Reliability Analysis Update

TEAC Meeting
August 20, 2008
Two alternatives are being evaluated to address the issues identified in Northern New Jersey:

- **230 kV Option**: rebuild several existing 138 kV lines and associated substations at 230 kV
- **500 kV Option**: extend a new 500 kV line from Branchburg to Roseland to Hudson along with some underlying 230 kV reinforcements

PJM has hired an independent engineering firm to evaluate the cost, constructability and effectiveness of each option.

Results of the study will be shared with stakeholders at a follow-up TEAC meeting.
Mid-Atlantic Power Pathway (MAPP) Project Update

- AC versus DC
- Continue to work with PHI on the cost differences and risks associated with each technology
2013 Reactive Analysis
• Voltage collapses:
  – Loss of Conastone – Peach Bottom 500 kV line
  – Loss of Keeney – Rock Spring 500 kV line

• Low voltage violation:
  – Cochranville 230 kV bus / loss of Peach Bottom – Rock Spring 500 kV line
• Voltage collapse:
  – Loss of Cedar Creek – Red Lion 230 kV line

• Low voltage violations:
  – Cochranville 230 kV bus / loss of Rock Spring – Keeney 500 kV line
  – Cochranville 230 kV bus / loss of Peach Bottom – Rock Spring 500 kV line
2013 N-2 Baseline Upgrades
- Steel Tap - Steelton 230 kV line / loss of Cumberland-Juniata 230 kV line and Cumberland #2 230/69 kV transformer + loss of West Shore-Brunner Island 230 kV line and West Shore #2 230/69 kV transformer
- Steelton-Steel H1 230 kV line / loss of Cumberland-Juniata 230 kV line and Cumberland #2 230/69 kV transformer + loss of West Shore-Brunner Island 230 kV line and West Shore #2 230/69 kV transformer
- Steelton-Steel H3 230 kV line / loss of Cumberland-Juniata 230 kV line and Cumberland #2 230/69 kV transformer + loss of West Shore-Brunner Island 230 kV line and West Shore #2 230/69 kV transformer
- Brunner Island - West Shore 230 kV line / loss of Cumberland - Juniata 230 kV line and Cumberland #2 230/69 kV transformer + loss of Steel Tap 230 kV bus and Steelton #1 230/69 kV transformer

- West Shore - Steelton 230 kV line / loss of Cumberland-Juniata 230 kV line and Cumberland #2 230/69 kV transformer + loss of West Shore-Brunner Island 230 kV line and West Shore #2 230/69 kV transformer

- Juniata - Cumberland 230 kV line / loss of Brunner Island - West Shore 230 kV line and West Shore #2 230/69 kV transformer + loss of Steel Tap 230 kV bus and Steelton #1 230/69 kV transformer
The following upgrade addresses the previous 6 violations:

- Rebuild existing Brunner Island – West Shore 230 kV line and add 2nd Brunner Island – West Shore 230 kV line.

- Estimated Project Cost: $34 M

- Expected IS Date: 6/01/2013
The following upgrade addresses the previous 6 violations prior to the Brunner Island – West Shore 230 kV line rebuild in 2013.

- SPS Scheme to drop 190 MVA of 69 kV radial load at West Shore and 56 MVA of 69 kV radial load at Cumberland.
- Estimated Project Cost: $0 M.
- Expected IS Date: 6/01/2010.
- Susquehanna – Jenkins 230 kV line / loss of Susquehanna – Lackawanna 500 kV line + loss of Mountain Tap 230 kV bus
- Susquehanna – Jenkins 230 kV line / loss of Susquehanna – Lackawanna 500 kV line + loss of Susquehanna-Mountain Tap 230 kV line
- Susquehanna – Jenkins 230 kV line / loss of Susquehanna – Lackawanna 500 kV line + loss of Stanton-H1 230 kV bus
- The following upgrade addresses the previous 3 violations
- Proposed Solution: SPS Scheme at Jenkins substation to open the Stanton #1 and Stanton #2 230 kV circuit breakers after the second contingency
- Estimated Project Cost: $0 M
- Expected IS Date: 6/01/2013
PEPCO N-2 Baseline Upgrades

- Quince Orchard – Bells Mill (030) 230 kV line / loss of Bells Mill (028) 230 kV bus + loss of Bells Mill (029) 230 kV bus
- Quince Orchard – Bells Mill (028) 230 kV line / loss of Bells Mill (029) 230 kV bus + loss of Bells Mill (031) 230 kV bus
- Recommended Solution: Upgrade terminal equipment on both lines
- Estimated Project Cost: $1.415 M
- Expected IS Date: 6/01/2012
- Oak Grove – Ritchie 23061 230 kV line / loss of Oak Grove – Ritchie 23058 230 kV line + loss of Oak Grove – Ritchie 23060 230 kV line
- Recommended Solution: Upgrade Oak Grove – Ritchie 23061 230 kV line
- Estimated Project Cost: $3.25 M
- Expected IS Date: 6/01/2013
PEPCO N-2 Baseline Upgrades

