Transmission Expansion Advisory Committee

August 12, 2009
Interregional Planning Update
SW Indiana Study Update
Southwest Indiana Study - Base Case Reliability Analysis

• **Study Cases**
  – 2014 Summer
  – 2019 Summer

• **Contingencies**
  – NERC Category A
  – NERC Category B1, B2, B3
  – NERC Category C1, C2, C3, C5

• **Test Type**
  – Thermal
  – Voltage

• **Result**
  – Number of 345 kV and 230 kV violations identified as valid constraints in the area
Southwest Indiana Study – Three Alternatives

- Power flow and economic analysis will be performed to evaluate the benefits of the 765 kV and 345 kV proposals as outlets to this generation
- 765 kV Alternatives
  - Greentown – Dequine – Sullivan – Edwardsport - Rockport 765kV
  - Greentown – Dequine – Sullivan 765kV
- 345 kV Alternatives:
  - Bloomington – Hanna 345 kV
- Power flow case update in progress
- Economic analysis to follow
Southwest Indiana Study – PV Analysis

- PV analysis that stresses the system by increasing the South to North flows
- Evaluate the transmission system voltage performance under credible conditions and provide insight into the remaining margin
- Full run on the base case, sensitivity analysis reinforced cases
- Lines to be monitored in the analysis:
  - Dequine – Olive 345 kV Circuit #1
  - Dequine – Olive 345 kV Circuit #2
  - Francis – Petersburg 345 kV line
  - Petersburg – Thompson 345 kV line
- Buses to be monitored in the analysis:
  - Dequine 345 kV Bus
  - Bloomington 230 kV Bus
  - Guion 345 kV Bus
  - Thornton 230 kV
  - Thompson 345 kV
  - Francis 345 kV
  - Kokomo 230 kV
Southwest Indiana Study - Next Steps

- Base case PV analysis
- Sensitivity studies (thermal and economic) looking at MISO and PJM queued generation
  - Approximately 5000 MW queued generation in the area
- Economic and reliability analysis to evaluate the benefits of three main transmission options (two 765 kV options and one 345 kV option)
- 2nd IPSAC Meeting on August 31st in Carmel
• Scope
  – Develop common case based on 2014 SW Indiana Study
  – Study focus: benefit of a stronger interface
    • Study current system configuration and Alternative upgrades
    • Reliability study of transfers using single and multiple contingencies
    • Market efficiency benefits of a stronger interface
    • Stability benefits to strengthened interface

• Target Completion - 2009
Baseline Projects
Potential generation deliverability violation on Dequine – Reynolds 345 kV for a fault on Dequine – Olive 345kV with a stuck breaker at Dequine in 2014
• Potential generation deliverability violation
• Dumont 765/345kV transformer is potentially overloaded in 2014 for a fault on Dumont – Wilton Center 765kV with a stuck breaker at Dumont 765kV
• Generation deliverability violation

• Lockport - Lisle 345 kV (Line 10801) is overloaded in 2014 for the single outage of line 10808 Lockport – Lombard 345 kV

• Proposed Solution: Replace the 345 kV Bus Tie CB 2-3 at Lisle. This CB can be upgraded from 2000A to 3000A with an inspection and new nameplate from the manufacturer for $10k.

• Estimated Project Cost: $10k

• Required IS Date: 6/1/2014
• Generation deliverability violation.


• Proposed Solution:
Replace Circuit Breaker, Station Cable, CTs and Wave Trap at Eddystone substation.
Replace Circuit Breaker, Station Cable, CTs, Wave Trap and Disconnect Switch at Island Rd. substation.

• Estimated Project Cost: $2.0 M

• Expected IS Date: 6/01/2014
• Generation deliverability violation.
• The Printz – Ridley 230 kV circuit overloaded for the loss of the Eddystone – Island Rd. 230 kV circuit.
• Proposed Solution: Replace 230 kV Circuit Breakers # 115 and # 125 at Printz substation.
• Estimated Project Cost: $1.0 M
• Expected IS Date: 6/01/2014
• Generation deliverability violation
• The Graceton – Bagley 230 kV circuit overloaded for tower contingency that removes the two Conastone – Northwest 230 kV circuits 2322 and 2310.
• Proposed Solution:
  Rebuild the Graceton – Bagley section as double circuit line using 1590 Kcmil ACSR. Terminate new line at Graceton with a new circuit breaker.
• Estimated Cost:
  $16.5 M
• Expected IS Date:
  6/01/2014
- Generation deliverability violation
- The South Mahwah – Waldwick 345 kV J-3410 and K-3411 circuits are overloaded. Loss of either J-3410 or K-3411 circuit overloads the other circuit.
- Proposed Solution: Reconducto both J-3410 and K3411 circuits and replace terminal equipment.
- Estimated Project Cost: $TBD M
- Expected IS Date: 6/01/2011
• PS-North load deliverability violation
• The Roseland – Cedar Grove – Clifton – Athenia 230 kV F-2206 and B-2228 circuits are overloaded. Loss of either F-2206 or B-2228 circuit overloads the other circuit.
• Proposed Solution: Replace terminal equipments at Roseland, Cedar Grove, Clifton and Athenia 230 kV substations.
• Estimated Project Cost: $3.5 M
• Expected IS Date: 6/01/2011
• Generation deliverability violation
• The Englishtown – Manalapan 230 kV circuit overloaded for tower contingency that removes the Atlantic – Larrabee and Atlantic – Smithburg 230 kV circuits.
• Proposed Solution: Replace a Wave Trap at Englishtown substation.
• Estimated Project Cost: About $0.1 M
• Expected IS Date: 6/01/2011
• Baseline b0755: Build a 15-mile long 230 kV line from Hamilton to Middleburg and convert Line #49 to 230 kV (10 miles).
• Upgrade to resolve a Dominion criteria violation for lines #49 Loudoun to Middleburg 115 kV and #2098 Pleasant View to Hamilton 230 kV line
• TEAC Est. Cost: $125M
• Revised Est. Cost: $400M – significant underground construction
• Proposed new solution: Tap Dickerson to Pleasant View 230 kV and build new Edwards Ferry Sub. This reduces loading on Pleasant View to Hamilton 230 kV. Construct 10 mile double ckt. 230 kV tower line from Loudoun to Middleburg. One ckt operating at 115 kV initially.
• Estimated cost: $35M
• Expected service date: May 2013
2014 N-1-1 Thermal Analysis
Preliminary Results
Potential BGE N-1 Violations

