Transmission Expansion Advisory Committee

December 16, 2009
MAAC Stability Analysis
• Objectives
  – To ensure that the PJM system meets stability criteria under the Capacity Emergency Transfer Objective (CETO), a critical stressed power transfer scenario.

• Study Case
  – 2013 load deliverability case (a 90/10 Summer Peak load condition).
  – Both thermal and voltage sample cases were studied.

• Tested Stability Criteria
  – Transient stability (angular stability).
  – Damping (positive damping).
• Procedure

Select Target Load Deliv. Case
- 2013 load deliverability case
- Thermal and voltage cases
- 90/10 summer peak load condition.

Build a dynamic stability case
- Modifying power flow generator models based on physical unit models.
- Preparing dynamic models.

Build Contingency List
- Select critical contingencies.
- Convert them into dynamic contingency format for dynamic simulation.

Perform Transient and Small Signal Stability Analysis
- Run 20 sec. time domain simulation.
- Perform Eigenvalue analysis to screen out possible insufficient damping modes.
- Assess transient and small signal stability.

• Analysis Tools
  – PSSE, SSAT.
• Studied Contingencies
  – Critical single contingencies (PJM 500kV lines) involving a 3-ph fault with normal clearing and several machine outage contingencies.

• Analysis Results
  – No transient stability issues have been identified.
  – All transient oscillations damp out within 10~20 seconds.
Example: PJM17: 3ph fault @ Peach Bottom 500kV on Peach Bottom - Conastone 500kV
• PJM21: 3ph fault @ Conemaugh 500kV on Conemaugh - Keystone 500kV.
Baseline Reliability Update
• **N-1-1 thermal overloads** of Edgewater – Vasco Tap 138 kV line; Edgewater – Loyalhanna 138 kV line for Loss of STNYSP 138 kV, SOAKFD kV bus, and NOAKFD 138 kV busses; and Loss of Youngwood – Yukon 138 kV line

• **Proposed Solution:**
  - Reconductor the Edgewater – Vasco Tap; Edgewater – Loyalhanna 138 kV lines with 954 ACSR (b1128)

• **Estimated Cost:** TBD

• **Expected IS Date:** 6/01/2014
• **N-1-1 thermal overload** of East Waynesboro – Ringgold 138 kV line for Loss of Antrim – Ried 138 kV; and Loss of Harmony 138 kV Bus

• **Proposed Solution:**
  - Reconductor the East Waynesboro – Ringgold 138 kV line with 954 ACSR (b1129).

• **Estimated Cost:** $3 M

• **Expected IS Date:** 6/01/2014
• **N-1-1 thermal overloads** of Double Tollgate – Meadowbrook CKT 1 138 kV line for Loss of DTG – Meadowbrook CKT 2 138 kV; and Loss of Meadowbrook – W Winchester 138 kV line

• **Proposed Solution:**
  - Upgrade Double Tollgate-Meadowbrook MDT Terminal Equipment (b1131)

• **Estimated Cost:** TBD
• **Expected IS Date:** 6/01/2014
• **N-1-1 thermal overloads** of Double Tollgate – Meadowbrook CKT 2 138 kV line for Loss of DTG – Meadowbrook CKT 1 138 kV; and Loss of Meadowbrook – W Winchester 138 kV line

• **Proposed Solution:**
  - Upgrade Double Tollgate-Meadowbrook MBG terminal equipment (b1132)

• **Estimated Cost:** TBD

• **Expected IS Date:** 6/01/2014
• **N-1-1 thermal overloads** of Grand Point – South Chamber 138 kV line for Loss of E Waynesboro – Ringgold 138 kV line; and Loss of Lewistown 230/115 kV Transformer # 3, Lewistown – Raystown 230 kV line, Lewistown – Shingletown 230 kV line, Lewistown – Yeagerstown 230 kV CKT 2, Lewistown Transformer #2

• **Proposed Solution:**
  - B0684 can be revised to reconductor Grand Point – South Chambersburg – Guliford. (B1152)

• **Estimated Cost:** $2.9 M

• **Expected IS Date:** 6/01/2014
• **N-1-1 thermal overloads** of Allegheny Ludlum 4 Junction – Springdale 138 kV line for Loss of Murrycrest 138 kV – Wallace 138 kV; and Loss of Shaffers Corner – Springdale 138 kV line

• **Proposed Solution:**
  - Upgrade terminal equipment at Springdale. (B1133)

• **Estimated Cost:** TBD

• **Expected IS Date:** 6/01/2014
• **N-1-1 thermal overloads** of Bartonville – Meadowbrook 138 kV line for loss of Bedington – Black Oak 500 kV line; and Loss of Bedington – Doubs 500 kV line