- Oak Grove – Ritchie 23058 230 kV line / loss of Oak Grove – Ritchie 23059 230 kV line + loss of Oak Grove – Ritchie 23060 230 kV line

- Recommended Solution: Upgrade Oak Grove – Ritchie 23058 230 kV line

- Estimated Project Cost: $3.25 M

• Expected IS Date: 6/01/2013
- Oak Grove – Ritchie 23059 230 kV line / loss of Oak Grove – Ritchie 23058 230 kV line + loss of Oak Grove – Ritchie 23060 230 kV line
- Recommended Solution: Upgrade Oak Grove – Ritchie 23059 230 kV line
- Estimated Project Cost: $3.25 M
• Expected IS Date: 6/01/2013
- Oak Grove – Ritchie 23060 230 kV line / loss of Oak Grove – Ritchie 23058 230 kV line + loss of Oak Grove – Ritchie 23059 230 kV line

- Recommended Solution: Upgrade Oak Grove – Ritchie 23060 230 kV line

- Estimated Project Cost: $3.25 M

- Expected IS Date: 6/01/2013
- Cecil - Colora 230 kV line / loss of Lums – Reybold 138 kV line + loss of Glasgow – Keeney 138 kV line
- Oil City – Steele 138 kV line / loss of Glasgow – Mount Pleasant 138 kV line + loss of Lums - Reybold 138 kV line
- Oil City – Church 138 kV line / loss of Glasgow – Mount Pleasant 138 kV line + loss of Lums - Reybold 138 kV line
- Recommended Solution: Build a new Church – Wye Mills 138 kV line
- Estimated Project Cost: $17.5 M
- Expected IS Date: 6/01/2013
- Steele 230/138 kV transformer AT21 / loss of Steele 230/138 kV transformer AT20 + loss of Mount Pleasant – Townsend 138 kV line
- Steele 230/138 kV transformer AT20 / loss of Steele 230/138 kV transformer AT21 + loss of Mount Pleasant – Townsend 138 kV line
- Townsend – Church 138 kV line / loss of Steele 230/138 kV transformer AT20 + loss of Steele 230/138 kV transformer AT21
- Recommended Solution: Add a 3rd Steele 230/138 kV transformer
- Estimated Project Cost: $8 M
- Expected IS Date: 6/01/2013
ComED Baseline Upgrades
Dynamic Voltage Criteria & Voltage Stability Criteria

- Solution: Add a 300 MVAR SVC at Elmhurst 138 kV “Red”
- Solution: Add a 300 MVAR SVC at Elmhurst 138 kV “Blue”
Voltage Stability

• Solution: Install 115.2 MVAR switched capacitors at the following locations:
  – East Frankfort 138 kV
  – Lisle 138 kV Red
  – Lisle 138 kV Blue
  – McCook 138 kV Red
  – McCook 138 kV Blue
  – Wayne 138 kV Blue
  – Wayne 138 kV Red
  – Crawford 138 kV Blue
  – Crawford 138 kV Red
  – Bedford 138 kV Blue
  – Bedford 138 kV Red
  – Wolfs 138 kV (57.6 MVAR)
Potential ComEd Baseline Upgrades

- Thermal Overload of East Frankfort – Goodings Grove 345 kV “Red”
- No contingency – all facilities in Service
- Solution: Add a 2nd East Frankfort 345 / 138 kV Autotransformer
- Generator and Load Deliverability
- IS Date: June 2013
- Cost Estimate: TBD
ComEd Baseline Upgrades

- Thermal overload of Wolfs 345/138 kV “Blue” transformer for the loss of the Wolfs 345/138 kV “Red” transformer
- Thermal overload of Wolfs – Oswego 138 KV “Blue” for the outage of Wolfs – Oswego 138 kV “Red”
- Solution for both violations: Replace the existing baseline upgrade to install a 2nd Wolfs 345/138 kV transformer. The replacement project is a 345/138 kV transformer at Plano “Red”
- Generator Deliverability
- Estimated Project Cost: TBD
- IS Date: June 2013
ComEd Baseline Upgrades

- Thermal overload of Plano – Electric Junction 345 kV “Red” for the loss of the parallel circuit
- Solution: Install a second 345/138 kV transformer at Plano “Red”
- Generator Deliverability
- Estimated Project Cost: TBD
- IS Date: June 2013
ComEd Baseline Upgrades

- Thermal overload of Prospect Heights 345/138 kV "Red" transformer for the loss of Prospect Heights – Leithton 138 kV line 11708
- Solution: Add a breaker at Aptakisic 138 kV to split the line in two for the 11708 contingency
- Load Deliverability
- Expected IS Date: 6/01/2013
- Cost estimate: TBD
ComEd Baseline Upgrades

- Thermal overload of Goodings Grove 345/138 kV “Red” transformer for the loss of Blue Island – Alsip 138 kV
- Solution: Install a third 345/138 kV transformer at Goodings Grove “Red”
- Generator Deliverability
- IS Date: June 2013
- Cost Estimate: TBD
ComEd Baseline Upgrades