- Middle River – Chesaco Park CKT 110502-A1 115kV / loss of Middle River – Northeast CKT 110583 115kV line (BG_110543).

- Benfield - Crownsville 115kV line / loss of Waugh Chapel – Crane H. Way – Bestgate CKT 110543 115kV line (BG_110583).
Potential BGE N-1-1 Violations

- Graceton – Bagley13 230kV line / loss of Brandon – Hawkins – Sollers – Riverside CKT 2345 230 kV line + loss of Brandon – Hawkins – Sollers – Riverside CKT 2344 230 kV line
- Summerfield – East Towson CKT 110518 115 kV line / loss of Windy Edge – Norch Cliff – Summer – East Towson CKT 110517 115 kV line + basecase.
Potential BGE N-1-1 Violations

- Mays Chapel 579 – Mount Washington 115kV line / loss of Mays Chapel – MT. Washington CKT 110702 115kV line + base case
- Mays Chapel 579– Texas 509 115kV line / loss of Mays Chapel – MT. Washington CKT 110702 + loss of Northwest – Delight – Gwynnbrook – Mays Chapel CKT 110579 115kV line
Potential BGE N-1-1 Violations

- Monument St. – Erdman CKT 110557 115 kV line / loss of Westport – Greene St. CKT 110554 115kV line + loss of Westport – Greene St. CKT 110553 115kV line
- Monument St. – Erdman CKT 110558 115 kV line / loss of Westport – Greene St. CKT 110554 115kV line + loss of Westport – Greene St. CKT 110553 115kV line
Potential BGE N-1-1 Violations

- Greene – Westport CKT 110553 115 kV line / loss of Windy Edge – Hillen Rd TP – Erdman CKT 110508 115 kV line + loss of Greene – Westport CKT 110554 115 kV line

- Greene – Westport CKT 110554 115 kV line / loss of Windy Edge – Hillen Rd TP – Erdman CKT 110507 115 kV line + loss of Greene – Westport CKT 110553 115 kV line
Potential BGE N-1-1 Violations

- Concord St. – Monument St. CKT 110564 115 kV line / loss of Westport – Greene St. CKT 110554 115kV line + loss of Westport – Greene St. CKT 110553 115kV line
- Concord St. – Monument St. CKT 110563 115 kV line / loss of Westport – Greene St. CKT 110554 115kV line + loss of Westport – Greene St. CKT 110553 115kV line
Potential BGE N-1-1 Violations

- Harrisonville – Granite CKT 110560 115kV line / loss of Northwest 230-5 230/115 kV Transformer + loss of Northwest 230-4 230/115 kV Transformer
- Dorsey T1 – High Ridge-5 115 kV line / loss of High Ridge – Dorsey Tap – Crystal Springs CKT 110542-A 115 kV line + basecase
- Dorsey T2 – High Ridge-4 115 kV line / loss of High Ridge – Dorsey Tap – Crystal Springs CKT 110541-A 115 kV line + basecases
Potential BGE N-1-1 Violations

- Waugh Chapel – Benfield 115 kV line / loss of Waugh Chapel – Crownsville – Bestgate CKT 110543 115 kV line + basecase
- Waugh Chapel – Crane HWY 115 kV line / loss of Waugh Chapel – Benfield – Crownsville – Bestgate CKT 110544 115 kV line + basecase
Potential BGE N-1-1 Violations

- Cedar – Bestgate Terminal 115 kV line / loss of Waugh Chapel – Crownsville – Bestgate CKT 110543 115 kV line + basecase
- Cedar 43 – Cedar Park 43TP 115 kV line / loss of Waugh Chapel – Benfield – Crownsville – Bestgate CKT 110544 115 kV line + basecase
Potential BGE N-1-1 Violations

- Conastone – MT CAR22 230 kV line / losses of BOWIE043 – Oak Grove 053 230kV line & CHALK230 – AQUASCO 230 kV line + loss of Conastone – Northwest CKT2310 230 kV line

- Solley34 – Lipins34 115kV line / loss of Pumphrey – Wagner CKT 110535 115kV line + basecase

- Wagner – Solley35 115kV line / loss of Pumphrey – Wagner CKT 110534 115kV line + basecase
Potential PEPCO N-1-1 Violations

- Benning T7-Tux 504 115 kV line / loss of Lanhm 505 115 kV bus + loss of Bowie 115 - Lanhm 506 CKT 1 115 kV line
- Tux 504-Lanhm506 115 kV line / loss of Lanhm 115 kV bus + loss of Bowie 115 - Lanhm 506 115 kV line
Potential PEPCo N-1-1 Violations

- Oak Grove – Ritchie 059 230kV line / losses of Oak Grove – Ritchie 061 230 kV line & Ritchie 061– Benning 230 kV line + loss of Oak Grove – Ritchie 058 230 kV line

