Market Efficiency Update

Transmission Expansion Advisory Committee

November 8, 2018

2018/19 Long Term Window

2018/19 Long Term Window

- Problem Statement and Eligible Congestion Drivers posted on the Competitive Planning Process web page
  - https://www.pjm.com/planning/competitive-planning-process.aspx
- Modeling data and supporting documentation posted on the Market Efficiency web page
  - http://www.pjm.com/planning/rtep-development/market-efficiency.aspx
- Long Term Proposal window opened on November 2nd, 2018
- Long Term Proposal window will close on March 1st, 2019
- Window Related Questions
  - Window related questions should be posted to the PJM Planning Community: https://pjm.force.com/planning/s/

Market Efficiency Modeling Data

- Market Efficiency Web Page located at
  - http://www.pjm.com/planning/rtep-development/market-efficiency.aspx
- Posted Market Efficiency Base Case (database date 11-01-2018)
  - Market Efficiency Base Case files for all study years (PROMOD 11.1.13 XML format)
    - Access requires CEII confirmation (PJM and MISO)
    - Access requires PROMOD vendor (ABB) confirmation
  - Posted model includes all years: 2019, 2023, 2026, 2029
- Additional PROMOD modeling files
  - PROMOD 15-years Monte Carlo outage library (.lib)
  - PROMOD Event file (.eve)
- Also posted separate PROMOD XML file to remove FSA units

Market Efficiency Auxiliary Files

- Auxiliary Files
  - Benefit/Cost Evaluation Tool
  - 2018 ARR Data
  - Benchmark test case and results
  - Procedure for executing PROMOD Simulations

- Assumptions and Simulation Results (Informational)
  - 2018 Market Efficiency Assumptions Whitepaper
  - Congestion results from posted base case (simulated years 2023 and 2026)

2018/19 Market Efficiency Sensitivities

Sensitivity	Range
Load Sensitivity	Plus or Minus 2%
Gas Sensitivity	Plus or Minus 20% Henry Hub
No FSA Sensitivity	Remove all units with FSA or suspended ISA status

- PJM reserves right to add sensitivities as necessary.

Congestion Drivers

Simulated Base Case Congestion

- Congestion results associated with the Long Term Window Base Case are posted on Market Efficiency web page:
  - https://www.pjm.com/-/media/planning/rtep-dev/market-efficiency/private-econ-plan-process/2023-2026-preliminary-market-efficiency-base-case-congestion-results.ashx?la=en
- This file includes congestion results for simulation years 2023 and 2026
- Also included are the congestion results for the noFSA sensitivity case.

PJM Eligible Congestion Drivers

- In determining eligible congestion drivers PJM considered
  - binding flowgates internal to the PJM footprint (including tie lines)
  - active Market-to-Market flowgates listed in the NERC book of flowgates
  - potential future Market-to-Market flowgates between PJM and MISO
- Eligible congestion drivers were selected to focus proposals on significant issues
- Only proposals which address one or more of these PJM identified congestion drivers will be evaluated
  - If the proposal does not substantially address a PJM identified congestion driver, or is otherwise substantially deficient or is seriously flawed, it will be rejected and the proposer will be notified

Criteria for Target Congestion Drivers

- Hours Binding
  - Annual simulated congestion frequency of at least 25 hours in each 2023 and 2026 study years
- Congestion Threshold
  - Lower voltage facilities: minimum of $1 million congestion in each 2023 and 2026 study years
  - Regional facilities: minimum of $10 million congestion in each 2023 and 2026 study years
  - Interregional facilities: minimum of $0.5 million congestion in each 2023 and 2026 study years (lower threshold as there may be interregional benefits in addition to the regional benefits)

Exceptions

- PJM may not recommend proposals for certain facilities meeting the criteria due to following exceptions:
  - Congestion is significantly influenced by a FSA generator or a set of FSAs
  - Majority of the congestion was already addressed in previous window(s)
  - Simulated congestion for future study years displays a declining trend

Note: PJM reserves right to add other exceptions as necessary.