• Thermal overload of East Frankfort – Goodings Grove 345 kV “Blue”
• No contingency – all Facilities in Service
• Solution: Install a 2nd East Frankfort 345/138 kV Autotransformer and reconductor Country Club Hills – Matteson 138 kV
• Load Deliverability
• IS Date: June 2013
• Cost Estimate: TBD
• Thermal overload of 0902 Frankfort – New Lenox 138 kV for the loss of Dresden – Shorewood 138 kV
• Solution: Reconductor line 0902 Frankfort - New Lenox 138 kV
• Expected IS Date: 6/01/2013
• Cost Estimate: TBD
- Thermal overload of 138 kV line 0902 between E. Frankfort TSS 66 and Davis Creek TSS 86 tap for the loss of East Frankfort – Matteson 138 kV
- Solution: Increase the capacity of the overloaded section
- Expected IS Date: 6/01/2013
- Cost Estimate: TBD
ComED Supplemental Upgrades
• Provide new service to a data customer west of Electric Junction on lines 11104 & 11106
• Supplemental Project
• Expected IS Date: 6/01/2013
ComEd Supplemental Upgrade

- Add 345/138 kV Transformer 81 at Pontiac to serve a new customer interconnection
- Supplemental Project
- Expected IS Date: 6/01/2013
Delmarva Baseline
Load Deliverability Violation - Delmarva

- Voltage collapse / loss of Indian River unit 3
- Voltage collapse / loss of Cedar Creek - Red Lion 230 kV line
- Voltage collapse / loss of Keeney - Steele 230 kV line
- Recommended Solution: Convert the 138 kV network path from Vienna to Loretto to Piney Grove to 230 kV and add 230/138 kV transformer at Loretto 230 kV station
- Estimated cost: $40M
- Expected in-service date: June 1, 2013
Load Deliverability Violation - Delmarva South

- Glasgow - Mt. Pleasant 138 kV line / loss of Lums Pond - Reybold 138 kV line
  - See solution for the same line on Delmarva load deliverability violation slide
- Delmarva South load deliverability test also has same voltage violations as Delmarva load deliverability as well as several issues on the underlying 138 kV and 69 kV
  - See solution for the same voltage issues on Delmarva load deliverability violation slide
• Keeney 500/230 kV transformer CKT 1 / Loss of Keeney – Red Lion + Keeney 500/230 kV transformer CKT 2 (Line_FB)
• Keeney 500/230 kV transformer CKT 2 / Loss of Keeney – Red Lion + Keeney 500/230 kV transformer CKT1 (Line_FB)
• Recommended Solution: Add two additional breakers at Keeney 500 kV
• Estimated cost: $4.5M
• Expected in-service date: June 1, 2013
Short Circuit Upgrades
- Replace Essex 138 kV breakers 4LM, 1LM, 1BM, 2BM
- Estimated Project Cost: $0.400 M per breaker
  • Expected IS Date: 6/01/2009
- Replace Linden 138 kV breaker 3
- Estimated Project Cost: $0.400 M
- Expected IS Date: 6/01/2009
- Replace Metuchen 138 kV breaker ‘2-2 transfer’
- Estimated Project Cost: $0.400 M
- Expected IS Date: 6/01/2009
- Replace Athenia 230 kV breaker 31H
- Estimated Project Cost: $0.400 M
- Expected IS Date: 6/01/2012
- Replace Bergen 230 kV breaker 10H
- Estimated Project Cost: $0.400 M
- Expected IS Date: 6/01/2012
- Replace Saddlebrook 230 kV breaker 21P
- Estimated Project Cost: $0.400 M
- Expected IS Date: 6/01/2012
PEPCO Breaker Upgrades

- Replace 13 Oak Grove 230 kV breakers
- Original Driver: Q48 – Calvert Cliffs nuclear project due in 12/15/2015
- Baseline driver: PEPCO 2012 Baseline upgrades
- Estimated Cost: $1.5 M per breaker
- Expected IS Date: 6/01/2012
- Replace Eastalco 230 kV breaker D-26, D-28, and D-31
- Estimated Project Cost: $0.300 M per breaker
- Expected IS Date: 6/01/2012
Previously Reviewed Upgrades for PJM Board Approval
APS Baseline Upgrades
APS Short Circuit Baseline Upgrades

- Upgrade (per ABB inspection) Hatfield 500 kV breakers due to Short Circuit
  - HFL-1
  - HFL-3
  - HFL-4
  - HFL-6
  - HFL-7
  - HFL-9
- Estimated Project Cost: $60K per breaker
- IS Date: 6/1/2011
• Replace Harrison 500 kV breaker HL-3
• Estimated Cost: $0.7M
• Upgrade (per ABB inspection) Harrison 500 kV breakers due to Short Circuit
  - HL-6
  - HL-7
  - HL-8
  - HL-10
• Estimated Cost: $60K per breaker
• IS Date: 6/1/2011
• Replace Fort Martin 500 kV breaker 'FL-1' due to Short Circuit
• Estimated Project Cost: $0.7 M
• IS Date: 6/1/2011
APS Baseline Upgrades

