



Sub Regional RTEP Committee PJM Mid-Atlantic First Energy MAAC

March 25, 2019

Needs

Stakeholders must submit any comments within 10 days of this meeting in order to provide time necessary to consider these comments prior to the next phase of the M-3 process

Need Number: JCPL-2019-016 and 018

Process Stage: Need Meeting

Date: 03/25/2019

Project Driver(s):

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

Specific Assumption Reference(s)

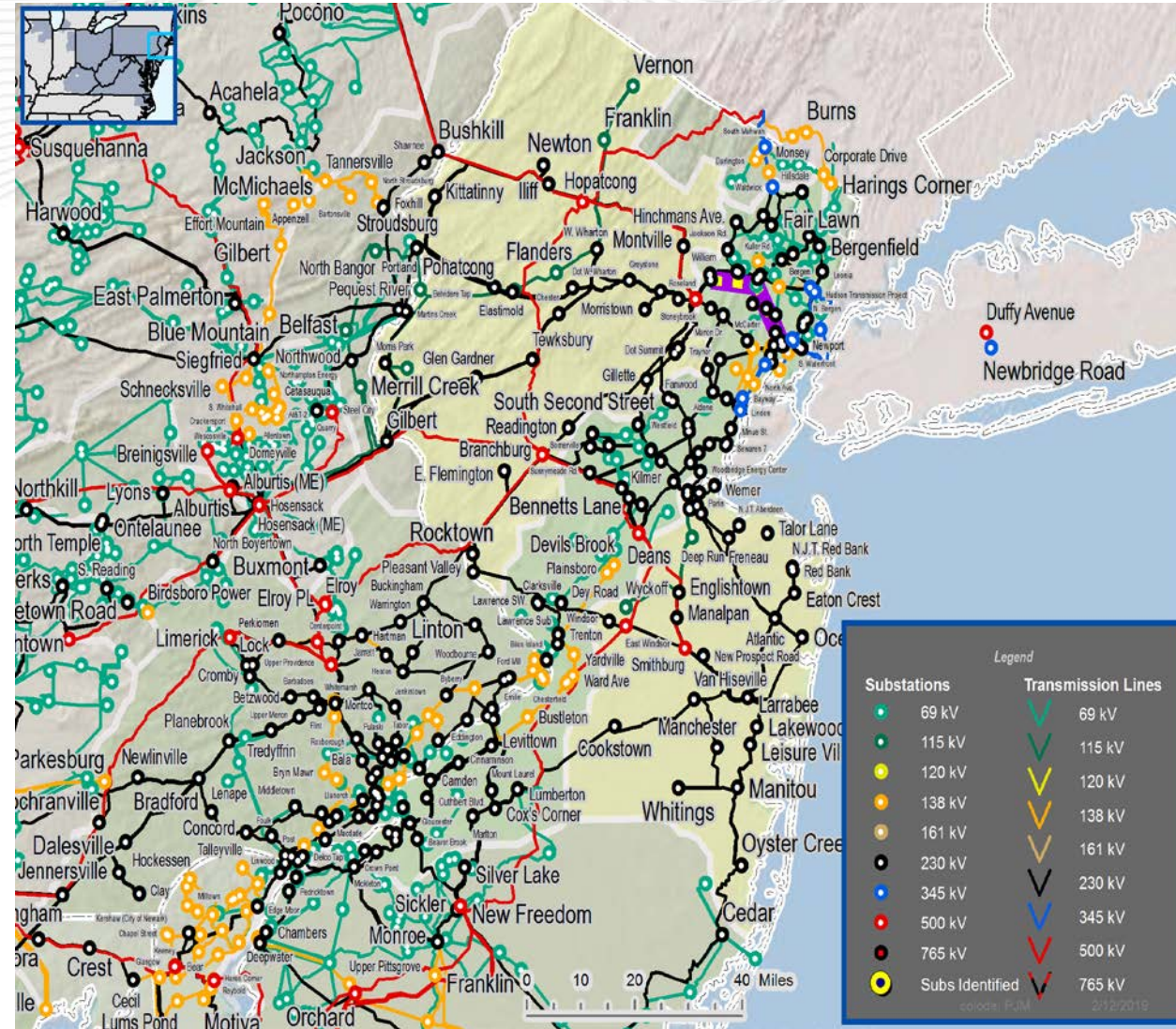
System Performance Projects Global Factors

- 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

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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cases the protection equipment cannot be repaired due to a lack of replacement parts and available expertise in the outdated technology.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.

JCPL-2019-	Transmission Line / Substation Locations	Existing MVA Line Rating (SN / SE)	Existing MVA Conductor Rating (SN / SE)	Limiting Terminal Equipment
016	Vernon – West Wharton 115 kV Line	141 / 148	147 / 176	Substation Conductor
018	Flanders – Glen Gardner 115 kV Line	173 / 218	184 / 223	Substation Conductor



Need Number: JCPL-2019-016
 Process Stage: Need Meeting
 Date: 03/25/2019

Project Driver(s):

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

Specific Assumption Reference(s)

System Performance Projects Global Factors

- System reliability and performance
- Substation/line equipment limits

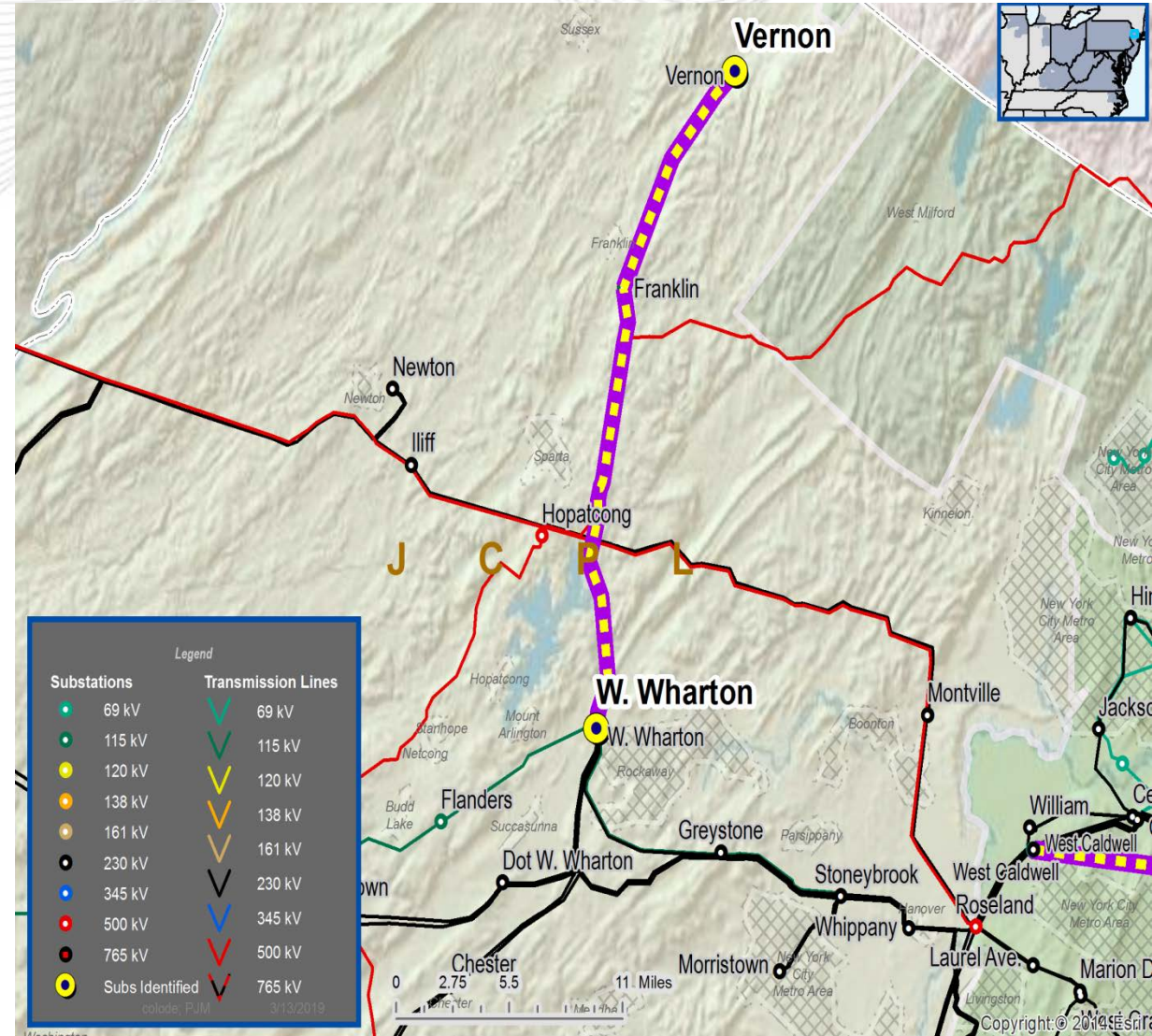
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JCP&L Transmission Zone



Need Number: JCPL-2019-018
 Process Stage: Need Meeting
 Date: 03/25/2019

Project Driver(s):
Equipment Material Condition, Performance and Risk
Operational Flexibility and Efficiency

Specific Assumption Reference(s)
 System Performance Projects Global Factors

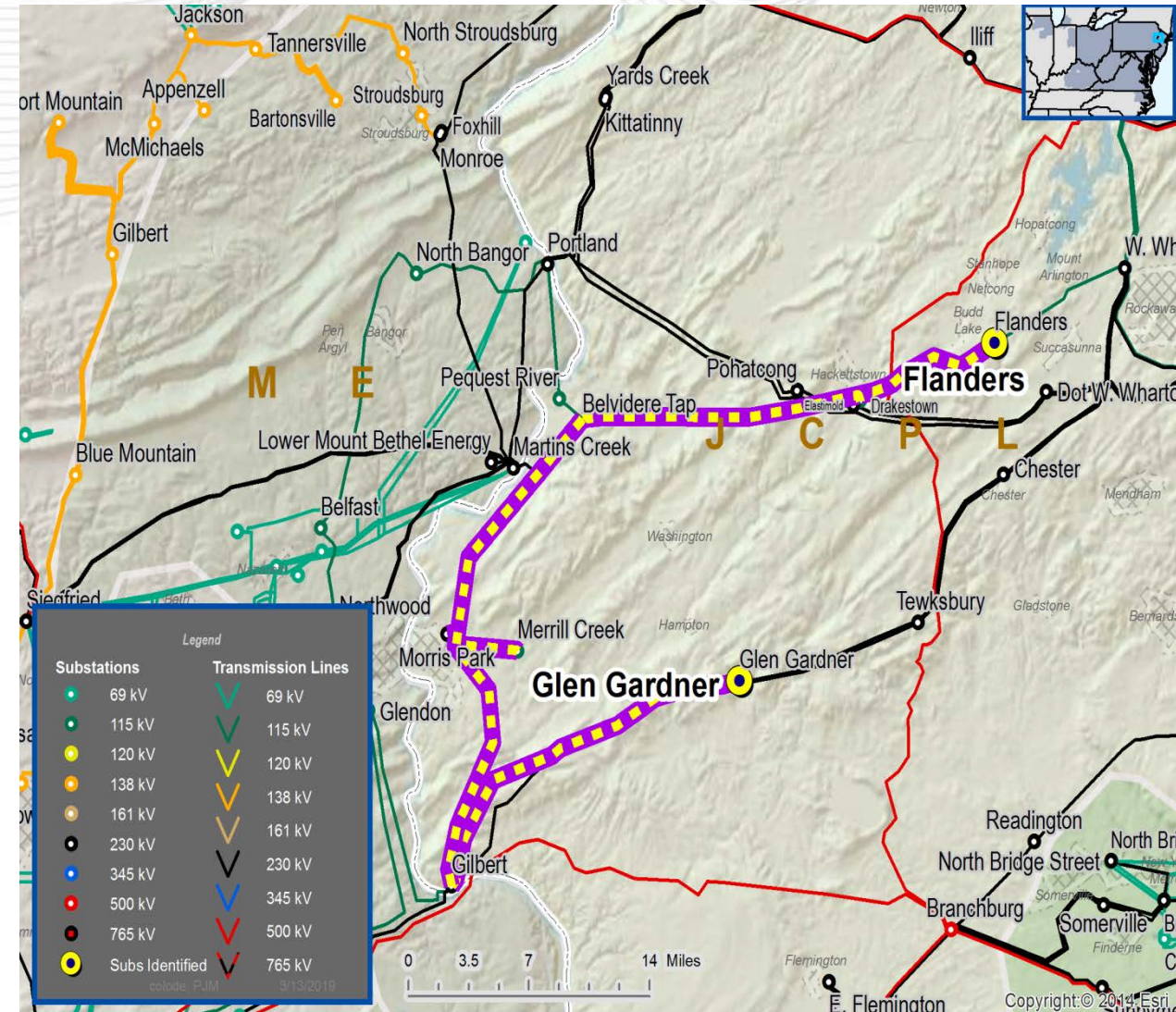
- System reliability and performance
- Substation/line equipment limits

Upgrade Relay Schemes

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Need Number: JCPL-2019-022 to 027

Process Stage: Need Meeting

Date: 03/25/2019

Project Driver(s):

Equipment Material Condition, Performance and Risk

Specific Assumption Reference(s)

Line Condition Rebuild/Replacement

- Age/condition of wood pole transmission line structures
- Age/condition of steel tower or steel pole transmission line structures
- Age/condition of transmission line conductors

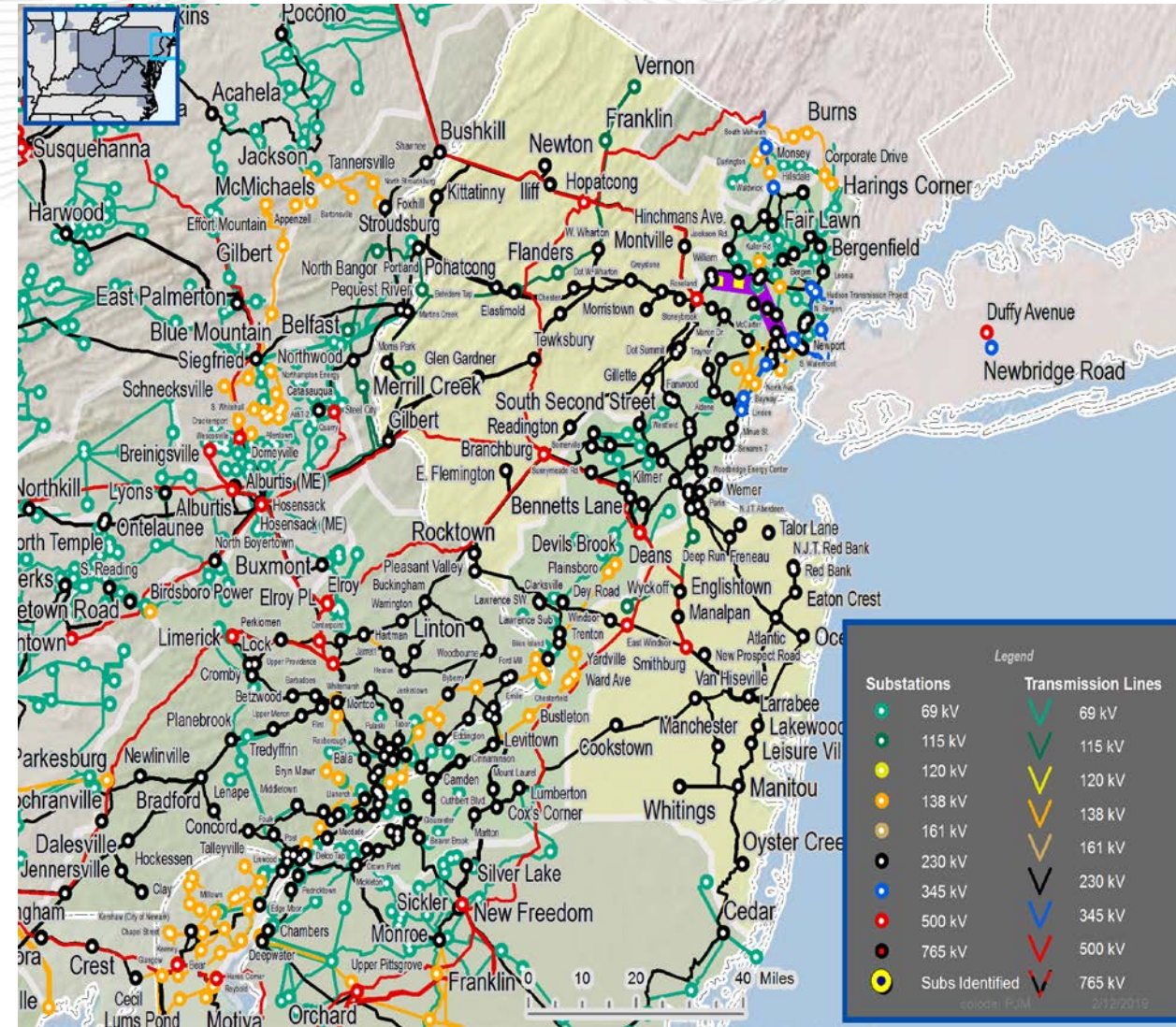
System Performance Projects

- Substation/line equipment limits

Problem Statement

- Line sections are exhibiting deterioration, increasing maintenance needs. Transmission line is approaching end of life
- Transmission line ratings are limited by terminal equipment

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JCPL-2019-	Transmission Line / Substation Locations	Existing Circuit Rating (SN / SE)	Existing Conductor Rating (SN / SE)	Limiting Terminal Equipment	Length of Line (miles)	Identified Structures (end of life / total)	Failure reasons
022	Bernardsville – Long Lines 34.5 kV Line	44 / 47	44 / 53	Line Relaying, Substation Conductor	5.3	260 / 416 (63% Failure Rate)	Age, bad/cut/missing grounds, woodpecker holes, etc.
	Long Lines – Greater Crossroads 34.5 kV Line	44 / 53	44 / 53	-	3.2		
	Greater Crossroads – Merck 34.5 kV Line	44 / 53	44 / 53	-	6.2		
023	Gilbert – Bridgeton 34.5 kV Line	37 / 45	37 / 45	-	3.9	275 / 346 (79% Failure Rate)	Age, bad/cut/missing grounds, woodpecker holes, etc.
	Bridgeton – Frenchtown 34.5 kV Line	37 / 45	37 / 45	-	2.3		
	Frenchtown – Frenchtown Solar 34.5 kV Line	39 / 48	39 / 48	-	4.6		
	Frenchtown Solar – Rosemont 34.5 kV Line	39 / 48	39 / 48	-	3.5		
	Rosemont – Alexauken 34.5 kV Line	39 / 48	39 / 48	-	4.5		
	Alexauken – Rocktown 34.5 kV Line	44 / 53	44 / 53	Line Relaying	2.0		
024	Greystone – Davis 34.5 kV Line	66 / 79	70 / 85	Substation Conductor	2.2	181 / 383 (48% Failure Rate)	Age, bad/cut/missing grounds, woodpecker holes, etc.
	Davis – Alderney 34.5 kV Line	46 / 58	46 / 58	-	0.3		
	Alderney – Tabor Tap 34.5 kV Line	46 / 58	46 / 58	-	0.3		
	Tabor Tap – Morristown Tap 34.5 kV Line	44 / 53	44 / 53	-	1.1		
	Morristown Tap – Morris Plains Tap 34.5 kV Line	44 / 53	44 / 53	-	0.2		
	Morris Plains Tap – Morristown 34.5 kV Line	34 / 43	34 / 43	-	3.6		
	Morris Plains Tap – Morris Plains 34.5 kV Line	41 / 52	83 / 100	Disconnect Switches	1.5		
	Morristown Tap – Whippany	41 / 50	41 / 50	-	6.2		