Simulated Market Congestion Results

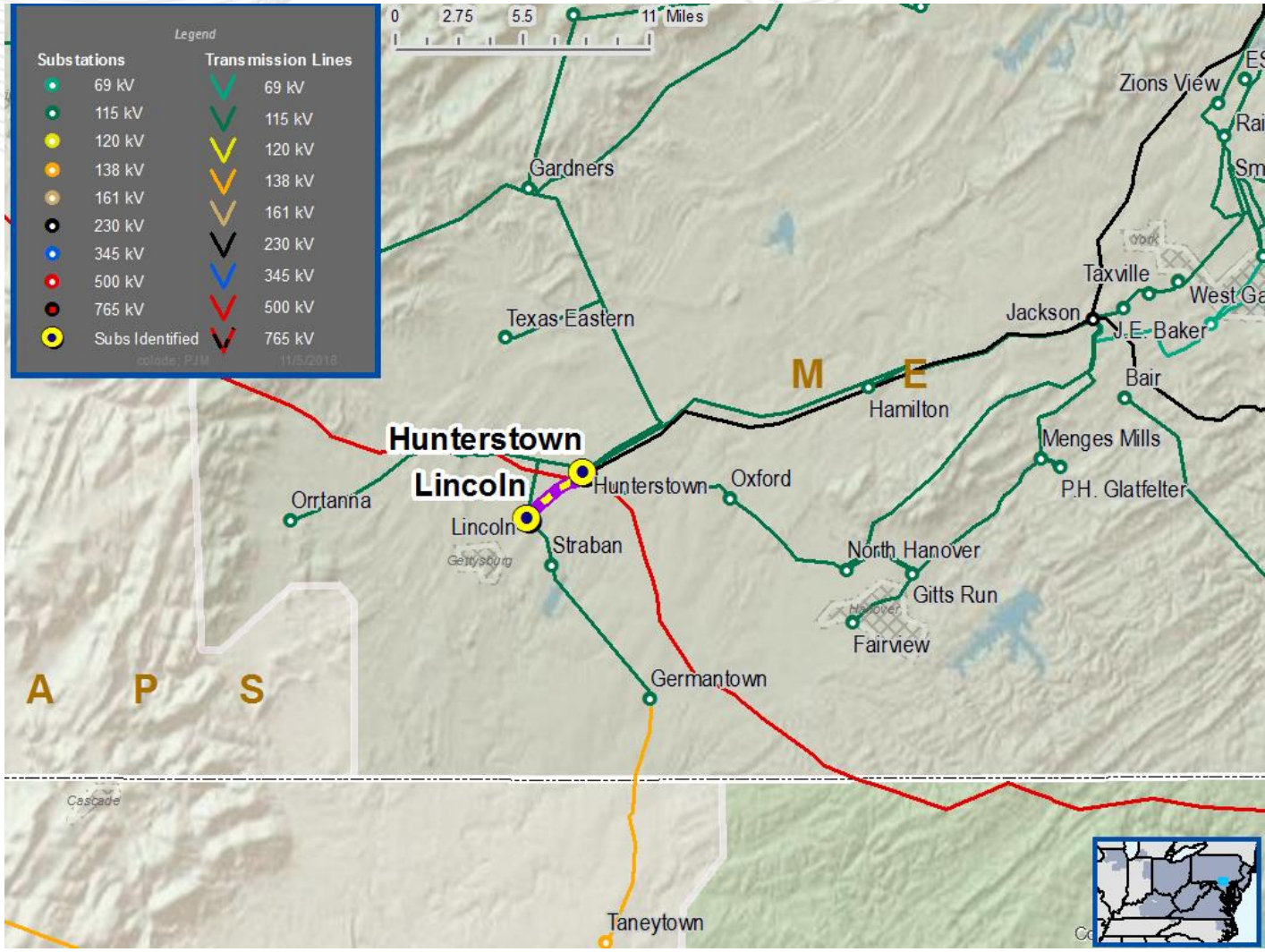
Constraint	From Area	To Area	Base with FSAs ($Million)		Sensitivity No FSAs ($Million)		Base with FSAs (Hours Binding)		Comment
			2023 Simulated Year	2026 Simulated Year	2023 Simulated Year	2023 Simulated Year	2023 Simulated Year	2023 Simulated Year	
AP South Interface	-	-	$75.04	$96.73	$12.67	$9.28	1,226	1,363	Large congestion reduction without FSA generation. Significant portion of congestion addressed in previous windows.
North Waverly to E Sayre 115 kV	NYZC	PN	$8.93	$17.30	$5.23	$6.90	3,367	4,421	SPS exists. NY reviewing
Hunterstown to Lincoln 115 kV	ME	ME	$7.45	$10.56	$24.99	$34.82	865	1,010	Solicit
Cumberland TR2 to Juniata Bus 1 230 kV	PPL	PPL	$8.99	$13.10	$0.73	$4.10	357	316	Solicit
Bosserman to Trail Creek 138 kV	AEP	MISOE	$7.04	$9.79	$0.69	$0.78	265	340	Solicit
Face Rock to Face Rock-Five Forks 69 kV	PPL	PPL	$4.55	$3.48	$1.01	$0.66	166	120	Declining congestion
Monroe 1&2 to Wayne 345 kV	MISOE	MISOE	$4.38	$9.51	$0.09	$2.26	148	271	Solicit
He Hubbell to Sunman Weisburg 138 kV	MISOC	MISOC	$3.19	$3.20	$0.42	$0.80	122	110	Solicit
Dauphin TR1 to Copperstone/N Lebanon 230 kV	PPL	PPL	$2.87	$1.12	$0.00	$0.00	349	85	Congestion depends on one FSA unit.
Furnace Run to Conastone 230 kV	PECO	BGE	$2.24	$2.19	$0.28	$0.29	80	78	Large congestion reduction without FSA generation. Significant portion of congestion addressed in previous windows.
Towanda East to N. Meshoppen 115 kV	PN	PN	$1.89	$6.51	$0.04	$0.25	1,180	2,080	Large congestion reduction without FSA generation.
Milton to Montour 230 kV	PPL	PPL	$0.97	$0.34	$0.01	$0.00	234	82	Under $1 million
Marblehead North Bus 1 161/138 kV	MISOC	MISOC	$0.95	$0.60	$2.97	$1.34	160	118	Solicit
50045005 Interface	-	-	$0.80	$19.97	$0.02	$3.57	92	756	Under $1 million
Sullivan to Casey West East Bus 345 kV	AEP	MISOC	$0.65	$0.42	$0.06	$0.00	32	34	Under $1 million
BC PEPCO Interface	-	-	$0.63	$0.59	$0.00	$0.00	25	22	Under $1 million
Clifty Creek to Northside 138 kV	OVEC	LKE	$0.58	$2.59	$0.00	$0.05	23	90	Under $1 million
E Frankfort to Goodings 345 kV	COMED	COMED	$0.56	$1.46	$0.33	$0.69	58	145	Solicit