- **Generator Deliverability Problem:** The Albright – Loughs Lane 138 kV path is overloaded for various Category C contingencies on the 138 kV system in West Virginia
- **Solution:** Reconductor Albright - Mettiki - William - Parsons - Loughs Lane 138 kV with 954 ACSR
- **Estimated Project Cost:** $14.7M
- **IS Date:** 6/1/2011
• Generator Deliverability Problem: Overload of Butler – Cabot 138 kV ckt “E” for the loss of the parallel circuit and Cabrey Junction 138 kV
• Solution: Reconfigure circuits in the Butler - Cabot 138 kV
• Estimated Project Cost: $ 1.18 M
• IS Date: 6/1/2012
• Replace Fort Martin 500 kV breaker 'FL-1' due to Short Circuit
• Estimated Project Cost: $0.7 M
• IS Date: 6/1/2011
• Install 33 MVAR 138 kV Capacitor at Necessity due to Low Voltage Magnitude for the loss of Bethelboro – North Union Tap 138 kV

• Estimated Project Cost: $0.77 M

• IS Date: 6/1/2009
• Increase Cecil 138 kV Capacitor size to 44 MVAR due to low voltage magnitude for the loss of Wylie Ridge – Smith 138 kV
• Estimated Project Cost: $ 0.1 M
• IS Date: 6/1/2010
• Replace five 138 kV breakers at Cecil due to increased Short Circuit fault duty as a result of the addition of the Prexy substation
• Estimated Project Cost: $ 0.45 M
• IS Date: 6/1/2010
APS Baseline Upgrades

- Increase Whiteley 138 kV Capacitor size to 44 MVAR due to Low Voltage Magnitude for the loss of Fairview – Miracle Run 138 kV
- Estimated Project Cost: $ 0.64 M
- IS Date: 6/1/2010
• Problem: Thermal overload of Tidd – Carnegie – Weirton 138 kV for the loss of Tidd – Mahans Lane 138 kV

• Solution: Reconductor AP portion of Tidd - Carnegie 138 kV and Carnegie - Weirton 138 kV with 954 ACSR due to Thermal Overload

• Estimated Project Cost: $ 3.16 M

• IS Date: 6/1/2011
• Install 40.8 MVAR 138 kV capacitor at Grassy Falls due to Voltage Magnitude for a stuck breaker at Powell Mountain 138 kV

• Estimated Project Cost: $0.5 M

• IS Date: 6/1/2010
• Replace #1 and #2 138 kV breakers at Charleroi due to increased Short Circuit fault duty as a result of the addition of the Prexy substation

• Estimated Project Cost: $0.45 M

• IS Date: 6/1/2009
• Install 25.2 MVAR 138 kV Capacitor at Seneca Caverns due to low voltage magnitude for the loss of Hardy-Junction 138 kV

• Estimated Project Cost: $0.63 M

• IS Date: 6/1/2010
- Overload on the Cabot #1 500/138 kV for the bus fault contingency of the #2 Main 500 kV bus resulting in loss of the #2 and #4 banks,
- Estimated Project Cost: $
- IS Date: 6/1/2011
Atlantic Electric Baseline Upgrades
- Scull #2 – Mill #2 138 kV line / Loss of the other circuit (Single)
- Recommended Solution: Upgrade a strand bus at MILL
- Estimated cost: $0.2M
- Expected in-service date: June 1, 2013
Load Deliverability Violation - Atlantic Electric

- Mickleton 230/69 kV transformer #4 / loss of the Mickleton 230/69kV transformer #1
- Recommended Solution: Move the Monroe 230/69 kV transformer to Mickleton
- Estimated cost: $1.24 M
- Expected in-service date: June 1, 2013
BG&E Baseline Upgrades
Generation Deliverability Violation – BG&E

- Brandon Shores – Hawkins Point Terminal 230 kV line / Loss of Brandon Shores – Hawkins Point Terminal – Sollers Point Terminal (#2344) 230 kV line and Brandon Shores 5T Breaker failed (Line_FB)
- Sollers Point Terminal – Riverside 230 kV line CKT 2345 / Loss of Brandon Shores – Hawkins Point Terminal – Sollers Point Terminal (#2344) 230 kV line and Brandon Shores 5T Breaker failed (Line_FB)
- Recommended Solution: Replace 230 kV breaker and associated CTs at Riverside on 2345 line. Replace all dead-end structures at Brandon Shores, Hawkins Point, Sollers Point and Riverside. Install a second conductor per phase on the spans entering each station. Brandon Shores – Hawkins Point N/E = 1243/1386 MVA. Sollers Pt. – Brandon Shores N/E = 1174/1386 MVA
- Expected service date: June 1, 2013
- Estimated Cost $1.5 M
• Conastone 500/230 kV transformer CKT 1 / Loss of Conastone – Peach Bottom 500 kV line + Conastone 500/230 kV transformer CKT 2 (Line_FB)
  – The limitation on the transformer is associated bus
  – The bus will be replaced as part of the transformer replacement (B0298)
• Burtonsville – Sandy Spring 230 kV line CKT #2314 / Loss of High Ridge – Sandy Springs – Burtonsville CKT # 2334 (Single)

