First Energy MAAC
Local Plan Submission for the 2019 RTEP

Met-Ed Transmission Zone

Need Number: ME-2018-001
Process Stage: Local Plan
Need Presented: 9/21/2018
Solution Presented: 10/29/2018

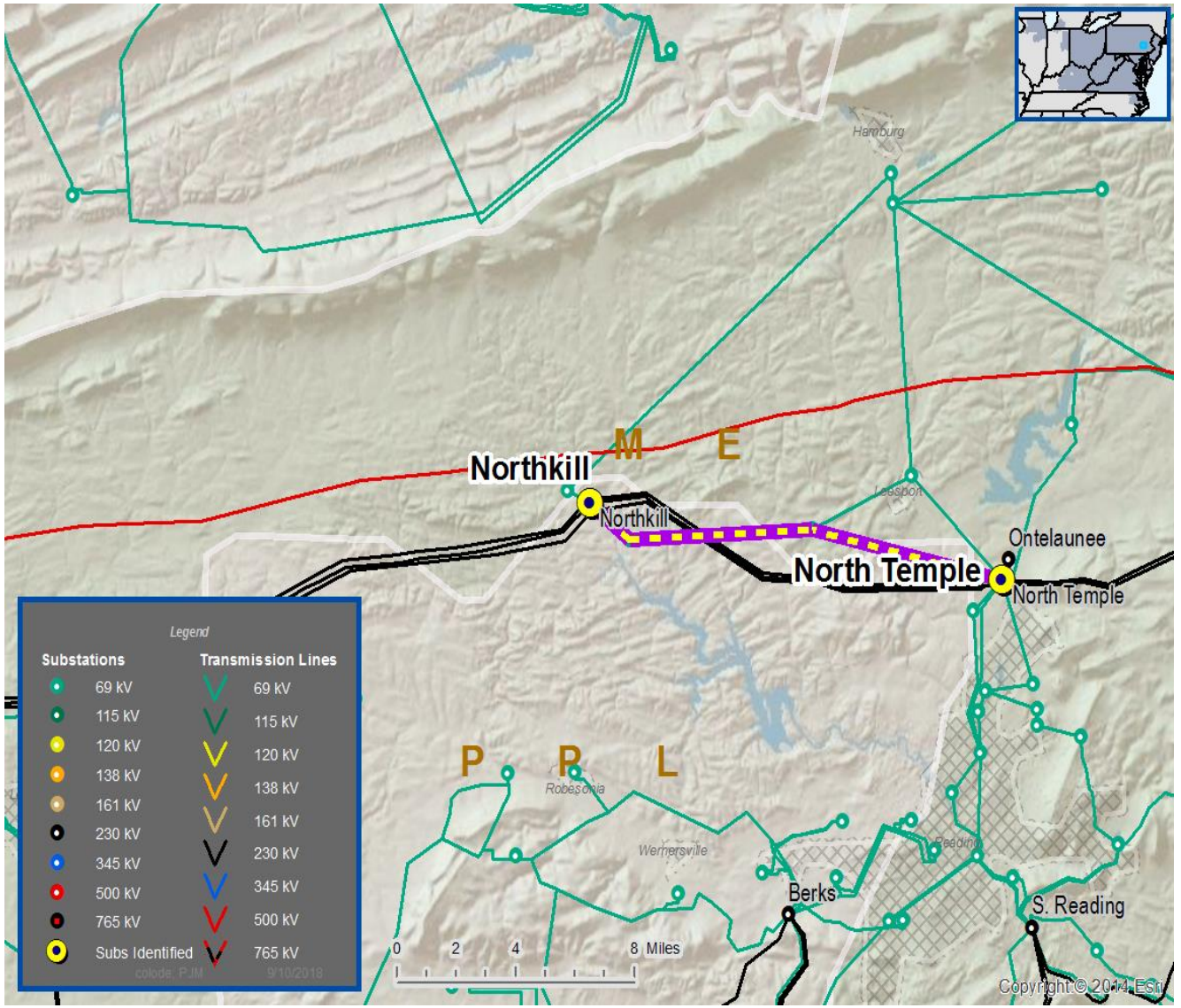
Project Driver(s):
Customer Service

Specific Assumption Reference(s)

- New customer connection request will be evaluated per FirstEnergy's "Requirements for Transmission Connected Facilities" document and "Transmission Planning Criteria" document.

Problem Statement

- New Customer Connection - A customer requested 69 kV service for load of approximately 17 MVA near the North Temple – Northkill 69 kV line. Requested in-service date is 12/2019.

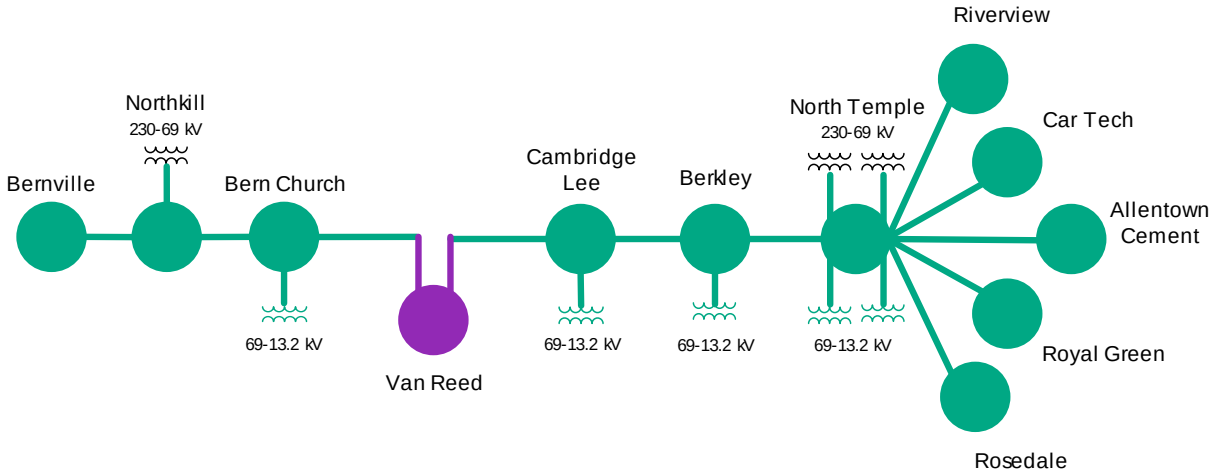


Need Number: ME-2018-001

Selected Solution:

Van Reed Substation

- Construct new Van Reed 69 kV Ring Bus Substation (s1761.1)
- Loop the Northkill - North Temple 69 kV line into Van Reed (s1761.2)
- Provide new 69 kV delivery point for customer (s1761.3)



Estimated Project Cost: $3.6M

Projected IS Date: 12/31/2019

Status: Conceptual

Supplemental Project Number: s1761.1, s1761.2, s1761.3

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

Met-Ed Transmission Zone

Need Number: ME-2018-002
Process Stage: Local Plan
Need Presented : 9/21/2018
Solution Presented: 10/29/2018

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

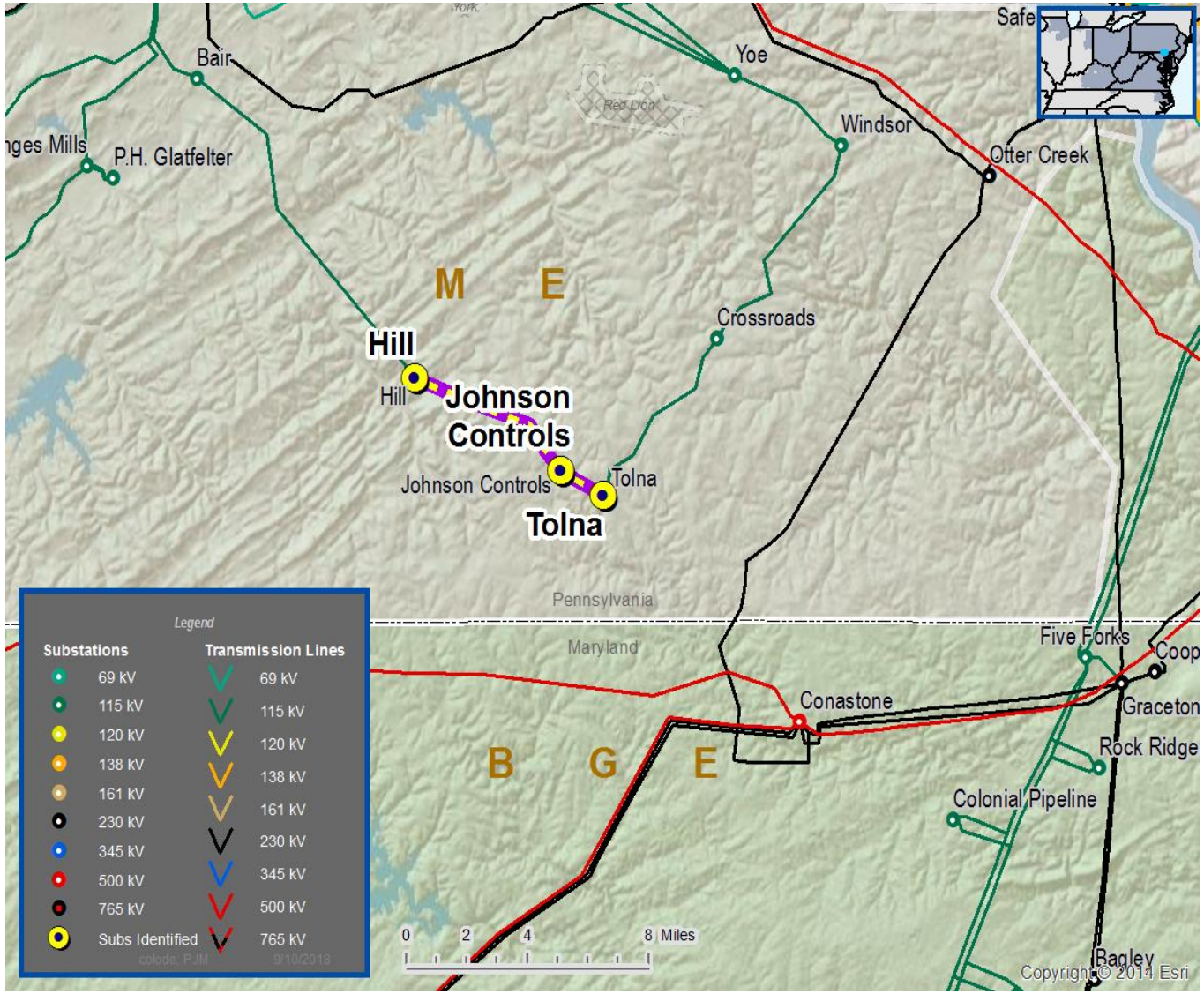
Specific Assumption Reference(s)
Substation/Line Equipment Limits

- Consider upgrading transmission line equipment (switches, conductor, splices, etc.) as well as terminal and protection equipment to meet or exceed the transmission line conductor rating.

Problem Statement
Maintenance/rehab work will be performed on the Hill-Tolna 115 kV line.

Transmission line rating limited by terminal equipment.

- Hill – Johnson Controls 115 kV line: Existing emergency line rating is 150 MVA. Existing conductor emergency rating is 223 MVA.
- Johnson Controls – Tolna 115 kV line: Existing emergency line rating is 208 MVA. Existing conductor emergency rating is 223 MVA.



Need Number: ME-2018-002

Selected Solution:

Replace terminal equipment at Hill and Tolna 115 kV

Hill 115 kV Substation – Terminal equipment to be replaced includes: (s1762.1)

- Line relaying, line drops, line trap, CCVT, line tuner, coax, substation conductor

Tolna 115 kV Substation – Terminal equipment to be replaced includes: (s1762.2)

- Line relaying, line drops, line trap, CCVT, line tuner, coax, substation conductor

<u>Transmission Line Ratings:</u>

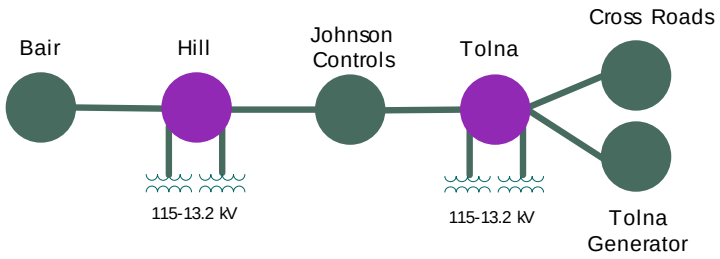
- Hill – Tolna 115 kV Line
  - Before Proposed Solution: 175 MVA SN / 208 MVA SE
  - After Proposed Solution: 184 MVA SN / 223 MVA SE

Estimated Project Cost: $3.0M

Projected IS Date: 12/31/2019

Status: Conceptual

Supplemental Project Number: s1762.1, s1762.2



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

Met-Ed Transmission Zone

Need Number: ME-2018-006

Process Stage: Local Plan

Need Presented : 9/21/2018

Solution Presented: 10/29/2018

Project Driver(s):

Equipment Material Condition, Performance and Risk

Specific Assumption Reference(s)

Upgrade Relay Schemes

Upgrade relay schemes that have historically high percentage of misoperation.

