Transmission Expansion Advisory Committee

January 9, 2014
2014 RTEP Assumptions
(Continued from December 2013 TEAC)
RTEP - 2019 Model Status

• Case currently out to TO’s for second review
  – Case distributed for second review has the first round of TO updates and updated queue generation

• In progress
  – Contingency update and check
  – Update interchange
  – Update generation dispatch
    • Machine list will be presented at February TEAC
  – Update load per latest 2014 load forecast
• End of January 2014
  – Receive TO feedback and updates, finalize case and associated files

• February 2014
  – Exercise the model using analysis, coordinate quality control check and benchmark

• February 2014 - March 2014
  – Begin formal RTEP analysis
Model On Demand (MOD) Status

- MOD desk reference completed Q4 2013
- Remote Access Pilot Program (Jan – Feb 2014)
  - Will be underway shortly to ensure TO’s can access MOD and all features work correctly
- All TO’s requested to use MOD Remote Access to manage PJM RTEP Base case modeling data (March 2014)
  - TO reviewed and updated 2014 MMWG case will be loaded as base case
  - PJM and TO’s will work remainder of 2014 to create, upload, and review individual project files
2019 RTEP Model Assumptions

- Load forecast
  - Latest 2014 load forecast for 2019 50/50 summer peak load
- Interchange
  - Based on latest reservations for 2019 in OASIS
- External topology
  - MMWG 2013 series 2019 summer peak
- Internal topology
  - Include all PJM Board approved upgrades through the December 11, 2013 PJM Board of Manager approvals as well as all anticipated February 2014 PJM Board approvals
2019 RTEP Model Assumptions

• Machine list
  – Updated CIR’s for existing units
  – Queues with an executed FSA or higher as of 12/11/2013 will be included in the base model
    • Consult posted machine list for exact modeling assumption
    • FSA will be turned off but allowed to contribute to problems in Generator Deliverability
    • Any identified network upgrades driven by included queue projects will also be modeled
  – Units that cleared in previous RPM auctions that do not yet have an executed FSA or higher will be modeled
  – 2019 RTEP machine list will be presented at February TEAC
Jacks Mountain 500 kV

PenElec and PPL assigned baseline project with PJM id:
• PenElec b0284.1, b0284.3, b0285.1, b0285.2, b0369 and b0370
• PPL b0284.2, b0284.4

Scope:
Build a new 500kV substation (Jacks Mountain) by tapping the existing Conemaugh – Juniata and Keystone – Juniata 500kV circuits. The circuits will be connected with a breaker and a half scheme and a total of 1000MVARs of capacitors
• Replace wave traps and relays at the Juniata 500kV substation
• Replace wave traps and upgrade a bus section at the Keystone 500kV substation.
• Replace wave traps and relays at the Conemaugh 500kV substation.

Status:
Jacks Mountain was not included in the 2013 RTEP
Jacks Mountain will be held in abeyance and not modeled in the starting point 2014 RTEP base model
Reliability Analysis Update
• **Generator Deliverability and Common Mode Violation**

  • The Meadow Lake – Reynolds 345kV line is overloaded for various contingencies

  • Rebuild the 7-mile 345 kV line between Meadow Lake and Reynolds 345 kV stations. (B2449)

  • Estimated Project Cost: $15M

  • Projected IS Date: 6/1/2017
Short Circuit Upgrades
The Tosco 230kV GIS breakers 5 - 10 are overstressed

Proposed Solution: Install two reactors at Tosco 230kV (b2438)

Estimated Project Cost: $1.25 M per reactor

Required IS Date: 6/1/2014
The Tosco 138kV breaker 'CB1/2 (CBT)' is overstressed

Proposed Solution: Replace the Tosco 138kV breaker 'CB1/2 (CBT)' with 63kA (b2439)

Estimated Project Cost: $350 K

Required IS Date: 6/1/2014
• The Cabot 138kV breaker ‘C9-KISKI VLY’ is overstressed

• Proposed Solution: Replace the Cabot 138kV breaker ‘C9-KISKI VLY’ with 63kA (b2440)

• Estimated Project Cost: $250 K

• Required IS Date: 6/1/2014
Generation Deactivation Update
Deactivation Update: Deactivation Notifications

