PJM Regional Transmission Expansion Planning (RTEP) Process

IPSAC

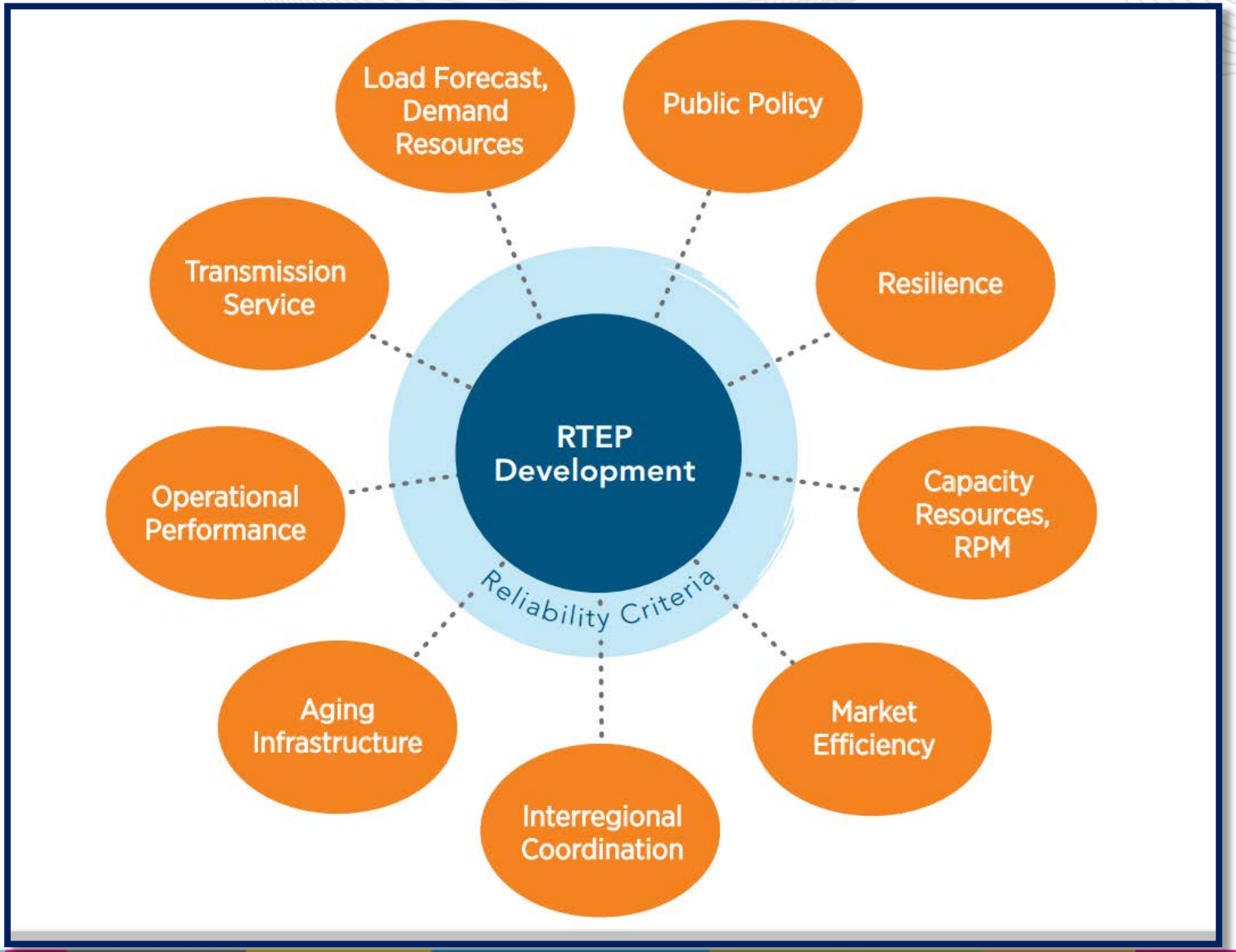
December 9, 2019

PJM Planning Links

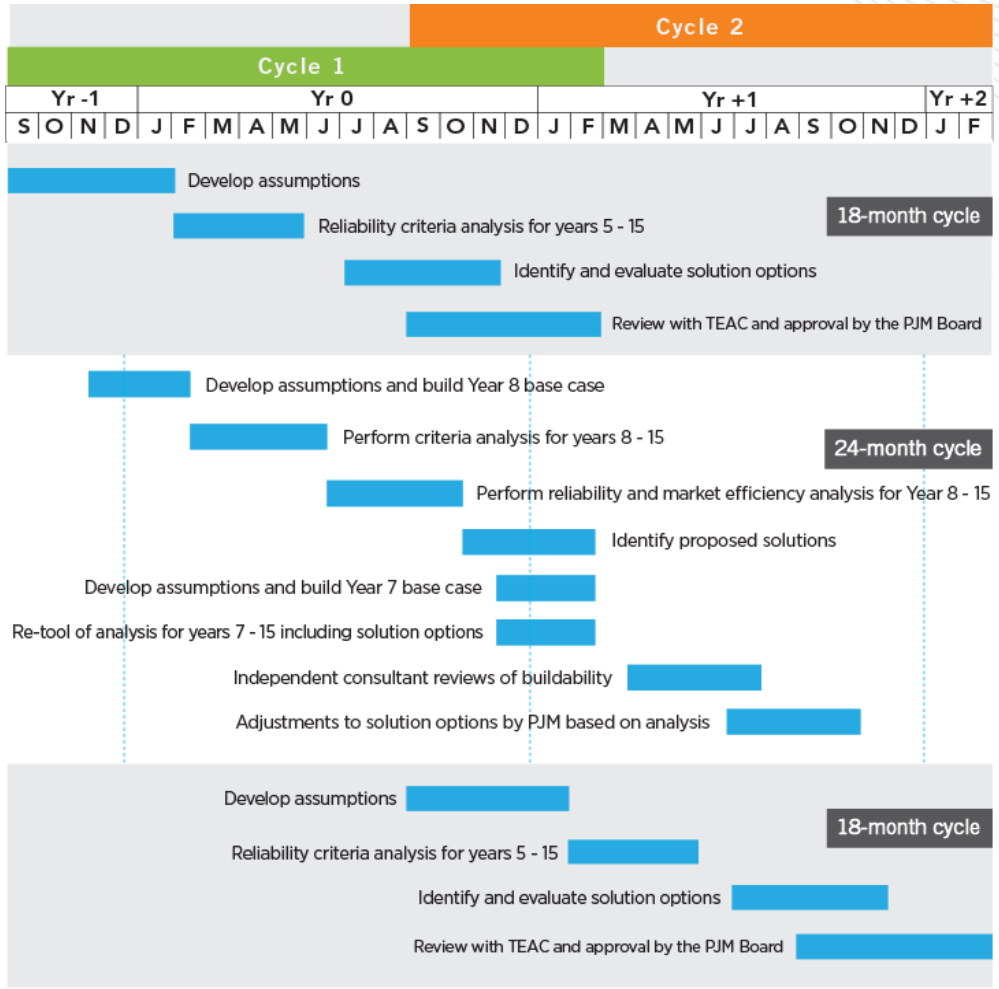
- Planning Committee (PC)
  - http://www.pjm.com/committees-and-groups/committees/pc.aspx
- Transmission Expansion Advisory Committee (TEAC)
  - http://www.pjm.com/committees-and-groups/committees/teac.aspx
- Interregional Planning
  - http://www.pjm.com/planning/interregional-planning.aspx
- Services and Requests
  - http://www.pjm.com/planning/services-requests.aspx
- RTEP Development
  - http://www.pjm.com/planning/rtep-development.aspx
- Manual 14B
  - http://www.pjm.com/-/media/documents/manuals/m14b.ashx

PJM RTEP Planning Cycles

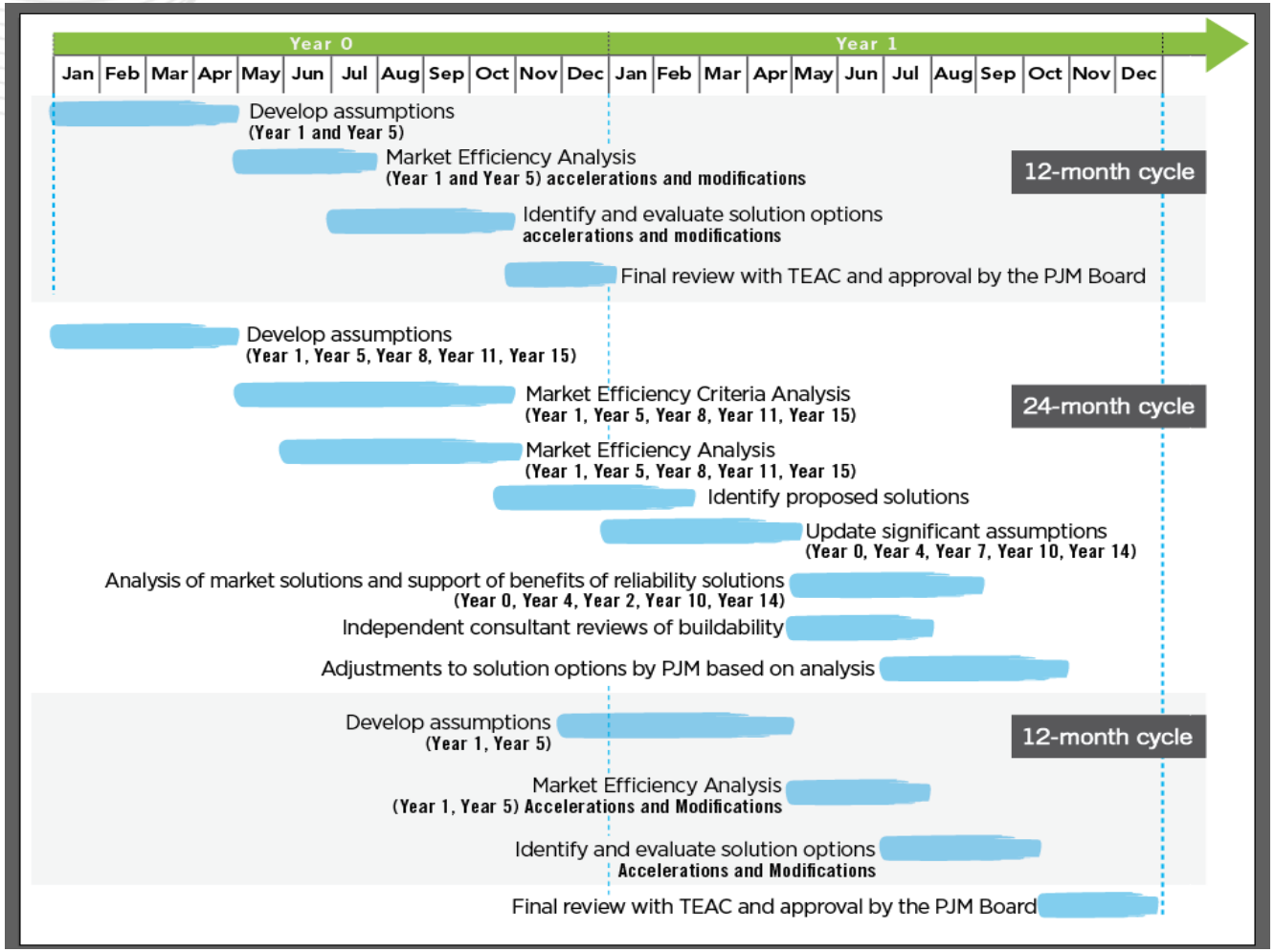
System Expansion Drivers



PJM's 2-year Reliability



PJM's 2-year Market Efficiency



PJM 2019 RTEP Assumptions

Overview

- Update of standard RTEP assumptions
- 2019 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 Planning Center Online Tool (Gen Model) – GOs
- RTEP Proposal Windows

