recommendation Approach

• Primary Considerations
  – Technical Analysis
  – Cost Factors
  – Project Schedule
All projects on the short list, with PJM modifications included, satisfied the required criteria including:

- Stability: Angle swing (including with AI generation at unity power factor)
- Load flow, short circuit, voltage, NERC cat-D contingencies

Additional analysis

- Market efficiency
- Additional reliability benefits
Projects Under Consideration

- LS Power 5A - Submarine Option
- Transource 2B - North Cedar Creek
- Transource 2A - Cedar Creek Expansion
- LS Power 5A - Overhead
- Dominion 1B - 500kV Overhead
- PHI/Exelon 4A - Red Lion to Salem
- LS Power 5B - Red Lion to Salem
- PSE&G 7K - Red Lion to Salem
- Transource 2C - Red Lion to Salem
- Dominion 1C - Red Lion to Salem
- Dominion Red Lion to Hope Creek with 2nd tie removed
- PSE&G Red Lion to Hope Creek with 2nd tie removed

Note: Estimated costs do not include the SVC cost estimate

PJM Estimated Project Costs
15-40% Contingency

 Millions of Dollars

- 450
- 400
- 350
- 300
- 250
- 200
• Permitting
  – Delaware River Crossing
    • Represents the greatest component of schedule risk for all projects
  – Land Permitting
    • All projects will face challenges
      – Red Lion to Artificial Island
        » Supawna Meadows National Wildlife Refuge
        » State wildlife management areas
      – Southern crossing lines
        » State wildlife management areas
    • Public opposition can be expected with all of the alternatives

• Siting and permitting for a new river crossing will be a major component in the project schedule for all projects under consideration
Differentiating Factors

- Evaluation of risks to cost and schedule
  - Project complexity
    - Modifications to Artificial Island
    - Line Crossings
    - Outage Requirements
• Modification of Artificial Island substations
  – Salem
    • Constrained with limited space for expansion. Proposed alternatives out of Salem would need to ensure continued maintenance access to station aux transformers
    • All protection and control equipment located inside the secure area of the generating station. There is limited spare conduit from the substation into the station for control wiring.
  – Hope Creek
    • Available land for expansion to the north
    • Protection and control equipment located in a separate control building in the substation.

• A new line from Hope Creek without impacts to Salem is considered more constructible
Project Complexity

• Line Crossings
  – All 500kV projects interconnecting at Salem substation included a line crossing
  – Line crossings create operational complexity and the potential for a multiple facility trip event
    • Referenced in NRC Regulations, General Design Criteria-17

• Solutions with no line crossings are preferable
• Outage Requirements
  – All projects require outages to support construction
  – 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
    • AI SPS
    • Coordination with planned generation and transmission outages

• A solution that minimizes outage requirements during construction is preferred
### Differentiating Factors

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Project Class</th>
<th>Southern Crossing 230kV Lines (Submarine)</th>
<th>Southern Crossing Lines (Overhead)</th>
<th>Red Lion to Salem 500kV Lines</th>
<th>Red Lion to Hope Creek 500kV Lines</th>
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<tbody>
<tr>
<td></td>
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<td>LS Power 5A - Submarine Option</td>
<td>LS Power 5A - 230kV Overhead</td>
<td>PHI/Exelon 4A - Red Lion to Salem</td>
<td>Dominion 1C - Red Lion to Hope Creek</td>
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<td>Transource 2B - North Cedar Creek</td>
<td>Transource 2A - Cedar Creek Expansion</td>
<td>LS Power 5B - Red Lion to Salem</td>
<td>PSE&amp;G 7K - Red Lion to Hope Creek</td>
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<td>Transource 2C - Red Lion to Salem</td>
<td>Dominon Red Lion to Hope Creek w/ 2nd tie removed</td>
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<td>PSE&amp;G Red Lion to Hope Creek w/ 2nd tie removed</td>
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<td>Proposal</td>
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<tr>
<th>Sub-Criteria</th>
<th>Project Complexity</th>
<th>Line Crossings</th>
<th>Outage Requirements</th>
<th>Modification of AI Subs</th>
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**Risks to Cost and Schedule**

- **Line Crossings**: Green indicates no risks, Yellow indicates minor risks, Red indicates major risks.
- **Outage Requirements**: Green indicates no risks, Yellow indicates minor risks, Red indicates major risks.
- **Modification of AI Subs**: Green indicates no risks, Yellow indicates minor risks, Red indicates major risks.
Additional Factors in Project Selection

- Artificial Island to Red Lion 500kV solutions are more robust and provide greater power transmission capacity as compared to the 230kV southern crossing solutions
  - Under normal system conditions, southern crossing solutions would provide little system support
  - Artificial Island to Red Lion 500kV solutions improve voltage drop for loss of 500kV facilities

- An Artificial Island to Red Lion 500 kV line is a more robust solution than a southern crossing line
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<td>Sub-Criteria</td>
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<td>Stability</td>
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<td>Market Efficiency Results</td>
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<td>Short Circuit</td>
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<td>Cost Factors</td>
<td>PJM Estimated Project Cost</td>
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<td>Project Costs as Proposed</td>
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<td>Project Complexity</td>
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<td>Wetlands Impact</td>
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<td>Land Permitting</td>
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<td>Public Opposition Risk</td>
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<td>Historic and Scenic Highway</td>
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<td>Delaware River Crossing</td>
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<td>Siting and Permitting</td>
<td>Artificial Island Facility Requirements</td>
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<td>Blackstart</td>
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<td>Route Diversity</td>
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<td>Ongoing Maintenance</td>
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**Technical Analysis**

- Stability: [Approximate 0.15 Benefit to Cost Ratio](#)
- Thermal: [Approximate 0.15 Benefit to Cost Ratio](#)
- Market Efficiency Results: [Approximate 0.2 Benefit to Cost Ratio](#)
- Short Circuit: [Approximate 0.2 Benefit to Cost Ratio](#)

**Cost Factors**

- PJM Estimated Project Cost: $248-$302
- Project Costs as Proposed: $148
- Market Efficiency: Approximately $92 over 15 years
- Outage Cost: Approximately $92 over 15 years

**Project Schedule**

- Permitting: [Dominion](#)
- Construction: [PSE&G](#)
- Long Lead Time Materials: [LS Power 5A - Submarine Option](#)

**Operational Impact**

- Artificial Island Facility Requirements: [Dominion](#)
- Blackstart: [Transource 2B - North Cedar Creek Expansion](#)
- Route Diversity: [Dominion 1C - Red Lion to Hope Creek](#)
- Ongoing Maintenance: [PSE&G Red Lion to Hope Creek](#)
• In consideration of all factors PJM staff will recommend for inclusion in the RTEP:
  – A new 500kV circuit from Hope Creek to Red Lion
Project Designation Differentiating Factor

• PSE&G and Dominion proposed solutions that included a new 500kV line from Red Lion to Hope Creek. FirstEnergy proposed a Red Lion to Hope Creek facility but declined construction designation.

• Right of Way Acquisition
  – The LDV agreement provides for usage of existing right of way along the recommended project path
    • PSE&G is a party to the LDV agreement
    • 8.5 miles of the right of way in New Jersey would need be expanded
  – Dominion will need to acquire right of way for the entire route of the line
• Assign designation of the Hope Creek – Red Lion 500 kV transmission line to PSE&G

• Assign the necessary connection facilities to accommodate the new transmission facility:
  – Red Lion 500kV station upgrade to PHI
  – Hope Creek 500kV station upgrade to PSE&G
SVC Considerations

• An SVC is a required component to achieve the necessary project performance
  – Locations at Artificial Island, Orchard and New Freedom were studied and all achieved the required performance

• New Freedom and Orchard locations have the lowest estimated cost and would not require construction at Artificial Island
SVC Differentiating Factors

- PSE&G New Freedom switching station has available property to accommodate the SVC

- New Freedom has stronger system ties to both the PJM 500kV and 230kV systems as compared to the Orchard location
• Construct an SVC at New Freedom 500 kV substation
  – Facilities design will determine the technical parameters

• Designate SVC upgrade at New Freedom to PSE&G
Artificial Island Recommendation

• At the Tuesday, July 22nd PJM Board meeting, PJM staff will recommend for inclusion in the RTEP:
  – Hope Creek to Red Lion 500 kV transmission line designated to PSE&G
    • Associated substation work at Hope Creek designated to PSE&G
    • Associated substation work at Red Lion designated to PHI
  – SVC at New Freedom 500 kV designated to PSE&G
Next Steps

• Detailed facility design
• Finalize review and recommendations on the protection issues raised around current directional carrier blocking scheme (DCB)

Note: Please supply any written comments to the PJM Board through RTEP@PJM.com
Appendix from Previous 5/19 Meeting
Artificial Island Problem Statement Summary

• Generate maximum power from the AI under both the baseline (N-0) and maintenance (N-1) assumptions

• Satisfy applicable planning criteria

Artificial Island Proposal Window Timeline

**Announcement**
- Announce window and potential timeline
- Request CEII/NDA submittals from anticipated participants
- Request Designated Entity Pre-Qualification

**PSS/E v32 Case Development**
Initial PSS/E v32 case created
- Benchmarking in Progress
- Develop and benchmark critical system condition cases

**Window Opened**
(4/29/2013 - 60 Day Duration)
- Open the "Artificial Island" RTEP Proposal Window
- Complete problem statement available
- Analytical files available

**Coordinate with Window Participants and Receive Solution Proposals**
- Coordination VIA www.pjm.com
- Data, Information
- Questions & Answers

**Proposal Window Closed on 6/28/2013**

**PJM Evaluates Solution Proposals**
Past Timeline

• 9/13/2012 – PJM discusses the Artificial Island with PJM Stakeholders
• March 2013 - TEAC Previewed conceptual timeline and next steps for an Artificial Island Proposal Window
• 4/29/2013 – Artificial Island Proposal Window Opened
• 6/28/2013 – Artificial Island Proposal Window Closed
• July 2013 through April 2014 – PJM discusses the details of project performance, cost and constructability
• 26 Proposals received from 7 individual entities

• **Cost Estimates:** Approximate range of $100 M to $1.5 B

• **Technology:** Static Var Compensator (SVC), Thyristor Controlled Series Compensation (TCSC), High Voltage Direct Current (HVDC) transmission line, (AC) transformers, (AC) overhead transmission line, underground/underwater cable transmission line, circuit breakers and associated protection equipment

• **Voltages:** 230 and 500kV

• **Station Connections:** Broad diversity of proposed methods to connect to existing stations or construct new stations as needed

