Transmission Expansion Advisory Committee
Market Efficiency Update

October 8, 2015

Market Efficiency Long Term Proposal Window Update

Proposals by Area

Area of Proposal	Number of Proposals	Greenfield Proposals	TO Upgrade Proposals
AEP	3	1	2
APS	5	3	2
APSOUTH and/or AEP-DOM Area	41	37	4
ATSI	4	-	4
BGE/PPL	4	-	4
ComEd	15	4	11
DEOK	8	8	-
DPL	1	-	1
DUQ	4	3	1
PECO	5	-	5
PSEG	3	2	1
Grand Total	93	58	35

Market Efficiency Proposal Window

Proposals were sorted based on the congestion they were addressing.

- Group 2-19 facilities include facilities in which congestion may be alleviated with lower cost more locational type projects. Projects associated with these facilities can be more easily constructed or sometimes only require upgrades to existing equipment.
  - ➢ Projects to be recommended to PJM board in October

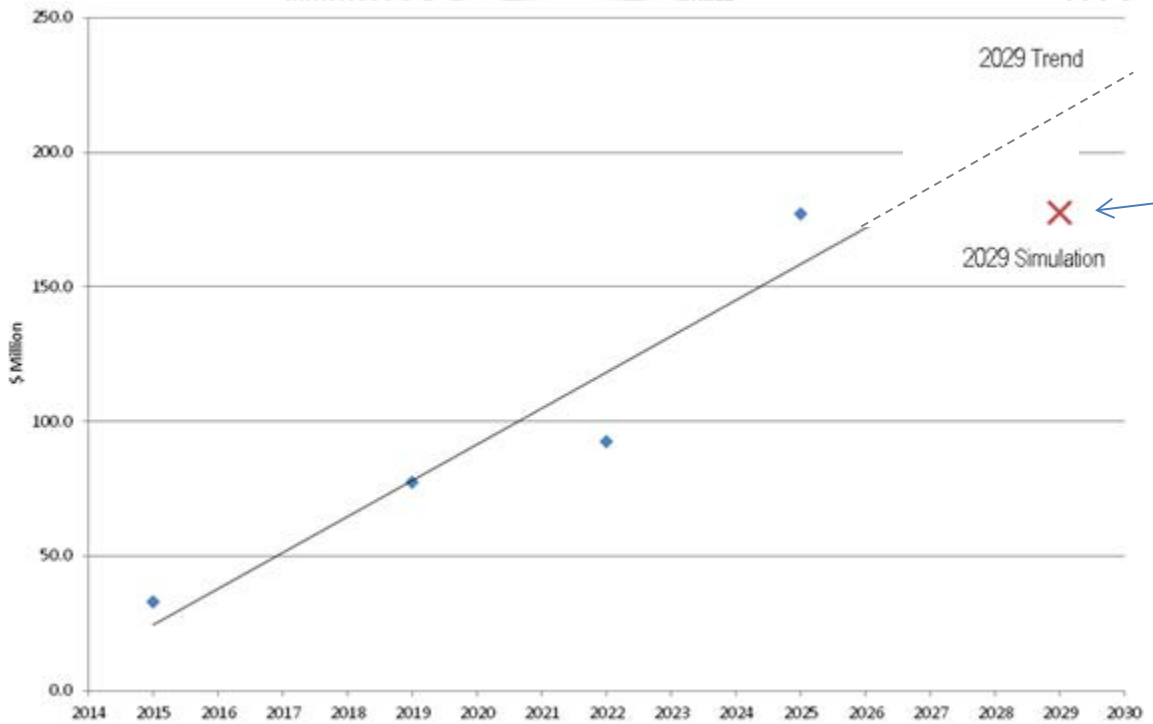
- Group 1 facilities are regional facilities associated with PJM IROL (Interconnected Reliability Operating Limit) Reactive interfaces. Evaluation of these projects is ongoing and may be complete either later this year or in 2016.

Summary: Recommended Projects

Group	PJM Window Project ID	Area	Constraint	Cost ($millions)	Type	In-service date	B/C 2014 Base	B/C 2015 Sensitivity	Does Project address congestion on Driver?
Group 4	201415_1-18G	APS	Taneytown to Carroll 138 kV	5.2	Upgrade	2019	55.7	90.1	Yes
Group 5	201415_1-12A	DUQ	Dravosburg to West Mifflin 138 kV	11.18	Upgrade	2018	5.8	2.0	Yes
Group 8	201415_1-2A	PPL - BGE	Safe Harbor to Graceton 230 kV	1.1	Upgrade	2019	4.3	14.4	Yes
Group 8	201415_1-2B	ME - PPL	Brunner Island to Yorkana 230 kV	3.1	Upgrade	2019	73.3	22.2	Yes
Group 9	201415_1-10J	COMED	Cordova to Nelson 345 kV	24.6	Upgrade	2019	1.7	1.9	Yes
Group 10	201415_1-10B	COMED	Wayne to South Elgin 138 kV	0.1	Upgrade	2019	7.2	6.4	Yes
Group 11	201415_1-11H	PECO	Peach Bottom 500 kV	9.7	Upgrade	2019	2.6	3.0	Yes
Group 14	201415_1-13E	DPL	Worcester to Ocean Pines (I) 69 kV	2.4	Upgrade	2019	82.7	65.3	Yes
Group 15	201415_1-18I	APS/ATSI	Krendale to Shanor Manor 138 kV	0.6	Upgrade	2019	35.8	123.4	Yes
Group 18	201415_1-4I	AEP	Fieldale to Thornton 138 kV	0.75	Upgrade	2019	114.2	101.2	Yes
Group 19	201415_1-4J	AEP	Jacksons Ferry to Cloverdale 765 KV	0.5	Upgrade	2019	15.8	62.0	Yes

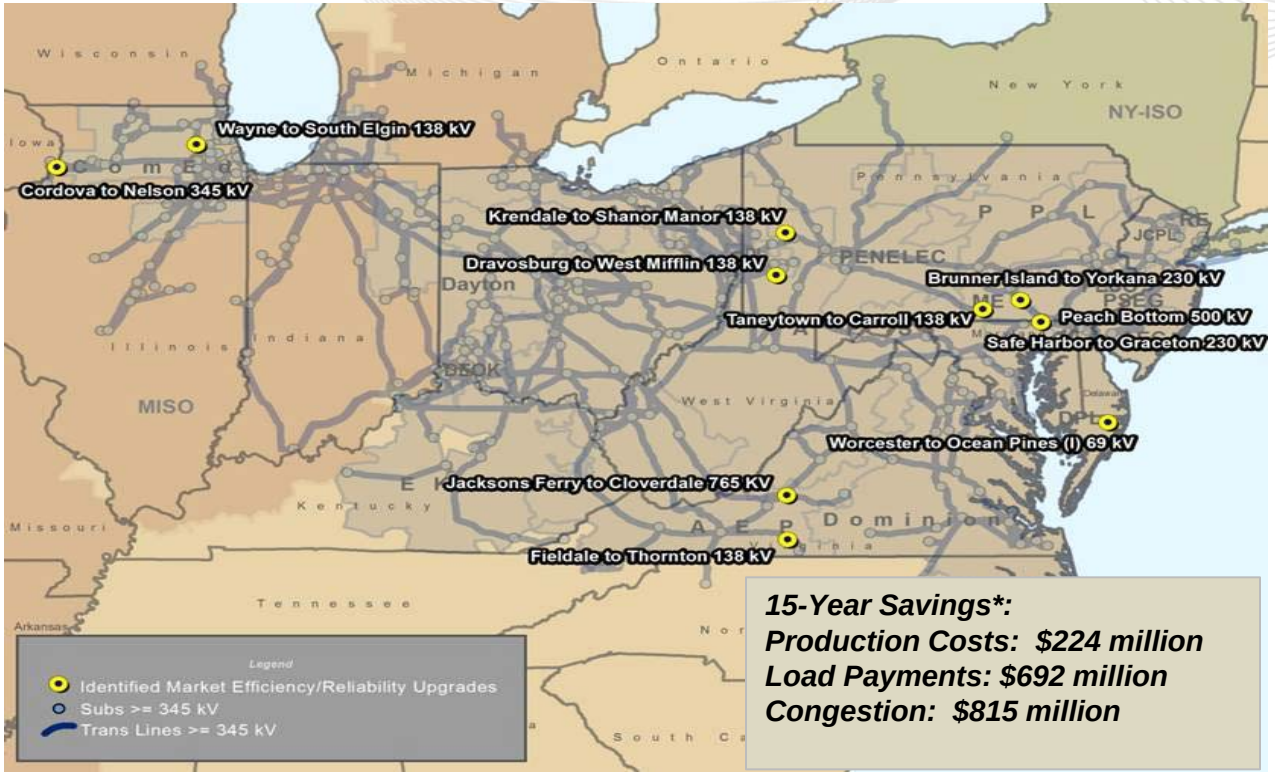
Total Cost **59.23**

Trend for Net Load Benefits of Recommended Projects



Not used in Actual B/C Evaluation

October Board Recommended Market Efficiency Projects



15-Year Savings*:
Production Costs: $224 million
Load Payments: $692 million
Congestion: $815 million

*Savings represent nominal value with assumptions of no additional RTEP upgrades

Summary: Recommended Projects

- Simulations were conducted to measure impact of all recommended projects simultaneously.
  - B/C Ratio = 15.6 with all upgrades included as one project
  - Projects continue to pass B/C test if include potential group 1 projects

- Order 1000 resulted in increased competition and market savings

- Recommended projects expected to provide following savings over a 15 year period*

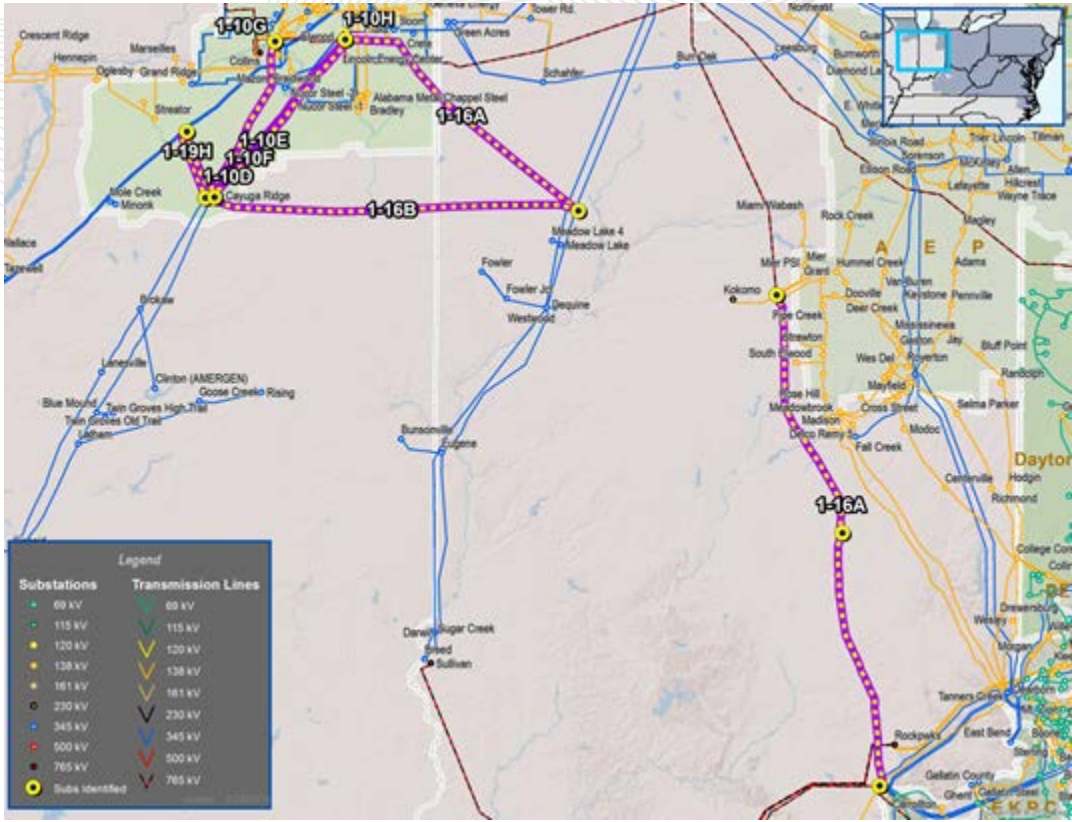
Production Costs: $224 million
Load Payments: $692 million
Congestion: $815 million

*Savings represent nominal value with assumptions of no additional RTEP upgrades

UNDER EVALUATION: Group 2: COMED - Loretto to Wilton Center

- 9 Projects:
  - 1-10C,1-10D,1-10E,1-10F,1-10G,1-10H, 1-16A,1-16B,1-19H
- Cost:
  - From $11.5M to $290M
- Constraints:
  - Loretto to Wilton CTR 345 kV

- 2018/2019 RPM BRA Results
  - COMED LDA binding with Loretto to Wilton CTR 345 kV as limiting CETL constraint