Substation/Line Equipment Limits

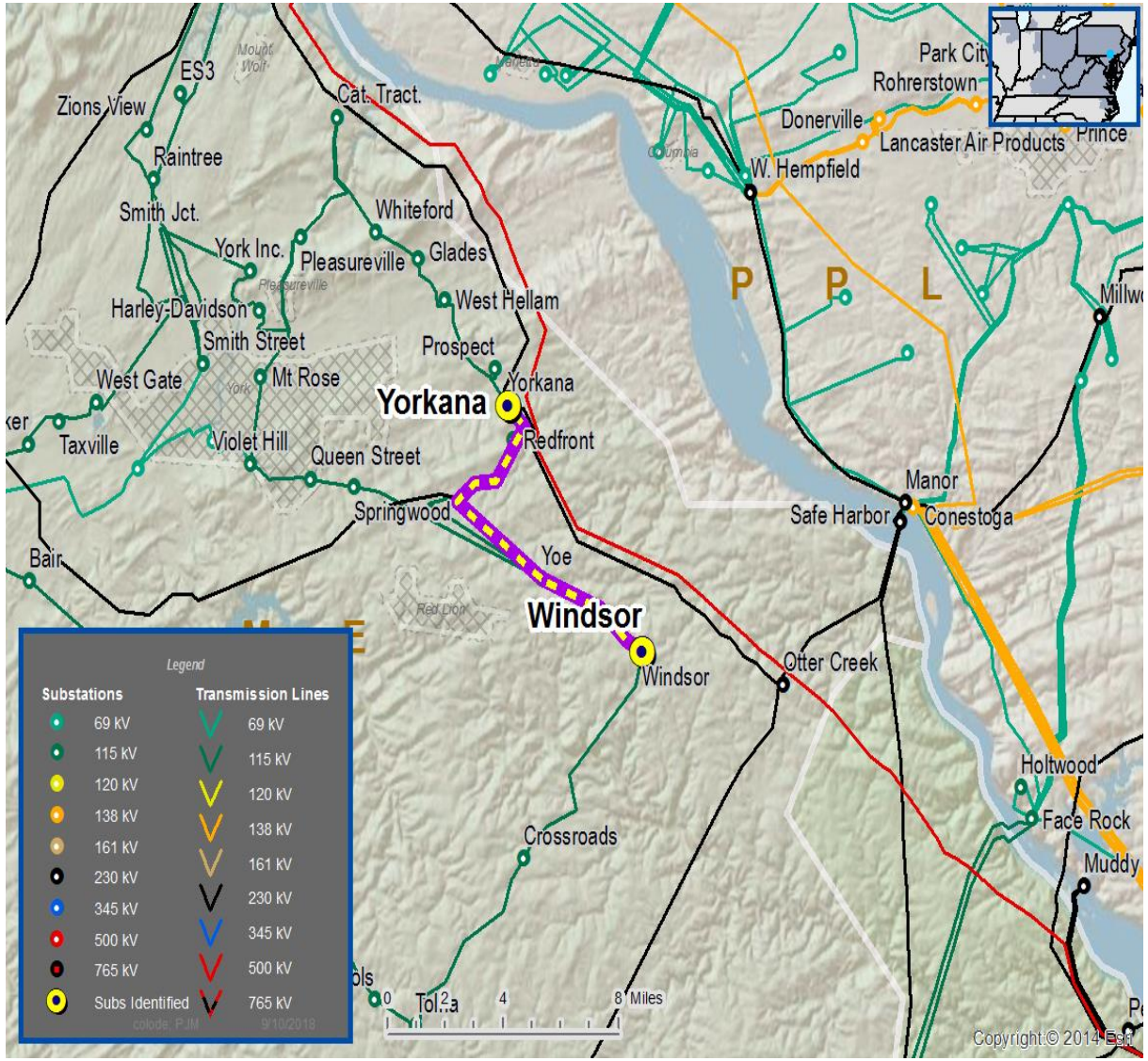
Consider upgrading transmission line equipment (switches, conductor, splices, etc.) as well as terminal and protection equipment to meet or exceed the transmission line conductor rating.

Problem Statement

Maintenance/rehab work will be performed on the Windsor-Yorkana Tap 115 kV line.

Relays on Windsor – Yorkana 115 kV line evaluated by Transmission Planning and Protection and determined to be obsolete and/or in a degraded condition.

Transmission line rating limited by terminal equipment. Existing emergency line rating is 277 MVA. Existing conductor emergency rating is 282 MVA.



Need Number: ME-2018-006

Selected Solution:

Replace terminal equipment at Windsor and Yorkana 115 kV

Windsor 115 kV Substation – Terminal equipment to be replaced includes: s1763.1)

- Line relaying, line drops, CCVT, line trap, line tuner, arresters, breaker, and breaker disconnect switches

*Yorkana 115 kV Substation – Terminal equipment to be replaced includes: (*s1763.2)

- Line relaying, CCVT, line trap, line tuner, arresters, breaker, and breaker disconnect switch

Transmission Line Ratings:

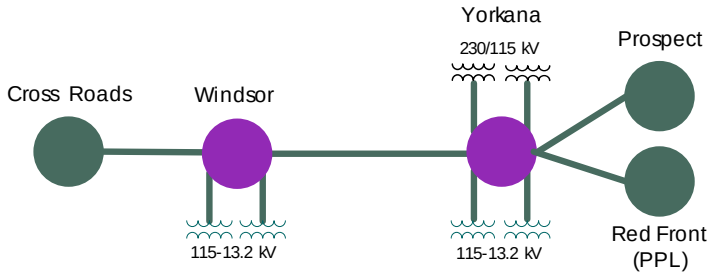
- Windsor – Yorkana 115 kV Line
  - Before Proposed Solution: 232 MVA SN / 277 MVA SE
  - After Proposed Solution: 232 MVA SN / 282 MVA SE

Estimated Project Cost: $10.0 M

Projected IS Date: 6/1/2020

Status: Conceptual

Supplemental Project Number: s1763.1, s1763.2



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

Met-Ed Transmission Zone

Need Number: ME-2018-007
Process Stage: Local plan
Need Presented : 9/21/2018
Solution Presented: 10/29/2018

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

Specific Assumption Reference(s)
Upgrade Relay Schemes

- Upgrade relay schemes that have historically high percentage of misoperation.

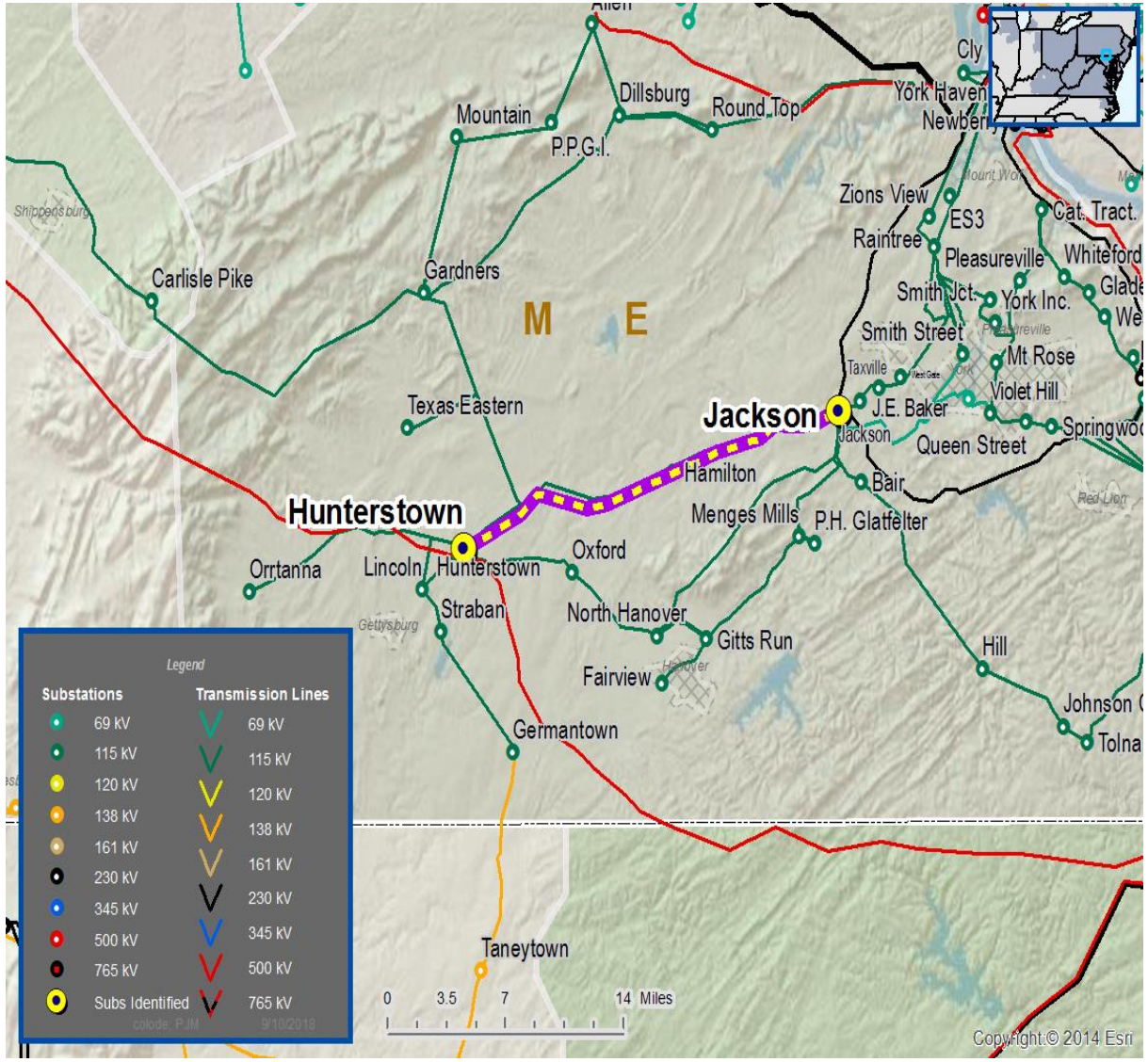
Substation/Line Equipment Limits

- Consider upgrading transmission line equipment (switches, conductor, splices, etc.) as well as terminal and protection equipment to meet or exceed the transmission line conductor rating.

Problem Statement

- Relays on Hunterstown – Jackson 230 kV line evaluated by Transmission Planning and Protection and determined to be obsolete and/or degraded condition.

- Transmission line rating limited by terminal equipment. Existing normal line rating is 678 MVA. Conductor normal rating is 709 MVA.



Need Number: ME-2018-007

Selected Solution:

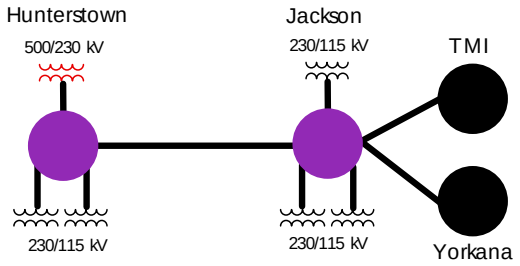
Replace terminal equipment at Hunterstown and Jackson 230 kV

Hunterstown 230 kV Substation – Terminal equipment to be replaced includes:

- Line relaying, CCVT, coax, and line tuner (s1764.1)

Jackson 230 kV Substation – Terminal equipment to be replaced includes:

- Line relaying, line drops, CCVT, coax, and line tuner (s1764.2)



Transmission Line Ratings:

- Hunterstown – Jackson 230 kV Line
  - Before Selected Solution: 678 MVA SN / 797 MVA SE
  - After Selected Solution: 709 MVA SN / 870 MVA SE

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

Estimated Project Cost: $0.8M

Projected IS Date: 12/31/2019

Status: Conceptual

Supplemental Project Number: s1764.1, s1764.2

Met-Ed Transmission Zone

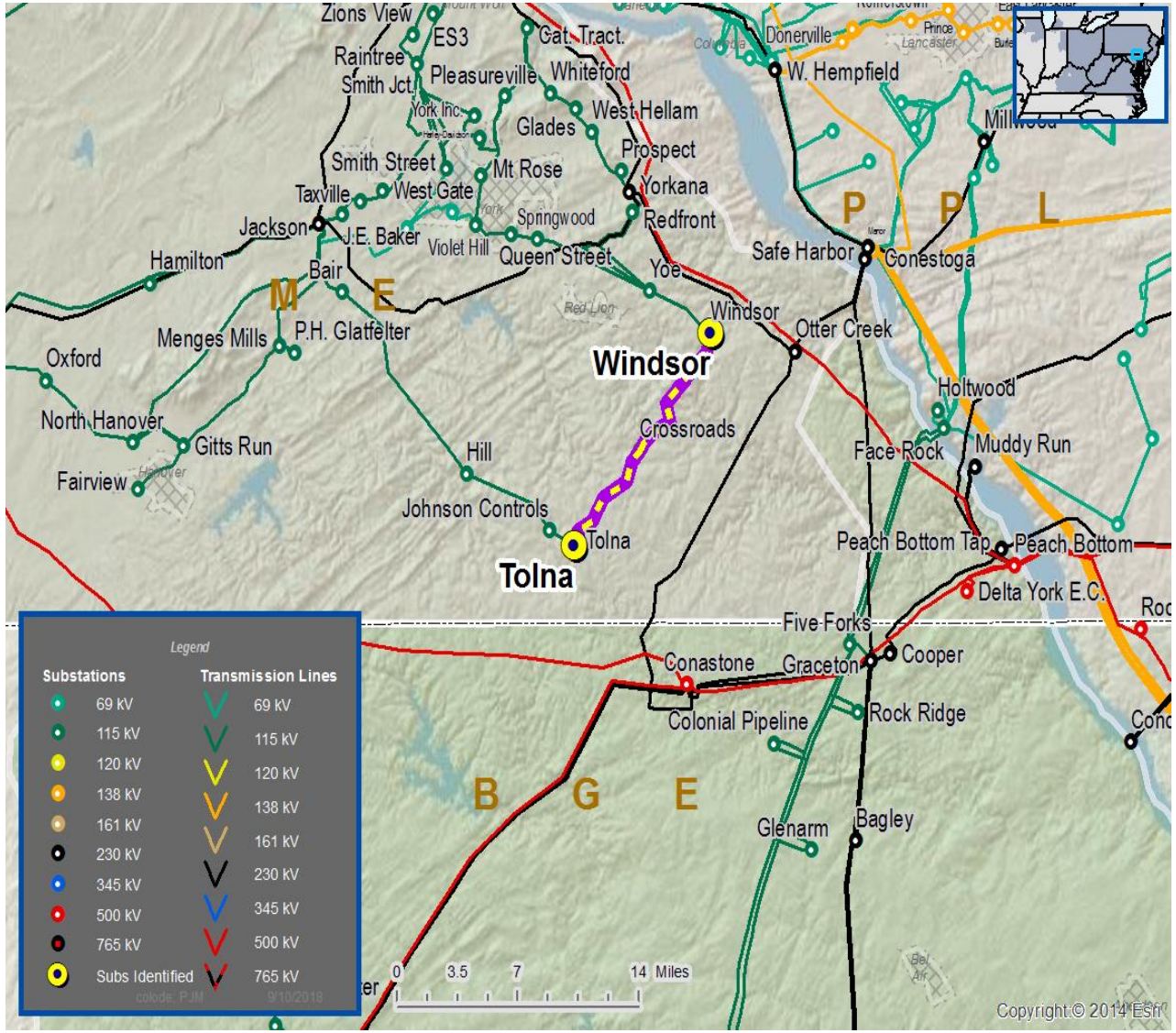
Need Number: ME-2018-008
Process Stage: Local Plan
Need Presented : 9/21/2018
Solution Presented: 10/29/2018

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

Specific Assumption Reference(s)
Upgrade Relay Schemes
Upgrade relay schemes that have historically high percentage of misoperation.
Substation/Line Equipment Limits
Consider upgrading transmission line equipment (switches, conductor, splices, etc.) as well as terminal and protection equipment to meet or exceed the transmission line conductor rating.

