# Artificial Island

Transmission Expansion Advisory Committee

March 3, 2017

Version 2

# Artificial Island Project Temporary Suspension

At their August 2016 meeting, the PJM Board of Managers directed PJM staff to temporarily suspend the project and perform a comprehensive analysis to support a future course of action due to the uncertainty around project cost estimates and the changing study parameters

- PSE&G provided cost estimates in February, 2016

- Analysis parameter updates from PSE&G and PSEG Nuclear
  - Updated critical relay clearing times
  - Generator Step-up transformer impedances
  - Generating unit excitation systems model updates
  - Artificial Island project 500/230 kV transformer anticipated impedance

# Current Artificial Island Recommendation

In consideration of all factors,  PJM staff recommends:

- Lifting the project suspension on the 230kV line from Artificial Island to the new Silver Run substation (b2633.1 and b2633.2).
- Changing the interconnection point at Artificial Island from Salem to the Hope Creek substation
- Eliminating the New Freedom SVC (b2633.3) and the OPGW relay upgrade projects (b2633.6, b2633.7, and b2633.8) from the Artificial Island project scope
- Implementing a voltage schedule for the Salem and Hope Creek units
- Revising the project in-service date to June 1, 2020

# Clearing Time Update

PSE&G Transmission Planning provided PJM information in April 2016 about clearing times associated with bus faults with delayed clearing that was not explicitly addressed in the existing operating guide

PJM has evaluated the impact of these new fault clearing times on the Artificial Island Operating Guide (AIOG) and the future configuration

- Evaluation of the AIOG:
  - Eighteen different system conditions for three units operation case were evaluated
  - With the existing/present configuration, PJM found the bus faults with delayed clearing were all stable for the studied system conditions
  - The bus faults with delayed clearing were less severe than the most critical fault defined in the AIOG in terms of margin to critical clearing time in most cases
- Impact on the future configuration:
  - The critical outage condition changes
  - The critical contingency changes

# OPGW/Relay Upgrade Reevaluation

## OPGW reevaluated due to clearing time update

## Optical ground wire (OPGW) application

- Typical benefits
  - Improved (faster) total fault clearing times that result in improved stability margin
  - May limit potential relay mis-operation resulting in an over-trip of un-faulted circuits
- High speed relaying utilizing OPGW on a number of 500kV lines is part of the existing approved solution
  - Due to the recent protection timing update, the most critical fault location has changed from a line fault to a bus fault
  - The proposed OPGW and line relay changes provide no benefit at this location to the timing of the clearing of the most critical bus fault
  - Since the timing is not improved by the OPGW and line relay changes, they will not improve the stability margin
  - OPGW and line relay changes may have other ancillary benefits however they do not directly impact the AIOG

# Current OPGW/Relay Upgrade Recommendation

- Recommendation to remove OPGW/relay upgrades from the project scope
  - Continue to evaluate OPGW/relay upgrades with respect to other relay system benefits
    - If a future need is identified for a OPGW/Relay upgrade, a solution would be pursued separately and would not be associated with the Artificial Island project

# Requirements of the Current Artificial Island Operating Guide (AIOG)

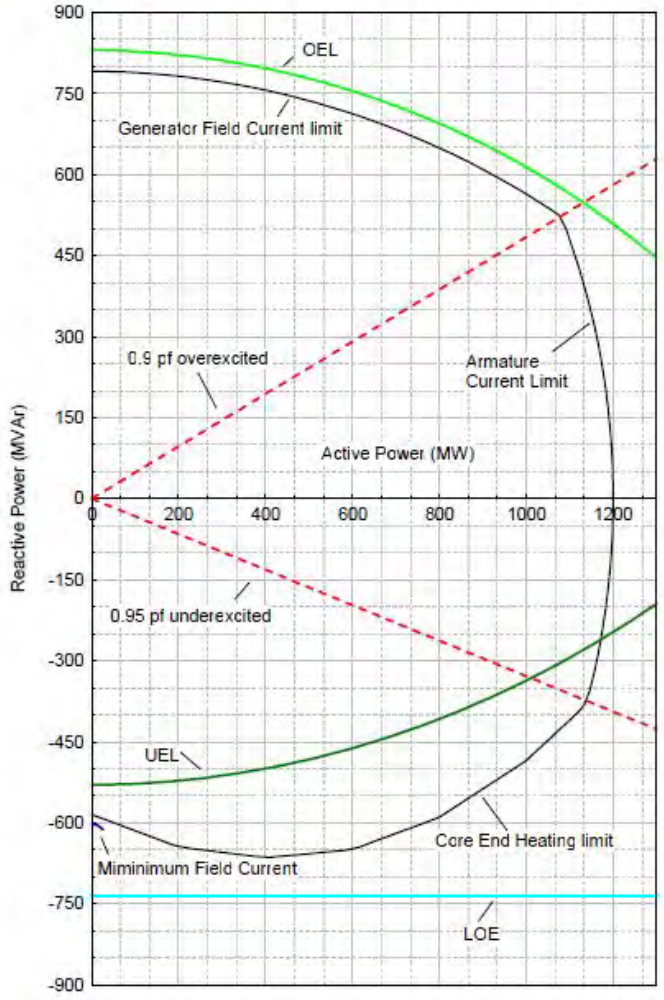
- Magnitude of simulations required
  - 19 critical outages
  - 11 unit status assumptions
  - 20 critical faults