Recommended Congestion Drivers

2018/19 RTEP Market Efficiency Window Eligible Congestion Drivers			ME Base Case with FSA units (Annual Congestion $million)		ME Base Case with FSA units (Hours Binding)			
Constraint	**FROM AREA**	**TO AREA**	**2023 Simulated Year**	**2026 Simulated Year**	**2023 Simulated Year**	**2026 Simulated Year**	**Comment**	**Potential Upgrades**
Hunterstown to Lincoln 115 kV	METED	METED	$ 7.45	$ 10.56	865	1010	Internal Flowgate	
Monroe 1&2 to Wayne 345 kV	MISOE	MISOE	$ 4.38	$ 9.51	148	271	M2M	
He Hubbell to Sunman Weisburg 138 kV	MISOC	MISOC	$ 3.19	$ 3.20	122	110	M2M	
E Frankfort (R) to Goodings (R) 345 kV	COMED	COMED	$ 0.56	$ 1.46	58	145	M2M	
Cumberland TR2 to Juniata Bus 1 230 kV	PLGRP	PLGRP	$ 8.99	$ 13.10	357	316	Internal Flowgate	
Marblehead North Bus 1 138/161	MISOC	MISOC	$ 0.95	$ 0.60	160	118	M2M	A PJM/MISO TMEP has been proposed for this facility
Bosserman to Trail Creek 138 kV	AEP	MISOE	$ 7.04	$ 9.79	265	340	M2M	

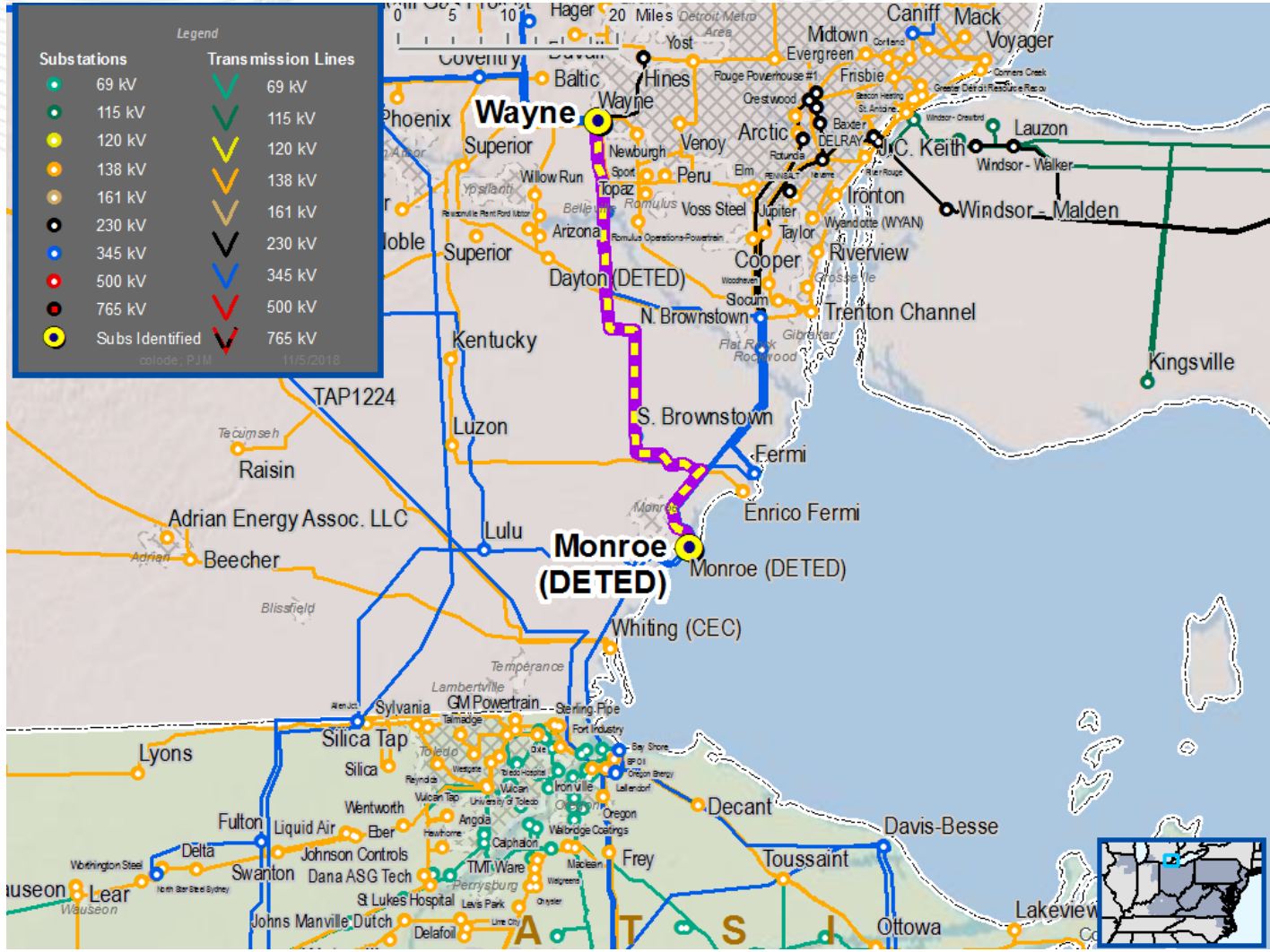
Hunterstown to Lincoln 115 kV

- Area: METED
- Voltage: 115 kV
- Simulated Market Congestion
  - 2023 ($mill): 7.45
  - 2026 ($mill): 10.56