- Oak Grove – Ritchie 060 230kV line / losses of Oak Grove – Ritchie 061 230 kV line & Ritchie 061– Benning 230 kV line + loss of Oak Grove – Ritchie 058 230 kV line
Potential PEPCo N-1-1 Violations

- Oak Grove – Ritchie 061 230 kV line / losses of Oak Grove – Ritchie 059 230 kV line & Buzzard – Ritchie CKT 23016 230 kV line + loss of Oak Grove – Ritchie 058 230 kV line
- Ritchie 059 – Benning 230kV line / loss of Oak Grove – Ritchie 058 230 kV line + losses of Oak Grove – Ritchie 061 230 kV line & Ritchie 061 – Benning 230 kV line
Potential PEPCo N-1-1 Violations

- Buzzard 138 – Ritchie 851 138 kV line / loss of Burches Hill – Palmers Corner – Alabama Ave. CKT 23089 230 kV line + loss of Palmers Corner – Alabama Ave. CKT 23088 230 kV line
Potential PEPCo N-1-1 Violations

- Buzzard 016 – Ritchie 059 230 kV line / loss of Burches Hill – Palmers Corner – Alabama Ave. CKT 23089 230 kV line + losses of Burches Hill – Palmers Corner CKT 23090 230 kV line & Palm90 – Palm69 230/69 kV Transformer
Potential PENELEC N-1-1 Violations

- Bedford North – Allegheny 115 kV line / loss of CLAYSBURG - CURRYVILLE - SAXTON 115 KV LINE AND CURRYVILLE 115/23 KV TRANSFORMER #1 + Basecase
- Carlisle - Roxbury 115 kV line / loss of TEXAS EASTERN TAP 115 KV BUS + loss of MIDDLETOWN JUNCTION - COLLINS - CLY 975 - NEWBERRY - ROUNDTOP 115 KV LINE
Potential PENELEC N-1-1 Violations

- Lewistown 230/115 kV transformer #1 / loss of Yeagerstown - Lewistown 2 230 kV line and Yeagerstown 230/46 kV transformer #1 and Yeagerstown 230/34.5 kV transformer #3 + loss of Lewistown 230 kV capacitor and Lewistown - Juniata 230 kV line and Lewistown - Yeagerstown 230 kV line and Lewistown 230/115 kV transformer #3 and Lewistown 115/46 kV transformer #1
Potential PENELEC N-1-1 Violations

- Lewistown 230/115 kV transformer #2 / loss of LEWISTOWN - RAYSTOWN 230 KV LINE AND LEWISTOWN - SHINGLETOWN 230 KV LINE AND LEWISTOWN - YEAGERSTOWN 230 KV LINE AND LEWISTOWN 230/115 KV TRANSFORMER #3 AND LEWISTOWN 115/46 KV TRANSFORMER #1 + loss of YEAGERSTOWN - LEWISTOWN 2 230 KV LINE AND YEAGERSTOWN 230/46 KV TRANSFORMER #1 AND YEAGERSTOWN 230/34.5 KV TRANSFORMER #3
Potential PENELEC N-1-1 Violations

- Lewistown – Reed Tap 115 kV line / loss of East Waynesboro - Ringgold 138 kV line + loss of Guilford - Chambers 138 kV line
- Reed Tap – Shade Gap 115 kV line / loss of East Waynesboro - Ringgold 138 kV line + loss of Guilford - Chambers 138 kV line
- Roxbury – Shade Gap 115 kV line / loss of East Waynesboro - Ringgold 138 kV line + loss of Guilford - Chambers 138 kV line
Potential PENELEC N-1-1 Violations

- Roxbury 138/115 kV transformer / loss of East Waynesboro - Ringgold 138 kV line + loss of Guilford - Chambers 138 kV line
- Scalp Level - Hooversville 115 kV line / loss of JOHNSTOWN 230 KV BUS + loss of COOPER - SEWARD 115 KV LINE
- Scalp Level – Rachel Hill 115 kV line / loss of COOPER - SEWARD 115 KV LINE + loss of JOHNSTOWN 230 KV BUS
Potential PENELEC N-1-1 Violations

- Mansfield – South Troy 115 kV line / loss of FARMERS VALLEY - RIDGWAY 115 KV LINE + loss of LEWIS RUN - GLADE 230 KV LINE AND LEWIS RUN 230/115 KV TRANSFORMER #1 AND LEWIS RUN 230/34.5 KV TRANSFORMER #2
- South Troy - Towanda 115 kV line / loss of LEWIS RUN - GLADE 230 KV LINE AND LEWIS RUN 230/115 KV TRANSFORMER #1 AND LEWIS RUN 230/34.5 KV TRANSFORMER #2 + loss of FARMERS VALLEY - RIDGWAY 115 KV LINE
Potential PENELEC N-1-1 Violations

- Buffalo Road - Erie SE115 kV line / loss of WARREN - GLADE 230 KV LINE AND WARREN 230/115 KV TRANSFORMER #4 + loss of GESG LINE TAP 115 KV BUS
- Eclipse – Clark Summit 115 kV line / loss of PINEY - HAYNIE - GRANDVIEW 115 KV LINE AND HAYNIE 115/34.5 KV TRANSFORMER #1 + Basecase
Potential PENELEC N-1-1 Violations

- Erie SE 230/115 kV transformer / loss of ERIE SOUTH 230 KV CAPACITOR AND ERIE SOUTH 230/115 KV TRANSFORMER #6 AND ERIE SOUTH 345/230 KV TRANSFORMER #5 AND ERIE SOUTH 230/34.5 KV TRANSFORMER #7 AND ERIE SOUTH 230/34.5 KV TRANSFORMER #3 + Basecase
Potential PENELEC N-1-1 Violations