- For each simulation, monitor several parameters
  - angle swing
  - damping
  - voltage

# AIOG – Transmission Outages Requiring Action

- Since 2000, there are several hundred instances of critical transmission line outages that required AIOG utilization

- Current AIOG process requires an operator to manually look up tables and curves and then interpolate the required MW and MVAR output based on the outage conditions



# Current PJM Recommendation

- Recommend implementation of a voltage schedule for the Salem and Hope Creek units requiring operation at or above 527.5kV and subject to final determination.
  - Statistical analysis of the units indicates this minimum voltage limit was maintained in nearly all conditions since 2012.
  - Offline studies would only be required if the Transient Stability Assessment (TSA) tool is unavailable and if the voltage schedule cannot be maintained.
- Recommend the removal of the New Freedom SVC from the project scope

# Cost Estimate and Alternative Artificial Island Attachment Analysis

# Cost and Constructability Analysis Conducted by Project Entities

- PJM, PSE&G and LS Power held multiple meetings
- More granular review and reevaluation of cost and the cost components
  - Additional marine and terrestrial surveying
  - Permit review
  - Property rights review
  - Schedule review
  - Additional site visits
  - Review of existing substation drawings
  - Preliminary engineering
  - Major equipment pricing
- Evaluation of alternatives
  - Investigated alternative Artificial Island attachments at both Salem and Hope Creek
  - Evaluated impacts to the 230kV line

# Hope Creek Attachment – Option 2B

Option 2B – Expand existing Hope Creek substation to add transformation and new interconnection

- Expand existing Hope Creek substation
- Route the new 230 kV submarine cable from DE; beach landing approximately 3000ft UG/OH in NJ to Hope Creek

# Updated Project Cost Estimates

| Project Components | Approved Artificial Island Project (July 2015) [1] | February 2016 Cost Update [1] | Current Recommended Artificial Island Project Scope [1] |
|---|---|---|---|
| 230kV Line and Silver Run Substation | $146 | $146 | $146 |
| Salem Interconnection | $61 - 74 | $152 | |
| Hope Creek 2B Interconnection | | | $132 |
| OPGW | $25 | $39 | |
| New Freedom SVC | $38 | $81 | |
| DE Interconnection | $2 | $2 | $2 |
| **Project Total** | **$272 - $285** | **$420** | **$280** |

[1] All costs are in millions.

# Approved Artificial Island Project Estimate and Timing Confidence

- $6.4 million in development and engineering work completed through August 2016
- Executed fixed price EPC agreement for submarine cable (material and installation)
- Pre-application meetings held with most permitting agencies
- All private real estate rights secured in Delaware
- Silver Run substation design complete for permitting
- Permitting level designs completed for submarine, HDD and aerial river crossings and six overland routes to support Corps alternatives analysis

Based on the current status of the project, there is increased certainty of the current cost estimate

- Current LS Power project cost estimate $133 million

# Stakeholder Input and Artificial Island Constructability Analysis

# Response to Stakeholder Input
## Fast Act Review

- Fixing America's Surface Transportation Act (Publication L. No. 114-94, Title XLI) (FAST-41) was signed into law on December 4, 2015

- The FAST Act does not amend, modify, or replace any existing federal law
  - May broadly impact existing federal environmental review and permitting practices for covered projects through:
    - enhanced (and early) communication with agencies about environmental review timelines and content
    - standardized, enforceable schedules for environmental review and permitting
    - shortened timeframes for legal challenges

- Could be applicable to the Artificial Island project

# Response to Stakeholder Input

## Alternative 500kV Hope Creek to Red Lion Route

- PSE&G has proposed an alternate route for the Red Lion to Hope Creek 500kV line (Project 7K)
  - To avoid Supawna Meadows National Wildlife Refuge, a portion of the new line could be constructed on new right of way outside of Supawna
  - Indicated that the original route, is still preferred
    - On or paralleling existing right-of-way
  - Potential constructability concerns
    - Require easements from multiple private land owners
    - Potential impact due to preserved farmland
    - May trigger cost containment exclusions

