Transmission Expansion Advisory Committee

March 7, 2013
Issues Tracking
• Open Issues
  – None

• New Issues
Stage 1AARR Transmission Project Update
Byron to Wayne 345 kV Transmission Line

- Eliminates COMED Area Stage 1A 10 year infeasibilities
- Approved by PJM Board for inclusion into Regional Transmission Expansion Plan (RTEP) in October 2012
- Operating Agreement requires an analysis of the benefits of the project given that this project is not subject to a market efficiency cost/benefit analysis
- Estimated 15-year Congestion Cost Savings: $200-250 million
- Estimated 15-year Production Cost Savings: $75-125 million
PJM Scenario Analysis Update
At-Risk Generation

- Approximately 4,500 MW of At-Risk generation remains
- Known deactivation notifications not included
• Proposed Scenario:
  – Develop 2018 At-Risk generation case
    • Perform load flow analysis
  – Determine potential transmission enhancements to accommodate current At-Risk Generation
  – Incorporate all recent deactivation notification upgrades and RTEP upgrades
  – Perform sensitivity study on the potential violations to queued FSA generation
2013 RTEP Scenario – DR Sensitivity

• Proposed Scenario
  – Develop Load Deliverability cases for each LDA to account for Demand Response sensitivity
    • Reduce each LDAs DR by amount of generation in LDA that did not clear in RPM auction (load deliverability test only)
  – Perform Load Deliverability analysis
  – Identify locational supply concerns before they actually occur
• Update state requirements as required
• Finalize RPS1 2GW scenario
• “Optimize” transmission overlay
  – 2013 RTEP will investigate what parts of overlay develop in 2012 RTEP may not be required for a given scenario
• Generation commitment
  – Sensitivity study around unit commitment assumptions used in production cost simulations – check impact on wind curtailment
• Refine Offshore HVDC Modeling (i.e. apply limits)
• State reporting of production cost simulation results
• Proposed scenarios reviewed with ISAC in February

• Incorporate state feedback

• Initiate analysis
High Voltage in PJM Operations Analysis Update
• Determined potential reactor locations
  – from historical PI data and high voltage alarm data

• Modeled and simulated reactors in several operational cases to determine the potential magnitude that is necessary to control high voltage

• Also simulated high voltage conditions and reactors in a planning case to determine system needs beyond the operational cases
High Voltage Locations from PJM Operations Cases

• 5 snapshot cases from PJM Operations evaluated
Progress Update

• Provided TOs with historic high voltage alarm data and voltage analysis performed on five historic EMS cases
• Received feedback from TOs
• Potential solutions received to date include
  – Shunt reactors
  – SVCs
  – Modifications to / optimization of existing facilities
    • Generator voltage schedules
    • Transformer tap settings
    • Switched shunt settings
Preliminary Solutions

- **AEC**
  - 50 MVAR shunt reactor at Mickleton 230 kV
  - +150/-100 MVAR SVC at Cedar 230 kV

- **AEP**
  - Install a 300 MVAR reactor at Dequine 345 kV
  - Replace existing 150 MVAR reactor on Amos – N. Proctorville Hanging Rock 765 kV with 300 MVAR reactor
  - Install 765 kV reactor breaker at Dumon and Marysville 765 kV substations

- **ComEd**
  - Optimization of existing facilities at Twin Grove and Kincaid

- **DLCO**
  - 200 MVAR shunt reactor at Brunot Island 345 kV
  - 200 MVAR shunt reactor on future Brunot Island – Carson 345 kV circuit
Preliminary Solutions

- **Dominion**
  - Previously approved RTEP upgrades b1805, b2125 and b2126

- **DPL**
  - Previously approved RTEP upgrades b0876 and b1899.1-b1899.3

- **FE**
  - 260 MVAR reactor at West Wharton 230 kV (JCPL, this solution is still under review by PJM and FirstEnergy)
  - 130 MVAR reactor at Monocacy 230 kV (APS, this solution is still under review by PJM and FirstEnergy)
  - Optimization of existing facilities (JCPL, ME, PN, APS)