Problem Statement
Relays on Tolna – Windsor 115 kV line evaluated and determined to be obsolete and/or degraded condition.

Transmission line rating limited by terminal equipment.
Tolna – Cross Roads 115 kV Line – Existing emergency line rating is 277 MVA.
Conductor emergency rating is 282 MVA.



Need Number: ME-2018-008

Selected Solution:

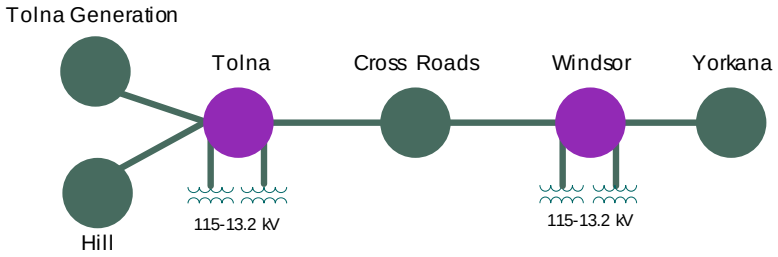
Replace terminal equipment at Tolna and Windsor 115 kV

Tolna 115 kV Substation – Terminal equipment to be replaced includes:

- Line relaying, line drops, CCVT, line trap, line tuner, and arresters (s1765.1)

Windsor 115 kV Substation – Terminal equipment to be replaced includes:

- Line relaying, CCVT, line trap, line tuner, and arresters (s1765.2)



Transmission Line Ratings:

- Tolna – Cross Roads 115 kV Line
  - Before Selected Solution: 232 MVA SN / 277 MVA SE
  - After Selected Solution: 232 MVA SN / 282 MVA SE

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

Estimated Project Cost: $0.7M

Projected IS Date: 12/31/2019

Status: Conceptual

Supplemental Project Number: s1765.1, s1765.2

Met-Ed Transmission Zone

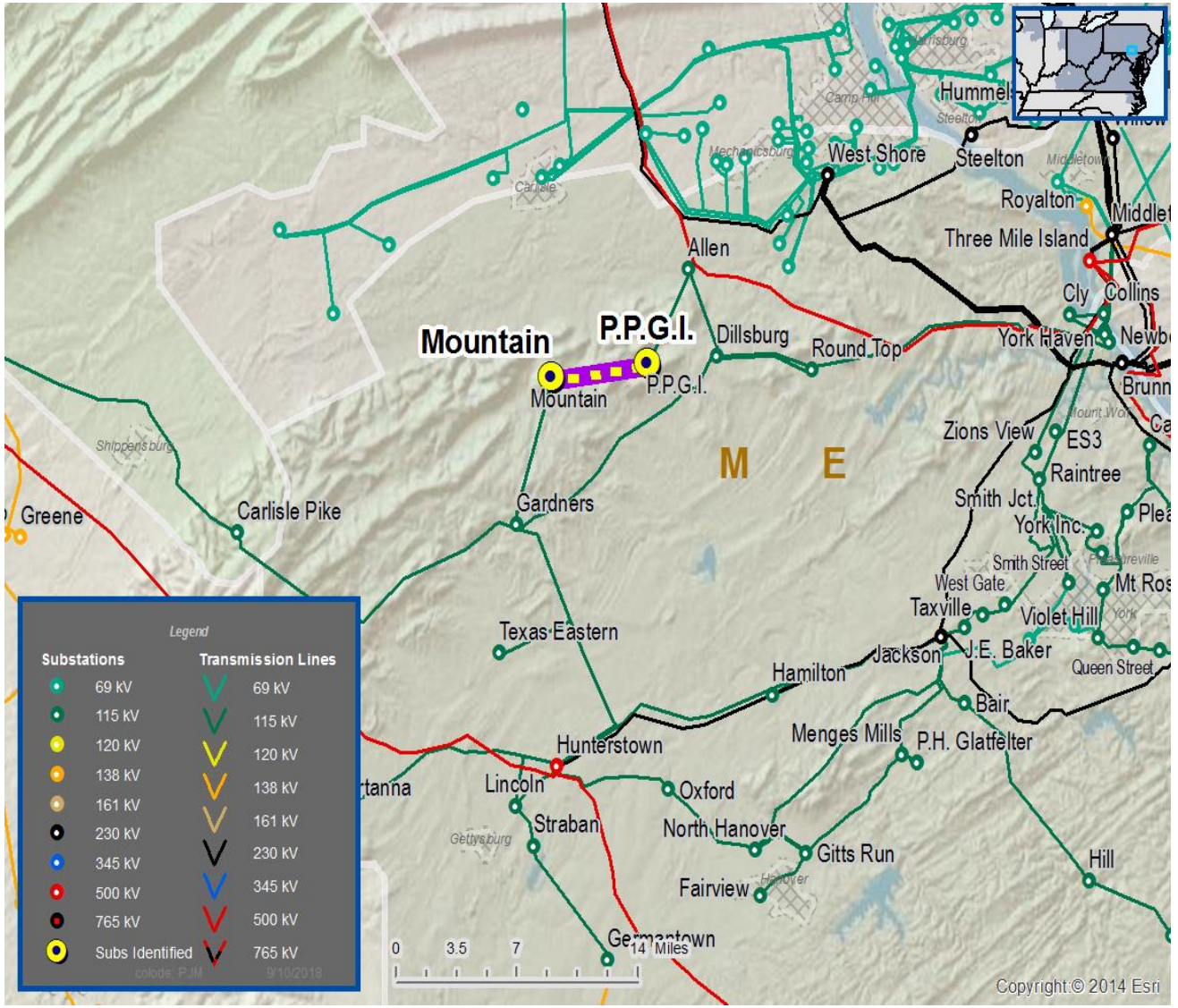
Need Number: ME-2018-009
Process Stage: Local Plan
Need Presented : 9/21/2018
Solution Presented: 10/29/2018

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

Specific Assumption Reference(s)
Upgrade Relay Schemes
Upgrade relay schemes that have historically high percentage of misoperation.
Substation/Line Equipment Limits
Consider upgrading transmission line equipment (switches, conductor, splices, etc.) as well as terminal and protection equipment to meet or exceed the transmission line conductor rating.

Problem Statement
Relays on Mountain – P.P.G.I. 115 kV line evaluated and determined to be obsolete and/or degraded condition.

Transmission line rating limited by terminal equipment. Existing normal line rating is 159 MVA. Conductor normal rating is 184 MVA.



Need Number: ME-2018-009

Selected Solution:

Replace terminal equipment at Mountain and PPGI 115 kV

Mountain 115 kV Substation – Terminal equipment to be replaced includes:

- Line relaying, line drops, CCVT, line trap, line tuner, arresters and breaker disconnect switch (s1766.1)

PPGI 115 kV Substation – Terminal equipment to be replaced includes:

- Line relaying, CCVT, line trap, line tuner, arresters, and breaker disconnect switch (s1766.2)

Transmission Line Ratings:

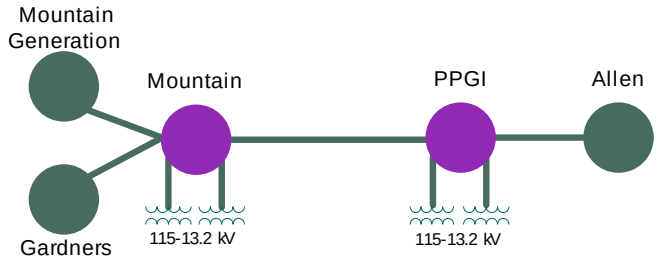
- Mountain – PPGI 115 kV Line
  - Before Selected Solution: 159 MVA SN / 211 MVA SE
  - After Selected Solution: 184 MVA SN / 223 MVA SE

Estimated Project Cost: $0.6M

Projected IS Date: 12/31/2019

Status: Conceptual

Supplemental Project Number: s1766.1, s1766.2



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

Met-Ed Transmission Zone

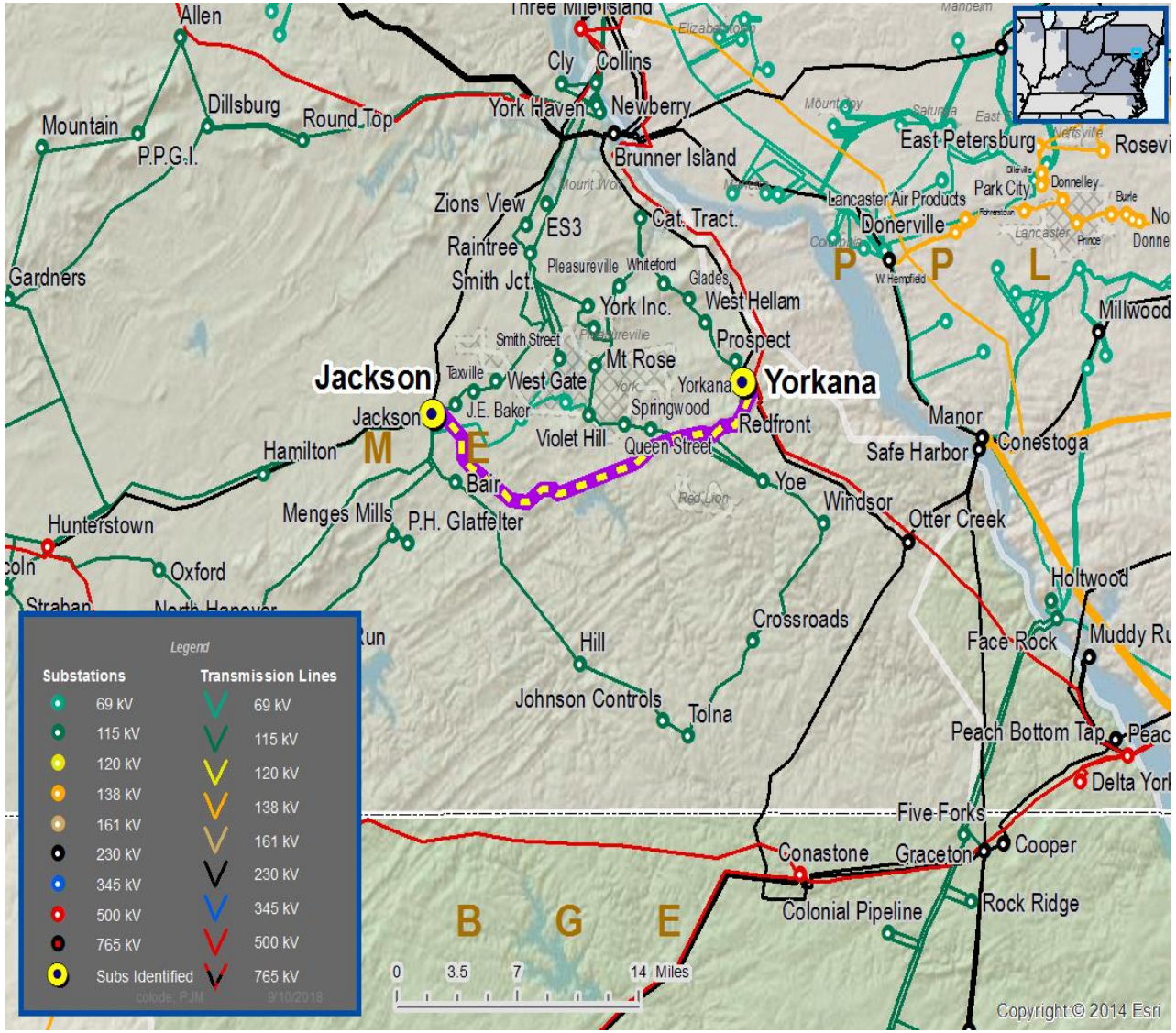
Need Number: ME-2018-010
Process Stage: Local Plan
Need Presented : 9/21/2018
Solution Presented: 10/29/2018

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

Specific Assumption Reference(s)
Upgrade Relay Schemes
Upgrade relay schemes that have historically high percentage of misoperation.
Substation/Line Equipment Limits
Consider upgrading transmission line equipment (switches, conductor, splices, etc.) as well as terminal and protection equipment to meet or exceed the transmission line conductor rating.

Problem Statement
Relays on Jackson – Yorkana 230 kV line evaluated and determined to be obsolete and/or degraded condition.

Transmission line rating limited by terminal equipment. Existing normal line rating is 650 MVA. Conductor normal rating is 709 MVA.



