Transmission Expansion Advisory Committee

October 10, 2013
Issues Tracking
Issues Tracking

• Open Issues
  – None

• New Issues
Stage 1A 10-Year ARR Analysis
• On an annual basis PJM conducts a simultaneous feasibility analysis test for stage 1A ARRs which shall access the simultaneous feasibility for a 10-year period

• 10-year analysis on 2013/14 Stage 1A ARRs resulted in violations on several ComEd facilities
  – Similar to 2012/2013 Stage 1A ARR analysis
  – The Byron-Wayne 345 kV upgrade contained in the current RTEP with a projected in-service date of 2017 alleviates these violations and restores Stage 1A ARR capability into COMED
• B2141 - Construct a new Byron – Wayne 345 kV
• ComEd transmission zone
Market Efficiency Update
Market Efficiency Proposal Window

Objective

- PJM seeks technical solution alternatives to provide mitigation of PJM internal facilities identified as a top 25 congestion event for the 2013 Market Efficiency Analysis from study years 2017, 2020, or 2023

- Proposal window opened on Monday, 8/12/2013

- Proposal window closed on Thursday, 9/26/2013
Regional proposals
- 16 proposals submitted
- 6 individual project sponsoring entities
- Upgrades proposed for approximately 15 constraints

Next Steps
- Post public version of proposals
- Develop Spreadsheet of all proposals for public viewing
- Start analysis
Proposals for relief of congestion for Market to Market (M2M) and other congested facilities in the PJM/MISO JOA Planning Study are also being accepted

- Studies will be coordinated with Interregional group
- Timeline for results different than for internal PJM facilities and is not yet determined
- PJM recommends also submitting proposal under Interregional Process

Inter-regional proposals due 10/11/2013

For more information, see:

2013 RTEP Scenario Analysis Update
2013 RTEP - At Risk Generation Scenarios
At-Risk Generation List Methodology

• At-risk generation categories
  – Environmental
    • Environmental controls retrofit status
    • Retrofit schedule (or lack of)
  – RPM
    • Cleared / Not cleared
  – Other announcements
• At-Risk MW in addition to known Deactivation Notifications
  – I.e. 3,724 of deactivation notifications in 2013 not included in the number below
• Approximately 6,000 MW
At-Risk Generation

• Purpose
  – Identify potential regional and local reliability concerns

• Overall Assumptions
  – 2018 RTEP Base Case
  – 2013 PJM Load Forecast Report
    • Include Demand Response (DR) and Energy Efficiency (EE)
• Next Steps
  – Complete modeling of at-risk generation
  – Complete analysis
  – Review results at 11/2013 TEAC meeting
2013 RTEP – Renewable Portfolio Standards Scenarios
Study Methodology

• Assumptions
  – Installed/Imported wind to meet PJM’s RPS requirements
  – Study year: 2028

• Analysis
  – Reliability Analysis (50/50 load level)
    • Generator Deliverability
      – Single Contingencies
      – Common Mode Outage test (DCTLs)
    • Security Constrained Optimal Power Flow (Light Load – 50% of Peak Load) (SCOPF)
  – Market Efficiency Analysis
    • Production cost simulation using PROMOD
## Renewable Portfolio Standards (RPS)

### 2028 RPS Study Generation (MW)

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<th>Solar</th>
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* Capacity factors based on historical data
** Assumes ~12,000 MW of DR
*** Assumes 38% for solar and 15% for wind
Study Methodology

• Results
  – Reliability Analysis
    • Thermal overloads (using PJM’s criteria)
    • Develop reliability overlay
  – Market Efficiency
    • Monitor: Market Flowgates & Reliability Analysis Flowgates (85% loading)
    • Future congestion $’s and load payments for year 2028
    • Generation curtailments
    • Adjust transmission overlay to fix high congestion elements
• Overlay Development Method
  – Terminal equipment upgrades
  – Re-conductor existing transmission lines
  – Build parallel circuits/transformers
  – Build new transmission lines/paths
    • Collection for offshore injection
• Scenario 1, 1A & 1B
  – Reliability Analysis Completed
    • Reliability Overlay Developed
  – Market Efficiency Simulation in Progress
    • Simulation with and without reliability overlay finished
    • Adjustment to transmission overlay for high congestion in progress

• Scenario 2 & 3
  – Reliability and Market Efficiency Analyses in Progress
RPS – Scenario 1