2019 RTEP Assumptions

- Load Flow Modeling
  - Power flow models for outside world load, capacity, and topology was based on the following 2018 Series MMWG power flow cases
    - 2018 Series 2023SUM MMWG outside world for
      - 2019 Series 2024SUM RTEP, 2022SUM RTEP
    - 2018 Series 2023SLL MMWG outside world for
      - 2019 Series 2024LL RTEP
    - 2018 Series 2023WIN MMWG outside world for
      - 2019 Series 2024WIN RTEP
  - PJM coordinated with neighbors to identify any updates to topology/corrections
  - PJM topology for all cases sourced from Model On Demand
    - Include all PJM Board approved upgrades through the December 2018 PJM Board of Manager approvals as well as all anticipated February 2019 PJM Board approvals
  - OVEC was included as a part of PJM

2019 RTEP Assumptions

- Firm Commitments
  - Long term firm transmission service consistent with those coordinated between PJM and other Planning Coordinators during the 2018 Series MMWG development

- Outage Rates
  - Generation outage rates are based on the most recent Reserve Requirement Study (RRS) performed by PJM
  - Generation outage rates for future PJM units were estimated based on class average rates

2019 RTEP Load Modeling

- Summer Peak Load
  - Summer Peak Load was modeled consistent with the 2019 PJM Load Forecast Report
  - The final load forecast released in December 2018
- Winter Peak Load
  - Winter Peak Load was modeled consistent with the 2019 PJM Load Forecast Report
- Light Load
  - The Light Load Reliability Criteria case was modeled consistent with the procedure defined in M14B
- Load Management, where applicable, was modeled consistent with the 2019 Load Forecast Report
  - Used in Locational Deliverability Area (LDA) under study in load deliverability analysis
  - Include Demand Response (DR) based on what cleared in the 2021/22 BRA

2019 RTEP Assumptions

- At a minimum, all PJM bulk electric system facilities, all tie lines to neighboring systems and all lower voltage facilities operated by PJM are monitored.

- At a minimum, contingency analysis included all bulk electric system facilities, all tie lines to neighboring systems and all lower voltage facilities operated by PJM.

- Thermal and voltage limits are consistent with those used in operations.

2019 RTEP Assumptions

- PJM/NYISO Interface
  - B & C cables are modeled out of service consistent with NYISO modeling

- Linden Variable Frequency Transformer (VFT)
  - Withdrawal : Modeled at 330 MW Non-Firm Transmission Withdrawal Rights & Modeled 330 MW Long-Term Firm Transmission Service (PJM-NYISO)
  - Injection : Modeled at 315 MW Capacity Transmission Injection Rights

- Hudson Transmission Project (HTP)
  - Modeled at 673 MW Non-Firm Transmission Withdrawal Rights

2019 Proposal Window Update

Short-term Project Proposal Window

		# of Flowgates posted	# of Flowgates Open to Window
Light Load	Basecase Analysis Voltage	15	13
Winter	Gen Deliv	23	6
	Basecase Analysis Thermal	9	0
	Basecase Analysis Voltage Mag	2	0
	N-1-1 Voltage Mag	16	6
	N-1-1 Voltage Drop	25	10
Summer	Gen Deliv	26	6
	Basecase Analysis Thermal	9	6
	Basecase Analysis Voltage Mag	19	19
	Basecase Analysis Voltage Drop	24	22
	N-1-1 Thermal	71	3
	N-1-1 Voltage Mag	29	13
	N-1-1 Voltage Drop	13	0

2019 RTEP Proposal Window 1 - Statistics

Timeline

- Window Opened: July 3, 2019
- Window Closed: September 6, 2019

15 proposals received from 5 entities

- 1 proposal from a non-incumbent entity
- 1 proposal includes cost containment provisions
- 5 proposals include greenfield construction

2019 RTEP Analysis Update

Re-evaluation of the 2024 Study Update

PJM re-evaluated the 2024 RTEP study due to reinstatement of the 3634 MW generators in the Western PJM area.

Re-evaluation assumptions :

- The reinstatements of Davis Besse 1 (896MW), Perry 1 (1247MW), and Sammis 5-7 (1491MW)
- Remove baseline upgrades B3005, B3013, B3014, B3010, B3011.6, B3012.3, B3012.4, B3017, B3061, B3062, B3063, B3065, B3065, B3066, B3067, B3068, B3069, B3070, B3071,B3072, B3073, B3074,B3075, B3076, B3077, B3078, B3079, B3080, B3081, B3082, B3083

The B3017 upgrade is the only one that has potential impact on the NYISO

Upgrade Number	TO	Description	Current Cost Estimate
b3017.1	PENELEC	Rebuild Glade to Warren 230 kV line with hi-temp conductor and substation terminal upgrades. 11.53 miles. New conductor will be 1033 ACSS. Existing conductor is 1033 ACSR.	$42.400
b3017.2	PENELEC	Glade substation terminal upgrades. Replace bus conductor, wave traps, and relaying.	$0.050
b3017.3	PENELEC	Warren substation terminal upgrades. Replace bus conductor, wave traps, and relaying.	$0.050

Re-evaluation of the 2024 Study Update

PJM performed the full scope RTEP study

As a result of the new RTEP study the following Flowgates are removed:

- Kammer – George Washington 138 kV line (GD-S10, GD-S539, GD-W444)
- Haviland 138 kV tie (GD-W272)
- Wilton 765/345 kV transformer #94 (GD-W252, GD-W253)
- Wilton 765/345 kV transformer #93 (GD-W257, GD-W258)
- Brighton – Alcoa 138 kV (GD-S544, N2-ST3, N2-ST4)
- Richland – Ridgeville 138 kV (GD-S9)
- Bartonville 138 kV (Z1-113 Area) (N2-WVD2, N2-WVD3, N2-WVD4, N2-WVD5, N2-WVD6, N2-WVD7, N2-WVD8, N2-WVD9, N2-WVD10)

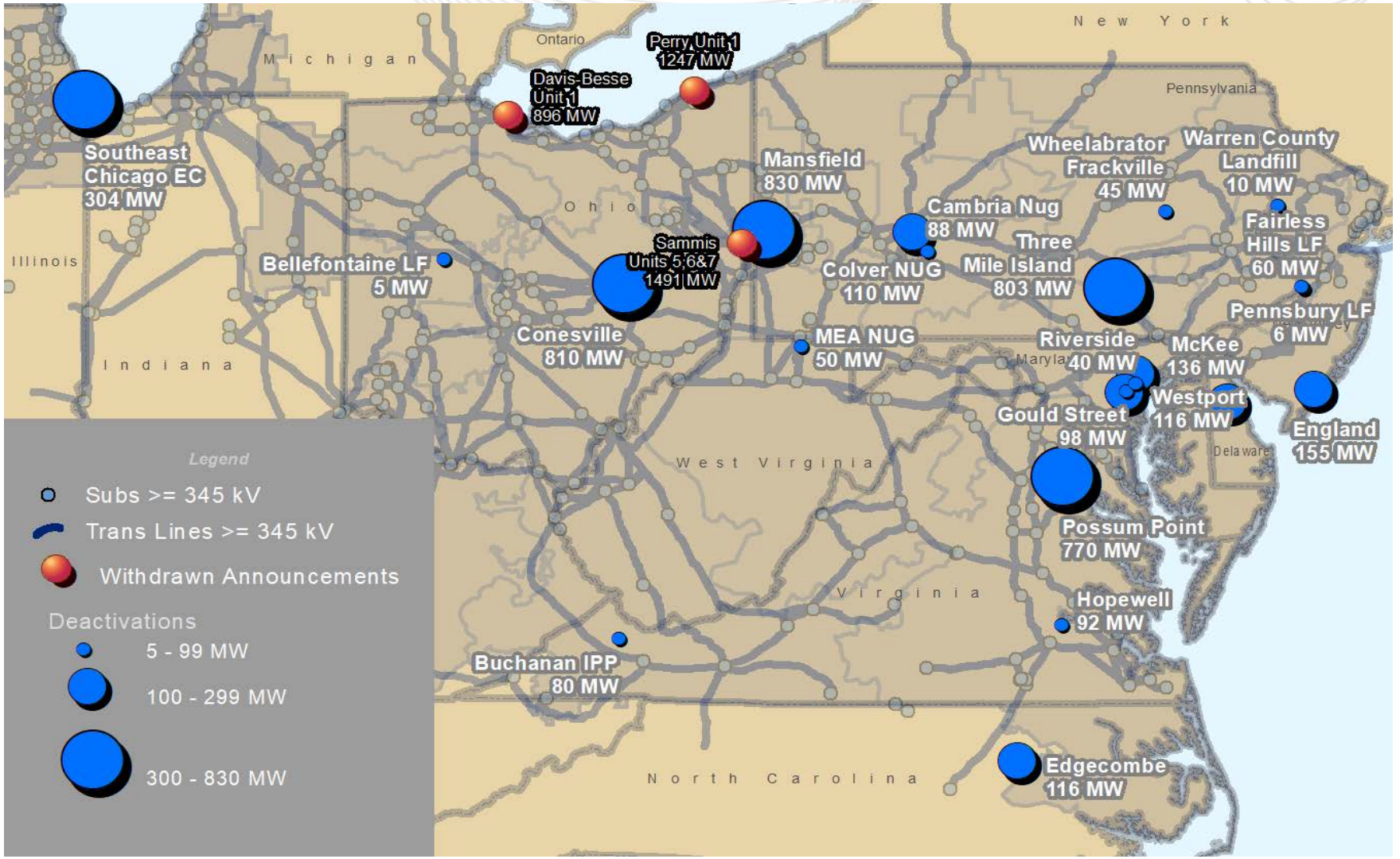
The following new potential issue was identified:

- Hayes 345/138 kV Transformer overloaded in retooled 2024 Winter Generator Deliverability Testing for tower contingency removing two 345 kV lines in the Hayes area – review of analysis underway

PJM is working on finalizing the study

Generation Deactivation Notification Update (as of November 1, 2019)

Generation Deactivations Update



Deactivation Status

Unit(s)	Transmission Zone	Requested Deactivation Date	PJM Reliability Status
Edgecomb NUG (116 MW)	Dominion	Deactivated on 4/22/2019	Reliability analysis complete. No impacts identified.
Warren County NUG (10 MW)	JCPL	Deactivated on 6/1/2019	Reliability analysis complete. No impacts identified.
BL England 2 (155 MW)	ACE	Deactivated on 4/30/2019	Reliability analysis complete. New baseline upgrade was issued to resolve the identified issue.
Gould Street Generation Station (98 MW)	BGE	Deactivated on 6/1/2019	Reliability analysis complete. No impacts identified
Conesville 5&6 (810 MW)	AEP	Deactivated on 6/1/2019	Reliability analysis complete. No impacts identified
Hopewell James River Cogeneration (92 MW)	Dominion	Deactivated on 6/25/2019	Reliability analysis complete. No impacts identified

Deactivation Status

Unit(s)	Transmission Zone	Requested Deactivation Date	PJM Reliability Status
Cambria CoGen (88 MW)	Penelec	Deactivated on 9/17/2019	Reliability analysis complete. No impacts identified
Riverside 7 (20 MW)	BGE	Deactivated on 3/14/2019	Reliability analysis complete. No impacts identified
Three Mile Island Unit 1 (802.8 MW)	ME	Deactivated on 9/20/2019	Reliability analysis complete. No impacts identified
Marcus Hook Refinery Co-gen (MH50) (49.6)	PECO	Deactivated on 6/1/2019	Reliability analysis complete. No impacts identified
Mansfield 3 (830 MW)	ATSI	Deactivated on 11/7/2019	Reliability analysis complete and upgrades expected to be completed in time for unit to deactivate as scheduled.

Deactivation Status

Unit(s)	Transmission Zone	Requested Deactivation Date	PJM Reliability Status
Riverside 8 (20 MW)	BGE	12/1/2019	Reliability analysis complete. No impacts identified
Southeast Chicago CT5–CT12 (304 MW)	ComEd	12/17/2019	Reliability analysis complete. No impacts identified
Fairless Hills Landfill A&B (60 MW)	PECO	6/1/2020	Reliability analysis complete. New baseline upgrade was issued to resolve the identified issue.
Notch Cliff GT1–GT8 (128 MW)	BGE	6/1/2020	Reliability analysis complete. No impacts identified
Pennsbury Generator Landfill 1&2 (6 MW)	PECO	6/1/2020	Reliability analysis complete. No impacts identified
Westport 5 (116 MW)	BGE	6/1/2020	Reliability analysis complete. No impacts identified

Deactivation Status

Unit(s)	Transmission Zone	Requested Deactivation Date	PJM Reliability Status
Colver NUG (110 MW)	Penelec	9/1/2020	Reliability analysis complete. New baseline upgrade was issued to resolve the identified issue.
Possum Point 5 (770.2 MW)	Dominion	5/31/2021	Reliability analysis complete. No impacts identified
Conesville 4 (780 MW)	AEP	6/1/2020	Reliability analysis complete. New baseline upgrade was issued to resolve the identified issue.
McKee 3 (102 MW)	DPL	6/1/2021	Reliability analysis complete. No impacts identified
Spruance NUG 1 (116 MW)	Dominion	1/12/2020	Reliability analysis complete. No impacts identified

Deactivation Status

Unit(s)	Transmission Zone	Requested Deactivation Date	PJM Reliability Status
Frackville Wheelabrator 1 (45.1 MW)	PPL	3/1/2020	Reliability analysis complete; no impacts identified
MEA NUG (WVU) (50 MW)	APS	1/1/2020	Reliability analysis complete; no impacts identified
Bellefontaine Landfill Generating Station (5 MW)	Dayton	12/31/2019	Reliability analysis complete; no impacts identified
Buchanan 1&2 (80 MW)	AEP	6/1/2023	Reliability analysis complete and upgrades expected to be completed in time for unit to deactivate as scheduled.

Deactivation Status

Unit(s)	Transmission Zone	Requested Deactivation Date	PJM Reliability Status
Davis Besse Unit 1 (896 MW)	ATSI	Withdrawn	PJM is evaluating the re-instatement of these generators and will potentially remove several baseline upgrades associated with the deactivation of the three generators
Perry Unit 1 (1247 MW)	ATSI	Withdrawn	
Sammis Unit 5,6&7 (1491.3 MW)	ATSI	Withdrawn	

2019 RTEP Projects Electrically Near the PJM-NYISO Interface as of November 2019

Penelec Transmission Zone

Need Number: PN-2019-001
Need Presented: 02/22/2019
Meeting Date: 03/25/2019
Process Stage: Solution

Project Driver(s):

Equipment Material Condition, Performance and Risk

Specific Assumption Reference(s)

Substation Condition Rebuild/Replacement

- Power transformers and load tap changers (LTCs)

System Performance Projects Global Factors

- Substation/line equipment limits

Problem Statement

East Towanda #4 230/115 kV Transformer

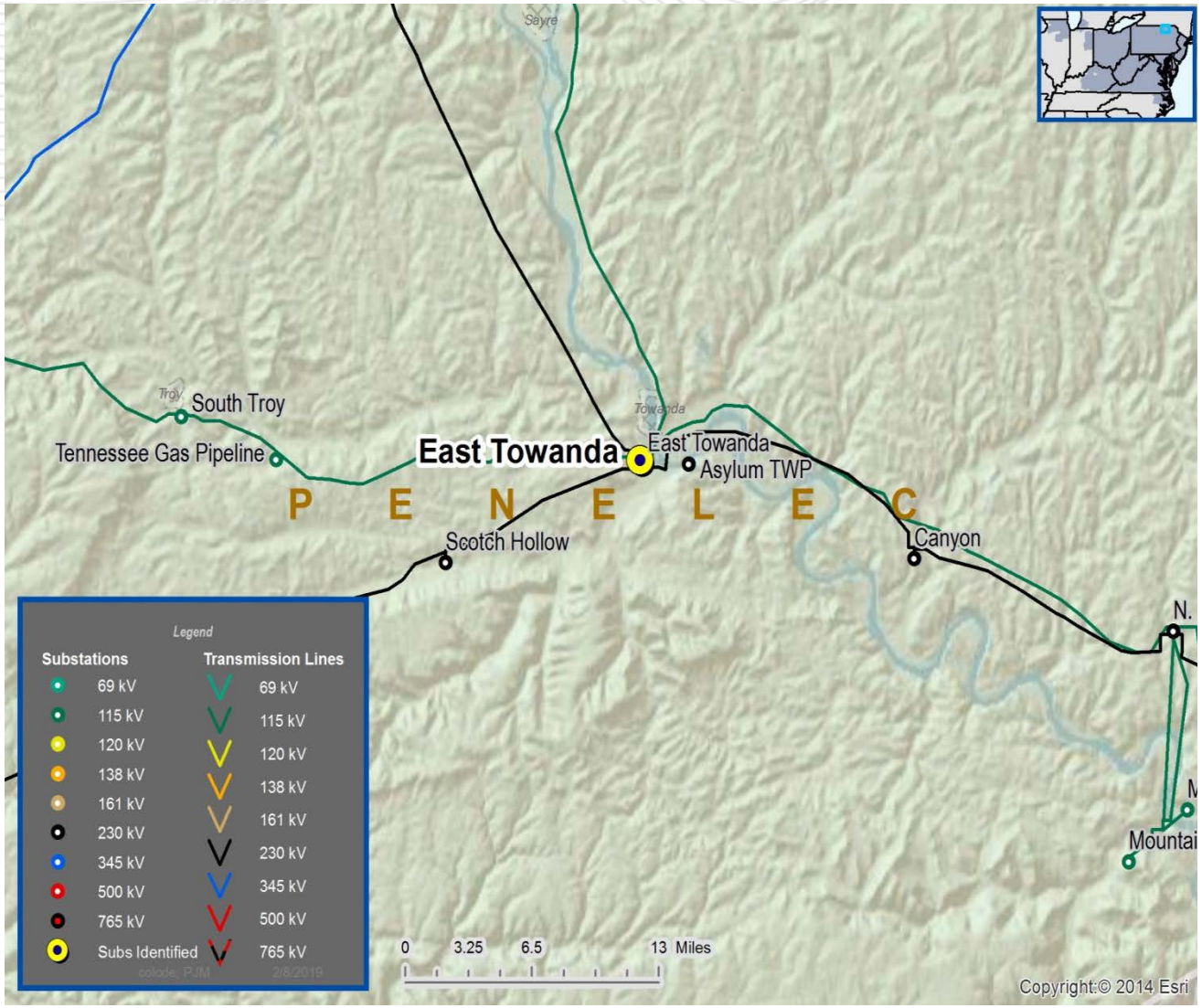
- Transformer has an increased failure probability due to type "U" bushings, dielectric breakdown, and is exhibiting high ethylene gas.
- Transformer is 45 years old.
- Approximately $64,000 spent on maintenance orders since 2003.

Transformer circuit rating is limited by terminal equipment.

Existing transformer circuit rating is 190 / 226 MVA (SN / SE).

Existing transformer rating is 195 / 244 MVA (SN / SE).