• Burtonsville – Sandy Spring 230 kV line CKT #2334 / Loss of High Ridge – Sandy Springs – Burtonsville CKT # 2314 (Single)

• Recommended Solution: Rebuild each line (0.2 miles each) to increase the normal rating to 968 MVA and the emergency rating to 1227 MVA

• Expected in-service: June 1, 2013

• Estimated cost: $0.27 M per line
Delmarva Baseline Upgrades
Load Deliverability Violation - Delmarva

- **Reybold – Lums Pond 138 kV line** for the loss of Glasgow – Keeney 138 kV line
  - **Recommended Solution:** Replace two circuit breakers to bring the emergency rating up to 348 MVA
  - **Estimated cost:** $1.0M
  - **Expected in-service:** June 1, 2013

- **Glasgow – Mt. Pleasant 138 kV line** for the loss of Lums Pond – Reybold 138 kV line
  - **Recommended Solution:** Rebuild 10 miles of Glasgow to Mt. Pleasant 138 kV line to bring the normal rating to 298 MVA and the emergency rating to 333 MVA
  - **Estimated cost:** $5.7 M
  - **Expected in-service:** June 1, 2013
Dominion Baseline Upgrades
• When the Possum Point #3 Unit is out and the outage of the Fredricksburg 230-115 kV Tx or the outage of the Fredricksburg to Possum Pt 115 kV line occurs the Possum Point 230-115 kV Tx. overloads.

• Solution: Install 2\textsuperscript{nd} 230-115 kV Tx.

• Expected service date: May 2009

• Est. Cost: $3.5 M
• Lanexa to Chesterfield is overloaded for the loss of Chickahominy to Lanexa
• Chickahominy to Lanexa is overloaded for the loss of Birchwood to Northern Neck
• Solution: Build new Elko station and transfer load from Turner and Providence Forge stations
• Expected service date: May 2009
• Est. Cost: $2.2 M
• The Yorktown to Whealton 115 kV line overloads for an outage of the remote end of the line
• Solution: Rebuild 17.5 miles of the line for a new summer rating of 262 MVA
• Expected service date: May 2009
• Est. Cost: $18.0 M
For an outage of the Chesapeake Energy Center end of the Greenwich – Chesapeake Energy Center line, the Greenwich end of the line overloads.

Solution: Increase the rating on 2.56 miles of the line between Greenwich and Thompson Corner. New rating to be 257 MVA.

Expected service Date: May 2009

Est. Cost: $4.0 M
• The loading on Kitty Hawk to Nag’s Head exceed 100 MW
• Solution: Build 115 kV line from Kitty Hawk to Colington 115 kV.
  – Colington on the existing line and Nag’s Head and Light House DP on new line.
• Service Date: May 2009
For N-2 events involving the loss of any combination of Bull Run #3 230-115 kV, Loudoun #3 230-115 kV or Loudoun #4 230-115 kV, the remaining autotransformer exceeds its emergency rating.

Solution: Add a second Bull Run 230-115 kV autotransformer.

Expected service date: May 2009.

Est. Cost: $3.0 M
• A section of the radial Loudoun to Middleburg line is expected to be overloaded due to increased load at various delivery points on the line
• Solution: Increase the rating of the line between Loudoun and Cedar Grove to at least 150 MVA
• Expected service date: May 2009
• Est. Cost: $0.2 M
Chickahominy-Old Church 230 kV Line

- Line loading at Pearsons and Old Church Subs. exceeds 100 MVA.
- Solution: Extend the line from Old Church to Chickahominy 230 kV
- Expected Service Date: November 2009
- Est. Cost $17.0 M
• For the loss of line #266 and line #273 into Glen Carlyn, Tx. #1 and #3 along with line #277 and line #278 will be out of service.

• Solution: Loop line #251 Idylwood to Arlington into the GIS sub.