- Erie South 230/115 kV transformer #6 / loss of ERIE SOUTHEAST 230 KV CAPACITOR AND ERIE SOUTHEAST - ERIE EAST 230 KV LINE AND ERIE SOUTHEAST 345/230 KV TRANSFORMER #8 AND ERIE SOUTHEAST 230/115 KV TRANSFORMER #1 AND ERIE SOUTHEAST 230/34.5 KV TRANSFORMER #4 + Basecase
Potential PENELEC N-1-1 Violations

- Erie South – GESG Tap 115 kV line / loss of ERIE SOUTH EAST - BUFFALO ROAD 115 KV LINE AND BUFFALO ROAD 115/34.5 KV TRANSFORMER #1 + Basecase
- Erie South – GESG Tap 115 kV line / loss of ERIE SOUTH EAST - BUFFALO ROAD 115 KV LINE AND BUFFALO ROAD 115/34.5 KV TRANSFORMER #1 + loss of ERIE WEST - FAIRVIEW EAST 115 KV LINE AND FAIRVIEW EAST 115/34.5 KV TRANSFORMER #2
Potential PENELEC N-1-1 Violations

- Ridgeway – Farmers Valley 115 kV line / loss of LEWIS RUN - GLADE 230 KV LINE AND LEWIS RUN 230/115 KV TRANSFORMER #1 AND LEWIS RUN 230/34.5 KV TRANSFORMER #2 + loss of MANSFIELD - SOUTH TROY - TOWANDA EAST 115 KV LINE AND SOUTH TROY 115/34.5 KV TRANSFORMER #1 AND TOWANDA EAST 115/34.5 KV TRANSFORMER #1
Potential PENELEC/AP Tie Line N-1-1 Violation

- Roxbury - Greene 138 kV line / loss of East Waynesboro - Ringgold 138 kV line + loss of Guilford - Chambers 138 kV line
Potential PENELEC/Met-Ed Ties N-1-1 Violation

- Carlisle Pike - Gardners 115 kV line / loss of East Waynesboro - Ringgold 138 kV line + loss of Guilford - Chambers 138 kV line
• Bair – Hill 115 kV line / loss of CATAPILLAR TRACTOR - PLEASUREVILLE 115 KV LINE + loss of YORKANA - BRUNNER ISLAND 230 KV LINE AND YORKANA 230/115 KV TRANSFORMER #4
Potential MetEd N-1-1 Violations

- Bair – Jackson 115 kV line / loss of YOE TAP 115 KV BUS + Basecase
- Baker Tap - Taxville 115 kV line / loss of YORKANA - BRUNNER ISLAND 230 KV LINE AND YORKANA 230/115 KV TRANSFORMER #4 + loss of YORKANA 230/115 KV TRANSFORMER #3
- Baker Tap - Taxville 115 kV line / loss of YORKANA 230/115 KV TRANSFORMER #3 + Basecase
Potential MetEd N-1-1 Violations

- Cat Tractor - Pleasureville 115 kV line / loss of YORKANA 230/115 KV TRANSFORMER #3 + loss of PLEASUREVILLE - HARLEY DAVIDSON - YORK COUNTY INCINERATOR 115 KV LINE
- Cly - Newberry 115 kV line / loss of TEXAS EASTERN TAP 115 KV BUS + loss of CARLISLE PIKE - ROXBURY 115 KV LINE
- Cly - Collins 115 kV line / loss of TEXAS EASTERN TAP 115 KV BUS + loss of CARLISLE PIKE - ROXBURY 115 KV LINE
Potential MetEd N-1-1 Violations

- Cly – York Haven 115 kV line / loss of YORKANA 230/115 KV TRANSFORMER #3 + loss of JACKSON - BAKER TAP - TAXVILLE - J.E. BAKER - WESTGATE 115 KV LINE
- Collins – Middletown Jct 115 kV line / loss of TEXAS EASTERN TAP 115 KV BUS + loss of MIDDLETOWN JUNCTION - MIDDLETOWN 115 KV LINE
- Gardners – Tex E Tap 115 kV line / loss of JOHNSTOWN 230 KV BUS + Basecase
Potential MetEd N-1-1 Violations

- Gardners – Tex E Tap 115 kV line / loss of East Waynesboro - Ringgold 138 kV line + loss of Guilford - Chambers 138 kV line
- Germantown - Straban 115 kV line / loss of Carroll 230/138 kV transformer #4 + Basecase
- Harley D - Pleasureville 115 kV line / loss of YORKANA 230/115 KV TRANSFORMER #3 + loss of YORKANA - BRUNNER ISLAND 230 KV LINE AND YORKANA 230/115 KV TRANSFORMER #4
Potential MetEd N-1-1 Violations

- Harley D – York Inc 115 kV line / loss of YORKANA 230/115 KV TRANSFORMER #3 + loss of YORKANA - BRUNNER ISLAND 230 KV LINE AND YORKANA 230/115 KV TRANSFORMER #4
- Hunterstown - Lincoln 115 kV line / loss of HUNTERSTOWN - LINCOLN TAP - LINCOLN - ORTANNA 115 KV LINE AND ORTANNA 115/13.8 KV TRANSFORMER #3 + loss of Carroll 230/138 kV transformer #4
Potential MetEd N-1-1 Violations

- Hunterstown – Lincoln Tap 115 kV line / loss of HUNTERSTOWN - LINCOLN 115 KV LINE + loss of Carroll 230/138 kV transformer #4
- Hunterstown 230/115 kV transformer F4 / loss of HUNTERSTOWN - CONASTONE 500 KV LINE + loss of HUNTERSTOWN - JACKSON 230 KV LINE AND HUNTERSTOWN 230/115 KV TRANSFORMER #4
Potential MetEd N-1-1 Violations