JCPL-2019-	Transmission Line / Substation Locations	Existing Circuit Rating (SN / SE)	Existing Conductor Rating (SN / SE)	Limiting Terminal Equipment	Length of Line (miles)	Identified Structures (end of life / total)	Failure reasons
025	Highlands – Sandy Hook 34.5 kV Line	37 / 38	37 / 38	-	1.1	182 / 257 (71% Failure Rate)	Age, bad/cut/missing grounds, rot/decay, woodpecker holes, etc.
	Sandy Hook Switch Point – Sandy Hook 34.5 kV Line	26 / 33	37 / 38	Substation Conductor	0.1		
	Sandy Hook Switch Point – Sea Bright Switch Point 34.5 kV Line	37 / 38	37 / 38	-	2.4		
	Sea Bright Switch Point – Monmouth Beach 34.5 kV Line	35 / 38	35 / 38	-	2.0		
	Monmouth Beach – Long Branch 34.5 kV Line	34 / 38	34 / 38	-	2.2		
026	Gillette – Green Village 34.5 kV Line	41 / 50	41 / 50	-	5.7	132 / 134 (99% Failure Rate)	Age, bad/cut/missing grounds, rot/decay, woodpecker holes, etc.
027	Traynor – Madison Switch Point 34.5 kV Line	39 / 50	39 / 50	-	1.5	155 / 322 (48% Failure Rate)	Age, bad/cut/missing grounds, rot/decay, woodpecker holes, etc.
	Madison Switch Point – Madison 34.5 kV Line	55 / 67	55 / 67	-	1.0		
	Madison Switch Point – Academy 34.5 kV Line	35 / 44	35 / 44	-	3.6		
	Academy – Okner 34.5 kV Line	44 / 53	44 / 53	-	2.2		
	Okner – Mount Pleasant 34.5 kV Line	38 / 49	38 / 49	-	1.1		
	Mount Pleasant – Whippany 34.5 kV Line	41 / 49	46 / 58	Substation Conductor	1.5		

Need Number: JCPL-2019-022
 Process Stage: Need Meeting
 Date: 03/25/2019

Project Driver(s):
Equipment Material Condition, Performance and Risk

Specific Assumption Reference(s)

Line Condition Rebuild/Replacement

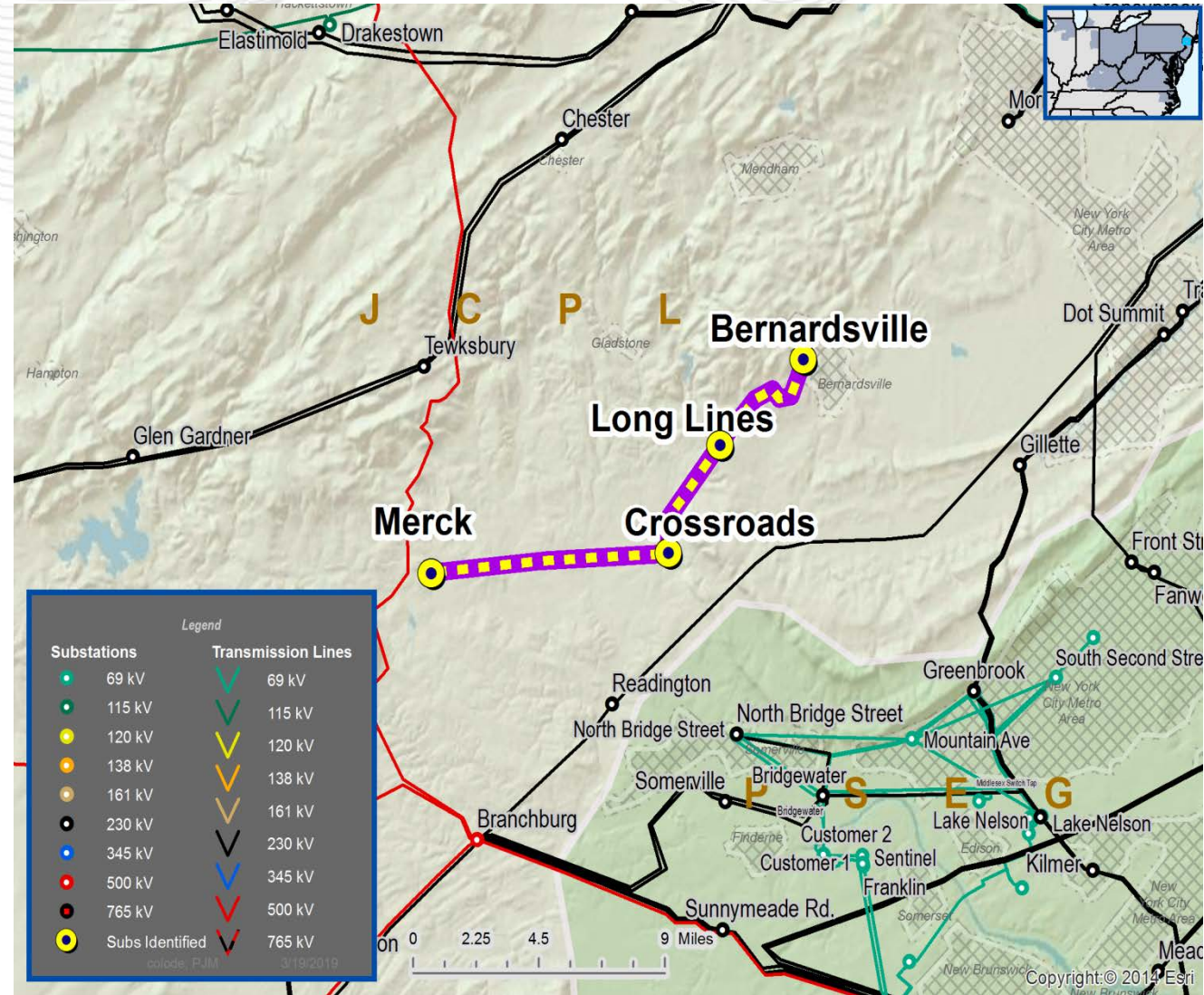
- Age/condition of wood pole transmission line structures
- Age/condition of steel tower or steel pole transmission line structures
- Age/condition of transmission line conductors

System Performance Projects

- Substation/line equipment limits

Problem Statement

- Line sections are exhibiting deterioration, increasing maintenance needs.
 Transmission line is approaching end of life
- Transmission line ratings are limited by terminal equipment



Need Number: JCPL-2019-023
 Process Stage: Need Meeting
 Date: 03/25/2019

Project Driver(s):

Equipment Material Condition, Performance and Risk

Specific Assumption Reference(s)

Line Condition Rebuild/Replacement

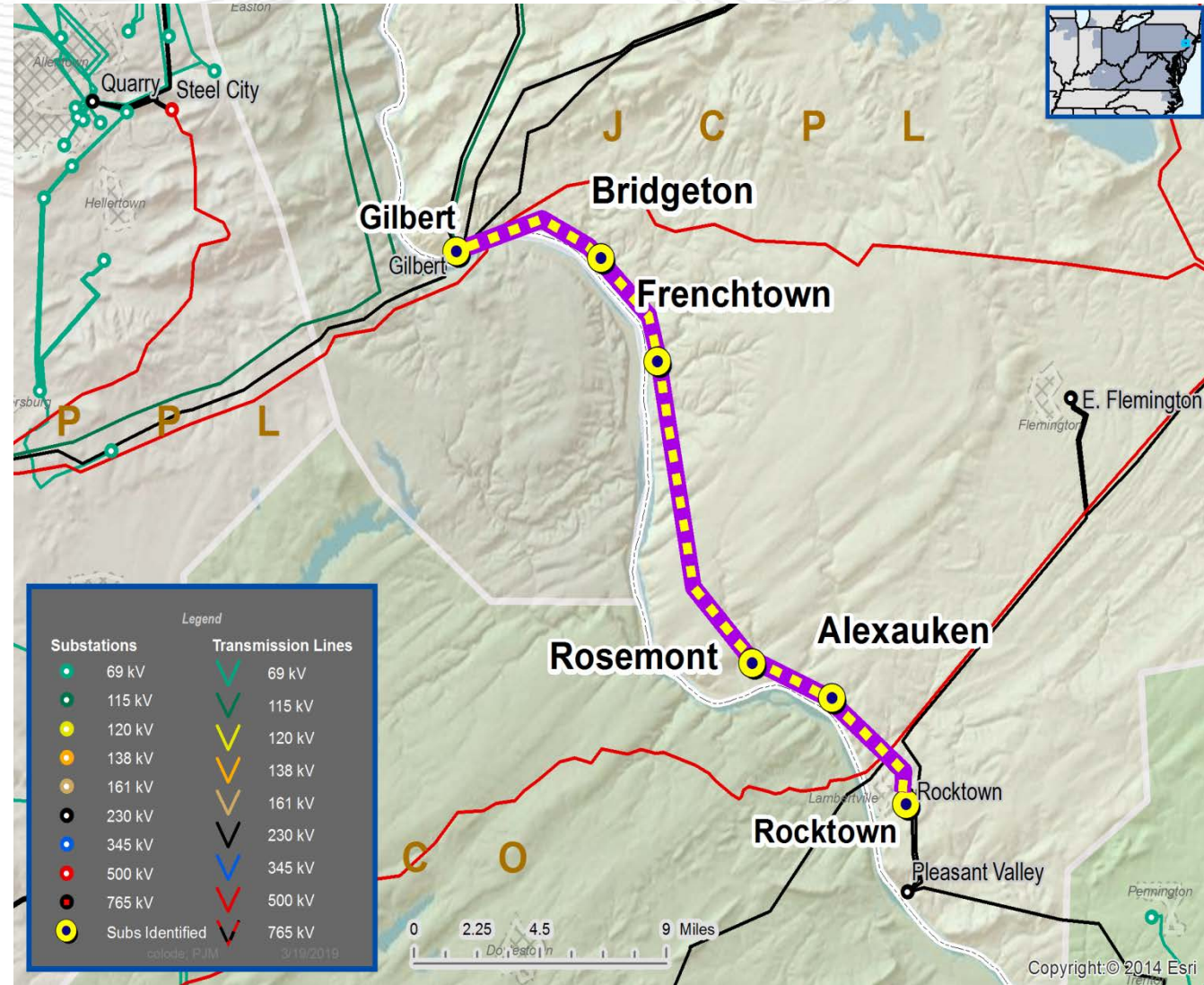
- Age/condition of wood pole transmission line structures
- Age/condition of steel tower or steel pole transmission line structures
- Age/condition of transmission line conductors

System Performance Projects

- Substation/line equipment limits

Problem Statement

- Line sections are exhibiting deterioration, increasing maintenance needs.
Transmission line is approaching end of life
- Transmission line ratings are limited by terminal equipment



Need Number: JCPL-2019-024
 Process Stage: Need Meeting
 Date: 03/25/2019

Project Driver(s):
Equipment Material Condition, Performance and Risk

Specific Assumption Reference(s)

Line Condition Rebuild/Replacement

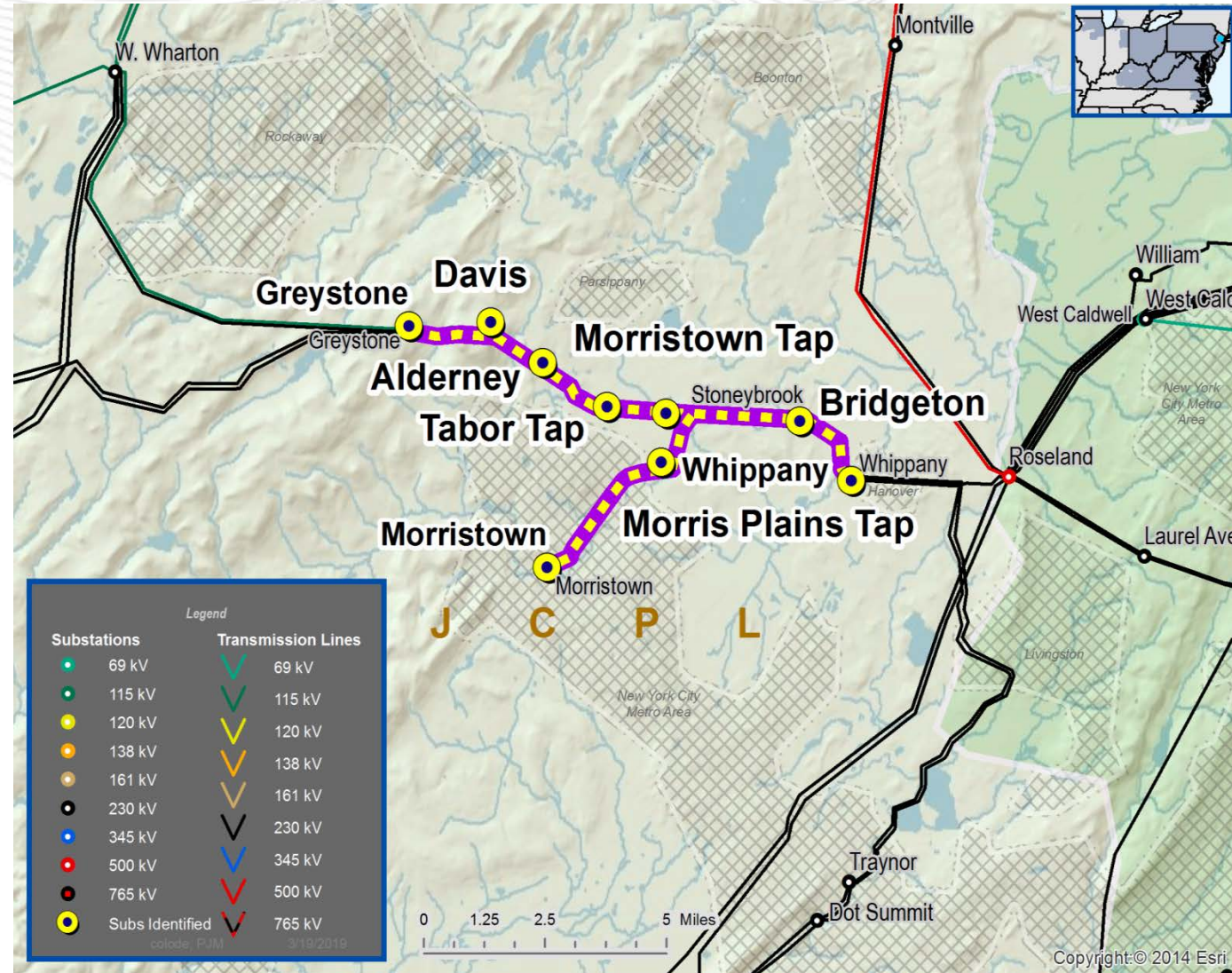
- Age/condition of wood pole transmission line structures
- Age/condition of steel tower or steel pole transmission line structures
- Age/condition of transmission line conductors

System Performance Projects

- Substation/line equipment limits

Problem Statement

- Line sections are exhibiting deterioration, increasing maintenance needs. Transmission line is approaching end of life
- Transmission line ratings are limited by terminal equipment



Need Number: JCPL-2019-025
 Process Stage: Need Meeting
 Date: 03/25/2019

Project Driver(s):
Equipment Material Condition, Performance and Risk

Specific Assumption Reference(s)

Line Condition Rebuild/Replacement

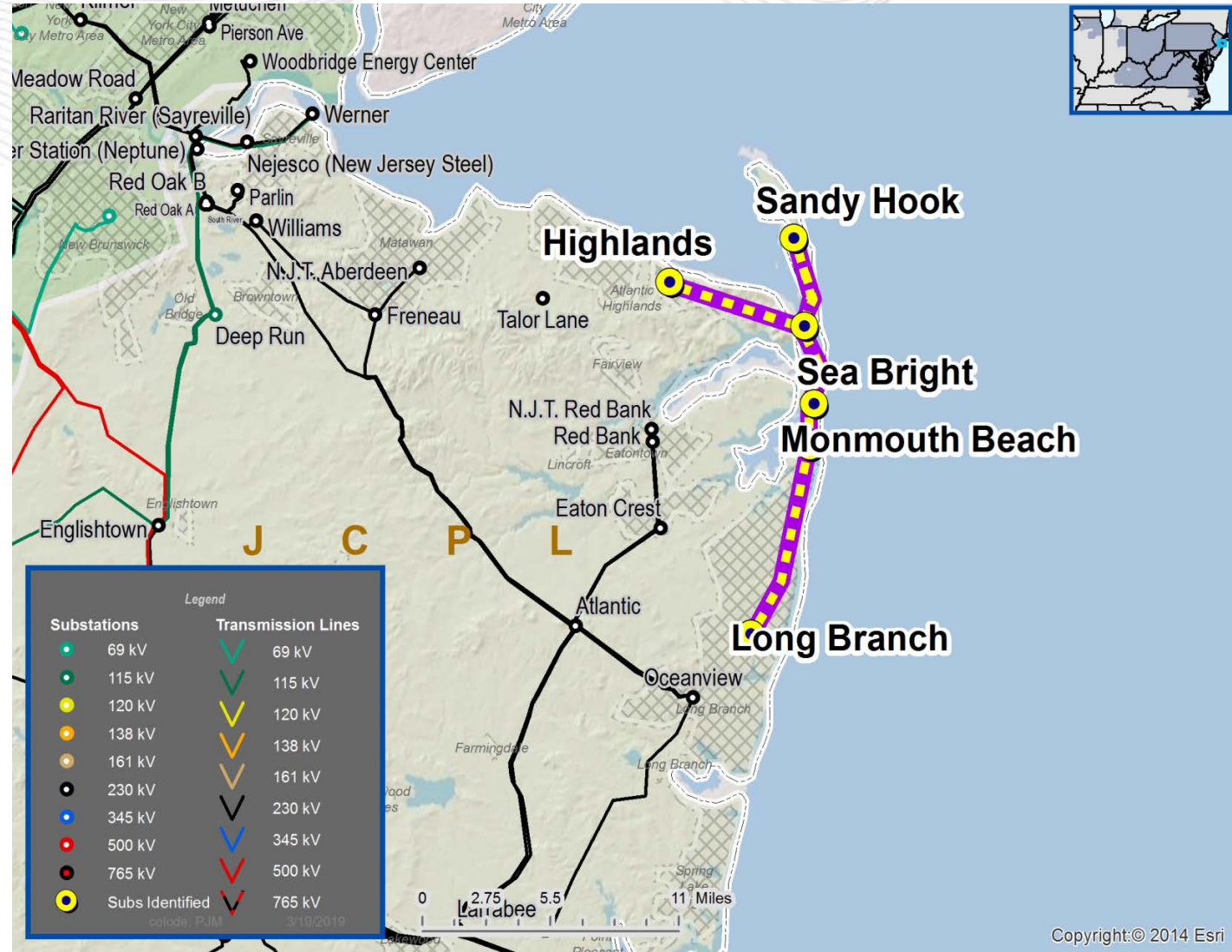
- Age/condition of wood pole transmission line structures
- Age/condition of steel tower or steel pole transmission line structures
- Age/condition of transmission line conductors