- **PECO**
  - 50 MVAR reactor at Buckingham 230 kV

- **PPL**
  - 150 MVAR reactor at Alburtis 500 kV
  - 100 MVAR reactor at Elimsport 230 kV
  - Change generator voltage schedule at Montour
• PSEG
  - Near Term: Optimization of existing facilities
  - Longer Term: Shunt reactors

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<th>Size (MVAR)</th>
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<tr>
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<td>100</td>
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<tr>
<td>Hawthorne/Hinchmans /Jackson Rd</td>
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<td><strong>Total</strong></td>
<td><strong>14</strong></td>
<td><strong>850</strong></td>
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Next Steps

• Analysis of the locations proposed by transmission owners

• Confirm proposed locations address the issues

• Evaluate the effectiveness of proposed locations for those that are electrically close to each other
Generation Deactivation Notification (Retirements) Update
Deactivation Status

- No additional generation deactivation requests received since 2/7/2013 TEAC update

- Completed analysis related to deactivation requests received in January 2013

- Continue to retool previous deactivation studies to refine required upgrades
• The Bergen – North Bergen 138 kV line is overloaded for loss of the Bergen 138 kV bus section #3.
• Proposed Solution: Rebuild 2.19 miles of overhead line E-1305-5 (Bergen - North Bergen). (b2217).
• Cost Estimate: $38 M
• Required IS Date: 6/1/2015.
• The Edison – Meadow Road Q138 kV line is overloaded for various contingencies.
• The Meadow Road Q – Metuchen 138 kV line is overloaded for various contingencies.
• Proposed Solution: Rebuild 4 miles of overhead line from Edison - Meadow Rd - Metuchen (Q-1317) (b2218).
• Cost Estimate: $46 M
• Required IS Date: 6/1/2015.
• Revised Required In-Service Date for previously approved baseline upgrade b1900:
  • The Linwood – Chichester 230 kV line #1 is overloaded for the single contingency loss of the Linwood – Chichester 230 kV line #2 and loss of Philips Island generating units CT2, CT3, and ST1.
  • The Linwood – Chichester 230 kV line #2 is overloaded for the single contingency (‘220-43’) loss of the Linwood – Chichester 230 kV line #1 and loss of Philips Island generating units CT2, CT3, and ST1.
• Proposed Solution: Add a 3rd 230 kV transmission line between Chichester and Linwood substations and remove the Linwood SPS (b1900).
• Original Required IS Date: 6/1/2018.
• Revised Required IS Date: 6/1/2015.
• Change in scope of upgrade addressing the Howard – Brookside 138 kV overload:
• The Howard – Brookside 138 kV tie line (AEP/ATSI) is overloaded for the tower contingency loss of the Galion - Leaside 138kV line and the Galion - GM Mansfield 138kV line.
• Original Proposed Solution to be cancelled: Build a new ATSI/AEP 138 kV Substation (Brubaker) near the territory border and a new 138 kV line from the new substation to Longview (B1935).
• Estimated Project Cost (B1935): $18M
• Required IS Date (B1935): 6/1/2015
• Recommend the cancellation of B1935
• New Proposed Solution: see next 2 slides.
Continued from previous slide…

Change in scope of upgrade addressing the Howard – Brookside 138 kV overload:

- The Howard – Brookside 138 kV tie line (AEP/ATSI) is overloaded for the tower contingency loss of the Galion - Leaside 138kV line and the Galion - GM Mansfield 138kV line.
- New Proposed Solution: Reconductor the ATSI portion of the Howard - Brookside 138 kV line (b2122.1).
  - Cost Estimate: $7.75 M