(substation conductor)



Penelec Transmission Zone

Need Number: PN-2019-001

Proposed Solution:

East Towanda #4 230/115 kV Transformer Replacement

- Replace the #4 230/115 kV transformer with a 230/115 kV 180/240/300 MVA transformer
- Replace substation conductor

Transformer Rating:

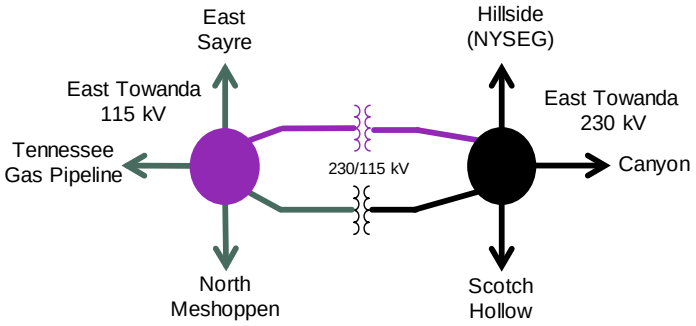
- East Towanda #4 230/115 kV Transformer
  - Before Proposed Solution: 190/226 MVA (SN/SE)
  - After Proposed Solution (anticipated): 375/438 MVA (SN/SE)

Alternatives Considered:

- Maintain existing condition and elevated risk of failure

Estimated Project Cost: $5.0M

Projected IS Date: 6/1/2021



Legend	
500 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
New	

Penelec Transmission Zone

Need Number: PN-2019-002
Need Presented: 02/22/2019
Meeting Date: 03/25/2019
Process Stage: Solution

Project Driver(s):

Equipment Material Condition, Performance and Risk

Specific Assumption Reference(s)

Substation Condition Rebuild/Replacement

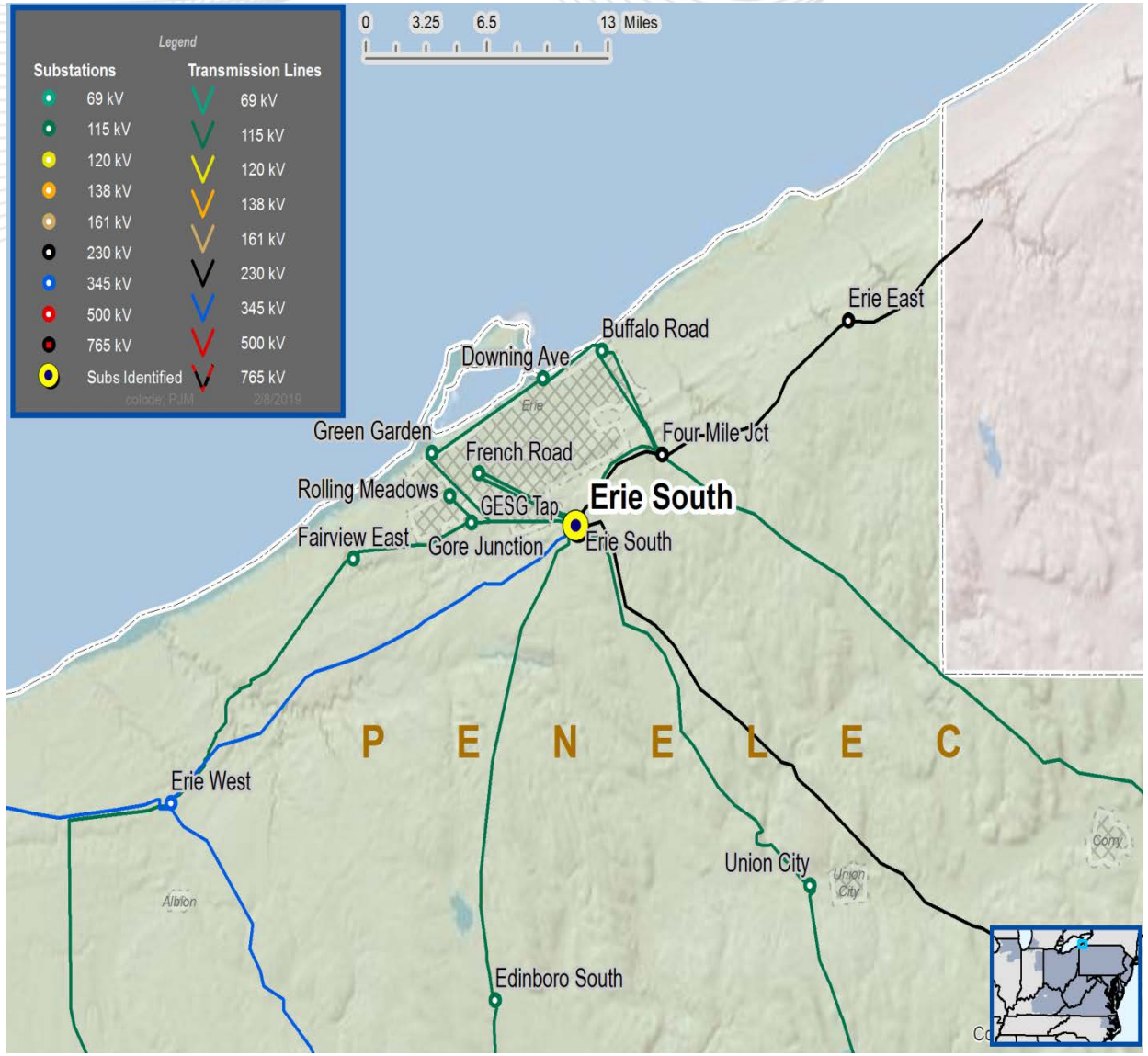
- Power transformers and load tap changers (LTCs)

Problem Statement

Erie South #6 230/115 kV Transformer

- Transformer has an increased failure probability due to type “U” bushings, nitrogen leaks, and is exhibiting an increase in ethylene gas. Power factor test results show deterioration of insulation.
- Transformer is 41 years old.
- Approximately $821,000 spent on maintenance orders since 2003.

Transformer circuit rating is the existing transformer rating of 262/326 MVA (SN/SE).



Penelec Transmission Zone

Need Number: PN-2019-002

Proposed Solution:

Erie South #6 230/115 kV Transformer Replacement

- Replace the #6 230/115 kV transformer with a 230/115 kV 180/240/300 MVA transformer
- Replace the 230 kV circuit switcher with a circuit breaker

Transformer Rating:

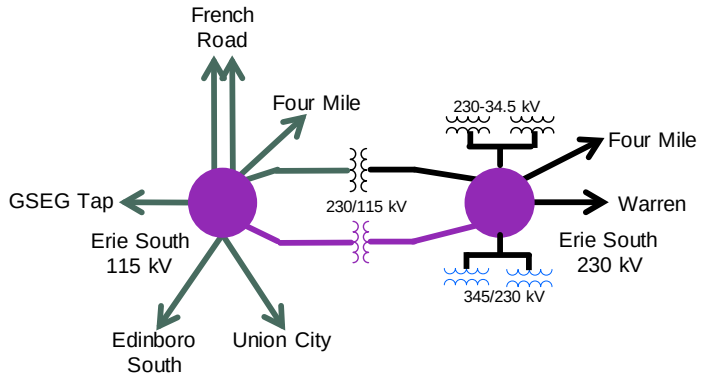
- Erie South #6 230/115 kV Transformer
  - Before Proposed Solution: 262/326 MVA (SN/SE)
  - After Proposed Solution (anticipated): 375/438 MVA (SN/SE)

Alternatives Considered:

- Maintain existing condition and elevated risk of failure

Estimated Project Cost: $4.2M

Projected IS Date: 10/1/2021



Legend	
500 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
New	

Penelec Transmission Zone

Need Number: PN-2019-007
Process Stage: Solution
Need Presented: 02/22/2019
Meeting Date: 03/25/2019

Project Driver(s):

Equipment Material Condition, Performance and Risk and Operational Flexibility and Efficiency

Specific Assumption Reference(s)

System Performance Projects Global Factors

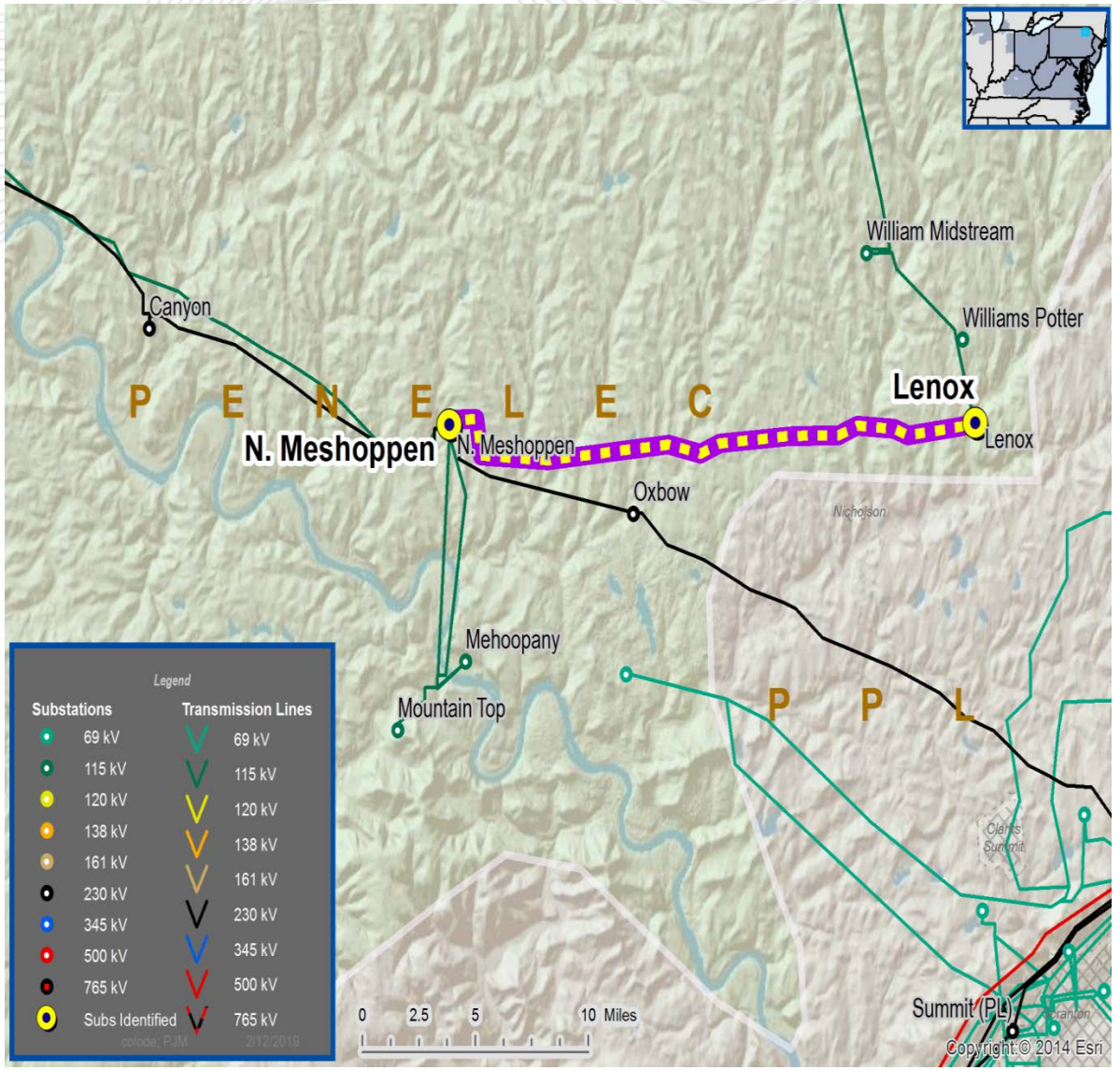
- System reliability and performance
- Substation/line equipment limits