Need Number: ME-2018-010

Selected Solution:

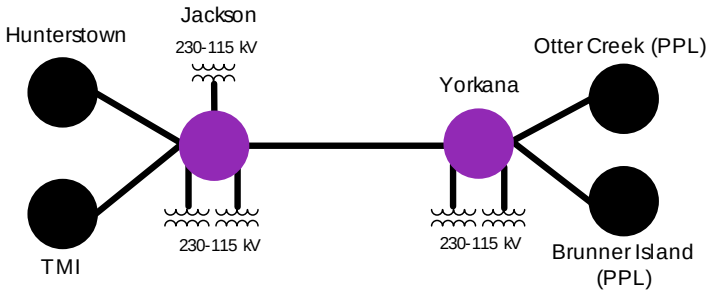
Replace terminal equipment at Jackson and Yorkana 230 kV

Jackson 230 kV Substation – Terminal equipment to be replaced includes:

- Line relaying, line drops, CCVT, line trap, and line tuner (s1767.1)

Yorkana 230 kV Substation – Terminal equipment to be replaced includes:

- Line relaying, line drops, CCVT, line trap, and line tuner (s1767.2)



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

Transmission Line Ratings:

- Jackson – Yorkana 230 kV Line
  - Before Selected Solution: 650 MVA SN / 817 MVA SE
  - After Selected Solution: 709 MVA SN / 869 MVA SE

Estimated Project Cost: $0.6M

Projected IS Date: 12/31/2019

Status: Conceptual

Supplemental Project Number: s1767.1, s1767.2

Met-Ed Transmission Zone

Need Number: ME-2018-011
Process Stage: Local Plan
Need Presented : 9/21/2018
Solution Presented: 10/29/2018

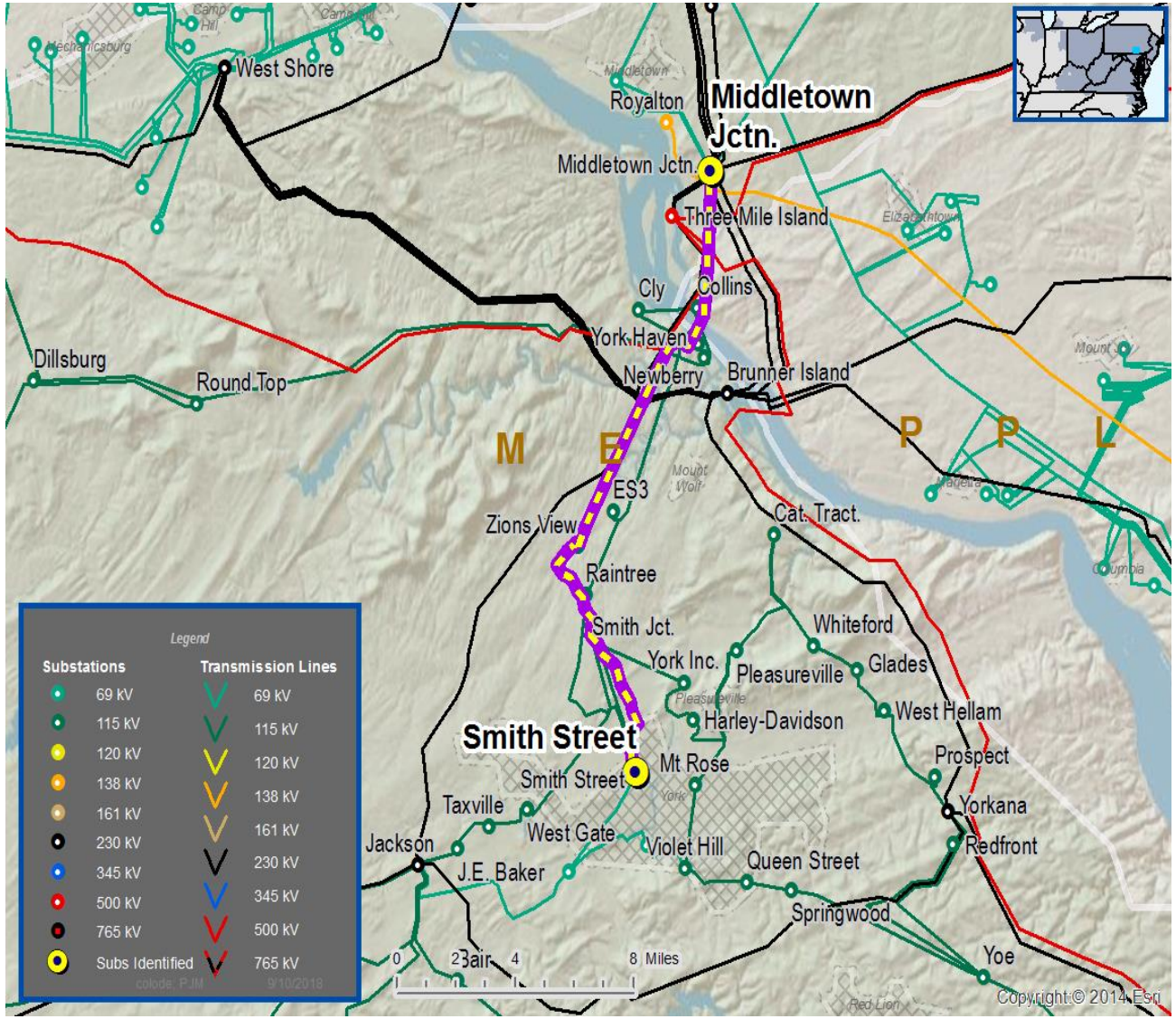
Project Driver(s):
Equipment Material Condition, Performance and Risk

Specific Assumption Reference(s)
Upgrade Relay Schemes
- Upgrade relay schemes that have historically high percentage of misoperation.

Substation/Line Equipment Limits
- Consider upgrading transmission line equipment (switches, conductor, splices, etc.) as well as terminal and protection equipment to meet or exceed the transmission line conductor rating.

Problem Statement
Relays on Middletown Junction – Smith Street (978) 115 kV line evaluated by Transmission Planning and Protection and determined to be obsolete and/or degraded condition.

Transmission line rating limited by terminal equipment.
- Raintree – Smith Street (978) 115 kV Line – Existing normal line rating is 103 MVA. Conductor normal rating is 129 MVA.



Need Number: ME-2018-011

Selected Solution:

Replace terminal equipment at Middletown Junction and Smith Street (978) 115 kV

Middletown Junction 115 kV Substation – Terminal equipment to be replaced includes:

- Line relaying, CCVT, line trap and line tuner (s1768.1)

Smith Street 115 kV Substation – Terminal equipment to be replaced includes:

- Line relaying, line drops, CCVT, line trap, line tuner, breaker and breaker disconnect switches (s1768.2)

Transmission Line Ratings:

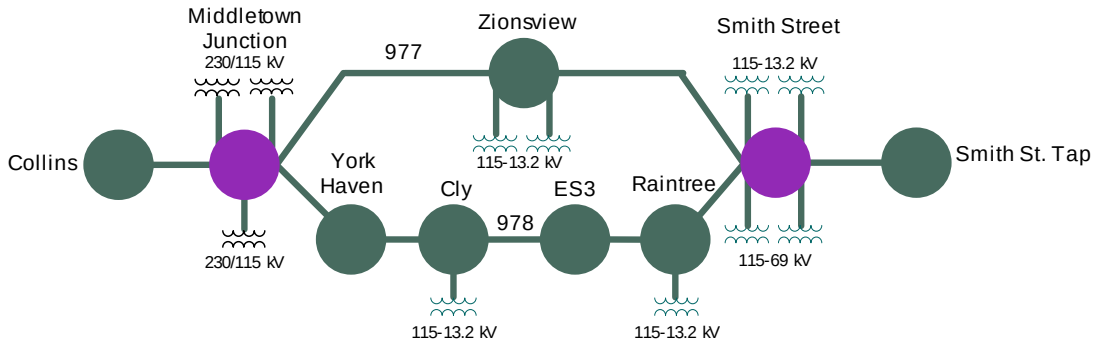
- Raintree – Smith Street (978) 115 kV Line
  - Before Selected Solution: 103 MVA SN / 129 MVA SE
  - After Selected Solution: 129 MVA SN / 156 MVA SE

Estimated Project Cost: $1.1M

Projected IS Date: 12/31/2019

Status: Conceptual

Supplemental Project Number: s1768.1, s1768.2



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

Met-Ed Transmission Zone M-3 Process
Pleasureville – Harley Davidson – York Incinerator 115 kV Line Rehab

Need Number: ME-2018-003

Process State: Submission of Supplemental Project for inclusion in the Local Plan 7/26/2019

Previously Presented:
Need Meeting 9/21/2018
Solution Meeting 11/28/2018

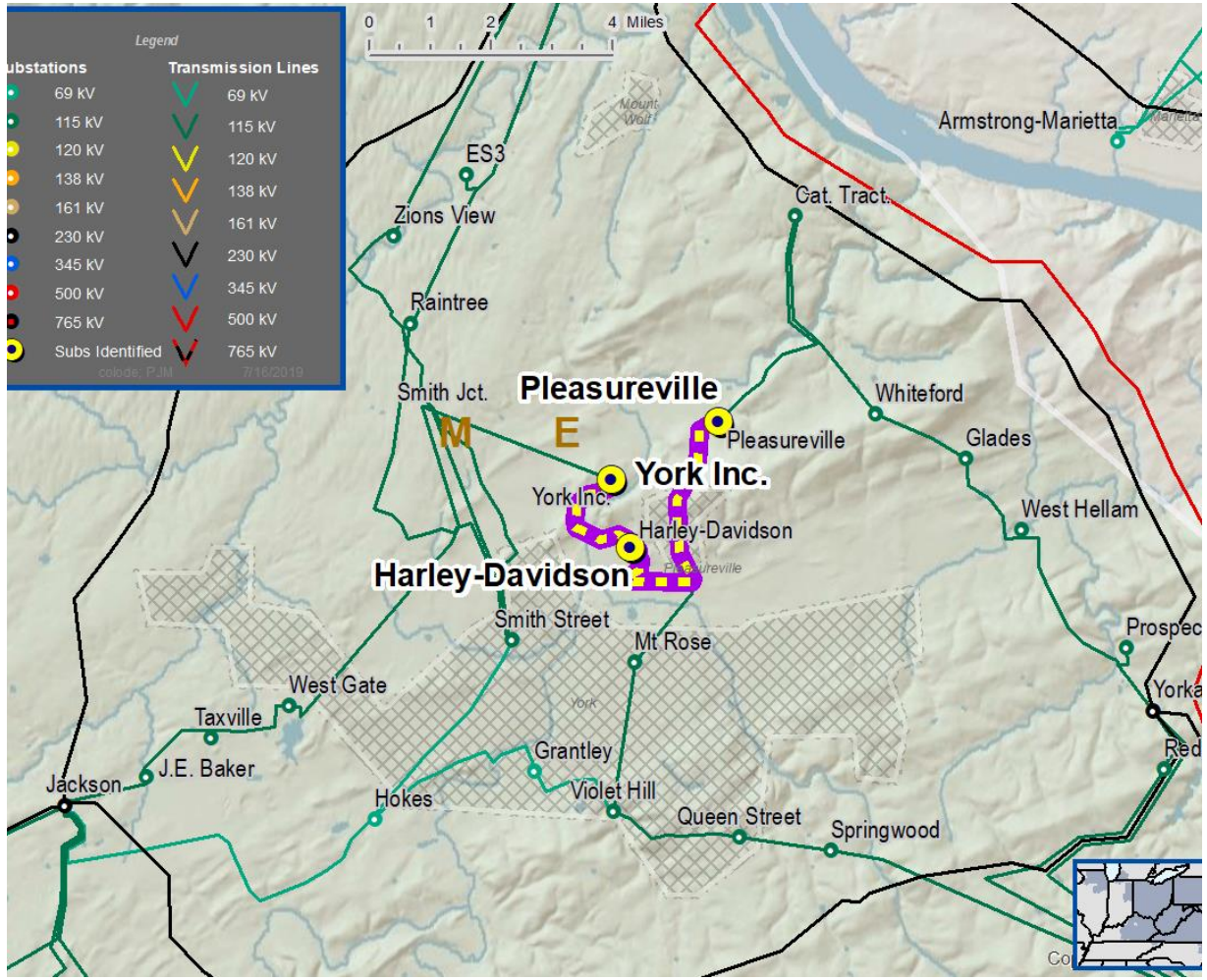
Project Driver:
Equipment Material Condition, Performance and Risk

Specific Assumption Reference:
Substation/Line Equipment Limits

- Consider upgrading transmission line equipment (switches, conductor, splices, etc.) as well as terminal and protection equipment to meet or exceed the transmission line conductor rating.

Problem Statement:
Maintenance/rehab work will be performed on the Pleasureville-Harley Davidson-York Solid Waste 115 kV line.
Transmission line rating limited by terminal equipment.

- Pleasureville – Harley Davidson 115 kV line: Existing emergency line rating is 263 MVA. Existing conductor emergency rating is 430 MVA.
- Harley Davidson – York Inc. 115 kV line: Existing emergency rating is 263 MVA. Existing conductor emergency rating is 282 MVA.