• **Routing:** Wide variety of proposed methods to route new transmission over/under existing rights of way (ROW) or through new ROW
Artificial Island Project Proposal Overviews
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<td>$133</td>
<td>500 MVAR SVC near New Freedom</td>
<td>Two (2) Thyristor Controlled Series Compensation (TCSC) Devices near New Freedom</td>
</tr>
<tr>
<td>P2013_1-B</td>
<td>Virginia Electric and Power Comn</td>
<td>$126</td>
<td>New 500 kV from Salem - a new station in Delaware</td>
<td>New 500/230 kV station in Delaware that taps existing Cedar Creek - Red Lion 230kV and Catanza - Red Lion 230kV</td>
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<tr>
<td>P2013_1-C</td>
<td>Virginia Electric and Power Comn</td>
<td>$202</td>
<td>New 500 kV from Hope Creek - a new station in Delaware</td>
<td>Install a new 500 kV line from Hope Creek - Red Lion, New Salem-Hope Creek, 500 kV line</td>
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<tr>
<td>P2013_1-2A</td>
<td>Transource</td>
<td>$213 - $289</td>
<td>Salem - Cedar Creek 230 kV</td>
<td>Two (2) 500/230 Transformers near Salem, Loop in Red Lion - Cartanza 230 to Cedar Creek</td>
</tr>
<tr>
<td>P2013_1-2B</td>
<td>Transource</td>
<td>$165 - $208</td>
<td>Salem - North Cedar Creek (new) 230 kV</td>
<td>Two (2) 500/230 transformers near Salem and loop in Red Lion - Cartanza 230 and Red Lion - Cedar Creek 230 kV</td>
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<tr>
<td>P2013_1-2C</td>
<td>Transource</td>
<td>$123 - $156</td>
<td>Salem - Red Lion 500 kV</td>
<td>New Salem - Hope Creek 500 kV line and new 500/230 station east of Lumberton</td>
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<tr>
<td>P2013_1-2D</td>
<td>Transource</td>
<td>$788 - $934</td>
<td>New Freedom - Lumberton - North Smithsburg (New) 500 kV line</td>
<td>New Salem - Hope Creek 500 kV line and new 500/230 station east of Lumberton</td>
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<tr>
<td>P2013_1-3A</td>
<td>First Energy</td>
<td>$410.7</td>
<td>Only First Energy portion</td>
<td>First Energy-Smithburg 500 kV line with a loop into Larrabee</td>
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<tr>
<td>P2013_1-4A</td>
<td>PHI Enelon</td>
<td>$475</td>
<td>Peach Bottom - Keeney - Red Lion - Salem 500 kV</td>
<td>Remove Keeney - Red Lion 230 kV, Reconfigure 230 around Hay Road, Reconnector Harmony-Chapel St 138</td>
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<tr>
<td>P2013_1-5A</td>
<td>LS Power</td>
<td>$116.3M - $149.3M</td>
<td>Salem - Silver Run (new) 230 kV; Salem 500/230 kV Transformer</td>
<td>New 230 kV station that taps existing Cedar Creek - Red Lion 230kV and Catanza - Red Lion 230kV</td>
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<tr>
<td>P2013_1-5B</td>
<td>LS Power</td>
<td>$170</td>
<td>Salem - Red Lion 500 kV</td>
<td>New 230 kV station that taps existing Cedar Creek - Red Lion 230kV and Catanza - Red Lion 230kV</td>
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<tr>
<td>P2013_1-6A</td>
<td>Atlantic Wind</td>
<td>$1,012</td>
<td>320 kV HVDC Salem/Hope Creek - Cardiff</td>
<td>SVC at Salem/Hope Creek; New HVDC Stations at Cardiff and Salem</td>
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<tr>
<td>P2013_1-7A</td>
<td>PSE&amp;G</td>
<td>$1,371</td>
<td>Salem-Hope Creek to Peach Bottom 500 kV</td>
<td>Existing ROW</td>
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<tr>
<td>P2013_1-7B</td>
<td>PSE&amp;G</td>
<td>$1,372</td>
<td>Salem-Hope Creek to Peach Bottom 500 kV</td>
<td>Same as 7A with Loop into Keeney</td>
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<tr>
<td>P2013_1-7C</td>
<td>PSE&amp;G</td>
<td>$1,372</td>
<td>Salem-Hope Creek to Peach Bottom 500 kV</td>
<td>Same as 7A with Loop into Red Lion</td>
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<tr>
<td>P2013_1-7D</td>
<td>PSE&amp;G</td>
<td>$831</td>
<td>Salem-Hope Creek to Peach Bottom 500 kV</td>
<td>Same as 7A with New ROW</td>
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<tr>
<td>P2013_1-7E</td>
<td>PSE&amp;G</td>
<td>$692</td>
<td>New Freedom - Deans 500 &amp; Salem - Hope Creek 500 kV lines</td>
<td>New Freedom - Deans 500 &amp; Salem - Hope Creek 500 kV lines</td>
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<tr>
<td>P2013_1-7F</td>
<td>PSE&amp;G</td>
<td>$873</td>
<td>New Freedom - Smithburg and Salem-Hope Creek 500 kV lines</td>
<td>New Freedom - Smithburg and Salem-Hope Creek 500 kV lines</td>
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<tr>
<td>P2013_1-7G</td>
<td>PSE&amp;G</td>
<td>$1,034</td>
<td>New Freedom - Smithburg and Salem-Hope Creek 500 kV lines</td>
<td>Same as 7F with a Loop into a new Larrabee 500 kV station</td>
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<tr>
<td>P2013_1-7H</td>
<td>PSE&amp;G</td>
<td>$1,177</td>
<td>New Freedom - Whiptail and Salem - Hope Creek 500 kV lines</td>
<td>New Freedom - Whiptail and Salem - Hope Creek 500 kV lines</td>
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<tr>
<td>P2013_1-7I</td>
<td>PSE&amp;G</td>
<td>$1,353</td>
<td>New Freedom - Whiptail and Salem - Hope Creek 500 kV lines</td>
<td>New Freedom - Whiptail and Salem - Hope Creek 500 kV lines</td>
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<tr>
<td>P2013_1-7J</td>
<td>PSE&amp;G</td>
<td>$915</td>
<td>New Freedom - New Station on Branchburg-Eloy 500 kV line (&quot;5017 Junction&quot;) and Salem - Hope Creek 500 kV line</td>
<td>New Freedom - New Station on Branchburg-Eloy 500 kV line (&quot;5017 Junction&quot;) and Salem - Hope Creek 500 kV line</td>
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<tr>
<td>P2013_1-7K</td>
<td>PSE&amp;G</td>
<td>$1,069</td>
<td>New Freedom - Deans &amp; Salem - Hope Creek - Red Lion 500 kV lines w/ Hope Creek - Red Lion (new)</td>
<td>Same as 7E with Hope Creek - Red Lion</td>
</tr>
<tr>
<td>P2013_1-7L</td>
<td>PSE&amp;G</td>
<td>$1,250</td>
<td>New Freedom - Smithburg &amp; Salem - Hope Creek - Red Lion 500 kV lines w/ Hope Creek - Red Lion (new)</td>
<td>Same as 7E with Hope Creek - Red Lion</td>
</tr>
<tr>
<td>P2013_1-7M</td>
<td>PSE&amp;G</td>
<td>$1,548</td>
<td>New Freedom - Whiptail (North) &amp; Salem - Hope Creek - Red Lion 500 kV lines w/ Hope Creek - Red Lion (new)</td>
<td>Same as 7F with Hope Creek - Red Lion</td>
</tr>
<tr>
<td>P2013_1-7N</td>
<td>PSE&amp;G</td>
<td>$1,289</td>
<td>New Freedom - new Station on the Branchburg-Eloy 500 kV line (&quot;5017 Junction&quot;) &amp; Salem-Hope Creek - Red Lion 500 kV lines w/ Hope Creek - Red Lion (new)</td>
<td>Same as 7H with Hope Creek - Red Lion</td>
</tr>
</tbody>
</table>
• New switching station cutting the 5023 and 5024 lines near New Freedom substation that includes
  – a 500kV SVC (+500 to -300 MVAr )
  – Two Thyristor Controlled Series Compensation (TCSC) devices

• Proposed Cost Estimate: $130MM
• Install a new 500kV line from Salem 500kV to a new station in Delaware

• Aerial crossing of the Delaware river

• New substation in Delaware that taps the existing Red Lion to Cartanza 230kV and Red Lion to Cedar Creek 230kV lines

• Proposed Cost Estimate: $133MM
• Expansion of Hope Creek substation

• 17 mile 500kV line from Hope Creek to Red Lion
  – Parallels existing 5015 Red Lion to Hope Creek 500 kV line

• Second Hope Creek to Salem tie line

• Reconfiguration of Red Lion substation into a breaker and a half scheme

• Proposed Cost Estimate: $199MM
• Expansion of the Salem substation

• New substation near Artificial Island with two 500/230 kV autotransformers

• Submarine line under the Delaware river

• Expand existing Cedar Creek substation to accept the new line and to loop in the Red Lion – Cartanza 230kV line

• Proposed Cost Estimate: $213-$269MM
• 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

• Proposed Cost Estimate: $165-$208MM
• Expansion of Salem substation

• Move 5024 and 5021 line bays within Salem substation

• 17 mile 500kV line from Red Lion to Salem
  – Parallels existing 5015 Red Lion to Hope Creek 500 kV line

• Reconfiguration of Red Lion substation into a breaker and a half scheme

• Proposed Cost Estimate: $123-$156MM
• Install a new 500kV line from New Freedom to Lumberton to North Smithburg

• New 500/230 substation east of Lumberton

• Second Hope Creek to Salem 500kV tie line

• Proposed Cost Estimate: $788-$994MM
FirstEnergy 3A

- Install a new, New Freedom to Smithburg 500kV line with a loop into Larrabee substation
- Install two new 500/230 auto-transformers at Larrabee
- 17 mile 500kV line from Hope Creek to Red Lion
  - Parallels existing 5015 Red Lion to Hope Creek 500 kV line
- Proposed Cost Estimate: $452MM
• Install a new Peach Bottom to Keeney to Red Lion to Salem 500kV line
• Remove existing Keeney to Red Lion 230 kV circuit
• Reconfigure the existing 230 kV line from Hay Road to Red Lion to terminate at Keeney instead of Red Lion
• Re-conductor the Harmony to Chapel Street 138 kV line
• Proposed Cost Estimate: $475MM
• Expansion of the Salem substation to the south to include a new 500/230kV auto-transformer

• Submarine or aerial line over 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

• Proposed Cost Estimate: $116 - $148MM
• Expansion of Salem substation

• 17 mile 500kV line from Red Lion to Salem
  – Parallels existing 5015 Red Lion to Hope Creek 500 kV line

• Expansion of Red Lion substation ring-bus

• Proposed Cost Estimate: $170MM
• Install a HVDC converter station near the Artificial Island
  – Install a SVC at the new Artificial Island HVDC station

• Install a HVDC converter station near the existing Cardiff 230 kV

• Install a 320kV HVDC line from the new Artificial Island HVDC station and the new HVDC station near Cardiff 230kV

• Proposed Cost Estimate: $1,012MM
• Second Salem to Hope Creek tie line

• Install a new Hope Creek to Peach Bottom 500 kV line on existing right of way

• Proposed Cost Estimate: $1,371MM
• Second Salem to Hope Creek tie line

• Install a new Hope Creek to Keeney to Peach Bottom 500 kV line on existing right of way

• Tie 5036 and 5025 lines together to open a bay position at Keeney substation

• Proposed Cost Estimate: $1,372MM
• Second Salem to Hope Creek tie line

• Install a new Hope Creek to Red Lion to Peach Bottom 500 kV line on existing right of way

• Tie 5036 and 5015 lines together to open a bay position at Red Lion substation

• Proposed Cost Estimate: $1,372MM
• Second Salem to Hope Creek tie line

• Install a new Hope Creek to Peach Bottom 500 kV line on new right of way

• Proposed Cost Estimate: $831MM
- Second Salem to Hope Creek tie line
- Install a new 500kV line Deans to New Freedom
- Proposed Cost Estimate: $692MM
• Second Salem to Hope Creek tie line

• Install a new Smithburg to New Freedom 500kV line

• Proposed Cost Estimate: $879MM
• Second Salem to Hope Creek tie line

• Install a new Smithburg to Larrabee to New Freedom 500kV line

• Expand Larrabee substation to accept the new 500kV connection

• Proposed Cost Estimate: $1,034MM
• Second Salem to Hope Creek tie line

• Install a new Whitpain to New Freedom 500kV line using a northern route

• Proposed Cost Estimate: $1,177MM
• Second Salem to Hope Creek tie line

• Install a new Whitpain to New Freedom 500kV line using a southern route

• Proposed Cost Estimate: $1,353MM
- Second Salem to Hope Creek tie line
- New substation at the 5017 junction site cutting the 5017 Elroy to Branchburg line
- Install a new 5017 Junction to New Freedom 500kV line
- Proposed Cost Estimate: $915MM
• Second Salem to Hope Creek tie line

• 17 mile 500kV line from Hope Creek to Red Lion
  – Parallels existing 5015 Red Lion to Hope Creek 500 kV line

• Install a new Deans to New Freedom 500kV line

• Proposed Cost Estimate: $1,066MM
- Second Salem to Hope Creek tie line
- 17 mile 500kV line from Hope Creek to Red Lion
  - Parallels existing 5015 Red Lion to Hope Creek 500 kV line
- Install a new Smithsburg to New Freedom 500kV line
- Proposed Cost Estimate: $1,250MM
• Second Salem to Hope Creek tie line

• 17 mile 500kV line from Hope Creek to Red Lion
  – Parallels existing 5015 Red Lion to Hope Creek 500 kV line

• Install a new Whitpain to New Freedom 500kV line using a northern route

• Proposed Cost Estimate: $1,548MM
• Second Salem to Hope Creek tie line

• 17 mile 500kV line from Hope Creek to Red Lion
  – Parallels existing 5015 Red Lion to Hope Creek 500 kV line

• New substation at the 5017 junction site cutting the 5017 Elroy to Branchburg line

• Install a new 5017 Junction to New Freedom 500kV line

• Proposed Cost Estimate: $1,289MM
Artificial Island Project Evaluation
Objectives

✓ Achieve desired system performance
✓ Minimize initial project cost
✓ Assess risk factors to minimize impact to cost and schedule
✓ Minimize impact to transmission operations
✓ No adverse impact to nuclear licensing
Evaluation of Proposals – PJM Approach

• Performed extensive technical analysis
  – Stability, thermal, voltage, short circuit, market efficiency
  – Studied all solutions as is and with modifications

  *Initial analysis showed only two of the highest cost solutions worked as submitted*

• Engage outside engineers to perform constructability review
  – focus on physical, cost, schedule, RoW, siting, permitting

• Met with all proposers for clarification as needed
• Met with AI nuclear plant representatives
• PJM Operations review
• PJM independent cost evaluation
• Met with equipment manufacturers
Artificial Island Evaluation Considerations

- **Primary Considerations**
  - Technical Analysis
    - Thermal
    - Stability
    - Short-circuit
  - Voltage
  - NERC Cat-D Contingencies

- **Secondary Considerations**
  - Schedule
    - Permitting
    - Construction
  - Project Complexity
    - Line crossings
    - Outage requirements
    - Modifications to other transmission facilities
    - Long lead time equipment
    - Modification to Artificial Island substations
    - Modifications to Red Lion substation

- **Cost Factors**
  - Cost effectiveness
  - Market efficiency
  - PJM estimated costs

- **Right of Way and Land Acquisition**
  - No eminent domain in Delaware
  - 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
Project Modifications
• Identified and implemented by PJM

• Modification Examples to Improve Performance
  – Move connection point to eliminate a critical fault
  – Add SVC to improve stability performance

• Modification Examples to reduce cost and improve constructability
  – Remove proposed new breakers that aren’t needed to pass applicable criteria testing
  – Remove proposed transmission that isn’t needed to pass applicable criteria testing
# Modification Summary

<table>
<thead>
<tr>
<th>Modifications</th>
<th>Southern Crossing Lines (Submarine)</th>
<th>Southern Crossing Lines (Overhead)</th>
<th>Red Lion to Artificial Island Lines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LS Power 5A - Submarine Option</td>
<td>LS Power 5A - Overhead</td>
<td>From Salem</td>
</tr>
<tr>
<td></td>
<td>Transource 2B - North Cedar Creek</td>
<td>PHI/Exelon 4A - Red Lion to Salem</td>
<td>From Hope Creek</td>
</tr>
<tr>
<td></td>
<td>Transsource 2A - Cedar Creek</td>
<td>LS Power 5B - Red Lion to Salem</td>
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<tr>
<td></td>
<td>Expansion</td>
<td>Transource 2C - Red Lion to Salem</td>
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<tr>
<td>SVC Additions at Orchard, NF, AI</td>
<td>✓</td>
<td>✓</td>
<td>✓ *</td>
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<tr>
<td>Moved Connection At Salem or Hope Creek</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Removed proposed breakers</td>
<td>✓</td>
<td></td>
<td>✓ *</td>
</tr>
<tr>
<td>Removed proposed Transmission</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* SVC option at AI is excluded.
PJM Evaluation of Potential Solutions
• New switching station cutting New Freedom to Hope Creek and New Freedom to Salem (5023 and 5024) lines. Two Thyristor Controlled Series Compensation (TCSC) devices at the new station.

