



Transmission Expansion Advisory Committee

Reliability Analysis Update

December 3, 2015



Review of 2016 RTEP Assumptions

- Update of standard RTEP assumptions
- New for 2016 RTEP
 - TPL-001-4
- Modeling
 - MOD-032 (GOs and TOs)
 - <http://pjm.com/planning/rtep-development/powerflow-cases/mod-032.aspx>
 - Siemens PSS®MOD - Model On Demand (TOs)
 - PJM.com Online Tool – coming soon (GOs)
 - Powertech SDDDB – System Dynamics Database (GOs)
- RTEP Proposal Windows

- Load Flow Modeling
 - Power flow models for world load, capacity and topology will be based on the 2021 summer peak case from the 2015 ERAG MMWG series power flow base case
 - Update of adjacent areas with latest topology
 - PJM topology will be based on the 2020 RTEP case that was used in the 2015 RTEP
 - Include all PJM Board approved upgrades through the December 2015 PJM Board of Manager approvals as well as all anticipated February 2016 PJM Board approvals



Locational Deliverability Areas (LDAs)

- Includes the existing 27 LDAs
- Total of 27 LDAs
 - All 27 to be evaluated for the 2019/2020 delivery year RPM base residual auction planning parameters
 - Also to be evaluated for the 2021 Summer RTEP case

LDA	Description
EMAAC	Global area - PJM 500, JCPL, PECO, PSEG, AE, DPL, RECO
SWMAAC	Global area - BGE and PEPSCO
MAAC	Global area - PJM 500, Penelec, Meted, JCPL, PPL, PECO, PSEG, BGE, Pepco, AE, DPL, UGI, RECO
PPL	PPL & UGI
PJM WEST	APS, AEP, Dayton, DUQ, Comed, ATSI, DEO&K, EKPC, Cleveland
WMAAC	PJM 500, Penelec, Meted, PPL, UGI
PENELEC	Pennsylvania Electric
METED	Metropolitan Edison
JCPL	Jersey Central Power and Light
PECO	PECO
PSEG	Public Service Electric and Gas
BGE	Baltimore Gas and Electric
PEPCO	Potomac Electric Power Company
AE	Atlantic City Electric
DPL	Delmarva Power and Light
DPLSOUTH	Southern Portion of DPL
PSNORTH	Northern Portion of PSEG
VAP	Dominion Virginia Power
APS	Allegheny Power
AEP	American Electric Power
DAYTON	Dayton Power and Light
DLCO	Duquesne Light Company
Comed	Commonwealth Edison
ATSI	American Transmission Systems, Incorporated
DEO&K	Duke Energy Ohio and Kentucky
EKPC	Eastern Kentucky Power Cooperative
Cleveland	Cleveland Area

- NERC Transmission Planning Standards
- TPL-001-4 Implementation
 - Manual 14B language is approved and effective 1/1/2016
 - 2016 RTEP will comply with TPL-001-4
 - Notable Changes
 - Dynamic load modeling
 - Dynamic voltage recovery criteria
 - Increased focus on the evaluation of extreme events
 - Short circuit requirements

- Firm Commitments
 - Long term firm transmission service will be consistent with operations
- Outage Rates
 - Generation outage rates will be based on the most recent Reserve Requirement Study (RRS) performed by PJM
 - Generation outage rates for future PJM units will be estimated based on class average rates

- Summer Peak Load
 - Summer Peak Load will be modeled consistent with the 2016 PJM Load Forecast Report
 - The final load forecast data is expected to be available late December 2015
 - Include Demand Response (DR) and Energy Efficiency (EE) that cleared in the 2018/19 BRA

- Winter Peak Load
 - Winter Peak Load will be modeled consistent with the 2016 PJM Load Forecast Report

- Light Load
 - Modeled at 50% of the Peak Load forecast per M14B
 - Will continue to pursue a load adjustment through the Planning Committee
 - The Light Load Reliability Criteria case will be modeled consistent with the procedure defined in M14B

- Load Management, where applicable, will be modeled consistent with the 2016 Load Forecast Report
 - Used in LDA under study in load deliverability analysis

- All existing generation expected to be in service for the year being studied will be modeled.
- Future generation with a signed Interconnection Service Agreement, or that cleared in the 2018/19 BRA, will be modeled along with any associated network upgrades.
 - Generation with a signed ISA will contribute to and be allowed to back-off problems.
- Generation with an executed Facility Study Agreement (FSA) will be modeled along with any associated network upgrades.

