



## PJM's 2014 Regional Transmission Expansion Plan

### Transmission Plan Proposed for Approval to Proceed with Construction Related to the 2014 Baseline Regional Transmission Expansion Plan

#### EXECUTIVE SUMMARY

On February 11, 2014 the PJM Board of Managers approved changes to the Regional Transmission Expansion Plan (RTEP), totaling over \$281.47 million, to resolve identified baseline reliability criteria violations and to incorporate network upgrades associated with new interconnection customers.

At the July PJM Board of Managers meeting PJM staff recommended a number of baseline upgrades to address violations that will occur for the anticipated deactivation of B. L. England generation in the Atlantic City Electric transmission zone. Although PJM has not been formally notified that the generation will deactivate, the units are considered to be at-risk. Baseline upgrades to address these issues are summarized below and were presented for the Board Reliability Committee's (BRC) consideration and for recommendation to the Board for approval. The projects described in this whitepaper were approved by the PJM Board of Managers. The total increase to the RTEP to include these baseline project additions and include these upgrades is \$143.6million. With these changes, the RTEP will include over \$29,308 million of transmission additions and upgrades since the first plan was approved by the Board in 2000.

In addition to the changes associated with the B. L. England units, PJM staff also reviewed the Artificial Island operational performance issue and proposed upgrades at the July board meetings. See the letter from Mr. Herling to the TEAC posted at the following link: <http://pjm.com/~media/committees-groups/committees/teac/20140807/20140807-teac-artificial-island-letter.ashx>

# Artificial Island

## Operational Performance Issue

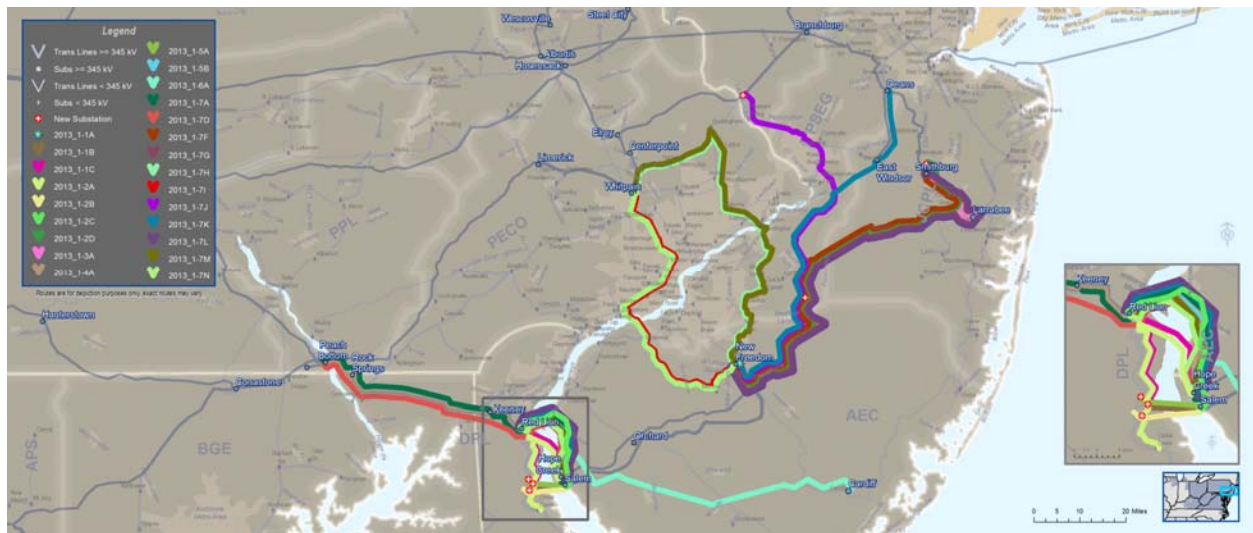
“Artificial Island” is the area in Southern New Jersey where the Salem and Hope Creek nuclear generation is located. The area has historically been stability constrained. Stability of the generation has been ensured through the use of operating procedures that require a minimum reactive output for each of the generators under various operating conditions. Higher generator reactive output generally results in higher local system voltages. Maintaining the minimum reactive output of each of the machines is becoming increasingly difficult while still respecting system high voltage limits. These issues are made even worse under transmission maintenance conditions since removing transmission typically requires maintaining higher reactive output from each of the generators.

## Proposal Window

In April of 2013 PJM opened a 60 day proposal window to solicit projects from stakeholders to address the operational performance issues around Artificial Island. PJM received 26 proposals from 7 different entities. The proposals, which are summarized in the table below, range in cost from just over \$100 million to over \$1,500 million and include FACTS devices, HVDC lines, new overhead and underground/underwater 230 kV lines and new overhead 500 kV lines. Additional information on each of the proposals is included in Appendix A – Artificial Island Proposal Descriptions.