• Service Date: May 2010
• Est. Cost: $25.0 M
• The Garner to Lancaster portion of Northern Neck to Harmony Village 115 kV line overloads for the loss of Lanexa to Harmony Village 230 kV

• Solution: Re-tension 15 miles of the line for a new summer rating of 216 MVA

• Expected service date: May 2010

• Est. Cost: $5.5 M
- Loss of the Lanexa to Correctional segment of Lanexa to Harmony Village overloads the Lanexa 230-115 kV autotransformer
- Solution: Add a second 230-115 kV autotransformer at Lanexa
- Expected service date: May 2010
- Est. Cost: $3.2 M
Dominion Baseline - New 230 kV Line Chickahominy - Lanexa

- In 2010 James River crossing is overloaded for the loss of Chickahominy to Yortown or the loss of Lanexa to Chickahominy.
- In 2012 a portion of the Chesterfield to Lanexa line between Chesterfield and Turner overloads for the loss of Chickahominy to Lanexa.
- Chickahominy to Lanexa overloads for the loss of Birchwood to Northern Neck.
- Chickahominy to Lanexa overloads for the loss of Chickahominy to Harmony Village.
- Solution: Build a parallel Chickahominy to Lanexa 230 kV line.
- In-service date: May 2010.
- Est. Cost: $3.5 M.
• The Northwest 230-115 kV autotransformer overloads for the loss of Elmont to Northwest 230 kV line
• Solution: Install a second Elmont 230-115 kV autotransformer
• In-service date: May 2010
• Est. Cost: $4.5 M
Dominion Baseline Upgrade – Install Dual Primary Protection Schemes on Gosport lines #62 and #51 at remote terminals

- Stability concerns exist at Gosport 115 kV for double line to ground faults.
- Solution: Install dual primary protection schemes on lines #62 and #51 at remote terminals
- Expected service date: May 2010
- Est. Cost: $0.46 M
• Loss of the Bremo 230-115 kV autotransformer is causing low voltage on the 115 kV system at Bremo
• Solution: Install a 33 MVAR capacitor on the Bremo 115 kV
• In-service: May 2011
• Est. Cost: $0.5 M
• The Bayside to Greenwich portion of Greenwich to Virginia Beach overloads for the loss of Greenwich to Amphibious Base
• The Greenwich to Davis Corner portion of Greenwich to Amphibious Base overloads for the loss of Greenwich to Virginia Beach
• Solution: Reconduct the Greenwich to Virginia Beach to bring it up to a summer rating of 261 MVA. Reconduct the Greenwich to Amphibious Base line to bring it up to 291 MVA
• In-service: May 2011
• Est. Cost: $2.1 M
• The Trowbridge to Winfall 115 kV overloads for the outage of the Elizabeth City to Shawboro 230 kV and the Suffolk to Winfall 230 kV.

• Solution: Re-build Trowbridge to Winfall 115 kV

• Expected in-service date: June 2011

• Est. Cost: $16.4 M
- Solution: Terminate the Thelma to Carolina 230 kV circuit into Lakeview 230 kV.
- Expected service date: June 2011
- Est. Cost: $4.0 M
Dominion Baseline Upgrade - Lebanon 115 kV Capacitor

- Loss of the Yorktown to Lanexa 115 kV line results in low voltage at Grafton and Lebanon
- Solution: Install 29.7 MVAR capacitor at Lebanon
- Expected service date: May 2012
- Est. Cost: $0.5 M
Dominion Baseline Upgrade - Hayes to Yorktown 115 kV

- Loss of Lanexa to Harmony results in low voltage on underlying 115 kV
- Solution: Build a new 230 kV line from Yorktown to Hayes but operate at 115 kV initially
- Expected service date: May 2012
- Est. Cost: $25.0 M
Chesapeake to Yadkin 115 kV is overloaded for the loss of Chesapeake to Yadkin 230 kV with reduced generation at Chesapeake #4 off (221MW)

Solution: Reconductor Chesapeake to Yadkin 115 kV line

Expected service date: May 2012

Est. Cost: $2.0 M
Dominion Baseline Upgrade – Upgrade Chesterfield-Shockoe and ACCA-Carver

- Chesterfield to Shockoe is overloaded for the loss of ACCA to Carver and visa-versa
- Solution: Reconductor and replace terminal equipment on line 17 and replace the wave trap on line 88
- Expected service date: May 2012
- Est. Cost: $0.3 M
• Loss of the Dooms source of Dooms to Dupont Waynesboro line results in low voltage at Waynesboro
• Install a new 115 kV capacitor at Dupont-Waynesboro substation
• Expected in-service date: May 2013
• Est. Cost: $0.5 M
First Energy Baseline Upgrades
PN Baseline Upgrades due to FE Criteria

- Voltage collapse / Forest 230 kV circuit breaker fault causing the loss of the Forest-Glade Tap 230 kV line
- Reconfigure and expand the Glade 230 kV ring bus to eliminate the Glade Tap 230 kV 3-terminal line
- Estimated Project Cost: $5.64 M
- Expected IS Date: 6/01/2010
PN Baseline Upgrades due to FE Criteria

- Altoona 230/46 kV transformer #1 / loss of Altoona-Raystown 230 kV line and Altoona 230/46 kV transformer #2
- Add 3 breakers to form a ring bus at Altoona 230 kV
- Estimated Project Cost: $2.73 M
- Expected IS Date: 6/01/2010
ME Baseline Upgrades