System Performance Projects

- Substation/line equipment limits

Problem Statement

- Line sections are exhibiting deterioration, increasing maintenance needs. Transmission line is approaching end of life
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Need Number: JCPL-2019-026
 Process Stage: Need Meeting
 Date: 03/25/2019

Project Driver(s):
Equipment Material Condition, Performance and Risk

Specific Assumption Reference(s)

Line Condition Rebuild/Replacement

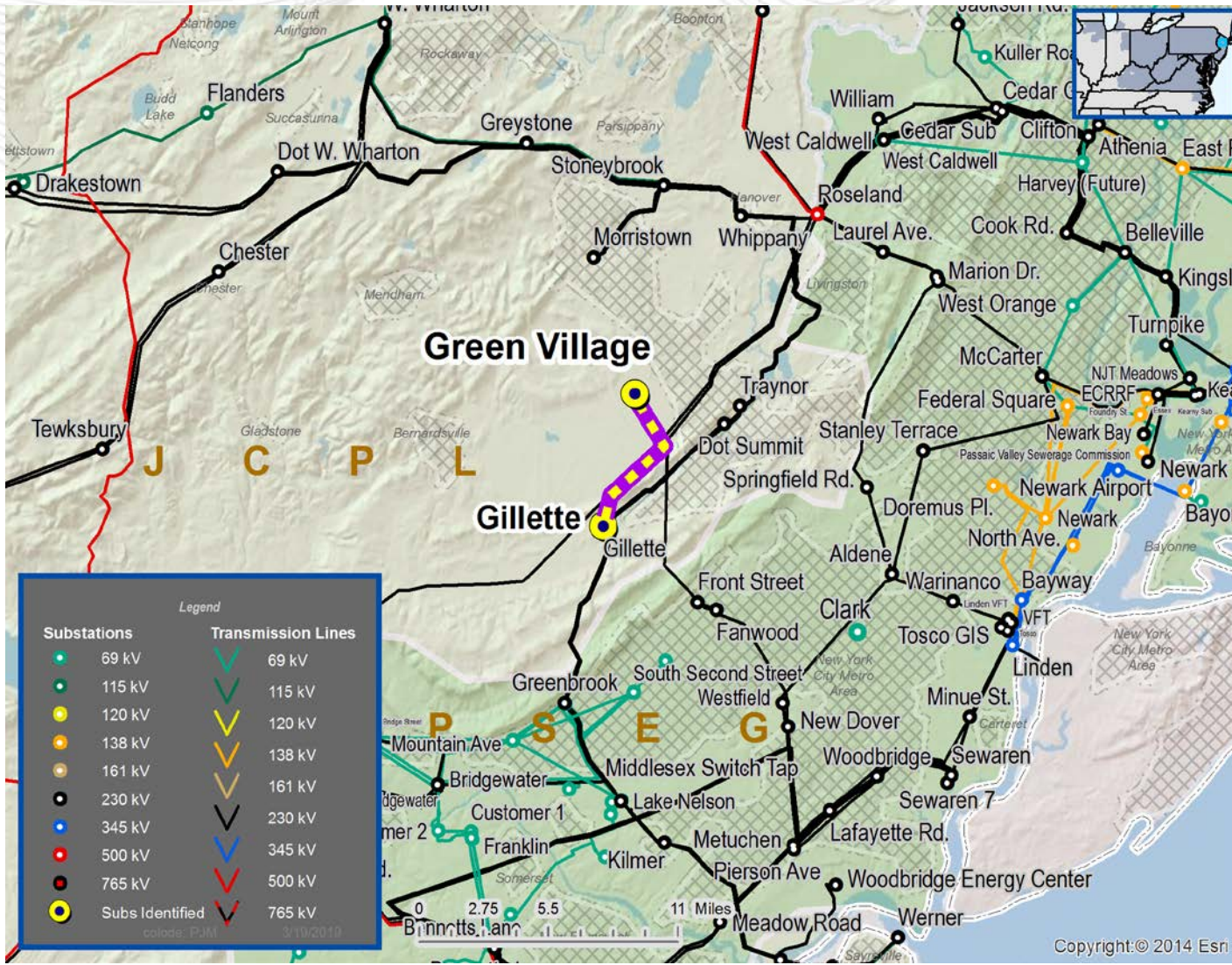
- Age/condition of wood pole transmission line structures
- Age/condition of steel tower or steel pole transmission line structures
- Age/condition of transmission line conductors

System Performance Projects

- Substation/line equipment limits

Problem Statement

- Line sections are exhibiting deterioration, increasing maintenance needs. Transmission line is approaching end of life
- Transmission line ratings are limited by terminal equipment





Need Number: JCPL-2019-027
 Process Stage: Need Meeting
 Date: 03/25/2019

Project Driver(s):

Equipment Material Condition, Performance and Risk

Specific Assumption Reference(s)

Line Condition Rebuild/Replacement

- Age/condition of wood pole transmission line structures
- Age/condition of steel tower or steel pole transmission line structures
- Age/condition of transmission line conductors

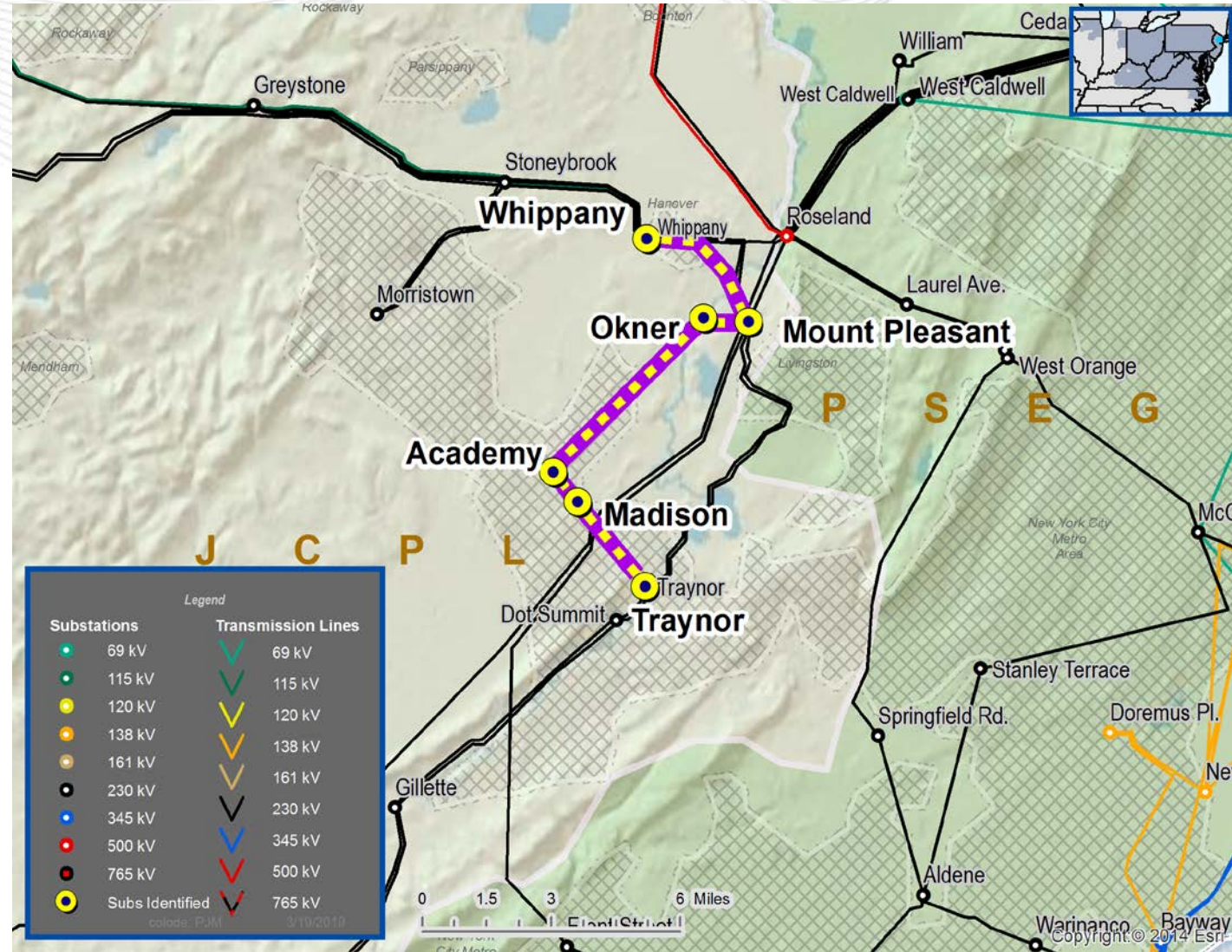
System Performance Projects

- Substation/line equipment limits

Problem Statement

- Line sections are exhibiting deterioration, increasing maintenance needs. Transmission line is approaching end of life
- Transmission line ratings are limited by terminal equipment

JCP&L Transmission Zone



Solutions

Stakeholders must submit any comments within 10 days of this meeting in order to provide time necessary to consider these comments prior to the next phase of the M-3 process

Need Number: JCPL-2019-001 to 005 and 007
 Need Presented: 02/22/2019
 Meeting Date: 03/25/2019
 Process Stage: Solution

Project Driver(s):
*Equipment Material Condition, Performance and Risk
 Operational Flexibility and Efficiency*

Specific Assumption Reference(s)

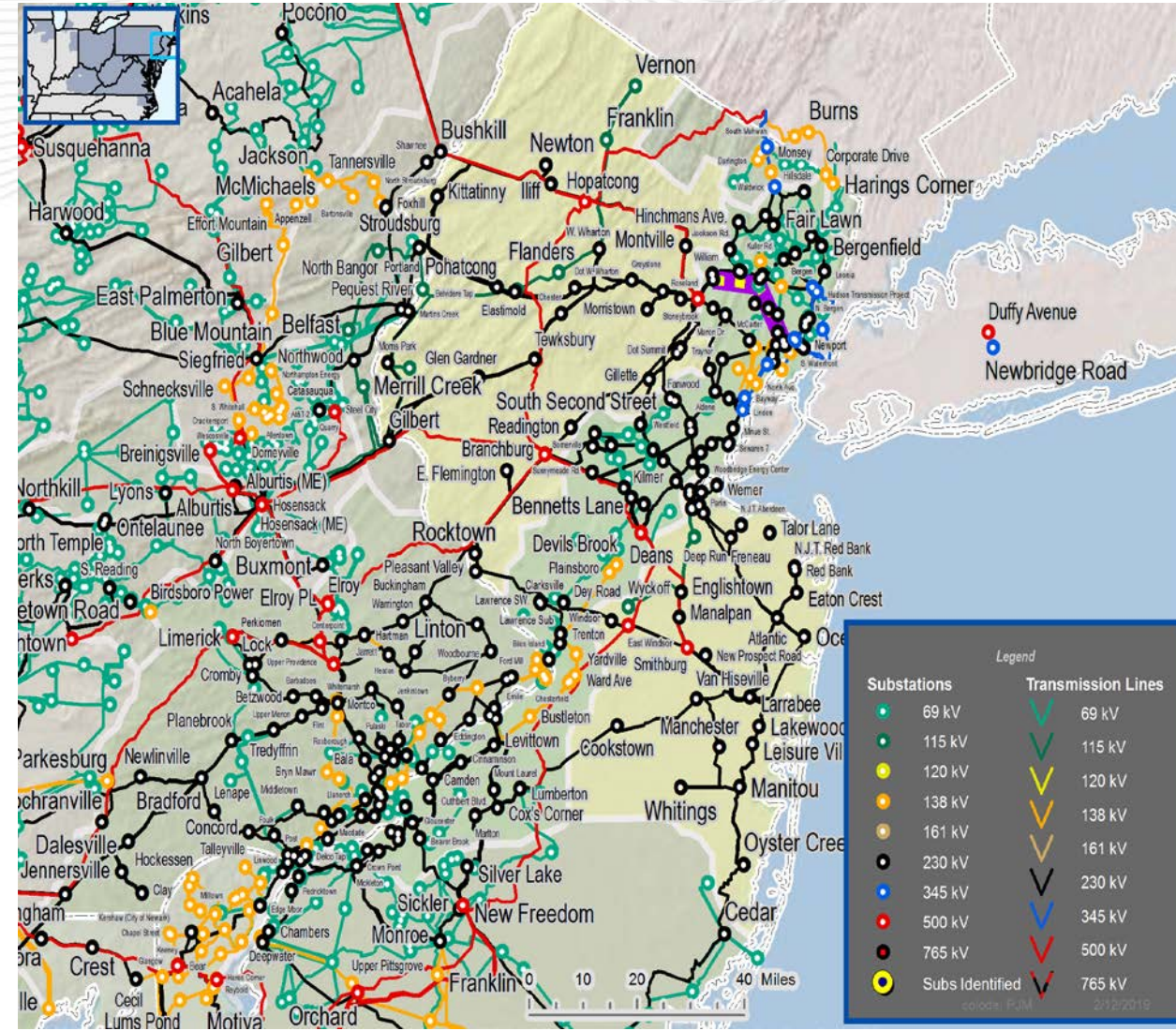
System Performance Projects Global Factors

- 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

Continued on next slide...



Problem Statement

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JCPL-2019-	Transmission Line / Substation Locations	Existing Line Rating (SN / SE)	Existing Conductor Rating (SN / SE)	Limiting Terminal Equipment
001	Atlantic – Freneau 230 kV Line	678 / 813	709 / 869	Substation Conductor
002	Kittatinny – Pohatcong 230 kV Line	650 / 817	709 / 869	Substation Conductor
003	Kittatinny – Portland 230 kV Line	1114 / 1195	1114 / 1285	Line Relaying
004	Lakewood – Leisure Village 230 kV Line	650 / 817	709 / 869	Substation Conductor
005	Leisure Village – Manitou 230 kV Line	650 / 817	709 / 869	Substation Conductor
007	Traynor – Whippany 230 kV Line	678 / 802	709 / 869	Line Relaying, Substation Conductor / Drops



JCP&L Transmission Zone

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

Project Driver(s):

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

Specific Assumption Reference(s)

System Performance Projects Global Factors

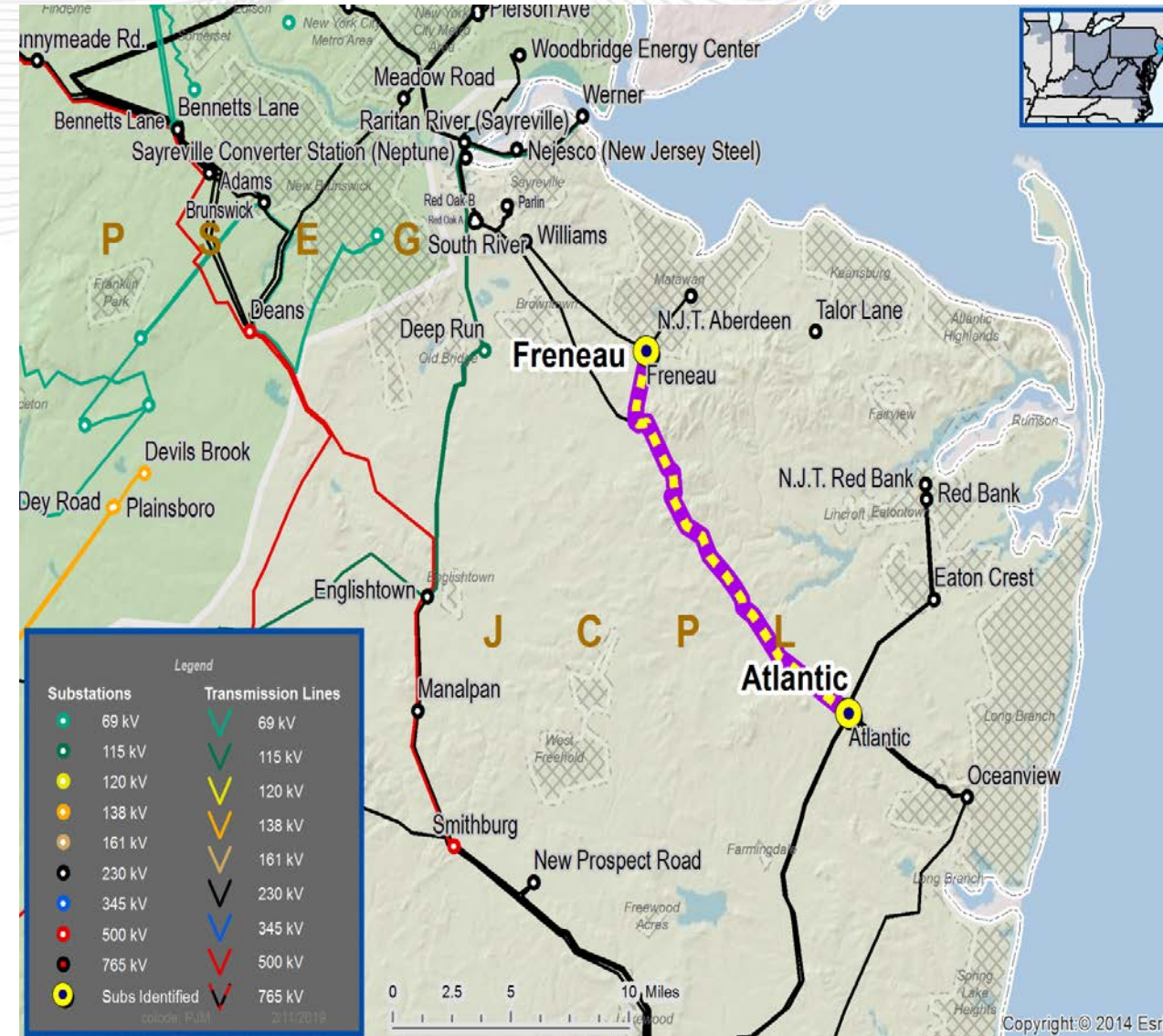
- System reliability and performance
- Substation/line equipment limits

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JCP&L Transmission Zone

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

Project Driver(s):

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

Specific Assumption Reference(s)