| Project ID | TO                              | Cost (\$)                          | Major Components   | Supporting info   |
|------------|---------------------------------|------------------------------------|--|---|
| P2013_1-1A | Virginia Electric and Power Com | \$ 133                             | 500 MVAR SVC near New Freedom  | Two (2) Thyristor Controlled Series Compensation (TCSC) Devices near New Freedom                                |
| P2013_1-1B | Virginia Electric and Power Com | \$ 126                             | New 500 kV from Salem - a new station in Delaware  | New 500/230 kV station in Delaware that taps existing Cedar Creek - Red Lion 230kV and Catanza - Red Lion 230kV |
| P2013_1-1C | Virginia Electric and Power Com | \$ 202                             | New 500 kV from Hope Creek - a new Station in Delaware   | Install a new 500kV line from Hope Creek - Red Lion; New Salem - Hope Creek 500 kV line                         |
| P2013_1-2A | Transource                      | \$213 - \$269                      | Salem - Cedar Creek 230 kV   | Two (2) 500/230 Transformers near Salem; Loop in Red Lion - Catanza 230 to Cedar Creek                          |
| P2013_1-2B | Transource                      | \$165 - \$208                      | Salem - North Cedar Creek (new) 230 kV   | Two (2) 500/230 transformers near Salem and loop in Red Lion - Cartanza 230 and Red Lion - Cedar Creek 230 kV   |
| P2013_1-2C | Transource                      | \$123 - \$156                      | Salem - Red Lion 500 kV  |   |
| P2013_1-2D | Transource                      | \$788 - \$994                      | New Freedom - Lumberton - North Smithburg (New) 500 kV line  | New Salem - Hope Creek 500 kV line and new 500/230 station east of Lumberton                                    |
| P2013_1-3A | First Energy                    | \$410.7 (Only FirstEnergy portion) | New Freedom-Smithburg 500 kV line with a loop into Larrabee  | Hope Creek - Red Lion 500 kV line   |
| P2013_1-4A | PHI Ekelon                      | \$ 475                             | Peach Bottom - Keeney - Red Lion - Salem 500 kV  | Remove Keeney - Red Lion 230 kV; Reconfigure 230 around Hay Road; Reconductor Harmony-Chapel St 138 kV          |
| P2013_1-5A | LS Power                        | \$116.3M - \$148.3M                | Salem - Silver Run (new) 230 kV; Salem 500/230 kV Transformer  | New 230 kV station that taps existing Cedar Creek - Red Lion 230kV and Catanza - Red Lion 230kV                 |
| P2013_1-5B | LS Power                        | \$ 170                             | Salem - Red Lion 500 kV  |   |
| P2013_1-6A | Atlantic Wind                   | \$ 1,012                           | 320 kV HVDC Salem/Hope Creek - Cardiff   | SVC at Salem/Hope Creek; New HVDC Stations at Cardiff and Salem   |
| P2013_1-7A | PSE&G                           | \$ 1,371                           | Salem-Hope Creek to Peach Bottom 500 kV  | Existing ROW  |
| P2013_1-7B | PSE&G                           | \$ 1,372                           | Salem-Hope Creek to Peach Bottom 500 kV  | Same as 7A with Loop into Keeney  |
| P2013_1-7C | PSE&G                           | \$ 1,372                           | Salem-Hope Creek to Peach Bottom 500 kV  | Same as 7A with Loop into Red Lion  |
| P2013_1-7D | PSE&G                           | \$ 831                             | Salem-Hope Creek to Peach Bottom 500 kV  | Same as 7A with New ROW   |
| P2013_1-7E | PSE&G                           | \$ 692                             | New Freedom - Deans 500 & Salem - Hope Creek 500 kV lines  |   |
| P2013_1-7F | PSE&G                           | \$ 879                             | New Freedom - Smithburg and Salem-Hope Creek 500 kV lines  | Existing ROW  |
| P2013_1-7G | PSE&G                           | \$ 1,034                           | New Freedom - Smithburg and Salem-Hope Creek 500 kV lines  | Same as 7F with a Loop into a new Larrabee 500 kV station   |
| P2013_1-7H | PSE&G                           | \$ 1,177                           | New Freedom - Whitpain and Salem - Hope Creek 500 kV lines   | Northern Route  |
| P2013_1-7I | PSE&G                           | \$ 1,353                           | New Freedom - Whitpain and Salem - Hope Creek 500 kV lines   | Same as 7H with the Southern Route  |
| P2013_1-7J | PSE&G                           | \$ 915                             | New Freedom - New Station on Branchburg-Elroy 500 kV line ("5017 Junction") and Salem - Hope Creek 500 kV line   | Existing ROW  |
| P2013_1-7K | PSE&G                           | \$ 1,066                           | New Freedom - Deans & Salem - Hope Creek - Red Lion 500 kV lines w/ Hope Creek - Red Lion (new);   | Same as 7E with Hope Creek - Red Lion   |
| P2013_1-7L | PSE&G                           | \$ 1,250                           | New Freedom - Smithburg & Salem - Hope Creek - Red Lion 500 kV lines w/ Hope Creek - Red Lion (new);   | Same as 7F with Hope Creek - Red Lion   |
| P2013_1-7M | PSE&G                           | \$ 1,548                           | New Freedom - Whitpain (North) & Salem - Hope Creek - Red Lion 500 kV lines w/ Hope Creek - Red Lion (new);  | Same as 7H with Hope Creek - Red Lion   |
| P2013_1-7N | PSE&G                           | \$ 1,289                           | New Freedom - a new Station on the Branchburg-Elroy 500 kV line ("5017 Junction") & Salem-Hope Creek - Red Lion 500 kV lines w/ Hope Creek - Red Lion (new); |   |

The locations of the various proposals are shown on the following map.



## Proposal Evaluation

The proposals were evaluated from several different perspectives to identify the most efficient and effective solution. PJM staff completed extensive technical evaluations of each of the proposals that included stability, thermal, voltage and short circuit assessments. In addition, “constructability” reviews of the proposals were completed to review the overall feasibility and anticipated cost associated with the proposals. Staff met with the entities that proposed the projects as needed to get clarification on the proposals. In addition, staff met with PJM Operations, Artificial Island plant representatives and equipment manufacturers to solicit their feedback on the proposals.