• Driver: Violation of FE Thermal Criteria / Hunterstown - Texas Eastern Tap - Gardners 115 kV
  • Solution: Rebuild Hunterstown - Texas Eastern Tap 115
  • Estimated Project Cost: $2.1 M
  • IS Date: 6/1/2008
• Solution: Rebuild Texas Eastern Tap - Gardners 115 kV and associated upgrades at Gardners including disconnect switches
  • Estimated Project Cost: $1.9 M
  • IS Date: 5/1/2009
ME Baseline Upgrades

- Replace disconnect switch at Portland on the Portland-Kittatinny 230 kV circuit
- Estimated Project Cost:
- IS Date: 6/1/2011
Generation Deliverability Violation - METED

• Yorkana 230/115 kV transformer bank 4 / losses of Yorkana-Jackson 230 kV line and Yorkana 230/115 kV bank 3 (also load deliverability violation)

• Recommended Solution: Add Yorkana 115 kV tie bus breaker

• Estimated Project Cost: $952,700

• IS Date: 6/1/2013
PECO Baseline Upgrades
• Bradford – Planebrook 230 kV line CKT 220-02 / Loss of the other 230 kV line (Single)
• Recommended Solution: Reconductor the line to provide a normal rating of 677 MVA and an emergency rating of 827 MVA
• Expected in-service: June 1, 2013
• Estimated cost: $7.0 M
• Bradford – Planebrook 230 kV line CKT 220-31 / Loss of Bradford – Planebrook 230 kV line + Bradford CB 220 failed (Line_FB)

• Recommended Solution: Reconductor the line to provide a normal rating of 677 MVA and an emergency rating of 827 MVA

• Expected in-service: June 1, 2013

• Estimated cost: $7.5 M
PEPCO Baseline Upgrades
Generation Deliverability Violation – PEPCO

- Station H – Quince Orchard 230 kV line / Loss of Dickerson – Quince Orchard DCTL
- Recommended Solution: Upgrade circuit to 3,000 amps using the ACCR
- Expected in-service date: June 1, 2013
- Estimated cost: $6.252M
PP&L Upgrades
PPL Baseline Upgrades

- 210 MVA load loss / loss of double circuit South Akron-South Reading 230 kV lines and Berks transformers #1 and #2
- Exceeds PPL guidelines for maximum allowable load loss
- Berks Substation modification on Berks-South Akron 230 kV Line. Modification will isolate the line fault on the South Akron line and will allow Berks transformer #2 to be energized by the South Lebanon 230kV circuit
- Estimated Project Cost: $0.523 M
- Expected IS Date: 5/01/2010
• Eldred-Pine Grove 69 kV Line / basecase
• Eldred-Pine Grove 69 kV Line Rebuild Part 2: 8 Miles
• Estimated Project Cost: $10.22 M
• IS Date: 5/1/2012
• Several overloads in Lackawanna/Providence 69 kV area / loss of DCTL Lackawanna-Mountain 230 kV line and Lackawanna-Stanton 230 kV line
• Stanton-Providence #1 & #2 69 kV Line: Reconductor/Rebuild w/ 69 kV Design: Approximately 8 Miles Total
• Estimated Project Cost: $4.89 M
• IS Date: 5/1/2011
PPL Baseline Upgrades

- Harwood 230/69 kV transformer / loss of DCTL Susquehanna-Harwood #1 & #2 230 kV lines
- Harwood Substation: Add 150MVA, 230/138/69 Transformer #6
- Estimated Project Cost: $13.97 M
- IS Date: 11/1/2011
• Siegfried-Jackson 138 kV line / loss of Monroe-Jackson 138 kV line and low voltage in Jackson 69 kV area
• Bartonsville Substation - New 138kV tap off Monroe-Jackson #1
• Stroudsburg Substation: New 138kv Taps from Monroe-Jackson Lines
• Gilbert Substation: New 138kV tap off Siegfried-Jackson #2 to Transformer #2
• Estimated Project Cost: $1.95 M
• IS Date: 11/1/2010
PPL Baseline Upgrades

- Siegfried-Jackson 138 kV line / loss of Monroe-Jackson 138 kV line and low voltage in Jackson 69 kV area
- Siegfried 230/138 kV Substation: New 138 kV Line and Terminal, Add Second Circuit to Siegfried-Jackson for 8.0 Miles
- Jackson 138/69 kV Substation: 138 kV Yard Upgrades and Transmission Line Rearrangements
- Estimated Project Cost: $10.03 M
- IS Date: 11/1/2010
• South Farmersville 69 kV overloads / basecase
• South Farmersville Substation: New 69kV Tap off Nazareth-Quarry #2 to Transformer #2
• Estimated Project Cost: $0.40 M
• IS Date: 5/1/2011
• Siegfried-Quarry 69 kV Line / basecase
• Siegfried-Quarry 69 kV Line Rebuild from Siegfried to North Bethlehem: 6.7 Miles
• Estimated Project Cost: $5.0 M
• IS Date: 5/1/2011
PPL Baseline Upgrades