System Performance Projects Global Factors

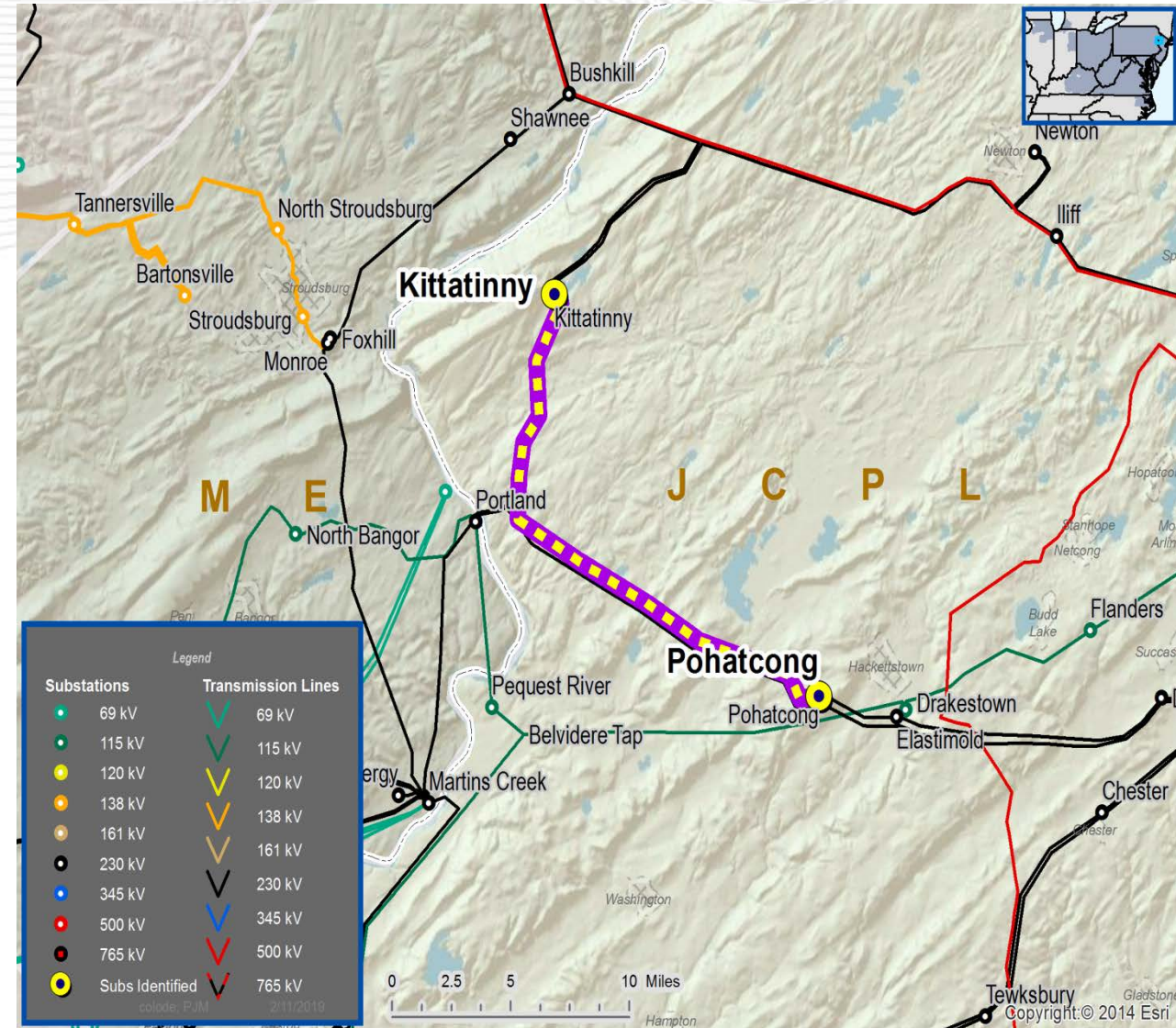
- System reliability and performance
- Substation/line equipment limits

Upgrade Relay Schemes

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Need Number: JCPL-2019-003
 Need Presented: 02/22/2019
 Meeting Date: 03/25/2019
 Process Stage: Solution

Project Driver(s):

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

Specific Assumption Reference(s)

System Performance Projects Global Factors

- System reliability and performance
- Substation/line equipment limits

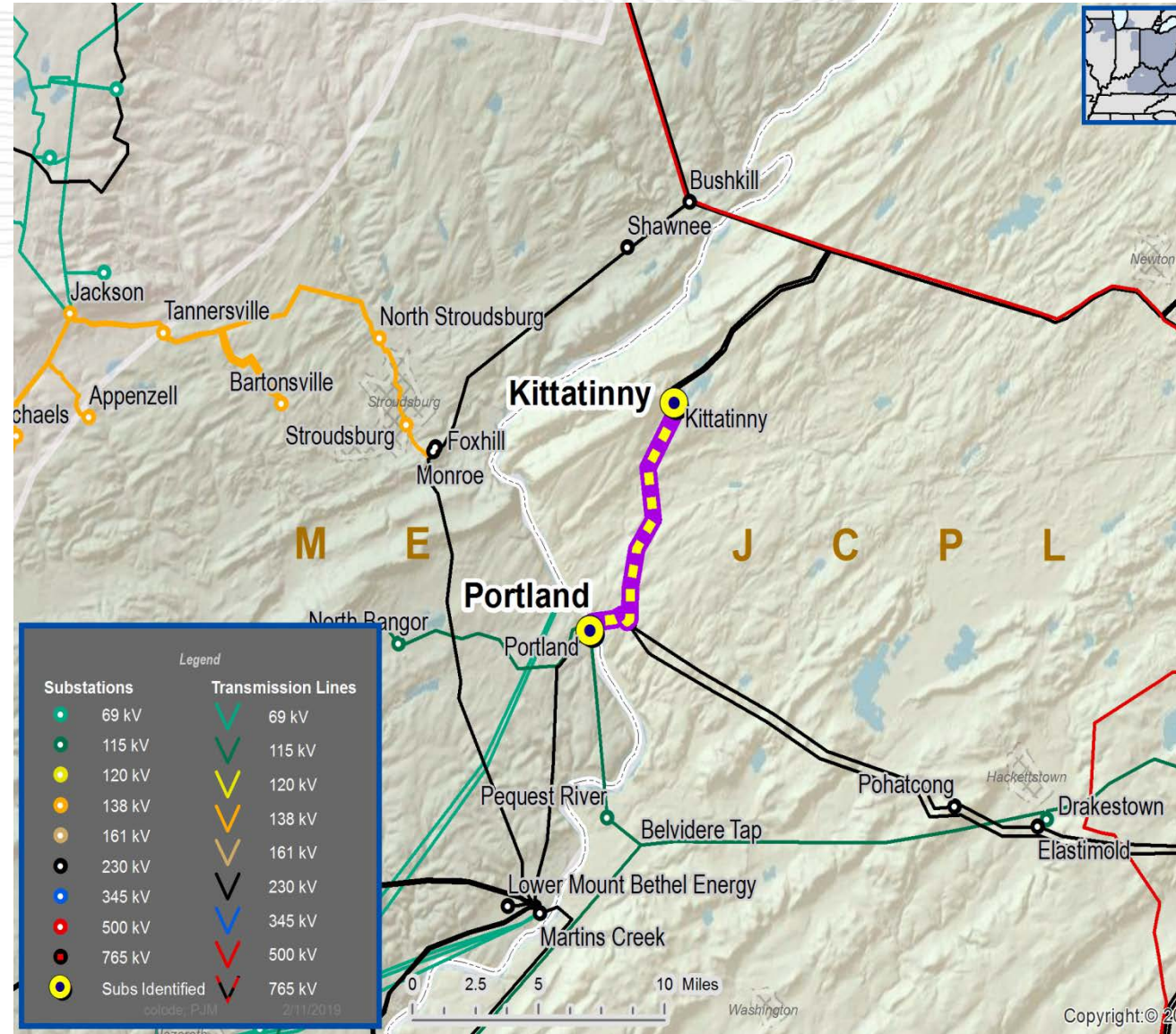
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JCP&L Transmission Zone





Need Number: JCPL-2019-004
 Need Presented: 02/22/2019
 Meeting Date: 03/25/2019
 Process Stage: Solution

Project Driver(s):

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

Specific Assumption Reference(s)

System Performance Projects Global Factors

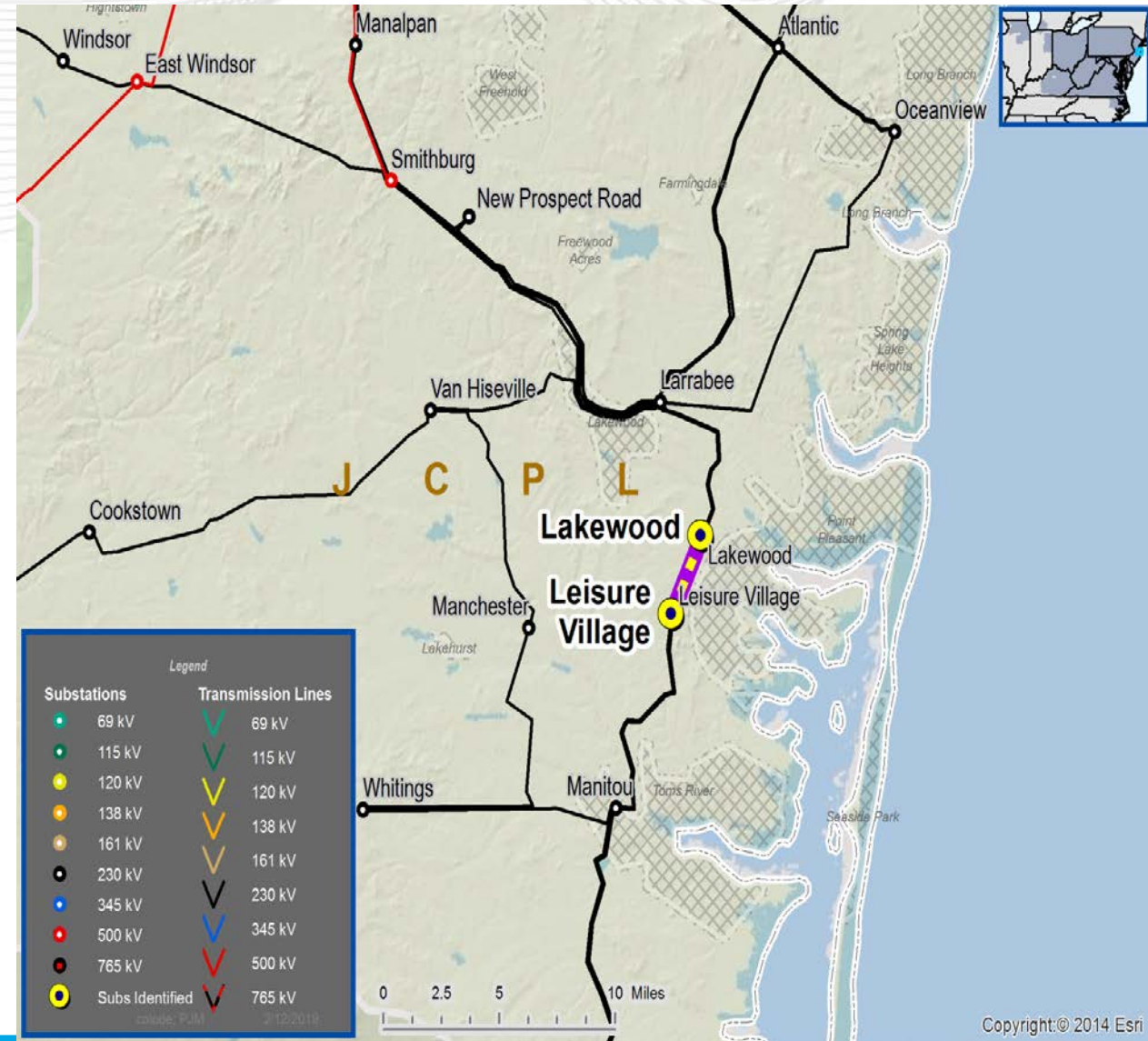
- System reliability and performance
- Substation/line equipment limits

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Need Number: JCPL-2019-005
 Need Presented: 02/22/2019
 Meeting Date: 03/25/2019
 Process Stage: Solution

Project Driver(s):

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

Specific Assumption Reference(s)

System Performance Projects Global Factors

- System reliability and performance
- Substation/line equipment limits

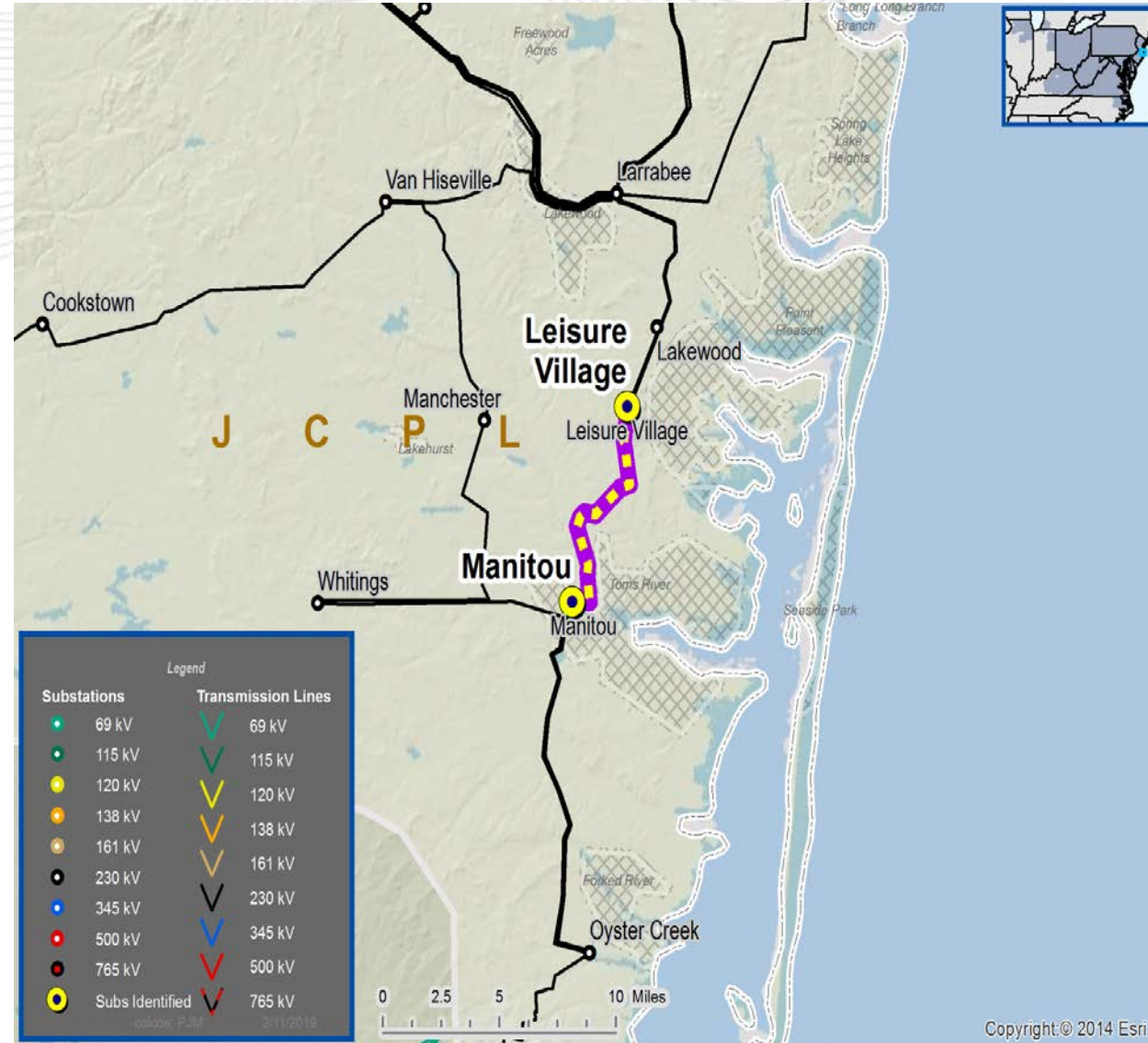
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JCP&L Transmission Zone





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

Project Driver(s):

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

Specific Assumption Reference(s)

System Performance Projects Global Factors

- System reliability and performance
- Substation/line equipment limits

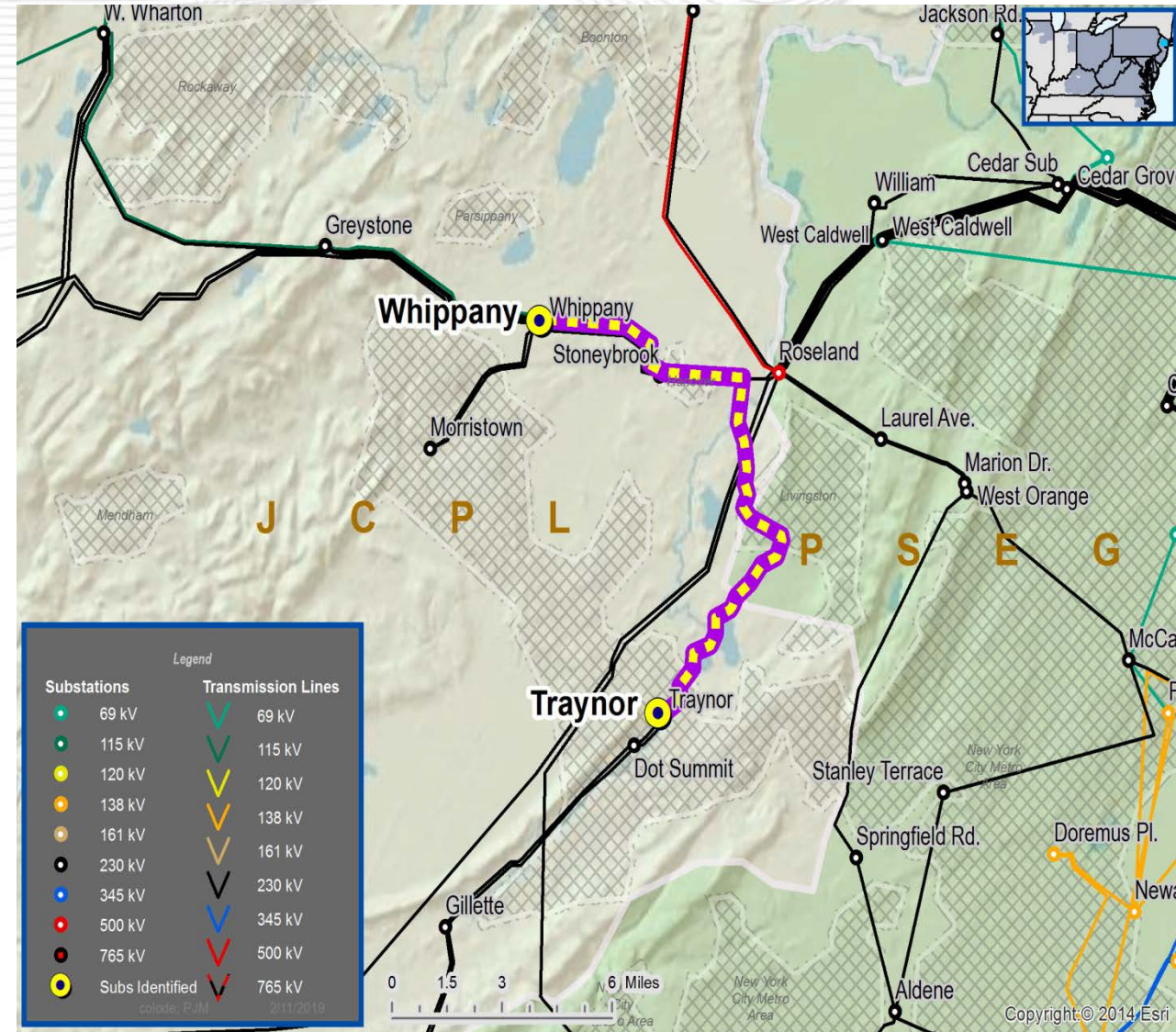
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JCP&L Transmission Zone