- Muskingum River unit 5
  - AEP Transmission Zone
  - 600 MW
  - Anticipated deactivation date: 6/1/2015

- Tanners Creek unit 4
  - AEP Transmission Zone
  - 500 MW
  - Anticipated deactivation date: 6/1/2015
• N-1-1 Violation
• The Scioto Trail – Scippo 138 kV line is overloaded for the loss of North Fork to Camp Sherman 138 kV line (‘246889(05NFORK)-246890(05CSHRMN)_1’) followed by the loss of Bixby to North Fork 345 kV line and Bixby 345/138 kV transformer #2 (‘6762_B2_TOR5200548_WOMOAB’)
• Previously identified baseline upgrade (b1454) - Perform sag study on the Ross-Delano 138 kV, Delano-Scioto Trail 138 kV, Scioto Trail-Scippo 138 kV circuits to identify and correct line deficiencies prohibiting use of conductor emergency ratings
• Cost Estimate: $393,000
• Required IS Date: 6/1/2015
Deactivation Update: Deactivation Notifications

- Sunbury unit 1-4
  - PPL Transmission Zone
  - Unit 1: 80 MW
  - Unit 2: 80 MW
  - Unit 3: 94 MW
  - Unit 4: 128 MW
  - Deactivation date: 06/01/2015
- Generation Deliverability Violation
- The Linwood – Chichester 230 kV circuit#1 is overloaded for the loss of Linwood to Chichester 230 kV circuit#2 ('213490(CHICHST2)-213750(LINWOOD)_2')
- The Linwood – Chichester 230 kV line #2 is overloaded for the loss of Linwood to Chichester 230 kV circuit#1 ('213490(CHICHST2)-213750(LINWOOD)_1')
- Previously identified baseline upgrade (b1900): Add a 3rd 230 kV transmission line between Chichester and Linwood substations and remove the Linwood SPS
- An SPS is in place until b1900 upgrade is completed
- Cost Estimate: $27 M
- Required IS Date: 6/1/2018

Deactivations – Sunbury units 1-4
• Generation Deliverability Violation
• The Eagle Point – Gloucester 230 kV line is overloaded for the loss of Mickleton to Deptford 230 kV circuit#2 (‘MICK-DEPT_A’)
• Previously identified baseline upgrade (b1588): Reconduct the Eagle Point - Gloucester 230 kV circuit #1 and #2 with higher conductor rating
• Cost Estimate: $25 M
• Expected IS Date: 6/1/2015
Deactivations – Sunbury units 1-4

- Generation Deliverability Violation
- The Mickleton – Deptford 230 kV circuit#2 is overloaded for the loss of Gloucester to Eagle Point 230 kV line ("219110(GLOUCSTR)-219120(EAGLE PT)_1")
- Previously identified baseline upgrades:
  - b2139: Reconductor the Mickleton - Gloucester 230 kV parallel circuits with double bundle conductor
  - b1398: Build two new parallel underground circuits from Gloucester to Camden (via Cuthbert Blvd)
- Expected IS Date: 6/1/2015
Deactivation Update: Deactivation Notifications

- Mad River or Clark units
  - ATSI Transmission Zone
  - 50 MW
  - Deactivation date: 01/09/2014
- N-1-1 Voltage Violation
- East Springfield and London 138 kV buses have voltage magnitude and voltage drop violations for the loss of Clark-Urbana 138 kV line ('OUTAGE_26A') followed by the loss of Clark-Greene 138 kV line and Greene 138/69 kV transformer#2 ('OUTAGE_25')
- Baseline upgrades
  - b2434: Build a new London - Tangy 138 kV line
  - b2435: Build a new East Springfield - London #2 138 kV line
- Cost estimate: $45.7 M
- Expected IS Date: 6/1/2014
Deactivation Update: Deactivation Notifications