Upgrade Relay Schemes

- Relay schemes that have a history of misoperation
- Obsolete and difficult to repair communication equipment (DTT, Blocking, etc.)
- Communication technology upgrades
- Bus protection schemes

Problem Statement

- FirstEnergy has identified protection schemes using a certain vintage of relays and communication equipment that have a history of misoperation.
- Proper operation of the protection scheme requires all the separate components perform adequately during a fault.
- In many cases the protection equipment cannot be repaired due to a lack of replacement parts and available expertise in the outdated technology.
- Transmission line ratings are limited by terminal equipment.
- Line has failed carrier equipment that cannot be repaired or replaced



Penelec Transmission Zone

Need Number: PN-2019-008
Process Stage: Solution
Need Presented: 02/22/2019
Meeting Date: 03/25/2019

Project Driver(s):

Equipment Material Condition, Performance and Risk and Operational Flexibility and Efficiency

Specific Assumption Reference(s)

System Performance Projects Global Factors

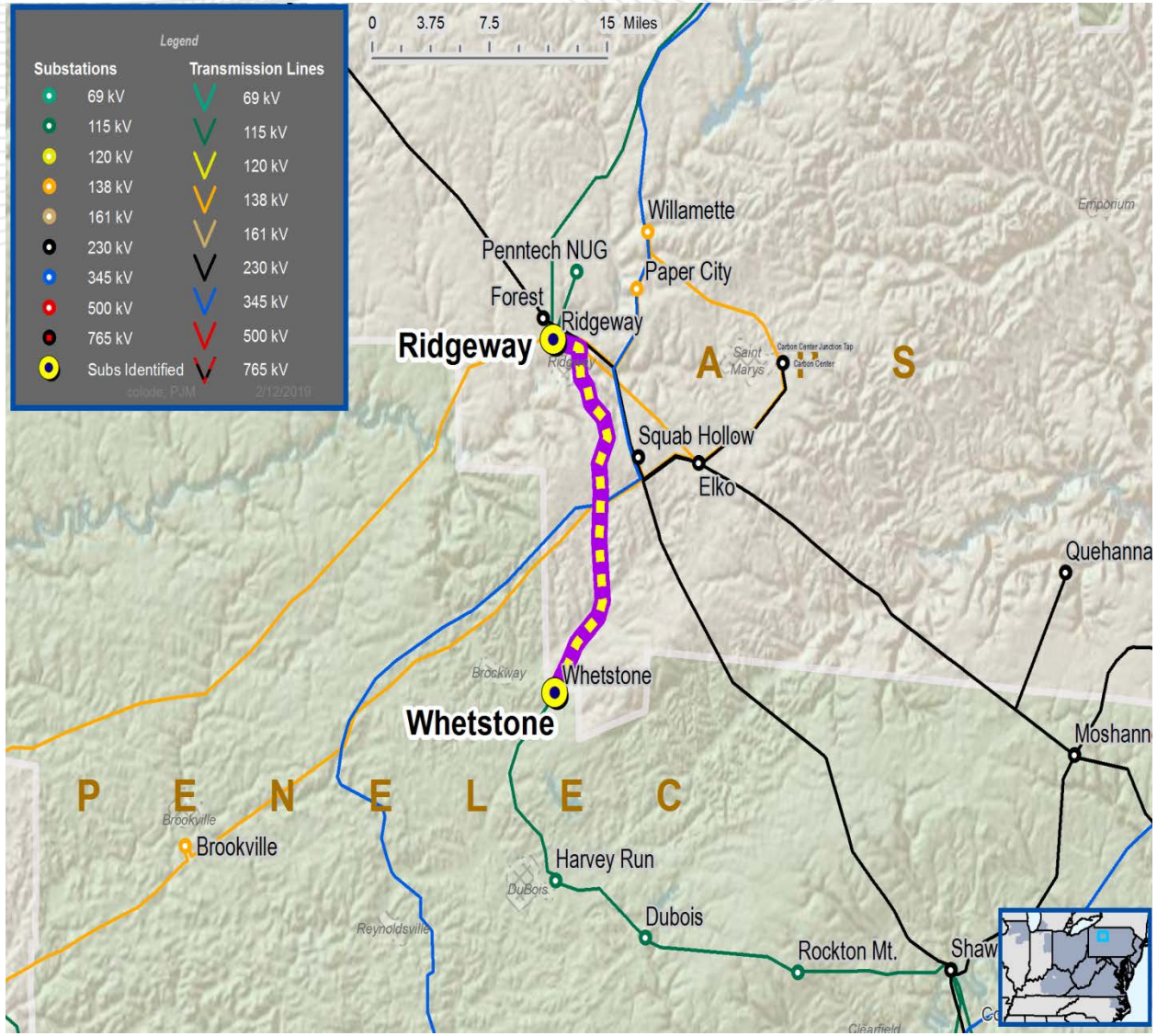
- System reliability and performance
- Substation/line equipment limits

Upgrade Relay Schemes

- Relay schemes that have a history of misoperation
- Obsolete and difficult to repair communication equipment (DTT, Blocking, etc.)
- Communication technology upgrades
- Bus protection schemes

Problem Statement

- FirstEnergy has identified protection schemes using a certain vintage of relays and communication equipment that have a history of misoperation.
- Proper operation of the protection scheme requires all the separate components perform adequately during a fault.
- In many cases the protection equipment cannot be repaired due to a lack of replacement parts and available expertise in the outdated technology.
- Transmission line ratings are limited by terminal equipment.
- Line has failed carrier equipment that cannot be repaired or replaced



Penelec Transmission Zone

Need Number: PN-2019-009
Process Stage: Solution
Need Presented: 02/22/2019
Meeting Date: 03/25/2019

Project Driver(s):

Equipment Material Condition, Performance and Risk and Operational Flexibility and Efficiency

Specific Assumption Reference(s)

System Performance Projects Global Factors

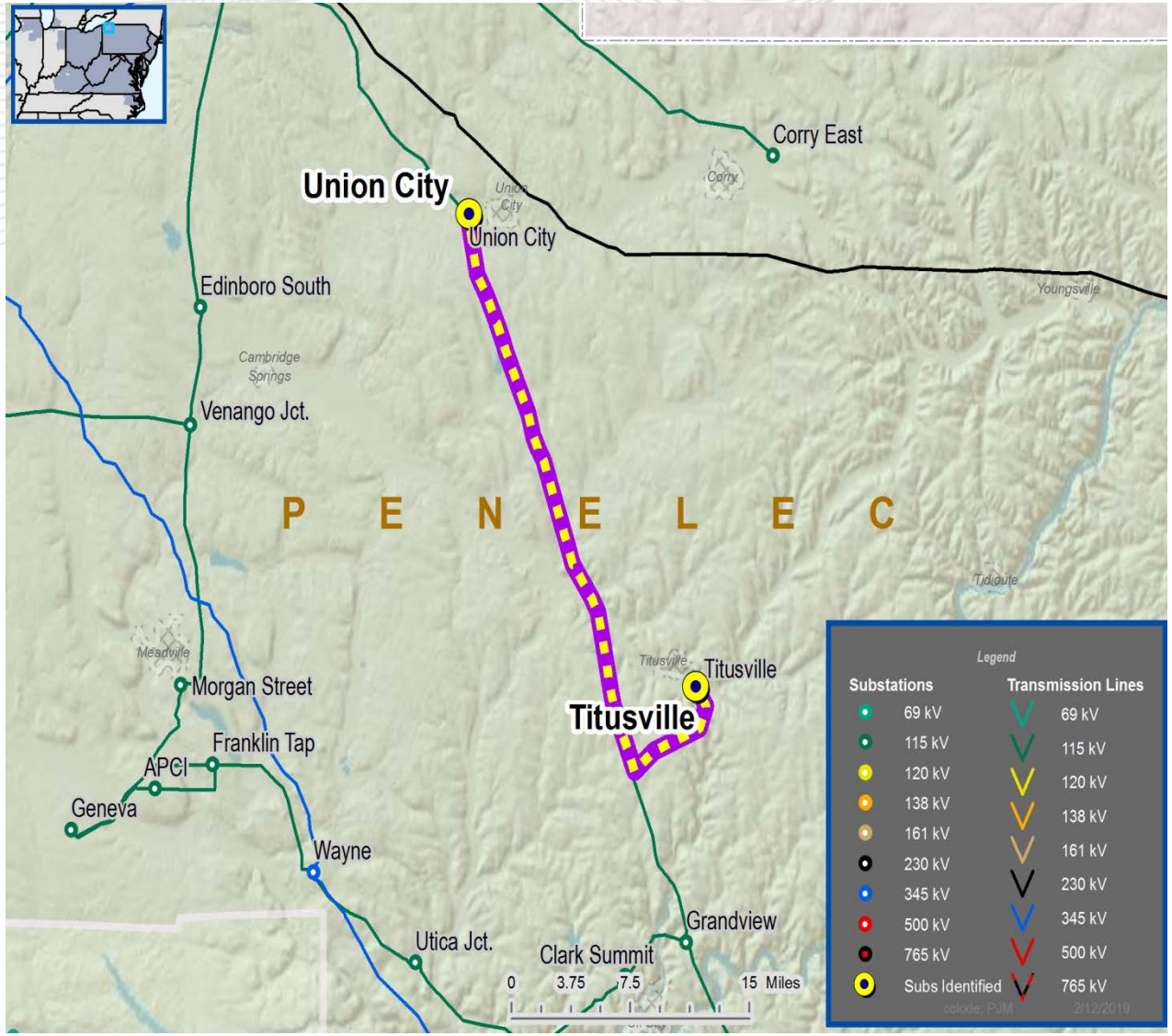
- System reliability and performance
- Substation/line equipment limits