Proposed Solution

JCPL-2019-	Transmission Line / Substation Locations	New MVA Line Rating (SN / SE)	Proposed Solution	Estimate Costs (\$ M)	Target ISD
001	Atlantic – Freneau 230 kV Line	709 / 869	<ul style="list-style-type: none"> Atlantic 230 kV Substation: Replace line relaying, substation conductor, and breaker and terminal switches. Freneau 230 kV Substation: Replace line relaying, substation conductor, and breaker and terminal switches. 	\$0.9M	12/31/2019
002	Kittatinny – Pohatcong 230 kV Line	709 / 869	<ul style="list-style-type: none"> Kittatinny 230 kV Substation: Replace line relaying, substation conductor, breaker and terminal switches, and line trap. Pohatcong 230 kV Substation: Replace line relaying, substation conductor, and line trap. 	\$1.0M	12/15/2019
003	Kittatinny – Portland 230 kV Line	1114 / 1285	<ul style="list-style-type: none"> Kittatinny 230 kV Substation: Replace line relaying. Portland 230 kV Substation: Replace line relaying and circuit breaker. 	\$0.4M (JCP&L) \$0.9M (ME)	12/15/2019
004	Lakewood – Leisure Village 230 kV Line	709 / 869	<ul style="list-style-type: none"> Lakewood 230 kV Substation: Replace line relaying, breaker switches, substation conductor, and circuit breakers. Leisure Village 230 kV Substation: Replace line relaying, substation conductor, and line trap. 	\$1.6M	12/31/2019
005	Leisure Village – Manitou 230 kV Line	709 / 869	<ul style="list-style-type: none"> Leisure Village 230 kV Substation: Replace line relaying, substation conductor, breaker switches, and line trap. Manitou 230 kV Substation: Replace line relaying, breaker switches, substation conductor, and line trap. 	\$1.5M	12/31/2019
007	Traynor – Whippany 230 kV Line	709 / 869	<ul style="list-style-type: none"> Traynor 230 kV Substation: Replace line relaying, substation conductor, breaker and terminal switches, and line trap. Whippany 230 kV Substation: Replace line relaying, breaker and terminal switches, circuit breakers, substation conductor, and line trap. 	\$2.4M	12/15/2019

Alternatives Considered:

- Maintain existing condition and elevated risk of failure

No topology changes, no bubble diagram required.

All projects are in the Conceptual phase.

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

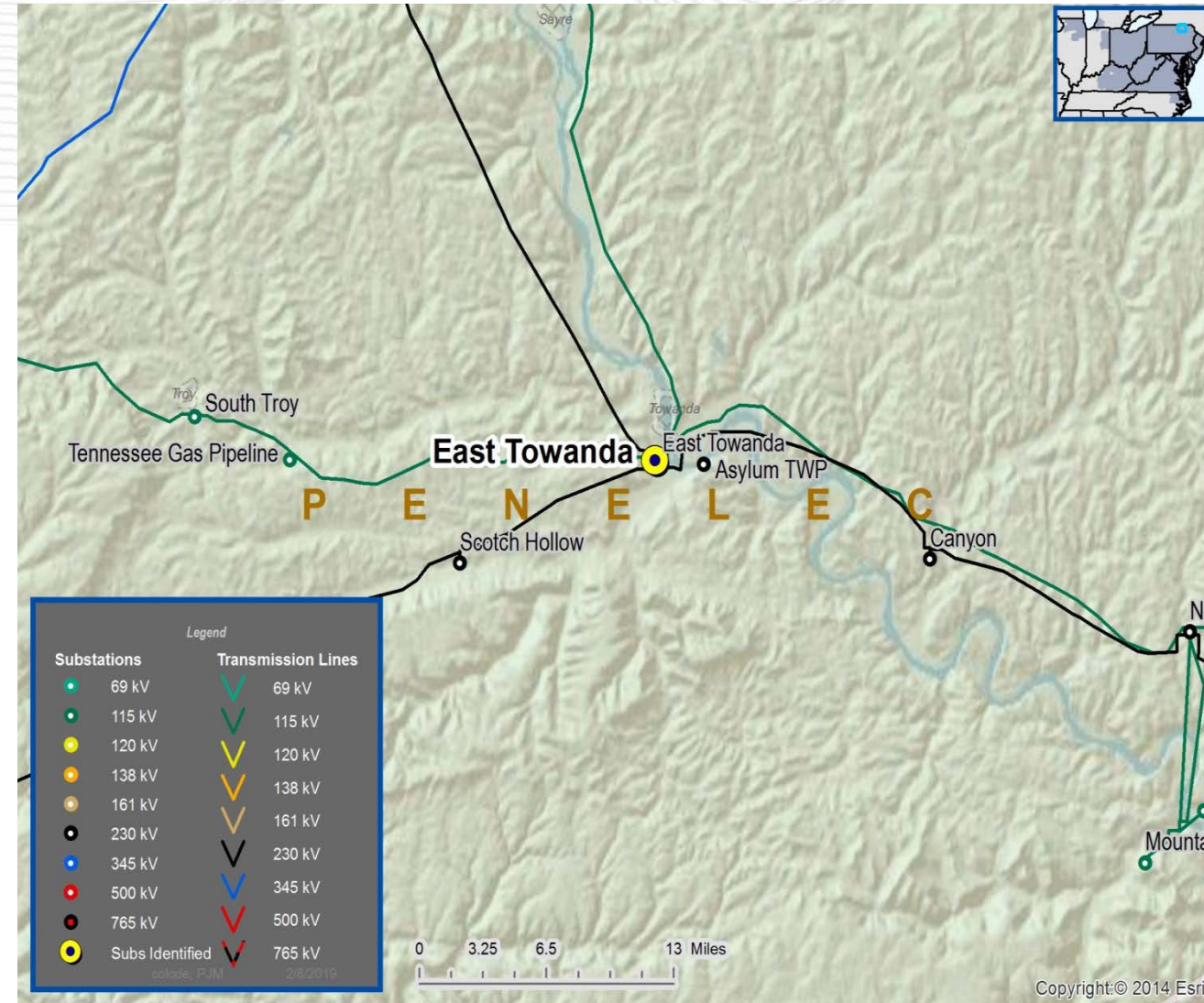
- Transformer has an increased failure probability due to type "U" bushings, dielectric breakdown, and is exhibiting high ethylene gas.
- Transformer is 45 years old.
- Approximately \$64,000 spent on maintenance orders since 2003.

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)



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:

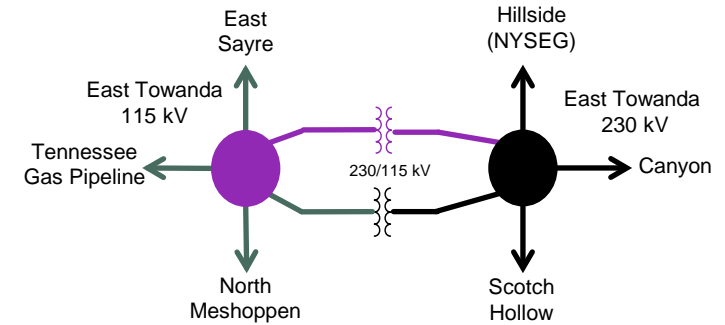
- East Towanda #4 230/115 kV Transformer
 - Before Proposed Solution: 190/226 MVA (SN/SE)
 - After Proposed Solution (anticipated): 375/438 MVA (SN/SE)

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	



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

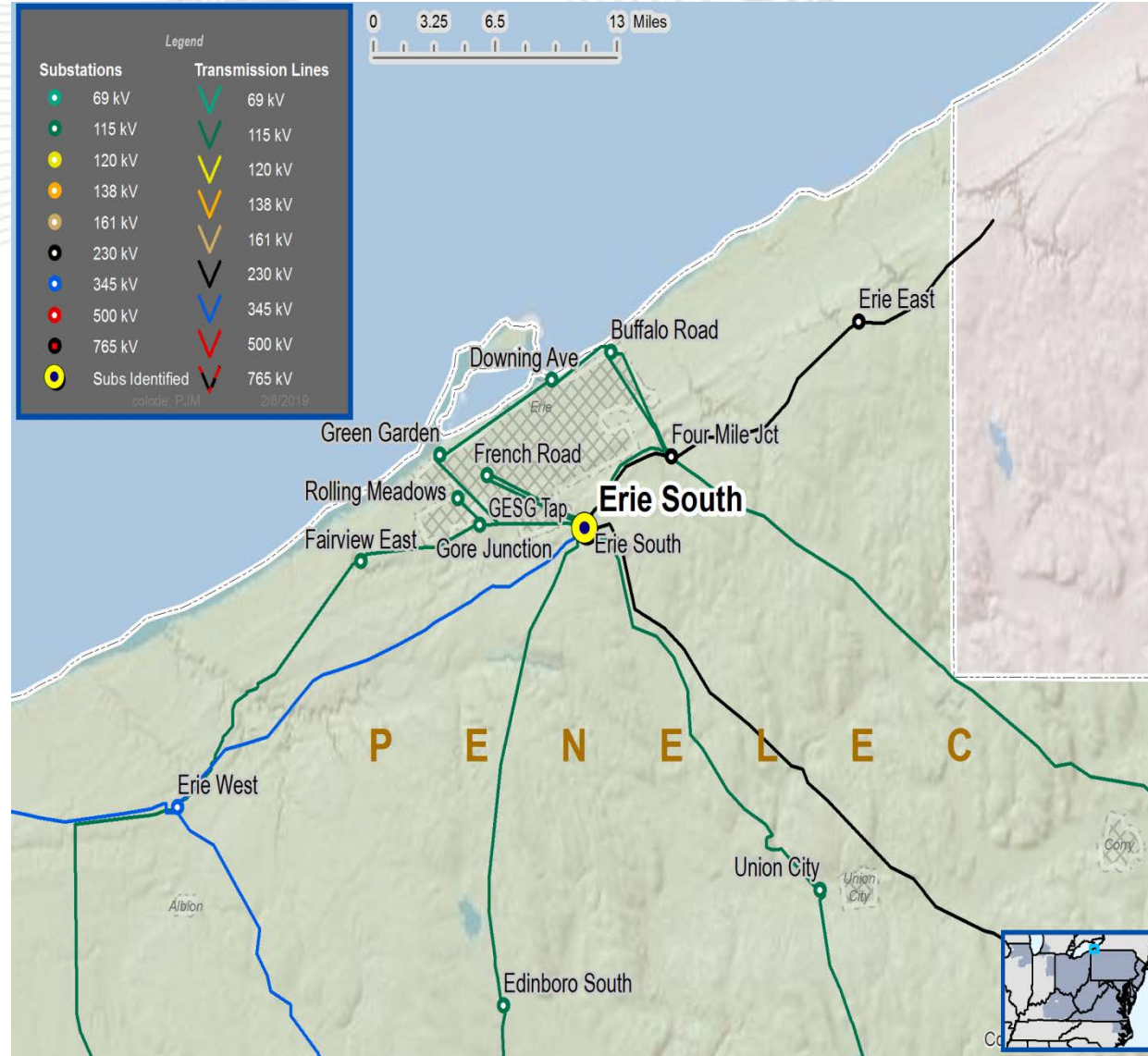
- Power transformers and load tap changers (LTCs)

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).



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:

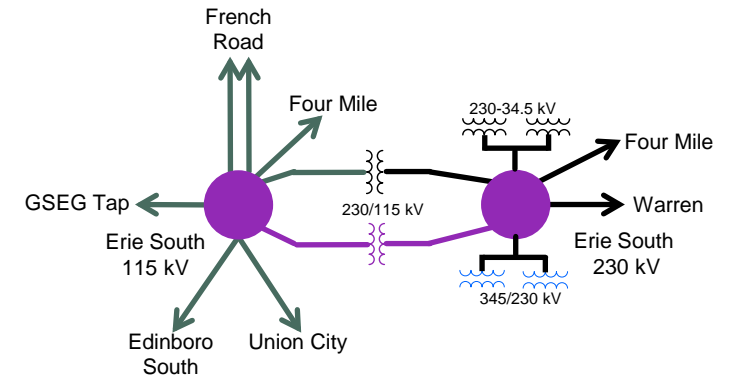
- Erie South #6 230/115 kV Transformer
 - Before Proposed Solution: 262/326 MVA (SN/SE)
 - After Proposed Solution (anticipated): 375/438 MVA (SN/SE)

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-2019-003

Process Stage: Solution

Need Presented: 02/22/2019

Meeting Date: 03/25/2019

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

Lewistown #1 230/115-46 kV Transformer

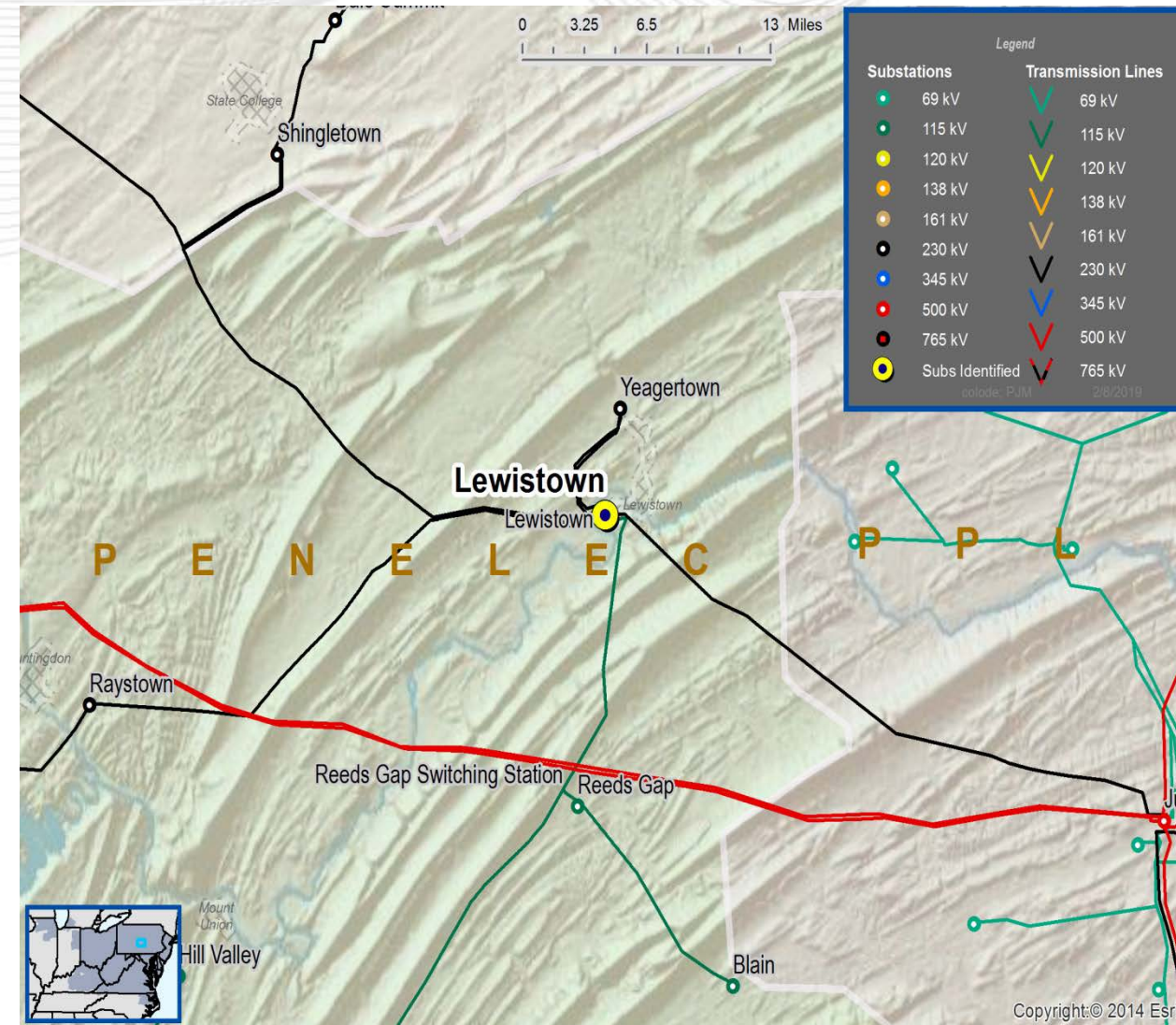
- Transformer has an increased failure probability due to high levels of combustible and ethylene gases and decrease in dielectric strength.
- Transformer is 66 years old.
- Approximately \$137,000 spent on maintenance orders since 2003.

Transformer circuit rating is limited by terminal equipment on 46 kV winding.

Existing transformer circuit rating is 55 / 67 MVA (SN / SE).

Existing transformer rating is 62 / 67 MVA (SN / SE).