- Generation with an FSA will be modeled consistent with the procedures noted in manual 14B
 - Exceptions to those procedures will be vetted with stakeholders at a future TEAC
- Generation with an executed FSA will be modeled off-line but will be allowed to contribute to problems in the generation deliverability testing.
 - Generation with an executed FSA will not be allowed to back-off problems.
- Additional generation information (i.e. machine lists) will be posted to the TEAC page when developed.

- Generation that has officially notified PJM of deactivation will be modeled offline in RTEP base cases for all study years after the intended deactivation date
- RTEP baseline upgrades associated with generation deactivations will be modeled
- Retired units capacity interconnection rights are maintained in RTEP base cases for 1 year after deactivation at which point they will be removed unless claimed by an interconnection queue project

- At a minimum, all PJM bulk electric system facilities, all tie lines to neighboring systems and all lower voltage facilities operated by PJM will be monitored.
- At a minimum, contingency analysis will include all bulk electric system facilities, all tie lines to neighboring systems and all lower voltage facilities operated by PJM.
- Thermal and voltage limits will be consistent with those used in operations.

- As part of the 24-month RTEP cycle, a year 8 (2024) base case will be developed and evaluated as part of the 2016 RTEP
- The year 8 case will be based on the 2020 case that was developed as part of this year's 2015 RTEP
 - The case will be updated to be consistent with the 2016 RTEP assumptions.
- Purpose: To identify and develop longer lead time transmission upgrades

- MOD-032-1 Data for Power System Modeling and Analysis is enforceable on 7/1/2016
- All modeling requirements and procedures are documented on PJM.com
 - <http://www.pjm.com/planning/rtep-development/powerflow-cases/mod-032.aspx>
 - Model on Demand
 - SDDB (final implementation is in progress)

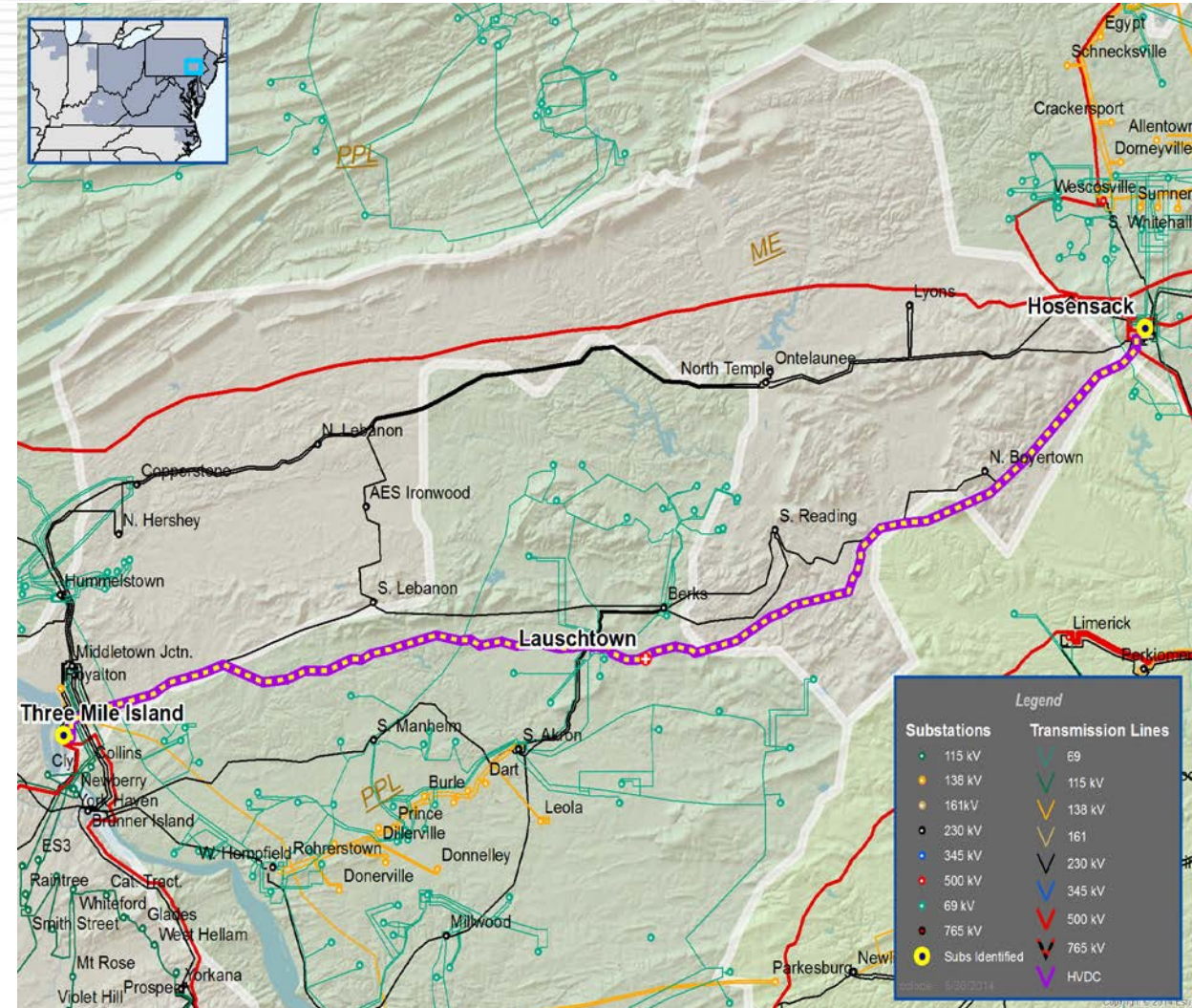
- Similar to the 2015 RTEP and per the PJM Operating Agreement, a proposal window will be conducted for all reliability needs that are not Immediate Need reliability upgrades.
- Implementation will be similar to the 2015 RTEP.
 - Advance notice and posting of potential violations
 - Advance notice of window openings
 - Window administration