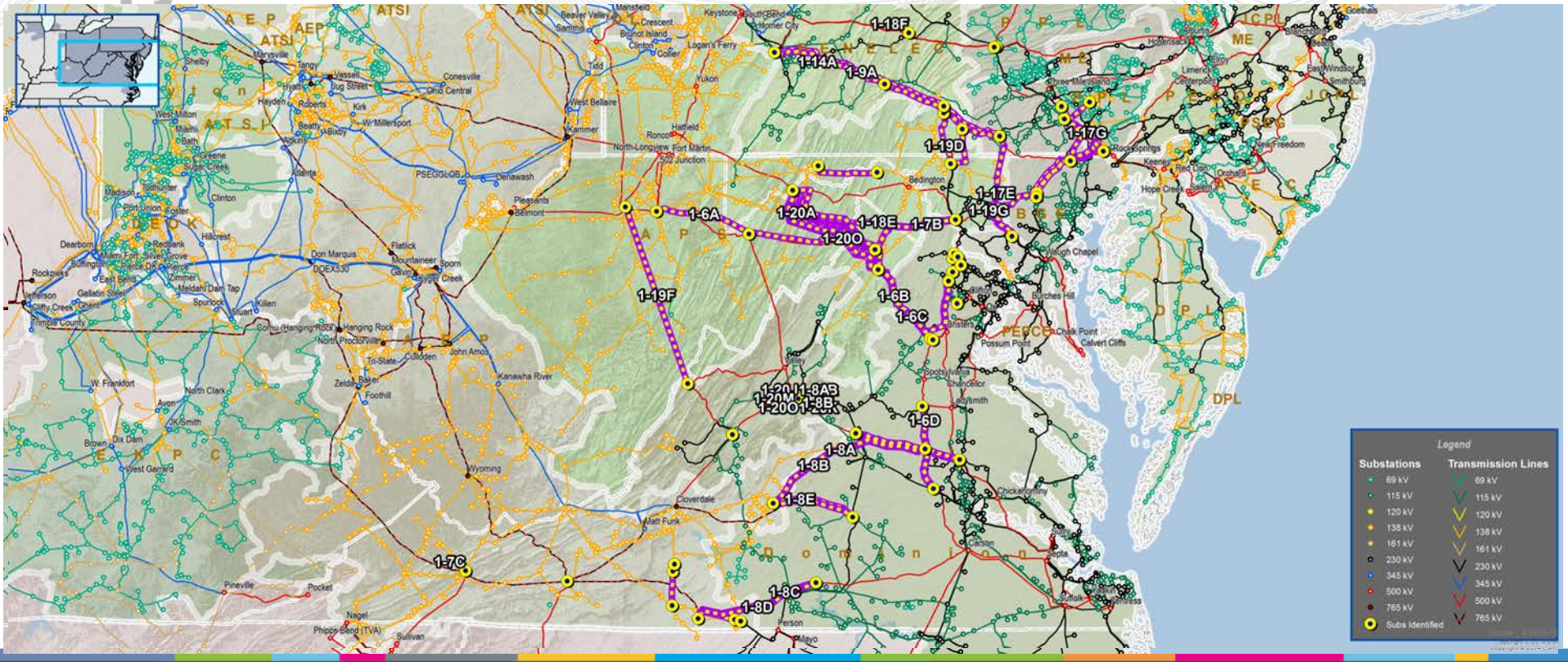
Group 2 Analysis

Project ID	Upgrade/ Greenfield	Cost ($M)	Target Zone	kV Level	ME Constraints Identified	Evaluation Type	B/C Ratio Base	B/C Ratio 2015 Sens.	Status
201415_1-10D	Upgrade	11.50	ComEd	345	Lorreto to Wilton CTR 345 kV	Lower Voltage	1.79	1.14	Not Recommended
201415_1-10F	Upgrade	14.00	ComEd	345	Lorreto to Wilton CTR 345 kV	Lower Voltage	1.38	0.79	Not Recommended
201415_1-16A	Greenfield	240.00	AEP/CE/NIPS	345	None Specified	Lower Voltage	0.04	N/A	Not Recommended
201415_1-16B	Greenfield	290.00	AEP/CE/NIPS	345	Lorreto to Wilton CTR 345 kV	Regional	0.14	N/A	Not Recommended
201415_1-10C	Greenfield	37.80	ComEd	345	Lorreto to Wilton CTR 345 kV	Lower Voltage	1.63	0.73	Not Recommended
201415_1-19H	Greenfield	42.90	Comed	345	Lorreto to Wilton CTR 345 kV	Lower Voltage	1.16	0.9	Not Recommended
201415_1-10E	Upgrade	17.40	ComEd	345	Lorreto to Wilton CTR 345 kV	Lower Voltage	1.17	0.93	Not Recommended
201415_1-10G	Upgrade	19.90	ComEd	345	Lorreto to Wilton CTR 345 kV	Lower Voltage	1.02	0.81	Not Recommended
201415_1-10H	Upgrade	25.90	ComEd	345	Lorreto to Wilton CTR 345 kV	Lower Voltage	0.78	0.62	Not Recommended

Projects will be evaluated to determine RPM Benefits

Project Evaluations
Group 1
(ApSouth/AEP-DOM Projects)

Group 1: ApSouth / AEP-DOM



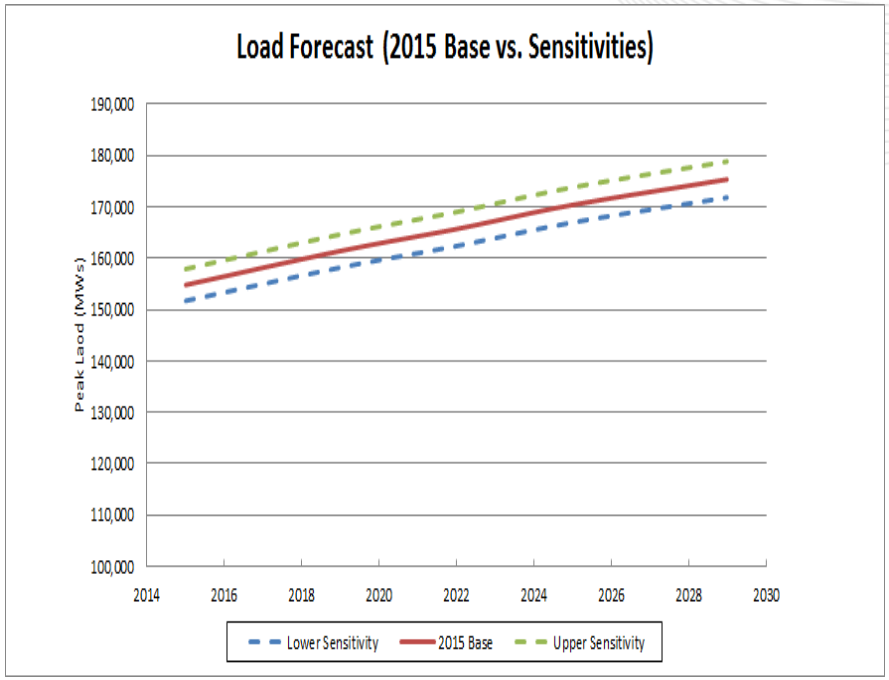
Group 1 Update: ApSouth/AEP-DOM

- PJM conducted ten different sensitivities on Group 1 projects that passed B/C test.
  - Fuel Price Sensitivity included an increase and decrease of $1/MMBtu.
  - Load Forecast Sensitivity included an increase and decrease of 2% of Load Forecast.
  - Interface Rating Sensitivity included changes in anticipated project impacts by 20%.
  - Combination of Fuel Price and Load Forecast Sensitivities.

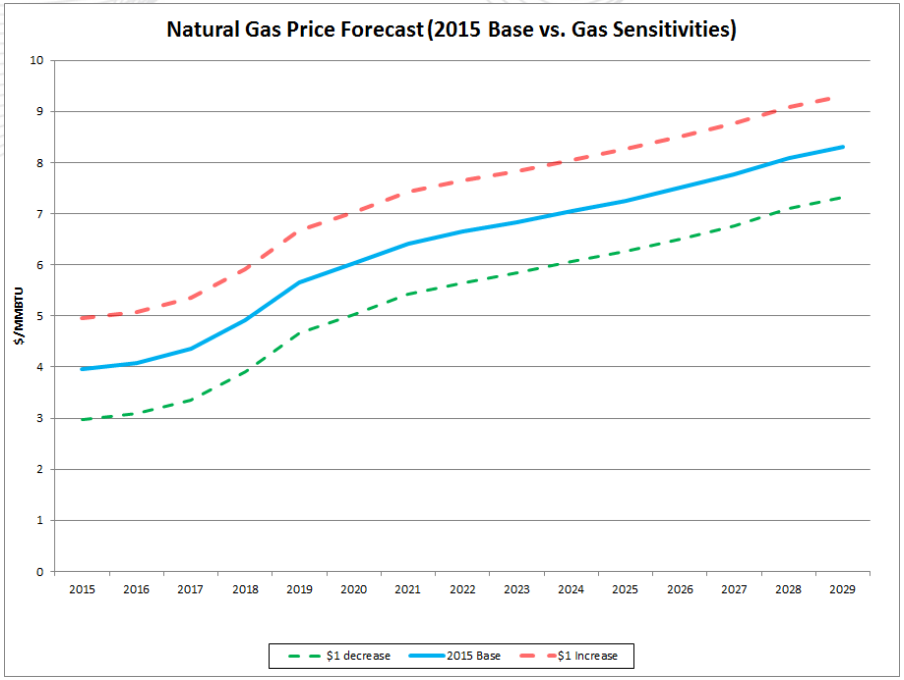
- Multiple Projects pass B/C test and address congestion driver(s)

- PJM to conduct analysis on the following:
  - Combination of components of multiple projects
  - Capacitors/Reactive device only projects
  - Incremental or multiple projects

Load Forecast Sensitivity



Gas Forecast Sensitivity



Benefit/Cost Ratios– All Sensitivities

Project Name	Company	Cost	In-service Date	Base with Recommended Groups 2-19 projects included	Gas price increase sensitivty	Gas price decrease sensitivty	Load increase sensitivty	Load decrease sensitivty	Interface rating increase sensitivty	Interface rating decrease sensitivty	Load decrease and Gas decrease	Load decrease and Gas increase	Load Increase and Gas decrease	Load Increase and Gas increase
201415_1-6B	Dominion	25.00	2019	1.94	1.48	1.82	2.02	1.97	2.53	1.70	2.00	1.86	1.73	1.54
201415_1-6C	Dominion	39.1	2019	4.64	4.05	3.46	5.05	4.60	5.55	3.57	4.35	5.31	4.44	4.35
201415_1-6D	Dominion	42.70	2019	2.42	2.93	2.67	3.06	2.64	2.74	2.02	2.77	2.66	3.05	3.12
201415_1-9A	DOM High Voltage/Transource	300.7	2020	2.64	2.09	3.39	3.02	2.56	2.70	2.56	3.21	2.14	3.73	2.24
201415_1-14A	DATC	51.53	2019	1.79	1.35	2.13	2.19	1.72	1.77	2.03	2.09	1.50	2.37	1.71
201415_1-17A	Nextera	16.5	2019	3.64	1.89	3.84	5.34	4.83	4.09	1.88	3.69	4.39	4.56	7.75
201415_1-17C	Nextera	15.7	2019	2.45	1.35	2.97	5.79	3.14	3.01	2.14	4.94	2.40	3.47	2.43
201415_1-18E	FirstEnergy	66.0	2019	1.71	1.92	1.60	1.93	2.08	2.53	1.24	1.87	2.11	1.72	1.91
201415_1-19B	LSPower	38.9	2020	4.07	2.68	2.82	4.08	3.47	4.17	3.07	2.34	2.14	2.12	1.24
201415_1-19C	LSPower	41.90	2020	5.66	5.49	3.67	6.17	4.02	6.63	3.47	5.47	3.57	6.53	1.92
201415_1-19G	LSPower	48.60	2020	2.76	1.82	4.17	4.13	2.81	2.40	2.68	3.68	2.61	4.75	2.52

Congestion Benefits: All Sensitivities

		Congestion Reductions ($million)							
		AEP-DOM		ApSouth		Interfaces		RTO Total	
Project ID	Project Costs	Average	STD Dev	Average	STD Dev	Average	STD Dev	Average	STD Dev
201415_1-6B	$25.0	-$3.3	$2.0	$13.5	$5.4	$26.5	$13.0	$26.2	$10.1
201415_1-6C	$39.1	-$2.4	$3.0	$92.3	$24.0	$79.1	$15.0	$79.8	$13.8
201415_1-6D	$42.7	-$3.0	$2.6	$55.9	$11.7	$68.5	$19.5	$66.4	$16.9
201415_1-9A	$300.7	$10.9	$1.9	$138.6	$29.5	$167.9	$39.0	$184.0	$15.7
201415_1-14A	$51.5	-$0.9	$2.3	$42.9	$11.0	$51.0	$13.7	$38.4	$12.5
201415_1-17A	$16.5	-$29.8	$13.0	$48.5	$10.9	$35.0	$8.3	$29.6	$7.8
201415_1-17C	$15.7	-$24.2	$11.4	$47.5	$12.8	$39.4	$12.0	$37.0	$10.2
201415_1-18E	$66.0	-$14.4	$7.5	$73.0	$26.6	$73.6	$28.1	$71.0	$20.5
201415_1-19B	$38.9	-$30.3	$13.9	$25.1	$8.0	$14.2	$7.0	$16.8	$6.6
201415_1-19C	$41.9	$6.0	$2.2	-$58.6	$16.7	-$33.4	$8.7	-$29.3	$10.3
201415_1-19G	$48.6	-$9.6	$4.3	$14.4	$5.8	$22.5	$12.1	$24.3	$9.8

*Congestion reductions represent 2019 + 2022 study years. Positive congestion reductions represents a benefit.

Appendix B includes details of all sensitivities

Project Evaluations: Group 1 Next Steps

- Reviews costs and in-service dates
- PJM to conduct analysis on the following:
  - Combination of components of multiple projects
  - Capacitors/Reactive device only projects
  - Incremental or multiple projects
- Determine project(s) that pass B/C test, address congestion driver(s), and provide greatest market benefits
- Reliability/Constructability Review
- Reduce/Recommend Project(s)

Market Efficiency Acceleration Analysis

Determine which reliability upgrades, if any, have an economic benefit if accelerated or modified.

- 2016 and 2020 set of economic input assumptions used to study impacts of approved RTEP projects
- Compare market congestion for near term vs. future topology

Acceleration Analysis: 2016 Load, Generation and Economic Assumptions

Constraints with a $5 million congestion reduction from 2020 model.

			2016 Input Assumptions				
			2016 Model		2020 Model		
Constraint Name	AREA	TYPE	Frequency (Hours)	Market Congestion ($ Millions)	Frequency (Hours)	Market Congestion ($ Millions)	Congestion Change ($ Millions)
Monticello to East Winamac 138 kV	M2M	LINE	2112	$78.8			-$78.8
Graceton to BAGLEY 230 kV	BGE	LINE	3663	$64.6			-$64.6
Oak Grove to MERCER5 161 kV	M2M	LINE	3294	$61.9			-$61.9
Cloverdale to Lexington 500 kV	AEP - DVP	LINE	306	$12.3			-$12.3
Hunterstown 230 kV	ME	XFMR	268	$10.4			-$10.4
WESTERN INTERFACE	PJM	INTERFACE	558	$10.2	73	$0.4	-$9.8
Woodville to 15USAP 138 kV	DLCO	LINE	356	$7.1	56	$0.4	-$6.7
Miami Fort to Willey 138 kV	DEO&K	LINE	101	$6.6			-$6.6
Staley North to Lafayette 138 kV	M2M	LINE	323	$6.0			-$6.0
AP SOUTH L/O BED-BLA	PJM	INTERFACE	1287	$66.2	1186	$61.1	-$5.0

Acceleration Analysis: 2020 Load, Generation and Economic Assumptions

Constraints with a $5 million congestion reduction from 2020 model.