(disconnect switches, transformer relaying)



Need Number: PN-2019-003

Proposed Solution:

Replace Lewistown #1 230/115-46 kV Transformer

- Replace the #1 230/115-46 kV transformer and with 230-46 kV 60/80/100 MVA transformer
- Replace relaying and disconnects switches
- Replace overdutied 46 kV breakers due to transformer replacement
(FMC Viscose (2FQ), Lewistown First Quality (1FQ), and #1 Transformer breakers)

Transformer Rating:

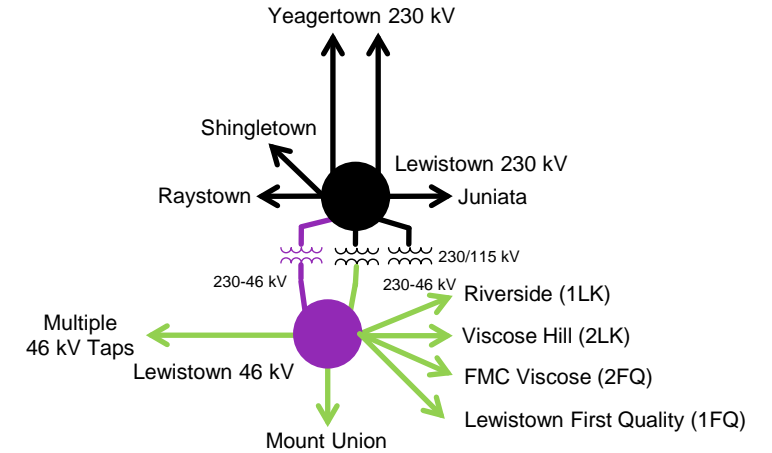
- Lewistown #1 230-46 kV Transformer
 - Before Proposed Solution: 55/67 MVA (SN/SE)
 - After Proposed Solution (anticipated): 120/129 MVA (SN/SE)

Alternatives Considered:

- Maintain existing condition and elevated risk of failure

Estimated Project Cost: \$3.4M

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-2019-004

Process Stage: Solution

Need Presented: 02/22/2019

Meeting Date: 03/25/2019

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

Westfall #3 115/46 kV Transformer

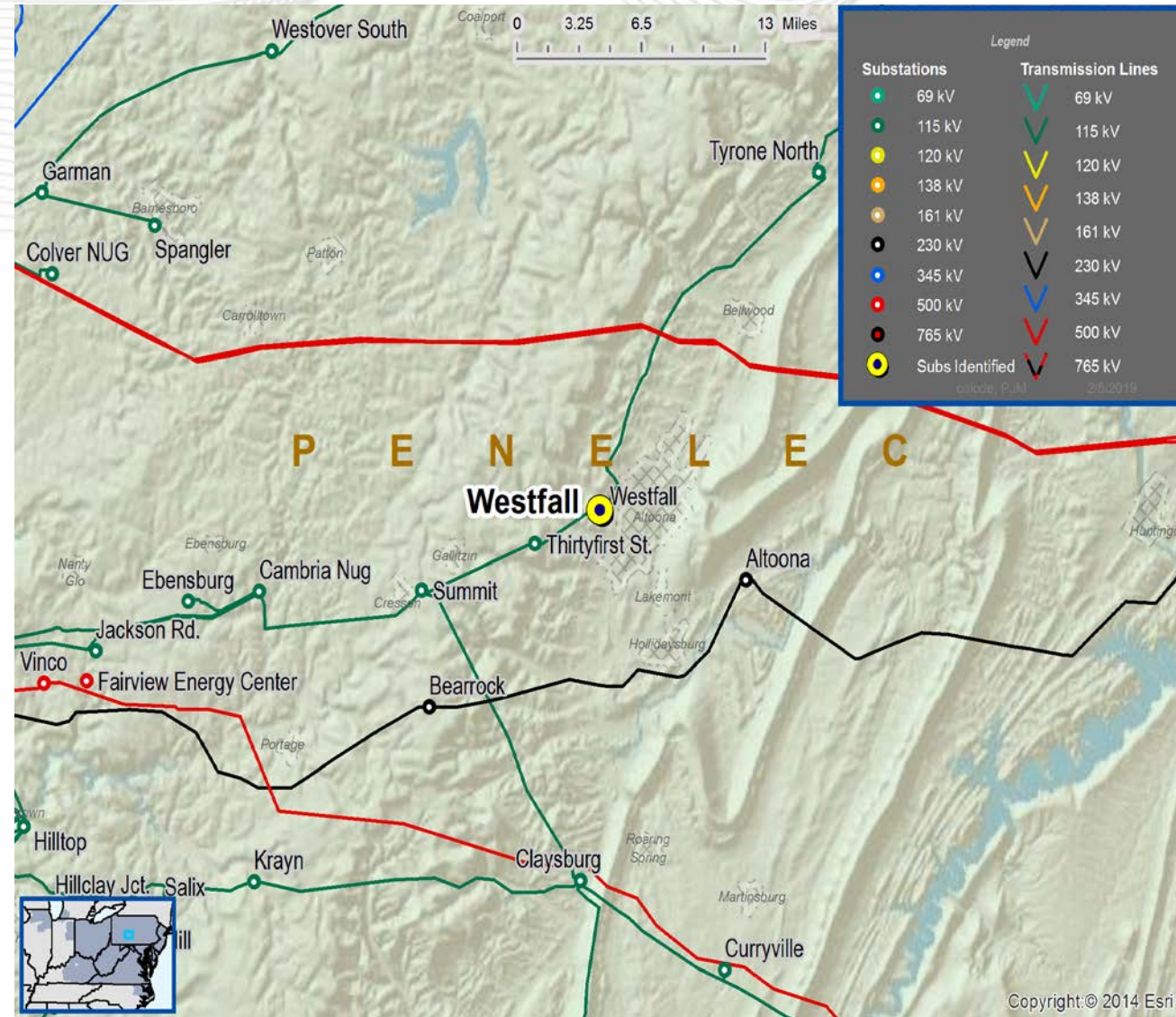
- Power factor test results show deterioration of windings and bushings.
- Transformer is 47 years old.
- Approximately \$79,000 spent on maintenance orders since 2004.

Transformer circuit rating is the existing transformer rating of 38 / 41 MVA (SN / SE).

Westfall #4 115/46 kV Transformer

- Power factor test results show deterioration of type "U" bushings.
- Transformer is 50 years old.
- Approximately \$18,000 spent on maintenance orders since 2003.

Transformer circuit rating is the existing transformer rating of 31 / 34 MVA (SN / SE).



Need Number: PN-2019-004

Proposed Solution:

Westfall #3 and #4 115/46 kV Transformer Replacements

- Remove the #3 and #4 115/46 kV transformers
- Install a new #3 115/46 kV 45/60/75 MVA transformer

Transformer Ratings:

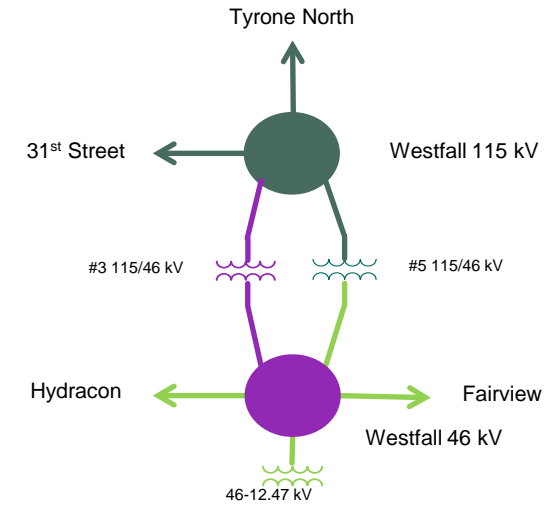
- Westfall #3 115/46 kV Transformer
 - Before Proposed Solution: 38/41 MVA (SN/SE)
 - After Proposed Solution (anticipated): 97/97 MVA (SN/SE)
- Westfall #4 115/46 kV Transformer
 - Before Proposed Solution: 31/34 MVA (SN/SE)
 - After Proposed Solution: N/A – Removed from service

Alternatives Considered:

- Maintain existing condition and elevated risk of failure

Estimated Project Cost: \$3.9M

Projected IS Date: 12/31/2021



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



Penelec Transmission Zone

Need Number: PN-2019-005

Process Stage: Solution

Need Presented: 02/22/2019

Meeting Date: 03/25/2019

Project Driver(s):

Equipment Material Condition, Performance and Risk

Specific Assumption Reference(s)

Line Condition Rebuild/Replacement

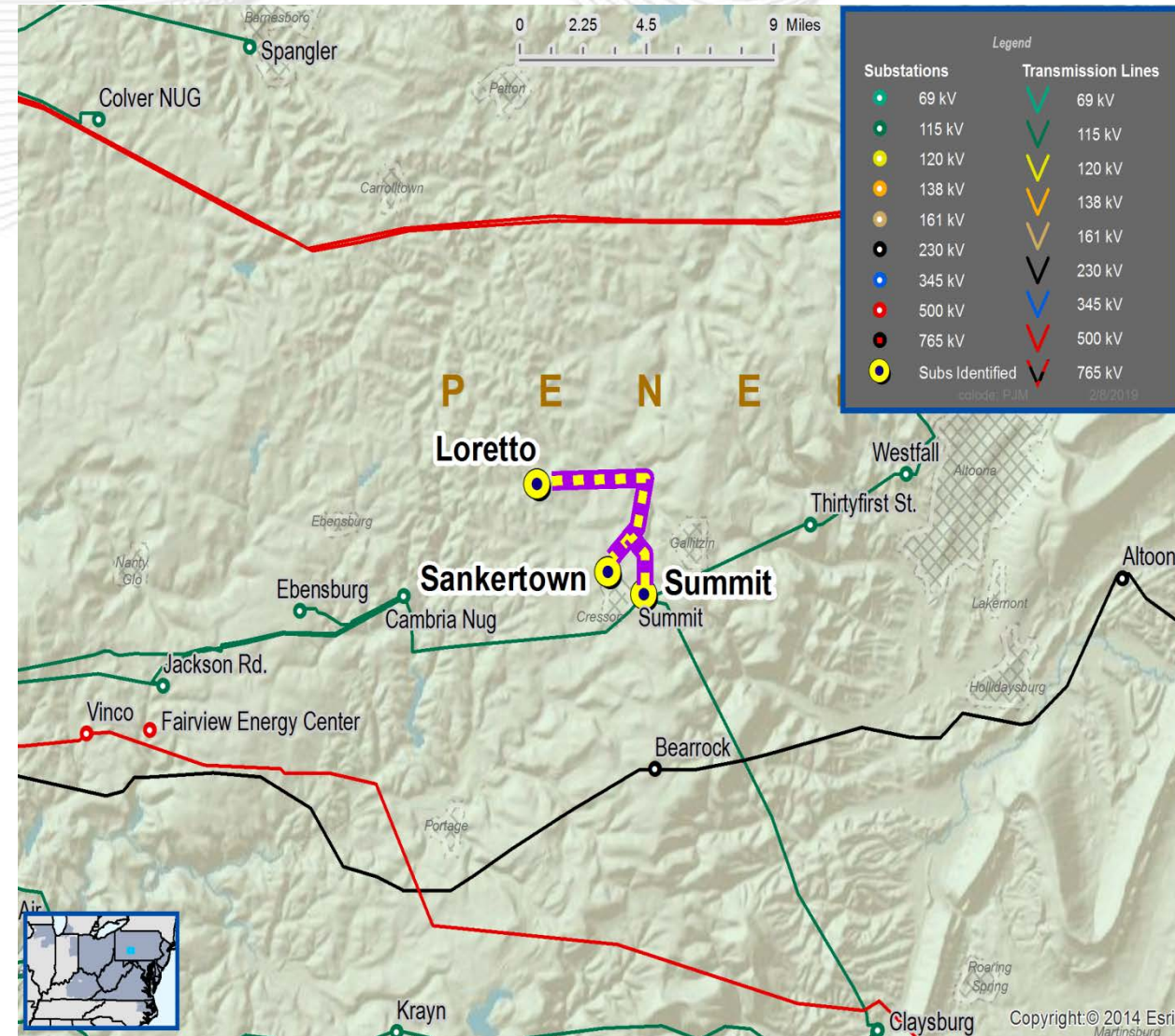
- Age/condition of wood pole transmission line structures

Problem Statement

The Loretto – Sankertown Bypass – Summit 46 kV line is exhibiting deterioration resulting in increased maintenance. The transmission line is approaching end of life.

- Total line distance is approximately 5.7 miles
 - 79 wood structures and 2 towers
 - Average age of failed structures is 51 years
- 81 out of 122 structures failed inspection (66% failure rate)
- Failure reasons include sound test, bad/cut/missing grounds, bayonet for static, woodpecker damage, etc.

Transmission line rating is the existing conductor rating 32 / 32 MVA (SN / SE).





Need Number: PN-2019-005

Penelec Transmission Zone

Proposed Solution:

Loretto – Sankertown Bypass – Summit 46 kV Line Rebuild

- Rebuild and reconductor approximately 5.7 miles of wood pole construction

Transmission Line Ratings:

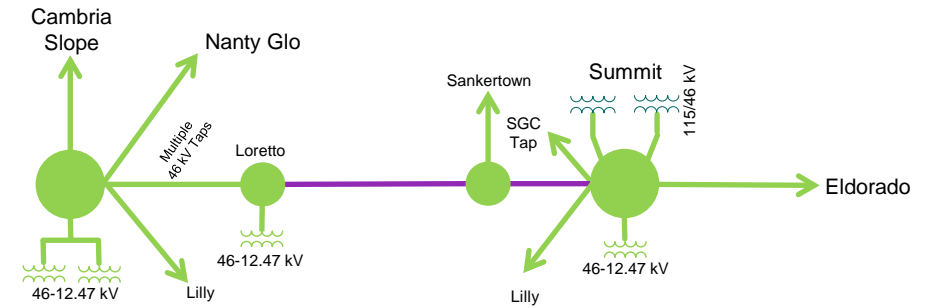
- Loretto – Sankertown Bypass 46 kV Line
 - Before Proposed Solution: 32/32 MVA (SN/SE)
 - After Proposed Solution: 54/65 MVA (SN/SE)
- Sankertown Bypass – Summit 46 kV Line
 - Before Proposed Solution: 32/32 MVA (SN/SE)
 - After Proposed Solution: 54/65 MVA (SN/SE)

Alternatives Considered:

- Maintain existing condition and elevated risk of failure

Estimated Project Cost: \$6.6M

Projected IS Date: 12/31/2020



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



Penelec Transmission Zone

Need Number: PN-2019-006

Process Stage: Solution

Need Presented: 02/22/2019

Meeting Date: 03/25/2019

Project Driver(s):

Equipment Material Condition, Performance and Risk

Specific Assumption Reference(s)

Substation Condition Rebuild/Replacement Global Factors

- Limited availability of spare parts, software obsolescence and/or compatibility, or vendor technical support
- Expected service life (at or beyond) or obsolescence

Substation Condition Rebuild/Replacement – Asset Types

- Circuit breakers and other fault interrupting devices, switches, carrier sets and associated wave-traps, line arresters

System Performance Projects Global Factors

- Substation/line equipment limits

Problem Statement

East Pike – Glory 115 kV Line – Terminal equipment is exhibiting an increase risk of failure and due to obsolescence of equipment, spare parts are limited.

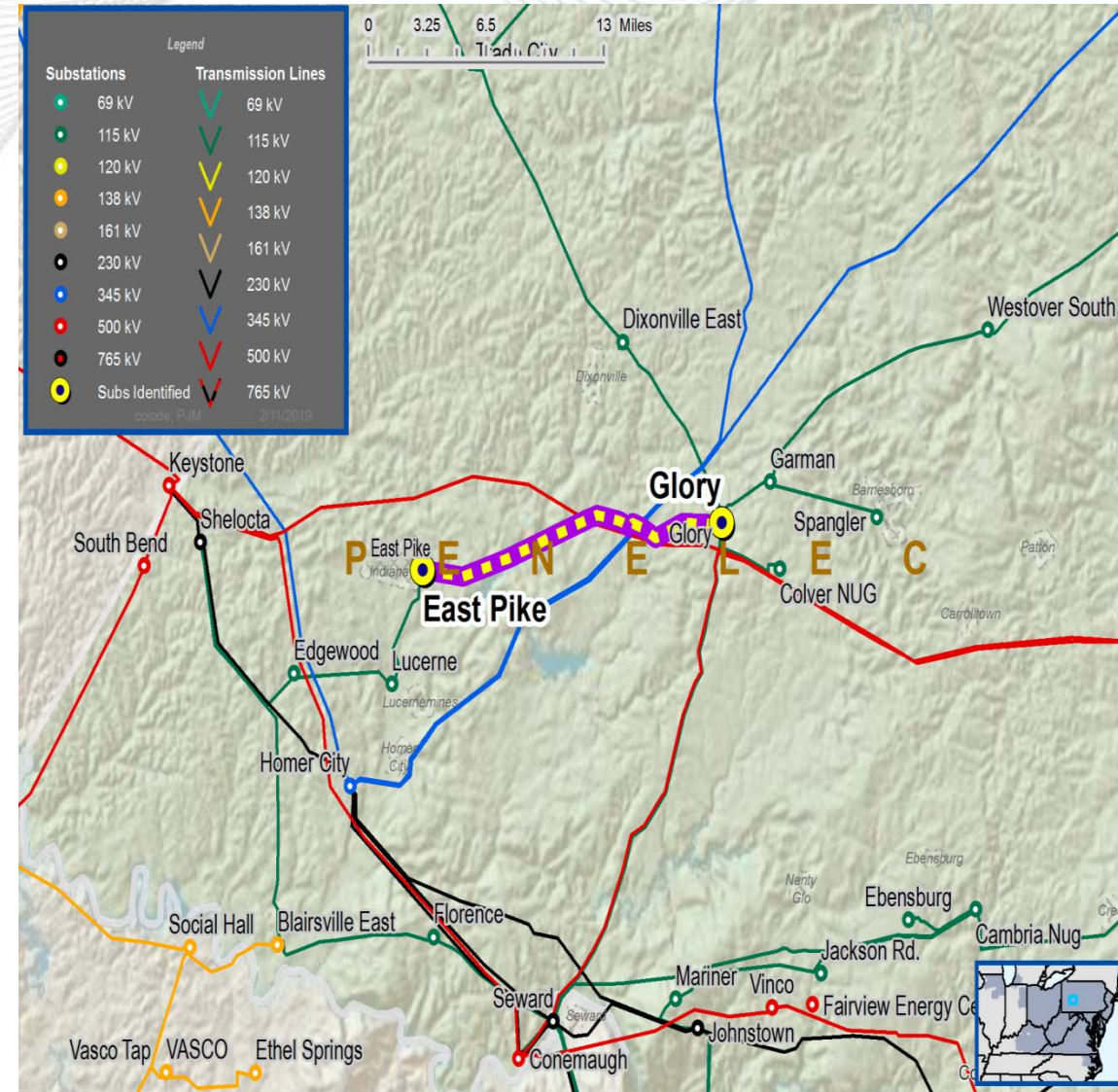
- At East Pike 115 kV substation – bus section breaker disconnect switches, CVTs, line trap, and surge arresters
- At Glory 115 kV substation – line side breaker disconnect switches

Transmission line rating is limited by terminal equipment.

Existing line rating is 163 / 185 MVA (SN / SE).