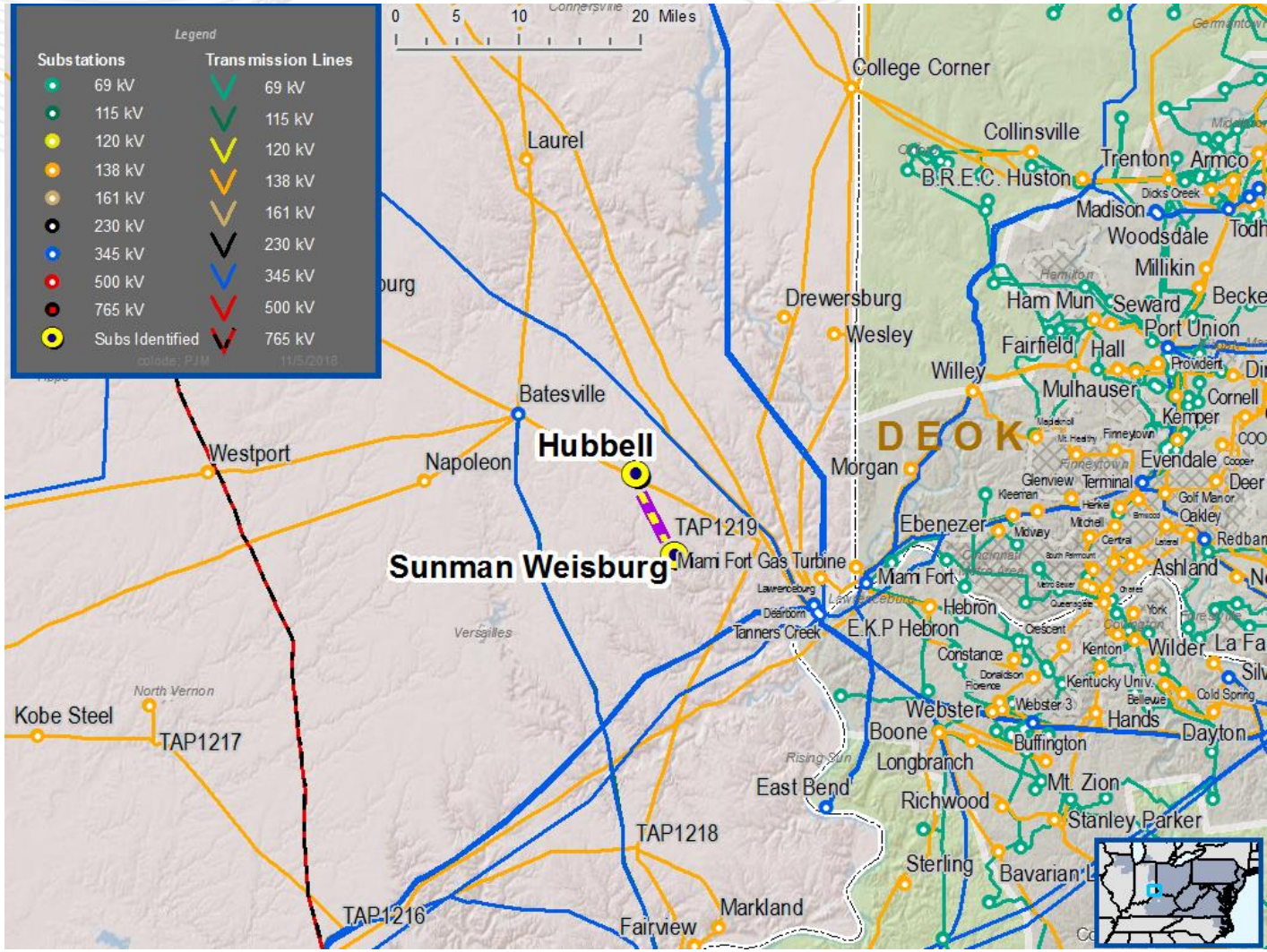
Monroe 1&2 to Wayne 345 kV

- Area: MISO
- Voltage: 345kV
- Simulated Market Congestion
  - 2023 ($mill): 4.38
  - 2026 ($mill): 9.51