# Response to Stakeholder Input
## PSE&G 7K 500kV Line Cost Estimate

| Project Components | PSE&G 7K Red Lion to Hope Creek Project Cost Estimate |
|---|---|
| 500kV Line and Hope Creek Interconnection | $221 |
| Red Lion Expansion | $33 |
| **Estimated Project Total** | **$254** |

| Project Components | Current Recommended Artificial Island Project Cost Estimate |
|---|---|
| 230kV Line and Silver Run Substation | $133[1] |
| Hope Creek 2B Interconnection | $132 |
| Delaware Interconnection | $2 |
| **Estimated Project Total** | **$267** |

[1] Current LS Power cost estimate

- $6.4 million in development and engineering work completed by LS Power on approved project
  - Abandonment recovery has been approved for LS Power on prudently-incurred costs

# Response to Stakeholder Input
## PSE&G Letter to the PJM Board

PSE&G comments relative to their Project 7K (excerpt below)

- Finally, although not a new development, we wish to reiterate that the PSE&G Project is a more robust solution than the LS Power Project because it provides: (1) a greater stability margin for the PJM system; (2) a greater system reliability margin; and (3) higher reliability associated with a 500 kV line compared to a 230 kV line, which provides over three times more capacity than the LS Power Project. In 2015, PJM Staff noted that the PSE&G Project provides a .5 cycle improvement for the Critical Clearing Time of the most critical fault over the LS Power Project. *See* Transmission Expansion Advisory Committee Presentation "Artificial Island Recommendation," April 28, 2015, slide 18, available at http://www.pjm.com/~/media/committees-groups/committees/teac/20150428-ai/20150428-artificial-island-recommendations.ashx.

- PJM analysis reflects current study parameters while PSE&G's comments are based on prior studies that do not reflect the current analysis parameters.

- The current recommended solution is still preferred based on consideration of overall performance, constructability, and current project cost estimates.

# Response to Stakeholder Input
## Cost Containment

PJM retained an outside firm to review the cost containment language provided by PSE&G and LS Power

- Confirmed PJM's assessment that the LS Power cost containment mechanism provides greater cost certainty

# Constructability Considerations

- No change to the relative constructability challenges has been identified
- LS Power confirmed cost cap still valid with alternate attachment options studied
  - Cost escalation will be applied per cost containment provisions for the project suspension directed by PJM
- Hope Creek remains the preferred point of interconnection
  - Option 2B mitigates constructability concerns with Salem interconnection

# Finalist Project Analysis Factors for Recommendation

| Project Type | Strengths | Weaknesses |
|---|---|---|
| 500kV Line Hope Creek to Red Lion | – Hope Creek expansion considered more constructible than Salem expansion<br>– Greater transfer capacity | – Permitting through Supawna Meadows National Wildlife Refuge<br>– Permitting through state wildlife management areas<br>– River crossing permitting<br>– Potential view-shed impacts<br>– 5015 line outage requirements |
| Southern Crossing 230kV Lines | – Submarine cable installation technology removes potential view-shed issue and lowers risk for a NEPA EIS being required<br>– Cost containment provisions provide greater cost certainty<br>– Resilient alternative path (black start and route diversity)<br>– Hope Creek expansion considered more constructible than Salem expansion | – ~~Salem is constrained with limited space for expansion~~<br>– River crossing permitting<br>– Permitting through state wildlife management areas |

Please refer to the 04/28/2015 TEAC presentation for full detail of 2015 evaluation and recommendation.

# Current Artificial Island Recommendation Summary

After an exhaustive review PJM did not identify any information to change the earlier fundamental recommendation:

- Lifting the project suspension on the 230kV line from Artificial Island to the new Silver Run substation (b2633.1 and b2633.2).
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# Next Steps

- The PJM Board meeting is scheduled for April 6.
- PJM requests all stakeholder comments be sent to PJM no later than close of business on March 31.
- Cost allocation accepted by FERC and now pending request for rehearing (Dockets EL15-0095, ER15-2563).

# Revision History

- Revision History V1
  - V1 – 03/03/2017 - Original version posted to PJM.com
  - V2 – 03/08/2017
    - Changed ‘PSEG Power’ to ‘PSEG Nuclear’ on slide 2
    - Added Delaware interconnection costs to slides 13 and 18
    - Changed ‘through 2016’ to ‘through August 2016’ on slide 14
    - Modified slide title to say ‘Response to Stakeholder Input’ on slides 16 through 20
    - Added ‘by LS Power’ to slide 18