- AES Beaver Valley units
  - DUQ Transmission Zone
  - 125 MW
  - Deactivation date: 06/01/2017
• Generation Deliverability Violation
• Willow to Eureka 138 kV line is overloaded for the loss of Kammer 765/345 kV transformer#4, Kammer to Mitchell 345/26 kV transformer#2 and unit#2 at Mitchell for the breaker CC failure (‘2937_C2_05KAMMER 345-CC’)
• Baseline upgrade (b2444): Willow - Eureka 138 kV line: reconductor 0.26 mile of 4/0 CU with 336 ACSS, new rating on the line will be 163/197 MVA (SN/SE)
• Cost estimate: $0.1 M
• Expected IS Date: 6/1/2017
• Generation Deliverability Violation
• Tidd to Mahans Lane 138 kV line is overloaded for the loss of Tidd to Collier 345 kV line and Tidd to Wylie Ridge 345 kV line for the breaker C2 failure (‘4743_C2’)
• Baseline upgrade (b2445): Tidd - Mahans Lake 138 kV line: completion of sag study will increase rating to 191/250 MVA (SN/SE)
• Expected IS Date: 6/1/2017
• Generation Deliverability Violation
• Brunot Island to Arsenal 345 kV circuit#2 (306) is overloaded for loss of Brunot Island to Arsenal 345 kV ckt#1 (305), Brunot Island to Collier 345 kV line (302, 331) and Brunot Island Auto1 for the 1-3 tie breaker#310 failure (‘BKR_62A’)
• Operating procedure in place for contingencies involving either of the Brunot Island to Arsenal 345 kV circuits
Deactivation Update: Deactivation Notifications

- Chalk Point 1, 2 units
  - PEPCO Transmission Zone
  - 683 MW
  - Deactivation date: 06/01/2017

- Dickerson 1, 2 and 3 units
  - PEPCO Transmission Zone
  - 546 MW
  - Deactivation date: 06/01/2017
• Generation Deliverability Violation
• Montour to Susquehanna T10 230 kV line is overloaded for loss of Sunbury 500/230 kV transformer#24, Sunbury unit 4 and Sunbury transformer 22 for the failure of Sunbury 230 kV 5S breaker (‘PL101002’)
• Baseline upgrades b2446, b2447: Replace wave trap and protective relays
• Cost estimate: $5 M
• Required IS Date: 6/1/2017
• Generation Deliverability Violation
• Sunbury 500/230 kV transformer# 24 is overloaded for the tower contingency loss of Montour – Susquehanna 230 kV line and Montour – Susquehanna T10 230 kV line (‘PL100484’)
• Baseline upgrade b2448: Install a second Sunbury 900MVA 500-230kV transformer and associated equipment
• Cost estimate: $25 M
• Required IS Date: 6/1/2017
• **Generation Deliverability Violation**
  
  **Ottercreek – Conastone 230 kV**
  line is overloaded for the loss of
  Conastone – Peachbottom 500 kV
  line and Conastone 500/230kV
  transformer#2 for the failure of
  Conastone B breaker (‘PJM8BG’)

• **Existing baseline upgrades**
  
  – b0497: Install a second Conastone -
    Graceton 230 kV circuit and replace
    Conastone 230 kV breaker 2323/2302
  
  – b1016: Rebuild Graceton - Bagley
    230 kV as double circuit line using
    1590 ACSR. Terminate new line at
    Graceton with a new circuit breaker.
  
  – b1251: Rebuild the existing Bagley -
    Raphael Rd. 230 kV line to double
    circuit 230 kV line
  
  – b1251.1: Reconfigure Raphael Rd. to
    terminate new circuit

• **Estimated IS Date: 6/1/2017**
• Generation Deliverability Violation
• Graceton – Bagley 230 kV line is overloaded for the tower contingency loss of 502 Junction – Whiteley 138 kV ckt#1 and 502 Junction – Whiteley 138 kV ckt#2 (‘AP_C5_19’)
• Existing baseline upgrades
  – b0497: Install a second Conastone - Graceton 230 kV circuit and replace Conastone 230 kV breaker 2323/2302
  – b1016: Rebuild Graceton - Bagley 230 kV as double circuit line using 1590 ACSR. Terminate new line at Graceton with a new circuit breaker.
  – b1251: Rebuild the existing Bagley - Raphael Rd. 230 kV line to double circuit 230 kV line
  – b1251.1: Reconfigure Raphael Rd. to terminate new circuit
• Estimated IS Date: 6/1/2017
• Generation Deliverability Violation
• Loudon 500/230 kV transformer#2 is overloaded for the loss of Loudon – Pleasant View 500 kV line and Loudon 500/230 kV transformer#1 for the failure of Loudon 500 kV breaker (‘LN558&H1T558’)
• Existing baseline upgrades b2373: Build a 2nd Loudoun - Brambleton 500 kV line within the existing ROW. The Loudoun - Brambleton 230 kV line will be relocated as an under build on the new 500 kV line
• Cost estimate: $13 M
• Estimated IS Date: 6/1/2017
Artificial Island Update
Artificial Island Analytical Evaluation Recap