• Scenario 1 (7GW Offshore)
  – Hudson approx. 1.5GW offshore injection
  – Cardiff approx. 1.5GW offshore injection
  – Indian River approx. 1.5GW offshore injection
  – Sewells Point approx. 1.5GW offshore injection
  – Existing offshore ISA/FSAs: approx. 1GW
Reliability Analysis Overloads - Scenario 1

Legend
- Subs >= 500 kV
- Trans Lines >= 500 kV
- Subs = 345 kV
- Trans Lines = 345 kV
- Generator Deliverability Constraints Scenario 1
- SCCP Constraints Scenario 1

S1 Reliability Analysis Overloads

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RPS – Scenario Sensitivities 1A & 1B

• Scenario Sensitivity RPS1A:
  – Hudson 1GW offshore injection
  – Cardiff 1GW offshore injection
  – DC line between Hudson and Cardiff

• Scenario Sensitivity RPS1B:
  – Hudson 1GW offshore injection
  – Cardiff 1GW offshore injection
  – Cedar 1GW offshore injection
  – DC line between Hudson and Cedar and Cardiff
Reliability Analysis Overloads - Scenario 1A

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Reliability Analysis Overloads - Scenario 1B

Legend
- Subs >= 500 kV
- Trans Lines >= 500 kV
- Subs = 345 kV
- Trans Lines = 345 kV
- SORPF Constraints Scenario 1B
- Generator Deliverability Constraints Scenario 1B

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<td>Grand Total</td>
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HVDC Flows – Scenario 1

No Overlay

- Hudson to Cardiff: 2,106 MW
- Cardiff to Hudson: 1,540 MW
- Indian River to Sewels Point: 1,027 MW
- Sewels Point to Indian River: 507 MW

with Overlay

- Hudson to Cardiff: 886 MW
- Cardiff to Hudson: 320 MW
- Indian River to Sewels Point: 614 MW
- Sewels Point to Indian River: 804 MW

Indian River

- 83 MW from Sewels Point
- 614 MW to Sewels Point

Cardiff

- 83 MW from Sewels Point
- 614 MW to Sewels Point

Sewels Point

- 804 MW from Indian River
- 539 MW to Indian River

Hudson

- 1,540 MW from Cardiff
- 566 MW to Cardiff
HVDC Flows – Scenario 1A

No Overlay

Hudson: 1,155MW to 384MW
Cardiff: 387MW to 384MW

with Overlay

Hudson: 857MW to 384MW
Cardiff: 89MW to 384MW
HVDC Flows – Scenario 1B

No Overlay

Hudson  
613MW  384MW

Cedar  
646MW  384MW

Cardiff  
735MW  384MW

with Overlay

Hudson  
423MW  384MW

Cedar  
804MW  384MW

Cardiff  
459MW  384MW

Cedar  
39MW  384MW

Cardiff  
75MW  384MW
RPS Market Efficiency Overview
Wind Curtailment – Scenarios 1, 1A, & 1B

[Graph showing wind curtailment scenarios.]
Congestion – Scenarios 1, 1A, & 1B
Load Payments – Scenarios 1, 1A, & 1B
Load Payments – Scenarios 1, 1A, & 1B
Offshore HVDC Comparison
Wind Curtailment – Scenarios 1, 1A, & 1B

RPS-1 w/out DC
Load Payments – Scenarios 1, 1A, & 1B
Load Payments – Scenarios 1, 1A, & 1B
Preliminary Observations

• The reliability overlay:
  o Remedies the reliability issues of load growth and interconnection
  o Significantly decreases congestion

• Reliability overlay less involved compared to last year
  o Small load growth
  o Increased ISA/FSA
  o Increased retirements
  o Only slight decrease in DR

• DC line
  o Benefits congestion
  o Causes locational increases and decreases in LMP
  o Benefits expected to diminish with onshore transmission build for congestion relief
  o More refined view of offshore wind for NJ BPU anticipated
2013 RTEP Baseline Update
2013 RTEP Progress

• Evaluation of 2018 Summer
  ✓ Base case analysis – complete
  ✓ Generator deliverability analysis – complete
  ✓ Load deliverability analysis – developing solutions
  ✓ N-1-1 Thermal and Voltage Analysis
    • Finalizing solutions
• 15 Year Analysis Update
• 24 Month RTEP Update
  – Year 7 base case analysis (study year 2020) analysis
15 Year Analysis Result for 2013 RTEP**