			2020 Input Assumptions				
			2016 Model		2020 Model		
Constraint2	AREA	TYPE	Frequency (Hours)	Market Congestion ($ Millions)	Frequency (Hours)	Market Congestion ($ Millions)	Congestion Change ($ Millions)
Monticello to East Winamac 138 kV	M2M	LINE	2049	$131.7			-$131.7
Cloverdale to Lexington 500 kV	AEP - DVP	LINE	1248	$115.8			-$115.8
Oak Grove to MERCER5 161 kV	M2M	LINE	2741	$72.9			-$72.9
Graceton to BAGLEY 230 kV	BGE	LINE	3335	$58.3	1	$0.0	-$58.3
WESTERN INTERFACE	PJM	INTERFACE	681	$27.7	56	$0.6	-$27.1
Staley North to Lafayette 138 kV	M2M	LINE	454	$17.3			-$17.3
Hennepin to Hennepin 138 kV	M2M	LINE	704	$17.0	14	$0.6	-$16.4
Crescent 345 kV	DLCO	XFMR	38	$14.4			-$14.4
Hunterstown 230 kV	ME	XFMR	297	$12.7			-$12.7
Breed to Wheatland Power Facility 345 kV	M2M	LINE	404	$9.4			-$9.4
Kewanee to E D Edwards 138 kV	M2M	LINE	268	$7.7			-$7.7

Acceleration Analysis: Upgrades Responsible for Congestion Reduction

Constraint	AREA	TYPE	Upgrade Responsible for Congestion Reduction	ISD
AP SOUTH L/O BED-BLA	PJM	INTERFACE		
Breed to Wheatland Power Facility 345 kV	M2M	LINE	MISO MVP 2202: Brookston to Greentown 765	2018
Cloverdale to Lexington 500 kV	AEP - DVP	LINE	PJM RTEP B1797, B1660: Rebuild line and add 765 kV XFMR	2016
Crescent 345 kV	DLCO	XFMR	PJM S0168: Install a third 345/138 kV autotransformer at Crescent	2015
Graceton to BAGLEY 230 kV	BGE	LINE	PJM RTEP B1017: Rebuild Graceton - Bagley 230 kV as double circuit line using 1590 ACSR	2017
Hennepin to Hennepin 138 kV	M2M	LINE	PJM RTEP B2141: New Byron-Wayne 345 kV circuit	2017
Hunterstown 230 kV	ME	XFMR	PJM RTEP B2452: Install 2nd Hunterstown XFMR and reconductor Hunterstown- Oxford Line	2017
Kewanee to E D Edwards 138 kV	M2M	LINE	MISO MVP 1203: Brookings, SD - SE Twin Cities 345 kV	2015
Miami Fort to Willey 138 kV	DEO&K	LINE	PJM RTEP B2634: Convert Miami Fort 345 kV substation to a ring bus terminating Feeder 4504, TB 9 and TB10 in separate ring positions	2018
Monticello to East Winamac 138 kV	M2M	LINE	MISO MVP 3203: Reynolds to Burr Oak to Hiple 345 kV	2019
Oak Grove to MERCER5 161 kV	M2M	LINE	MISO MVP 3022: Fargo-Oak Grove 345 kV Line	2016
Staley North to Lafayette 138 kV	M2M	LINE	MISO Project: Reconductor Lafayette 230 to Staley	
WESTERN INTERFACE	PJM	INTERFACE		
Woodville to 15USAP 138 kV	DLCO	LINE	PJM S0168: Install a third 345/138 kV autotransformer at Crescent	2015

Projects responsible for congestion reductions are unlikely able to be accelerated

- Facilities are either external, ISD is in near future, or project scope too large to accelerate
- Update will be provided if any of facilities may be accelerated

Appendix A
Group 2-19
Recommended Projects Details

Recommended Project: 1-2A

Project ID: 201415_1-2A

Proposed by: PPL

Proposed Solution: Reconductor two spans of the Graceton-Safe Harbor 230kV transmission line. Includes termination point upgrades

kV Level: 230

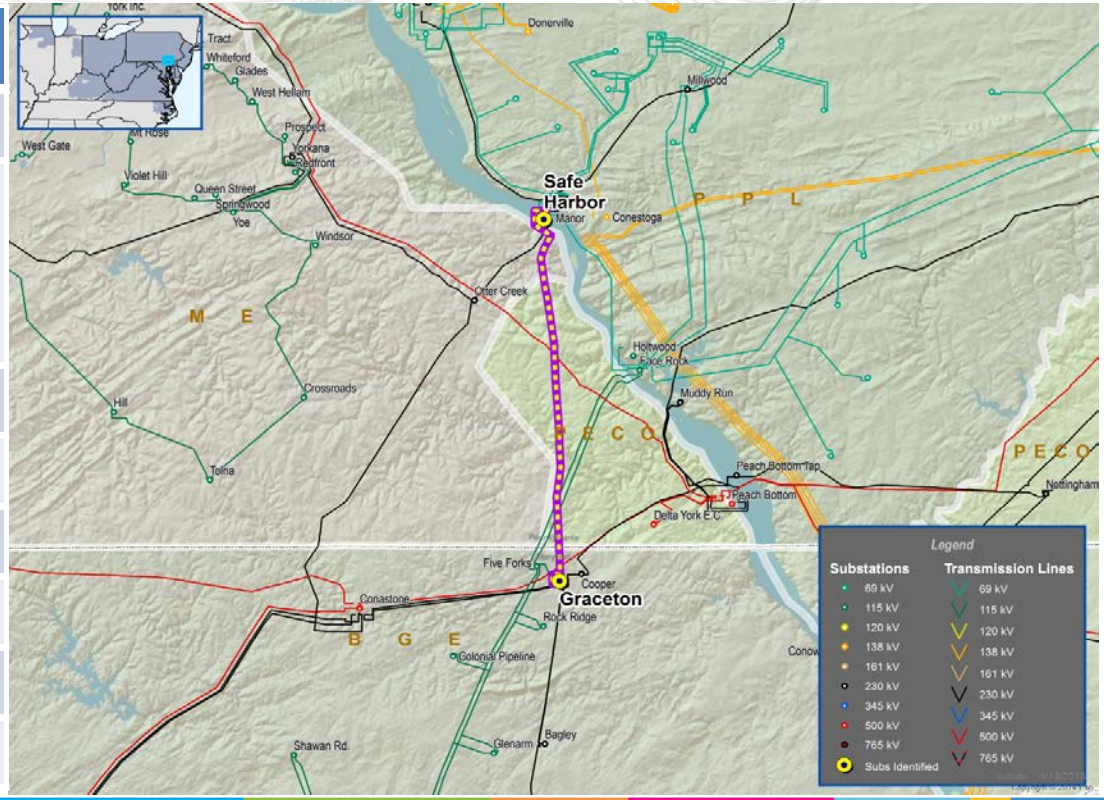
Cost ($M): 1.1

IS Date: 2019

Target Zone: PPL/BGE

ME Constraints: Safe Harbor to Graceton 230 kV

Notes: Recommended



Recommended Project: 1-2B

Project ID: 201415_1-2B

Proposed by: PPL

Proposed Solution: Reconductor three spans limiting the Brunner Island - Yorkana 230kV line, add 2 breakers to Brunner Island Switchyard, upgrade associated terminal equipment

kV Level: 230

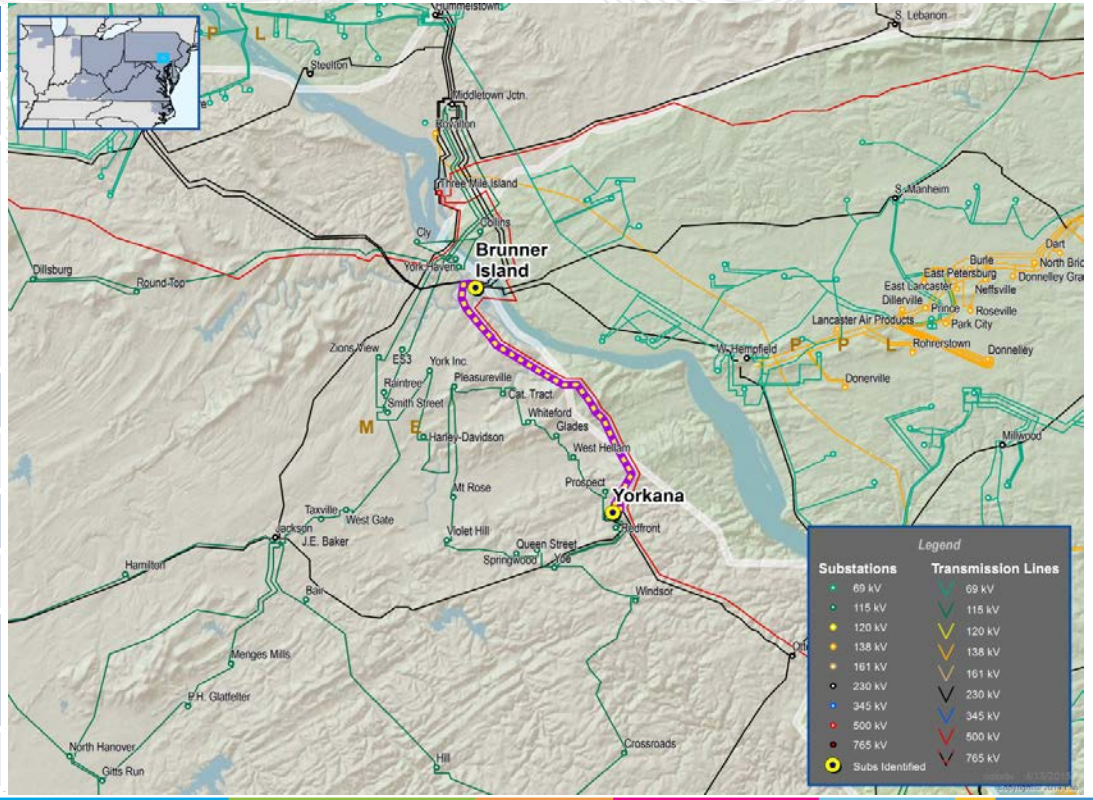
Cost ($M): 3.1

IS Date: 2019

Target Zone: PPL/Meted

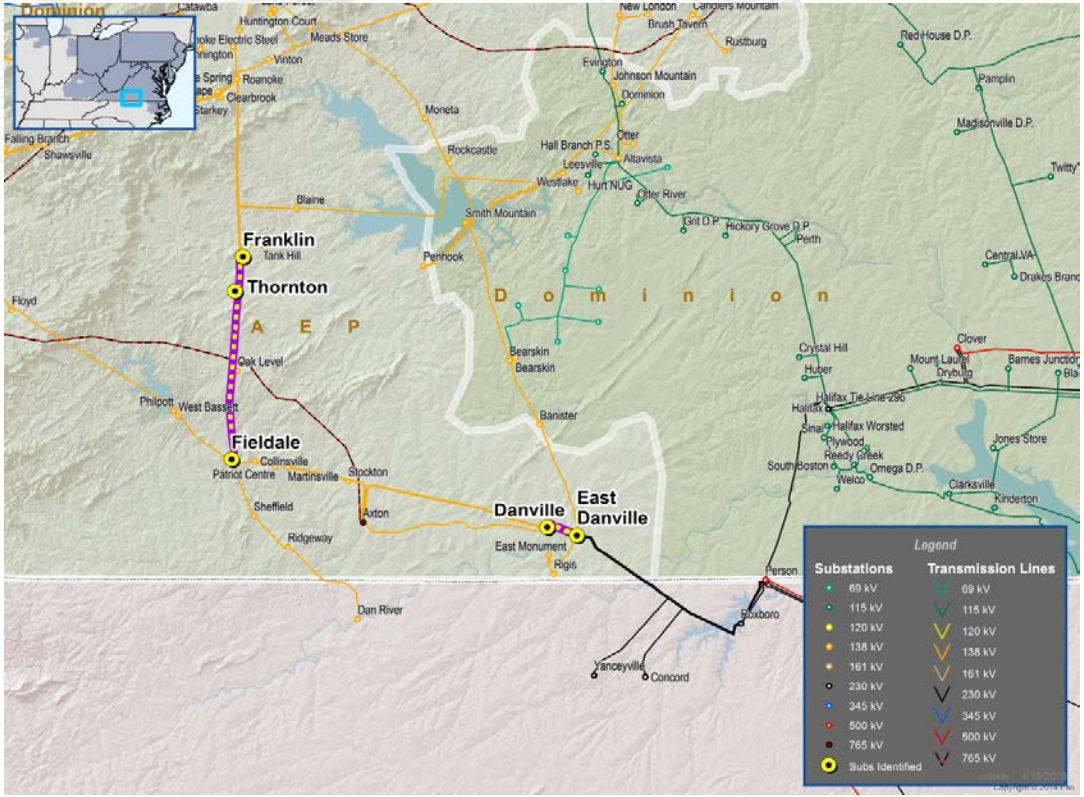
ME Constraints: Brunner Island to Yorkana 230 kV