- New Proposed Solution: Upgrade terminal equipment at Brookside on the Howard - Brookside 138 kV line (b2122.2).
  - Cost Estimate: $63 K
  - Required IS Date: 6/1/2015.
Continued from previous slide…
Change in scope of upgrade addressing the Howard – Brookside overload:
The Howard – Brookside 138 kV tie line (AEP/ATSI) is overloaded for the tower contingency loss of the Galion -Leaside 138kV line and the Galion - GM Mansfield 138kV line.
New Proposed Solution: Upgrade terminal equipment at Howard on the Howard - Brookside 138 kV line (b2122.3).
Cost Estimate: $600 K
New Proposed Solution: Perform a sag study on the Howard - Brookside 138 kV line(b2122.4).
Cost Estimate: $32 K
Required IS Date: 6/1/2015.
- Seneca pumping low voltages
- There are various low voltage magnitude and voltage drop violations in the Seneca area for various contingencies.
- Proposed Solution: Build a 2nd Glade - Warren 230 kV line (b2180).
- Cost Estimate: $29.6 M
- Required IS Date: 6/1/2015.
• Need to relocate substation control equipment due to the generation deactivations at Shawville.

• Proposed Solution: Shawville Substation: Relocate 230 kV and 115 kV controls from the generating station building to a new control building (b2212).

• Cost Estimate: $6.7 M

• Required IS Date: 12/1/2014.
• Need to relocate substation control equipment due to the generation deactivations at Armstrong.

• Proposed Solution: Armstrong Substation: Relocate 138 kV controls from the generating station building to a new control building (b2213).

• Cost Estimate: $2.7 M

• Required IS Date: 12/1/2013.
• Need to relocate substation control equipment due to generation deactivations at Albright.
• Proposed Solution: Albright Substation: Install a new control building in the switchyard and relocate controls and SCADA equipment from the generating station building to the new building (b2214).
• Cost Estimate: $3.4 M
• Required IS Date: 6/30/2014.
• Need to relocate substation control equipment due to generation deactivations at Rivesville.
• Proposed Solution: Rivesville Switching Station: Relocate controls and SCADA equipment from the generating station building to a new control building (b2215).
• Cost Estimate: $800 K
• Required IS Date: 12/31/2013.
• Need to relocate substation control equipment due to generation deactivation at Willow Island.

• Proposed Solution: Willow Island: Install a new 138 kV cross bus at Belmont Substation and reconnect and reconfigure the 138 kV lines to facilitate removal of the equipment at Willow Island switching station (b2216).

• Cost Estimate: $2.0 M

• Required IS Date: 12/31/2014.
• The Brues 138 kV bus section 1-2 is overloaded for the N-1-1 loss of the Kammer – South Canton 765 kV line and South Canton 765/345 kV transformer and South Canton 345/138 kV transformer #4 followed by the loss of the Tidd – West Bellaire 345 kV line.

• Proposed Solution: Upgrade relay at the Brues station (b2055).

• Cost Estimate: $100 K

• Required IS Date: 6/1/2015.
• The Willow Island – Belmont 138 kV line is overloaded for the N-1-1 loss of the Belmont – Kammer 765 kV line followed by the loss of the Belmont - Roche Vitamin 138 kV line.

• The Willow Island – Roche Vitamin - Belmont 138 kV line is overloaded for the N-1-1 loss of the Belmont – Kammer 765 kV line followed by the loss of the Willow Island – Belmont 138 kV line.

• Proposed Solution: Replace wave traps at Willow Island and Belmont to improve both Willow Island - Belmont 138 kV lines (b2116).

• Cost Estimate: $150 K

• Required IS Date: 6/1/2015.
The Parkersburg – Belpre 138 kV line is overloaded for the N-1-1 loss of the Waverly – Williamstown 138 kV line followed by the loss of the Muskingham River 345/138 kV transformer banks A & B.

Proposed Solution: Reconductor 1.5 miles of the Parkersburg - Belpre line and upgrade Parkersburg terminal equipment (b2117).