• PJM modifications
  – Changed SVC size
• Stability Performance
  – Failed required performance
    • Failed as proposed by project sponsor. Did not satisfy stability criteria for a three phase fault with normal clearing with AI units at unity power factor under 5038 maintenance outage condition
  – Passed required performance when SVC size increased to 750MVAr to achieve acceptable performance.
  – Stability performance is not as good as 230kV options + SVC or as good as 500kV options + SVC.
  – Anticipate nuclear regulatory concerns in approving this configuration.
• Lines between:
  – New Freedom to Lumberton
  – Lumberton to North Smithburg
  – Hope Creek to Salem tie

• Estimated costs higher than other proposals
FirstEnergy 3A

- Lines between:
  - Smithburg to Larrabee
  - Larrabee to New Freedom
  - Hope Creek to Red Lion

- Estimated costs higher than other proposals
• HVDC line between Artificial Island and Cardiff

• SVC at Artificial Island converter station

• Estimated costs higher than other proposals
Atlantic Wind 6A – Technical Analysis

• Stability Performance

  – Failed required performance
    • Failed as proposed by project sponsor.
    • Did not satisfy stability criteria for a SLG fault with stuck breaker with AI units at unity power factor under 5015 maintenance outage condition without significant MW flow on the proposed HVDC facility from the AI to Cardiff.
• Lines between:
  – Salem to Hope Creek tie
  – Hope Creek to Peach Bottom (existing right of way)

• Estimated costs higher than other proposals
• Lines between:
  – Salem to Hope Creek tie
  – Hope Creek to Keeney
  – Keeney to Peach Bottom
  – Remove Keeney from existing Rock Springs to Keeney to Red Lion lines (5025 and 5036)

• Estimated costs higher than other proposals
• Lines between:
  – Salem to Hope Creek tie
  – Hope Creek to Red Lion
  – Red Lion to Peach Bottom
  – Remove Red Lion from existing Keeney to Red Lion to Hope Creek lines (5036 and 5015)

• Estimated costs higher than other proposals
• Lines between:
  – Salem to Hope Creek tie
  – Hope Creek to Peach Bottom (new right of way)

• Estimated costs higher than other proposals
• Lines between:
  – Salem to Hope Creek tie
  – Deans to New Freedom

• Estimated costs higher than other proposals
• Lines between:
  – Salem to Hope Creek tie
  – Smithburg to New Freedom

• Estimated costs higher than other proposals
• Lines between:
  – Salem to Hope Creek tie
  – Smithburg to Larrabee
  – Larrabee to New Freedom

• Estimated costs higher than other proposals
- Lines between:
  - Salem to Hope Creek tie
  - Whitpain to New Freedom (northern route)

- Estimated costs higher than other proposals
• Lines between:
  – Salem to Hope Creek tie
  – Whitpain to New Freedom (northern route)

• Estimated costs higher than other proposals
• Lines between:
  - Salem to Hope Creek tie
  - Whitpain to New Freedom (southern route)

• Estimated costs higher than other proposals
• Lines between:
  – Salem to Hope Creek tie
  – 5017 Junction (cutting the 5017 Elroy to Branchburg line) to New Freedom

• Estimated costs higher than other proposals
• Lines between:
  – Salem to Hope Creek tie
  – Hope Creek to Red Lion
  – New Smithburg to New Freedom

• Estimated costs higher than other proposals
• Lines between:
  – Salem to Hope Creek tie
  – Hope Creek to Red Lion
  – Whitpain to New Freedom (northern route)

• Estimated costs higher than other proposals
- Lines between:
  - Salem to Hope Creek tie
  - Hope Creek to Red Lion
  - 5017 Junction (cutting the 5017 Elroy to Branchburg line) to New Freedom

- Estimated costs higher than other proposals
Submarine Southern Delaware Crossing Lines

- Expansion of the Salem substation to the south
- Submarine line under the Delaware river
- New or expansion of existing substation in Delaware
- Proposing Entities:
  - Transource
  - LS Power
• Line between new substation near Artificial Island and Cedar Creek substation

• Submarine under the Delaware river

• PJM modifications
  – Technical:
    • Added SVC
  – Constructability:
    • Spare submarine cable added
    • New Salem connection as a full bay
Transource (AEP) 2A – Technical Analysis

• Stability Performance

  – Failed required performance
    • Failed as proposed by project sponsor
    • Did not satisfy stability criteria for a single line to ground fault with stuck breaker with AI units at unity power factor under 5015 maintenance outage condition.

  – Passed required performance
    • Passed when modified with the addition of an SVC at Orchard, New Freedom or Artificial Island
Artificial Island

Transource (AEP) 2A
Salem Expansion

Proposed new 500/230kV substation
• Two 500/230kV auto-transformers

New bay for 5024 line
• No aerial line crossings
• Outages for final tie in
- Submarine cable under Delaware River
- 1.5 – 3 mile aerial line in Delaware
- Cedar Creek substation modifications includes:
  - Expanding the ring bus by two positions bringing in the new Salem line and the existing Red Lion to Cartanza line
Transource (AEP) 2A - Cost Factors

PJM Estimated Cost: $366-$446 (million)
- 5.7 circuit miles of submarine cable (two cables per phase plus one spare cable)
- Six 500/230kV auto-transformers

Proposed Cost Estimate: $213-269 (million)

Market Efficiency Analysis Sensitivity Study
- Scenario:
  - New path from the AI to Delaware (on the Cedar Creek - Catanza / Red Lion – Catanza path)
- Results:
  - Approximate benefit to cost ratio of 0.25
  - Approximately $92 million over 15 years

Outage Cost
- 230kV outage during substation cut-in
Proposed Schedule 42 months (items run concurrent)

- Permitting: 24 months
- RoW acquisition: 12 months

Schedule Criteria

- Permitting
  - CPCNs in two states and Army Corps of Engineers
- Long Lead Time Materials
  - Auto-transformers and submarine cable

- Construction
  - Specialized equipment needed for submarine cable installation
  - Could be impacted by restrictions due to endangered species and shipping traffic
Right of Way and Land Acquisition Criteria

- No Eminent Domain in Delaware
  - Approximately 3 miles of right of way needs to be acquired in Delaware

- New Right of Way Required
  - Approximately 3 miles of right of way needs to be acquired in Delaware

- Substation Land Required
  - Land in New Jersey will need to be acquired for the new substations
Siting and Permitting Criteria

• Wetlands Impact
  – Permits required to cross the Delaware state lands on the river coast
  – Impacts approximately 10 acres of forested wetlands

• Public Opposition Risk
  – Submarine crossing of the Delaware river does not incur any new view-shed impact
  – Some opposition to any river crossing is expected

• Historic and Scenic Highway
  – Not applicable

• Delaware River Crossing
  – Numerous approvals and permits required: (a few major permits are listed below)
    – Delaware River Basin Commission approval required
    – Delaware and New Jersey CPCNs required
    – US Army Corps of Engineers Section 404 and 10 authorizations
    – Multiple US Fish and Wildlife permits required
    – National Marine Fisheries Service
Operational Impact Criteria

- **Artificial Island Facility Requirements**
  - PJM Operations Review
    - Request to minimize impact to existing transmission facilities
  - Salem/Hope Creek Facility Owner Feedback
    - Request to minimize outage and physical impacts to existing transmission facilities
    - Salem is space constrained so expansion needs to incorporate maintenance access to substation equipment
    - Salem control house is a part of plant facilities and access is constrained

- **Blackstart**
  - 230kV connection may provide additional benefit

- **Route Diversity**
  - Project route is new and does not parallel an existing line

- **Ongoing Maintenance**
  - Auto-transformers as line component may increase outage frequency
  - Salt spray concern with proximity to Delaware river
• Line between new substation near Artificial Island and new substation in Delaware

• Submarine under the Delaware river

• PJM modifications
  – Technical:
    • Added SVC
  – Constructability:
    • Spare submarine cable added
    • New Salem connection as a full bay
• Stability Performance

  – Failed required performance
    • Failed as proposed by project sponsor.
    • Did not satisfy stability criteria for a single line to ground fault with stuck breaker with AI units at unity power factor under 5015 maintenance outage condition.

  – Passed required performance
    • Passed as proposed with the addition of an SVC at Orchard, New Freedom or Artificial Island
Artificial Island

Transource (AEP) 2B
Salem Expansion

Proposed new 500/230kV substation
• Two 500/230kV auto-transformers

New bay for 5024 line
• No aerial line crossings
• Outages for final tie in
• Approximately 3 mile submarine cable under Delaware River
• 1.5 – 3 mile aerial line in Delaware
• New substation in Delaware cut in two existing 230kV lines
PJM Estimated Cost: $257-$313 (million)
- Approximately 3 miles of submarine cable (two cables per phase plus one spare cable)
- Six 500/230kV auto-transformers

Proposed Cost Estimate: $165-$208 (million)

Market Efficiency Analysis Sensitivity Study
- Scenario:
  - New path from the AI to Delaware (on the Cedar Creek - Catanza / Red Lion – Catanza path)
- Results:
  - Approximate benefit to cost ratio of 0.25
  - Approximately $92 million over 15 years

Outage Cost
- 230kV outage during substation cut-in
Proposed Schedule 42 months (items run concurrent)

- Permitting: 30 months
- RoW acquisition: 9 months

Schedule Criteria

- Permitting
  - CPCNs in two states and Army Corps of Engineers

- Long Lead Time Materials
  - Auto-transformers and submarine cable

- Construction
  - Specialized equipment needed for submarine cable installation
  - Could be impacted by restrictions due to endangered species and shipping traffic
Right of Way and Land Acquisition Criteria

• No Eminent Domain in Delaware
  – 1.5 to 3 miles of right of way needs to be acquired in Delaware

• New Right of Way Required
  – 1.5 to 3 miles of right of way needs to be acquired in Delaware

• Substation Land Required
  – Land in Delaware and New Jersey will need to be acquired for the new substations
Siting and Permitting Criteria

• Wetlands Impact
  – Permits required to cross the Delaware state lands on the river coast
  – New route will allow flexibility

• Public Opposition Risk
  – Submarine crossing of the Delaware river does not incur any new view-shed impact
  – Some opposition to any river crossing is expected

• Historic and Scenic Highway
  – Proposed line route crosses Delaware state route 9, which is classified as a "Scenic and Historic" highway which may impact permitting

• Delaware River Crossing
  – Numerous approvals and permits required:
    (a few major permits are listed below)
    – Delaware River Basin Commission approval required
    – Delaware and New Jersey CPCNs required
    – US Army Corps of Engineers Section 404 and 10 authorizations
    – Multiple US Fish and Wildlife permits required
    – National Marine Fisheries Service
Transource (AEP) 2B - Operational Impact

Operational Impact Criteria

• Artificial Island Facility Requirements
  – PJM Operations Review
    • Request to minimize impact to existing transmission facilities
  – Salem/Hope Creek Facility Owner Feedback
    • Request to minimize outage and physical impacts to existing transmission facilities
    • Salem is space constrained so expansion needs to incorporate maintenance access to substation equipment
    • Salem control house is a part of plant facilities and access is constrained

• Blackstart
  – 230kV connection may provide additional benefit

• Route Diversity
  – Project route is new and does not parallel an existing line

• Ongoing Maintenance
  – Auto-transformers as line component may increase outage frequency
  – Salt spray concern with proximity to Delaware river
LS Power 5A (Submarine)

- Line between Salem and new substation in Delaware

- Submarine under the Delaware river

- PJM modifications
  - Technical:
    - Added SVC
  - Constructability:
    - Spare transformer phase added
    - Spare submarine cable added
LS Power 5A (Submarine) – Technical Analysis

• Stability Performance

  – Failed required performance
    • Failed as proposed by project sponsor.
    • Did not satisfy stability criteria for a three phase fault with Al units at unity power factor under 5015 maintenance outage condition.

  – Passed required performance
    • Passed as proposed with the addition of an SVC at Orchard, New Freedom or Artificial Island
Artificial Island
LS Power – Proposal 5A
Salem Expansion

New 500kV bay and 500/230kV autotransformer in Salem substation
- No aerial line crossings
- Outages for final tie in

Proposed 500/230kV Salem Expansion
- Approximately 3 mile submarine cable under Delaware River
- 1.5 – 3 mile aerial line in Delaware
- New substation in Delaware cut in two existing 230kV lines
LS Power 5A (Submarine) - Cost Factors

PJM Estimated Cost: $248 - $311 (million)
- 3.3 circuit miles of submarine cable (two cables per phase plus one spare cable)
- Four 500/230kV auto-transformers

Proposed Cost Estimate: $148 (million)

Market Efficiency Analysis Sensitivity Study
- Scenario:
  - New path from the AI to Delaware (on the Cedar Creek - Catanza / Red Lion – Catanza path)
- Results:
  - Approximate benefit to cost ratio of 0.25
  - Approximately $92 million over 15 years

Outage Cost
- 230kV outage during substation cut-in
Proposed Schedule 42 months (items run concurrent)

- Permitting: 30 months
- RoW acquisition: 9 months

Schedule Criteria

- Permitting
  - CPCNs in two states and Army Corps of Engineers

- Long Lead Time Materials
  - Auto-transformers and submarine cable

- Construction
  - Specialized equipment needed for submarine cable installation
  - Could be impacted by restrictions due to endangered species and shipping traffic
Right of Way and Land Acquisition Criteria

• No Eminent Domain in Delaware
  – 1.5 to 3 miles of right of way needs to be acquired in Delaware

• New Right of Way Required
  – 1.5 to 3 miles of right of way needs to be acquired in Delaware

• Substation Land Required
  – Has acquired an option on a site for the proposed new switching station in Delaware
Siting and Permitting Criteria

• Wetlands Impact
  – Permits required to cross the Delaware state lands on the river coast
  – New route will allow flexibility

• Public Opposition Risk
  – Submarine crossing of the Delaware river does not incur any new view-shed impact
  – Some opposition to any river crossing is expected

• Historic and Scenic Highway
  – Proposed line route parallels Delaware state route 9, which is classified as a “Scenic and Historic” highway which may impact permitting

• Delaware River Crossing
  – Numerous approvals and permits required:
    (a few major permits are listed below)
    – Delaware River Basin Commission approval required
    – Delaware and New Jersey CPCNs required
    – US Army Corps of Engineers Section 404 and 10 authorizations
    – Multiple US Fish and Wildlife permits required
    – National Marine Fisheries Service
Operational Impact Criteria

- **Artificial Island Facility Requirements**
  - PJM Operations Review
    - Request to minimize impact to existing transmission facilities
  - Salem/Hope Creek Facility Owner Feedback
    - Request to minimize outage and physical impacts to existing transmission facilities
    - Salem is space constrained so expansion needs to incorporate maintenance access to substation equipment
    - Salem control house is a part of plant facilities and access is constrained

- **Blackstart**
  - 230kV connection may provide additional benefit

- **Route Diversity**
  - Project route is new and does not parallel an existing line

- **Ongoing Maintenance**
  - Auto-transformers as line component may increase outage frequency
  - Salt spray concern with proximity to Delaware river
Overhead Southern Delaware Crossing Lines

- Expansion of the Salem substation to the south
- Aerial line over the Delaware river
- New substation in Delaware
- Proposing Entities:
  - Dominion
  - LS Power
• Line between Salem and new substation in Delaware

• Aerial crossing of the Delaware river

• PJM modifications
  – Technical:
    • Added SVC
  – Constructability:
Dominion Virginia Power (DVP) 1B – Technical Analysis

- Stability Performance

  - Failed required performance
    - Failed as proposed by project sponsor.
    - Failed with modification to remove proposed breakers.
    - Did not satisfy stability criteria for a three phase fault with AI units at unity power factor under 5015 maintenance outage condition.
    - Did not satisfy stability criteria for a three phase fault with AI units at unity power factor under 5015 maintenance outage condition with modification to remove proposed breakers.