Notes: Recommended



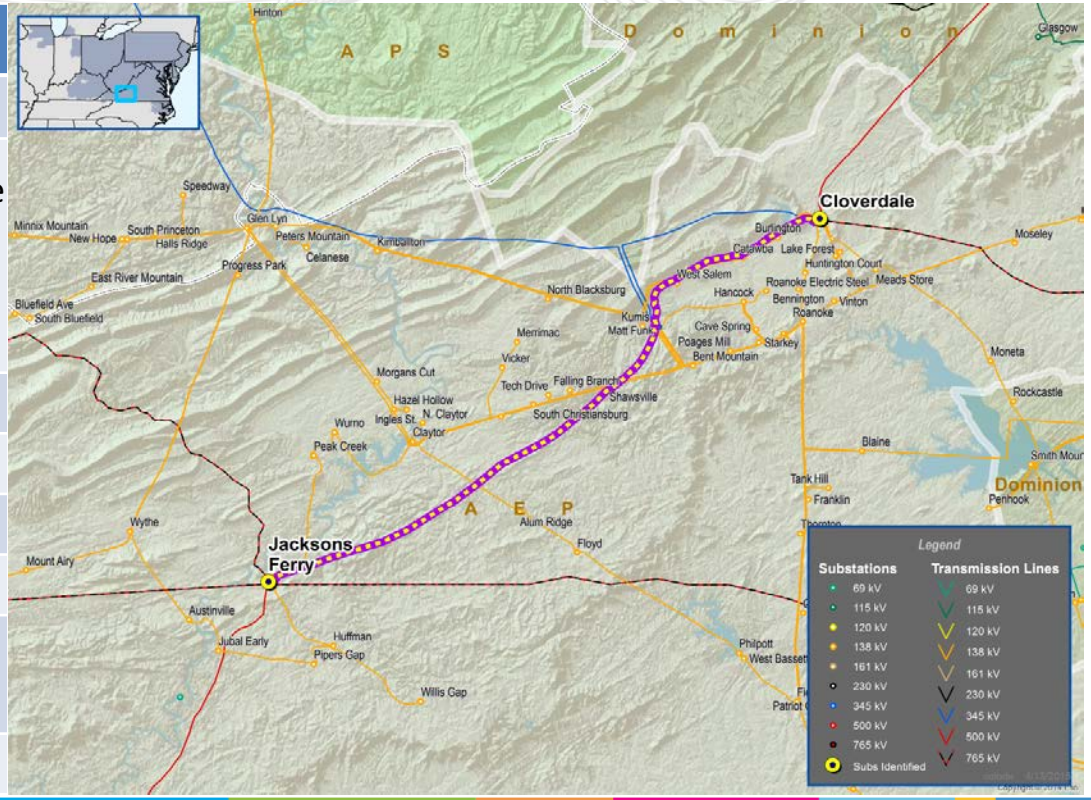
Recommended Project: 1-4I

Project ID: 201415_1-4I
Proposed by: AEP
Proposed Solution: Operate the Fieldale - Thornton - Franklin overhead at maximum operating temperature. Replace terminal equipment at Danville and East Danville substations.
kV Level: 138
Cost ($M): 0.75
IS Date: 2019
Target Zone: AEP
ME Constraints: Fieldale to Thornton 138 kV Danville to East Danville 138 kV
Notes: Recommended



Recommended Project: 1-4J

Project ID: 201415_1-4J
Proposed by: AEP
Proposed Solution: Replace relays at AEP's Cloverdale and Jackson's Ferry substation to improve the thermal capacity of Cloverdale - Jackson's Ferry 765 kV line
kV Level: 765
Cost ($M): 0.5
IS Date: 2019
Target Zone: AEP
ME Constraints: Jackson's Ferry to Cloverdale 765 KV
Notes: Recommended



Recommended Project: 1-10B

Project ID: 201415_1-10B

Proposed by: ComEd

Proposed Solution: Replace L7815 B phase line trap at Wayne substation

kV Level: 138

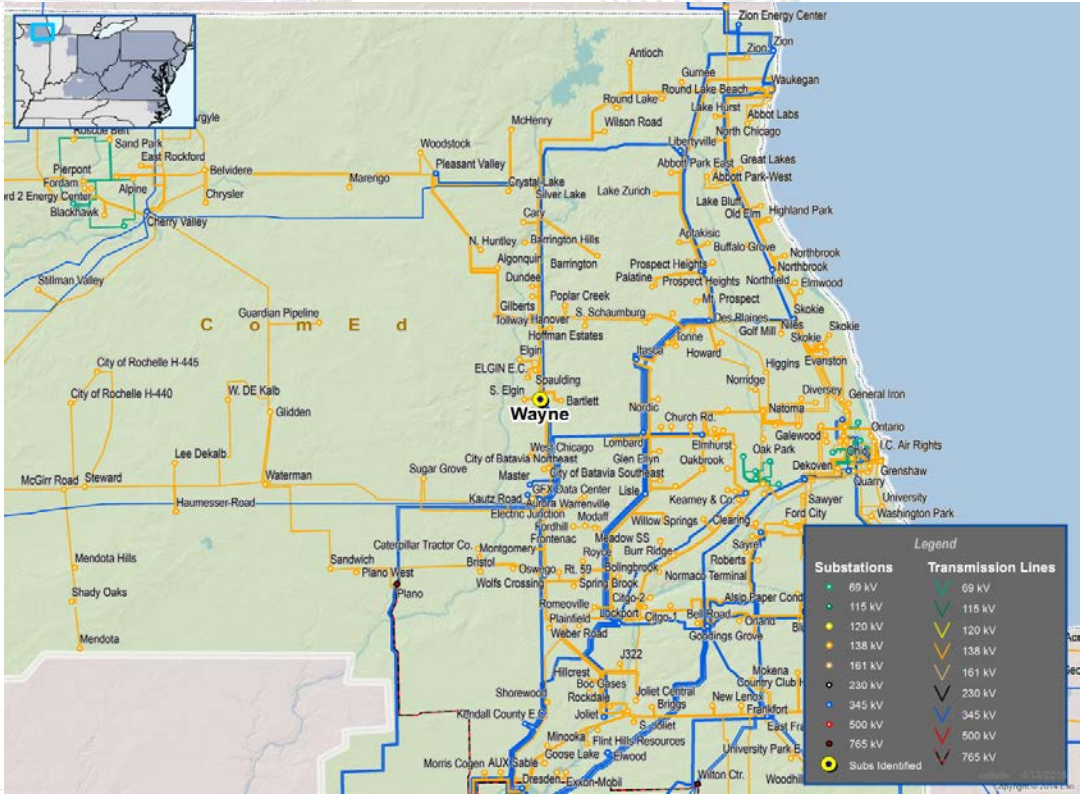
Cost ($M): 0.1

IS Date: 2019

Target Zone: ComEd

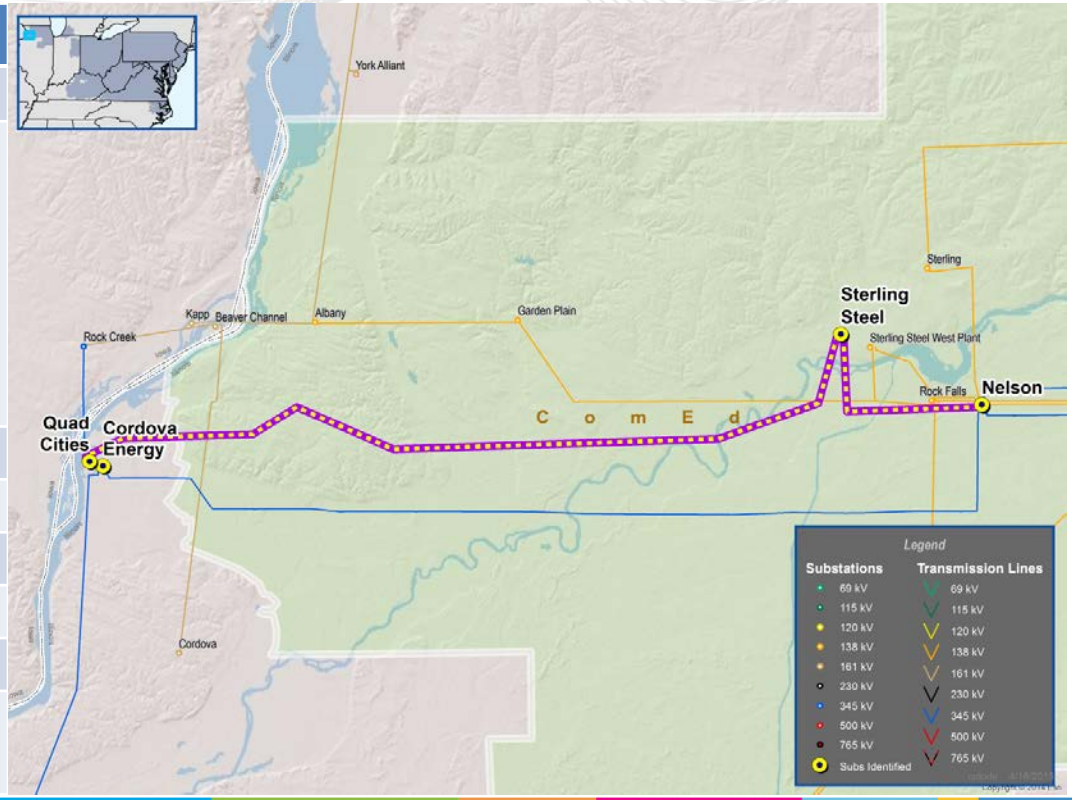
ME Constraints: Wayne to South Elgin 138 kV

Notes: Recommended



Recommended Project: 1-10J

Project ID: 201415_1-10J
Proposed by: ComEd
Proposed Solution: Replace station equipment at three stations and upgrade conductor rating of three lines by re-conductoring and mitigating sag limitations. NOTE: Component 1 of this project (s0704) is scheduled to complete on March 13, 2015
kV Level: 345
Cost ($M): 24.6
IS Date: 2019
Target Zone: ComEd
ME Constraints: Cordova to Nelson 345 kV
Notes: Recommended



Recommended Project: 1-11H

Project ID: 201415_1-11H

Proposed by: PECO

Proposed Solution: Increase ratings of Peach Bottom 500-230 kV transformer to 1479 MVA normal / 1839 MVA emergency

kV Level: 230

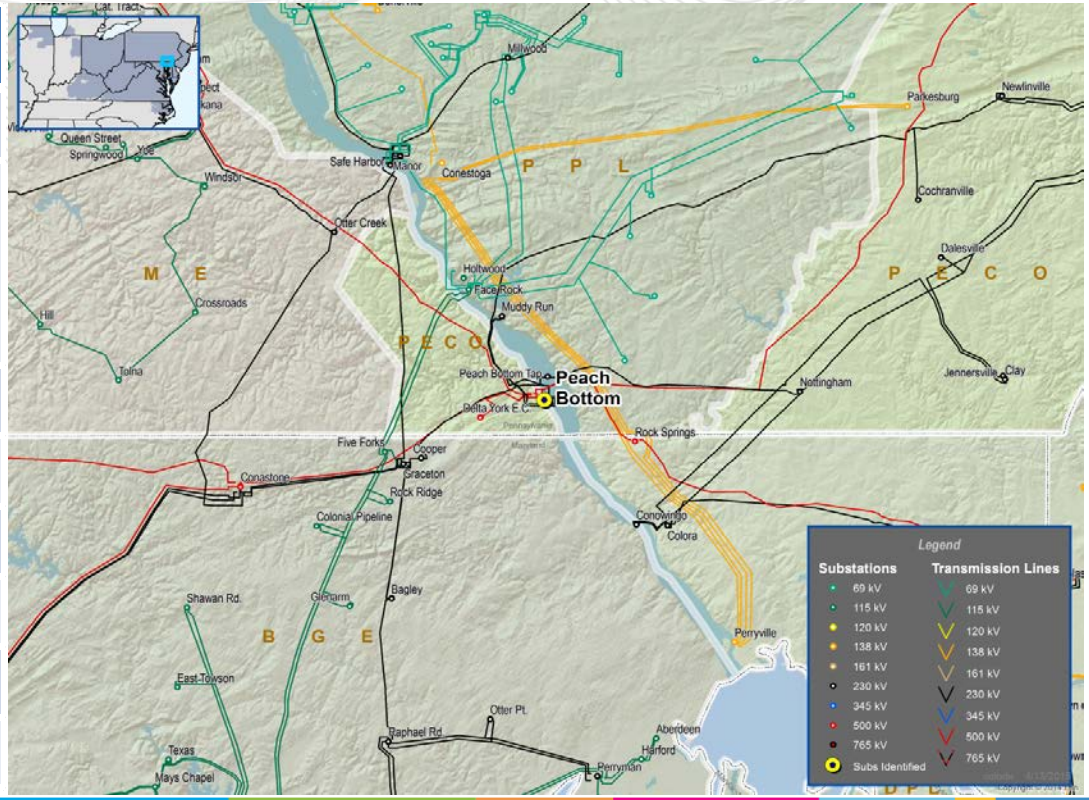
Cost ($M): 9.7

IS Date: 2019

Target Zone: PECO

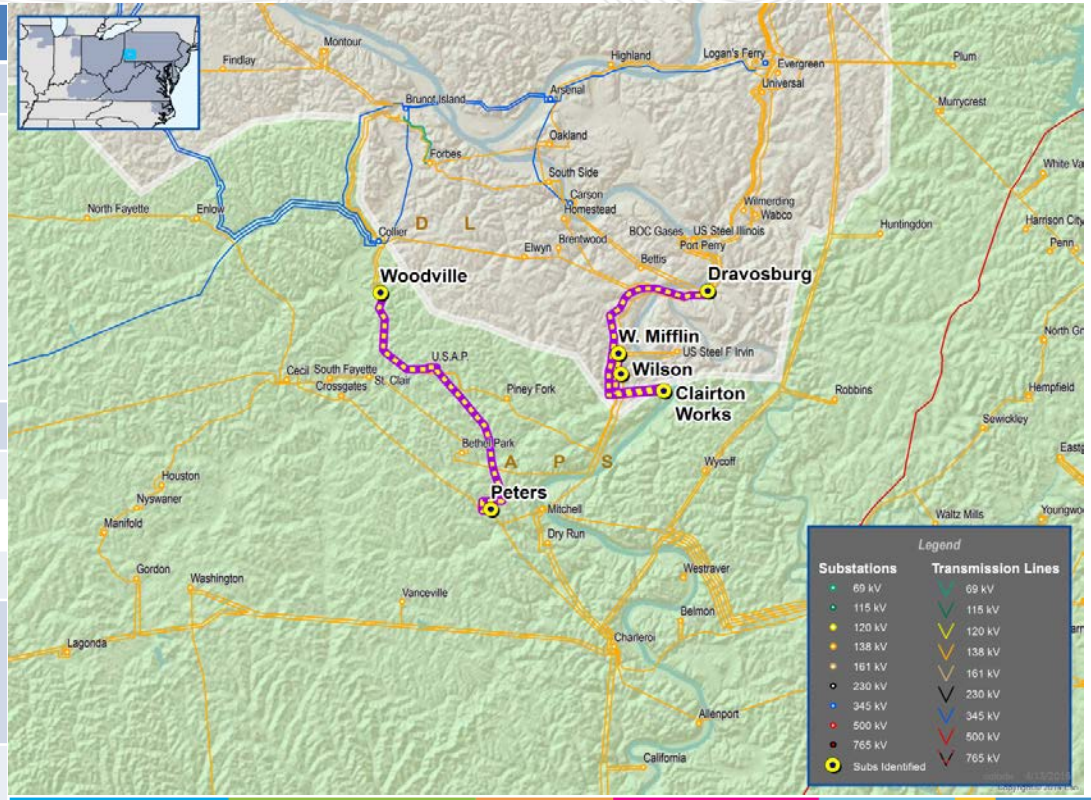
ME Constraints: Peach Bottom 500 kV

Notes: Recommended



Recommended Project: 1-12A

Project ID: 201415_1-12A
Proposed by: Duquesne Light
Proposed Solution: Reconductor approximately 7 miles of the Woodville-Peters (Z-117) 138kV circuit, reconfigure the West Mifflin-USS Clairton (Z-15) 138kV circuit to establish the Dravosburg-USS Clairton (Z-14) 138kV circuit and the West Mifflin-Wilson (Z-15) 138kV circuit
kV Level: 138
Cost ($M): 11.184
IS Date: 2018
Target Zone: DUQ
ME Constraints: Dravosburg to West Mifflin 138 kV Woodville to 15USAP 138 kV
Notes: Reduces overall PJM congestion. Recommended