Reliability Analysis Update

- B2006 Related upgrades cost Change:

UpgradeID	Description	Previous Cost Estimate	New Cost Estimate (\$M)
b2006	Install Lauschtown 500/230 kV substation (below 500 kV portion) - Includes the 500/230 kV transformer	28.23	8.82
b2006.1	Install Lauschtown 500/230 kV substation (500 kV portion) - Includes 500 kV yard work, 500 kV CBs, and 500 kV line tie-in	20	41.08
b2006.2	Construct a new 230/69 kV Lauschtown substation. The South Akron - Berks 230 kV line and South Akron - South Reading 230 kV line will terminate into the new 230 kV yard at Lauschtown	18.72	32.53
b2006.3	Construct new 69/138 kV transmission from Lauschtown 230/69 kV sub to Brecknock and Honeybrook areas	13.65	19.87



Project Scope Change to Existing Project: b2187

- Initially, a tower outage was projected to drop more than 300 MW between Greenway and Shellhorn Substations.
- Additional load in the immediate need timeframe from the Pacific and Yardley Ridge Substations create a 300 MW loss for an N-1-1 event involving Line #2137 (Brambleton-Yardley) and Line #2165 (Pacific-BECO).

Due to the time sensitive nature that this current issue presents, DOM (Local TO) will be the Designated Entity
 Due to the local upgrade nature of the work and time sensitive need, no additional alternatives were evaluated.