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<th>To Name</th>
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* The most limiting thermal condition from the generator deliverability or load deliverability test
** Results based on a 2018 model

= Shaded cells indicate that upgrades are pending
**15 Year Analysis Result for 2013 RTEP**

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<tr>
<th>Fr Bus</th>
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* The most limiting thermal condition from the generator deliverability or load deliverability test
** Results based on a 2018 model

= Shaded cells indicate that upgrades are pending
24 Month RTEP Update

• Approach for Year 7 case analysis (2020 study year)
  
  – Update latest 2018 RTEP case with 2020 load forecast
    • Include all approved upgrades
    • Coordinate update of 2020 topology with Transmission Owners

  – Complete RTEP criteria testing including long-term DC analysis

  – Compare result to long-term DC analysis from near-term case
- Generator Deliverability Violation

- The Meadow Lake – Reynolds 345kV line is overloaded for the loss of the Greentown - Jefferson 765kV line.

- Loop in the Meadow Lake - Olive 345 kV circuit into Reynolds 765/345kV station (B2287)

- Estimated Project Cost: $1M

- Expected IS Date: 6/1/2018
• Light Load Reliability Analysis violation
• The Hegewisch 138 kV circuit is overloaded for several single contingencies
• Proposed Solution: Replace the 138 kV bus tie 1-2 circuit breaker, station conductor, relays, and a wave trap at TSS 55 Hegewisch substation (b2365)
• Estimated Project Cost: $2M
• Expected IS Date: 3/1/2015
• Light Load Reliability Analysis violation
• The LaSalle County 138 kV line is overloaded with all facilities in service
• Proposed Solution: Reconductor 1.4 miles of 138 kV line 0112, Kickapoo Creek – LaSalle County 138 kV line (b2366)
• Estimated Project Cost: $2M
• Expected IS Date: 3/1/2015
Dominion Transmission Zone

• **Dominion Criteria:**
  - Under critical system conditions (No Possum PT#5)
  - An outage of Line #590 (Loudoun to Brambleton 500 kV) overloads the Loudoun 500-230 kV Tx#1 & #2. (NERC Category B)
  - An outage of Line #590 (Loudoun to Brambleton 500 kV) and Line #551 (Mt Storm to Doubs 500 kV) overloads the Loudoun 500-230 kV Tx #1 & #2. (NERC Category C3 – “N-1-1”)

• **Solutions Considered**
  - Build second Loudoun – Brambleton 500 kV on existing ROW -$13 M
  - Install a third 500/230 kV transformer at Loudoun - $20 M
  - Replace both transformers with larger units - $30 M

• **Proposed Solution:** Build a second Loudoun – Brambleton 500 kV Line within the existing ROW. Line #2094 (Loudoun to Brambleton 230 kV) will be relocated as an underbuild on the new 500 kV Line.

• Estimated Project Cost $13 M

• Expected In-service Date: 06/01/2018
• Baseline Contingency and Common Mode Outage Voltage Violation:
  • Several voltage magnitude and voltage drop violations in the Erie East vicinity for multiple contingencies.
• Proposed Solution:
  – Install 75 MVAR capacitor at the Erie East 230 kV substation (B2371).
• Estimated Project Cost:
  – $1.5M
• Expected IS Date:
  – 6/1/2018
PEPCO Transmission Zone

- Generation Deliverability Violation
  - Each of the Chalk Point – T133TAP 230 kV circuits #1 and #2 are overloaded for the loss of the parallel circuit.
- Proposed Solution:
  - Upgrade the Chalk Point – T133TAP 230 kV circuits #1 (23063) and #2 (23065) to 1200 MVA ACCR (B2372).
- Estimated Project Cost:
  - $6.79 M
- Expected IS Date:
  - 6/1/2018
Short Circuit Upgrades
• The East Springfield 138 kV breaker ‘211-B-63’ is overstressed

• Proposed Solution: Replace the East Springfield 138 kV breaker ‘211-B-63’ with 40kA breaker (b2349)

• Estimated Project Cost: $250 K

• Expected IS Date: 6/1/2018
• The East Akron 138 kV breaker '36-B-46' is overstressed

• Proposed Solution: Replace the East Akron 138 kV breaker '36-B-46' with 40kA breaker (b2367)

• Estimated Project Cost: $250 K

• Expected IS Date: 6/1/2018
The Brambleton 230 kV breakers ‘20902,’ ‘213702,’ and ‘H302’ are overstressed.