Met-Ed Transmission Zone M-3 Process
Pleasureville – Harley Davidson – York Incinerator 115 kV Line Rehab

Need Number: ME-2018-003

Process State: Submission of Supplemental Project for inclusion in the Local Plan 7/26/2019

Selected Solution:

Pleasureville – Harley Davidson – York Incinerator 115 kV Line Rehab (**s1811.1**)

Pleasureville 115 kV Substation – Terminal equipment to be replaced includes:

- Line relaying, line trap, CCVT, line tuner, coax, substation conductor, and breaker disconnect switches (**s1811.2**)

York Incinerator 115 kV Substation – Terminal equipment to be replaced includes:

- Line relaying, line trap, CCVT, line tuner, coax, substation conductor, circuit breaker, and disconnect switches (**s1811.3**)

Transmission Line Ratings:

Pleasureville – Harley Davidson 115 kV Line

- Before Proposed Solution: 221/263 MVA (SN/SE)
- After Proposed Solution: 297/376 MVA (SN/SE)

Harley Davidson – York Incinerator 115 kV Line

- Before Proposed Solution: 221/263 MVA (SN/SE)
- After Proposed Solution: 232/282 MVA (SN/SE)

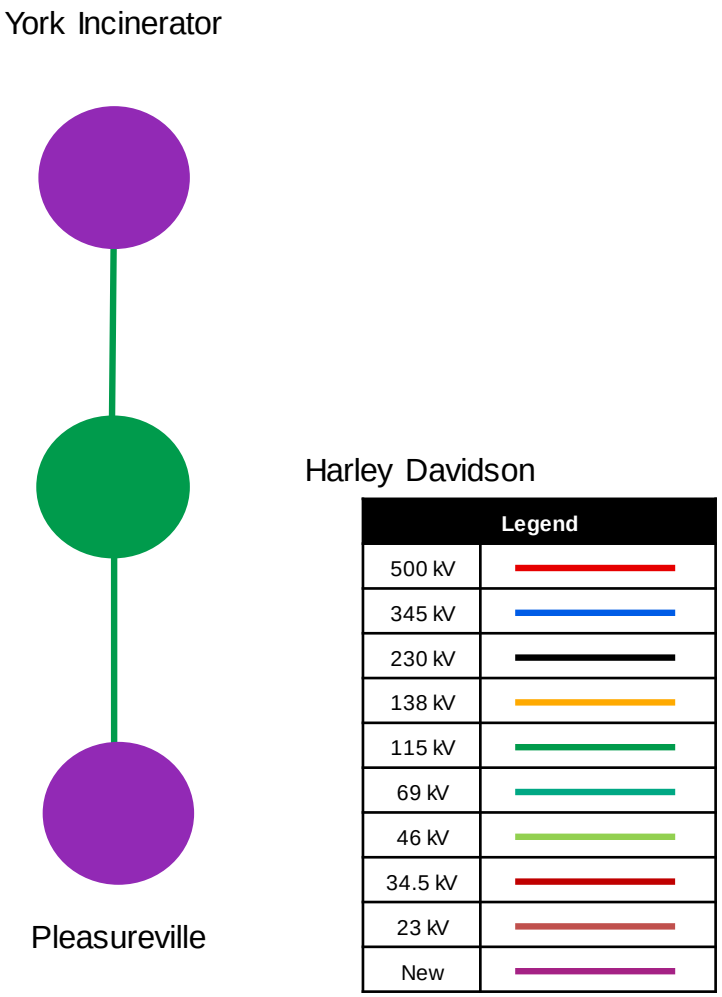
Estimated Cost: $3.9 M

Projected In-Service: 12/22/2021

Supplemental Project ID: **s**1811.1, s1811.2, **:** s1811,.3

Project Status: Conceptual

Model: 2018 Series 2023 Summer RTEP 50/50



Pleasureville – Mt. Rose – Violet Hill 115 kV Line Rehab & Misoperation Relay Replacement

Need Number: ME-2018-004 & ME-2018-012

Process State: Submission of Supplemental Project for inclusion in the Local Plan 7/26/2019

Previously Presented:

Need Meeting 9/21/2018

Solution Meeting 11/28/2018

Project Driver:

Equipment Material Condition, Performance and Risk

Specific Assumption Reference:

Upgrade Relay Schemes

- Upgrade relay schemes that have historically high percentage of misoperation.

Substation/Line Equipment Limits

- Consider upgrading transmission line equipment (switches, conductor, splices, etc.) as well as terminal and protection equipment to meet or exceed the transmission line conductor rating.

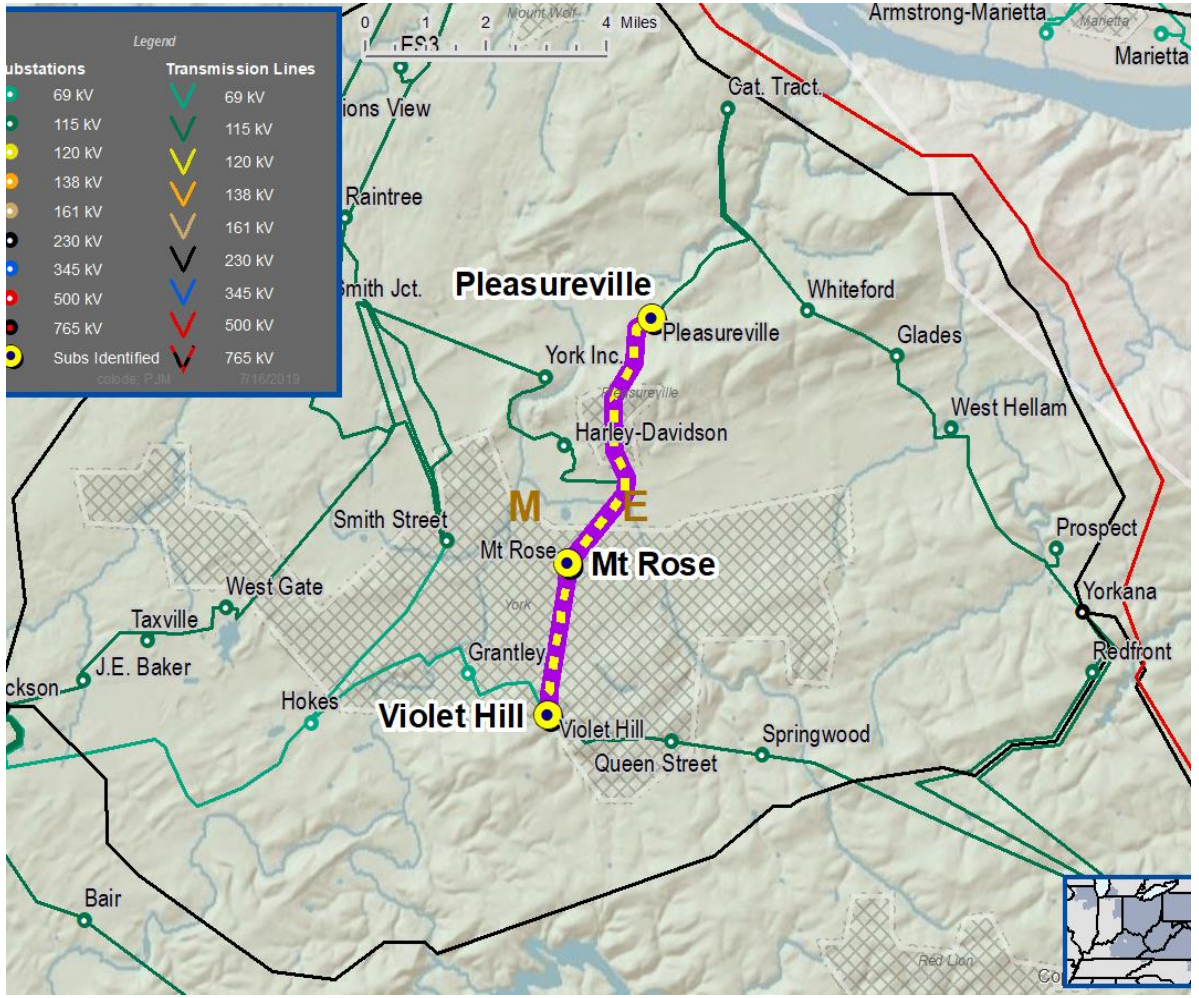
Problem Statement:

Maintenance/rehab work will be performed on the Pleasureville-Mt. Rose-Violet Hill 115 kV line.

Relays on Pleasureville – Violet Hill 115 kV line evaluated and determined to be obsolete and/or degraded condition. 204 MVA.

Transmission line rating limited by terminal equipment.

- Pleasureville – Mt. Rose 115 kV line: Existing emergency line rating is the existing conductor emergency rating.
- Mt. Rose – Violet Hill 115 kV line: Existing emergency line rating is 204/266 MVA (SN/SE). Existing conductor rating is 232/282 MVA (SN/SE).



Pleasureville – Mt. Rose – Violet Hill 115 kV Line Rehab & Misoperation Relay Replacement

Need Number: ME-2018-004 & ME-2018-012

Process State: Submission of Supplemental Project for inclusion in the Local Plan 7/26/2019

Selected Solution:

Pleasureville – Mt. Rose – Violet Hill 115 kV line rehab & replace relays prone to misoperation (**s1812**)

Violet Hill 115 kV Substation – Terminal equipment to be replaced includes:

- Line relaying, line drops, CCVT, wave trap, line tuner, arresters, and breaker disconnect switches

Transmission Line Ratings:

Mt. Rose – Violet Hill 115 kV Line

- Before Proposed Solution: 204/266 MVA (SN/SE)
- After Proposed Solution: 232/282 MVA (SN/SE)

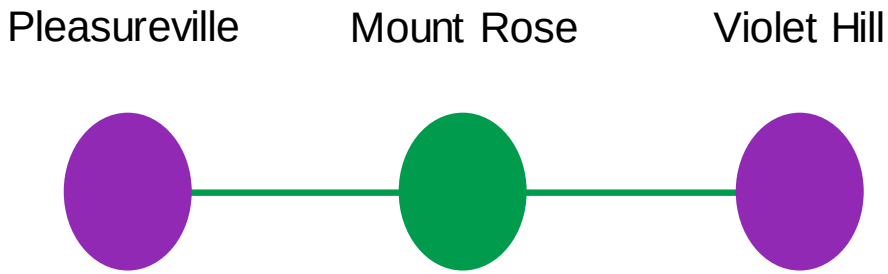
Estimated Cost: $0.9M

Projected In-Service: 12/31/2019

Supplemental Project ID: s1812

Project Status: Conceptual

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
Smith Street – Westgate– York Solid Waste 115 kV Line Rebuild

Need Number: ME-2018-005

Process State: Submission of Supplemental Project for inclusion in the Local Plan 7/26/2019

Previously Presented:
Need Meeting 9/21/2018
Solution Meeting 11/28/2018

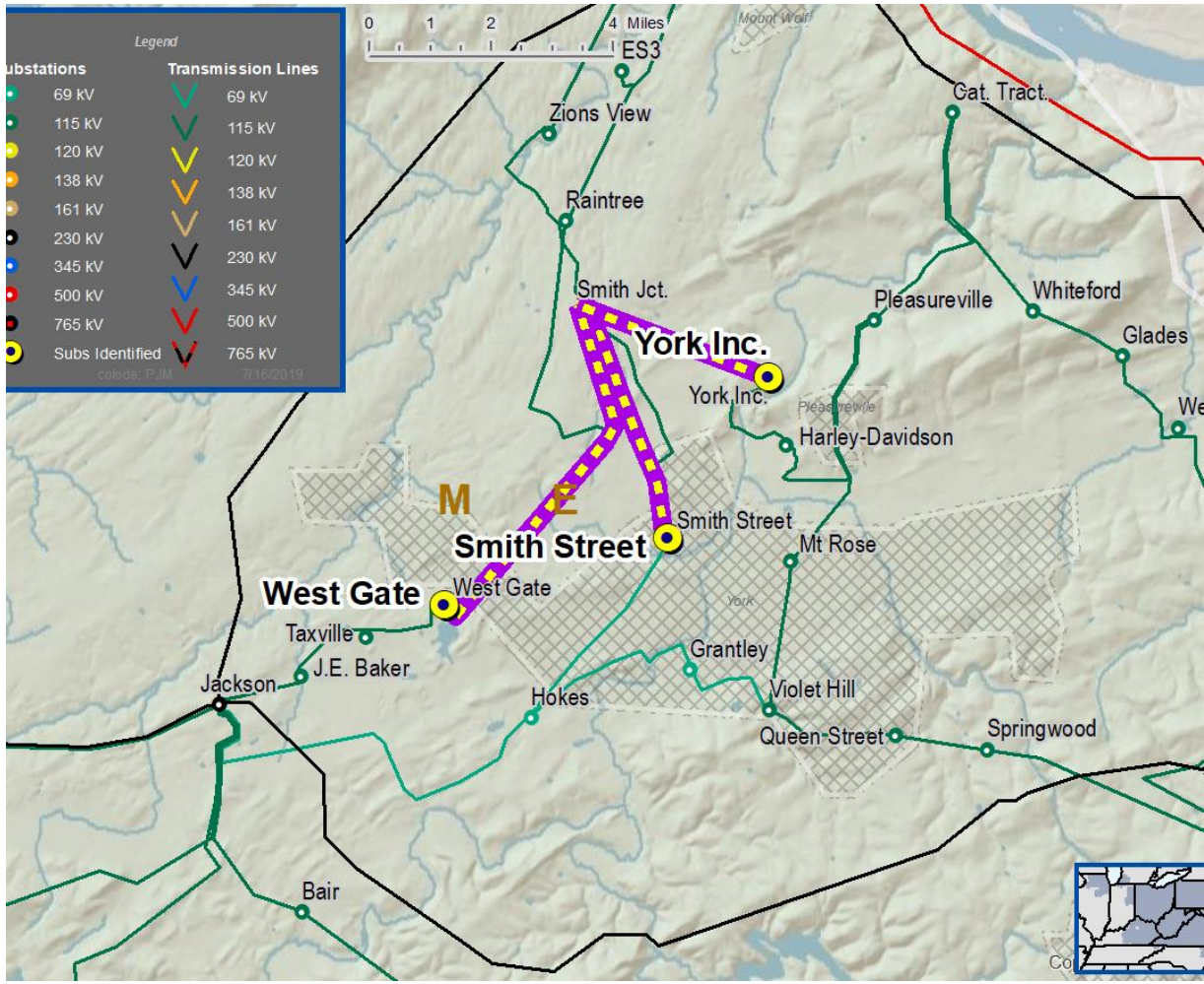
Project Driver:
Equipment Material Condition, Performance and Risk

Specific Assumption Reference:
Line Condition Rebuild/Replacement
- Equipment characteristics are near or beyond existing service life or contain components that are obsolete.

Reconductor/Rebuild Transmission Lines
- Transmission lines with high loading while factoring in its overall condition assessment.

Substation/Line Equipment Limits
- Consider upgrading transmission line equipment (switches, conductor, splices, etc.) as well as terminal and protection equipment to meet or exceed the transmission line conductor rating.

Problem Statement:
Segments of Smith Street-Westgate-York Solid Waste 115 kV line are at or beyond service life.
Transmission line rating limited by terminal equipment.
- Smith Street – Smith Street Tap 115 kV line: Existing emergency line rating is 152 MVA. Existing conductor emergency rating is 223 MVA.
- Westgate – Smith Street Tap 115 kV line: Existing emergency line rating is 263 MVA. Existing conductor emergency rating is 282 MVA.
- York Inc. – Smith Street Tap115 kV line: Existing emergency line rating is the existing conductor emergency rating.