Cost Estimate: $250 K

Required IS Date: 6/1/2015.
• Low voltage magnitude at the Paden City and New Martinsville 138 kV buses for the N-1-1 loss of the Kammer – Natrium 138 kV line followed by the loss of the Kammer – Ormet 138 kV line.

• Proposed Solution: Add a 44 MVAR Capacitor at New Martinsville (b2118).

• Cost Estimate: $1.10 M

• Required IS Date: 6/1/2015.
• The Carlls Corner - Laurel 69 kV line is overloaded for the tower contingency loss of the BL England – Scull – Mill 138 kV lines #1 and #2.

• Proposed Solution: Upgrade the 69 kV bus at Laurel (b2123).

• Cost Estimate: $175 K

• Required IS Date: 6/1/2015.
Brattle Recommendation – 2017 CETO/CETL Values
• 2012 RTEP Assumptions
  – Include transmission approved by the PJM Board through December 2012

• 2017 CETO & CETL values from 2012 RTEP

• Limiting facilities identified
### 2017 RTEP Base Case CETO & CETL Values

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<tr>
<th>Area</th>
<th>CETO</th>
<th>CETL</th>
<th>CETL/CETO %</th>
<th>Limiting Facility</th>
<th>Violation Type</th>
<th>Limiting Element</th>
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Artificial Island
Max generation power output for stable operation is expressed as:

\[ P_{\text{max}} = \frac{(V_t \times E_i)}{X_d} \]

- \( V_t \) is system voltage
  - More is theoretically better, but has operational limits
- \( E_i \) is internal machine voltage
- \( X_d \) is system impedance
  - Smaller is better
• Stability Requirements
  • Artificial Island Operating Guide (AIOG)
  • Minimum MVAR output requirements from Hope Creek, Salem 1&2

• Reliability Issues
  – High voltage
Artificial Island Proposal Window

• Goals

  1. System Performance
     • Outage conditions - improve system performance and AI
       stability margin under N-1 (forced or unforced)
     • Normal conditions - Improve system performance and
       stability margin under normal system conditions

  2. AIOG
     • Eliminate the AIOG
• See Today’s Planning Committee Presentations
  – Pre-Qualification Submittal
  – CEII & NDA Requirements
  – Possible window timeline
Artificial Island Proposal Requirements

• Sponsoring entity information
  – Company name, contact information etc.

• Project Description
  – Include scope, interconnection points, configuration (e.g. overhead, underground, AC/DC etc.), ROW, high level project schedule including CPCN, engineering, construction start, and in-service date
  – Project cost estimate
Artificial Island Proposal Requirements

• Technical Report
  – Include assumptions and calculations demonstrating the efficacy of the project
    • Report should include information about the origin of power flow case and any modifications, station single line drawings and results of any sensitivity studies
  
    • Modeling information such as conductor type, calculated impedances, contingency files, *.idev files and dynamic files
Artificial Island Case Development

• PJM coordinating development and benchmark of critical system condition cases to the current case
  – Cases will be available in PSS/E v32.1.1 (*.sav format)
  – Power flow case and dynamics data file
  – Other environment files (.snp, .dll and .rsp)
Artificial Island Proposal Window Timeline

**Announcement**
Today (3/7/2013)
- Announce window and potential timeline
- Request CEII/NDA submittals from anticipated participants
- Request Designated Entity Pre-Qualification

**Case Development**
- Develop and benchmark critical system condition cases

**Open Window**
(60 Day Duration)
- Open the "Artificial Island" RTEP Proposal Window
- Analytical files available

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

**Close Proposal Window**
(Estimated 6/7/2013)

**PJM Evaluates Solution Proposals**
Next Steps

- Update Artificial Island Proposal window progress
- Finalize 2013 RTEP base case development (2018)
- Finalize 2013 RTEP scenario scope
- Recommend solution package for High Voltage in PJM Operations
Questions?

Email: RTEP@pjm.com