  - Passed required performance
    - Passed as modified with the addition of an SVC at Orchard, New Freedom or Artificial Island.
New 500kV bay with two breakers in Salem substation
- Aerial line impact to generator lead
- Generator lead proximity will require unit outage for final tie in
- Breaker installation may require multiple Salem outages
Approximately 3 mile aerial line over the Delaware River
1.5 – 3 mile aerial line in Delaware
New substation in Delaware cut in two existing 230kV lines
Dominion Virginia Power (DVP) 1B- Cost Factors

PJM Estimated Cost: $233 - $283 (million)
• Six 500/230kV auto-transformers
• Aerial crossing of the Delaware River

Proposed Cost Estimate: $133 (million)

Market Efficiency Analysis Sensitivity Study
• Scenario:
  – New path from the AI to Delaware (on the Cedar Creek - Catanza / Red Lion – Catanza path)
• Results:
  • Approximate benefit to cost ratio of 0.25
  • Approximately $92 million over 15 years

Outage Cost
• 230kV outage during substation cut-in
Dominion Virginia Power (DVP) 1B - Project Schedule

Proposed Schedule 93 months (items run concurrent)
- Permitting: 50 months
- RoW acquisition: 56 months

Schedule Criteria
- Permitting
  - CPCNs in two states and Army Corps of Engineers
- Long Lead Time Materials
  - Auto-transformers
- Construction
  - Could be impacted by restrictions due to endangered species and shipping traffic
Right of Way and Land Acquisition Criteria

• No Eminent Domain in Delaware
  – 1.5 to 3 miles of right of way needs to be acquired in Delaware

• New Right of Way Required
  – 1.5 to 3 miles of right of way needs to be acquired in Delaware

• Substation Land Required
  – Land in Delaware will need to be acquired for the new substation
Siting and Permitting Criteria

• Wetlands Impact
  – Permits required to cross the Delaware state lands on the river coast
  – New route will allow flexibility

• Public Opposition Risk
  – Aerial crossing of the Delaware river would create a new view-shed impact
  – Some opposition to any river crossing is expected

• Historic and Scenic Highway
  – Proposed line route parallels Delaware state route 9, which is classified as a “Scenic and Historic” highway which may impact permitting

• Delaware River Crossing
  – Numerous approvals and permits required:
    (a few major permits are listed below)
    – Delaware River Basin Commission approval required
    – Delaware and New Jersey CPCNs required
    – US Army Corps of Engineers Section 404 and 10 authorizations
    – Multiple US Fish and Wildlife permits required
    – National Marine Fisheries Service
Dominion Virginia Power (DVP) 1B - Operational Impact

Operational Impact Criteria

- **Artificial Island Facility Requirements**
  - PJM Operations Review
    - Request to minimize impact to existing transmission facilities
  - Salem/Hope Creek Facility Owner Feedback
    - Request to minimize outage and physical impacts to existing transmission facilities
    - Salem is space constrained so expansion needs to incorporate maintenance access to substation equipment
    - Salem control house is a part of plant facilities and access is constrained

- **Blackstart**
  - 500kV connection may provide additional benefit

- **Route Diversity**
  - Project route is new and does not parallel an existing line

- **Ongoing Maintenance**
  - Auto-transformers as line component may increase outage frequency
• Line between Salem and new substation in Delaware

• Aerial crossing of the Delaware river

• PJM modifications
  – Technical:
    • Added SVC
  – Constructability:
    • Spare transformer phase added
LS Power 5A (Overhead) – Technical Analysis

• Stability Performance

  – Failed required performance
    • Failed as proposed by project sponsor.
    • Did not satisfy stability criteria for a three phase fault with AI units at unity power factor under 5015 maintenance outage condition.

  – Passed required performance
    • Passed as proposed with the addition of an SVC at Orchard, New Freedom or Artificial Island.
Artificial Island
LS Power (Aerial) 5A
Salem Expansion

New 500kV bay and 500/230kV autotransformer in Salem substation
- No aerial line crossings
- Two bus outages for final tie in

Red Lion (5015)
New Freedom (5023)
Hope Creek (5037)
Orchard (5021)
New Freedom (5024)
Proposed
500/230kV
Salem Expansion

PJM TEAC - Artificial Island 06/16/2014
• Approximately 3 mile aerial line over the Delaware River
• 1.5 – 3 mile aerial line in Delaware
• New substation in Delaware cut in two existing 230kV lines
LS Power 5A (Aerial) - Cost Factors

PJM Estimated Cost: $211 - $257 (million)
- Four 500/230kV auto-transformers
- Aerial Delaware river crossing

Proposed Cost Estimate: $116 (million)

Market Efficiency Analysis Sensitivity Study
- Scenario:
  - New path from the AI to Delaware (on the Cedar Creek - Catanza / Red Lion – Catanza path)
- Results:
  - Approximate benefit to cost ratio of 0.25
  - Approximately $92 million over 15 years

Outage Cost
- 230kV outage during substation cut-in
Proposed Schedule 42 months (items run concurrent)

- Permitting: 30 months
- RoW acquisition: 9 months

Schedule Criteria

- Permitting
  - CPCNs in two states and Army Corps of Engineers

- Long Lead Time Materials
  - Auto-transformers

- Construction
  - Could be impacted by restrictions due to endangered species and shipping traffic
Right of Way and Land Acquisition Criteria

- **No Eminent Domain in Delaware**
  - Has acquired an option on a site for the proposed new switching station in Delaware
  - 1.5 to 3 miles of right of way needs to be acquired in Delaware

- **New Right of Way Required**
  - 1.5 to 3 miles of right of way needs to be acquired in Delaware

- **Substation Land Required**
  - Has acquired an option on a site for the proposed new switching station in Delaware
Siting and Permitting Criteria

• Wetlands Impact
  – Permits required to cross the Delaware state lands on the river coast
  – New route will allow flexibility

• Public Opposition Risk
  – Aerial crossing of the Delaware river would create a new view-shed impact
  – Some opposition to any river crossing is expected

• Historic and Scenic Highway
  – Proposed line route parallels Delaware state route 9, which is classified as a "Scenic and Historic" highway which may impact permitting

• Delaware River Crossing
  – Numerous approvals and permits required:
    (a few major permits are listed below)
    – Delaware River Basin Commission approval required
    – Delaware and New Jersey CPCNs required
    – US Army Corps of Engineers Section 404 and 10 authorizations
    – Multiple US Fish and Wildlife permits required
    – National Marine Fisheries Service
Operational Impact Criteria

**Artificial Island Facility Requirements**

- PJM Operations Review
  - Request to minimize impact to existing transmission facilities

- Salem/Hope Creek Facility Owner Feedback
  - Request to minimize outage and physical impacts to existing transmission facilities
  - Salem is space constrained so expansion needs to incorporate maintenance access to substation equipment
  - Salem control house is a part of plant facilities and access is constrained

**Blackstart**

- 230kV connection may provide additional benefit

**Route Diversity**

- Project route is new and does not parallel an existing line

**Ongoing Maintenance**

- Auto-transformers as line component may increase outage frequency
- Salt spray concern with proximity to Delaware river
• Expansion of Salem substation
• 17 mile 500kV line
• Parallels 5015 (Existing Red Lion – Hope Creek 500 kV)
• Proposing Entities:
  PHI/Exelon
  LS Power
  Transource
• New 500kV Line between Salem and Red Lion substations

• PJM modifications
  – Technical:
    • Analysis based on building only the Salem to Red Lion segment of proposed Salem to Peach Bottom proposal
    • Added SVC
  – Constructability:
    • Dead-end towers added around line crossing
    • New Salem connection as a full bay
• Stability Performance
  – Failed required performance
    • Failed as proposed by project sponsor.
    • Failed with modification to change connection point at Salem to bus bar #1 from #2.
    • Did not satisfy stability criteria for a single line to ground fault with stuck breaker with AI units at unity power factor under 5015 maintenance outage condition.
    • Did not satisfy stability criteria for a single line to ground fault with stuck breaker with AI units at unity power factor under 5015 maintenance outage condition with modification to change connection point at Salem to bus bar #1 from #2.
  – Passed required performance
    • Passed as modified with the addition of an SVC at Orchard, New Freedom or Artificial Island.
Artificial Island

PHI/Exelon 4A

Salem Expansion

Required Outages:
• Cut-in of new bay at Salem
• 5015 outage to cut over to new bays at Salem and Red Lion substations
• Raising the 5024, 5021 and 5023 lines at crossing points
Relocate 5015 to a new 500kV line terminal and add double breaker between lines.
PJM Estimated Cost: $216-$263 (million)
  • New 17 mile 500kV line
  • Aerial Delaware river crossing

Proposed Cost Estimate: $181 (million)

Market Efficiency Analysis Sensitivity Study
  – Scenario:
    • New 500 kV path from the AI to Red Lion
  – Results:
    • Approximate benefit to cost ratio of 0.15
    • Approximately $57 million over 15 years

Outage Cost
  • 5015 outage estimated at 30 days
Proposed Schedule 60 months (items run concurrent)

- Permitting: 34 months
- Design and Construction: 50 months
- Property Acquisition: 0 months

Schedule Criteria

- Permitting
  - CPCNs in two states and Army Corps of Engineers

- Long Lead Time Materials
  - No significant long lead time equipment required

- Construction
  - Could be impacted by restrictions due to endangered species and shipping traffic
Right of Way and Land Acquisition Criteria

• No Eminent Domain in Delaware
  – All project have approximately 0.5 miles of right of way to either expand or acquire in Delaware
    – Land is coastal and under state jurisdiction
    – Red Lion substation expansion is on land currently owned by PHI

• New Right of Way Required
  – As participants in the LDV agreement, party has a right of way agreement for the new line

• Substation Land Required
  – Red Lion substation expansion will be done on land currently owned by PHI.
Siting and Permitting Criteria

- **Wetlands Impact**
  - Permits required to cross the Delaware state lands on the river coast
  - Impacts approximately 350 acres of forested wetland

- **Public Opposition Risk**
  - View-shed impacts minimal as this is adjacent to the existing 5015
  - Some opposition to any river crossing is expected

- **Historic and Scenic Highway**
  - No impact

- **Delaware River Crossing**
  - Numerous approvals and permits required:
    - Delaware River Basin Commission approval required
    - Delaware and New Jersey CPCNs required
    - US Army Corps of Engineers Section 404 and 10 authorizations
    - Multiple US Fish and Wildlife permits required
    - National Marine Fisheries Service

- **Land Permitting**
  - USFWS right of way permit to cross Supawna National Wildlife Refuge required
Operational Impact Criteria

• **Artificial Island Facility Requirements**
  - PJM Operations Review
    • Request to minimize impact to existing transmission facilities
  - Salem/Hope Creek Facility Owner Feedback
    • Request to minimize outage and physical impacts to existing transmission facilities
    • Salem is space constrained so expansion needs to incorporate maintenance access to substation equipment
    • Salem control house is a part of plant facilities and access is constrained

• **Blackstart**
  - No blackstart advantage

• **Route Diversity**
  - Project route is parallels the existing 5015 line

• **Ongoing Maintenance**
  - Salt spray concern with proximity to Delaware river
• New 500kV Line between Salem and Red Lion substations

• PJM modifications
  – Technical:
    • Added SVC
  – Constructability:
    • Dead-end towers added around line crossing
    • New Salem connection as a full bay
LS Power 5B – Technical Analysis

• Stability Performance

  – Failed required performance
    • Failed as proposed by project sponsor.
    • Did not satisfy stability criteria for a three phase fault with AI units at unity power factor under 5015 maintenance outage condition.