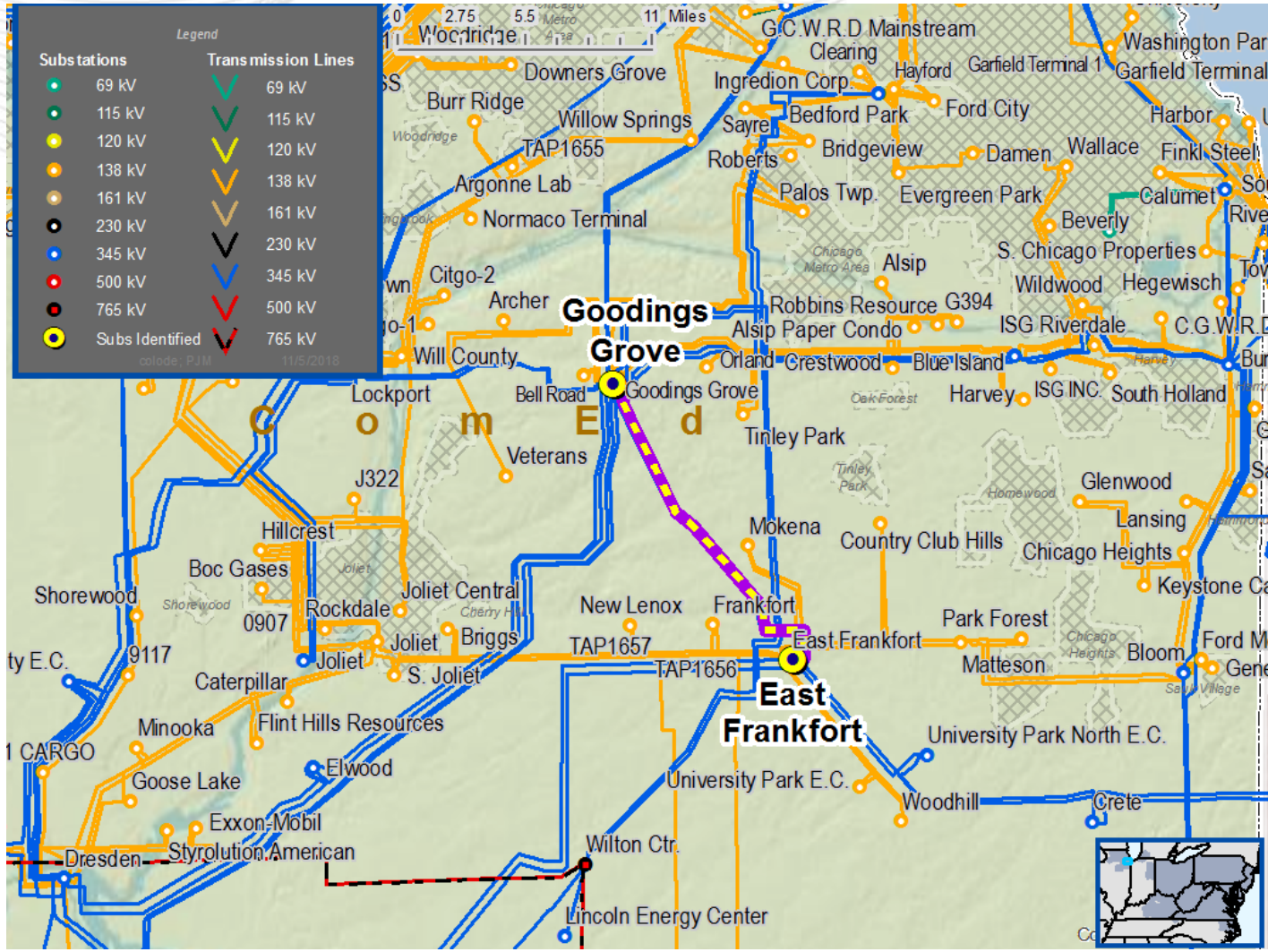
He Hubbell to Sunman Weisburg 138 kV

- Area: MISO
- Voltage: 138kV
- Simulated Market Congestion
  - 2023 ($mill): 3.19
  - 2026 ($mill): 3.20