• **Proposed Solution:**
  - Reconduct the Bartonville – Meadowbrook 138 kV line with high temperature conductor. (B1135)

• **Estimated Cost:** TBD

• **Expected IS Date:** 6/01/2014
• **N-1-1 thermal overloads** of Eastgate 2 – Luxor 138 kV line; Eastgate – Sony 138 kV line for loss of Youngwood – Yukon 138 kV line; and Loss of Waltz T 138 kV and Waltz Mills 138 kV busses

• **Proposed Solution:**
  - Reconductor the Eastgate – Luxor 138 kV; Eastgate – Sony 138 kV line with 954 ACSR. (B1137)

• **Estimated Cost:** TBD

• **Expected IS Date:** 6/01/2014
• **N-1-1 thermal overloads** of King Farm – Sony 138 kV line for loss of Youngwood – Yukon 138 kV line; and Loss of Waltz T 138 kV and Waltz Mills 138 kV busses

• **Proposed Solution:**
  - Reconduct the King Farm – Sony 138 kV line with 954 ACSR.
  (B1138)

• **Estimated Cost:** TBD

• **Expected IS Date:** 6/01/2014
• N-1-1 thermal overloads of Yukon – Waltz T 138 kV line for loss of Youngwood – Yukon 138 kV line; and Loss of Springdale – Wallace 138 kV line

• Proposed Solution:
  - Reconductor the Yukon – Waltz Mills 138 kV line with high temperature conductor. (B1139)

• Estimated Cost: TBD

• Expected IS Date: 6/01/2014
• **N-1-1 thermal overloads** of Bracken Junction – Luxor 138 kV line for loss of Youngwood – Yukon 138 kV line; and Loss of Loyalhanna – Luxor 138 kV line

• **Proposed Solution:**
  - Reconduct the Bracken Junction – Luxor 138 kV line with 954 ACSR. (B1140)

• **Estimated Cost:** $0.8 M

• **Expected IS Date:** 6/01/2014
• **N-1-1 thermal overloads** of Sewickley – Waltz T 138 kV line for loss of Bedington – Doubs 500 kV line; and Loss of Springdale – Wallace 138 kV line

• **Proposed Solution:**
  - Reconduct the Sewickley – Waltz Mills Tap 138 kV line with high temperature conductor. (B1141)

• **Estimated Cost:** TBD

• **Expected IS Date:** 6/01/2014
• **N-1-1 thermal overloads** of Bartonville – Stephenson 138 kV line; Stonewall – Stephenson 138 kV line for loss of Bedington – Doubs 500 kV line; and Loss of Black Oak – Hatfield 500 kV

• **Proposed Solution:**
  - Reconducto the Bartonville – Stephenson 138 kV; Stonewall – Stephenson 138 kV line with 954 ACSR. (B1142)

• **Estimated Cost:** TBD

• **Expected IS Date:** 6/01/2014
• **N-1-1 thermal overloads** of Youngwood – Yukon 138 kV line for loss of Hempfield – Sewickley 138 kV line; and Loss of Springdale – Wallace 138 kV line

• **Proposed Solution:**
  - Reconductor the Youngwood – Yukon 138 kV line with high temperature conductor. (B1143)

• **Estimated Cost:** TBD

• **Expected IS Date:** 6/01/2014
• **N-1-1 thermal overloads** of Bull Creek Junction – Cabot 138 kV line for loss of Cabrey 138 kV bus; and loss of Lawson 138 kV bus

• **Proposed Solution:**
  - Recductor the Bull Creek Junction – Cabot 138 kV line with high temperature conductor. (B1144)

• **Estimated Cost:** TBD

• **Expected IS Date:** 6/01/2014
• **N-1-1 thermal overloads** of Cabot – Lawson 138 kV line for loss of Bull Creek Junction 138 kV bus; and Loss of Cabrey 138 kV bus

• **Proposed Solution:**
  - Reconductor the Lawson Junction – Cabot 138 kV line with high temperature conductor. (B1145)

• **Estimated Cost:** TBD
• **Expected IS Date:** 6/01/2014
• **N-1-1 thermal overloads** of Layton – Smith 61 138 kV line for Loss of Waltz T 138 kV Bus and Waltz Mills 138 kV bus; and Loss of Youngwood – Yukon 138 kV line

• **Proposed Solution:**
  - Replace structures along Layton – Smith 61 138 kV to increase line rating. (B1146)

• **Estimated Cost:** TBD

• **Expected IS Date:** 6/01/2014
• **N-1-1 thermal overloads** of Smith – Yukon 138 kV line for Loss of Waltz T 138 kV Bus and Waltz Mills 138 kV bus; and Loss of Youngwood – Yukon 138 kV line