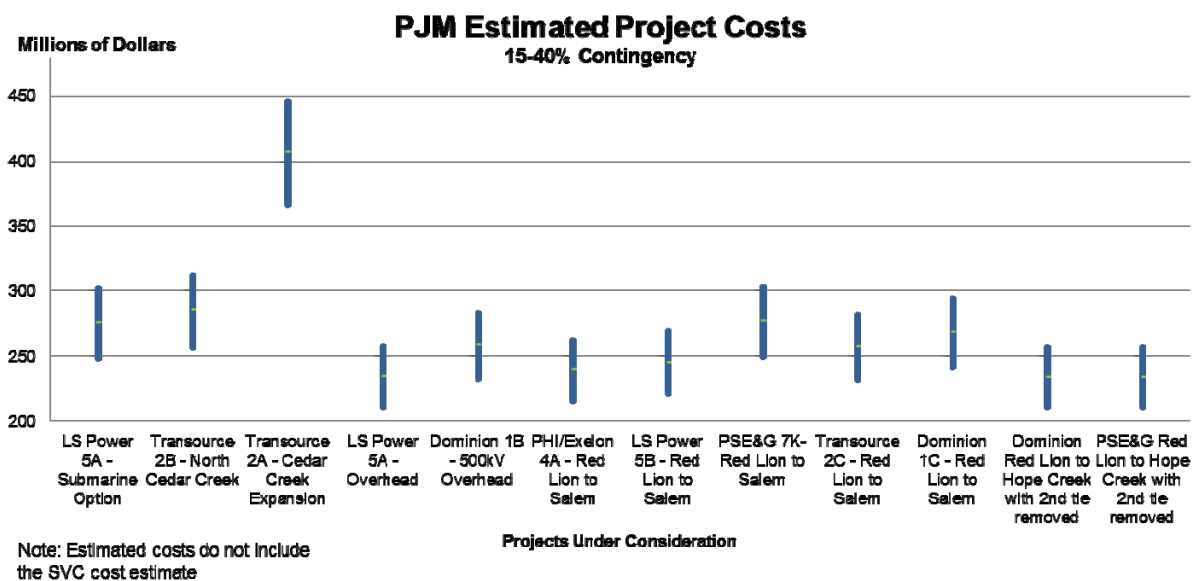
PJM staff performed an initial analytical screen of all of the proposals and found that only two of the projects as proposed satisfied PJM criteria. However, PJM staff determined that many of the proposals could be made more effective or efficient with some modification. The modifications included substation configuration changes, device changes such as increasing the size of a Static Var Compensator (SVC), and adding or removing substation components such as circuit breakers and SVCs. Considering the results of the analytical screening and the estimated cost of each of the proposals, PJM began to focus on a subset of proposals that included projects to build new lines from Artificial Island, across the Delaware River to transmission facilities in Delaware. The subset of proposals included both southern Delaware River crossings (both overhead and submarine) that terminated at the existing 230 kV system in Delaware and new 500 kV lines from either Hope Creek or Salem substations to the Red Lion 500 kV substation in Delaware.

The Delaware River crossing proposals were further evaluated for a number of factors including technical analysis. The technical analysis considered things such as generator rotor angle swing, voltage and thermal performance, short circuit, and NERC category D performance. All of the proposals with the PJM modifications noted above satisfied the required criteria. In addition, production cost simulations were done to determine the market efficiency benefits of the different proposals. These simulations showed that there were market efficiency benefits of the proposals however they were only on the order of several million

dollars per year and were far below the savings that would be required to satisfy the market efficiency criteria.

In addition to the evaluation of the technical performance of the Delaware River crossing proposals, projects were also evaluated for cost, schedule, operational factors, and factors or risks to cost and schedule. PJM engaged outside consultants to perform independent constructability reviews. These reports were factored into PJM's overall constructability evaluation.

The PJM estimated cost of the proposed projects ranged in cost from just over \$200 million to just over \$300 million with the exception of the Transource-2A proposal. The estimated costs are shown in the table below. Note that a range of cost for each proposal is shown below considering the risk and contingency variance for project components that ranged from 15% to 40%.



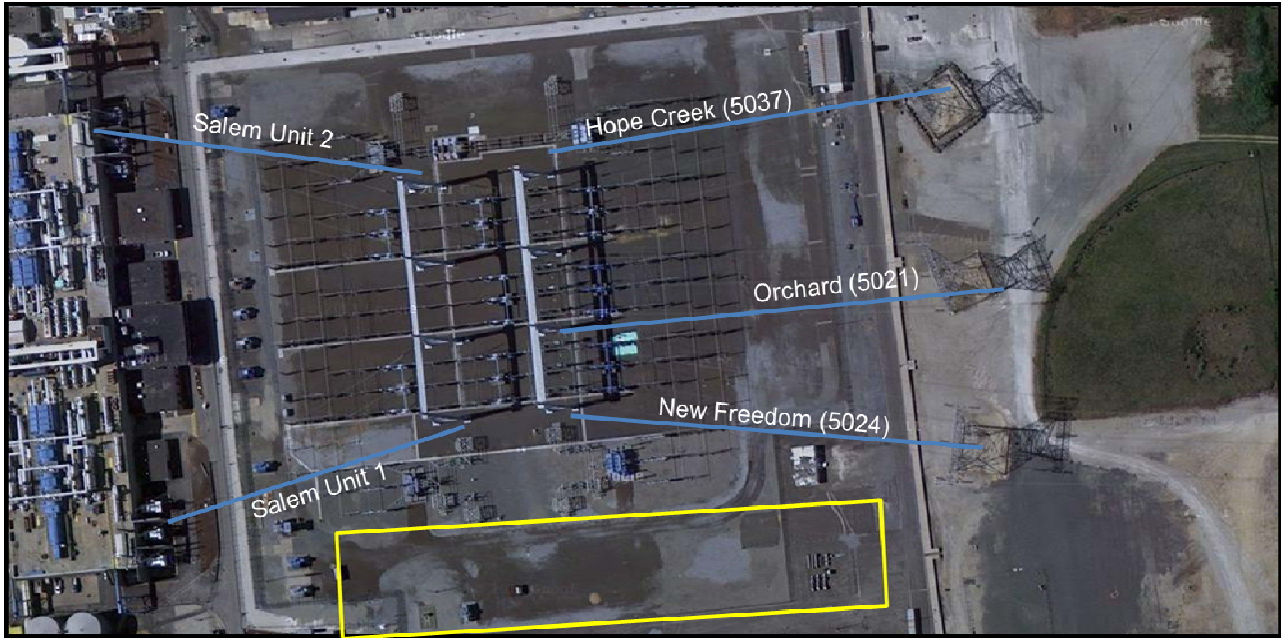
Cost estimates were driven by four major components:

- Delaware River Crossing (aerial)
- Submarine Cable Installation
- 500 kV Transmission Line Installation
- 500/230 kV Auto-Transformers

Factors considered for project schedule included permitting, construction and long-lead time equipment. Multiple permits would be required for any of the proposals including CPCN or the equivalent from two states as well as permits from the Army Corp of Engineers. The construction schedule for any of the proposals would need to consider spawning and nesting seasons of endangered species however the southern crossing 230 kV submarine lines would also need to consider the time for obtaining or scheduling the specialized equipment required for installation of submarine cable. Materials can also impact overall project schedule. Long lead time materials for the southern crossing proposals include the 500/230 kV auto-transformers that would be required and the submarine cable and associated terminations that would be required for the submarine southern 230 kV crossings.

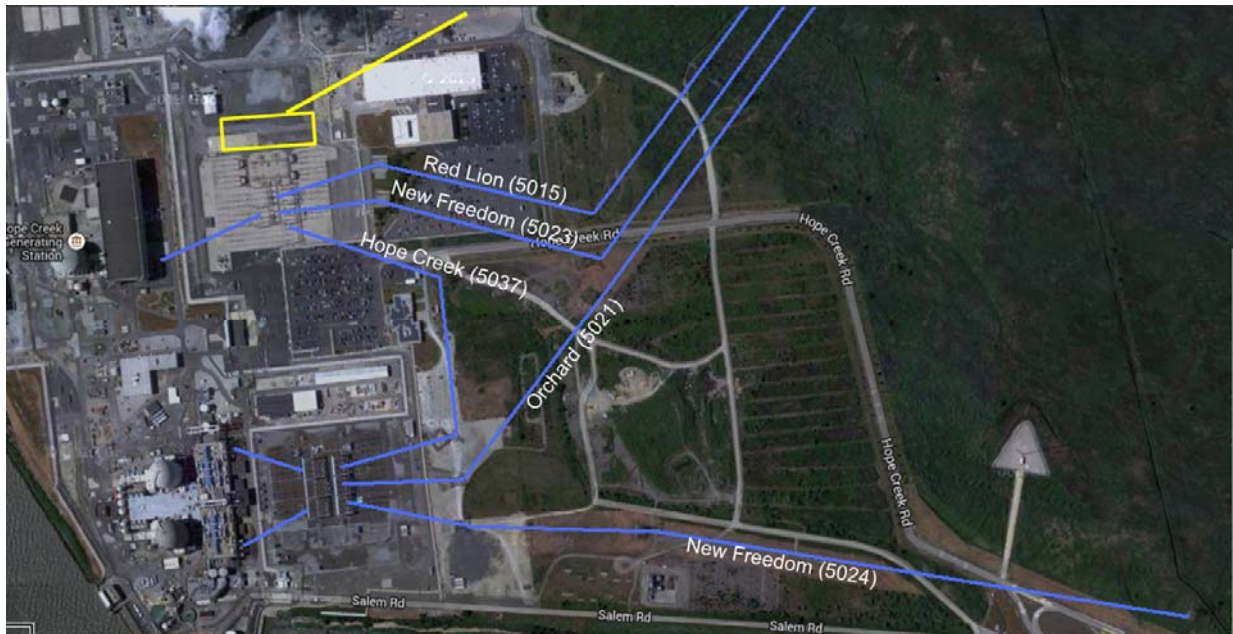
Risks to project cost and schedule were also considered in the evaluation of the proposals. Factors that could impact overall project cost and schedule include overall project complexity, right-of-way and land acquisition, and siting and permitting. All of the proposals will face challenges from a siting and permitting perspective and public opposition can be expected for all of the proposals. All of the projects would require a Delaware River crossing. All projects will require approval to cross coastal state lands and in addition, the Artificial Island to Red Lion 500 kV proposals will need approval to cross the Supawna Meadows National Wildlife Refuge. All of the projects are likely to impact wetlands which may require remediation and/or special construction methods to minimize impact. All of the projects will need to acquire land and right-of-way however there is existing right-of-way along the Hope Creek to Red Lion route that will need to be expanded in some locations to accommodate a second 500 kV line. Overall project complexity may also impact cost and schedule. All of the projects will require outages to interconnect to the existing system. The outages will need to be closely coordinated with Artificial Island operating personnel as well as with other required transmission system outages. Line crossings also add additional complexity to some of the proposals from the design, construction and operational perspectives. Projects with no line crossings are preferred. The extent to which proposals require modifications to the Artificial Island substations is also a factor related to project complexity. Projects that minimize the modifications required at the Artificial Island substations, and in particular the Salem substation, are viewed as more constructible due to the limited space for expansion and the complexity of installing new protection and control equipment in the secure area of the generating station at Salem.