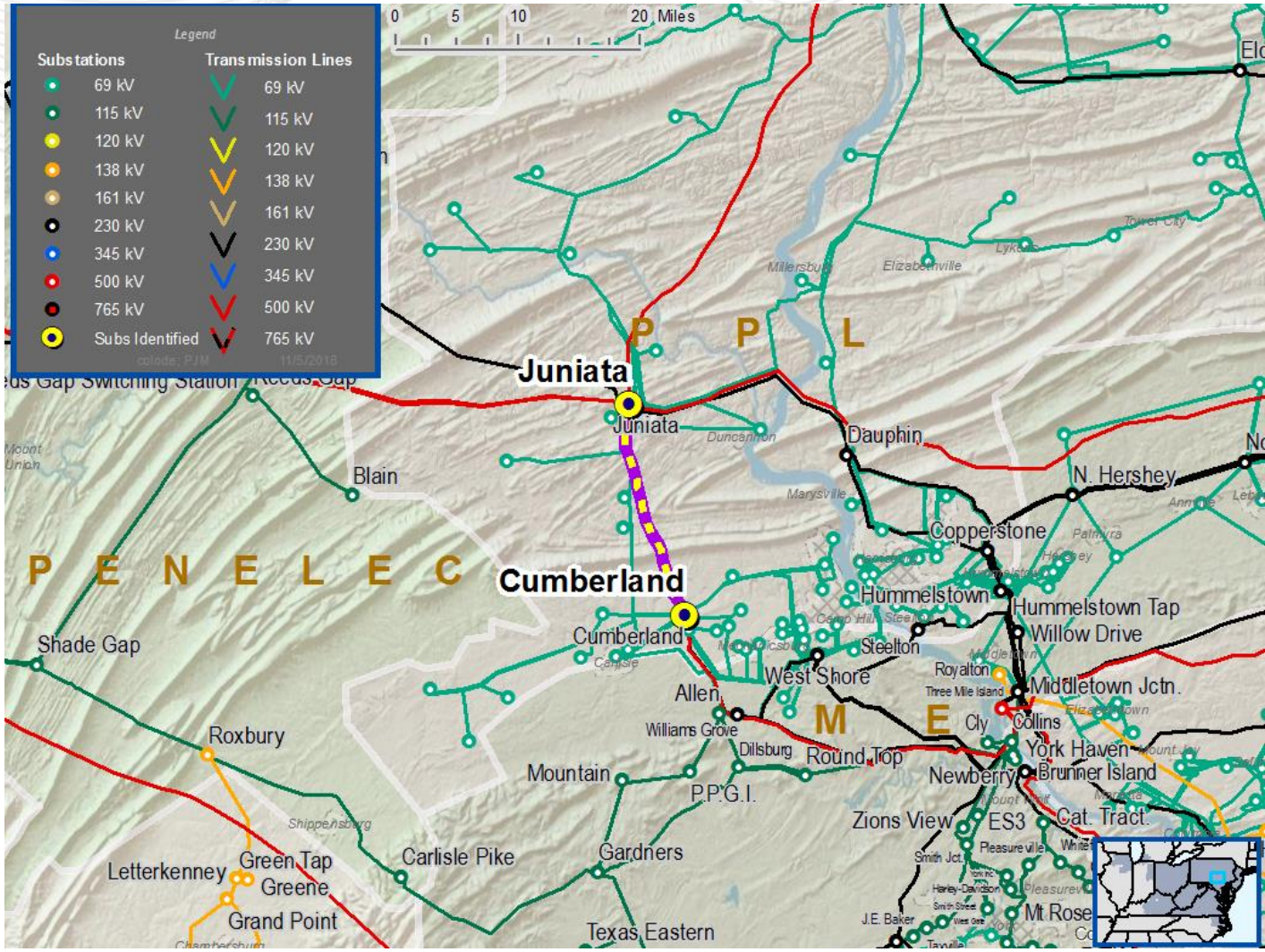
E Frankfort (R) to Goodings (R) 345 kV

- Area: COMED
- Voltage: 345 kV
- Simulated Market Congestion
  - 2023 ($mill): 0.56
  - 2026 ($mill): 1.46



Cumberland to Juniata 230 kV

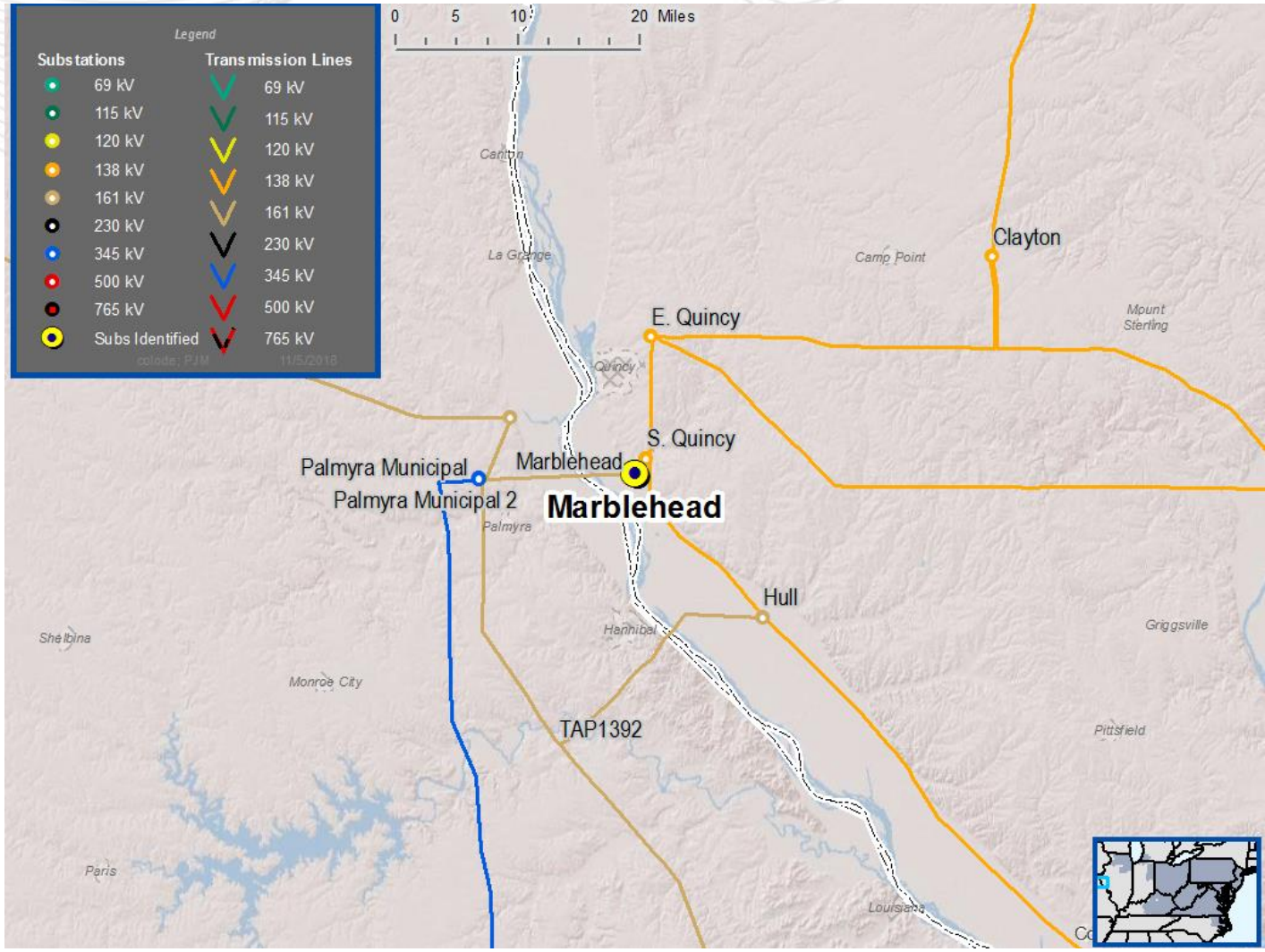
- Area: PLGRP
- Voltage: 230 kV
- Simulated Market Congestion
  - 2023 ($mill): 8.99
  - 2026 ($mill): 13.10