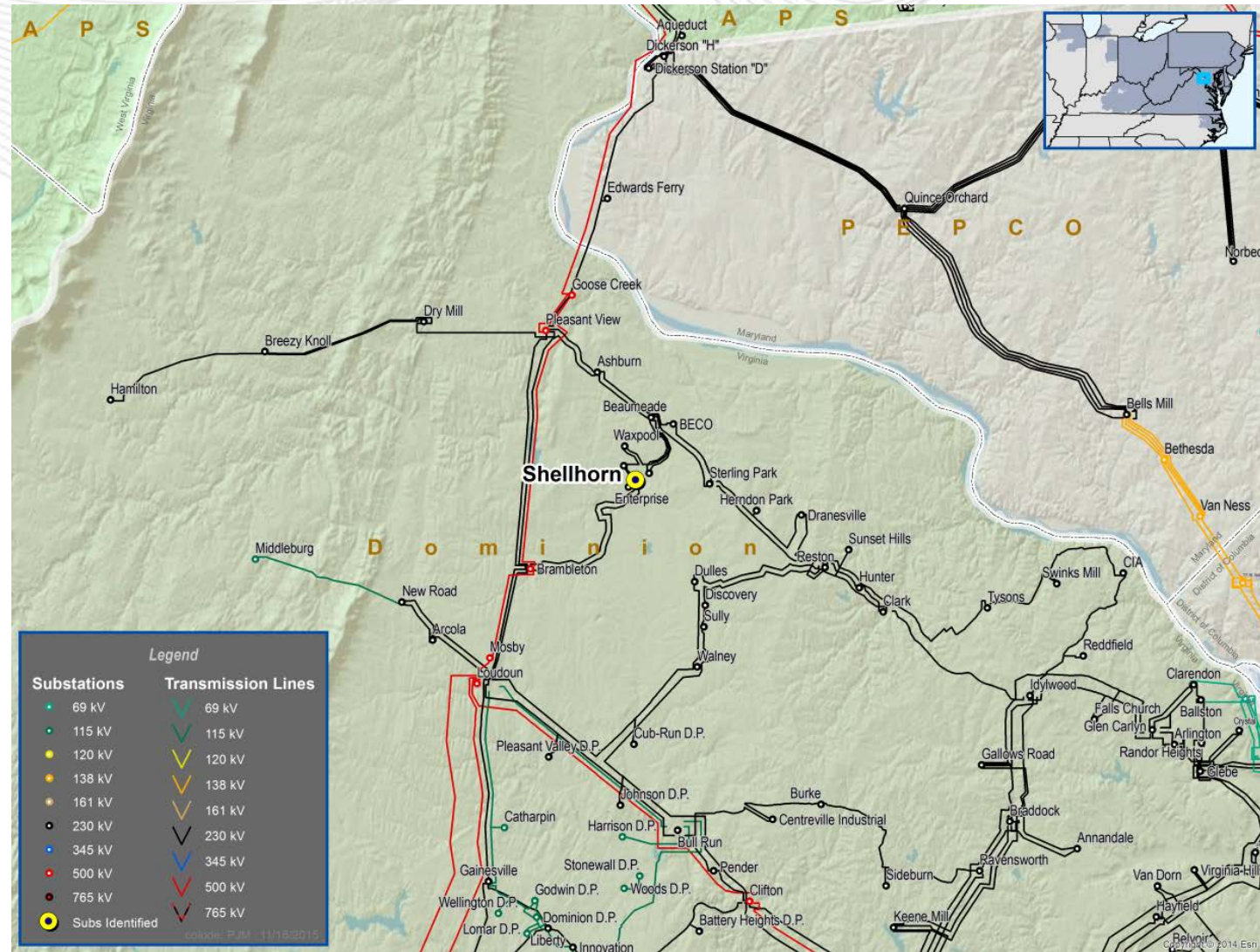
Proposed Solution:

- Old Scope : Install four 230kV breakers at Shellhorn.
- New Scope: Install six 230kV breakers at Shellhorn and terminate Line #2095 into Shellhorn. (b2187)