Proposed Solution: Brambleton 230 kV breakers ‘20902,’ ‘213702,’ and ‘H302’ with 63kA breaker (b2368-2370)

Estimated Project Cost: $215 K

Expected IS Date: 6/1/2016
The Erie South 115 kV breaker ‘French #2’ is overstressed

Proposed Solution: Replace the Erie South 115 kV breaker ‘French #2’ with 40kA breaker (b2302)

Estimated Project Cost: $179 K

Expected IS Date: 6/1/2014
• The East Windsor 230 kV breaker ‘E1’ is overstressed

• Proposed Solution: Replace the East Windsor 230 kV breaker ‘E1’ with 63kA breaker (b2357)

• Estimated Project Cost: $850 K

• Expected IS Date: 6/1/2016
PSE&G Transmission Zone - Northern NJ
Short Circuit
PSEG Transmission Zone Short Circuit

• PSEG Short Circuit Issue
  – 2012 RTEP identified several busses in PSEG zone where the fault currents exceed 80 kA
  – A number of alternatives evaluated including rebuilding stations to 90 kA standard, installing current limiting reactors, splitting the system, installing FCL (fault current limiters) technology
• PJM is evaluating alternative solutions
  – Double circuit 345 kV Solution
    • Isolate Hudson 230 kV from the 138 kV at Marion and 345 kV at Farragut
    • Convert the 138 kV buses and transmission facilities on the path from Linden to Bergen to double circuit 345 kV
  – Back to Back HVDC at Hudson
  – Other solutions considered
    • Double circuit 230 kV Solution
      – Isolate Hudson 230 kV from the 138 kV at Marion and 345 kV at Farragut
      – Convert the 138 kV buses and transmission facilities on the path from Linden to Bergen to double circuit 230 kV
    • Other configurations
      – Transformer based fault current limiters
  – Hudson #2 generation location assumption
    • Existing Hudson 230 kV or converted Marion 230 kV or 345 kV station?
### 345 kV Alternative – Cost Estimate* & Breakdown

<table>
<thead>
<tr>
<th>Project Description</th>
<th>Project Status</th>
<th>PJM Project ID</th>
<th>Estimated Cost ($ M)</th>
<th>Subtotal Cost Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>345 kV Solution Alternative</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>345 kV Conversion Alternative</td>
<td>Under TEAC Review</td>
<td></td>
<td>$1,082.62</td>
<td>$1,102.62</td>
</tr>
<tr>
<td>Reconfigure Hudson 2 to inject into 345 kV</td>
<td></td>
<td></td>
<td>$20</td>
<td></td>
</tr>
<tr>
<td><strong>PJM Board Approved RTEP Projects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reconfigure Lindon - PVSC Corridor - Reconfigure the Lindon, Bayway, North Ave, and Passaic Valley S.C. 138 kV substations. Construct and loop new 138 kV circuit to new airport station (b2159)</td>
<td>Baseline - Approved</td>
<td>b2159</td>
<td>$250</td>
<td>$ (325.50)</td>
</tr>
<tr>
<td>Install 230/138 kV transformer at Bergen substation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rebuild 2.19 miles of overhead line E-1305-5 (Bergen - North Bergen)</td>
<td></td>
<td></td>
<td>$37.5</td>
<td></td>
</tr>
<tr>
<td>Reconfigure Marion for Breaker and Half. Build for 230 kV, operate at 139 kV with 80 kA breakers</td>
<td>Supplemental</td>
<td>s0316</td>
<td>$30</td>
<td>$ (150)</td>
</tr>
<tr>
<td><strong>Anticipated solutions for 2018 RTEP Criteria Violations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recondductor of PVSC - Bayonne Circuit</td>
<td></td>
<td></td>
<td>$65</td>
<td></td>
</tr>
<tr>
<td>Build a parallel Stanley Terrace - McCarter</td>
<td></td>
<td></td>
<td>$147.70</td>
<td></td>
</tr>
<tr>
<td>Build a parallel K-2211-7 circuit (Aldene - StanleyTce)</td>
<td></td>
<td></td>
<td>$134.50</td>
<td></td>
</tr>
<tr>
<td>Build a parallel McCarter - West Orange</td>
<td></td>
<td></td>
<td>$119.50</td>
<td></td>
</tr>
<tr>
<td>Build a parallel G-2285 (Aldene - SpringfieldRd)</td>
<td></td>
<td></td>
<td>$73.22</td>
<td>(565)</td>
</tr>
<tr>
<td>Upgrade U-2273 (VFT - Warrinanco)</td>
<td></td>
<td></td>
<td>$25.00</td>
<td></td>
</tr>
<tr>
<td>Upgrade N-2240 (Warrinanco - Aldene)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upgrade S-2271 (Tosco - VFT)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upgrade B-2254 (Tosco - Linden)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Planning level cost estimates provided by PSE&G