Marblehead 161/138 kV

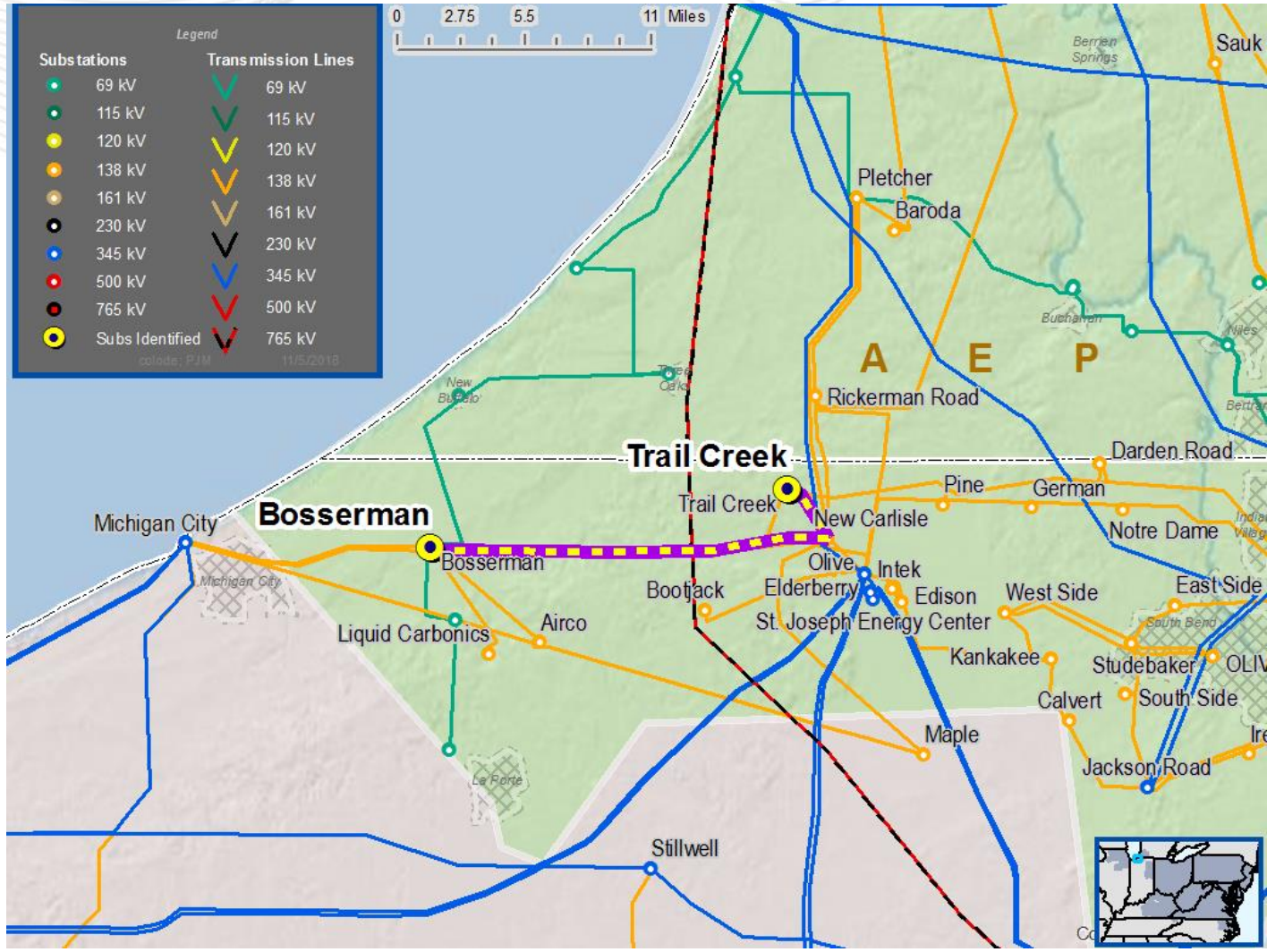
- Area: MISO
- Voltage: 138/161 kV
- Simulated Market Congestion
  - 2023 ($mill): 0.95
  - 2026 ($mill): 0.60

Note: A PJM/MISO TMEP has been proposed for this facility



Bosserman to Trail Creek 138 kV

- Area: AEP
- Voltage: 138 kV
- Simulated Market Congestion
  - 2023 ($mill): 7.04
  - 2026 ($mill): 9.79



Next Steps

Step	Timeline
Long Term Proposal Window	November 2018 - February 2019
2018 Reevaluation Analysis	November – December 2018
2018 Acceleration Analysis	November – December 2018
Analysis of Proposed Solutions	March - November 2019
Final TEAC Review and Board Approval	November - December 2019

2018 Reevaluation
Approved Market Efficiency Projects

Reevaluation Overview

- Applies to market efficiency projects approved during the 2014/15 and 2016/17 RTEP Windows
- Using the Market Efficiency Base Case
- Projects already in-service, under construction or with a near in-service date will not be reevaluated
- Projects must meet the B/C criterion of 1.25
- Analysis Status
  - 9 projects already in service or under construction (see slide 17 for details)
  - 5 projects completed reevaluation and passed
  - 4 projects reevaluation in progress

- PJM anticipates completing the reevaluation process by the December 2018 TEAC meeting