Upgrade Relay Schemes

- Relay schemes that have a history of misoperation
- Obsolete and difficult to repair communication equipment (DTT, Blocking, etc.)
- Communication technology upgrades
- Bus protection schemes

Problem Statement

- FirstEnergy has identified protection schemes using a certain vintage of relays and communication equipment that have a history of misoperation.
- Proper operation of the protection scheme requires all the separate components perform adequately during a fault.
- In many cases the protection equipment cannot be repaired due to a lack of replacement parts and available expertise in the outdated technology.
- Transmission line ratings are limited by terminal equipment.
- Line has failed carrier equipment that cannot be repaired or replaced



Penelec Transmission Zone

Need Number: PN-2019-010
Process Stage: Solution
Need Presented: 02/22/2019
Meeting Date: 03/25/2019

Project Driver(s):

Equipment Material Condition, Performance and Risk and Operational Flexibility and Efficiency

Specific Assumption Reference(s)

System Performance Projects Global Factors

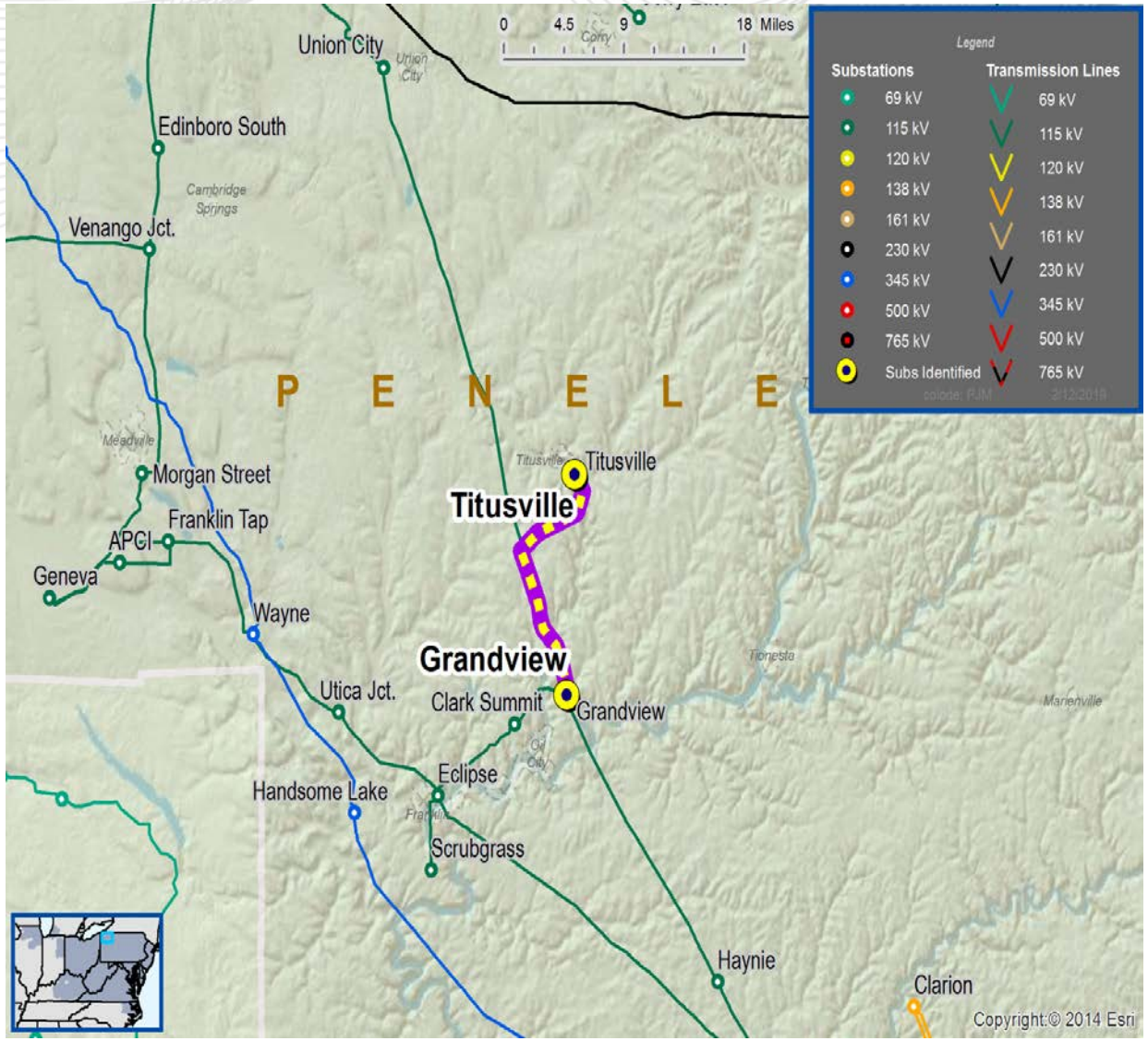
- System reliability and performance
- Substation/line equipment limits

Upgrade Relay Schemes

- Relay schemes that have a history of misoperation
- Obsolete and difficult to repair communication equipment (DTT, Blocking, etc.)
- Communication technology upgrades
- Bus protection schemes

Problem Statement

- FirstEnergy has identified protection schemes using a certain vintage of relays and communication equipment that have a history of misoperation.
- Proper operation of the protection scheme requires all the separate components perform adequately during a fault.
- In many cases the protection equipment cannot be repaired due to a lack of replacement parts and available expertise in the outdated technology.
- Transmission line ratings are limited by terminal equipment.
- Line has failed carrier equipment that cannot be repaired or replaced



Penelec Transmission Zone

Need Number: PN-2019-012
Process Stage: Solution
Need Presented: 02/22/2019
Meeting Date: 03/25/2019

Project Driver(s):

Equipment Material Condition, Performance and Risk and Operational Flexibility and Efficiency

Specific Assumption Reference(s)

System Performance Projects Global Factors

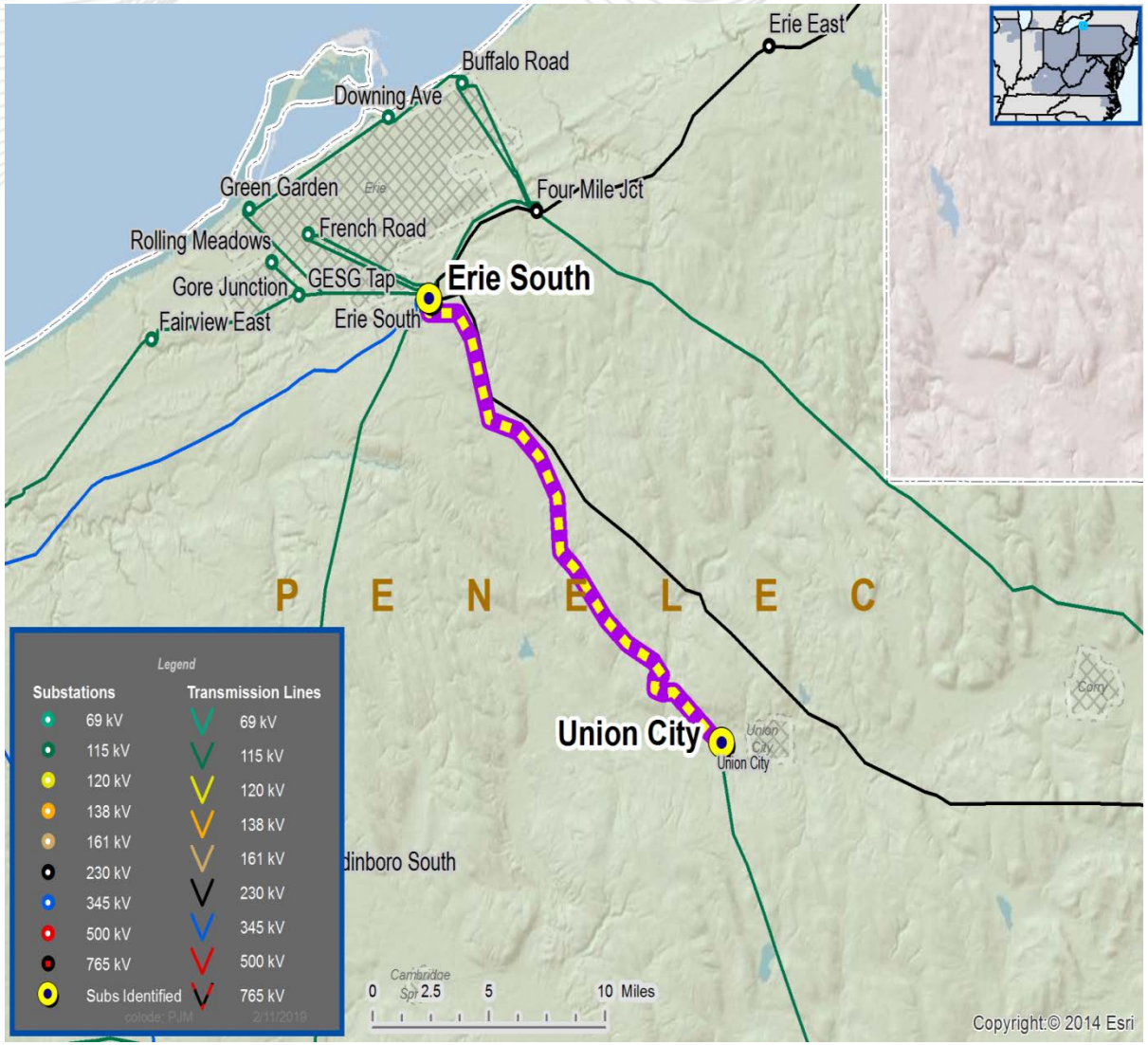
- System reliability and performance
- Substation/line equipment limits

Upgrade Relay Schemes

- Relay schemes that have a history of misoperation
- Obsolete and difficult to repair communication equipment (DTT, Blocking, etc.)
- Communication technology upgrades
- Bus protection schemes