Old Estimated Project Cost: \$2.0M

New Estimated Project Cost: \$4.0M

Projected Target Date: 11/30/2017

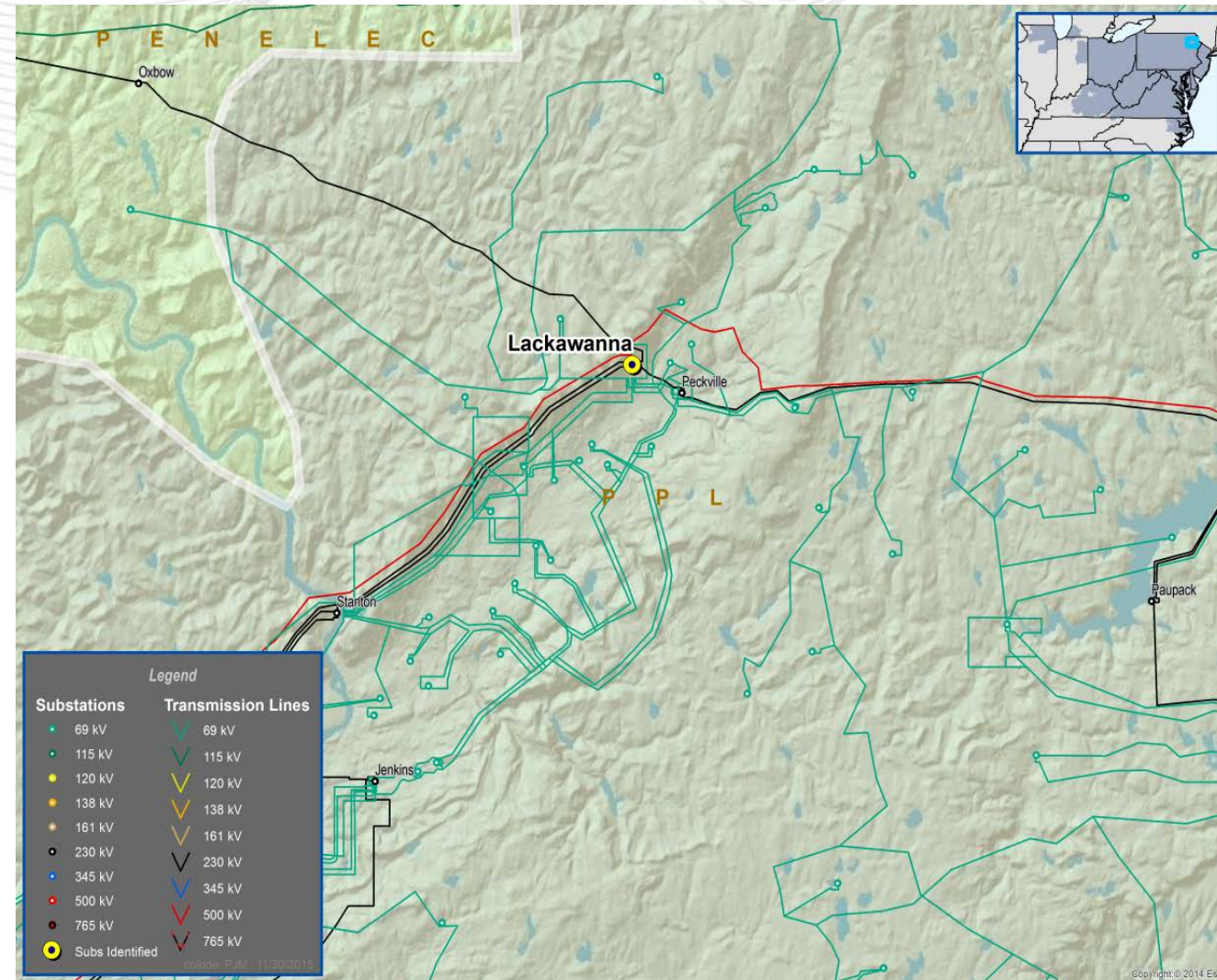




High Voltage in PJM Operations

- November 5th, 2015 TEAC
 - Several switchable shunt reactors and an SVC recommended to control high voltages in Eastern and Southern PJM.
- The system was re-studied with the final combination of reactive devices and an additional need for voltage control in the PP&L transmission zone was identified.

- Immediate Need Reliability Project
- Due to the time sensitive need for this project, a proposal window is infeasible
- The need for this project was identified in the immediate need timeframe
- Additional PJM operational data was evaluated beyond what was used for the November 2015 reactive recommendations
- Solution alternatives were evaluated by PJM and Lackawanna was determined to be an optimal location
- Problem: High voltages at Lackawanna 500 kV substation resulting in operational performance issues.
- Proposed Solution: Install a 200 MVAR reactor at Lackawanna 500 kV substation. (b2716)
- Estimated Project Cost: \$10 M
- Expected in-service date: December 2018



Supplemental Projects

Problem:

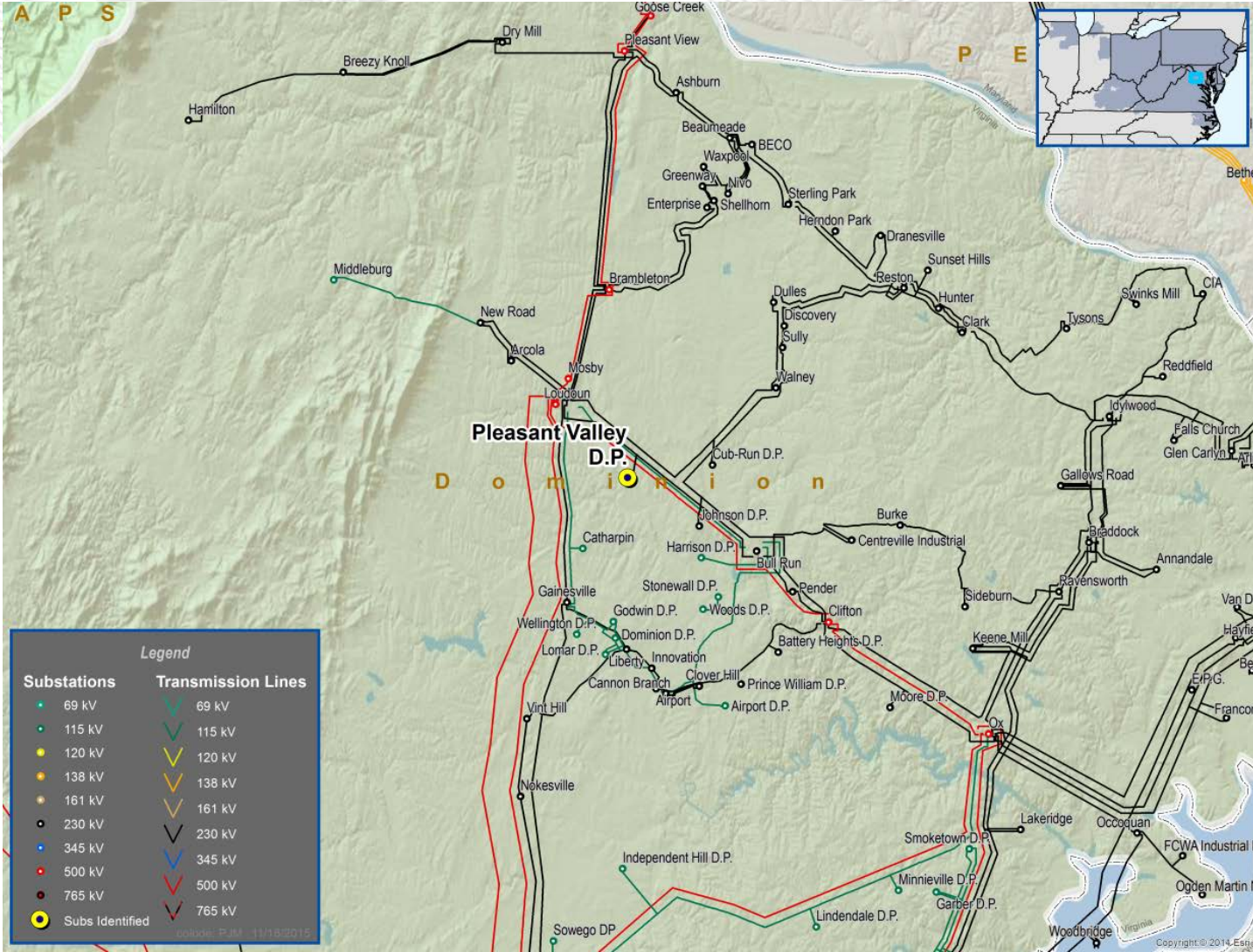
- NOVEC is expanding its Pleasant Valley DP to accommodate an expansion of a gas compressor facility. Approximately 70 MW of new motor load will increase the DP load to above 100 MW (116 MW) by 2017.

Proposed Solution

- Install a new four breaker 230kV ring bus at Pleasant Valley DP and convert the existing T-tap feed from the Loudoun - Bull Run 230kV Line #295 to a loop feed in and out of the new four breaker ring. (s1085)