• Recap of Previous November 2013 TEAC Update
  – 230 kV Transmission Solutions
    • Assuming the same AI Voltage, observe the AI MVAr output and maximum angle swing
      – Less AI MVAr output means more MVAr margin.
      – Less angle swing correlates to a larger stability margin
    • Given the same AI MVAr output compare the maximum angle swing
      – Less angle swing correlates to a larger stability margin
  – SVC Locations
    • Evaluate the effectiveness of the SVC locations by observing AI MVAr output and maximum angle swing
      – Less angle swing correlates to a larger stability margin
Artificial Island Analytical Evaluation Recap

- Recap of Previous December 2013 TEAC Update
  - 500 kV Transmission Solutions
    - Assuming the same AI Voltage, observe the AI MVAr output and maximum angle swing
      - Less AI MVAr output means more MVAr margin.
      - Less angle swing correlates to a larger stability margin
    - Given the same AI MVAr output compare the maximum angle swing
      - Less angle swing correlates to a larger stability margin
  - TCSC
  - HVDC
  - SVC Locations
    - Evaluate the effectiveness of the SVC locations by observing AI MVAr output and maximum angle swing
      - Less angle swing correlates to a larger stability margin
Artificial Island Project Evaluation:
Artificial Island Proposed
Constructability Considerations
Artificial Island Proposed Constructability Considerations

- Project Cost
- Project Schedule
- Rights of Way and Land Acquisition

- Siting / Permitting
- Project and Coordination Complexity
Artificial Island Proposed Constructability Considerations

Project Cost

- Project proposal estimated cost
  - Independent analysis of estimated cost and risk of cost variability
    - Cost estimates for any missing line items
  - Evaluation of proposed risk and contingency
- Estimated cost impact of project proposal enhancements
- Estimated costs of additional scope to meet PJM reliability requirements
Project Schedule

- Project proposal estimate of time to complete the project
  - Risk to completion by proposed / required date

- Estimated schedule impact of project proposal enhancements

- Estimated schedule impact of additional scope to meet PJM reliability requirements
Artificial Island Proposed Constructability Considerations

Rights of Way and Land Acquisition

- Existing or joint rights
- Entities to be engaged or affected
  - Private / public
- Eminent Domain rights
  - Lack of Eminent Domain in DE
- Size of rights of way or land required
  - Congested area / non-condemnable properties
  - Underground / overhead
Artificial Island Proposed Constructability Considerations

Siting / Permitting

- Water crossings
  - US Army Corps of Engineers
  - Delaware River Basin Commission
  - US Coast Guard
  - National Marine Fisheries Service

- Federal / state / local
  - Scenic, archeological, DOT, endangered species, historic, parks, CPCN

- Public opposition risk
- Wetlands / environmental impact
Artificial Island Proposed Constructability Considerations

Project and Coordination Complexity

- Incumbent Transmission Owner coordination

- Construction complexity
  - Wetlands, work over/on water, constrained area

- Technology employed
  - Long lead time items

- Engineering complexity

- Generator impact
Artificial Island Proposed Constructability Considerations

Project and Coordination Complexity (cont.)

- Outage constraints / coordination
  - Generator and incumbent coordination
  - Outage duration constraints
  - Construction sequencing

- Relocation / expansion / modification of existing facilities
  - Complexity of substation modification
  - Modification of other transmission facilities
• 26 proposed solutions
• Approximate cost range of $100 M to $1,550 M
• Technology includes transmission at both 500 kV and 230 kV, new transformation, substations and associated equipment, additional circuit breakers, system reconfiguration, dynamic reactive, dynamic series compensation
• Diversity of project risk, requirements and timelines