The proposals were also evaluated from an operational impact perspective. Several operational impact factors were evaluated including on-going maintenance requirements, route diversity, blackstart benefits and Artificial Island facility requirements. The 230 kV projects are considered to have additional on-going maintenance needs primarily due to the new 500/230 kV transformers and associated equipment. In addition, projects that would utilize portions of the Salem substation would likely have additional maintenance needs from salt contamination due to the proximity to the river. Artificial Island facility requirements were also a consideration for operational impact. All of the projects will impact Artificial Island facilities to some degree however proposals that involve the Salem substation are considered to have a greater impact.



The picture above is an aerial view of the Salem Substation. Proposed space for expansion of the substation is highlighted by the yellow box. Most of the projects had proposed using this parcel of property to interconnect either a new 500 kV line bay for the proposals to add a new line to Red Lion, or to install equipment associated with a new 500/230 kV substation. Any additions to this section of the substation would need to be carefully designed given the proximity to the connections to the Salem 1 generator step-up leads. In addition, installing equipment in this section of the substation would impede access to station auxiliary transformers shown just above and to the left of the yellow box. In addition, the Salem to Red Lion 500 kV proposals would need to either relocate and/or cross existing lines. Finally, all of the controls for the Salem substation are located within the protected area of the generating station. There is currently limited spare conduit from the substation back into the plant that could be used for any of the control cable associated with the new substation facilities.

By way of comparison, the picture below provides an aerial view of the Artificial Island complex, including Hope Creek substation. Proposals to build a new line from Hope Creek to Red Lion would likely utilize the space in the yellow box. This space is believed to be of sufficient size for a new 500 kV line bay, and use of this space would not significantly impede access to station equipment as compared to the alternatives out of Salem. Controls for the equipment in the Hope Creek substation are located in a separate control building in the substation yard, eliminating the need to run new control cable into either Hope Creek or Salem protected areas. Finally, building a new 500 kV line from this part of the Hope Creek substation to Red Lion would not introduce any new 500 kV line crossings.



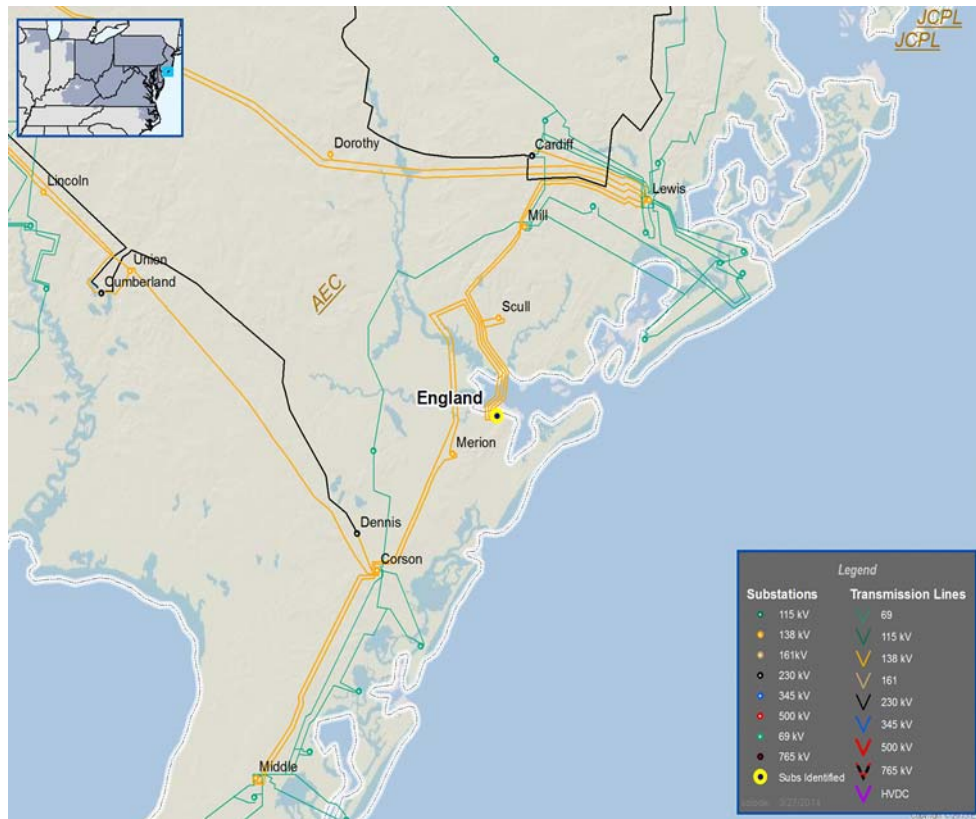
Considering all of these factors, proposals out of the Hope Creek substation that do not impact the Salem substation are preferred from an operational impact perspective.

The projects were also evaluated based on their impact to the thermal and voltage performance of the system. The southern river crossing proposals that were interconnecting with 230 kV facilities along the Delmarva Peninsula are expected to be very lightly loaded under normal conditions. The 500 kV path from Peach Bottom through Keeney and Red Lion to the Artificial Island is normally heavily loaded and is often a limiting contingency for transfers into the eastern part of PJM. Given that, the proposals between Red Lion and the Artificial Island will make the system more robust by providing additional transmission capability along a heavily loaded path and by eliminating a critical contingency improving overall reactive performance of the system.