Recommended Project: 1-13E

Project ID: 201415_1-13E

Proposed by: PHI

Proposed Solution: Rebuild Worcester - Ocean Pine 60 kV ckt 1 to 1400A capability summer emergency

kV Level: 69

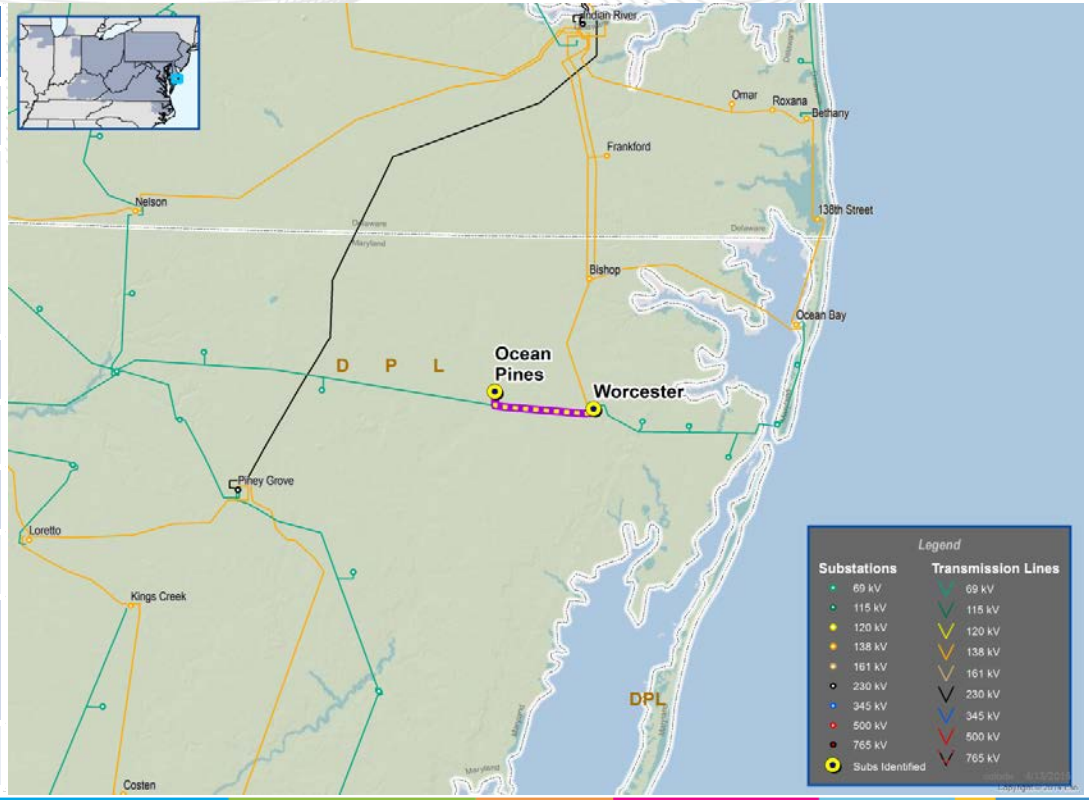
Cost ($M): 2.4

IS Date: 2016

Target Zone: DPL

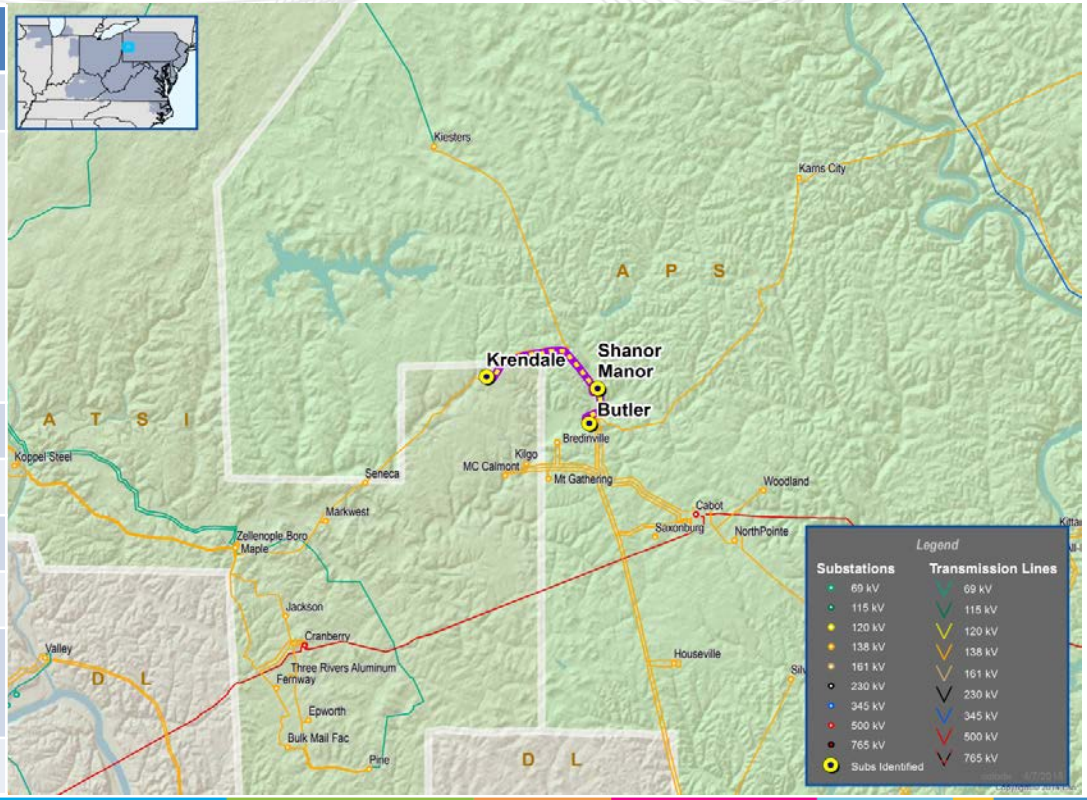
ME Constraints: Worcester to Ocean Pines (I) 69 kV

Notes: Recommended



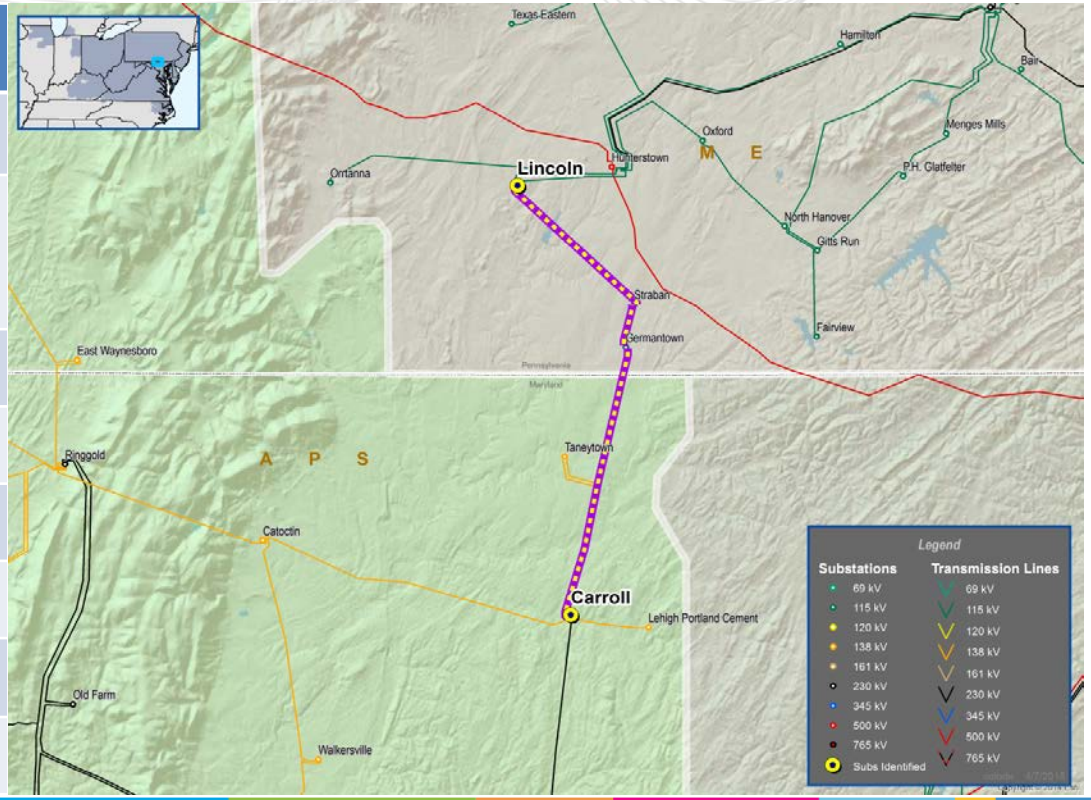
Recommended Project: 1-18I

Project ID: 201415_1-18I
Proposed by: FirstEnergy
Proposed Solution: Upgrade 138 kV substation equipment at Butler, Shanor Manor, and Krendale substations. New rating of the line will be 353 MVA summer normal and 422 MVA summer emergency
kV Level: 138
Cost ($M): 0.6
IS Date: 2019
Target Zone: APS/ATSI
ME Constraints: Krendale to Shanor Manor 138 kV
Notes: Recommended



Recommended Project: 1-18G

Project ID: 201415_1-18G
Proposed by: FirstEnergy
Proposed Solution: Upgrade terminal equipment on the Lincoln - Carroll 115/138kV path.
kV Level: 138
Cost ($M): 5.2
IS Date: 2019
Target Zone: APS/Meted
ME Constraints: Taneytown to Carroll 138 kV
Notes: Recommended



Appendix B
Updated Group 1 Results and Details
(ApSouth/AEP-DOM Projects)

Updated Group 1 Detailed Results – Congestion Reductions – AEP-DOM

Project	AEP-DOM Total Congestion Savings ($million)										
	Base	Gas Decrement	Gas Increment	Load Decrement	Load Increment	Interf Decrement	Interf Increment	Load Decrement Gas Decreme	Load Decrement Gas Increme	Load Increment Gas Decreme	Load Increment Gas Increme
201415_1-6B	$ (2.88)	$ (1.60)	$ (5.17)	$ (3.94)	$ (1.22)	$ (1.80)	$ (4.41)	$ (2.55)	$ (7.93)	$ (1.88)	$ (3.47)
201415_1-6C	$ (2.27)	$ 2.12	$ (5.10)	$ (3.48)	$ (1.55)	$ (0.38)	$ (3.00)	$ 0.18	$ (8.45)	$ 0.30	$ (5.31)
201415_1-6D	$ (2.50)	$ (0.17)	$ (5.70)	$ (3.79)	$ (1.67)	$ (2.09)	$ (1.47)	$ (0.91)	$ (8.91)	$ (1.21)	$ (4.81)
201415_1-9A	$ 10.92	$ 11.29	$ 15.19	$ 10.26	$ 9.20	$ 9.79	$ 12.67	$ 8.96	$ 12.49	$ 10.00	$ 9.57
201415_1-14A	$ 0.16	$ 1.66	$ (4.40)	$ (0.87)	$ 1.11	$ 0.54	$ (0.96)	$ (0.65)	$ (5.43)	$ 0.76	$ (2.08)
201415_1-17A	$ (28.21)	$ (13.83)	$ (50.61)	$ (32.38)	$ (24.35)	$ (20.62)	$ (35.99)	$ (14.11)	$ (49.10)	$ (19.04)	$ (39.67)
201415_1-17C	$ (20.76)	$ (10.89)	$ (39.61)	$ (25.56)	$ (19.66)	$ (15.56)	$ (27.53)	$ (11.77)	$ (44.27)	$ (15.17)	$ (35.50)
201415_1-18E	$ (13.04)	$ (5.83)	$ (22.76)	$ (16.27)	$ (10.87)	$ (7.02)	$ (19.36)	$ (6.00)	$ (27.97)	$ (8.81)	$ (20.47)
201415_1-19B	$ (28.73)	$ (12.87)	$ (51.01)	$ (30.26)	$ (25.34)	$ (20.95)	$ (34.48)	$ (14.79)	$ (54.39)	$ (19.11)	$ (41.64)
201415_1-19C	$ 5.95	$ 3.43	$ 9.42	$ 5.07	$ 4.89	$ 5.17	$ 7.12	$ 2.85	$ 9.49	$ 4.71	$ 7.81
201415_1-19G	$ (7.95)	$ (4.22)	$ (15.99)	$ (9.81)	$ (7.35)	$ (7.51)	$ (11.72)	$ (4.88)	$ (16.59)	$ (5.92)	$ (13.28)

*Congestion reductions represent 2019 + 2022 study years. Positive congestion reductions represents a benefit.