<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>P071_14A</td>
<td>YEP</td>
<td>$155</td>
<td>9.5 MVAR SVC near New Freedom</td>
<td>Two (2) Transformer/Controlled Series Compensation (TCS) Devices near New Freedom</td>
</tr>
<tr>
<td>P071_14B</td>
<td>YEP</td>
<td>$126</td>
<td>New 500 kV Substation, Salem, a new station in Delaware</td>
<td>New 500 kV Station in Delaware that taps existing Cedar Creek-Red Lion 230 kV and Cedar Creek-Red Lion 230 kV</td>
</tr>
<tr>
<td>P071_14C</td>
<td>YEP</td>
<td>$282</td>
<td>New 500 kV Substation, new Station in Delaware</td>
<td>Install a new 500 kV line from Hope Creek to Red Lion, New Salem-Hope Creek 500 kV line</td>
</tr>
<tr>
<td>P071_14A</td>
<td>Transource</td>
<td>$219 - $269</td>
<td>Salem-Cedar Creek 230 kV</td>
<td>Two (2) 230 kV Transformers near Salem, Loop in Red Lion - Carries 230 kV Cedar Creek,</td>
</tr>
<tr>
<td>P071_14B</td>
<td>Transource</td>
<td>$165 - $209</td>
<td>Salem-North Cedar Creek (Near) 230 kV</td>
<td>Two (2) 230 kV Transformers near Salem and Loop in Red Lion - Carries 230 kV Red Lion - Cedar Creek 230 kV</td>
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<tr>
<td>P071_14C</td>
<td>Transource</td>
<td>$123 - $253</td>
<td>Salem-Red Lion 500 kV</td>
<td></td>
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<tr>
<td>P071_14D</td>
<td>Transource</td>
<td>$720 - $834</td>
<td>New Freedom-Lumberton-North Smithsburg-Hope Creek 500 kV line</td>
<td>New Salem-Hope Creek 500 kV line and new 500 kV station east of Lumberton</td>
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<tr>
<td>P071_14A</td>
<td>FirstEnergy</td>
<td>$412</td>
<td>(Technical approx) New Freedom-South Bruce 500 kV line with a loop in Laurel</td>
<td>Hope Creek - Pile Line 500 kV line</td>
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<tr>
<td>P071_14A</td>
<td>Philadmark</td>
<td>$415</td>
<td>Pile Line-Brookley-Red Lion - Salem 500 kV</td>
<td>Remove 500 kV line from Salem-Hope Creek - Red Lion, 500 kV Reconductor Homestead Cedar, 500 kV</td>
</tr>
</tbody>
</table>
## AI Project Proposals – Consider Scope & Cost

### Project Grouping Methodology for Further Study
- In the three lower cost groups, grouped projects share major characteristics (i.e. voltage of 230 kV or 500 kV, transmission endpoints)
- Consider scope and cost ranges

### Initial Approach
- Group by cost, scope, project characteristics, technology

### Project ID and Sponsorship

<table>
<thead>
<tr>
<th>Analytical Study Group</th>
<th>From the Artificial Island To the 230 kV system on the Delmarva Peninsula between Cedar Creek and Red Lion 230 kV</th>
<th>From the Artificial Island To Red Lion 500 kV</th>
<th>TCSC Near New Freedom 500 kV</th>
<th>Higher Cost Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approximate Cost Range</td>
<td>$115 M - $275 M</td>
<td>$125 - $300 M</td>
<td>$133</td>
<td>$692 - $1,548 M</td>
</tr>
</tbody>
</table>

- Project grouping methodology for further study
  - In the three lower cost groups, grouped projects share major characteristics (i.e. voltage of 230 kV or 500 kV, transmission endpoints)
  - Consider scope and cost ranges

- Initial Approach
  - Group by cost, scope, project characteristics, technology
• Types of failure in the stability evaluation
  – Under unity power factor test criteria, the technical reason of all failure cases of the sponsored projects is **transient (rotor angle) instability** for critical contingencies under critical outage conditions.
  – There are no failure cases due to either damping violation or voltage criteria that are more critical than the transient criteria failures.
• PJM identified and evaluated several enhancements to lower cost projects
  – Improved performance of lower cost proposals through simple enhancements
• Limited Enhancements Tested
  – Re-configuration of proposed circuit breakers (by moving breakers) to avoid double line trips due to a critical stuck breaker contingency
  – Change the capability of a proposed SVC
    • Orchard, New Freedom and Artificial Island
  – Add SVC
Several SVC locations considered