  – Passed required performance
    • Passed as proposed with the addition of an SVC at Orchard, New Freedom or Artificial Island.
Required Outages:
- Cut-in of new bay at Salem
- 5037 outage to cut over to new bay
- Raising the 5015 and 5023 lines at crossing points
Relocate 5015 to a new 500kV line terminal and add double breaker between lines
PJM Estimated Cost: $221-$269 (million)
- New 17 mile 500kV line
- Aerial Delaware river crossing

Proposed Cost Estimate: $171 (million)

Market Efficiency Analysis Sensitivity Study
  - Scenario:
    - New 500 kV path from the AI to Red Lion
  - Results:
    - Approximate benefit to cost ratio of 0.15
    - Approximately $57 million over 15 years

Outage Cost
- 5015 outage estimated at 30 days
LS Power 5B - Project Schedule

Proposed Schedule 60 months (items run concurrent)
- Permitting: 27 months
- Design and Construction: 60 months
- Property Acquisition: 18 months

Schedule Criteria
- Permitting
  - CPCNs in two states and Army Corps of Engineers
- Construction
  - Could be impacted by restrictions due to endangered species and shipping traffic
- Long Lead Time Materials
  - No significant long lead time equipment required
Right of Way and Land Acquisition Criteria

• No Eminent Domain in Delaware
  – All project have approximately 0.5 miles of right of way to either expand or acquire in Delaware
    – Land is coastal and under state jurisdiction
  – Red Lion substation expansion is on land currently owned by PHI

• New Right of Way Required
  – Will need to either negotiate with the LDV parties or negotiate with individual land owners and public entities

• Substation Land Required
  – Red Lion substation expansion will be done on land currently owned by PHI.
Siting and Permitting Criteria

• **Wetlands Impact**
  – Permits required to cross the Delaware state lands on the river coast
  – Impacts approximately 350 acres of forested wetland

• **Public Opposition Risk**
  – View-shed impacts minimal as this is adjacent to the existing 5015
  – Some opposition to any river crossing is expected

• **Historic and Scenic Highway**
  – No impact

• **Land Permitting**
  – USFWS right of way permit to cross Supawna National Wildlife Refuge required

• **Delaware River Crossing**
  – Numerous approvals and permits required:
    (a few major permits are listed below)
    – Delaware River Basin Commission approval required
    – Delaware and New Jersey CPCNs required
    – US Army Corps of Engineers Section 404 and 10 authorizations
    – Multiple US Fish and Wildlife permits required
    – National Marine Fisheries Service
LS Power 5B - Operational Impact

Operational Impact Criteria

• Artificial Island Facility Requirements
  – PJM Operations Review
    • Request to minimize impact to existing transmission facilities
  – Salem/Hope Creek Facility Owner Feedback
    • Request to minimize outage and physical impacts to existing transmission facilities
    • Salem is space constrained so expansion needs to incorporate maintenance access to substation equipment
    • Salem control house is a part of plant facilities and access is constrained

• Blackstart
  – No blackstart advantage

• Route Diversity
  – Project route is parallels the existing 5015 line

• Ongoing Maintenance
  – No impact
• New 500kV Line between Salem and Red Lion substations

• PJM modifications
  – Technical:
    • Added SVC
  – Constructability:
    • Dead-end towers added around line crossing
    • New Salem connection as a full bay
Transource (AEP) 2C – Technical Analysis

• Stability Performance

  – Failed required performance
    • Failed as proposed by project sponsor.
    • Did not satisfy stability criteria for a single line to ground fault with stuck breaker with Al units at unity power factor under 5015 maintenance outage condition.

  – Passed required performance
    • Passed as proposed with the addition of an SVC at Orchard, New Freedom or Artificial Island.
Artificial Island

Transource (AEP) 2C
Salem Expansion

Required Outages:
• Cut-in of new bay at Salem
• 5021 and 5024 outages to cut over to the new bays
• Raising the 5023 lines at crossing point
Red Lion Substation
Transource (AEP) 2C

Create a 500kV terminal for the new line and add double breaker between the lines.
Transource (AEP) 2C - Cost Factors

PJM Estimated Cost: $232-$282 (million)
- New 17 mile 500kV line
- Aerial Delaware river crossing

Proposed Cost Estimate: $123-156 (million)

Market Efficiency Analysis Sensitivity Study
- Scenario:
  - New 500 kV path from the AI to Red Lion
- Results:
  - Approximate benefit to cost ratio of 0.15
  - Approximately $57 million over 15 years

Outage Cost
- 5015 outage estimated at 14 days
Proposed Schedule 48 months (items run concurrent)

- Permitting: 27 months
- Design and Construction: 30 months
- Property Acquisition: 15 months

Schedule Criteria

- Permitting
  - CPCNs in two states and Army Corps of Engineers

- Long Lead Time Materials
  - No significant long lead time equipment required

- Construction
  - Could be impacted by restrictions due to endangered species and shipping traffic
Right of Way and Land Acquisition Criteria

• No Eminent Domain in Delaware
  – All project have approximately 0.5 miles of right of way to either expand or acquire in Delaware
    – Land is coastal and under state jurisdiction
  – Red Lion substation expansion is on land currently owned by PHI

• New Right of Way Required
  – Will need to either negotiate with the LDV parties or negotiate with individual land owners and public entities

• Substation Land Required
  – Red Lion substation expansion will be done on land currently owned by PHI.
Transource (AEP) 2C - Siting and Permitting

Siting and Permitting Criteria

• Wetlands Impact
  – Permits required to cross the Delaware state lands on the river coast
  – Impacts approximately 350 acres of forested wetland

• Public Opposition Risk
  – View-shed impacts minimal as this is adjacent to the existing 5015
  – Some opposition to any river crossing is expected

• Historic and Scenic Highway
  – No impact

• Land Permitting
  – USFWS right of way permit to cross Supawna National Wildlife Refuge required

• Delaware River Crossing
  – Numerous approvals and permits required:
    (a few major permits are listed below)
    – Delaware River Basin Commission approval required
    – Delaware and New Jersey CPCNs required
    – US Army Corps of Engineers Section 404 and 10 authorizations
    – Multiple US Fish and Wildlife permits required
    – National Marine Fisheries Service
Operational Impact Criteria

- **Artificial Island Facility Requirements**
  - PJM Operations Review
    - Request to minimize impact to existing transmission facilities
  - Salem/Hope Creek Facility Owner Feedback
    - Request to minimize outage and physical impacts to existing transmission facilities
    - Salem is space constrained so expansion needs to incorporate maintenance access to substation equipment
    - Salem control house is a part of plant facilities and access is constrained

- **Blackstart**
  - No blackstart advantage

- **Route Diversity**
  - Project route is parallels the existing 5015 line

- **Ongoing Maintenance**
  - Salt spray concern with proximity to Delaware river
• Expansion of Hope Creek substation

• 17 mile 500kV line

• Parallels 5015 (Existing Red Lion – Hope Creek 500 kV)

• Proposing Entities:
  - Dominion
  - PSE&G
- New 500kV Line between Hope Creek and Red Lion substations
- New bus tie between Hope Creek and Salem substations
- PJM modifications
  - Technical: Added SVC
  - Constructability: Dead-end towers added around line crossing
Dominion Virginia Power (DVP) 1C – Technical Analysis

• Stability Performance

  – Failed required performance
    • Failed as proposed by project sponsor.
    • Failed with modification to remove proposed breakers.
    • Did not satisfy stability criteria for a SLG fault with stuck breaker with AI units at unity power factor under new Hope Creek – Red Lion line maintenance outage condition.
    • Did not satisfy stability criteria for a SLG fault with stuck breaker with AI units at unity power factor under new Hope Creek – Red Lion line maintenance outage condition with modification to remove proposed breakers.

  – Passed required performance
    • Passed as modified with the addition of an SVC at Orchard, New Freedom or Artificial Island.

Artificial Island
Dominion 1C
Artificial Island Expansion

Proposed
Hope Creek
Attachment

Proposed
New Station
Tie Line

Red Lion (5015)
New Freedom (5023)
Hope Creek (5037)
Orchard (5021)
New Freedom (5024)

Required Outages:
• Cut-in of new bay at Hope Creek
• Installation of tie-line
Substation proposed to be rebuilt as a double bus – double breaker scheme
New line crosses the 5015 line
Dominion Virginia Power (DVP) 1C - Cost Factors

PJM Estimated Cost: $242-$294 (million)
- New 17 mile 500kV line
- Aerial Delaware river crossing

Proposed Cost Estimate: $199 (million)

Market Efficiency Analysis Sensitivity Study
- Scenario:
  - New 500 kV path from the AI to Red Lion
- Results:
  - Approximate benefit to cost ratio of 0.15
  - Approximately $57 million over 15 years

Outage Cost
- 5015 outage estimated at 40 days
Dominion Virginia Power (DVP) 1C - Project Schedule

Proposed Schedule 111 months (items run concurrent)

- Permitting: 24 months
- Design and Construction: 38 months
- Property Acquisition: 78 months

Schedule Criteria

- Permitting
  - CPCNs in two states and Army Corps of Engineers

- Long Lead Time Materials
  - No significant long lead time equipment required

- Construction
  - Could be impacted by restrictions due to endangered species and shipping traffic
Right of Way and Land Acquisition Criteria

• No Eminent Domain in Delaware
  – All project have approximately 0.5 miles of right of way to either expand or acquire in Delaware
    – Land is coastal and under state jurisdiction
    – Red Lion substation expansion is on land currently owned by PHI

• New Right of Way Required
  – Will need to either negotiate with the LDV parties or negotiate with individual land owners and public entities

• Substation Land Required
  – Red Lion substation expansion will be done on land currently owned by PHI.
Siting and Permitting Criteria

• **Wetlands Impact**
  – Permits required to cross the Delaware state lands on the river coast
  – Impacts approximately 350 acres of forested wetland

• **Public Opposition Risk**
  – View-shed impacts minimal as this is adjacent to the existing 5015
  – Some opposition to any river crossing is expected

• **Historic and Scenic Highway**
  – No impact

• **Land Permitting**
  – USFWS right of way permit to cross Supawna National Wildlife Refuge required

• **Delaware River Crossing**
  – Numerous approvals and permits required:
    (a few major permits are listed below)
    – Delaware River Basin Commission approval required
    – Delaware and New Jersey CPCNs required
    – US Army Corps of Engineers Section 404 and 10 authorizations
    – Multiple US Fish and Wildlife permits required
    – National Marine Fisheries Service
Dominion Virginia Power (DVP) 1C - Operational Impact

Operational Impact Criteria

• **Artificial Island Facility Requirements**
  – PJM Operations Review
    • Request to minimize impact to existing transmission facilities
  – Salem/Hope Creek Facility Owner Feedback
    • Request to minimize outage and physical impacts to existing transmission facilities
    • Salem is space constrained so expansion needs to incorporate maintenance access to substation equipment
    • Salem control house is a part of plant facilities and access is constrained

• **Blackstart**
  – No blackstart advantage

• **Route Diversity**
  – Project route parallels the existing 5015 line

• **Ongoing Maintenance**
  – Limited physical access could lead to maintenance issues on the new tie line between Salem and Hope Creek
• New 500kV Line between Hope Creek and Red Lion substations

• New bus tie between Hope Creek and Salem substations

• PJM modifications
  – Technical:
    • Removed the New Freedom to Deans portion of the project
    • Added SVC
  – Constructability:
    • Dead-end towers added around line crossing
• **Stability Performance**

  – Failed required performance
    • Failed as proposed by project sponsor.
    • Did not satisfy stability criteria for a single line to ground fault with stuck breaker with AI units at unity power factor under 5037 maintenance outage condition.

  – Passed required performance
    • Passed as modified with the addition of an SVC at Orchard, New Freedom or Artificial Island.
Artificial Island
PSE&G 7K
Artificial Island Expansion

Proposed
Hope Creek
Attachment

Tie Line

Red Lion (5015)
New Freedom (5023)
Hope Creek (5037)
Orchard (5021)

Proposed
New Station

New Freedom (5024)

Required Outages:
• Cut-in of new bay at Hope Creek
• Installation of tie-line
Substation proposed to be rebuilt as a breaker and a half scheme
New line crosses the 5015 line
PJM Estimated Cost: $249-$304 (million)
- New 17 mile 500kV line
- Aerial Delaware river crossing

Proposed Cost Estimate: $297 (million)

Market Efficiency Analysis Sensitivity Study
- Scenario:
  - New 500 kV path from the AI to Red Lion
- Results:
  - Approximate benefit to cost ratio of 0.15
  - Approximately $57 million over 15 years

Outage Cost
- 5015 outage estimated at 40 days
Proposed Schedule 51 months (items run concurrent)

- Permitting: 51 months
- Design and Construction: 48 months
- Property Acquisition: 0 months

Schedule Criteria

- Permitting
  - CPCNs in two states and Army Corps of Engineers

- Long Lead Time Materials
  - No significant long lead time equipment required

- Construction
  - Could be impacted by restrictions due to endangered species and shipping traffic
Right of Way and Land Acquisition Criteria

• No Eminent Domain in Delaware
  – All project have approximately 0.5 miles of right of way to either expand or acquire in Delaware
    – Land is coastal and under state jurisdiction
    – Red Lion substation expansion is on land currently owned by PHI

• New Right of Way Required
  – As participants in the LDV agreement, party has a right of way agreement for the new line

• Substation Land Required
  – Red Lion substation expansion will be done on land currently owned by PHI.
Siting and Permitting Criteria

• Wetlands Impact
  – Permits required to cross the Delaware state lands on the river coast
  – Impacts approximately 350 acres of forested wetland

• Public Opposition Risk
  – View-shed impacts minimal as this is adjacent to the existing 5015
  – Some opposition to any river crossing is expected

• Historic and Scenic Highway
  – No impact

• Land Permitting
  – USFWS right of way permit to cross Supawna National Wildlife Refuge required

• Delaware River Crossing
  – Numerous approvals and permits required:
    (a few major permits are listed below)
    – Delaware River Basin Commission approval required
    – Delaware and New Jersey CPCNs required
    – US Army Corps of Engineers Section 404 and 10 authorizations
    – Multiple US Fish and Wildlife permits required
    – National Marine Fisheries Service
Operational Impact Criteria

• Artificial Island Facility Requirements
  – PJM Operations Review
    • Request to minimize impact to existing transmission facilities
  – Salem/Hope Creek Facility Owner Feedback
    • Request to minimize outage and physical impacts to existing transmission facilities
    • Salem is space constrained so expansion needs to incorporate maintenance access to substation equipment
    • Salem control house is a part of plant facilities and access is constrained

• Blackstart
  – No blackstart advantage

• Route Diversity
  – Project route is parallels the existing 5015 line

• Ongoing Maintenance
  – The new gas-insulated bus tie line between Salem and Hope Creek may require more frequent maintenance
• New 500kV Line between Hope Creek and Red Lion substations