- Jackson – N Hanover 115 kV line / loss of JACKSON - MENGES MILLS - P.H. GLATFELTER 115 KV LINE + loss of HUNTERSTOWN - OXFORD - NORTH HANOVER 115 KV LINE
- Lincoln Tap – Lincoln 115 kV line / loss of HUNTERSTOWN - LINCOLN 115 KV LINE + loss of Carroll 230/138 kV transformer #4
- Newberry – Round Top 115 kV line / loss of TEXAS EASTERN TAP 115 KV BUS + loss of MIDDLETOWN JUNCTION - MIDDLETOWN 115 KV LINE
Potential MetEd N-1-1 Violations

- Smith St 115/69 kV transformer 3A / loss of YORKANA 230/115 KV TRANSFORMER #3 + loss of PLEASUREVILLE - MT ROSE - VIOLET HILL 115 KV LINE
- Smith Tap – York Inc 115 kV line / loss of YORKANA 230/115 KV TRANSFORMER #3 + loss of YORKANA - BRUNNER ISLAND 230 KV LINE AND YORKANA 230/115 KV TRANSFORMER #4
Potential MetEd N-1-1 Violations

- Straban – Lincoln 115 kV line / loss of Carroll 230/138 kV transformer #4 + Basecase
- W.Hellam – Yorkana 115 kV line / loss of YORKANA 230/115 KV TRANSFORMER #3 + loss of PLEASUREVILLE - HARLEY DAVIDSON - YORK COUNTY INCINERATOR 115 KV LINE
- Yorkana 230/115 kV transformer #1 / loss of YORKANA 230/115 KV TRANSFORMER #3 + Basecase
Potential MetEd N-1-1 Violations

- Yorkana 230/115 kV transformer #1 / loss of PLEASUREVILLE - HARLEY DAVIDSON - YORK COUNTY INCINERATOR 115 KV LINE + loss of YORKANA 230/115 KV TRANSFORMER #3
- York Haven – Middletown Jct 115 kV line / loss of YORKANA 230/115 KV TRANSFORMER #3 + Basecase
- Zions View – Middletown Jct 115 kV line / loss of YORKANA 230/115 KV TRANSFORMER #3 + loss of JACKSON - BAKER TAP - TAXVILLE - J.E. BAKER - WESTGATE 115 KV LINE
Potential MetEd N-1-1 Violations

- Glendon - Hosensack 115 kV line / loss of PORTLAND - NORTH BANGOR 115 KV LINE AND NORTH BANGOR 115/34.5 KV TRANSFORMER #2 + loss of QUARRY - NORTHWOOD 230 KV LINE AND NORTHWOOD 230/115 KV TRANSFORMER #6

- North Boyertown – South Reading 230 kV line / loss of SOUTH MANHEIM - BRUNNER ISLAND 230 KV LINE AND SOUTH MANHEIM 230/69 KV TRANSFORMER #3 + loss of MILLWOOD 230 KV BUS AND SOUTH AKRON 230 KV BUS
Potential MetEd/PPL Ties N-1-1 Violation

- South Lebanon – Berks 230 kV line / loss of SOUTH MANHEIM - BRUNNER ISLAND 230 KV LINE AND SOUTH MANHEIM 230/69 KV TRANSFORMER #3 + loss of MILLWOOD 230 KV BUS AND SOUTH AKRON 230 KV BUS

- North Boyertown - Hosensack 230 kV line / loss of SOUTH MANHEIM - BRUNNER ISLAND 230 KV LINE AND SOUTH MANHEIM 230/69 KV TRANSFORMER #3 + loss of MILLWOOD 230 KV BUS AND SOUTH AKRON 230 KV BUS
Potential PPL N-1-1 Violation

- Berks – Berks TR2 230 kV line / loss of SOUTH MANHEIM - BRUNNER ISLAND 230 KV LINE AND SOUTH MANHEIM 230/69 KV TRANSFORMER #3 + loss of MILLWOOD 230 KV BUS AND SOUTH AKRON 230 KV BUS
Potential AEP N-1 Violations

- New Carlisle - Tralck 138 kV line \ loss of Dumont - Wilton Center 765 kV line
- South Bend - Twin Branch 138 kV line \ loss of Olive 345/138 kV transformer, Laporte - Olive 138 kV line
- Beech - Cleveland 138 kV line \ loss of Cook - East Elkhart - Hiple 345 kV line, East Elkhart 345/138 Transformer
- New Carlisle - Olive 138 kV line \ loss of Dumont - STLWEL - BABCOK 345 kV line, STLWEL 345/138 kV transformer
- Beech - Twin Branch 138 kV line \ loss of Cook - East Elkhart - Hiple 345 kV line, East Elkhart 345/138 Transformer
Potential AEP N-1 Violations

- Northeast Canton - Wagenhals 138 kV line \ loss of Torrey - Negley - Reedurban 138 kV line
- Torrey - Warner 138 kV line \ loss of South Canton - Torrey 138 kV line
Potential AEP N-1 Violations

- East Side Lima - Sterling 138 kV line \ loss of Robison Park - Convoy 138 kV line, Robison Park 345/138 transformer
Potential AEP N-1-1 Violations

- Benton Harbor - Riverside 138 kV line / loss of Benton - Riverside 138 kV circuit 2, Benton Harbor - West Street 138 kV line, Hartford - Valley 138 kV line, Hartford – West Street 138 kV line + Base Case
- Kenzie Creek- Pokagon 138 kV line / loss of Twin Branch 345/138 kV transformer 7 + Jackson Road 345/138 kV transformer
Potential AEP N-1-1 Violations