Estimated Project Cost: \$5.0 M

Projected IS Date: 5/31/2016



Problem: Improve Reliability

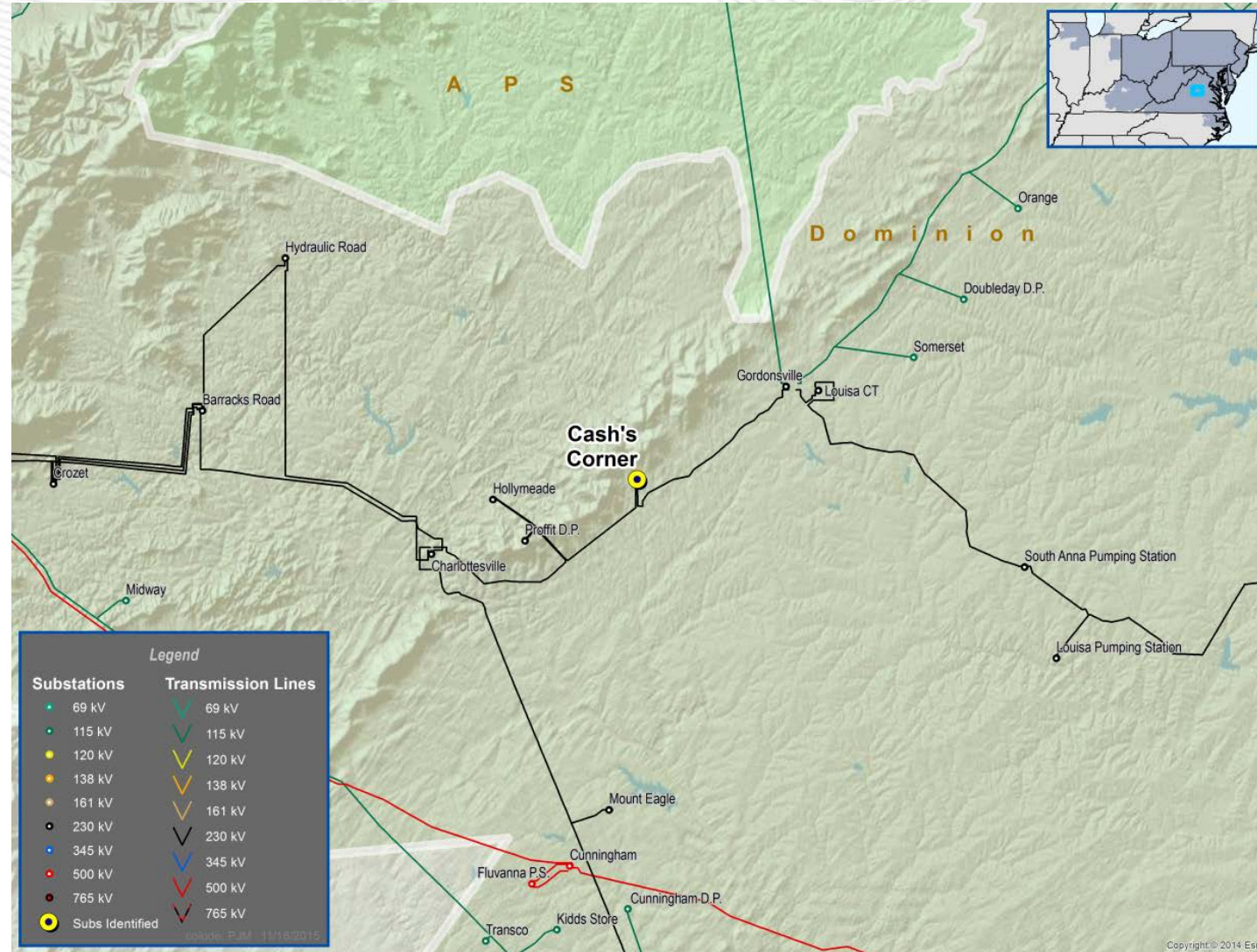
- CVEC is in the process of creating a tie within its network between the Cash's Corner and Columbia delivery points.
- Related to this work, a breaker is needed for the high side of the Dominion 230/115kV transformer at Cash's Corner to prevent inadvertent tripping of line # 2135 when the station is being fed exclusively from CVEC's line to Columbia. This will also improve the reliability of the Hollymead – Gordonsville 230kV Line #2135 by upgrading existing control schemes.
- The current protection scheme for the Hollymead – Gordonsville 230kV line #2135 calls for the opening of the line in the event a fault is detected at the Cash's Corner delivery point while it is being fed from Columbia DP.

Proposed Solution:

- Install a breaker on the high side of the existing Dominion 230/115kV transformer at Cash's Corner. This work will include the installation of a control house. (s1091)

Estimated Project Cost: \$1.63 M

Projected IS Date: 09/30/2016





Northern New Jersey Sensitivity Study

PJM – NYISO Operating Agreement (“Wheel” Agreement)

- PJM – NYISO Wheel calls for an export of 1000 MW to NYISO at Goethals and Farragut and an import of 1000 MWs at Ramapo
- PJM performed a sensitivity evaluation of the continued need for several baseline projects in Northern New Jersey without the wheel modeled

Evaluation: There are 4 major baseline upgrades that were evaluated for the continuing need for the sensitivity case of no wheel transfer.