• PJM modifications
  - Technical:
    • Removed the new tie between Salem and Hope Creek substations
    • Added SVC
  - Constructability:
    • Red Lion expansion changed from a breaker and a half to an expansion of the existing ring-bus
• **Stability Performance**
  - Failed required performance
    • Failed as proposed by project sponsor.
    • Failed with modification to remove proposed breakers and transmission line.
    • Did not satisfy stability criteria for a SLG fault with stuck breaker with AI units at unity power factor under Hope Creek – Red Lion line maintenance outage condition.
    • Did not satisfy stability criteria for a SLG fault with stuck breaker with AI units at unity power factor under Hope Creek – Red Lion line maintenance outage condition with modification to remove proposed breakers and transmission line.
  - Passed required performance
    • Passed as modified with the addition of an SVC at Orchard or New Freedom.
Artificial Island
Dominion 1C (No New Bus Tie)
Hope Creek Expansion

Proposed Hope Creek Attachment

Required Outages:
• Cut-in of new bay at Hope Creek
Red Lion Substation
Dominion 1C (No New Bus Tie)

Relocate 5015 to a new 500kV line terminal and add double breaker between lines.
Dominion Virginia Power (DVP) 1C (No New Bus Tie)

Cost Factors

PJM Estimated Cost: $211-$257 (million)
• New 17 mile 500kV line
• Aerial Delaware river crossing

Market Efficiency Analysis Sensitivity Study
  – Scenario:
    • New 500 kV path from the AI to Red Lion
  – Results:
    • Approximate benefit to cost ratio of 0.15
    • Approximately $57 million over 15 years

Outage Cost
• 5015 outage estimated at 14 days
Proposed Schedule 111 months (items run concurrent)
• Permitting: 24 months
• Design and Construction: 38 months
• Property Acquisition: 78 months

Schedule Criteria
• Permitting
  – CPCNs in two states and Army Corps of Engineers

• Long Lead Time Materials
  – No significant long lead time equipment required

• Construction
  – Could be impacted by restrictions due to endangered species and shipping traffic
Dominion Virginia Power (DVP) 1C (No New Bus Tie)
RoW and Land Acquisition

Right of Way and Land Acquisition Criteria

• No Eminent Domain in Delaware
  – All project have approximately 0.5 miles of right of way to either expand or acquire in Delaware
    – Land is coastal and under state jurisdiction
    – Red Lion substation expansion is on land currently owned by PHI

• New Right of Way Required
  – Will need to either negotiate with the LDV parties or negotiate with individual land owners and public entities

• Substation Land Required
  – Red Lion substation expansion will be done on land currently owned by PHI.
Siting and Permitting Criteria

• Wetlands Impact
  – Permits required to cross the Delaware state lands on the river coast
  – Impacts approximately 350 acres of forested wetland

• Public Opposition Risk
  – View-shed impacts minimal as this is adjacent to the existing 5015
  – Some opposition to any river crossing is expected

• Historic and Scenic Highway
  – No impact

• Land Permitting
  – USFWS right of way permit to cross Supawna National Wildlife Refuge required

• Delaware River Crossing
  – Numerous approvals and permits required:
    (a few major permits are listed below)
    – Delaware River Basin Commission approval required
    – Delaware and New Jersey CPCNs required
    – US Army Corps of Engineers Section 404 and 10 authorizations
    – Multiple US Fish and Wildlife permits required
    – National Marine Fisheries Service
Operational Impact Criteria

• Artificial Island Facility Requirements
  – PJM Operations Review
    • Request to minimize impact to existing transmission facilities
  – Salem/Hope Creek Facility Owner Feedback
    • Request to minimize outage and physical impacts to existing transmission facilities
    • Hope Creek north has available land for expansion
    • Hope Creek control house has adequate space and access for expansion

• Blackstart
  – No blackstart advantage

• Route Diversity
  – Project route is parallels the existing 5015 line

• Ongoing Maintenance
  – No impact
• New 500kV Line between Hope Creek and Red Lion substations

• PJM modifications
  – Technical:
    • Removed the New Freedom to Deans portion of the project
    • Removed the new tie between Salem and Hope Creek substations
    • Added SVC
  – Constructability:
    • Red Lion expansion changed from a breaker and a half to an expansion of the existing ring-bus

PSE&G 7K (No New Bus Tie)
PSE&G 7K (No New Bus Tie) – Technical Analysis

• Stability Performance

  – Failed required performance
    • Failed as proposed by project sponsor.
    • Did not satisfy stability criteria for a single line to ground fault with stuck breaker with Al units at unity power factor under new Hope Creek – Red Lion 500kV line maintenance outage condition with modification to remove Salem – Hope Creek 2nd tie and proposed breakers.

  – Passed required performance
    • Passed as modified with the addition of an SVC at Orchard or New Freedom.
Artificial Island
PSE&G 7K (No New Bus Tie)
Hope Creek Expansion

Proposed Hope Creek Attachment

Required Outages:
- Cut-in of new bay at Hope Creek
Red Lion Substation
PSE&G 7K (No New Bus Tie)

Relocate 5015 to a new 500kV line terminal and add double breaker between lines
PSE&G 7K (No New Bus Tie) - Cost Factors

PJM Estimated Cost: $211-$257 (million)
- New 17 mile 500kV line
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Market Efficiency Analysis Sensitivity Study
- Scenario:
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Outage Cost
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Proposed Schedule: 51 months (items run concurrent)
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Schedule Criteria
- Permitting
  - CPCNs in two states and Army Corps of Engineers
- Construction
  - Could be impacted by restrictions due to endangered species and shipping traffic
- Long Lead Time Materials
  - No significant long lead time equipment required
Right of Way and Land Acquisition Criteria

- No Eminent Domain in Delaware
  - All project have approximately 0.5 miles of right of way to either expand or acquire in Delaware
    - Land is coastal and under state jurisdiction
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- New Right of Way Required
  - As participants in the LDV agreement, party has a right of way agreement for the new line

- Substation Land Required
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Siting and Permitting Criteria

• Wetlands Impact
  – Permits required to cross the Delaware state lands on the river coast
  – Impacts approximately 350 acres of forested wetland

• Public Opposition Risk
  – View-shed impacts minimal as this is adjacent to the existing 5015
  – Some opposition to any river crossing is expected

• Historic and Scenic Highway
  – No impact

• Land Permitting
  – USFWS right of way permit to cross Supawna National Wildlife Refuge required

• Delaware River Crossing
  – Numerous approvals and permits required:
    (a few major permits are listed below)
    – Delaware River Basin Commission approval required
    – Delaware and New Jersey CPCNs required
    – US Army Corps of Engineers Section 404 and 10 authorizations
    – Multiple US Fish and Wildlife permits required
    – National Marine Fisheries Service
PSE&G 7K (No New Bus Tie) - Operational Impact

Operational Impact Criteria

- **Artificial Island Facility Requirements**
  - PJM Operations Review
    - Request to minimize impact to existing transmission facilities
  - Salem/Hope Creek Facility Owner Feedback
    - Request to minimize outage and physical impacts to existing transmission facilities
    - Hope Creek north has available land for expansion
    - Hope Creek control house has adequate space and access for expansion

- **Blackstart**
  - No blackstart advantage

- **Route Diversity**
  - Project route is parallels the existing 5015 line

- **Ongoing Maintenance**
  - No impact
• SVC Locations Considered:
  – New Freedom
  – Orchard
  – Artificial Island

• Schedule Estimate 36 months
  – SVC lead time of 24 months
  – Permitting and land acquisition 6 months

• Cost Estimate $80 million
  – SVC $60 million
SVC Constructability Analysis

• No determining factor difference between the Orchard or New Freedom SVC
  – Project complexity
    • Expansion of existing substations at either Orchard or New Freedom
  – Land acquisition
    • New land purchase at Orchard
    • PSE&G owns adjacent land at New Freedom
  – Siting and permitting will be similar between the two projects
  – Cost and schedule estimates are the same

• Artificial Island
  – Anticipated nuclear regulatory concerns in approving this device at Artificial Island
Consolidated Summary
## Artificial Island Technical Summary

<table>
<thead>
<tr>
<th>Technical Analysis Criteria</th>
<th>Southern Crossing Lines (Submarine)</th>
<th>Southern Crossing Lines (Overhead)</th>
<th>Red Lion to Artificial Island Lines</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stability</strong></td>
<td>LS Power 5A - Submarine Option</td>
<td>LS Power 5A - Overhead</td>
<td>PHI/Exelon 4A - Red Lion to Salem</td>
</tr>
<tr>
<td></td>
<td>Transource 2B - North Cedar Creek</td>
<td>Dominion 1B - 500kV Overhead</td>
<td>LS Power 5B - Red Lion to Salem</td>
</tr>
<tr>
<td></td>
<td>Transource 2A - Cedar Creek Expansion</td>
<td></td>
<td>Transource 2C - Red Lion to Salem</td>
</tr>
<tr>
<td><strong>Thermal</strong></td>
<td>Maximum angle swing range of 80 - 112 degrees, dependent on solution and SVC location</td>
<td>Maximum angle swing range of 80 - 110 degrees, dependent on solution and SVC location</td>
<td>Maximum angle swing range of 77 - 102 degrees, dependent on solution and SVC location</td>
</tr>
<tr>
<td><strong>Market Efficiency</strong></td>
<td>Preliminary analysis indicates no thermal overloads</td>
<td>Preliminary analysis indicates no thermal overloads</td>
<td>Preliminary analysis indicates no thermal overloads</td>
</tr>
<tr>
<td><strong>Results</strong></td>
<td>Approximate $92 M cost savings over 15 Years</td>
<td>Approximate $92 M cost savings over 15 Years</td>
<td>Approximate $57 M cost savings over 15 Years</td>
</tr>
<tr>
<td><strong>Short Circuit</strong></td>
<td>Three overdutied 230 kV breakers</td>
<td>No overdutied breakers</td>
<td>No overdutied breakers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>From Salem</th>
<th>From Hope Creek</th>
<th>From Salem</th>
<th>From Hope Creek</th>
<th>From Salem</th>
<th>From Hope Creek</th>
<th>From Salem</th>
<th>From Hope Creek</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS Power 5A - Submarine Option</td>
<td>Transource 2B - North Cedar Creek</td>
<td>Dominion 1B - 500kV Overhead</td>
<td>PHI/Exelon 4A - Red Lion to Salem</td>
<td>LS Power 5B - Red Lion to Salem</td>
<td>Transource 2C - Red Lion to Salem</td>
<td>Dominion 1C - Red Lion to Hope Creek</td>
<td>PSE&amp;G 7K - Red Lion to Hope Creek (Remove HC-S 2nd Tie)</td>
</tr>
<tr>
<td>Transource 2A - Cedar Creek Expansion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Stability**: Maximum angle swing range of 80 - 112 degrees, dependent on solution and SVC location.
- **Thermal**: Preliminary analysis indicates no thermal overloads.
- **Market Efficiency**: Approximate $92 M cost savings over 15 Years.
- **Short Circuit**: Three overdutied 230 kV breakers.
• The following slides provide a summary review of PJM’s assessment of the modified proposals in terms of technical performance, cost, constructability and other factors, which are covered in greater detail in the preceding slides.

• Legend:

<table>
<thead>
<tr>
<th>Impact Type</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive or limited impact</td>
<td>Green</td>
</tr>
<tr>
<td>Some impact</td>
<td>Yellow</td>
</tr>
<tr>
<td>Negative impact</td>
<td>Red</td>
</tr>
<tr>
<td>Does not apply</td>
<td>Gray</td>
</tr>
</tbody>
</table>
# Southern Crossing Lines – Project Complexity

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Project Class</th>
<th>Southern Crossing 230kV Lines (Submarine)</th>
<th>Southern Crossing Lines (Overhead)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Project Complexity</td>
<td>LS Power 5A - Submarine Option</td>
<td>LS Power 5A - 230kV Overhead</td>
</tr>
<tr>
<td>Proposal Sub-Criteria</td>
<td></td>
<td>Transource 2B - North Cedar Creek</td>
<td>Transource 2B - 230kV Overhead</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Transource 2A - Cedar Creek Expansion</td>
<td>Generator Lead line</td>
</tr>
<tr>
<td></td>
<td>Line Crossings</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Outage Requirements</td>
<td>New bay tie-in at Salem</td>
<td>New bay tie-in at Salem</td>
</tr>
<tr>
<td></td>
<td>Modification to other Transmission Facilities</td>
<td>Cutting the two 230kV lines into the new Delaware substation; installing one new span on the 5024 line.</td>
<td>Cutting the two 230kV lines into the new Delaware substation; the existing Red Lion to Cartanza line; installing one new bus on the 5024 line.</td>
</tr>
</tbody>
</table>

- New tie-in at Salem will necessitate a unit outage: Breaker installation may require multiple Salem outages.
# Southern Crossing Lines – Project Complexity

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<thead>
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<th>Criteria</th>
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<th>Southern Crossing 230kV Lines (Submarine)</th>
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<tbody>
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<td></td>
<td></td>
<td>LS Power 5A - Submarine Option</td>
<td>Transource 2B - North Cedar Creek</td>
</tr>
<tr>
<td>Proposal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-Criteria</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Complexity</td>
<td>Modification of Artificial Island Substations</td>
<td>New bay and auto-transformer to the south in Salem</td>
<td>New bay for 5024 line to the south in Salem</td>
</tr>
<tr>
<td></td>
<td>Modification of Red Lion Substation</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>
## AI to Red Lion Lines – Project Complexity

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Red Lion to Salem 500kV Lines</th>
<th>Red Lion to Hope Creek 500kV Lines</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Project Class</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Proposal</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sub-Criteria</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Line Crossings</strong></td>
<td>5023, 5021, 5024 lines</td>
<td>5015 and 5023 lines</td>
</tr>
<tr>
<td><strong>Outage Requirements</strong></td>
<td>5015 line position changing at both ends; raising the three 500kV lines</td>
<td>Relocating the 5024 and 5021 lines at Salem; new line crosses the 5023 line.</td>
</tr>
<tr>
<td><strong>Modification to other Facilities</strong></td>
<td>Impacts detailed in other sub-criteria</td>
<td>Impacts detailed in other sub-criteria</td>
</tr>
</tbody>
</table>