Met-Ed Transmission Zone M-3 Process
Smith Street – Westgate– York Solid Waste 115 kV Line Rebuild

Need Number: ME-2018-005

Process State: Submission of Supplemental Project for inclusion in the Local Plan 7/26/2019

Selected Solution:

Smith Street – Smith Street Tap115 kV Line Rebuild (**s1813.1**)
- Rebuild approximately 1.3 miles of wood pole construction (**s1813.2**)

Smith Street Tap – York Incinerator 115 kV Line Rebuild
- Rebuild/reconductor approximately 2 miles of wood pole construction (**s1813.3**)

Smith Street 115 kV Substation – Terminal equipment to be replaced includes:
- Line relaying, substation conductor, CCVT, circuit breaker and breaker disconnects (**s1813.4**)

Westgate 115 kV Substation – Terminal equipment to be replaced includes:
- Substation conductor (**s1813.5**)

York Incinerator 115 kV Substation – Terminal equipment to be replaced includes:
- Substation conductor (**s1813.6**)

<u>Transmission Line Ratings:</u>

Smith Street – Smith Street Tap 115 kV Line
- Before Proposed Solution: 118/152 MVA (SN/SE)
- After Proposed Solution: 184/223 MVA (SN/SE)

Westgate – Smith Street Tap 115 kV Line
- Before Proposed Solution: 221/263 MVA (SN/SE)
- After Proposed Solution: 232/282 MVA (SN/SE)

York Incinerator – Smith Street Tap 115 kV Line
- Before Proposed Solution: 184/223 MVA (SN/SE)
- After Proposed Solution: 232/282 MVA (SN/SE)

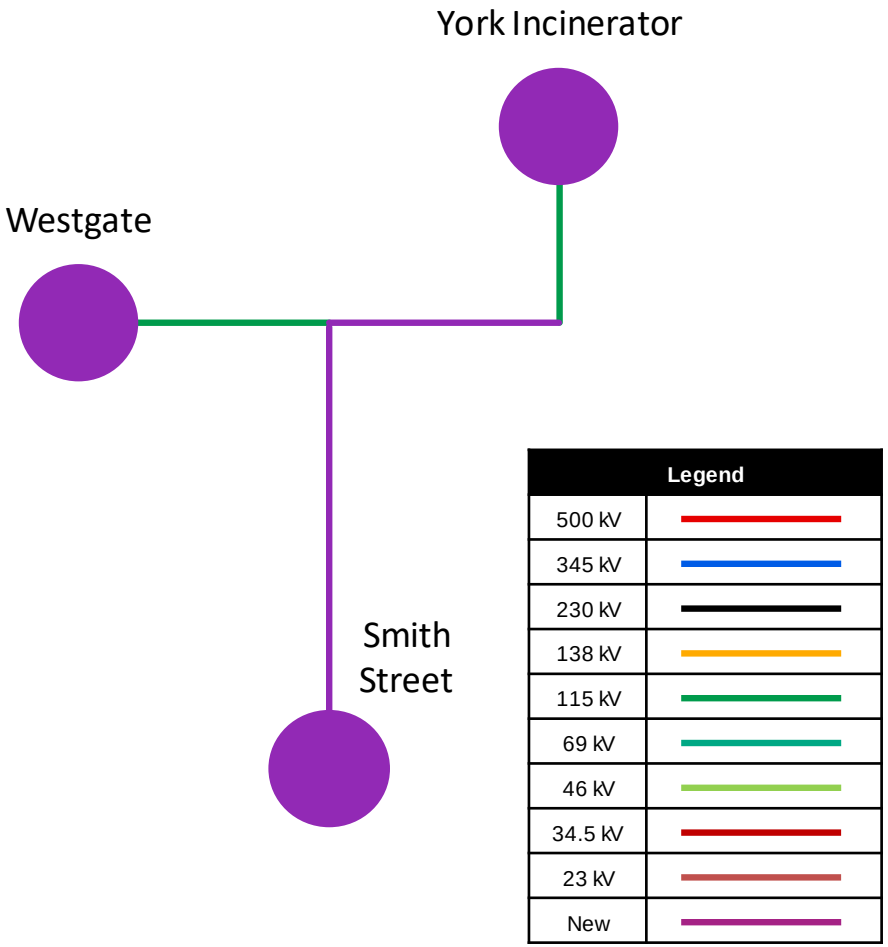
Estimated Cost: $6.4 M

Projected In-Service: 12/31/2019

Supplemental Project ID: s1813.1, s1813.2, s1813.3, s1813.4, s1813.4, s1813.5, s1813.6

Project Status: Conceptual

Model: 2018 Series 2023 Summer RTEP 50/50



Met-Ed Transmission Zone M-3 Process
Middletown Junction #3 230-69 kV Transformer Replacement

Need Number: ME-2018-013

Process State: Submission of Supplemental Project for inclusion in the Local Plan 7/26/2019

Previously Presented:

Need Meeting 10/29/2018

Solution Meeting 11/28/2018

Project Driver:

Equipment Material Condition, Performance and Risk

Specific Assumption Reference:

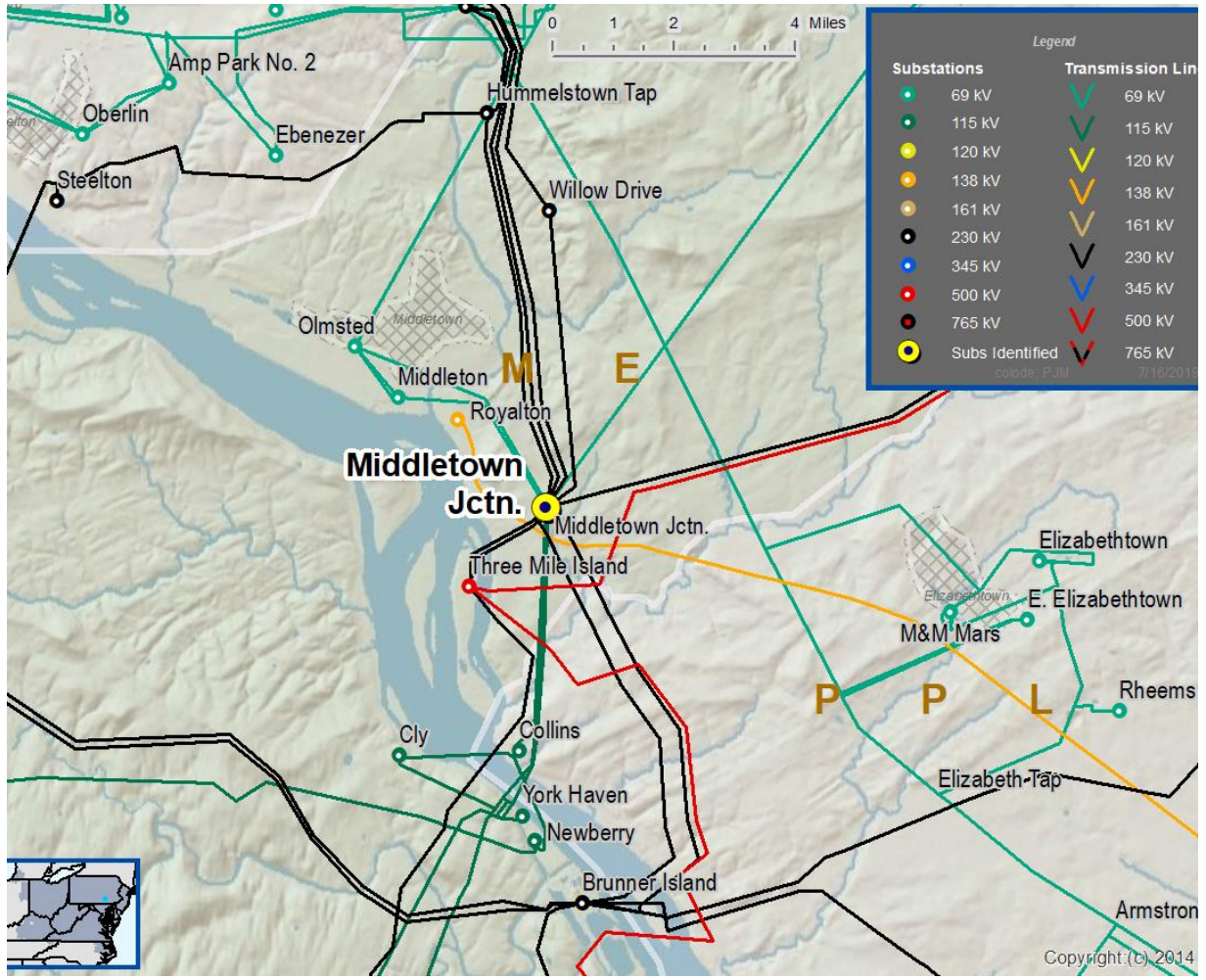
Substation Condition Rebuild/Replacement

System Performance Projects – Substation/Line Equipment Limits

Problem Statement:

Middletown Junction #3 230-69 kV:

- Transformer is 55 years old
- There have been 44 maintenance orders since 2003
- Multiple oil leaks in load tap changer
- Combustible gasses found in load tap changer oil



Met-Ed Transmission Zone M-3 Process
Middletown Junction #3 230-69 kV Transformer Replacement

Need Number: ME-2018-013

Process State: Submission of Supplemental Project for inclusion in the Local Plan 7/26/2019

Selected Solution:

Middletown Junction #3 230-69 kV transformer replacement **(s1814**)

Middletown Junction Substation – Equipment to be replaced includes:

- 230-69 kV 100/134/168 MVA Transformer, grounding transformer, circuit breaker, breaker drops, bus conductor

Transformer Ratings:

Middletown Junction 230-69 kV Transformer No.3

- Before Proposed Solution: 88/106 MVA (SN/SE)
- After Proposed Solution (anticipated): 211/232 MVA (SN/SE)

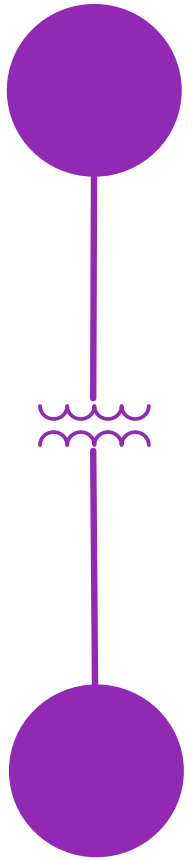
Estimated Cost: $2.6M

Projected In-Service: 12/31/2019

Supplemental Project ID: s1814

Project Status: Conceptual

Model: 2018 Series 2023 Summer RTEP 50/50



Middletown Junction
230-69 kV

Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

West Lebanon – Broad Street 69 kV Misoperation Relay Replacement

Need Number: ME-2018-014

Process State: Submission of Supplemental Project for inclusion in the Local Plan 7/26/2019

Previously Presented:

Need Meeting 10/29/2018

Solution Meeting 11/28/2018

Project Driver:

Equipment Material Condition, Performance and Risk

Specific Assumption Reference:

Substation Condition Rebuild/Replacement – Station system protection and controls – Electromechanical relays

System Performance Projects – Substation/Line Equipment Limits

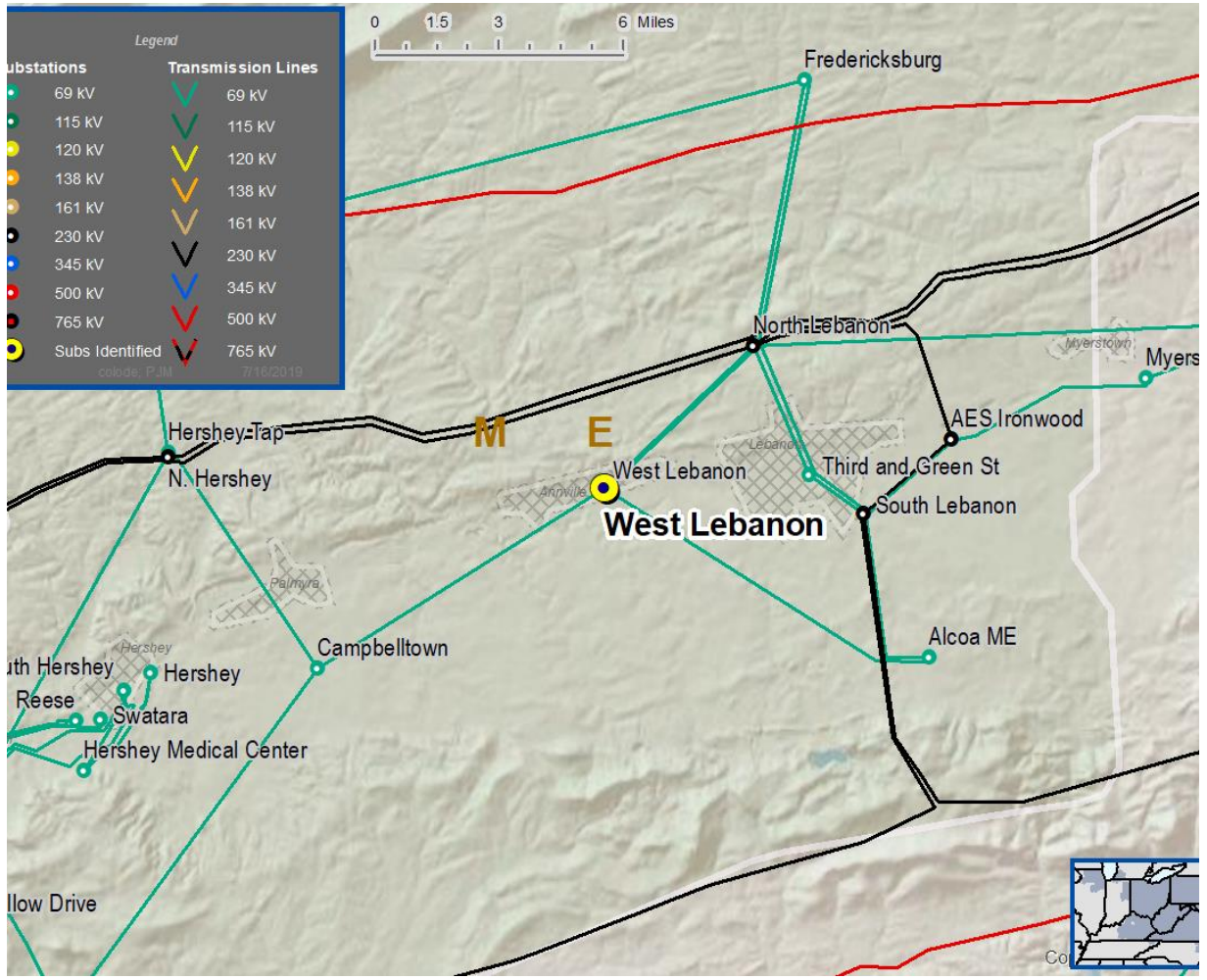
Upgrade Relay Schemes

Problem Statement:

Relays on Broad Street – West Lebanon 69 kV line evaluated and determined to be obsolete and/or degraded condition.