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

(line trap, substation conductor, CTs)



Need Number: PN-2019-006

Proposed Solution:

East Pike – Glory 115 kV Line: Upgrade Terminal Equipment

East Pike 115 kV Substation – Equipment to be replaced includes:

- Bus section breaker disconnect switches, line trap, and substation conductor

Glory 115 kV Substation – Equipment to be replaced includes:

- Line side breaker disconnect switch

Transmission Line Ratings:

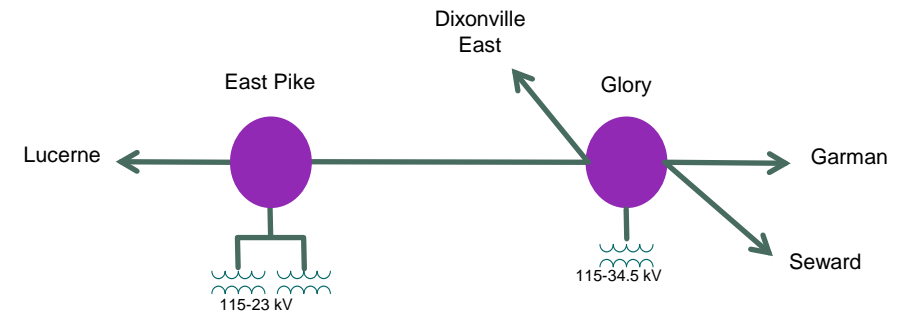
- East Pike – Glory 115 kV Line
 - Before Proposed Solution: 163/185 MVA (SN/SE)
 - After Proposed Solution: 202/245 MVA (SN/SE)

Alternatives Considered:

- Maintain existing condition and elevated risk of failure

Estimated Project Cost: \$0.5M

Projected IS Date: 6/1/2021



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

Need Number: PN-2019-007 to 012

Process Stage: Solution

Need Presented: 02/22/2019

Meeting Date: 03/25/2019

Project Driver(s):

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

Specific Assumption Reference(s)

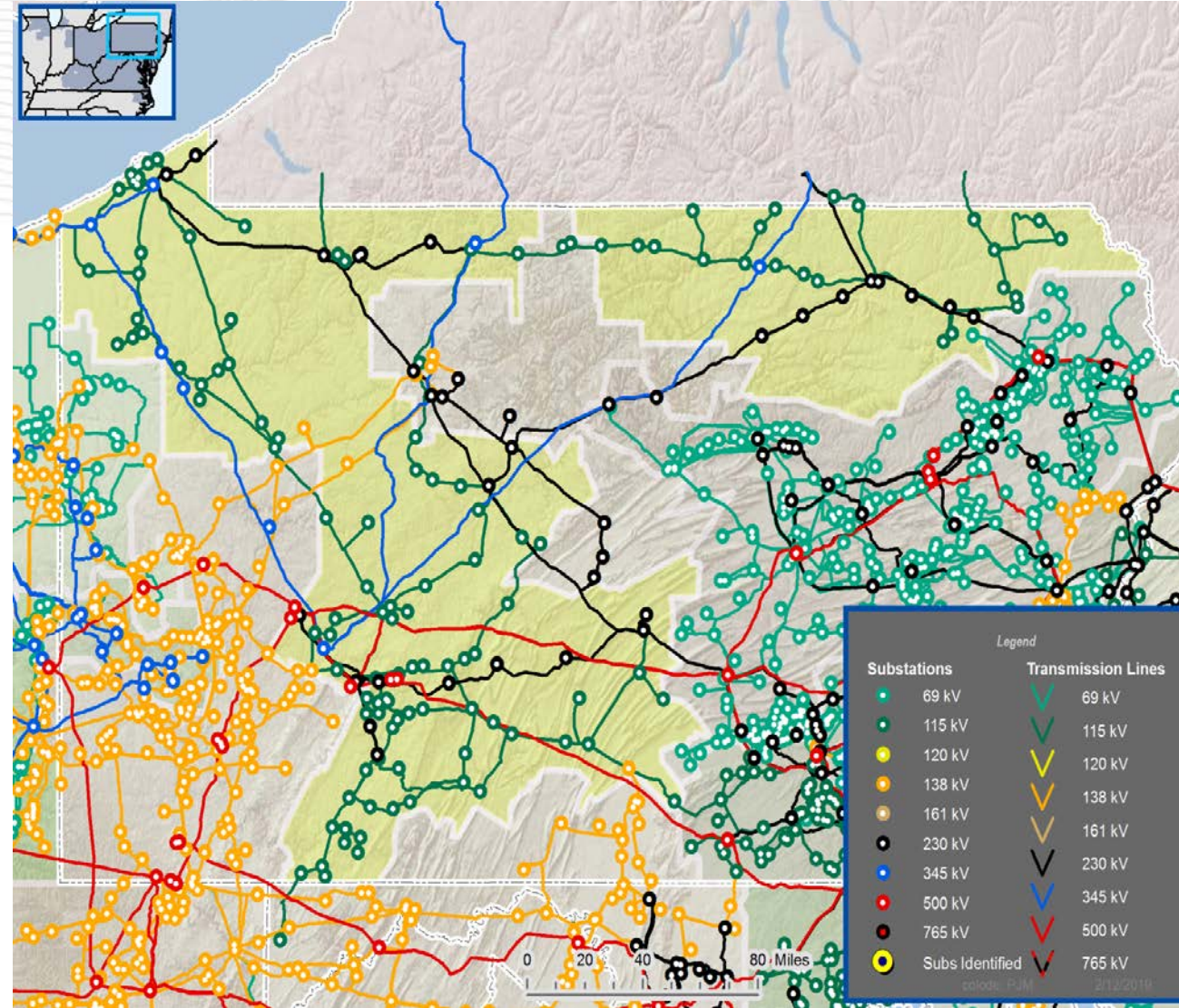
System Performance Projects Global Factors

- 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

Continued on next slide...



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.
- ¹Line has failed carrier equipment that cannot be repaired or replaced

PN-2019-	Transmission Line / Substation Locations	Existing Line Rating (SN / SE)	Existing Conductor Rating (SN / SE)	Limiting Terminal Equipment
007	Lenox – North Meshoppen 115 kV Line	136 / 189	167 / 202	Line Relaying, Substation Conductor / Drops, Line Trap
008	Ridgway – Whetstone 115 kV Line	193 / 239	202 / 245	Line Relaying
009 ¹	Union City – Titusville 115 kV Line	120 / 120	202 / 245	Line Relaying, Substation Conductor, Line Trap
010 ¹	Grandview – Titusville 115 kV Line	147 / 149	202 / 245	Line Relaying, Substation Conductor, Line Trap
011	Cooper – Seward 115 kV Line	222 / 277	273 / 333	Line Relaying, Substation Conductor / Drops, Line Trap, Circuit Breaker
012	Erie South – Union City 115 kV Line	176 / 224	232 / 282	Line Relaying, Substation Conductor / Drops



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

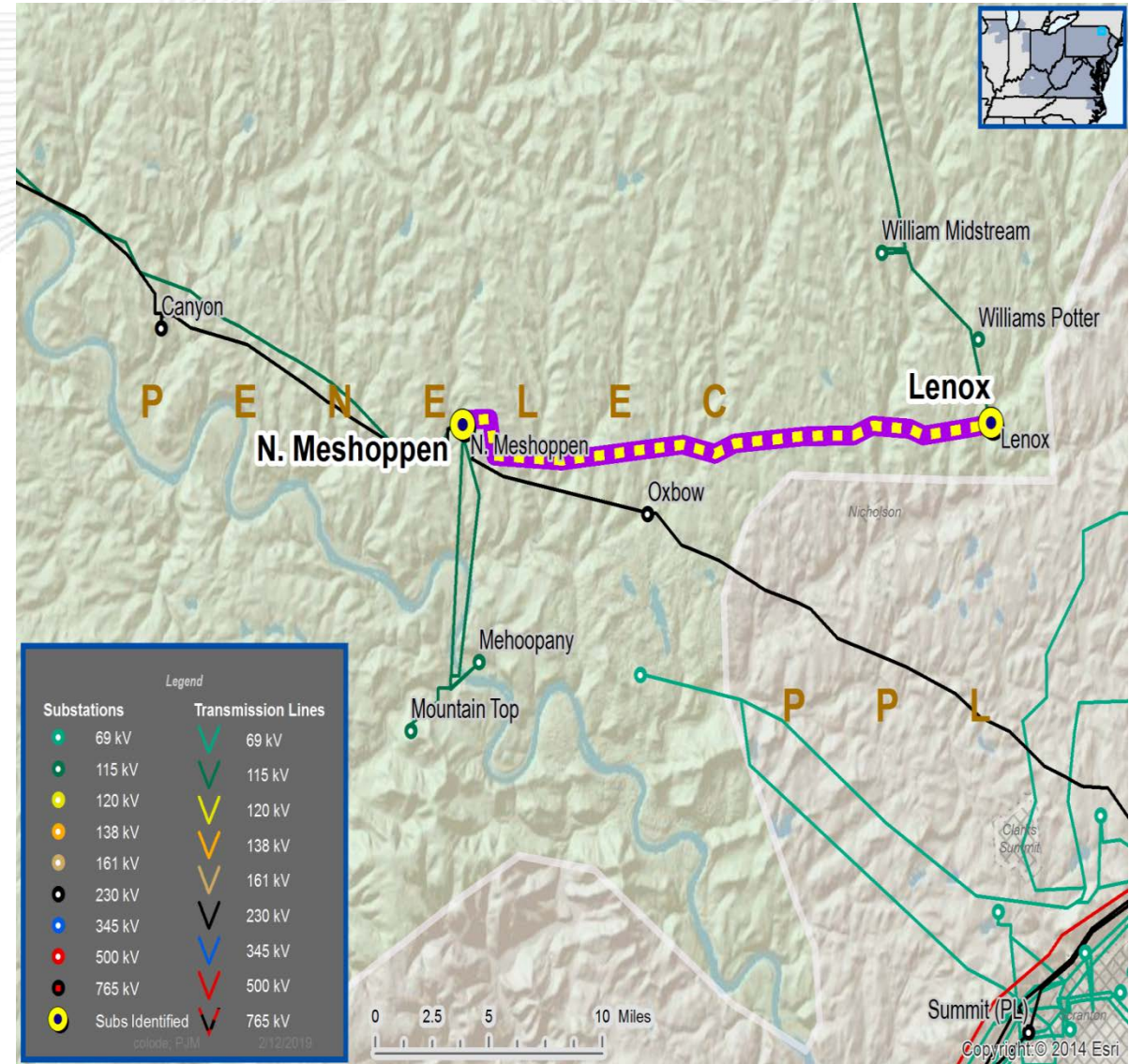
- System reliability and performance
- Substation/line equipment limits

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.
- ¹Line has failed carrier equipment that cannot be repaired or replaced





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

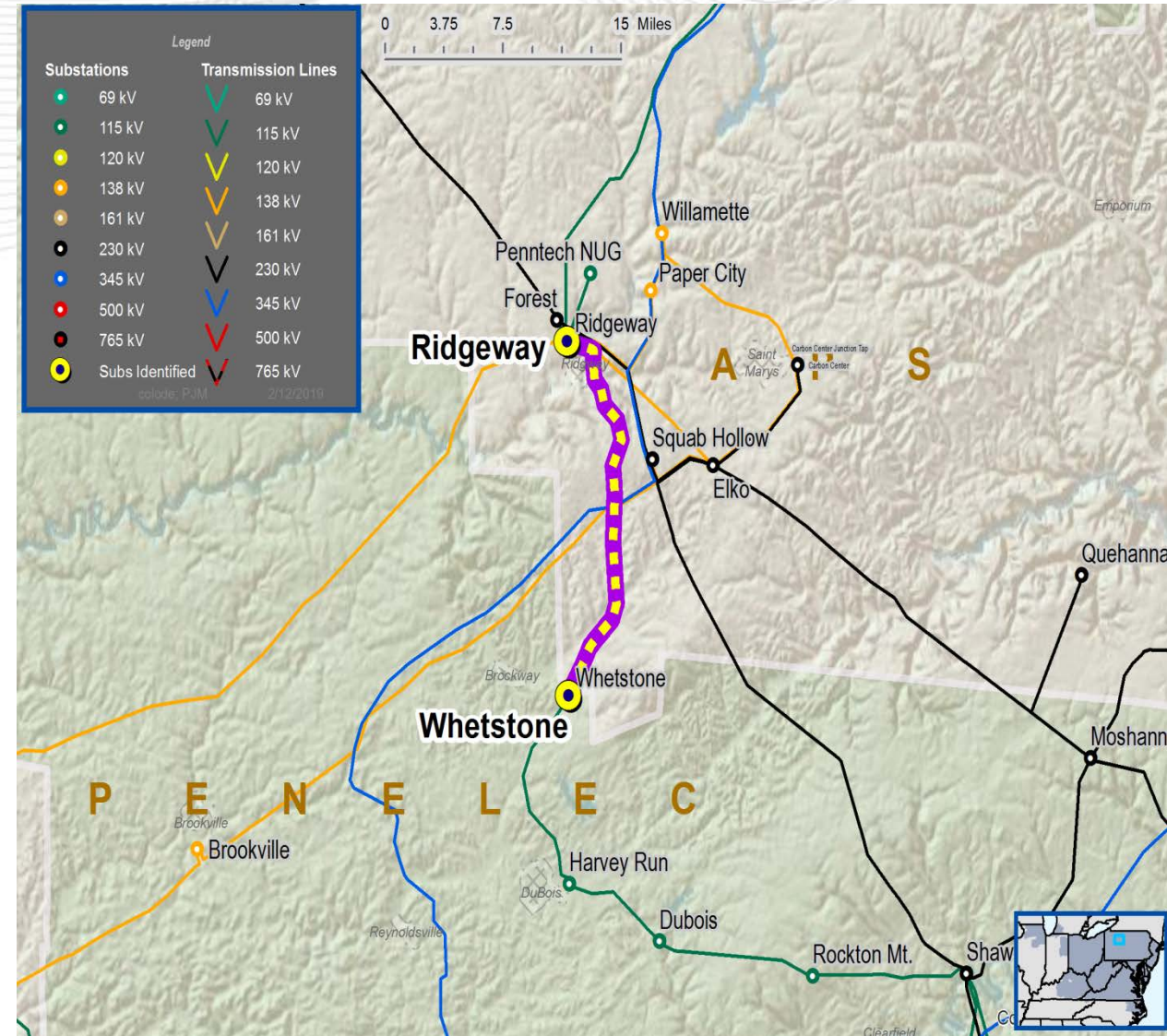
Upgrade Relay Schemes

- 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.
- ¹Line 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

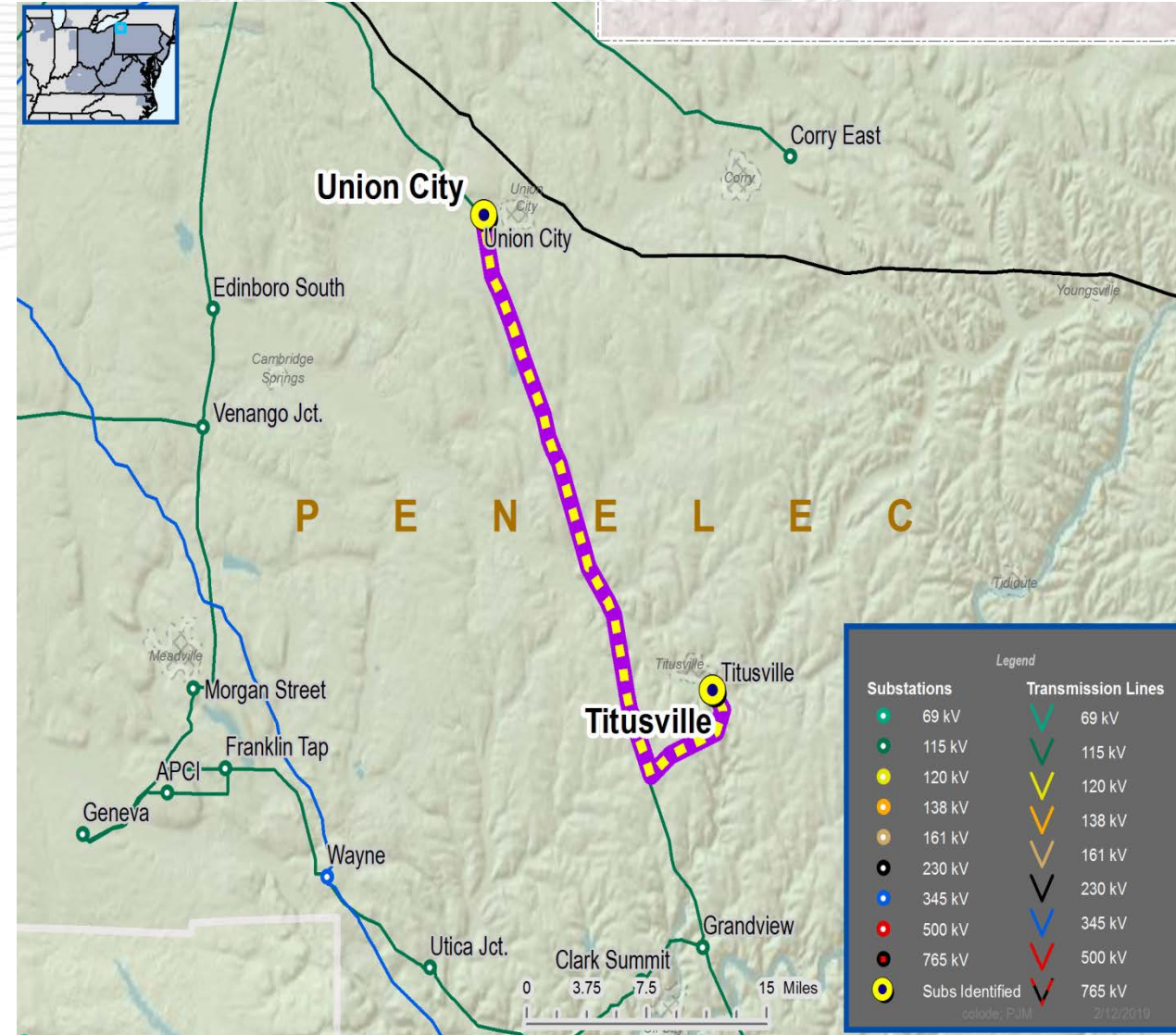
- System reliability and performance
- Substation/line equipment limits

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.
- ¹Line has failed carrier equipment that cannot be repaired or replaced