Updated Group 1 Detailed Results – Congestion Reductions – AP SOUTH

Project	AP South Total Congestion Savings ($million)										
	Base	Gas Decrement	Gas Increment	Load Decrement	Load Increment	Interf Decrement	Interf Increment	Load Decrement Gas Decreme	Load Decrement Gas Increme	Load Increment Gas Decreme	Load Increment Gas Increme
201415_1-6B	$ 10.95	$ 12.71	$ 16.59	$ 9.03	$ 11.40	$ 4.02	$ 19.05	$ 11.21	$ 24.33	$ 13.18	$ 15.62
201415_1-6C	$ 91.67	$ 65.27	$ 111.53	$ 91.12	$ 97.07	$ 64.85	$ 112.40	$ 62.70	$ 135.45	$ 72.38	$ 110.74
201415_1-6D	$ 52.58	$ 47.11	$ 66.01	$ 49.54	$ 58.77	$ 40.70	$ 64.28	$ 40.61	$ 75.28	$ 50.36	$ 69.44
201415_1-9A	$ 134.02	$ 103.69	$ 172.07	$ 129.45	$ 142.12	$ 122.19	$ 148.87	$ 98.49	$ 186.16	$ 112.31	$ 174.91
201415_1-14A	$ 37.40	$ 33.36	$ 55.25	$ 40.65	$ 49.56	$ 42.45	$ 35.67	$ 25.52	$ 58.82	$ 35.10	$ 57.65
201415_1-17A	$ 45.18	$ 37.67	$ 63.38	$ 45.90	$ 53.83	$ 36.18	$ 56.20	$ 32.20	$ 65.15	$ 43.94	$ 53.93
201415_1-17C	$ 42.49	$ 37.99	$ 59.00	$ 42.45	$ 49.54	$ 32.24	$ 52.68	$ 30.57	$ 71.16	$ 41.95	$ 62.13
201415_1-18E	$ 65.80	$ 53.03	$ 95.40	$ 65.11	$ 72.26	$ 30.72	$ 99.80	$ 47.45	$ 113.83	$ 56.11	$ 103.72
201415_1-19B	$ 19.04	$ 23.50	$ 31.54	$ 18.79	$ 28.58	$ 20.57	$ 20.68	$ 16.18	$ 44.14	$ 23.06	$ 30.23
201415_1-19C	$ (56.37)	$ (40.49)	$ (80.51)	$ (64.50)	$ (53.76)	$ (38.61)	$ (71.28)	$ (37.47)	$ (69.12)	$ (47.30)	$ (84.80)
201415_1-19G	$ 7.87	$ 15.75	$ 20.17	$ 8.71	$ 14.23	$ 6.93	$ 13.04	$ 12.20	$ 26.94	$ 15.21	$ 17.67

*Congestion reductions represent 2019 + 2022 study years. Positive congestion reductions represents a benefit.

Updated Group 1 Detailed Results – Congestion Reductions – Interfaces

Project	Interfaces Total Congestion Savings ($million)										
	Base	Gas Decrement	Gas Increment	Load Decrement	Load Increment	Interf Decrement	Interf Increment	Load Decrement Gas Decreme	Load Decrement Gas Increme	Load Increment Gas Decreme	Load Increment Gas Increme
201415_1-6B	$ 24.03	$ 14.27	$ 43.01	$ 21.33	$ 23.00	$ 18.91	$ 30.33	$ 11.43	$ 50.60	$ 14.41	$ 40.49
201415_1-6C	$ 79.33	$ 64.92	$ 86.23	$ 79.74	$ 85.15	$ 57.23	$ 97.66	$ 60.31	$ 104.91	$ 70.39	$ 84.69
201415_1-6D	$ 64.81	$ 49.47	$ 91.29	$ 60.21	$ 69.84	$ 53.28	$ 77.85	$ 42.43	$ 99.52	$ 51.95	$ 93.21
201415_1-9A	$ 163.57	$ 122.25	$ 218.32	$ 158.54	$ 167.18	$ 149.63	$ 179.64	$ 115.54	$ 229.86	$ 129.98	$ 212.88
201415_1-14A	$ 44.49	$ 39.71	$ 67.00	$ 46.83	$ 58.27	$ 56.08	$ 38.62	$ 30.38	$ 69.90	$ 40.90	$ 68.89
201415_1-17A	$ 32.82	$ 28.22	$ 43.70	$ 29.37	$ 42.58	$ 31.32	$ 36.49	$ 21.49	$ 48.98	$ 28.50	$ 41.08
201415_1-17C	$ 37.47	$ 30.23	$ 50.77	$ 32.85	$ 42.38	$ 31.32	$ 41.56	$ 21.86	$ 60.32	$ 29.72	$ 55.37
201415_1-18E	$ 66.99	$ 49.62	$ 102.32	$ 63.92	$ 74.85	$ 38.83	$ 93.47	$ 42.69	$ 117.06	$ 49.65	$ 109.90
201415_1-19B	$ 9.89	$ 16.75	$ 15.32	$ 7.95	$ 18.74	$ 19.05	$ 4.84	$ 7.04	$ 26.95	$ 8.79	$ 21.03
201415_1-19C	$ (29.65)	$ (29.89)	$ (38.63)	$ (39.65)	$ (31.47)	$ (16.76)	$ (42.90)	$ (27.45)	$ (27.41)	$ (35.59)	$ (48.24)
201415_1-19G	$ 17.71	$ 15.15	$ 38.48	$ 15.69	$ 20.71	$ 15.34	$ 19.69	$ 10.50	$ 47.08	$ 12.21	$ 35.07

*Congestion reductions represent 2019 + 2022 study years. Positive congestion reductions represents a benefit.

Updated Group 1 Detailed Results – Congestion Reductions – Total RTO

Project	RTO Total Congestion Savings ($million)										
	Base	Gas Decrement	Gas Increment	Load Decrement	Load Increment	Interf Decrement	Interf Increment	Load Decrement Gas Decreme	Load Decrement Gas Increme	Load Increment Gas Decreme	Load Increment Gas Increme
201415_1-6B	$ 23.80	$ 18.19	$ 39.18	$ 21.25	$ 23.90	$ 18.51	$ 30.41	$ 14.97	$ 45.87	$ 16.80	$ 35.18
201415_1-6C	$ 82.35	$ 66.85	$ 84.44	$ 81.60	$ 85.69	$ 61.16	$ 99.99	$ 63.26	$ 103.21	$ 70.45	$ 79.15
201415_1-6D	$ 63.31	$ 49.87	$ 87.07	$ 58.51	$ 68.88	$ 52.90	$ 74.24	$ 43.68	$ 92.23	$ 51.75	$ 87.53
201415_1-9A	$ 174.41	$ 177.13	$ 201.02	$ 166.14	$ 181.39	$ 161.55	$ 189.57	$ 173.61	$ 213.68	$ 187.87	$ 197.53
201415_1-14A	$ 33.48	$ 27.35	$ 50.66	$ 33.12	$ 47.61	$ 43.94	$ 28.38	$ 19.84	$ 54.01	$ 27.59	$ 56.34
201415_1-17A	$ 30.97	$ 27.42	$ 41.78	$ 26.18	$ 41.25	$ 29.38	$ 36.11	$ 22.42	$ 26.72	$ 27.01	$ 15.82
201415_1-17C	$ 35.62	$ 30.39	$ 46.63	$ 29.16	$ 41.24	$ 29.12	$ 39.12	$ 22.00	$ 53.31	$ 29.36	$ 51.11
201415_1-18E	$ 68.03	$ 56.19	$ 91.54	$ 62.38	$ 72.21	$ 42.07	$ 93.31	$ 49.95	$ 101.78	$ 52.40	$ 91.42
201415_1-19B	$ 11.44	$ 26.89	$ 15.37	$ 6.88	$ 19.05	$ 19.47	$ 6.60	$ 15.96	$ 24.81	$ 17.12	$ 21.12
201415_1-19C	$ (25.91)	$ (19.14)	$ (38.25)	$ (38.91)	$ (28.75)	$ (14.16)	$ (39.07)	$ (18.52)	$ (25.91)	$ (26.90)	$ (46.88)
201415_1-19G	$ 17.15	$ 24.00	$ 37.26	$ 14.84	$ 22.50	$ 14.53	$ 18.81	$ 19.58	$ 44.67	$ 21.04	$ 33.31

*Congestion reductions represent 2019 + 2022 study years. Positive congestion reductions represents a benefit.

Project ID: 201415_1-6B

Proposed by: Dominion

Proposed Solution: Build one 500kV Thyristor Controlled Series Capacitors (TCSC) at Loudoun substation on the Loudoun - Meadowbrook line to reduce congestion on AP South and other PJM interfaces

kV Level: 500

Cost ($M): 25

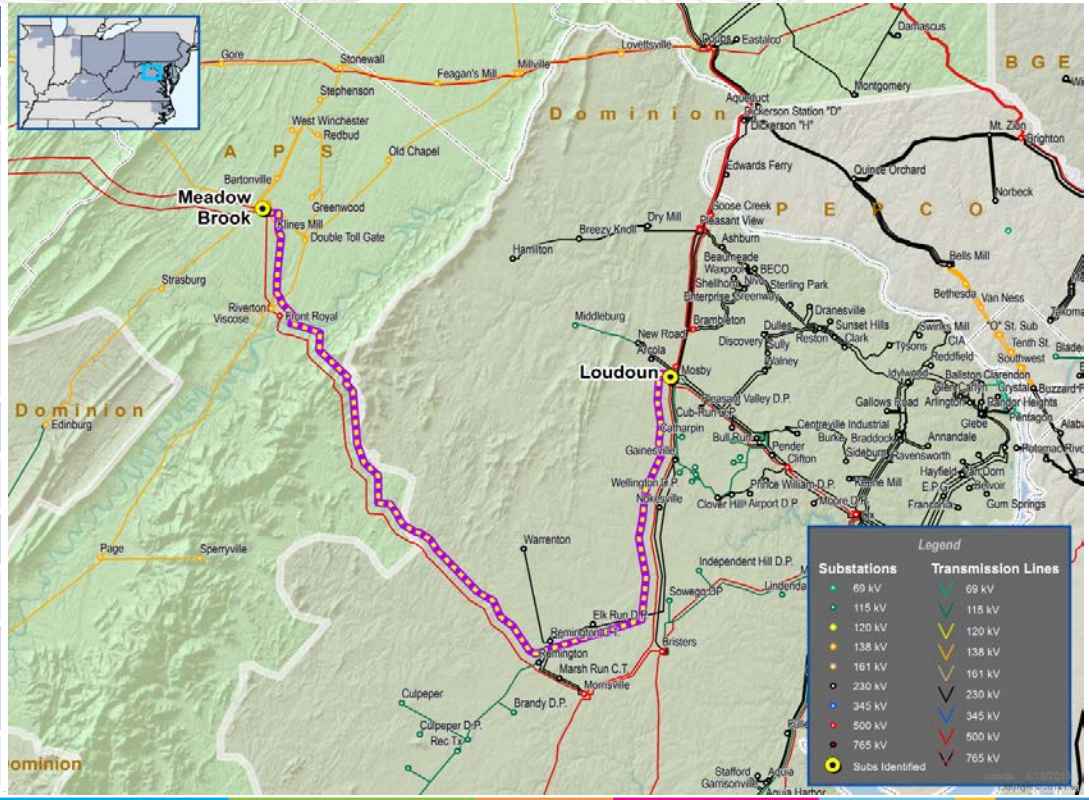
IS Date: 2019

Target Zone: Dominion

ME Constraints: AP SOUTH L/O BED-BLA

Other Interfaces

Notes:



Project ID: 201415_1-6C

Proposed by: Dominion

Proposed Solution: Build one 500kV Thyristor Controlled Series Capacitor (TCSC) at Loudoun substation on the Loudoun - Meadowbrook (535) line and build five (5) 230 kV capacitor banks at five (5) DVP substations to alleviate congestion on AP South and other PJM interfaces

kV Level: 500

Cost ($M): 39.06

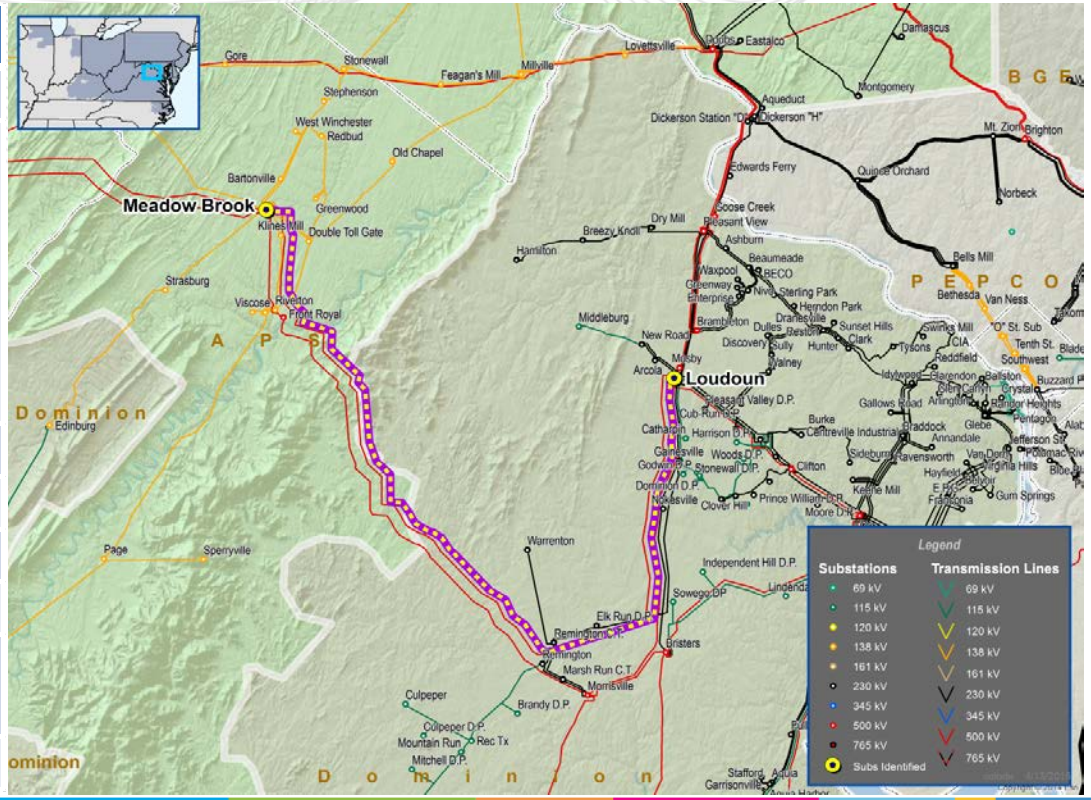
IS Date: 2019

Target Zone: Dominion

ME Constraints: AP SOUTH L/O BED-BLA

Other Interfaces

Notes:



Project ID: 201415_1-6D

Proposed by: Dominion

Proposed Solution: Build a new 500kV station (Palmyra) by connecting at the intersection of two (2) 500kV lines of North Anna - Midlothian 500kV line and Cunningham - Elmont 500kV line and build five (5) capacitor banks in DVP zone to alleviate AP South and AEP-DOM congestions

kV Level: 500

Cost ($M): 42.7

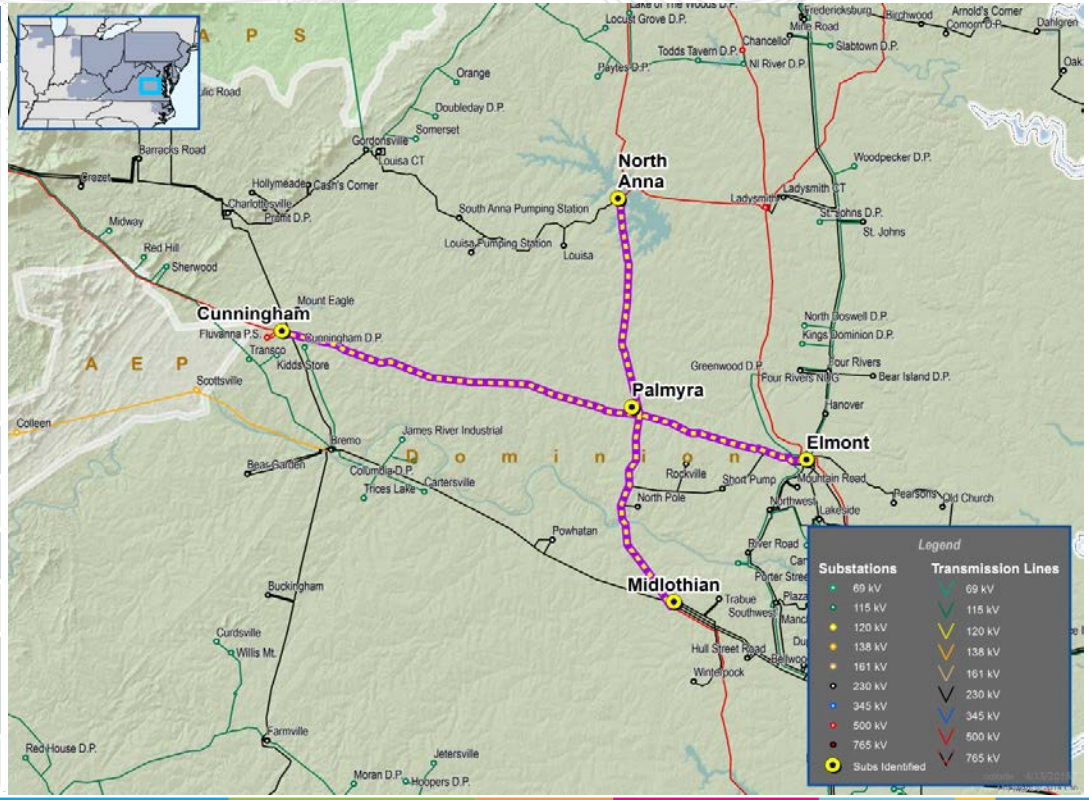
IS Date: 2019

Target Zone: Dominion

ME Constraints: AP SOUTH L/O BED-BLA

Other Interfaces

Notes:



Project ID: 1-9A

Proposed by: Dominion / Transource

Proposed Solution: Tap the Conemaugh - Hunterstown 500 kV line and build new 230 kV double circuit line between Rice and Ringgold. Build new 230 kV double circuit line between Furnace Run and Conastone. Add cap banks to Jackson's Ferry, Broadford, Lexington, Dooms, Ashburn and Brambleton stations. Rebuild the Conastone - Northwest 230 kV line.

kV Level: 230

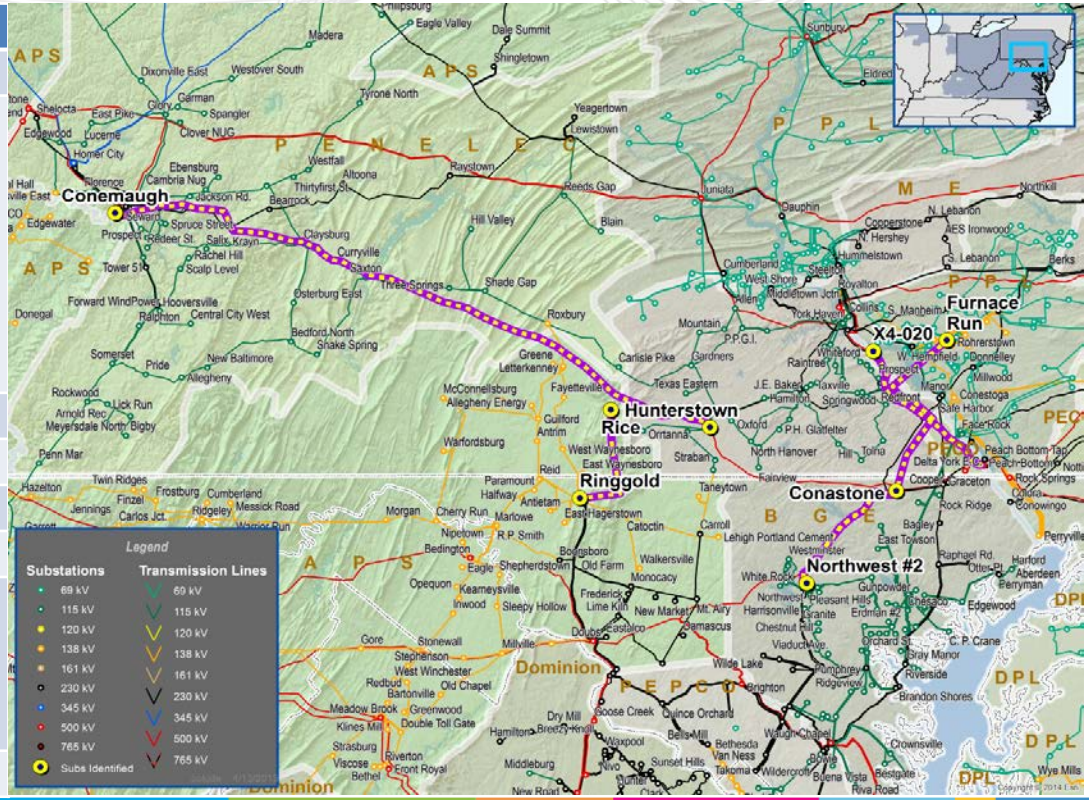
Cost ($M): 269

IS Date: 2020

Target Zone: PECO/Dominion/AEP

ME Constraints: AP SOUTH L/O BED-BLA, Brunner Island to Yorkana 230 kV, Taneytown to Carroll 138 kV, Safe Harbor to Graceton 230 kV, Conastone to Northwest 230 kV

Notes:



Project ID: 201415_1-14A

Proposed by: DATC

Proposed Solution: A hybrid series capacitor and thyristor controlled series capacitor near the midpoint of Conemaugh to Hunterstown 500 kV line in southern Pennsylvania. Add a phase angle regulator on the Messick to Morgan 138 kV line and close the circuit in Maryland.

kV Level: 500

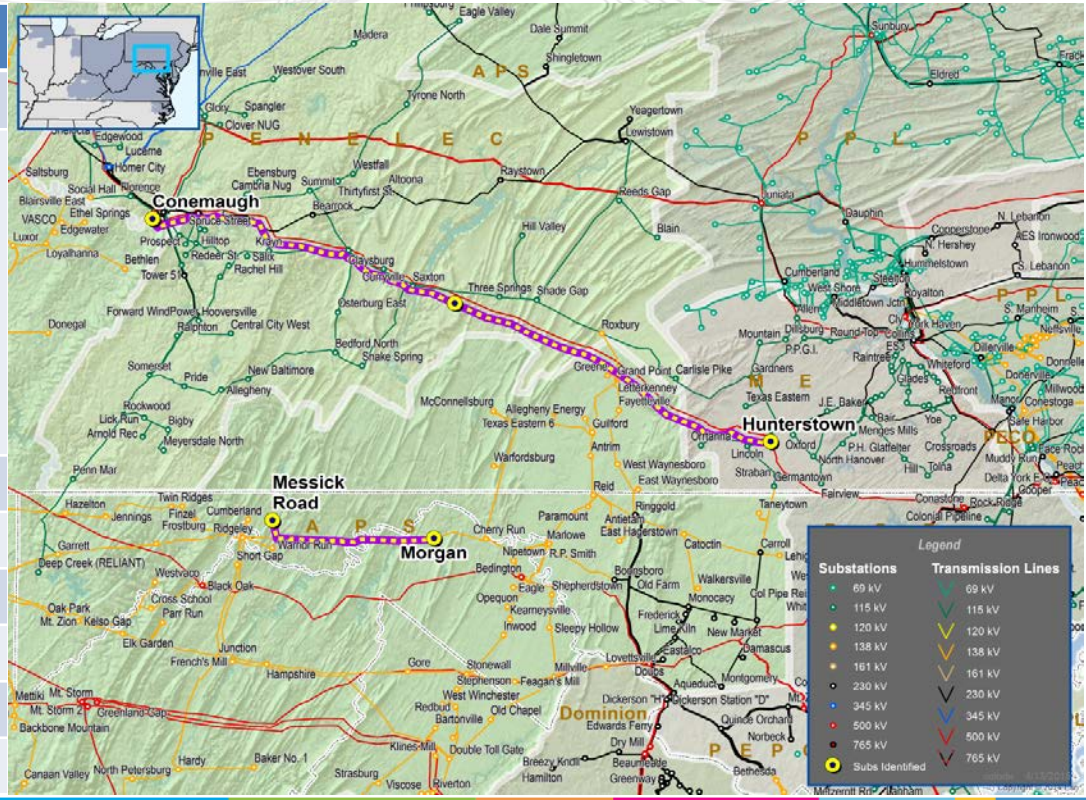
Cost ($M): 47.14: 51.53(Escalated for 2019)

IS Date: 2019

Target Zone: PECO/Meted/APS

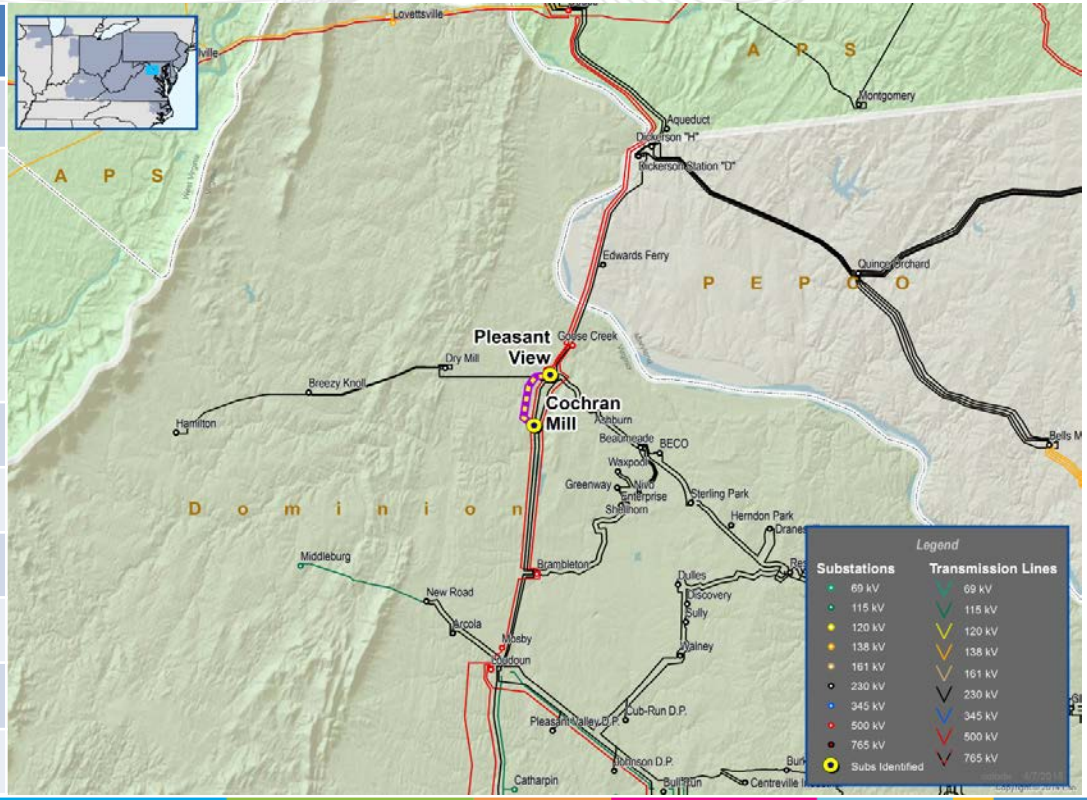
ME Constraints: AP SOUTH L/O BED-BLA

Notes:

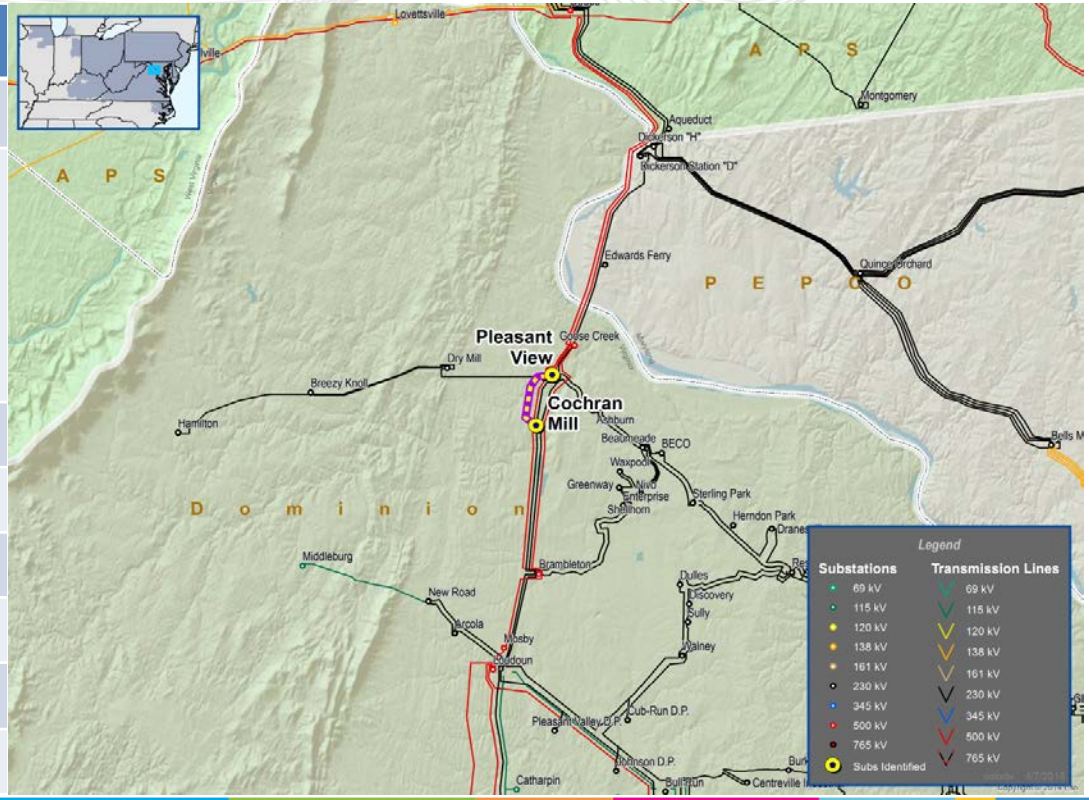


1-17A

Project ID: 201415_1-17A
Proposed by: Nextera
Proposed Solution: Build new Cochran Mill 230 kV switchyard with 600 MVAR Capacitors, and a new 230 kV line from Cochran Mill - Pleasant View 230 kV
kV Level: 230
Cost ($M): 16.5
IS Date: 2019
Target Zone: Dominion
ME Constraints: AP SOUTH L/O BED-BLA
Notes:

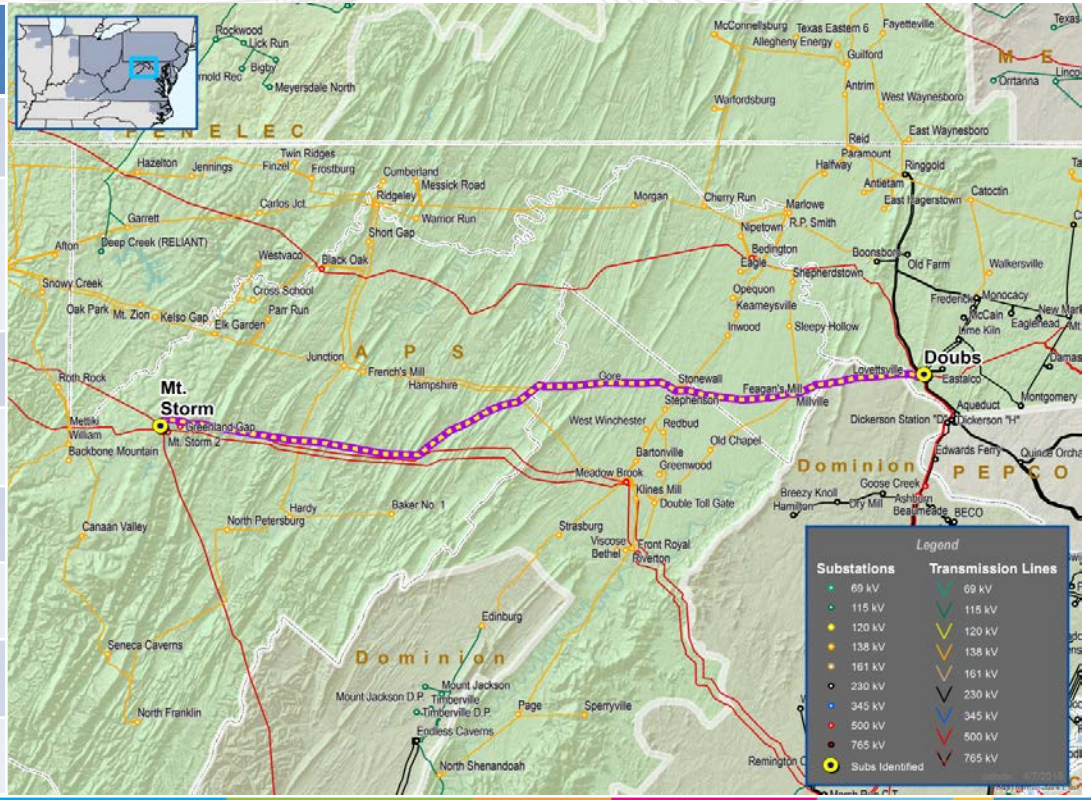


Project ID: 201415_1-17C
Proposed by: Nextera
Proposed Solution: Build new Cochran Mill 230 kV switchyard with 400 MVAR Capacitors, and a new 230 kV line from Cochran Mill - Pleasant View 230 kV
kV Level: 230
Cost ($M): 15.7
IS Date: 2019
Target Zone: Dominion
ME Constraints: AP SOUTH L/O BED-BLA
Notes:

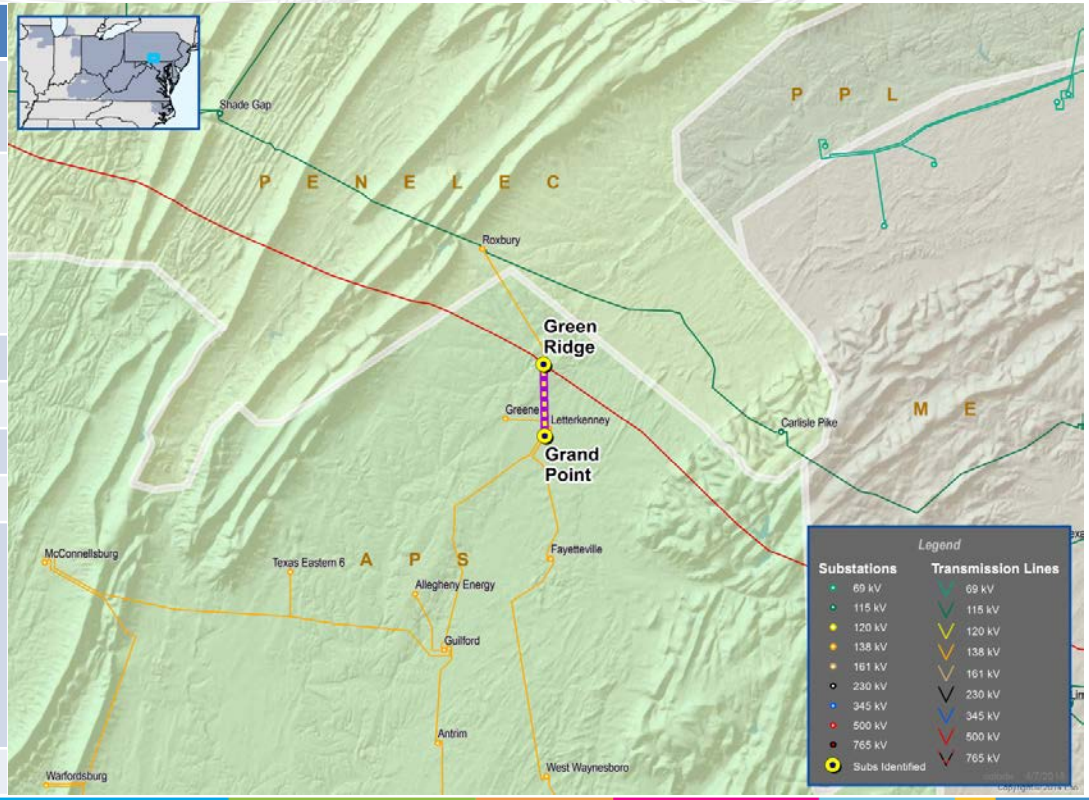


1-18E

Project ID: 201415_1-18E
Proposed by: FirstEnergy
Proposed Solution: Install series capacitors on the Doubs-Mt. Storm 500 kV line
kV Level: 500
Cost ($M): 66
IS Date: 2019
Target Zone: Dominion/APS
ME Constraints: AP SOUTH L/O BED-BLA
Notes:



Project ID: 201415_1-19B
Proposed by: Northeast Transmission Development
Proposed Solution: Approximately 6-mile 138 kV Line from Grand Point to a new 500/138 kV substation on the Conemaugh-Hunterstown 500 kV Line ("Green Ridge")
kV Level: 138
Cost ($M): 38.9
IS Date: 2020
Target Zone: Meted/Penelec
ME Constraints: AP SOUTH L/O BED-BLA BED-BLA L/O MTS-DOU Taneytown to Carroll 138 kV Conastone to Northwest 230 kV Peach Bottom 500 kV
Notes:



Project ID: 201415_1-19C

Proposed by: Northeast Transmission Development

Proposed Solution: Approximately 6-mile 138 kV Line from Grand Point to a new 500/138 kV substation on the Conemaugh-Hunterstown 500 kV Line ("Green Ridge") with a series reactor at Green Ridge.

kV Level: 138

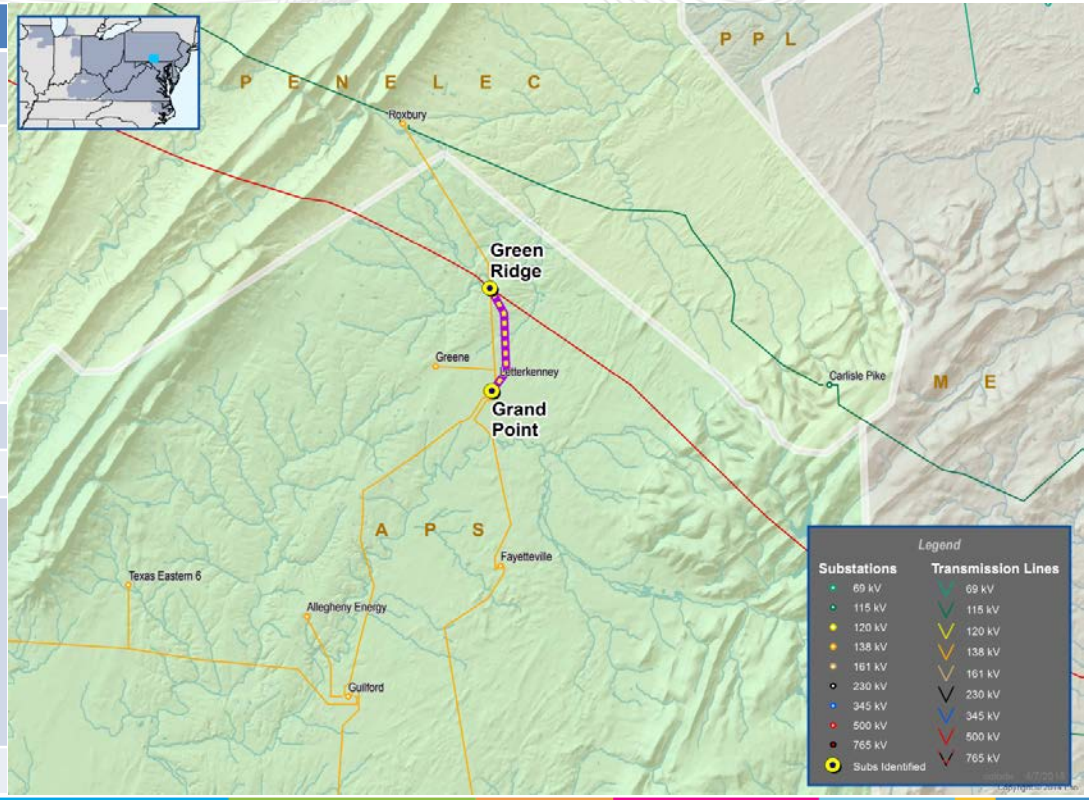
Cost ($M): 41.9

IS Date: 2020

Target Zone: Meted/Penelec

ME Constraints: AP SOUTH L/O BED-BLA
L/O MTS-DOU
Taneytown to Carroll 138 kV
Conastone to Northwest 230 kV
Peach Bottom 500 kV
Jacksons Ferry to Cloverdale 765 KV 765 kV

Notes:



1-19G

Project ID: 201415_1-19G

Proposed by: Northeast Transmission Development

Proposed Solution: Build 500/230 kV Substation (Keysers Run) Interconnecting Conastone-Brighton 500 kV Line to Northwest 230 kV Substation.

kV Level: 230

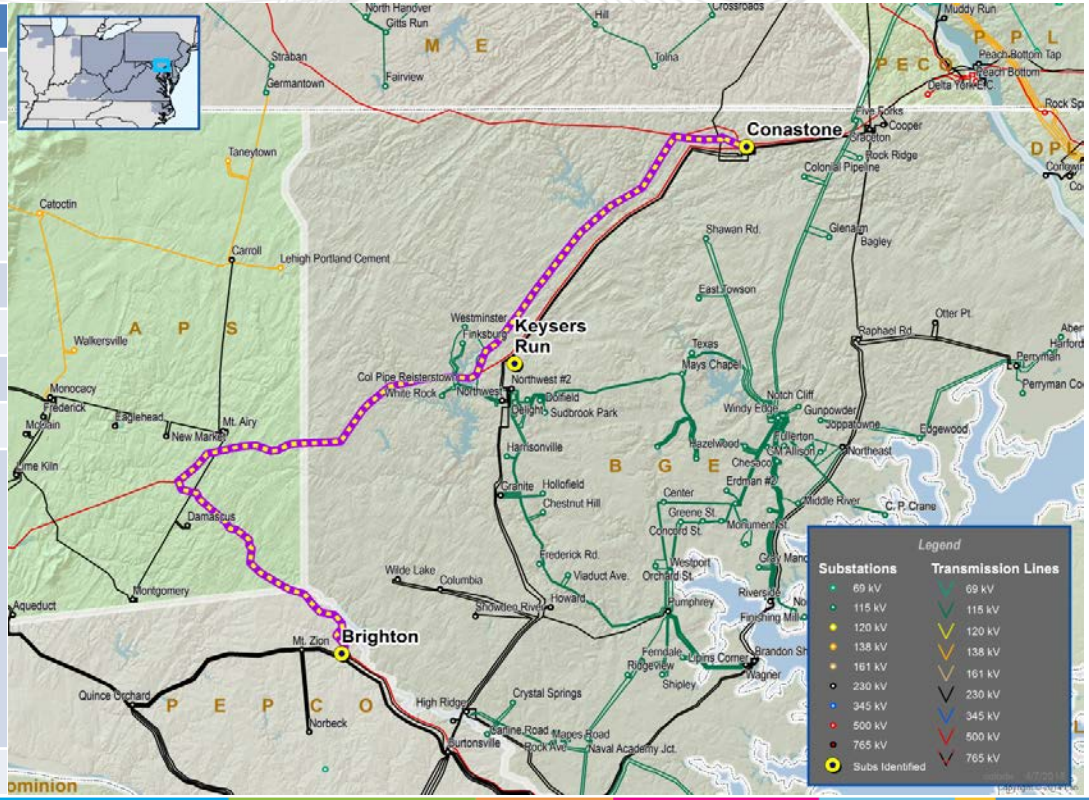
Cost ($M): 48.6

IS Date: 2020

Target Zone: Pepco/BGE

ME Constraints: AP SOUTH L/O BED-BLA
L/O MTS-DOU
50045005 L/O RCKSPG-KEENY
Safe Harbor to Graceton 230 kV
Conastone to Northwest 230 kV
Peach Bottom 500 kV

Notes:



Questions?

Email: RTEP@pjm.com