Transmission line rating limited by terminal equipment. Existing line rating is 71/91 MVA (SN/SE). Existing conductor rating is 111/134 MVA (SN/SE).

(substation conductor and disconnect switches)



Met-Ed Transmission Zone M-3 Process
West Lebanon – Broad Street 69 kV Misoperation Relay Replacement

Need Number: ME-2018-014

Process State: Submission of Supplemental Project for inclusion in the Local Plan 7/26/2019

Selected Solution:
West Lebanon – Broad Street 69 kV replace relays prone to misoperation (**s1815.1**)
West Lebanon 69 kV Substation – Terminal equipment to be replaced includes:
- Line relaying, line drops, arresters, a circuit breaker, and disconnect switches (**s1815.2**)

Broad Street 69 kV Substation – Terminal equipment to be replaced includes:
- Line relaying, line drops, arresters, a circuit breaker, and disconnect switches (**s1815.3**)

Transmission Line Ratings:
West Lebanon – Broad Street 69 kV Line
- Before Proposed Solution: 71/91 MVA (SN/SE)
- After Proposed Solution: 111/134 MVA (SN/SE)

Estimated Cost: $0.7 M

Projected In-Service: 12/31/2019

Supplemental Project ID: s1815.1, s1815.2, s1815.3

Project Status: Conceptual

Model: 2018 Series 2023 Summer RTEP 50/50

Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Need Number: ME-2018-015

Process State: Submission of Supplemental Project for inclusion in the Local Plan 7/26/2019

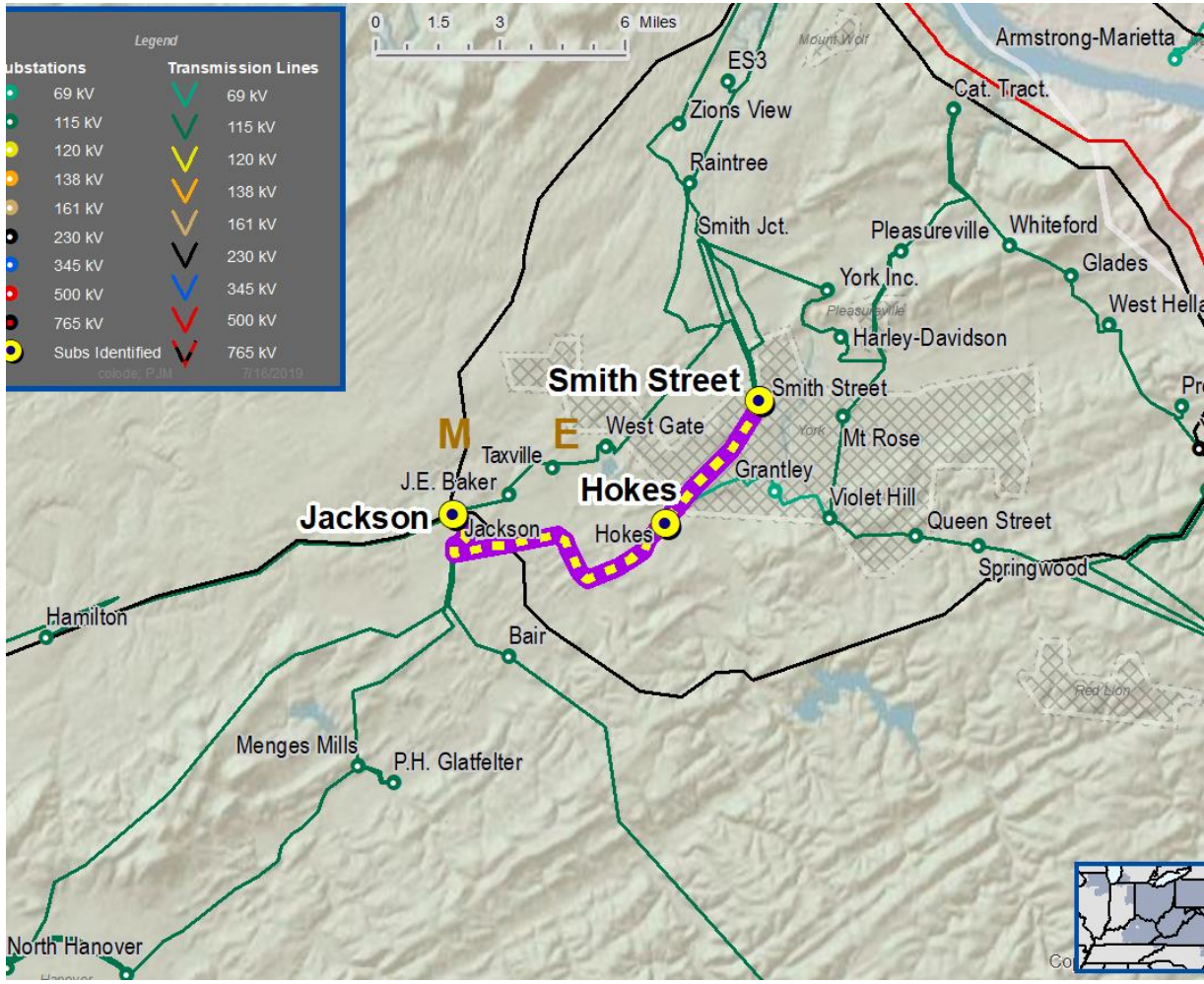
Previously Presented:
Need Meeting 10/29/2018
Solution Meeting 11/28/2018

Project Driver:
Equipment Material Condition, Performance and Risk

Specific Assumption Reference:
Substation Condition Rebuild/Replacement – Station system protection and controls – Electromechanical relays
System Performance Projects – Substation/Line Equipment Limits Upgrade Relay Schemes

Problem Statement:
Relays on Hokes – Smith St, Hokes – Lehigh Cement, & Hokes – Jackson 69 kV lines evaluated and determined to be obsolete and/or degraded condition.
Transmission line rating limited by terminal equipment.

- Hokes – Jackson 69 kV line: Existing line rating is 51/56 MVA (SN/SE). Existing conductor rating is 53/56 MVA (SN/SE). (substation conductor)



Hokes, Jackson, and Smith Street 69 kV Misoperation Relay Replacement

Need Number: ME-2018-015

Process State: Submission of Supplemental Project for inclusion in the Local Plan 7/26/2019

Selected Solution:

Hokes, Jackson, and Smith Street 69 kV Substations - replace relays prone to misoperation (**s1816.1**)

<u>At Hokes Substation:</u>

Smith St Line Terminal – Terminal equipment to be replaced includes:

- Circuit breaker and disconnect switches (**s1816.2**)

Jackson Line Terminal – Terminal equipment to be replaced includes:

- Circuit breaker, disconnect switches, and substation conductor (**s1816.3**)

Lehigh Cement Terminal – Terminal equipment to be replaced includes:

- Circuit breaker and disconnect switches (**s1816.4**)

<u>At Jackson Substation:</u>

Hokes Terminal – Terminal equipment to be replaced includes:

- Substation conductor (**s1816.5**)

<u>Transmission Line Ratings:</u>

Hokes – Jackson 69 kV Line

- Before Proposed Solution: 51/56 MVA (SN/SE)
- After Proposed Solution: 53/56 MVA (SN/SE)

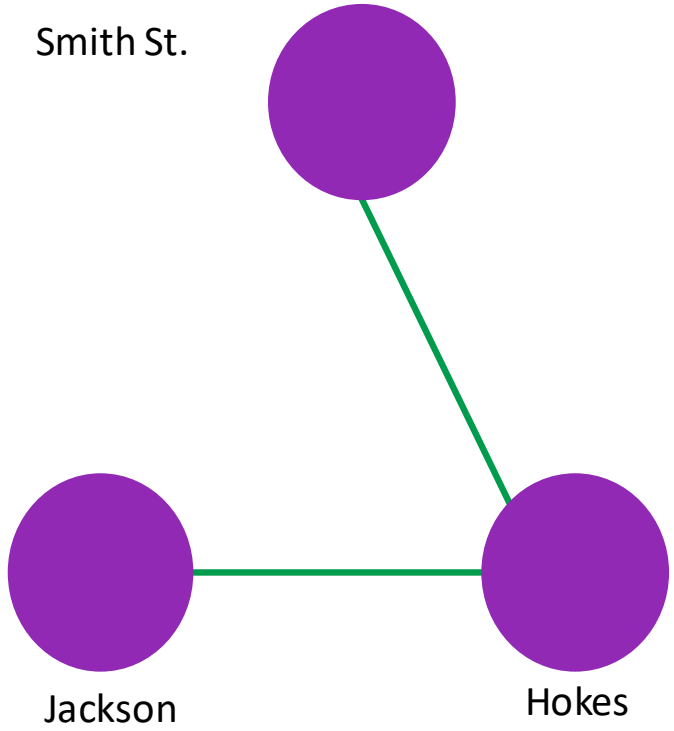
Estimated Cost: $1.6M

Projected In-Service: 12/31/2019

Supplemental Project ID: s1816.1, s1816.2, s1816.3, s1816.4, s1816.5

Model: 2018 Series 2023 Summer RTEP 50/50

Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	



Need Number: ME-2018-016

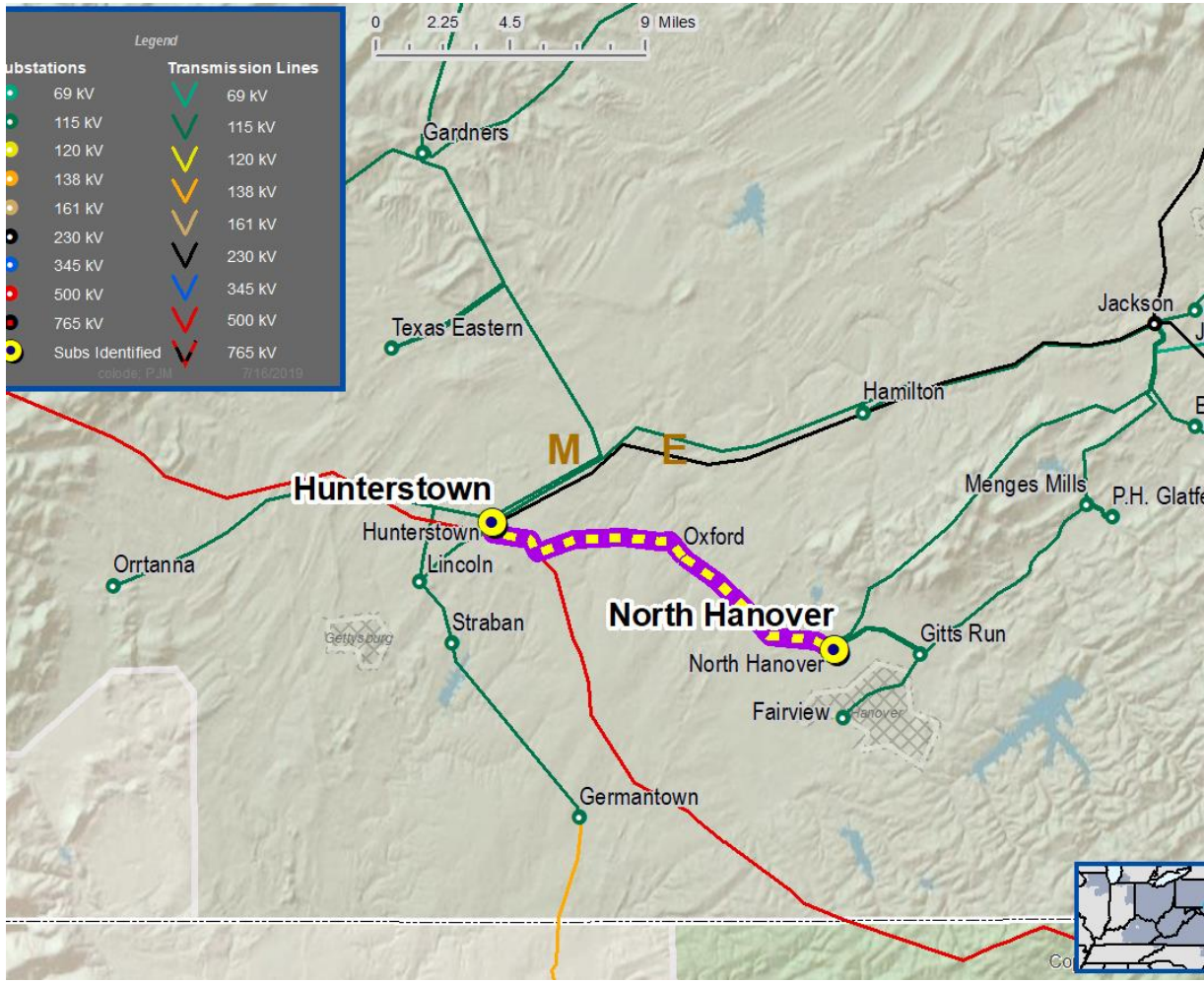
Process State: Submission of Supplemental Project for inclusion in the Local Plan 7/26/2019

Previously Presented:
Need Meeting 10/29/2018
Solution Meeting 11/28/2018

Project Driver:
Equipment Material Condition, Performance and Risk

Specific Assumption Reference:
Substation Condition Rebuild/Replacement – Station system protection and controls – Electromechanical relays
System Performance Projects – Substation/Line Equipment Limits Upgrade Relay Schemes

Problem Statement:
Relays on Hunterstown – North Hanover 115 kV line evaluated and determined to be obsolete and/or degraded condition.
Transmission line rating limited by terminal equipment. Existing line rating is 232/277 MVA (SN/SE). Existing conductor rating is 232/282 MVA (SN/SE). (line trap)



Met-Ed Transmission Zone M-3 Process
Hunterstown – North Hanover 115 kV Misoperation Relay Replacement

Need Number: ME-2018-016

Process State: Submission of Supplemental Project for inclusion in the Local Plan 7/26/2019