- Cross Street - Madison 138 kV line / loss of Desoto - Royerton 138 kV line, Royerton – Wes Del 138 kV line + Desoto - Mayfield 138 kV line
- Auburn - Dekalb 138 kV line / loss of Albion - Skinner 138 kV line, Garret - Bixler 138 kV line, Bixler - Kendal 138 kV line, Kendal - Skinner 138 kV line + Apci - Wilmington - Auburn 138 kV line, Robison Park – County Line - Wilmington 138 kV line
- Greentown - Greentown 765/138 kV transformer / loss of Greentown 765/345/138 transformer + Dumont - Greentown 765 kV line
Potential AEP N-1-1 Violations

- Central Canton - Central Canton 345/138 kV transformer / loss of Secant 245/138 kV transformer + South Canton - Southeast Canton 345/138 kV transformer
- Cante - Torrey 138 kV line / loss of South Canton/Southwest Canton 345/138 kV transformer + Base Case
- Miles - West Canton 138 kV line / loss of Promway – South Canton 138 kV line + NE Canton - Packard - West Canton 138 kV line
- Negley - Torrey 138 kV line / loss of Promway – South Canton 138 kV line + NE Canton - Packard - W Canton 138 kV line
- Negley - Reedurban 138 kV line / loss of Promway – South Canton 138 kV line + NE Canton - Packard - W Canton 138 kV line
Potential AEP N-1-1 Violations

- Mills Pride - Waverly 138 kV line / loss of Don Marquis - Waverly 138 kV + Base Case
- Bixby - Threec 138 kV line / loss of Bixby - Groves 138 kV line + Base Case
- Poston - Blooingville 138 kV line / loss of Mulberry - Rozell - Waverly 138 kV line + Circleville - Harrison 138 kV line
- Bethel - Brookside 138 kV line / loss of Davidson - Dublin 138 kV line + Hyatt - Sawmill 138 kV line
- Bixby - Pickerington 138 kV line / loss of South Baltimore – West Millersport 138 kV line + Kimberly - Poston 138 kV line
- Bethel - Robert 138 kV line / loss of Davidson - Roberts 138 kV line + Hyatt - Sawmill 138 kV line
Potential AEP N-1-1 Violations

- Muskingum River - North Muskingum River 138 kV line / loss of Bath 345/138 kV transformer + Rutland - Sporn 138 kV line
- South Baltimore - West Lancaster 138 kV line / loss of Kimberly - Poston 138 kV line + Crooksville - South Lancaster 138 kV line
- Don Marquis – Mills Pride 138 kV line / loss of Don Marquis - Waverly 138 kV line + Base Case
Potential AEP N-1-1 Violations

- Chemical - Union Carbide 138 kV line / loss of Poca - Amos 138 kV line, Poca - Ortim 138 kV line, Poca - Sisson 138 kV line + Amos - Dalewood - Chemical 138 kV line
- Ruth - Turner 138 kV line / loss of + Kanawha River 345/138 kV transformer
- Amos - Poca 138 kV line / loss of Carb Z - Carb B 138 kV line, Carb Z - Chem 1 138 kV line + Amos - Dalewd - Chem 2 138 kV line
Potential AEP N-1-1 Violations

- Beckham - Vicco 138 kV line / loss of Wooten - Hyden 161 kV line, Arnold - Hyden 161 kV line, Delvin - Hyden 161 kV line + Stinnet – Pineville 161 kV line
Potential AEP N-1-1 Violations

- Stinnett - Pineville 161 kV line / loss of Wooten - Hyden 161 kV line, Arnold - Hyden 161 kV line, Delvin - Hyden 161 kV line + Beaver Creek - Topmost 138 kV line
- Beaver Creek - Topmost 138 kV line / loss of Wooten - Hyden 161 kV line, Arnold - Hyden 161 kV line, Delvin - Hyden 161 kV line + Stinne - Pineville 161 kV line
Potential AEP N-1-1 Violations

- Leslie - Leslix 161 kV circuit BP / loss of Wooten - Hyden 161 kV line, Arnold - Hyden 161 kV line, Delvin - Hyden 161 kV line + Beaver Creek - Topmost 138 kV line
- Leslix - Stinnett 161 kV line / loss of Wooten - Hyden 161 kV line, Arnold - Hyden 161 kV line, Delvin - Hyden 161 kV line + Beaver Creek - Topmost 138 kV line
Potential AEP N-1-1 Violations

- Hazard - Wooten 161 kV line / loss of Leslie - Leslix 161 kV circuit BP, Leslie - Leslix 161 kV circuit SR, Leslie - Wooten 161 kV line, Leslix - Stinne 161 kV line, Leslie - Bridgc 161/115 transformer, Leslie 161/69 kV transformer, Bridgc - Leslie 115/69 kV transformer + Beaver Creek - Topmost 138 kV line

- Hazard 161/138 kV transformer / loss of Leslie - Leslix 161 kV circuit BP, Leslie - Leslix 161 kV circuit SR, Leslie - Wooten 161 kV line, Leslix - Stinne 161 kV line, Leslie - Bridgc 161/115 transformer, Leslie 161/69 kV transformer, Bridgc - Leslie 115/69 kV transformer + Beaver Creek - Topmost 138 kV line
Potential AEP N-1-1 Violations

- Scottsville - Bremo 138 kV line / loss of Cloverdale - Jacksons Ferry 765 kV line, Cloverdale - Joshua Falls 765 kV line, Cloverdale 765/345 kV transformer, Joshua Falls 765/138 kV transformer + Lexington - Cloverdale 500 kV, Cloverdale 500/345 transformers 1 and 2, Lexington 500/230 kV transformer 3