• **Proposed Solution:**
  - Replace structures along Smith – Yukon 138 kV to increase line rating. (B1147)

• **Estimated Cost:** TBD

• **Expected IS Date:** 6/01/2014
• **N-1-1 thermal overloads** of Loyalhanna - Luxor 138 kV line for Loss of Bracken Junction - Eastgate 138 kV line, Eastgate - Youngwood 138 kV, Bracken Junction - Luxor 138 kV line, Bracken Junction - Unity 138 kV + Vasco - Vasco Tap 138 kV line, Vasco - Ethel Springs 138 kV line, Vasco Tap - Edgewater - Loyalhanna 138 kV line, Vasco Tap - Social Hall 138 kV line

• **Proposed Solution:**
  - Reconduct the Loyalhanna – Luxor 138 kV line with 954 ACSR. (B1148)

• **Estimated Cost:** TBD

• **Expected IS Date:** 6/01/2014
• **N-1-1 thermal overloads** of Luxor - Stony Springs Junction 138 kV line for Loss of Yukon - Waltz Mills - Sewickley 138 kV line + Springdale - Wallace 138 kV line

• **Proposed Solution:**
  - Reconductor the Luxor – Stony Springs Junction 138 kV line with 954 ACSR. (B1149)

• **Estimated Cost:** TBD

• **Expected IS Date:** 6/01/2014
- **N-1-1 thermal overloads** of Social Hall - Vasco Tap 138 kV line for loss of Youngwood - Yukon 138 kV line + Yukon - Waltz Mills - Sewickley 138 kV line

- **Proposed Solution:**
  - Upgrade terminal equipment at Social Hall. (B1150)

- **Estimated Cost:** TBD

- **Expected IS Date:** 6/01/2014
• **N-1-1 thermal overloads** of Greenwood - Redbud 138 kV line for Loss of Meadow Brook - West Winchester 138 kV line + Base Case

• **Proposed Solution:**
  - Reconductor the Greenwood – Redbud 138 kV line with 954 ACSR. (B1151)

• **Estimated Cost:** $2.7 M

• **Expected IS Date:** 6/01/2014
N-1-1 thermal overload of Mays Chapel – Texas 115kV line for the loss of Mays Chapel – Mt. Washington CKT 110702 + loss of Northwest – Delight - Gwynnbrook - Mays Chapel CKT 110579 115kV line

- Proposed Solution:
  - Transfer 6 MW of load from Mt. Washington to East Towson.

- Estimated Cost: $ 0.0 M

- Expected IS Date: 6/01/2014
N-1-1 voltage drop violations in Texas, Delight, Notch Cliff, Shawn Rd. vicinity for the following contingencies:


Proposed Temporary Solution in 2014 (permanent solution to be determined):
Apply a special protection scheme (load drop and H/S switching removal at Mt. Washington)

- Estimated Cost: $ 0.1 M
- Expected IS Date: 6/01/2014
• N-1-1 Voltage Violation
• Voltage drop and voltage magnitude violation in the West Orange 138 kV vicinity for several contingencies.
• Proposed Solution:
  Convert the following facilities from 138 kV to 230 kV. (B1154)
  >West Orange 138 kV substation
  >The Roseland – West Orange two 138 kV circuits (S-1319 & T-1320).
  >The Roseland – Sewaren 138 kV circuit (O-1315).
• Estimated Cost: 
  $200 M
• Expected IS Date: 
  06/01/2014
• **N-1-1 Voltage Violation**
  Voltage drop and voltage magnitude violation in the Bridgewater, Greenbrook and Lake Nelson 230 kV vicinity for several contingencies.

• **Proposed Solution:**
  Build a new 230 kV circuit from Branchburg to Middlesex Sw. Rack. Build a new 230 kV substation at Middlesex by connecting the new and the existing circuits from Branchburg, plus the two 230 kV parallel circuits from Raritan River to Gillette (I-1023 and W-1037). (B1155)

• **Estimated Cost:**
  $125 M

• **Expected IS Date:**
  06/01/2014
• N-1-1 Voltage Violation
• Voltage drop and voltage magnitude violation in the Burlington 138 kV vicinity for several contingencies.
• Proposed Solution:
  Convert the following facilities from 138 kV to 230 kV (B1156).
  > The Burlington 138 kV substation.
  > The Camden 138 kV substation.
  > The 138 kV circuits from Burlington to Camden (I-1309 and J-1310).
  > The 138 kV circuit from Camden to Cuthbert Blvd. and the Cuthbert Blvd 138 kV substation
• Estimated Cost:
  $150 M
• Expected IS Date:
  06/01/2014