Problem Statement

- FirstEnergy has identified protection schemes using a certain vintage of relays and communication equipment that have a history of misoperation.
- Proper operation of the protection scheme requires all the separate components perform adequately during a fault.
- In many cases the protection equipment cannot be repaired due to a lack of replacement parts and available expertise in the outdated technology.
- Transmission line ratings are limited by terminal equipment.
- Line has failed carrier equipment that cannot be repaired or replaced



Proposed Solution

PN-2019-	Transmission Line / Substation Locations	New MVA Line Rating (SN / SE)	Scope of Work	Estimate Costs ($ M)	Target ISD
007	Lenox – North Meshoppen 115 kV Line	167 / 202	• Lenox 115 kV Substation: Replace line relaying, line trap, substation conductor and line drops, and circuit breaker.	$0.6M	12/31/2020
008	Ridgway – Whetstone 115 kV Line	202 / 245	• Ridgway 115 kV Substation: Replace line relaying and circuit breaker. • Whetstone 115 kV Substation: Replace line relaying.	$1.1M	12/31/2022
009	Union City – Titusville 115 kV Line	202 / 245	• Union City 115 kV Substation: Replace line relaying and line trap. • Titusville 115 kV Substation: Replace line relaying and line trap. (Note - Limiting substation conductor will be replaced as part of PN-2019-013.)	$0.8M	3/1/2020
010	Grandview – Titusville 115 kV Line	202 / 245	• Grandview 115 kV Substation: Replace line relaying and line trap. • Titusville 115 kV Substation: Replace line relaying, breaker, and line trap. (Note - Limiting substation conductor will be replaced as part of PN-2019-013.)	$1.1M	10/31/2020
012	Erie South – Union City 115 kV Line	232 / 282	• Erie South 115 kV Substation: Replace line relaying and line trap. • Union City 115 kV Substation: Replace line relaying, line trap, and substation conductor.	$1.3M	3/31/2022

Alternatives Considered:

- **Maintain existing condition and elevated risk of failure**

No topology changes, no bubble diagram required.

All projects are in the Conceptual phase.

Penelec Transmission Zone M-3 Process
Buffalo Road 115 kV Ring Bus

Need Number: PN-2019-021

Process Stage: Solutions Meeting 5/31/2019

Previously Presented: Need Meeting 4/26/2019

Supplemental Project Driver:

Operational Flexibility and Efficiency

Specific Assumption References:

System Performance Projects

- Substation/line equipment limits
- Load at risk in planning and operational scenarios

Add/Expand Bus Configuration

- Eliminate simultaneous outages to multiple networked elements

Problem Statement:

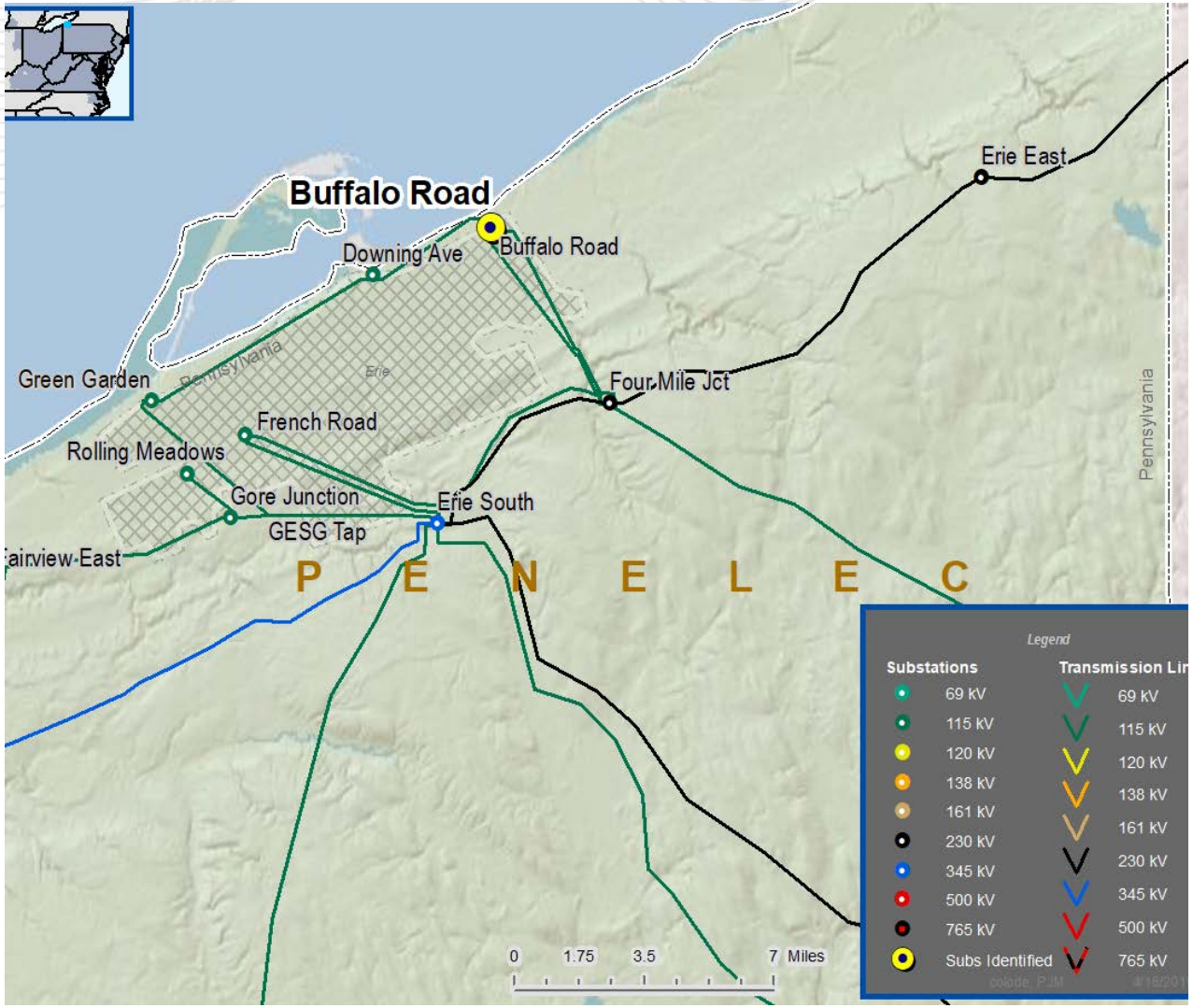
Buffalo Road 115 kV substation serves approximately 106 MW of load and 3,500 customers. A stuck bus tie breaker at Buffalo Road will outage both 115-34.5 kV transformers and three 115 kV lines.

Transmission lines are limited by terminal equipment.

- Buffalo Road – Four Mile Junction BRFM2 115 kV Line:

Existing line rating is 190/226 MVA (SN/SE). Existing conductor rating is 202/245 MVA (SN/SE).

(substation conductor)



Penelec Transmission Zone M-3 Process
Buffalo Road 115 kV Ring Bus

Need Number: PN-2019-021

Process Stage: Solutions Meeting 5/31/2019

Potential Solution:

Construct Buffalo Road 115 kV Ring Bus

At Buffalo Road:

- Expand the bus configuration to a six breaker ring bus by installing three new 115 kV breakers
- Replace limiting substation conductor

At Green Garden:

- Adjust remote end relaying as necessary

At Four Mile:

- Adjust remote end relaying as necessary

Transmission Line Rating:

- Buffalo Road – Four Mile Junction BRFM2 115 kV Line:
  - Before Proposed Solution: 190/226 MVA (SN/SE)
  - After Proposed Solution: 202/245 MVA (SN/SE)

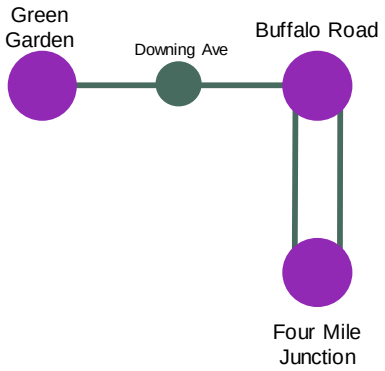
Alternatives Considered:

- Maintain existing condition

Estimated Project Cost: $9.0M

Projected In-Service: 6/1/2022

Status: Conceptual



Legend	
500 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
New	

Penelec Transmission Zone: Baseline

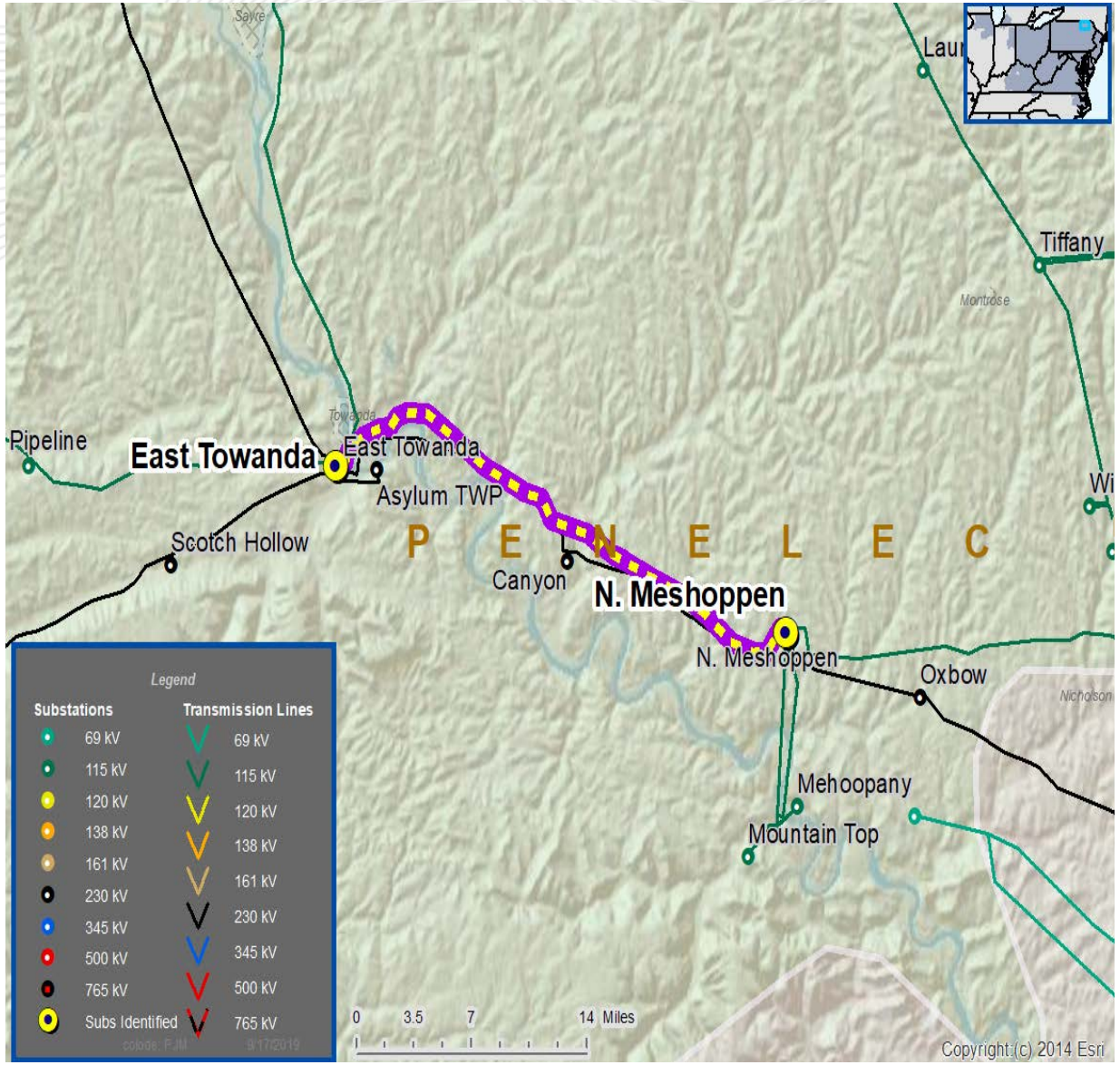
Process Stage: Second Review
Previously Presented: 9/24/2019