Net Cost: $62.20
• Analysis update
  – Completed thermal and voltage testing of double circuit 345 kV solution
  – Validated that the 345 kV solution would replace the need for the PJM Board approved upgrades on the previous slide and also eliminate the need for the anticipated 2018 solutions on the previous slide
Northern PSE&G Short Circuit Solution - Conceptual Feasibility Study

- **Scope**
  - HVDC and 345 kV Double Circuit Alternatives

- **Progress**
  - Consultant review underway

- **Coordination with project sponsors**

- **Deliverables**
  - Validate costs, schedules, identify risk areas

- **Timeline**
  - Study completion expected early November
Conceptual Schedule

- September 12th TEAC
  - Review analytical results
- October 10th TEAC
  - Update feasibility study progress
- November 7th TEAC
  - Recommend solution to TEAC
- December PJM Board
  - Recommend solution to PJM Board
Next Steps

- Finalize feasibility analysis
  - Cost & Constructability

- Recommend solution
Deactivation Analysis Update
<table>
<thead>
<tr>
<th>Unit(s)</th>
<th>Transmission Zone</th>
<th>Requested Deactivation Date</th>
<th>PJM Reliability Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deepwater units 1 &amp; 6</td>
<td>AE</td>
<td>Change deactivation date</td>
<td>No new violations identified</td>
</tr>
<tr>
<td>(158 MWs)</td>
<td></td>
<td>from 5/31/2015 to 5/31/2014</td>
<td></td>
</tr>
<tr>
<td>Beckjord units 2 &amp; 3</td>
<td>DEOK</td>
<td>Change deactivation date</td>
<td>No new violations identified</td>
</tr>
<tr>
<td>(222 MWs)</td>
<td></td>
<td>from 4/1/2015 to 11/21/2013</td>
<td></td>
</tr>
<tr>
<td>(or earlier if possible)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hatfield’s Ferry Units 1-3</td>
<td>APS</td>
<td>10/9/2013</td>
<td>Analysis complete, impacts identified in September 2013</td>
</tr>
<tr>
<td>(1590MWs)</td>
<td></td>
<td></td>
<td>TEAC posting</td>
</tr>
<tr>
<td>Mitchell Units 1 &amp; 2</td>
<td>APS</td>
<td>10/9/2013</td>
<td>Analysis complete, impacts identified in September 2013</td>
</tr>
<tr>
<td>(359MWs)</td>
<td></td>
<td></td>
<td>TEAC posting</td>
</tr>
</tbody>
</table>
Generation Retirements

Legend

Substations
- 500 kV
- 765 kV

Transmission Lines
- 500 kV
- 765 kV
- HVDC

Pending Retirements
- 21 - 121
- 122 - 245
- 246 - 401
- 402 - 597
- 598 - 1500
Deactivation status - New Deactivation Requests

- Hatsfield’s Ferry, Units 1-3
  - 1590 MWs
  - Requested Deactivation Date: October 9, 2013

- Mitchell, Units 2-3
  - 359MWs
  - Requested Deactivation Date: October 9, 2013
Artificial Island RTEP Proposal Window
Artificial Island Proposal Window Status