- Bonsack - Cloverdale 138 kV line / loss of Joshua Falls - Cloverdale 765 kV line, Joshua Falls 765/138 kV transformer + Cloverdale - Huntington CT 138 kV line

- Centerville - Cloverdale 138 kV line / loss of Joshua Falls - Cloverdale 765 kV line, Joshua Falls 765/138 kV transformer + Moseley - Roanoak 138 kV line
Potential AEP N-1-1 Violations

- Centerville - Ivy Hill 138 kV line / loss of Joshua Falls - Cloverdale 765 kV line, Joshua Falls 765/138 kV transformer + Moseley - Roanoak 138 kV line
- Moseley - Roanoak 138 kV line / loss of Candlers Mountain - Smith Mountain 138 kV line + Joshua Falls - Cloverdale 765 kV line, Joshua Falls 765/138 kV transformer
- Otter - Altavista 138 kV line / loss of Cloverdale - Jacksons Ferry 765 kV line, Cloverdale - Joshua Falls 765 kV line, Cloverdale 765/345 kV transformer, Joshua Falls 765/138 kV transformer + Candlers Mountain - Smith Mountain 138 kV line
Potential AEP N-1-1 Violations

- Ivy Hill - Reusens 138 kV line / loss of Joshua Falls - Cloverdale 765 kV line, Joshua Falls 765/138 kV transformer + Moseley - Roanoak 138 kV line
- Edgemont – Falling Branch 138 kV line / loss of Celanz - Celanese 138 kV line, Celanese – North Blackburg 138 kV line, Kumis - Matt Funk 138 kV line, Kumis – North Blackburg 138 kV line + Claytor - Edgemont 138 kV line
- Falling Branch - Shawsville 138 kV line / loss of Celanz - Celanese 138 kV line, Celanese – North Blackburg 138 kV line, Kumis - Matt Funk 138 kV line, Kumis – North Blackburg 138 kV line + Claytor - Edgemont 138 kV line
Potential AEP N-1-1 Violations

- Claytor - Edgemont 138 kV line / loss of Celanz - Celanese 138 kV line, Celanese – North Blackburg 138 kV line, Kumis - Matt Funk 138 kV line, Kumis – North Blackburg 138 kV line + Matt Funk - Shawsville 138 kV line
- Matt Funk - Shawsville 138 kV line / loss of Celanz - Celanese 138 kV line, Celanese – North Blackburg 138 kV line, Kumis - Matt Funk 138 kV line, Kumis – North Blackburg 138 kV line + Claytor - Edgemont 138 kV line
Potential AEP N-1-1 Violations

- Darrah - Trista 138 kV line / loss of East Proctorville - Darrah 138 kV line, East Proctorville - North Proctorville 138 kV line + Amos - Curry - Milton 138 kV line
Potential AEP N-1-1 Violations

- East Monument – East Danville 138 kV line / loss of Danville - Riverside 138 kV line + Base Case
• Sullivan - Breed 765/345 kV line / loss of Jefferson - Rockport 765 kV transformer + Sullivan - Breed 765/345 kV transformer

• Anthony - Lincoln 138 kV line / loss of Robison Park - Lincoln 138 kV line + Robison Park 345/138 kV transformer
Potential APS N-1-1 Violations

- Smith - Wylie Ridge 138 kV line / loss of Union Junction - Mitchell 138 kV line, Union Junction - Charleroi 138 kV line, Union Junction - Peters 138 kV line + Buffalo Junction - Cecil 138 kV line, Buffalo Junction - Parkview 138 kV line, Buffalo Junction - Windsor 138 kV line
- Hamilton - Weirton 138 kV line / loss of Union Junction - Mitchell 138 kV line, Union Junction - Charleroi 138 kV line, Union Junction - Peters 138 kV line + Smith - Wylie Ridge 138 kV line
Potential APS N-1-1 Violations

- Greenwood - Redbud 138 kV line / loss of Meadow Brook - West Winchester 138 kV line + Base Case
- Redbud - West Winchester 138 kV line / loss of Double Toll Gate - Greenwood 138 kV line + Base Case
- Stonewall - Stephen 138 kV line / loss of Bedington - Doubs 500 kV line + Bedington - Black Oak 500 kV line
- Bartonville - Stephen 138 kV line / loss of Bedington - Doubs 500 kV line + Bedington - Black Oak 500 kV line
Potential APS N-1-1 Violations

- Bartonville - Meadow Brook 138 kV line / loss of Bedington - Black Oak 500 kV line + Bedington - Doubs 500 kV line
- Double Toll Gate - Greenwood 138 kV line / loss of Meadow Brook - West Winchester 138 kV line + Base Case
- Double Toll Gate - Meadow Brook 138 kV line / loss of Meadow Brook - Double Toll Gate 138 kV line + Meadow Brook - West Winchester 138 kV line
• Elko - Ridgway 138 kV line / loss of Burma - Clarion 138 kV line + William - Bear Run 138 kV line
Potential APS N-1-1 Violations

- Bedington - Bedington 500/138 kV transformer 2 / loss of Bedington 500/138 kV transformer 1, Bedington 500/138 kV transformer 3 + Bedington 500/138 kV transformer 4
- Doubs - Doubs 500/230 kV transformer 3 / loss of Doubs 500/230 kV transformer 2, Doubs 500/230 kV transformer 4 + Doubs 500/230 kV transformer 1
Potential APS N-1-1 Violations