Winter: GD-W18

Problem Statement:
The Towanda – North Meshoppen 115 kV circuit is overloaded for single contingency the loss of the East Towanda – Canyon – North Meshoppen 230 kV circuit in the Winter generation deliverability study. The circuit is rated at 167N/202E Summer and 188N/239W Winter.

Proposal Window Exclusion: Below 200 kV

Recommended Solution:
Rebuild ~20 miles of the East Towanda - North Meshoppen 115 kV line and adjust relay settings at East Towanda and North Meshppen 115 kV. (B3137)
(New rating 202N/245E summer 228N/290E winter)
Alternatives Considered:
None
Estimated Project Cost : $58.6 M
Required IS Date: 6/1/2024
Projected IS date: 6/1/2024
Status: Conceptual



RTEP Projects Previously Presented to IPSAC

Previously Presented Projects sorted by Projected In Service Date

Upgrade ID	Description	Transmission Owner	Date Presented to IPSAC	Projected In Service Date
s1646	Install a second Wayne 345/115 kV 168/224 MVA transformer. Convert the 115 kV yard to a 4 breaker ring bus.	PENELEC	12/10/2018	6/1/2019
s1731	Convert the Erie West 115 kV substation into a five (5) breaker ring bus.	PENELEC	12/10/2018	12/31/2019
b3029	Install 69 kV underground transmission line from Harings Corner Station terminating at Closter Station (about 3 miles).	RECO	12/10/2018	5/31/2020
s1350	Niles Valley-Wellsboro. Construct ~5 miles of 115 kV line using existing right-of-way (where possible). Install new 115 kV bus tie breaker at Niles Valley. Relocate Potter 115 kV line at Niles Valley. Install two SCADA controlled switches. Install switch structure for future network line extension.	PENELEC	5/18/2018	6/1/2020
s1729	Expand the existing North Meshoppen 115 kV yard to a breaker-and-a-half configuration	PENELEC	12/10/2018	12/31/2020
b3017.1	Rebuild Glade to Warren 230 kV line with hi-temp conductor and substation terminal upgrades. 11.53 miles. New conductor will be 1033 ACSS. Existing conductor is 1033 ACSR.	PENELEC	12/10/2018	6/1/2021
b3017.2	Glade substation terminal upgrades. Replace bus conductor, wave traps, and relaying.	PENELEC	12/10/2018	6/1/2021
b3017.3	Warren substation terminal upgrades. Replace bus conductor, wave traps, and relaying.	PENELEC	12/10/2018	6/1/2021
b3016	Upgrade terminal equipment at Corry East 115 kV to increase rating of Four Mile to Corry East 115 kV line. Replace bus conductor.	PENELEC	12/10/2018	6/1/2021
b3024	Upgrade terminal equipment at Corry East 115 kV to increase rating of Warren to Corry East 115 kV line. Replace bus conductor.	PENELEC	12/10/2018	6/1/2021
b2836	Convert the N-1340 and T-1372/D-1330 (Brunswick – Trenton) 138 kV circuits to 230 kV circuits	PSEG	5/18/2018	12/31/2021
b2952	Replace the North Meshoppen #3 230/115kV transformer eliminating the old reactor and installing two breakers to complete a 230kV ring bus at North Meshoppen	PENELEC	5/18/2018	6/1/2022
b2837	Convert the F-1358/Z1326 and K1363/Y-1325 (Trenton - Burlington) 138 kV circuits to 230 kV circuits	PSEG	5/18/2018	6/1/2022
s1672	Rebuild ~66 miles of 115 kV line (Seward-Piney-Glory) using double circuit 230 kV construction (Install 1033 ACSR conductor (six-wired) energized at 115 kV)	PENELEC	12/10/2018	12/1/2023

PJM Market Efficiency Update
NYISO/ISO-NE IPSAC meeting

Dec 9, 2019

PJM Market Efficiency Process Enhancement Task Force Update

Background and PJM Filings

- Market Efficiency Process Enhancement Task Force (MEPETF) was approved in January 2018
  - Address challenges and opportunities for improvements to the Market Efficiency process since implementing Order 1000 processes
  - MEPETF Phase 1 and Phase 2 completed
- At the end of 2018, PJM filed proposed revisions to
  - Benefit/cost analysis it conducts in its evaluation of economic-based projects as part of its regional transmission expansion plan (RTEP) process
  - Generation assumptions that go into PJM's market efficiency analysis
- In February 2019, FERC accepted PJM's proposed revisions*

**Benefit/Cost Analysis Docket Nos. ER19-80-000 and ER19-80-001; Generation Assumptions Docket No.ER19-562-000*

Phase 3 – Status and Next Steps

- MEPETF Phase 3 authorized by Planning Committee in June 2019
  - Address concerns with the coupling of energy and capacity benefits
  - Discuss Regional TMEP concept and explore any necessary alternatives
  - Evaluate alternative method for the benefits summation
- PJM is proposing three changes to the market efficiency process
  - create stand-alone process to address RPM drivers independent of energy driver analysis
  - modify calculation inputs for RPM benefits
  - create a backwards looking “quick hit” market efficiency process to address persistent congestion not identified in the forward looking planning model
- Next Steps
  - Planning Committee first read December 2019, vote January 2020
  - Recommend group sunset at January PC vote
  - MRC first read (if necessary) February 2020, vote (if necessary) March 2020
  - File OA changes with FERC April 2020 effective for 20/21 window

2018/19 Long Term Window Update

2018/19 RTEP Window Posted Congestion Drivers

2018/19 RTEP Market Efficiency Window Eligible Congestion Drivers*				Simulated Annual Congestion ($M)		Hours Binding				
FG#	Constraint	From Area	To Area	2023 Simulated Year	2026 Simulated Year	2023 Simulated Year	2026 Simulated Year	Line is conductor limited?	Comment	Potential Upgrades
ME-1	Hunterstown to Lincoln 115 kV	METED	METED	$20.77	$29.62	1720	1832	Yes	Internal Flowgate	
ME-2	Monroe to Wayne 345 kV	MISOE	MISOE	$1.44	$0.61	45	30	MISO	M2M	
ME-6	Marblehead 161/138 kV	MISOC	MISOC	$1.41	$1.18	195	138	MISO	M2M	A PJM/MISO TMEP has been approved for this facility.
ME-7	Bosserman to Trail Creek 138 kV	AEP	MISOE	$1.47	$1.69	66	89	Yes	M2M	

* Market Efficiency Base Case witout FSA/Susp ISA units

Analysis Timeline

• Data Validation	Mar-Apr 2019
• Independent review of cost and ability to build	Apr-Nov 2019
• Finalize Mid-cycle base case	May 2019
• Analysis of proposed solutions*	May-Oct 2019
• Review of Analysis with TEAC	Jun-Nov 2019
• Determination of Final Projects	Dec 2019

* Due to the need to coordinate with MISO, interregional proposals will be analyzed first.

PJM-MISO Interregional Market Efficiency Project Study

- In parallel with the 2018/19 RTEP Window, PJM and MISO have conducted a two-year Interregional Market Efficiency Project (IMEP) study
- Issues identification and benefit determination conducted in each regional process consistent with current effective JOA
- Interregional proposals must:
  - Address at least one identified issue in each region (could be same issue if identified by both RTOs)
  - Be submitted to both regional processes

PJM-MISO IMEP Study Conclusions

- Study is complete, concluding 2019 Coordinated System Plan

- Three drivers identified:
  - Marblehead N 161/138 kV Transformer
    - No proposed project met B/C criteria in either region
  - Lallendorf – Monroe 345 kV
    - No proposed project effectively resolved congestion
  - Bosserman – Trail Creek 138 kV
    - Rebuilding Michigan City to Trail Creek to Bosserman 138 kV pending regional approvals

Hunterstown – Lincoln Analysis

- Preliminary results presented at July 2019 TEAC
  - Calculated preliminary benefits and determined preliminary B/C ratios

- Three lower cost proposals fully relieve congestion on the driver with minimal shift in congestion
  - HL_469: Install SmartWire** power flow control series device
  - HL_622: Rebuild the Hunterstown-Lincoln 115 kV line
  - HL_960: Build new Hunterstown-Lincoln 115 kV line

- Proposals currently under Cost / Constructability Analysis

Next Steps

- 2nd read for proposal BT_481, Bosserman-Trail Creek 138 kV, at November TEAC and recommend BT_481 for provisional* approval at the December Board meeting

- Complete Hunterstown – Lincoln cluster analysis**

Notes:

**Dependent on MISO Board approval of same project*

***PJM is currently monitoring on-going developments relating to the Hunterstown-Lincoln congestion driver. The outcome of these developments may impact the market efficiency analysis for this driver. Further updates will be provided as they become available.*

Questions?