- Window opened on 4/29/2013
- Closed on 6/28/2013

- 26 individual proposals
- 7 entities

- Project Naming Convention
- Project Identification Taxonomy: 2013_1-1A
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
<table>
<thead>
<tr>
<th>Project ID</th>
<th>TO</th>
<th>Cost ($)</th>
<th>Major Components</th>
<th>Supporting info</th>
</tr>
</thead>
<tbody>
<tr>
<td>P2003_1-1A</td>
<td>Virginia Electric and Power Co</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>
</tr>
<tr>
<td>P2003_1-1B</td>
<td>Virginia Electric and Power Co</td>
<td>$126</td>
<td>New 500 kV lines from Salem - new station in Delaware</td>
<td>New 600/230 kV station in Delaware that taps existing Cedar Creek - Red Lion 230 kV and Catansas - Red Lion 230 kV</td>
</tr>
<tr>
<td>P2003_1-1C</td>
<td>Virginia Electric and Power Co</td>
<td>$202</td>
<td>New 500 kV lines from Hope Creek - new station in Delaware</td>
<td>Install new 500 kV lines from Hope Creek - Red Lion - New Salem - Hope Creek 500 kV lines</td>
</tr>
<tr>
<td>P2003_1-2A</td>
<td>Transource</td>
<td>$218 - $263</td>
<td>Salem - Cedar Creek 230 kV</td>
<td>Two (2) 200/230 Transformers near Salem; Loop in Red Lion - Catansas 230 to Cedar Creek</td>
</tr>
<tr>
<td>P2003_1-2B</td>
<td>Transource</td>
<td>$155 - $203</td>
<td>Salem - North Cedar Creek (new) 230 kV</td>
<td>Two (2) 200/230 Transformers near Salem and loop in Red Lion - Catansas 230 and Red Lion - Cedar Creek 230 kV</td>
</tr>
<tr>
<td>P2003_1-2C</td>
<td>Transource</td>
<td>$121 - $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>
</tr>
<tr>
<td>P2003_1-2D</td>
<td>Transource</td>
<td>$788 - $944</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>
</tr>
<tr>
<td>P2003_1-3A</td>
<td>First Energy</td>
<td>$410.7 (Only First Energy project)</td>
<td>New Freedom-Smithsburg 500 kV line with a loop into Luray</td>
<td>Hope Creek - Red Lion 500 kV line</td>
</tr>
<tr>
<td>P2003_1-4A</td>
<td>PFI Electric</td>
<td>$475</td>
<td>Peach Bottom - Keene - Red Lion - Salem 500 kV</td>
<td>Remove Keene - Red Lion 230 kV Reconfigure 230 around Hay Road; Reconfigure Hammonds Chapel Street 138 kV</td>
</tr>
<tr>
<td>P2003_1-5A</td>
<td>LS Power</td>
<td>$116.3M - $146.3M</td>
<td>Salem - Silver Run (new) 230 kV; Salem 500/230 Transformer</td>
<td>New 230 kV station that taps existing Cedar Creek - Red Lion 230 kV and Catansas - Red Lion 230 kV</td>
</tr>
<tr>
<td>P2003_1-5B</td>
<td>LS Power</td>
<td>$170</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>
</tr>
<tr>
<td>P2003_1-6A</td>
<td>Atlantic Wind</td>
<td>$1,072</td>
<td>32 kV MVDC Lines Salem - Hope Creek - Cardiff</td>
<td>SVC at Salem/Hope Creek; New HVDC Stations at Cardiff and Salem</td>
</tr>
<tr>
<td>P2003_1-7A</td>
<td>PSE&amp;G</td>
<td>$1,771</td>
<td>Salem-Hope Creek to Peach Bottom 500 kV</td>
<td>Existing ROW</td>
</tr>
<tr>
<td>P2003_1-7B</td>
<td>PSE&amp;G</td>
<td>$1,725</td>
<td>Salem-Hope Creek to Peach Bottom 500 kV</td>
<td>Same as 1A with Loop into Keene</td>
</tr>
<tr>
<td>P2003_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 1A with Loop into Keene</td>
</tr>
<tr>
<td>P2003_1-7D</td>
<td>PSE&amp;G</td>
<td>$811</td>
<td>Salem-Hope Creek to Peach Bottom 500 kV</td>
<td>Same as 1A with New ROW</td>
</tr>
<tr>
<td>P2003_1-7E</td>
<td>PSE&amp;G</td>
<td>$828</td>
<td>New Freedom - Dranes 500 kV &amp; Salem - Hope Creek 500 kV lines</td>
<td>Existing ROW</td>
</tr>
<tr>
<td>P2003_1-7F</td>
<td>PSE&amp;G</td>
<td>$879</td>
<td>New Freedom - Smithsburg and Hope Creek 500 kV lines</td>
<td>Existing ROW</td>
</tr>
<tr>
<td>P2003_1-7G</td>
<td>PSE&amp;G</td>
<td>$1,034</td>
<td>New Freedom - Smithsburg and Salem-Hope Creek 500 kV lines</td>
<td>Same as 1F with a Loop into a new Luray 500 kV station</td>
</tr>
<tr>
<td>P2003_1-7H</td>
<td>PSE&amp;G</td>
<td>$1,177</td>
<td>New Freedom - Valtight and Salem - Hope Creek 500 kV lines</td>
<td>Northern Route</td>
</tr>
<tr>
<td>P2003_1-7I</td>
<td>PSE&amp;G</td>
<td>$1,383</td>
<td>New Freedom - Valtight and Salem - Hope Creek 500 kV lines</td>
<td>Same as 1H with the Southern Route</td>
</tr>
<tr>
<td>P2003_1-7J</td>
<td>PSE&amp;G</td>
<td>$965</td>
<td>New Freedom - New Station on Branchburg-Ellwood 500 kV line (&quot;5017 Junction&quot;) and Salem - Hope Creek 500 kV line</td>
<td>Existing ROW</td>
</tr>
<tr>
<td>P2003_1-7K</td>
<td>PSE&amp;G</td>
<td>$1,006</td>
<td>New Freedom - Dranes &amp; Salem - Hope Creek - Red Lion 500 kV lines w/ Hope Creek - Red Lion (new)</td>
<td>Same as 1E with Hope Creek - Red Lion</td>
</tr>
<tr>
<td>P2003_1-7L</td>
<td>PSE&amp;G</td>
<td>$1,268</td>
<td>New Freedom - Smithsburg &amp; Salem - Hope Creek - Red Lion 500 kV lines w/ Hope Creek - Red Lion (new)</td>
<td>Same as 1F with Hope Creek - Red Lion</td>
</tr>
<tr>
<td>P2003_1-7M</td>
<td>PSE&amp;G</td>
<td>$1,546</td>
<td>New Freedom - Valtight (North) - Salem - Hope Creek - Red Lion 500 kV lines w/ Hope Creek - Red Lion (new)</td>
<td>Same as 1H with Hope Creek - Red Lion</td>
</tr>
<tr>
<td>P2003_1-7N</td>
<td>PSE&amp;G</td>
<td>$1,289</td>
<td>New Freedom - a new Station on the Branchburg Ellwood 500 kV line (&quot;5017 Junction&quot;) - Salem - Hope Creek - Red Lion 500 kV lines w/ Hope Creek - Red Lion (new)</td>
<td>Same as 1H with Hope Creek - Red Lion</td>
</tr>
</tbody>
</table>
Artificial Island Proposals
Artificial Island RTEP Proposal Window – Analytical Progress