#### PJM Staff Recommendation

In consideration of all of these factors, PJM staff prepared a recommendation to the PJM Board to build a new 500 kV line from Hope Creek to Red Lion be added to the RTEP to address the Artificial Island operational performance issues. In addition, PJM staff noted that stakeholders could comment on their recommendation. The PJM Board received a wide range of comments from interested stakeholders related to among other things, electrical performance, environmental impact and cost allocation. In addition LS Power, in its comments to the PJM Board modified their initial proposal to include a fixed cost cap on their proposal. The PJM Board deferred decision on the issue and asked PJM staff to take a number of additional steps. These additional actions are noted in the letter from Mr. Herling to the TEAC which is posted at the following link: <http://pjm.com/~media/committees-groups/committees/teac/20140807/20140807-teac-artificial-island-letter.ashx>

## B. L. England At-Risk Analysis

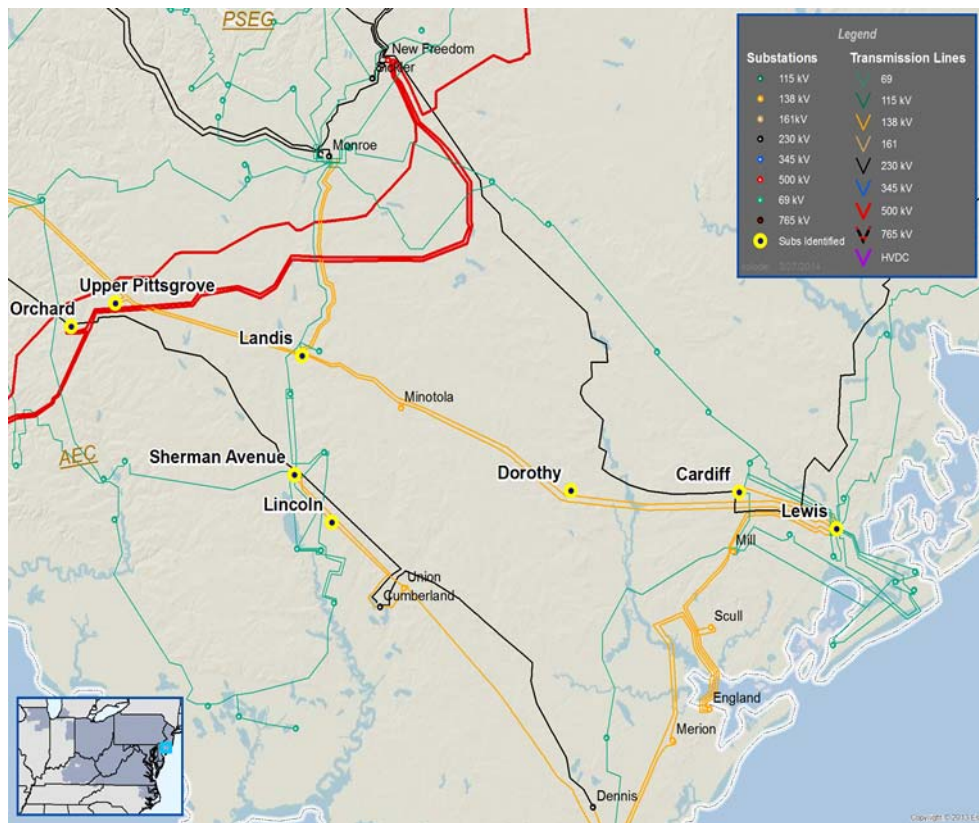


PJM staff completed a series of “at-risk” scenario studies related to the B. L. England units in the Atlantic City Electric transmission zone. These studies evaluated the impact to the system of the complete shutdown of all generation at the site by June of 2015. There are currently three steam units and four diesel units at the site. The B. L. England #1 unit is a 129 MW coal fired unit that retired in May of this year. In January of 2013 we were notified by the owners of the B. L. England diesels, which total 8 MW, of their intent to deactivate the units in the fall of 2015. The B. L. England #2 and #3 units are 155 MW oil fired steam units that had notified PJM back in 2004 of their intent to deactivate but withdrew that notice in 2007. In addition the #2 unit is under a consent order to shut down in 2017 due to environmental concerns. The owners of the B. L. England generators have entered an interconnection queue request (Y1-001) to build a new gas fired combustion turbine on site to replace the existing generation. The request is currently suspended. Earlier in 2014, a permit for the construction of a new gas pipeline to the B. L. England facility was rejected.

PJM staff evaluated the impact of the deactivation of all of the generation at B. L. England. Deactivation of all of the generation at B. L. England will have an adverse impact on the reliability of the transmission system. Specifically PJM staff identified a number of thermal and voltage reliability criteria violations primarily on the 138 kV and 69 kV systems in Atlantic City Electric. The following transmission upgrades were identified to address the potential thermal and voltage violations:



- Install new Dennis 230/69 kV transformer, environmental work –\$15.2 M
- Upgrade 138 kV and 69 kV breakers at Corson substation – \$0.8 M
- Reconductor 2.74 miles of Sherman - Lincoln 138 kV line and associated substation upgrades - \$4.22 M
- New Orchard - Cardiff 230 kV line (remove, rebuild and reconfigure existing 138 kV line) and associated substation upgrades - \$69.25 M
- New Upper Pittsgrove - Lewis 138 kV line and associated substation upgrades - \$7.23 M
- Relocate Monroe to Deepwater Tap 138 kV to Landis 138 kV and associated substation upgrade - \$0.57 M
- New Landis - Lewis 138 kV line and associated substation upgrades - \$31.03 M
- New Cardiff - Lewis #2 138 kV line and associated substation upgrades - \$11.26 M
- Install a 100 MVAR capacitor bank and B. L. England - \$4 M



It should be noted that a number of these upgrades will use existing right-of-way and will address an aging infrastructure issue for a roughly 40 mile 138 kV double circuit tower line.