Projects In Service or Under Construction

PJM Window Project ID	Baseline#	Type	Area	Constraint	Status	Last Updated Date	Description
201415_1-2B	b2691	Upgrade	ME/PPL	Brunner Island to Yorkana 230 kV	IS	11/06/2017	Reconductor three spans limiting Brunner Island - Yorkana 230 kV line, add 1 breaker to Brunner Island switchyard, upgrade associated terminal equipment
201415_1-4J	b2698	Upgrade	AEP	Jacksons Ferry to Cloverdale 765 KV	IS	10/31/2018	Replace relays at Cloverdale and Jackson's Ferry substations
201415_1-10B	b2693	Upgrade	COMED	Wayne to South Elgin 138 kV	IS	11/01/2018	Replace L7915 B phase line trap at Wayne substation
201415_1-10D	b2728	Upgrade	COMED	Loretto to Wilton 345 kV (RPM)	IS	05/21/2018	Mitigate sag limitations on Loretto - Wilton Center 345 kV Line and replace station conductor at Wilton Center
201415_1-12A	b2689.1-3	Upgrade	DUQ	Dravosburg to West Mifflin 138 kV	IS	1: 05/02/2018 2: 10/31/2018 3: 01/22/2018	Reconductor ~7 miles of the Woodville - Peters 138 kV circuit. Reconfigure West Mifflin-USS Clairton 138 kV circuit. Upgrade terminal equipment
201415_1-13E	b2695	Upgrade	DPL	Worcester to Ocean Pines (I) 69 kV	IS	04/04/2018	Rebuild Worcester - Ocean Pine 69 kV ckt. 1
201415_1-18G	b2688.1-3	Upgrade	APS	Taneytown to Carroll 138 kV	1: UC 2,3: IS	1: 09/25/2018 2: 06/07/2018 3: 06/07/2018	Upgrade terminal equipment on the Lincoln - Carroll 115/138kV path.
201415_1-2A	b2690	Upgrade	PPL/BGE	Safe Harbor to Graceton 230 kV	UC	10/17/2018	Reconductor two spans of the Graceton - Safe Harbor 230 kV transmission line
201415_1-18I	b2696	Upgrade	APS/ATSI	Krendale to Shanor Manor 138 kV	UC	10/31/2018	Upgrade 138 kV substation equipment at Butler, Shanor Manor and Krendale substations

IS – In Service
UC – Under Construction

Reevaluations Completed

PJM Window Project ID	Baseline#	Type	Area	Constraint	BC Reevaluation 2018	Capital Cost ($ million)	Reevaluation TEAC Date	Status	Projected ISD	Description
201415_1-4I	b2697.1-2	Upgrade	AEP	Fieldale to Thornton 138 kV	3.30	$0.75	11/8/2018	EP	1: 06/01/2019 2: 12/31/2019	Mitigate violations identified by sag study to operate Fieldale-Thornton-Franklin 138 kV overhead line conductor at its max. operating temperature Replace terminal equipment at Danville and East Danville substations
201415_1-9A*	b2743.1-8, b2752.1-7	Greenfield	APS/BGE	AP-South	1.40*	$372.23	9/13/2018	EP	11/01/2020	New double-circuit Rice – Ringgold 230 kV. New double-circuit Furnace Run - Conastone 230 kV. Reconductor Conastone – NWest 230 kV.
201415_1-11H	b2694	Upgrade	PECO	Peach Bottom 500 kV	1.76	$9.70	11/8/2018	EP	06/01/2019	Increase ratings of Peach Bottom 500/230 kV transformer
Optimal Caps	b2729	Upgrade	DOM	AP-South	2.51	$8.98	11/8/2018	EP	12/01/2019	New capacitor banks at Brambleton, Ashburn, Shelhorn and Liberty substations
201617_1-5E	B2992.1-4	Upgrade	BGE	Conastone - Graceton - Bagley 230 kV	9.18	$39.65	10/11/2018	EP	06/01/2021	Reconductor the Conastone to Graceton 230 kV 2323 & 2324 circuits Add Bundle conductor on the Graceton-Bagley-Raphael Road 2305 & 2313 230kV circuits Reconductor Raphael Road - Northeast 2315 & 2337 circuits

EP – Engineering Procurement

* 9A Ratio updated based on Transource cost update from October 2018

Reevaluation In Progress

PJM Window Project ID	Baseline#	Type	Area	Constraint	Status	Projected ISD	Description
201415_1-10J	b2692.1-2	Upgrade	COMED	Cordova to Nelson 345 kV	1: EP 2: UC	06/01/2019	Replace station equipment at Nelson, ESS H-471 and Quad Cities Upgrade conductor ratings of Cordova - Nelson, Quad Cities - ESS H-471 and ESS H-471 - Nelson 345 kV lines and mitigating sag limitations
201617_1-3A	b2930 (RPM)	Upgrade	COMED	E. Frankfort to University Park 345 kV	On Hold	06/10/2021	Upgrade capacity on E. Frankford-University Park 345kV
201617_1-3B	b2931 (RPM)	Upgrade	COMED	Pontiac to Brokaw 345 kV	EP	06/01/2021	Upgrade substation equipment at Pontiac Midpoint station
201617_1A_RPM_DEOK	b2968 (RPM)	Upgrade	DEOK	Tanners Creek to Miami Fort 345 kV	EP	06/01/2021	Upgrade existing 345kV terminal equipment at Tanners Creek station on Tanners Creek - Miami Fort 345kV line

EP – Engineering Procurement
UC – Under Construction

2018 Acceleration Analysis

Acceleration Analysis

- Scope
  - Determine which reliability upgrades, if any, have an economic benefit if accelerated or modified.
- Study Years
  - 2019 and 2023 set of economic input assumptions used to study impacts of approved RTEP projects
- Process
  - Compare market congestion for near term vs. future topology
  - Estimate economic impact of accelerating planned upgrades

Acceleration Analysis Status

- Currently building the 2019 AS-IS PROMOD model
- Identifying RTEP reliability projects responsible for congestion reductions
- Acceleration analysis results to be presented at the December TEAC

Revision History

- Revision History
  - V1 – 11/05/2018 – Original Version Posted to PJM.com