*Note:* The table provides a detailed comparison of project complexity between Red Lion to Salem and Red Lion to Hope Creek 500kV lines, including line crossings, outage requirements, and modification to other facilities.
## AI to Red Lion Lines – Project Complexity

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Project Class</th>
<th>Red Lion to Salem 500kV Lines</th>
<th>Red Lion to Hope Creek 500kV Lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Complexity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modification of Artificial Island Substations</td>
<td>PHI/Exelon 4A - Red Lion to Salem</td>
<td>New bay to the south in Salem</td>
<td>New bay in Hope Creek and a new tie between Hope Creek and Salem; moving the 5037 into the existing open bay at Hope Creek</td>
</tr>
<tr>
<td></td>
<td>LS Power 5B - Red Lion to Salem</td>
<td>New bay for 5037 line to the north in Salem</td>
<td>New bay in Hope Creek</td>
</tr>
<tr>
<td></td>
<td>Transource 2C - Red Lion to Salem</td>
<td>New bay for 5024 line to the south and relocate 5021 line in Salem</td>
<td>New bay in Hope Creek</td>
</tr>
<tr>
<td>Modification of Red Lion Substation</td>
<td>PHI/Exelon 4A - Red Lion to Salem</td>
<td>Moving 5015 line into new ring-bus position</td>
<td>Rebuilding the substation as a double bus - double breaker scheme</td>
</tr>
<tr>
<td></td>
<td>LS Power 5B - Red Lion to Salem</td>
<td>Moving 5015 line into new ring-bus position</td>
<td>Rebuilding the substation as a breaker and a half scheme</td>
</tr>
<tr>
<td></td>
<td>Transource 2C - Red Lion to Salem</td>
<td>New position created for the new line.</td>
<td>Moving 5015 line into new ring-bus position</td>
</tr>
<tr>
<td></td>
<td>Dominion 1C - Red Lion to Hope Creek</td>
<td>Moving 5015 line into new ring-bus position</td>
<td>Moving 5015 line into new ring-bus position</td>
</tr>
<tr>
<td></td>
<td>PSE&amp;G 7K - Red Lion to Hope Creek</td>
<td>New position created for the new line.</td>
<td>Moving 5015 line into new ring-bus position</td>
</tr>
<tr>
<td></td>
<td>PSE&amp;G Red Lion to Hope Creek w/ 2nd tie removed</td>
<td>New position created for the new line.</td>
<td>Moving 5015 line into new ring-bus position</td>
</tr>
</tbody>
</table>
## Southern Crossing Lines – Cost Factors

### Cost Factors

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Project Class</th>
<th>Proposal</th>
<th>Sub-Criteria</th>
<th>Cost Factors</th>
<th>Market Efficiency</th>
<th>Outage Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Southern Crossing 230kV Lines (Submarine)</td>
<td></td>
<td></td>
<td>PJM Estimated Project</td>
<td>$248-$302</td>
<td>Approximately $92 over 15 years</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Transource 2B</td>
<td>North Cedar Creek</td>
<td>Proposed Project Costs</td>
<td>$148</td>
<td>230kV outage during substation cut-in</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Transource 2A</td>
<td>Cedar Creek Expansion</td>
<td></td>
<td>$165-$208</td>
<td>230kV outage during substation cut-in</td>
</tr>
<tr>
<td></td>
<td>Southern Crossing Lines (Overhead)</td>
<td>LS Power 5A</td>
<td>230kV Overhead</td>
<td>Cost Factors</td>
<td>Market Efficiency</td>
<td>Outage Cost</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$211-$257</td>
<td>$233-$283</td>
<td>Proposed Project Costs</td>
<td>$116</td>
<td>230kV outage during substation cut-in</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$213-269</td>
<td>$133</td>
<td></td>
<td></td>
<td>230kV outage during substation cut-in</td>
</tr>
</tbody>
</table>

Note: Costs are for the line project only; SVC costs are not included.
## AI to Red Lion Lines – Cost Factors

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<tr>
<th>Criteria</th>
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<td></td>
<td></td>
<td></td>
<td>PH/Exelon 4A - Red Lion to Salem</td>
<td>Dominion 1C – Red Lion to Hope Creek</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>LS Power 5B - Red Lion to Salem</td>
<td>PSE&amp;BG 7K – Red Lion to Hope Creek</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Transsource 2C - Red Lion to Salem</td>
<td>PSE&amp;BG Red Lion to Hope Creek w/ 2nd tie removed</td>
</tr>
<tr>
<td></td>
<td>PJM Estimated Project</td>
<td>Proposed Project Costs</td>
<td>Market Efficiency</td>
<td>Cost Factors</td>
</tr>
<tr>
<td></td>
<td>$216-$263</td>
<td>$221-$269</td>
<td>$232-$282</td>
<td>$242-$294</td>
</tr>
<tr>
<td></td>
<td>$181</td>
<td>$171</td>
<td>$123-156</td>
<td>$199</td>
</tr>
<tr>
<td></td>
<td>Approximately $57 over 15 years</td>
<td>Approximately $57 over 15 years</td>
<td>00:15 outage estimated at 30 days</td>
<td>5015 outage estimated at 40 days</td>
</tr>
<tr>
<td></td>
<td>00:15 outage estimated at 30 days</td>
<td>5015 outage estimated at 14 days</td>
<td>5015 outage estimated at 40 days</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5015 outage estimated at 14 days</td>
<td></td>
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Note: Costs are for the line project only; SVC costs are not included.
## Southern Crossing Lines – Operational Impact

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<thead>
<tr>
<th>Criteria</th>
<th>Project Class</th>
<th>Southern Crossing 230kV Lines (Submarine)</th>
<th>Southern Crossing Lines (Overhead)</th>
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<tr>
<td></td>
<td></td>
<td>LS Power 5A - Submarine Option</td>
<td>LS Power 5A - 230kV Overhead</td>
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<tr>
<td>Proposal</td>
<td></td>
<td>Transource 2B - North Cedar Creek</td>
<td>Dominion 1B - 500kV Overhead</td>
</tr>
<tr>
<td>Sub-Criteria</td>
<td></td>
<td>Transource 2A - Cedar Creek Expansion</td>
<td></td>
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<tr>
<td>Artificial Island Facility</td>
<td>Expansion at Salem needs to incorporate maintenance access to substation equipment; Salem is space constrained; Control house access is also constrained</td>
<td>Expansion at Salem needs to incorporate maintenance access to substation equipment; Salem is space constrained; Control house access is also constrained</td>
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<tr>
<td>Requirements</td>
<td>Additional access to blackstart resources</td>
<td>Additional access to blackstart resources</td>
<td>Additional access to blackstart resources</td>
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<tr>
<td>Blackstart</td>
<td>New route</td>
<td>New route</td>
<td>New route</td>
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<tr>
<td>Route Diversity</td>
<td>Salt spray concern with proximity to Delaware river; auto-transformer maintenance may increase line outage frequency</td>
<td>Salt spray concern with proximity to Delaware river; auto-transformer maintenance may increase line outage frequency</td>
<td>Salt spray concern with proximity to Delaware river; auto-transformer maintenance may increase line outage frequency</td>
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<tr>
<td>Ongoing Maintenance</td>
<td></td>
<td>Salt spray concern with proximity to Delaware river; auto-transformer maintenance may increase line outage frequency</td>
<td>Auto-transformer maintenance may increase line outage frequency</td>
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<td>Criteria</td>
<td>Proposal Sub-Criteria</td>
<td>Artificial Island Facility Requirements</td>
<td>Red Lion to Salem 500kV Lines</td>
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<td>Expansion at Salem needs to incorporate maintenance access to substation equipment; Salem is space constrained; Control house access is also constrained.</td>
<td>Expansion at Salem needs to incorporate maintenance access to substation equipment; Salem is space constrained; Control house access is also constrained.</td>
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<td>Expansion at Salem needs to incorporate maintenance access to substation equipment; Salem is space constrained; Control house access is also constrained.</td>
<td>Expansion at Salem needs to incorporate maintenance access to substation equipment; Salem is space constrained; Control house access is also constrained.</td>
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<tr>
<td>Artificial Island Facility Requirements</td>
<td>Blackstart</td>
<td>No blackstart advantage</td>
<td>Expansion at Salem needs to incorporate maintenance access to substation equipment; Salem is space constrained; Control house access is also constrained.</td>
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<td>Route Diversity</td>
<td>Parallels existing 5015 line</td>
<td>No blackstart advantage</td>
<td>Expansion at Salem needs to incorporate maintenance access to substation equipment; Salem is space constrained; Control house access is also constrained.</td>
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<td>Ongoing Maintenance</td>
<td>Salt spray concern with proximity to Delaware river</td>
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PJM TEAC - Artificial Island 06/16/2014
## Southern Crossing Lines
### Right of Way and Land Acquisition

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Proposal Sub-Criteria</th>
<th>Southern Crossing 230kV Lines (Submarine)</th>
<th>Southern Crossing Lines (Overhead)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>No Eminent Domain in Delaware</td>
<td>1.5-3 miles of new RoW to acquire in Delaware</td>
<td>1.5-3 miles of new RoW to acquire in Delaware</td>
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<tr>
<td>Right of Way and Land Acquisition</td>
<td>New Right of Way Required</td>
<td>1.5-3 miles of new RoW to acquire in Delaware</td>
<td>1.5-3 miles of new RoW to acquire in Delaware</td>
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<td>Substation Land Required</td>
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<td>Acquired an option on a substation location in Delaware</td>
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<td></td>
<td></td>
<td>New substation land required in Delaware and New Jersey</td>
<td>New substation land required in Delaware and New Jersey</td>
</tr>
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<td></td>
<td></td>
<td>New substation land required in Delaware and New Jersey</td>
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**Project Class**
- Submarine Option
- North Cedar Creek
- Cedar Creek Expansion

**Lines**
- LS Power 5A - 230kV Overhead
- Dominion 1B - 500kV Overhead
<table>
<thead>
<tr>
<th>Criteria</th>
<th>Project Class</th>
<th>Proposal 1</th>
<th>Proposal 2</th>
<th>Proposal 3</th>
<th>Proposal 4</th>
<th>Proposal 5</th>
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<tr>
<td></td>
<td>AI to Red Lion Lines Right of Way and Land Acquisition</td>
<td>PH/Exelon 4A - Red Lion to Salem (0.5 miles of right of way to expand in Delaware and under state jurisdiction)</td>
<td>LS Power 5B - Red Lion to Salem (0.5 miles of right of way to expand in Delaware and under state jurisdiction)</td>
<td>Transource 2C - Red Lion to Salem (0.5 miles of right of way to expand in Delaware and under state jurisdiction)</td>
<td>Dominion 1C - Red Lion to Hope Creek (0.5 miles of right of way to expand in Delaware and under state jurisdiction)</td>
<td>PSE&amp;G 7K - Red Lion to Hope Creek (0.5 miles of right of way to expand in Delaware and under state jurisdiction)</td>
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<td>Negotiate with LDV parties or individual land owners</td>
<td>Negotiate with LDV parties or individual land owners</td>
<td>Participant in the LDV agreement which governs 5015 RoW</td>
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<tr>
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<td>None</td>
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## Southern Crossing Lines - Siting and Permitting

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<tr>
<th>Siting and Permitting</th>
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<th>Southern Crossing Lines (Overhead)</th>
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<td>LS Power 5A - Submarine Option</td>
<td>Transource 2B - North Cedar Creek</td>
</tr>
<tr>
<td></td>
<td>Proposal Sub-Criteria</td>
<td>Wetlands Impact</td>
<td>New route will allow flexibility</td>
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<td></td>
<td>Proposal Sub-Criteria</td>
<td>Land Permitting</td>
<td>No major permit identified</td>
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<td></td>
<td>Proposal Sub-Criteria</td>
<td>Public Opposition Risk</td>
<td>No view-shed impact; some opposition to any river crossing is expected</td>
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<td></td>
<td>Proposal Sub-Criteria</td>
<td>Historic and Scenic Highway</td>
<td>New line parallels Delaware state route 9</td>
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<td>Proposal Sub-Criteria</td>
<td>Delaware River Crossing</td>
<td>Numerous approvals and permits will be required for any Delaware river crossing</td>
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<td>Project Class</td>
<td>Siting and Permitting</td>
<td>Proposal</td>
<td>Sub-Criteria</td>
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<td>-----------------------</td>
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</tr>
<tr>
<td>Criteria</td>
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<tr>
<td>Wetlands Impact</td>
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<td></td>
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<td>Land Permitting</td>
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<tr>
<td>Public Opposition Risk</td>
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<tr>
<td>Historic and Scenic Highway</td>
<td></td>
<td></td>
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<tr>
<td>Delaware River Crossing</td>
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</tbody>
</table>

**Overview:**

- **PJM TEAC - Artificial Island 06/16/2014**
- **AI to Red Lion Lines - Siting and Permitting**
- **Criteria**
  - Wetlands Impact
  - Land Permitting
  - Public Opposition Risk
  - Historic and Scenic Highway
  - Delaware River Crossing
- **Proposal**
  - PHI/Exelon 4A - Red Lion to Salem
  - LS Power 5B - Red Lion to Salem
  - Transource 2C - Red Lion to Salem
  - Dominion 1C - Red Lion to Hope Creek
  - PSE&G 7K - Red Lion to Hope Creek
  - Dominion Red Lion to Hope Creek w/ 2nd tie removed
  - PSE&G Red Lion to Hope Creek w/ 2nd tie removed
- **Sub-Criteria**
  - Impacts approximately 350 acres of forested wetland
  - USFWS ROW permit to cross Supauva National Wildlife Refuge required
  - View-shed impacts minimized by proximity to the existing 5015; some opposition to any river crossing is expected
  - Numerous approvals and permits will be required for any Delaware river crossing
  - Dominions Red Lion to Hope Creek w/ 2nd tie removed
  - PSE&G Red Lion to Hope Creek w/ 2nd tie removed
- **Table:**
  - Comparison of impact and permitting requirements for Red Lion to Salem 500KV Lines and Red Lion to Hope Creek 500KV Lines.
## Southern Crossing Lines – Project Schedule