Given the concerns that the existing generation at B. L. England will shut down due to environmental / economic concerns and the viability of the new generation given the permitting issues related to the new gas pipeline, PJM staff recommended the upgrades described above be added to the 2014 RTEP. If the status of the existing or proposed generation at B. L. England changes, staff will re-evaluate the need for the upgrades.

### **Review by the Transmission Expansion Advisory Committee (TEAC)**

The results of the evaluation summarized in this report were reviewed with the TEAC throughout the process. The most recent analyses, along with the recommended solutions, were reviewed at the June 16, 2014 TEAC meeting for the Artificial Island upgrades and June 5<sup>th</sup>, 2014 TEAC meeting for the B. L. England upgrades. Written comments were requested to be submitted to PJM communicating any concerns with the recommendations and any alternative transmission solutions for consideration. .


### **Cost Allocation**

Pursuant to FERC order, the allocations for the preliminary baseline reliability upgrades associated with the B. L. England “at-risk” studies that were recommended to the PJM Board were developed using the new “use based” allocation methodology. The preliminary cost allocations are attached at the end of this whitepaper.


### **Board Approval**

The PJM Board Reliability Committee was requested to endorse the new baseline reliability projects associated with the BL England at-risk analysis and associated cost allocations and recommend to the Board approval of the baseline upgrades to the 2014 RTEP.


On July 23<sup>rd</sup>, 2014, the PJM Board approved the changes to the RTEP associated with the BL England at-risk analysis as described within this document.

 Dominion Virginia Power (DVP) 1A


- 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



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 Dominion Virginia Power (DVP) 1B

- 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



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### Dominion Virginia Power (DVP) 1C

- 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


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### Transource (AEP) 2A


- 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

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- 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

## Transource (AEP) 2B

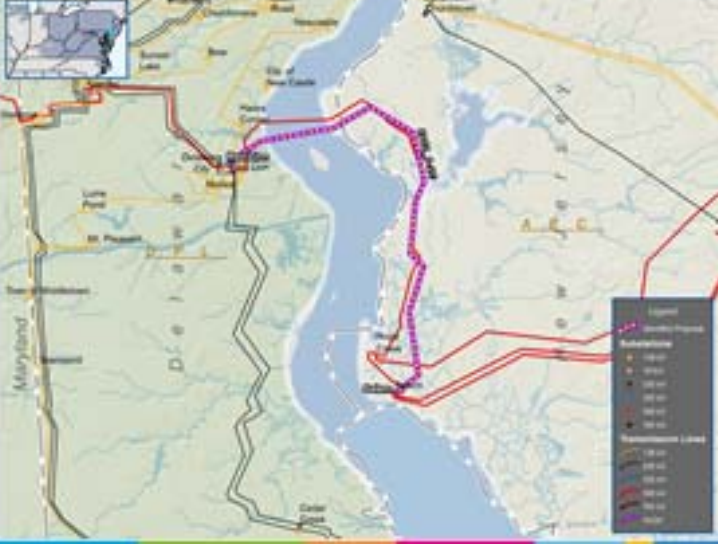


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- Expansion of Salem substation
- Move 5024 and 5021 line bays within Salem substation
- 17 mile 500kV line from Red Lion to Salem
  - Parallels existing 5015 Red Lion to Hope Creek 500 kV line
- Reconfiguration of Red Lion substation into a breaker and a half scheme
- Proposed Cost Estimate: \$123-\$156MM


## Transource (AEP) 2C




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 **Transource (AEP) 2D**


- 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



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 **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




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### PHI / Exelon 4A

- 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




The map displays the project area across Maryland and Delaware. A new 500kV line is shown in red, connecting Peach Bottom, Keeney, Red Lion, and Salem. Existing 230kV lines are shown in black, with a reconfiguration from Hay Road to Red Lion. A 138kV line is shown in purple, connecting Harmony to Chapel Street. A legend on the right side of the map lists various line types and voltages.

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### LS Power 5A

- 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




The map displays the project area across Maryland and Delaware. A new 500kV line is shown in red, connecting Salem to a new substation in Delaware. Existing 230kV lines are shown in black, with a new substation in Delaware tapping into the Red Lion to Cartanza and Red Lion to Cedar Creek lines. A legend on the right side of the map lists various line types and voltages.

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### LS Power 5B

- 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




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### Atlantic Wind 6A

- 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




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### PSE&G 7A

- 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



The map displays the project area for PSE&G 7A, showing a network of transmission lines and substations. A pink line indicates the proposed new Hope Creek to Peach Bottom 500 kV line. Other lines are color-coded by voltage: 500 kV (red), 345 kV (orange), 230 kV (yellow), 138 kV (green), and 69 kV (blue). Substations are marked with black dots. The map includes an inset map of the region and a legend for line types and voltages.

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### PSE&G 7B

- 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




The map displays the project area for PSE&G 7B, showing a network of transmission lines and substations. A pink line indicates the proposed new Hope Creek to Keeney to Peach Bottom 500 kV line. Other lines are color-coded by voltage: 500 kV (red), 345 kV (orange), 230 kV (yellow), 138 kV (green), and 69 kV (blue). Substations are marked with black dots. The map includes an inset map of the region and a legend for line types and voltages.