Result: Each baseline reliability project is still needed even in the sensitivity case without the Wheel

B2218

- Description - Rebuild 4 miles of overhead line from Edison - Meadow Rd - Metuchen (Q-1317)
- The existing tariff allocation is HTP- 36.49% & ECP – 63.51%
- The sensitivity allocation with the approved scope if the wheel is terminated is HTP – 36.43% & ECP – 63.57%.

B2276

- Description - Eliminate the Sewaren 138kV bus by installing a new 230 kV bay at Sewaren 230 kV
- The existing allocation is ConEd – 50.82% & ECP – 49.18%
- The expected sensitivity allocation if the wheel is terminated is ECP – 100.00%.

B2436

- Northern New Jersey 345 kV Project – Convert the Bergen to Linden Corridor to 345 kV
- The existing allocation is among all Transmission Owners, including ConEd, ECP and HTP.
- The expected sensitivity allocation if the wheel is terminated would re-allocate most of the current ConEd allocation to ECP and HTP

B2437.10

- New Bergen 345/230 kV transformer and any associated substation upgrades
- The existing allocation is among all Transmission Owners, including ConEd, ECP and HTP.
- The expected sensitivity allocation if the wheel is terminated would re-allocate most of the current ConEd allocation to ECP and HTP



2015 RTEP Proposal Window Update



2015 RTEP Proposal Window Summary

- 2015 RTEP Proposal Windows
 - 2014/15 Long Term Proposal Window
 - 2015 RTEP Proposal Window #1
 - 2015 RTEP Proposal Window #2

	2014/15 RTEP Long Term Proposal Window	2015 RTEP Proposal Window 1	2015 RTEP Proposal Window 2
Window Open	10/30/2014	6/18/2015	8/5/2015
Window Close	2/27/2015	7/20/2015	9/4/2015
Objective	Long Term Reliability Criteria; Long Term TO Criteria; Market Efficiency	N-1 Thermal and Voltage; Gen Deliv and Common Mode Outage, Load Deliv Thermal and Voltage; N-1-1 Thermal and Voltage	TO Thermal Criteria, TO Voltage Criteria; Light Load Thermal and Voltage
Flowgates	77	306	22
Proposals	118	91	23
Proposal From Incumbents	67	34	14
Proposal From Non-Incumbent	52	57	9
Entities	22	9	4
Cost Range	\$0.1M - \$432.5M	\$0.013M-\$167.1M	\$.075 - \$31
Proposals approved by PJM Board	11	19 ⁽¹⁾	0 ⁽²⁾
Board Dates	Oct-15	Oct-15	N/A
Approved Greenfield Projects	0	0	N/A
Approved Upgrade Projects	11	19	N/A
Approved Incumbent	11	19	N/A
Approved Non-Incumbent	0	0	N/A

Notes

1. Portions of this project were awarded to both the incumbent and non-incumbent entities, additionally this project includes both greenfield and upgrade aspects
1. One additional project is recommended for approval at the December 2015 Board Meeting
2. Six additional are expected to be recommended for approval at the December 2015 Board Meeting

- 2015 RTEP Proposal Window 1

September 10, 2015 TEAC

- There were several overloads in Dominion Transmission Zone that were dependent on the final outcome of an FSA generator.
- The previous FSA generator has signed an ISA and as a result PJM is re-engaging the evaluation of the existing solution alternatives

DOM Transmission Zone

- Generation Deliverability Violation (FG# New-52)**
- The Carson – Rogers Rd 500 kV circuit is overloaded for single contingency loss of the Carson – Rawlings 500 kV circuit.
- Alternatives considered:**

2015_1-1B	2015_1-1C	2015_1-1D	2015_1-1E
2015_1-1F	2015_1-5F	2015_1-6A	2015_1-6B
2015_1-6C	2015_1-7D	2015_1-8X	2015_1-8Y
2015_1-9A	2015_1-9B	2015_1-9C	2015_1-9D
2015_1-9E			

- Cost: (\$27.8 to 167.1 M)**
- Status:** These violations have been identified as FSA related generation violations. PJM will perform an evaluation if the associated planned FSA generation signs an ISA

PJM TEAC 9/10/2015 75 PJM©2015

- Continue assumptions discussion
- Present the final 2015 RTEP Window #1 recommendation
- Continue RTEP and RPM case building

Questions?

Email: RTEP@pjm.com

- Revision History
 - Original version posted to PJM.com – 11/30/2015
 - Minor grammatical updates – 12/3/2015