- Orchard 500 kV
- New Freedom 500 kV
- Artificial Island 500 kV

<table>
<thead>
<tr>
<th>Proposed SVC Location</th>
<th>Orchard 500 kV</th>
<th>New Freedom 500 kV</th>
<th>Artificial Island 500 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>SVC Size Used in SVC Sensitivity Evaluations</td>
<td>+650/-400 MVAR</td>
<td>+650/-400 MVAR</td>
<td>Two +525 / -525 MVAR SVCs (Total of +1050/-1050 MVAR)</td>
</tr>
</tbody>
</table>
### AI Project Proposals – Proposal Enhancement Evaluations

<table>
<thead>
<tr>
<th>Analytical Study Group</th>
<th>From the Artificial Island To the 230 kV system on the Delmarva Peninsula between Cedar Creek and Red Lion 230 kV</th>
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<th>TCSC near New Freedom 500 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance</td>
<td>Performance with SVC enhancements described on previous slide meets stability criteria</td>
<td>Performance with SVC enhancements described on previous slide meets stability criteria</td>
<td>Increased SVC capability required</td>
</tr>
</tbody>
</table>

- Over 200 stability cases created
  - Enhancement evaluations
- Critical contingencies evaluated for each case
- 1000+ stability simulations performed
• Next Steps
  – Finalize analytical studies
  – Review the results of the constructability studies
  – Finalize individual project sponsor evaluations
Conceptual Artificial Island Schedule

- September 12th TEAC
  - Update analytical progress
- October, November, and December TEAC meetings
  - Update analytical progress
  - Update feasibility study progress
- January 2014
  - Update analytical progress
  - Constructability criteria discussion
- February – March 2014
  - Recommend solution to TEAC
- 2014
  - Recommend solution to PJM Board
Order 1000

Feedback Discussion
March 2013 – PJM, along with stakeholder input, developed and posted requirements for the pre-qualification submittal information.

April 2013 – PJM, along with stakeholder input, developed and presented the pre-qualification evaluation criteria.

To date, PJM has received 18 submittals, 2 of which are currently being processed.
• It appeared that some entities were not aware of the evaluation criteria presented at the PC meeting in April 2013. This added to time needed to review and assess the qualifications
• Some proposing entities required additional time to determine what confidential information needed to be redacted in order to be posted
• Concerns with confidentiality of financial data resulted in delays in processing
• 04/29/13 Artificial Island window opened; RFP documents made available on PJM.com
• 06/28/13 Artificial Island window closed
• 26 project proposals received from 7 different entities
• Sept / Oct – PJM met with proposers
• Technical analysis ongoing
  – Updates provided at TEAC meetings
• 08/12/13 Market Efficiency window opened and RFP documents posted on PJM.com
• 09/26/13 Market Efficiency window closed
• 38 project proposals received from 10 different entities
• Technical analysis ongoing
  – Updates provided at TEAC meetings
Proposal Process Window Observations

- RFP format and content
- Window length
  - Announcement versus actual window opening date and duration
- Load flow cases and data for performing analysis
  - Data updates
- Data submission process and tools
• Project proposals varied considerably in level of detail provided

• Some proposing entities required additional time to determine what confidential information needed to be redacted in order to post project proposals
Recommendations to PJM Board in February 2014
Recommendations to PJM Board in December 2013

• This is the first request for PJM Board approval of the RTEP in 2014
  – Includes reliability projects reviewed at the 12/2013
  – Includes upgrades in the Reliability Analysis Update through 1/2014 (today)
  – Also reference today’s Market Efficiency RTEP proposal window for any additional recommendations

• The PJM Board will be requested in 2/2014 to approve projects in this section of the presentation for inclusion in the RTEP
NERC and Dominion Criteria Violations:

- **NERC Category B single contingency overloads:**
  - Franconia 230kV to Van Dorn 230kV overloads for the outage of Possum Point 230kV to Woodbridge A 230kV
  - Ox 500/230kV Tx #1 overloads for the outage of Tx #2 and vise versa under stressed conditions with Possum Point #6 off