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Project Class</th>
<th>Southern Crossing 230kV Lines (Submarine)</th>
<th>Southern Crossing Lines (Overhead)</th>
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<td>LS Power 5A - Submarine Option</td>
<td>LS Power 5A - 230kV Overhead</td>
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<td>Sub-Criteria</td>
<td>Transource 2B - North Cedar Creek</td>
<td>Dominion 1B - 500kV Overhead</td>
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<td>Permitting</td>
<td>Multi permits required including CPCNs from two states and Army Corp of Engineers permits</td>
<td>Multi permits required including CPCNs from two states and Army Corp of Engineers permits</td>
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<tr>
<td></td>
<td>Construction</td>
<td>Submarine cable installation requires specialized equipment; Spawning/nesting seasons of endangered species may impact construction timeframes</td>
<td>Spawning/nesting seasons of endangered species may impact construction timeframes</td>
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<tr>
<td></td>
<td>Long Lead Time Materials</td>
<td>Submarine cable and auto-transformers</td>
<td>Auto-transformers</td>
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</table>

PJM TEAC - Artificial Island 06/16/2014
## AI to Red Lion Lines – Project Schedule

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Project Class</th>
<th>Permitting</th>
<th>Construction</th>
<th>Long Lead Time Materials</th>
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<td>Red Lion to Salem 500kV Lines</td>
<td>Multiple permits required including CPCNs from two states and Army Corp of Engineers permits</td>
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<td>None</td>
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<td></td>
<td>Red Lion to Salem 500kV Lines</td>
<td>Multiple permits required including CPCNs from two states and Army Corp of Engineers permits</td>
<td>Spawning/nesting seasons of endangered species may impact construction timeframes</td>
<td>None</td>
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<tr>
<td></td>
<td>Transource 2C - Red Lion to Salem</td>
<td>Multiple permits required including CPCNs from two states and Army Corp of Engineers permits</td>
<td>Spawning/nesting seasons of endangered species may impact construction timeframes</td>
<td>None</td>
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<tr>
<td></td>
<td>Dominon 1C - Red Lion to Hope Creek</td>
<td>Multiple permits required including CPCNs from two states and Army Corp of Engineers permits</td>
<td>Spawning/nesting seasons of endangered species may impact construction timeframes</td>
<td>None</td>
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<tr>
<td></td>
<td>PSE&amp;G 7K - Red Lion to Hope Creek</td>
<td>Multiple permits required including CPCNs from two states and Army Corp of Engineers permits</td>
<td>Spawning/nesting seasons of endangered species may impact construction timeframes</td>
<td>None</td>
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<tr>
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<td>PSE&amp;G Red Lion to Hope Creek w/ 2nd tie removed</td>
<td>Multiple permits required including CPCNs from two states and Army Corp of Engineers permits</td>
<td>Spawning/nesting seasons of endangered species may impact construction timeframes</td>
<td>None</td>
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<tr>
<td></td>
<td>PSE&amp;G Red Lion to Hope Creek w/ 2nd tie removed</td>
<td>Multiple permits required including CPCNs from two states and Army Corp of Engineers permits</td>
<td>Spawning/nesting seasons of endangered species may impact construction timeframes</td>
<td>None</td>
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<td>Criteria</td>
<td>Project Class</td>
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<td>Southern Crossing Lines (Overhead)</td>
<td>Red Lion to Salem 500kV Lines</td>
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<td>-----------------------------------------</td>
<td>-----------------------------------</td>
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<tr>
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<td>Sub-Criteria</td>
<td>Stability</td>
<td>Thermal</td>
<td>Approximate 0.15 Benefit to Cost Ratio</td>
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<td>Technical Analysis</td>
<td>Market Efficiency Results</td>
<td>Short Circuit</td>
<td>NERC Cat-D Contingencies</td>
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<td>Cost Factors</td>
<td>PJM Estimated Project Cost</td>
<td>Project Costs as Proposed</td>
<td>Project Efficiency</td>
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<td></td>
<td></td>
<td>$248-$302</td>
<td>$148</td>
<td>Approximately 92 over 15 years</td>
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<td></td>
<td>$257-$313</td>
<td>$166-$208</td>
<td>Approximately 92 over 15 years</td>
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<td></td>
<td></td>
<td>$316-$346</td>
<td>$213-$269</td>
<td>Approximately 92 over 15 years</td>
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<td>Risks to Cost and Schedule</td>
<td>Line Crossings</td>
<td>Outage Requirements</td>
<td>Modification to other Facilities</td>
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<td></td>
<td>Project Complexity</td>
<td>No Eminent Domain in Delaware</td>
<td>New Right of Way Required</td>
<td>Substation Land Required</td>
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<td>Siting and Permitting</td>
<td>Historic and Scenic Highway</td>
<td>Delaware River Crossing</td>
<td>Delaware River Crossing</td>
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<td>Operational Impact</td>
<td>Artificial Island Facility Requirements</td>
<td>Blackstart</td>
<td>Route Diversity</td>
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</table>
Today - Monday, May 19th Special TEAC
  - 3 hour stakeholder technical meeting
  - In-person at PJM CTC

Monday, June 2nd – Due date for stakeholder comment/feedback (14 day comment period)

June 5th TEAC

Monday, June 16th – PJM review of stakeholder comment/feedback and final decision meeting
  - Special TEAC Webex / Teleconference

Comment Period to the PJM Board (36 days for comment period)

July 10th TEAC

Tuesday, July 22nd – PJM Board meeting
  - Artificial Island solution recommendation to the PJM Board
Appendix
Technical Overview
Minimum AI voltage for 230kV proposals

Comparison Method:
Assume 1.065 p.u. at the AI (unstable below 1.065), solve the power flow for the corresponding Salem and Hope Creek MVAr output. Simulate the combination of the most critical fault and outage. Do not assume the addition of an SVC.

Result:
Measure the maximum machine angle swing.
All 230 kV proposals pass the stability criteria.

<table>
<thead>
<tr>
<th>Group</th>
<th>Project ID</th>
<th>230 kV Transmission Solution</th>
<th>AI 500kV bus voltage</th>
<th>AI MVAr output</th>
<th>Critical Outage</th>
<th>Critical Contingency</th>
<th>Maximum Angle Swing (deg.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>P2013_1-5A</td>
<td>LS Power</td>
<td>1.065 pu</td>
<td>1044</td>
<td>5015*</td>
<td>14b**</td>
<td>102</td>
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<td>1.1</td>
<td>P2013_1-2B</td>
<td>Transource (AEP)</td>
<td>1.065 pu</td>
<td>965</td>
<td>5015</td>
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<td>110</td>
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<td>1.2</td>
<td>P2013_1-1B</td>
<td>DVP</td>
<td>1.065 pu</td>
<td>926</td>
<td>5015</td>
<td>14b</td>
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</table>

5015*: Hope Creek – Red Lion 500kV line
14b**: single-line-to-ground fault on the new line from Salem w/ delayed clearing due to stuck breaker
Comparison Method:
For each proposal, assume a fixed MVAR output at the Artificial Island, solve the power flow for the corresponding Artificial Island bus voltages. Simulate the combination of the most critical fault and outage. Do not assume the addition of an SVC.

Result:
Measure the maximum machine angle swing.
All 230 kV proposal pass the stability criteria.

<table>
<thead>
<tr>
<th>Group</th>
<th>Project ID</th>
<th>230 kV Transmission Solution</th>
<th>AI 500kV bus voltage</th>
<th>AI MVAR output</th>
<th>Critical Outage</th>
<th>Critical Contingency</th>
<th>Maximum Angle Swing (deg)</th>
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<tr>
<td>1.1</td>
<td>P2013_1-5A</td>
<td>LS Power</td>
<td>1.065</td>
<td>1044</td>
<td>5015</td>
<td>14b</td>
<td>102</td>
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<td>Transource (AEP)</td>
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<td>5015</td>
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<td>5015</td>
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5015*: Hope Creek – Red Lion 500kV line
14b**: single-line-to-ground fault on the new line from Salem w/ delayed clearing due to stuck breaker
Comparison Method:
For each proposal, assume a fixed MVAr output at the Artificial Island, solve the power flow for the corresponding Artificial Island bus voltages. Simulate the combination of the most critical fault and outage. Do not assume the addition of an SVC.

Result:
Measure the maximum machine angle swing.
All 230 kV proposal pass the stability criteria.

<table>
<thead>
<tr>
<th>Group</th>
<th>Project ID</th>
<th>230 kV Transmission Solution</th>
<th>AI 500kV bus voltage</th>
<th>AI MVAr output</th>
<th>Critical Outage</th>
<th>Critical Contingency</th>
<th>Maximum Angle Swing (deg)</th>
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</table>

5038*: New Freedom – East Windsor 500kV line
2b**: single-line-to-ground fault on Hope Creek-Red Lion 500kV line w/ delayed clearing due to stuck breaker
Comparison Method:
For each proposal, assume the addition of an SVC at each of three locations. Simulate the combination of the most critical fault and outage.

Result:
Measure the maximum machine angle swing.
All 230 kV proposals with SVC additions pass the stability criteria with greater margin than without SVCs.

<table>
<thead>
<tr>
<th>Project ID</th>
<th>230 kV Transmission Solution</th>
<th>SVC option</th>
<th>AI 500kV Bus Voltage</th>
<th>AI MVar Output</th>
<th>Critical Outage</th>
<th>Critical Contingency</th>
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<td>P2013_1-2B-SVC</td>
<td>Transource (AEP)</td>
<td>Artificial Island</td>
<td>1.042</td>
<td>664</td>
<td>5015</td>
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<td>Orchard</td>
<td>1.042</td>
<td>662</td>
<td>5015</td>
<td>14b</td>
<td>105</td>
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<td></td>
<td>New Freedom</td>
<td>1.042</td>
<td>662</td>
<td>5015</td>
<td>14b</td>
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<td>P2013_1-2A-SVC</td>
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<td>14b</td>
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</table>

Note: The study results are obtained under the assumption of unity power factor at the high side of GSU.
## Compare TCSC + SVC (assumes +750 MVAR) alternative to 230 kV + SVC alternatives

<table>
<thead>
<tr>
<th>Project</th>
<th>Project ID</th>
<th>TO</th>
<th>SVC location</th>
<th>AI 500kV bus voltage</th>
<th>AI MVar output</th>
<th>Outage</th>
<th>Contingency</th>
<th>Maximum Angle Swing</th>
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<tbody>
<tr>
<td>230kV+SVC</td>
<td>P2013_1-5A-SVC</td>
<td>LS Power</td>
<td>New Freedom</td>
<td>1.032</td>
<td>645</td>
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<td>2a</td>
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<td>Transource</td>
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<td>Transource</td>
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<td>1.037</td>
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<tr>
<td>TCSC+SVC</td>
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<td>DVP</td>
<td>New Freedom</td>
<td>1.029</td>
<td>645</td>
<td>5038</td>
<td>2a</td>
<td>88</td>
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</table>
• Load Flow Analysis
  – 230 kV Transmission Solutions
    • No thermal or voltage violations identified for summer peak case
  – New 500 kV transmission from the Artificial Island to Red Lion 500 kV
    • No thermal or voltage violations identified for summer peak case
• Short Circuit Analysis
  – 230 kV Transmission Solutions
    • Several 50 kA circuit breakers over duty ed at Red Lion 230 kV
  – New 500 kV transmission from the Artificial Island to Red Lion 500 kV
    • No new over duty ed breakers identified
Cost Factors
Constructability Review – PJM Cost Estimates

• PJM performed a per-unit cost estimate analysis

• Major components account for 70% - 90% of estimated material and construction costs
  – Submarine cable at $5.3 million per mile
  – 500kV aerial at $3.6 million per mile
  – Aerial Delaware river crossing at $100 million
  – 500/230kV auto transformer at $7.8 to $10.5 million per phase
Constructability Review – PJM Cost Estimates

• Costs independently estimated in collaboration with PJM outside consultants
  – Engineering at 2.5%
  – Project management at 5%
  – Contingency range from 15% to 40%

• Estimate Sources
  – RTEP project cost estimates and actuals
  – Inputs from multiple outside consultants
  – Industry sources
<table>
<thead>
<tr>
<th>Class</th>
<th>Proposals</th>
<th>PJM Estimate</th>
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<tbody>
<tr>
<td>Southern Crossing Lines</td>
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<tr>
<td>(Submarine)</td>
<td>LS Power 5A - Submarine Option</td>
<td>$248 $302</td>
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<td>Transource 2B - North Cedar Creek</td>
<td>$257 $313</td>
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<td>Transource 2A - Cedar Creek Expansion</td>
<td>$366 $446</td>
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<tr>
<td>Southern Crossing Lines</td>
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<td>(Overhead)</td>
<td>LS Power 5A - Overhead</td>
<td>$211 $257</td>
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<tr>
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<td>Dominion 1B - 500kV Overhead</td>
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<td>Red Lion to Salem Lines</td>
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<td>PHI/Exelon 4A - Red Lion to Salem</td>
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<td>LS Power 5B - Red Lion to Salem</td>
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<td>Transource 2C - Red Lion to Salem</td>
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<td>Red Lion to Hope Creek Lines</td>
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<td>Dominion 1C - Red Lion to Hope Creek</td>
<td>$242 $294</td>
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<td>PSE&amp;G 7K- Red Lion to Hope Creek</td>
<td>$249 $304</td>
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<td>Dominion – Red Lion to Hope Creek (No New Bus Tie)</td>
<td>$211 $257</td>
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<tr>
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<td>PSE&amp;G – Red Lion to Hope Creek (No New Bus Tie)</td>
<td>$211 $257</td>
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</table>
Revision History
• Original Version Distributed to PJM TEAC
  – V1 – 6/16/2014 – Original Version presented to the PJM TEAC
  – V2 – 6/16/2014 – Modified slide 31 – “Project Designation Differentiating Factor” to include FirstEnergy