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

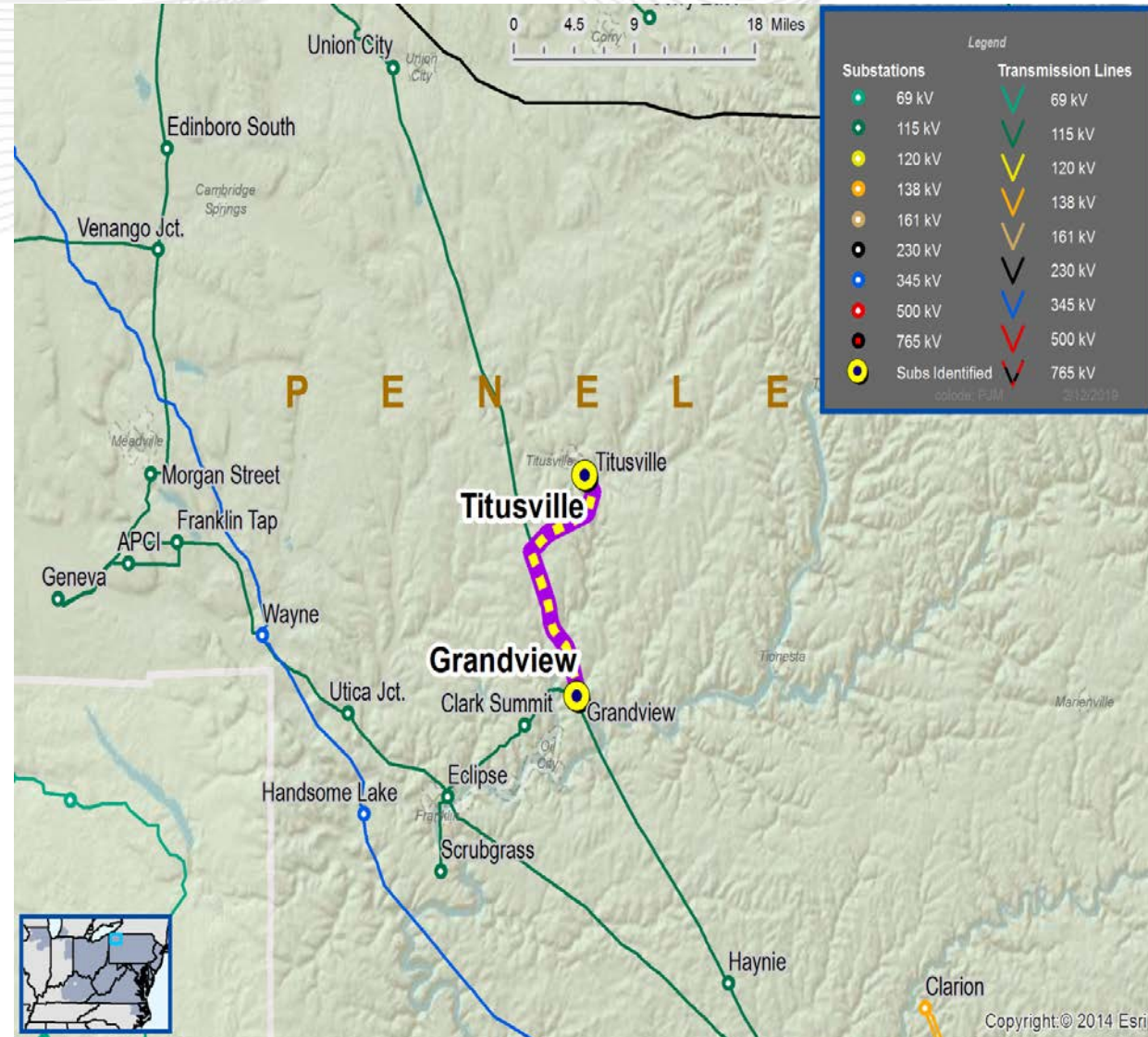
- System reliability and performance
- Substation/line equipment limits

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.
- ¹Line has failed carrier equipment that cannot be repaired or replaced



Need Number: PN-2019-011
 Process Stage: Need Meeting
 Date: 02/22/2019

Project Driver(s):
Equipment Material Condition, Performance and Risk and Operational Flexibility and Efficiency

Specific Assumption Reference(s)
 System Performance Projects Global Factors

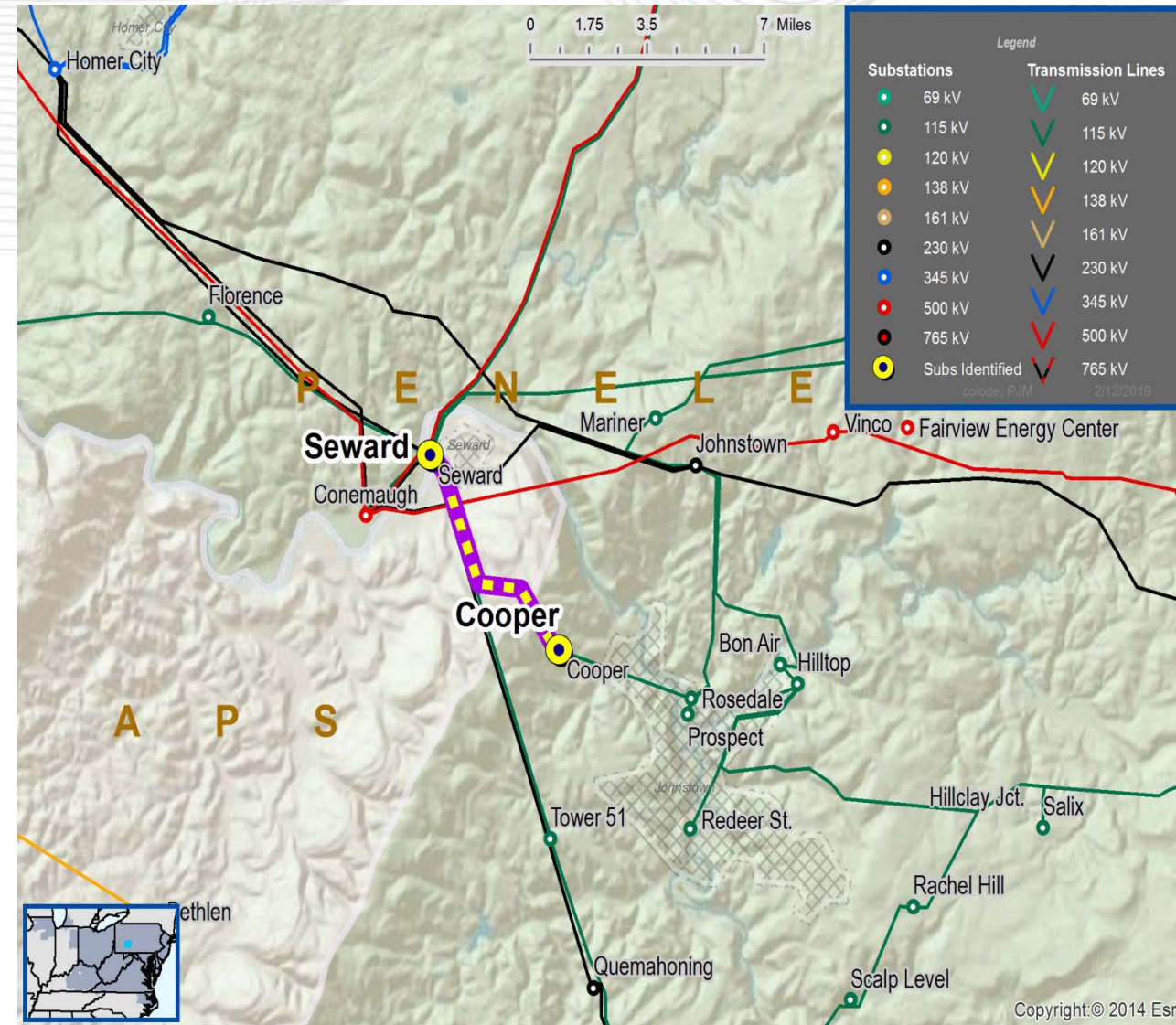
- System reliability and performance
- Substation/line equipment limits

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.
- ¹Line has failed carrier equipment that cannot be repaired or replaced



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

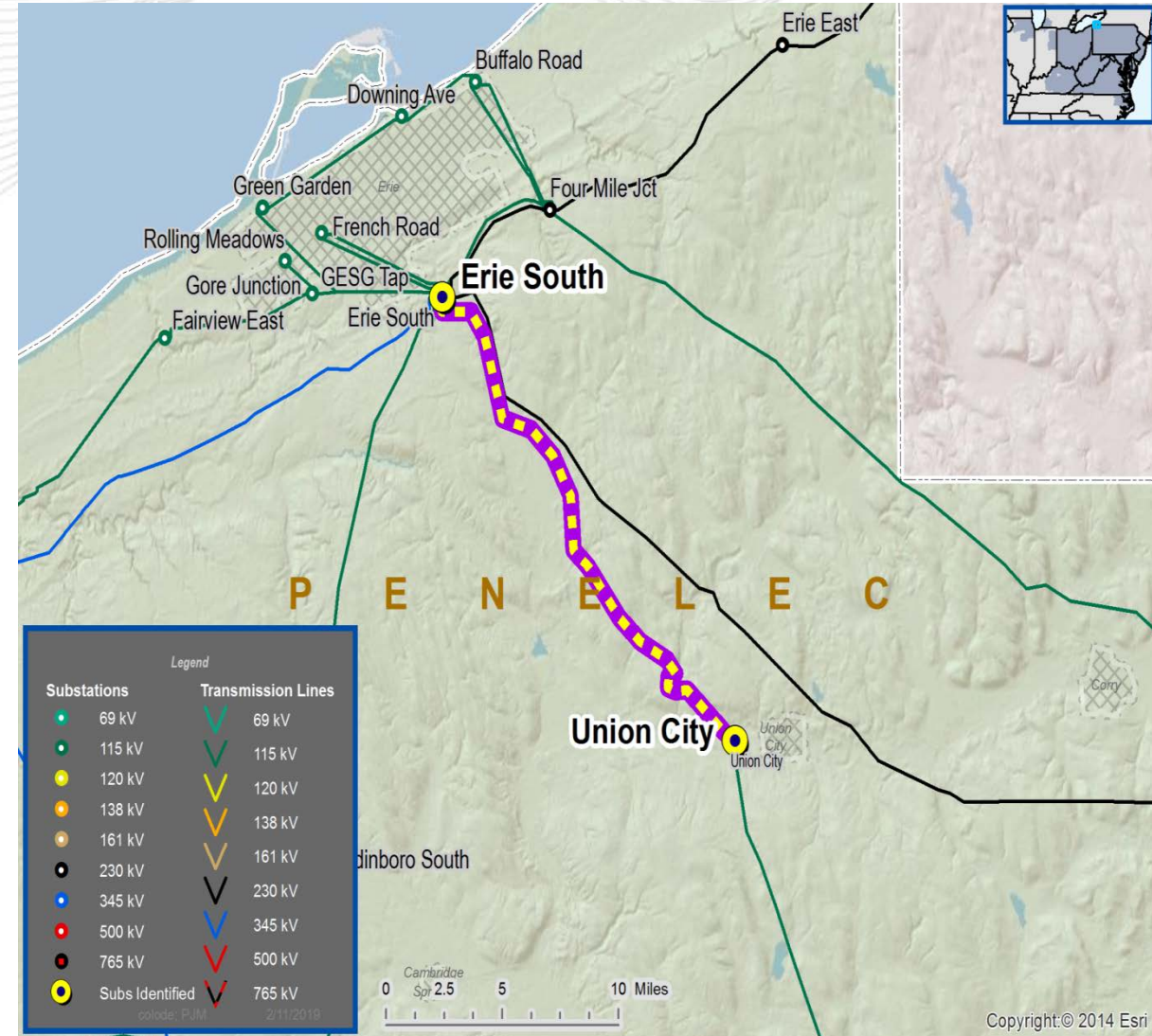
- System reliability and performance
- Substation/line equipment limits

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.
- ¹Line 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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
011	Cooper – Seward 115 kV Line	273 / 333	<ul style="list-style-type: none"> Cooper 115 kV Substation: Replace line relaying, circuit breaker, and substation conductor. Seward 115 kV Substation: Replace line relaying, circuit breaker, substation conductor, and line trap. 	\$1.7M	12/31/2019
012	Erie South – Union City 115 kV Line	232 / 282	<ul style="list-style-type: none"> 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

Need Number: PN-2019-013

Process Stage: Solution

Need Presented: 02/22/2019

Meeting Date: 03/25/2019

Project Driver(s):

Operational Flexibility and Efficiency

Specific Assumption Reference(s)

System Performance Projects Global Factors

- Substation/line equipment limits
- Load at risk in planning and operational scenarios
- Load and/or customers at risk on single transmission line

System Conversion Methodology

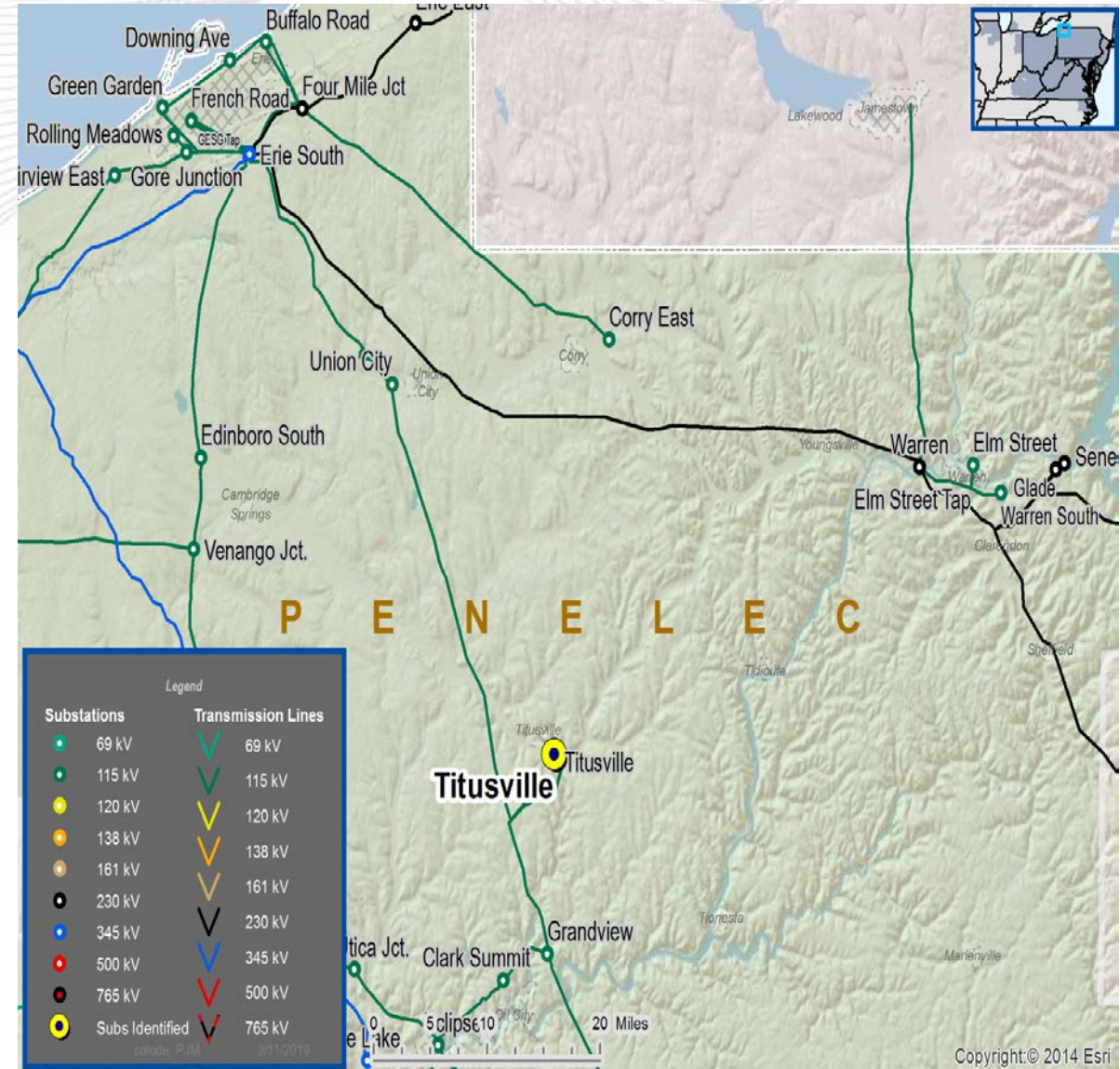
- Customer feedback

Problem Statement

- Titusville 115 kV substation serves approximately 45 MW of load to 5,300 customers. A stuck bus tie breaker at Titusville will outage both #1 and #2 115-34.5 kV transformers and 115 kV network path.

Transmission line ratings are limited by terminal equipment.

- Union City – Titusville 115 kV line: Existing line rating is 120 / 120 MVA (SN / SE). Existing conductor rating is 202 / 245 MVA (SN / SE)
(line relaying, substation conductor, line trap)
- Grandview – Titusville 115 kV line: Existing line rating is 147 / 149 MVA (SN / SE). Existing conductor rating is 202 / 245 MVA (SN / SE)
(line relaying, substation conductor, line trap)



Need Number: PN-2019-013

Proposed Solution:

Construct Titusville 115 kV Ring Bus

Titusville 115 kV Substation:*

- Construct a four breaker ring bus

Union City 115 kV Substation:*

- Replace substation conductor

Grandview 115 kV Substation:*

- Replace substation conductor

Transmission Line Rating:

- Union City – Titusville 115 kV Line
 - Before Proposed Solution: 120/120 MVA (SN/SE)
 - After Proposed Solution*: 202/245 MVA (SN/SE)
- Grandview – Titusville 115 kV Line
 - Before Proposed Solution: 147/149 MVA (SN/SE)
 - After Proposed Solution*: 202/245 MVA (SN/SE)

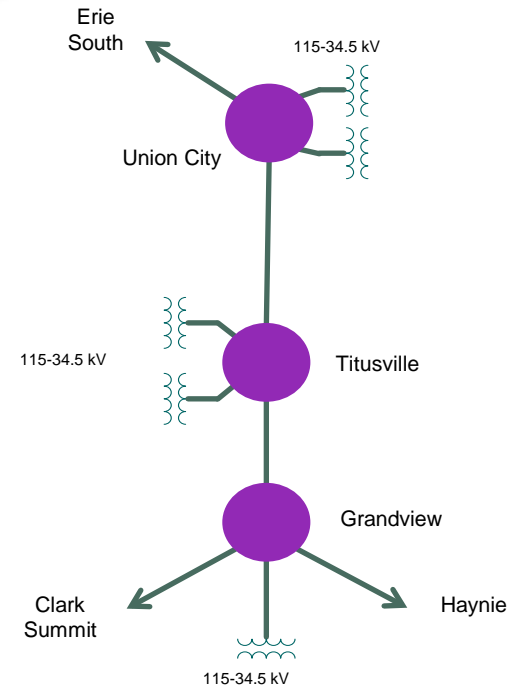
Alternatives Considered:

- None

Estimated Project Cost: \$9.3M

Projected IS Date: 12/1/2022

*Note – Line relaying and line trap will be replaced per need: PN-2019-009 and PN-2019-010



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

Questions?



Appendix



Assumptions

Activity	Timing
Posting of TO Assumptions Meeting information	20 days before Assumptions Meeting
Stakeholder comments	10 days after Assumptions Meeting

Needs

Activity	Timing
TOs and Stakeholders Post Needs Meeting slides	10 days before Needs Meeting
Stakeholder comments	10 days after Needs Meeting

Solutions

Activity	Timing
TOs and Stakeholders Post Solutions Meeting slides	10 days before Solutions Meeting
Stakeholder comments	10 days after Solutions Meeting

Submission of Supplemental Projects & Local Plan

Activity	Timing
Do No Harm (DNH) analysis for selected solution	Prior to posting selected solution
Post selected solution(s)	Following completion of DNH analysis
Stakeholder comments	10 days prior to Local Plan Submission for integration into RTEP
Local Plan submitted to PJM for integration into RTEP	Following review and consideration of comments received after posting of selected solutions



Revision History

3/15/2019 – V1 – Original version posted to pjm.com

3/20/2019 – V2 – Slide #47 modified problem statement. Replaced maps on slide #10 - #15