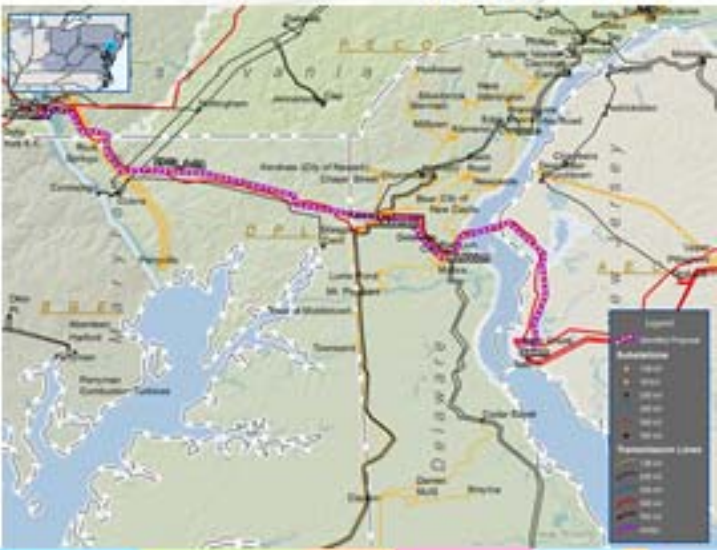
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 **PSE&G 7C**

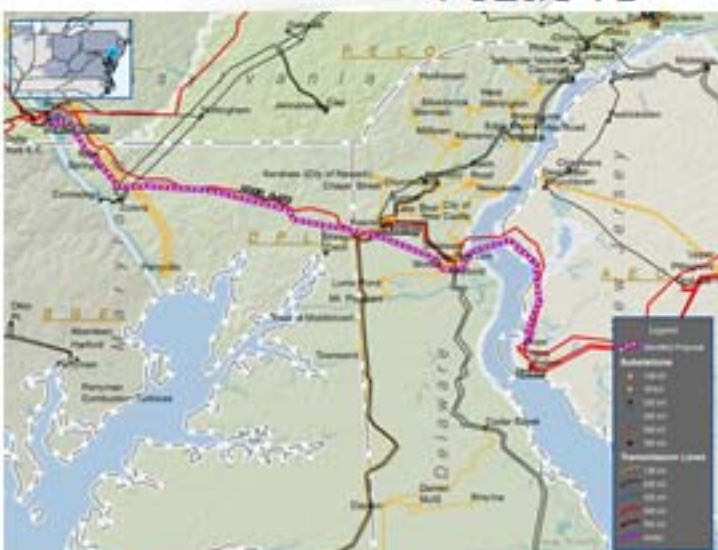
- Second Salem to Hope Creek tie line
- Install a new Hope Creek to Red Lion to Peach Bottom 500 kV line on existing right of way
- Tie 5036 and 5015 lines together to open a bay position at Red Lion substation
- Proposed Cost Estimate: \$1,372MM




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 **PSE&G 7D**


- 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




PJM T&E - Artificial Island 06/16/2014 26 PJM2014

 PSE&G 7E


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




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 PSE&G 7F


- Second Salem to Hope Creek tie line
- Install a new Smithburg to New Freedom 500kV line
- Proposed Cost Estimate: \$879MM




PJM T&C - Artificial Island 06/16/2014 28 PJM2014

 **PSE&G 7G**


- 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




PJM T&E - Artificial Island 06/16/2014 28 PJM2014

 **PSE&G 7H**


- 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




PJM T&E - Artificial Island 06/16/2014 30 PJM2014

 **PSE&G 7I**


- Second Salem to Hope Creek tie line
- Install a new Whippain to New Freedom 500kV line using a southern route
- Proposed Cost Estimate: \$1,353MM




PJM T&C - Artificial Island 06/16/2014 31 PJM2014

 **PSE&G 7J**


- 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




PJM T&C - Artificial Island 06/16/2014 32 PJM2014

 **PSE&G 7K**


- 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



PJM T&E - Artificial Island 06/16/2014 33 PJM2014

 **PSE&G 7L**

- 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 Smithburg to New Freedom 500kV line
- Proposed Cost Estimate: \$1,250MM




PJM T&E - Artificial Island 06/16/2014 34 PJM2014

**pjm**

### PSE&G 7M

- 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



PJM T&C - Artificial Island 06/16/2014 36 PJM2014

**pjm**

### PSE&G 7N

- 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



PJM T&C - Artificial Island 06/16/2014 38 PJM2014

## Appendix B – RTEP Baseline Upgrade Cost Allocation

### Single Zone Allocations

| Upgrade ID | Description   | Cost Estimate (\$M) | Cost Allocation |
|------------|---|---------------------|-----------------|
| b2476      | Install new Dennis 230/69 kV transformer  | \$15.29             | AEC - 100%      |
| b2477      | Upgrade 138 kV and 69 kV breakers at Corson substation                                      | \$0.80              | AEC - 100%      |
| b2478      | Reconductor 2.74 miles of Sherman - Lincoln 138 kV line and associated substation upgrades  | \$4.33              | AEC - 100%      |
| b2480.1    | New Upper Pittsgrove - Lewis 138 kV line and associated substation upgrades                 | \$7.80              | AEC - 100%      |
| b2480.2    | Relocate Monroe to Deepwater Tap 138 kV to Landis 138 kV and associated substation upgrades | \$0.57              | AEC - 100%      |
| b2480.3    | New Landis - Lewis 138 kV line and associated substation upgrades                           | \$31.03             | AEC - 100%      |
| b2481      | New Cardiff - Lewis #2 138 kV line and associated substation upgrades                       | \$11.54             | AEC - 100%      |
| b2489      | Install a 100 MVAR capacitor at BL England  | \$4.00              | AEC - 100%      |

### Multiple Zone Allocations

| Upgrade ID | Description   | Cost Estimate (\$M) | Cost Allocation             |
|------------|---|---------------------|-----------------------------|
| b2479      | New Orchard - Cardiff 230 kV line (remove, rebuild and reconfigure existing 138 kV line) and associated substation upgrades | \$69.81             | AEC - 68.57%, JCPL - 31.43% |