• Analytical Progress
  – PJM analyzed the effectiveness of elements of, or entire transmission proposals combined with SVCs at several proposed locations

• Method
  – Analysis focused on combining the lower cost estimated transmission solutions with SVCs

• Results
  – Performance of solution combinations
• **Alternative Comparison Considerations**
  - Cost estimates range from just over $100M to just under $1.5B
  - Initial analysis shows the transmission proposals from AI interconnecting with facilities to the west on the Delmarva peninsula are effective and have the lowest estimated costs (estimates provided by proposing entity)

• **System Voltage Performance**
  - SVC Locations
    - Salem 500 kV, Orchard 500 kV, New Freedom 500kV all proposed as potential SVC locations
  - Machine voltage schedules
Artificial Island - Conceptual Feasibility Study

– Scope
  • Currently defining Statement of Work (SOW)

– Progress
  • Consultant outreach, identifying conflicts of interest

– Approach & Deliverables
  • Evaluate costs and schedules of major similarities and differences between proposals
  • Validate costs, schedules, identify risk areas
  • Identify potential alternatives

– Timeline
Conceptual Artificial Island Schedule

- **September 12th TEAC**
  - Update analytical progress
- **October 10th TEAC**
  - Update analytical progress
  - Update feasibility study progress
- **November 7th TEAC**
  - Update feasibility study progress
- **December 11th TEAC**
  - Update feasibility study progress
- **January – February 2014**
  - Recommend solution to TEAC
- **January – February 2014**
  - Recommend solution to PJM Board
RTEP Next Steps

- Recommend Northern PSE&G Short Circuit solution alternative

- Continue Artificial Island evaluation including thermal and voltage analysis of alternatives

- Finalize 2013 RTEP criteria violations
Questions?

Email: RTEP@pjm.com
• 10/9/2013 – Original version distributed to PJM TEAC