- Buxmont-Hatfield #3 69 kV line / loss of Buxmont-Hatfield #4 69 kV line
- Elroy Substation Expansion and New Elroy-Hatfield 138/69 kV Double Circuit Lines: 1.9 Miles
- Estimated Project Cost: $38.42 M
- IS Date: 5/1/2013
- Quarry-Elliott Heights #1 69 kV Line / loss of Quarry-Elliott Heights #3 69 kV Line
- Seidersville-Quakertown 138/69 kV Reconductor/Rebuild 12 Miles and Hosensack New 75 MVA, 230/69 kV Transformer #4
- Estimated Project Cost: $23.14 M
- IS Date: 5/1/2009
• Buxmont-Quakertown #2 69 kV line / loss of Buxmont-Quakertown #1 69 kV Line
• New Springfield 230/69 kV Substation and Transmission Line Connections
• Estimated Project Cost: $16.40 M
• IS Date: 5/1/2011
PPL Baseline Upgrades

- West Shore-Cumberland #1 69 kV line / loss of West Shore 69 kV bus section 2
- New Double Circuit 138/69 kV Line from West Shore to Whitehill Taps: 1.3 Miles
- Estimated Project Cost: $4.91 M
- IS Date: 5/1/2013
PPL Baseline Upgrades

- **West Shore-Cumberland #2 69 kV line / basecase**
- **Cumberland-West Shore 69 kV Double Circuit Line**: Reconductor 3.7 Miles from Cumberland to Wertzville
  - Estimated Project Cost: $2.87 M
  - IS Date: 12/1/2009
- **West Shore-Cumberland #3 & #4 69 kV lines / Cumberland #1 & #2 230/69 kV transformers**
  - Reconductor West Shore-Cumberland #3 & #4 69 kV Lines from Mt. Allen to Rossmoyne: 1.6 Miles
  - Estimated Project Cost: $1.03 M
  - IS Date: 5/1/2013
PPL Baseline Upgrades

- Harrisburg-Captial Park #1 69 kV line / loss of Dauphin 69 kV bus section 1
- Replace UG Cable from Walnut Substation to Center City Harrisburg Substation for Higher Ampacity: 0.25 Miles
- Estimated Project Cost: $1.73 M
- IS Date: 5/1/2013
PPL Baseline Upgrades

- Lincoln 69 kV transformer / basecase
- Lincoln Substation - 69 kV Tap to Convert to Modified Twin A
- Estimated Project Cost: $0.12 M
- IS Date: 11/1/2012
PPL Baseline Upgrades

- W. Hempfield - Donegal 69 kV Line / loss of DCTL West Hempfield-Grin & West Hempfield-Hummelston 69 kV lines
- W. Hempfield - Donegal 69 kV Line - Reconductor/Rebuild from Landisville Tap to Mt. Joy Substation to Double Circuit 69 kV: 2 Miles
- W. Hempfield - Donegal 69 kV line - Reconductor/Rebuild to Double Circuit from Mt. Joy Substation to Donegal Substation: 2 Miles
- Terminate new S.Manheim-Donegal 69 kV Circuit into South Manheim #3 69 kV Bay
- Estimated Project Cost: $4.50 M
- IS Date: 10/1/2013
W. Hempfield - Donegal 69 kV Line / loss of DCTL West Hempfield-Grin & West Hempfield-Hummelston 69 kV lines

South Manheim-West Hempfield #3 69 kV Line - Rebuild from South Manheim to near Fuller Tap for Double Circuit 69 kV: 1.0 Mile

West Hempfield - South Manheim #3 69 kV Line - Reconductor from Fuller tap to Landisville: Double Circuit 4.1 Miles

Estimated Project Cost: $5.66 M

IS Date: 9/1/2011
PSE&G Baseline Upgrades
PSEG Baseline Upgrades

- Driver: Short Circuit Violation
- Replace Athenia 230 kV breaker 31H due to Short Circuit
- Estimated Project Cost: $ 0.4 M
- IS Date: 6/1/2012
- Replace Bergen 230 kV breaker 10H due to Short Circuit
- Estimated Project Cost: $ 0.4 M
- IS Date: 6/1/2012
- Replace Saddlebrook 230 kV breaker 21P due to Short Circuit
- Estimated Project Cost: $ 0.4 M
- IS Date: 6/1/2012
PSEG Baseline Upgrades

- Driver: 2009 Base Conditions
- Replace Essex 138 kV breakers due to Short Circuit
  - 4LM (C1355 line to ECRRF)
  - 1LM (220-1 TX)
  - 1BM (BS1-3 tie)
  - 2BM (BS3-4 tie)
- Estimated Project Cost each: $0.4 M
- IS Date: 6/1/2009
PSEG Baseline Upgrades

- Driver: 2009 Base Conditions
- Replace Linden 138 kV breaker 3 (132-7 TX) due to Short Circuit
- Estimated Project Cost: $0.4 M
- IS Date: 6/1/2009
- Replace Metuchen 138 kV breaker ‘2-2 Transfer’ due to Short Circuit
- Estimated Project Cost: $0.4 M
- IS Date: 6/1/2009