- **NERC Category C “N-1-1” overloads:**
  - Franconia to Van Dorn 230kV overloads for the N-1-1 outage of N Potomac Yards A 230 kV to S Carlyle 230kV and Possum Point to Woodbridge A 230 kV
  - Ox 500/230kV Tx #1 overloads for the N-1-1 outage of Loudoun 500kV to Ox 500kV and Ox 500/230 kV Tx#2 or Tx#2 for Tx#1.
  - Lines 2023 & 2112 N. Potomac Yards to N. Alexandria to S Carlyle 230 kV overloads for the N-1-1 outage of Line 248 N Potomac Yards to S Carlyle 230 kV and Falls C 230 kV to Idylewood 230 kV.
  - Line 248 N Potomac Yards 230kV to S Carlyle 230 kV overloads for the N-1-1 outage of line 241 Hayfield 230 kV to Jefferson St. 230 kV and Franconia A to Ox 230 kV
Solutions Considered:

- Several alternatives internal to Dominion.
- Evaluated several Dominion to PHI tie-line alternatives.

Recommended Solution:

- Construct new underground 230 kV line from Glebe to Station C, rebuild Glebe Substation, construct 230 kV high-side bus at Station C with option to install a 800MVA PAR.

Estimated Project Cost:  
- $165.4M (including PAR)  
- $155.4M (not including PAR)

Expected In-Service Date:  6/1/2018
• Load deliverability and N-1-1 Voltage Violation:
  – Several voltage magnitude and voltage drop violations in the Erie vicinity for PenElec and WMAAC LDA load deliverability and N-1-1 test.

• Proposed Solution:
  – Install +250/-100 MVAR SVC at the Erie South 230 kV station (B2441).

• Estimated Project Cost:
  – $42 M

• Expected IS Date:
  – 6/1/2018
• **N-1-1 Voltage Violation:**
  – Voltage drop violations in the Lewistown vicinity for several N-1-1 contingencies.

• **Proposed Solution:**
  – Install three 230 kV breakers on the 230 kV side of the Lewistown #1, #2 and #3 transformers (B2442).

• **Estimated Project Cost:**
  – $2.3 M

• **Expected IS Date:**
  – 6/1/2018
• N-1-1 Thermal Violation:
  – The Somerset to Allegheny 115 kV circuit is overloaded for the N-1-1 contingency loss of the Cambria Slope – Summit and Claysburg – Krayn 115 kV circuits.

• Proposed Solution:
  – Construct a new 115 kV line from Central City West to Bedford North (B2450). This project will replace baseline project B1607 (Reconductor the New Baltimore-Bedford North 115 kV Line).

• Estimated Project Cost:
  – $37.5 M

• Expected IS Date:
  – 6/1/2018
• The Churchtown 69kV 'D' is overstressed
• Significant Driver: Install second 230/69 kV transformer and 230 kV circuit breaker at Churchtown substation (B2354)
• Proposed Solution: Replace Churchtown 69kV breaker 'D' (b2354.1)
• Estimated Project Cost: $300 K
• Required IS Date: 6/1/2015
• The Farmers Valley 115kV ‘BUS_SEC’ is overstressed
• Significant Driver: Construct Farmers Valley 345/230 kV and 230/115 kV substation. Loop the Homer City-Stolle Road 345 kV line into Farmers Valley (b1991)
• Proposed Solution: Replace the Farmers Valley 115kV breaker 'BUS_SEC' with 40kA (b1991.1)
• Estimated Project Cost: $300 K
• Required IS Date: 6/1/2015
• The Blooming Grove 230 kV breaker 'Peckville' is overstressed
• Significant Driver: Build a new 230-69 kV (Paupack) substation and a new Pocono 230/69 kV substation with two 230/69 kV transformers (b1813)
• Proposed Solution: Replace the Blooming Grove 230 kV breaker 'Peckville' (b1813.12)
• Estimated Project Cost: $350 K
• Required IS Date: 11/30/2016
RTEP Next Steps

• Continue Artificial Island evaluation

• Finalize RTEP power flow case
Questions?

Email: RTEP@pjm.com
1/8/2014 v1
  - Original version distributed to PJM TEAC
1/9/2014 v2
  - Slide 72 – TBD cost updated with actual cost estimate
  - Slide 36 – Updated Transmission Zone from APS to Dominion