- Bull Creek Junction - Cabot 138 kV line / loss of Lawson Junction - Cabot 138 kV line, Lawson Junction - McCalmont 138 kV line, Lawson Junction - Middlesex Tap 138 kV line + Cabrey Junction - Cabot 138 kV line, Cabrey Junction - Butler 138 kV line, Cabrey Junction - Bredinville 138 kV line
- Bull Creek Junction - McCalmont 138 kV line / loss of Lawson Junction - Cabot 138 kV line, Lawson Junction - McCalmont 138 kV line, Lawson Junction - Middlesex Tap 138 kV line + Cabrey Junction - Cabot 138 kV line, Cabrey Junction - Butler 138 kV line, Cabrey Junction - Bredinville 138 kV line
Potential APS N-1-1 Violations

- Cabot - Lawson Junction 138 kV line / loss of Bull Creek Junction - Cabot 138 kV line, Bull Creek Junction - Houseville 138 kV line, Bull Creek Junction - McCalmont 138 kV line + Cabrey Junction - Cabot 138 kV line, Cabrey Junction - Butler 138 kV line, Cabrey Junction - Bredinville 138 kV line

- Lawson Junction - McCalmont 138 kV line / loss of Cabrey Junction - Cabot 138 kV line, Cabrey Junction - Butler 138 kV line, Cabrey Junction - Bredinville 138 kV line + Bull Creek Junction - Cabot 138 kV line, Bull Creek Junction - Houseville 138 kV line, Bull Creek Junction - McCalmont 138 kV line
• Eureka - St. Mary 138 kV line / loss of Belmont - Kammer 765 kV line, Belmont - Mountaineer 765 kV line, Belmont 765/500 kV transformer + Belmont - Harrison 500 kV line
Potential APS N-1-1 Violations

- Carrol - Mount Airy 230 kV line / loss of Lime Kiln - Urbana 138 kV line + Eaglehead - Monocacy 230 kV line
- Bedington - Bedington 138 kV line / loss of Bedington - Eagle 138 kV line + Inwood - Stonewall 138 kV line
Potential Dayton N-1-1 Violations

- Bath - Trebein 138 kV line / loss of Bath - Miami 345 kV line + Bath 345/138 kV transformer
- Sidney - Shelby 138 kV line / loss of Darby 138/69 kV transformer + Urbana 138/69 kV transformer
- Sidney - Quincy 138 kV line / loss of Darby 138/69 kV transformer + Urbana 138/69 kV transformer
- Greene - Alpha 138 kV line / loss of Greene 345/138 transformer 1 + Greene 345/138 kV transformer
Potential Dayton N-1-1 Violations

- Roxbury - Greene 138 kV line / loss of East Waynesboro - Ringgold 138 kV line + Guilford - Chambers 138 kV line
- Greene - Greene 345/138 kV transformer 1 / loss of Greene 345/138 transformer 2 + Bath 345/138 kV transformer
- Miami - Northridge 138 kV line / loss of Darby 138/69 kV transformer + Overlook - Knollwood 138 kV line, Overlook - Monument 138 kV line, Overlook 138/69 kV transformer
- Miami - Miami 345/138 kV transformer / loss of Wilmington 345/138 kV transformer + Miami - Shelby 345 kV
• Normandy - Sugarcreek 138 kV line / loss of Sugarcreek - Bellbrook 138 kV line + Base Case
Potential Duquesne N-1-1 Violations

- Arsenal - Highland 138 kV line / loss of Logans Ferry 345/138 kV transformer + Remove 580 MW unit from Cheswick
- Brunot Island - Brady 345 kV line / loss of Brunot Island - Arsenal 345 kV circuit 1 + Brunot Island - Arsenal 345 kV circuit 2
Potential Dominion N-1-1 Violation

- Cloverdale to Lexington 500 kV overloads for the outage of Dooms to Lexington 500 kV and Bath to Valley 500 kV
- Valley 230/500 kV XFMR overloads for the outage of Bath to Lexington 500 kV and Dooms to Valley 500 kV
Potential Dominion N-1-1 Violation

- Bayside to Burton 115 kV overloads for the outage of Lynnhaven to Virginia Beach 230 kV and Landstown to Pendleton 115 kV
- Bayside to Longs Creek 115 kV overloads for the outage of Lynnhaven to Virginia Beach 230 kV; VA Beach 230/115 kV XMFR CKT 1 and 2 and the loss of Landstown-Princess Anne-London-Pendleton 115 kV
Potential Dominion N-1-1 Violation

- Burton to Davis 115 kV overloads for the outage of Lynnhaven to Virginia Beach 230 kV; VA Beach 230/115 kV XMFR CKT 1 and 2 and the loss of Landstown-Princess Anne-London-Pendleton 115 kV
• Davis to Greenwich 115 kV overloads for the outage of Lynnhaven to Virginia Beach 230 kV; VA Beach 230/115 kV XMFR CKT 1 and 2 and the loss of Landstown-Princess Anne-London-Pendleton 115 kV
Potential Dominion N-1-1 Violation

- Landstown to Princess Anne 115 kV overloads for the outage of Landstown to London 115 kV and Lynnhaven to Virginia Beach 230 kV; VA Beach 230/115 kV XFMNR CKT 1 and CKT2

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Potential Dominion N-1-1 Violation

- Bains Store to Longs Creek 115 kV overloads for the outage of Lynnhaven to Virginia Beach 230 kV; VA Beach 230/115 kV XMFR CKT 1 and 2 and the loss of Landstown-Princess Anne-London-Pendleton 115 kV
Potential Dominion N-1-1 Violation

- Bains Store to VA Beach 115 kV overloads for the outage of Lynnhaven to Virginia Beach 230 kV; VA Beach 230/115 kV XMFR CKT 1 and 2 and the loss of Landstown-Princess Anne-London-Pendleton 115 kV
Next Steps

- Complete remaining deliverability analysis
- Long Term Planning
- N-1-1 reactive analysis
- Subregional RTEP Committee Meetings
- Validate potential violations
- Develop upgrades for outstanding problems