Selected Solution:
Hunterstown – North Hanover 115 kV replace relays prone to misoperation (**s1817.1**)
Hunterstown 115 kV Substation – Terminal equipment to be replaced includes:
- Line relaying, line trap, line tuner, arresters, and disconnect switches (**s1817.2**)

North Hanover 115 kV Substation – Terminal equipment to be replaced includes:
- Line relaying, CCVT, line trap, line tuner, arresters, and disconnect switches (**s1817.3**)

<u>Transmission Line Ratings:</u>
Hunterstown – North Hanover 115 kV Line
- Before Proposed Solution: 232/277 MVA (SN/SE)
- After Proposed Solution: 232/282 MVA (SN/SE)

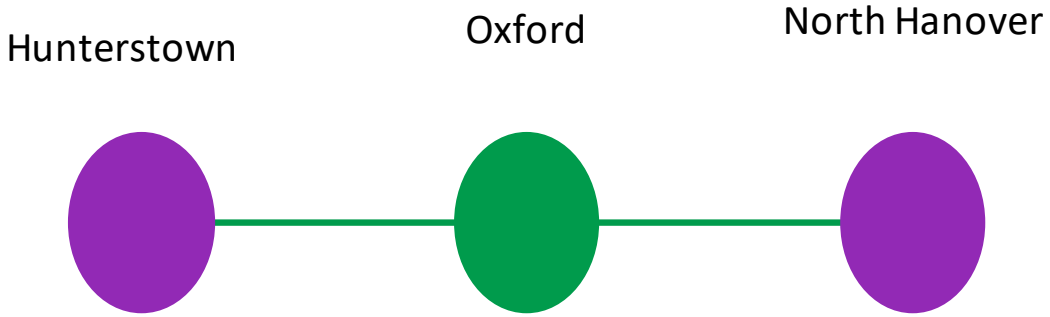
Estimated Cost: $0.8M

Projected In-Service: 12/31/2019

Supplemental Project ID: s1817.1, s1817.2, s1817.3

Project Status: Conceptual

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
Jackson – Westgate 115 kV Misoperation Relay Replacement

Need Number: ME-2018-017

Process State: Submission of Supplemental Project for inclusion in the Local Plan 7/26/2019

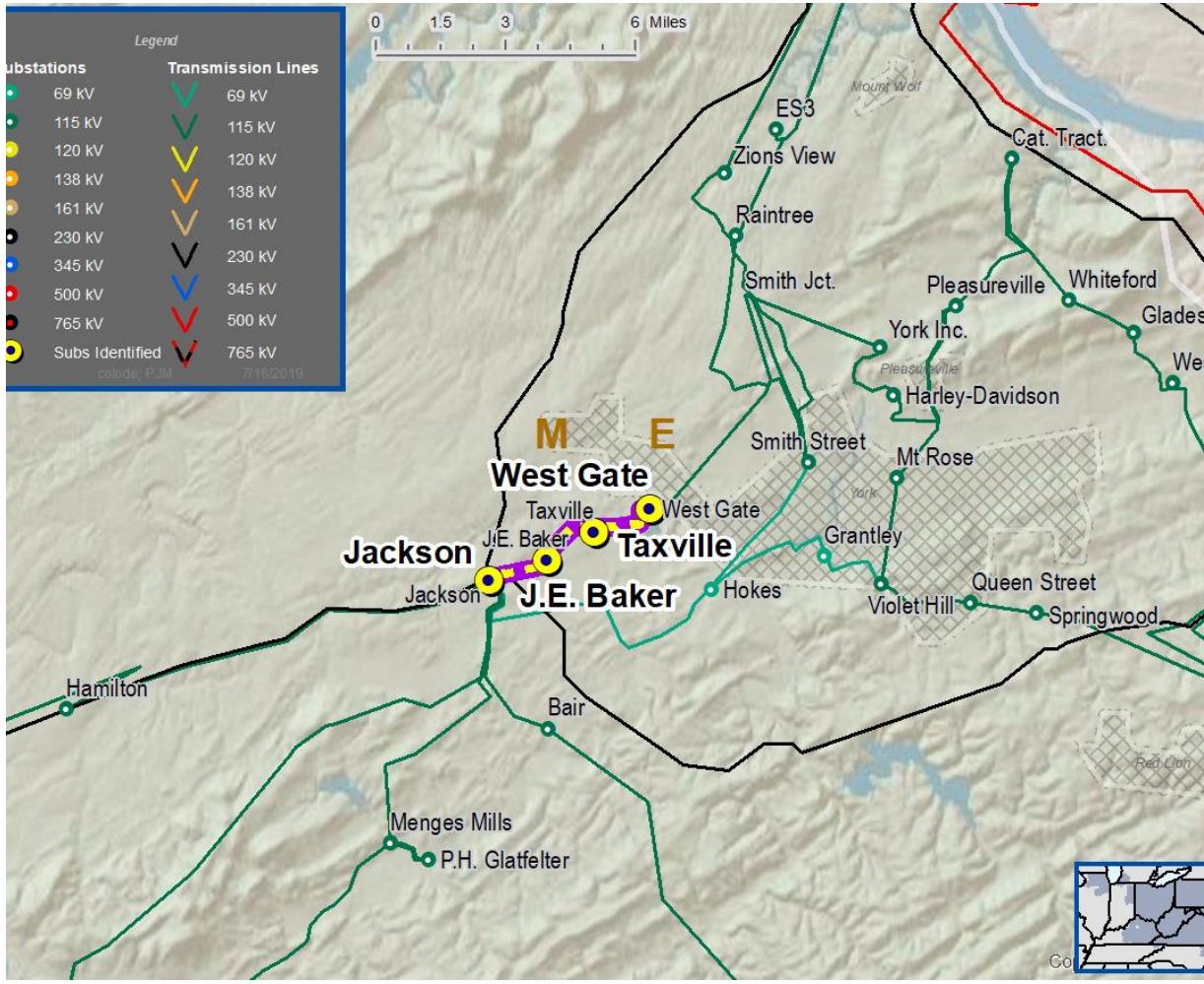
Previously Presented:
Need Meeting 10/29/2018
Solution Meeting 11/28/2018

Project Driver:
Equipment Material Condition, Performance and Risk

Specific Assumption Reference:
Substation Condition Rebuild/Replacement – Station system protection and controls – Electromechanical relays
System Performance Projects – Substation/Line Equipment Limits
Upgrade Relay Schemes

Problem Statement:
Relays on Jackson – Westgate 115 kV line evaluated and determined to be obsolete and/or degraded condition.

- Jackson - JE Baker 115 kV line: Existing line rating is 274/344 MVA (SN/SE). Existing conductor rating is 373/430 MVA (SN/SE). (substation conductor and disconnect switches)
- JE Baker - Taxville 115 kV line: Existing line rating is 274/344 MVA (SN/SE). Existing conductor rating is 373/430 MVA (SN/SE). (substation conductor and disconnect switch)
- Taxville - Westgate 115 kV line: Existing line rating is 232/277 MVA (SN/SE). Existing conductor rating is 232/282 MVA (SN/SE). (line trap)



Met-Ed Transmission Zone M-3 Process
Jackson – Westgate 115 kV Misoperation Relay Replacement

Need Number: ME-2018-017

Process State: Submission of Supplemental Project for inclusion in the Local Plan 7/26/2019

Selected Solution:

Jackson – Westgate 115 kV replace relays prone to misoperation (**s1818.1**)

Jackson – Taxville 115 kV Line section equipment to be replaced includes:

- Line disconnect switches (JE Baker Tap) (**s1818.2**)

Jackson 115 kV Substation – Terminal equipment to be replaced includes:

- Line relaying, line drops, CCVT, line trap, line tuner, coax, substation conductor, and breaker disconnect switches (**s1818.3**)

Westgate 115 kV Substation – Terminal equipment to be replaced includes:

- Line relaying, CCVT, line trap, line tuner, and arresters (**s1818.4**)

<u>Transmission Line Ratings:</u>

Jackson – JE Baker 115 kV Line

- Before Proposed Solution: 274/344 MVA (SN/SE)
- After Proposed Solution: 373/430 MVA (SN/SE)

JE Baker – Taxville 115 kV Line

- Before Proposed Solution: 274/344 MVA (SN/SE)
- After Proposed Solution: 365/430 MVA (SN/SE)

Taxville – Westgate 115 kV Line

- Before Proposed Solution: 232/277 MVA (SN/SE)
- After Proposed Solution: 232/282 MVA (SN/SE)

Estimated Cost: $1.1M

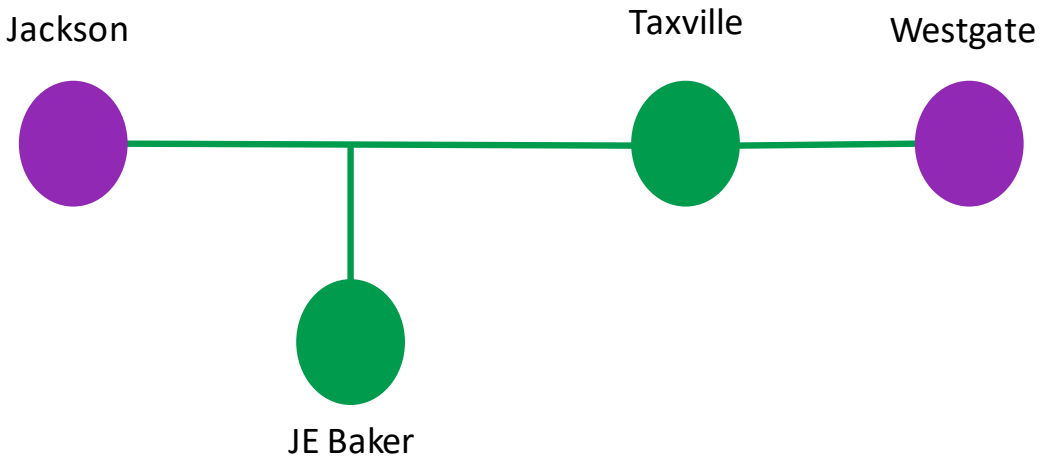
Projected In-Service: 12/31/2019

Supplemental Project ID: s1818.1, s1818.2, s1818.3, s1818.4

Project Status: Conceptual

Model: 2018 Series 2023 Summer RTEP 50/50

Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	



Gardners – Hunterstown 115 kV Misoperation Relay Replacement

Need Number: ME-2018-018

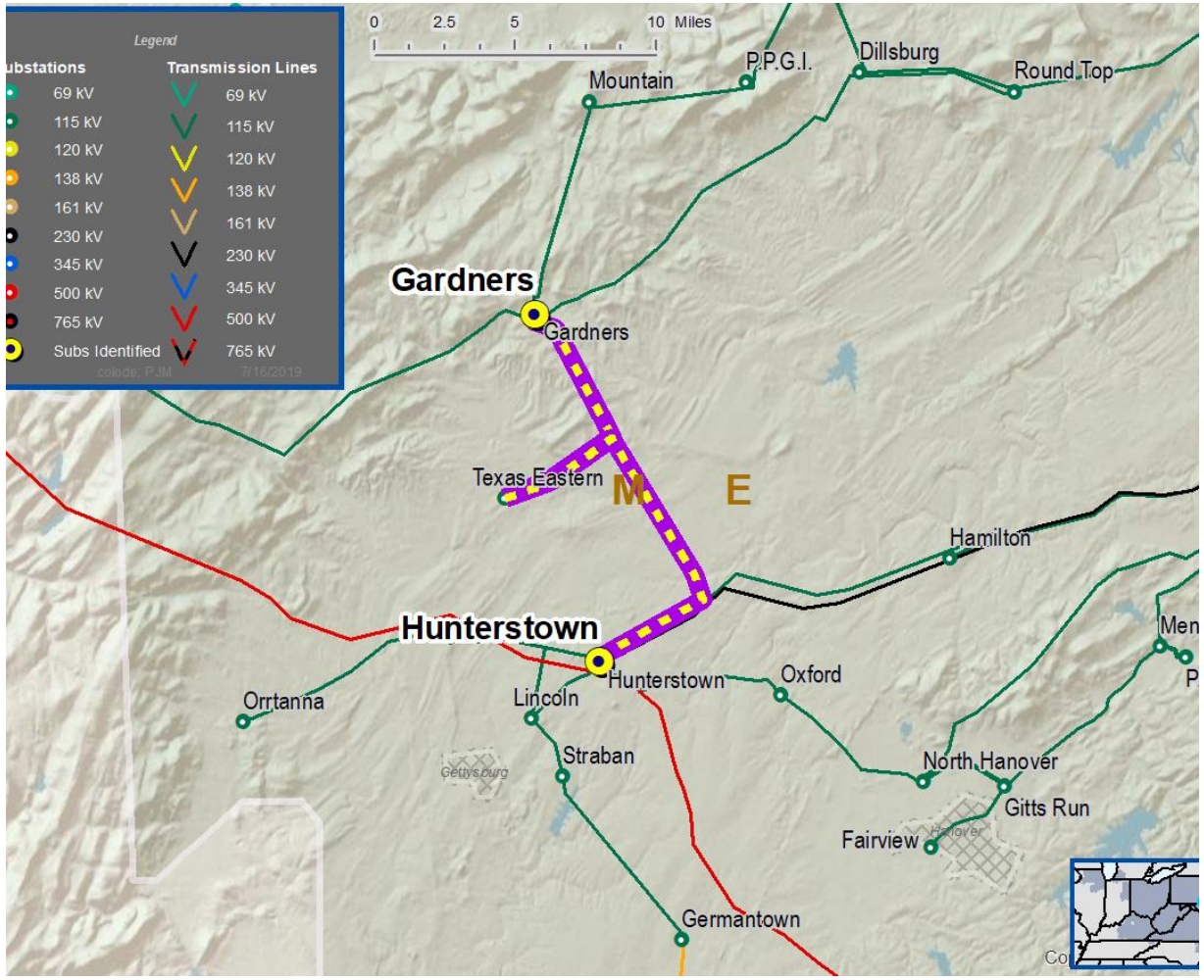
Process State: Submission of Supplemental Project for inclusion in the Local Plan 7/26/2019

Previously Presented:
Need Meeting 10/29/2018
Solution Meeting 11/28/2018

Project Driver:
Equipment Material Condition, Performance and Risk

Specific Assumption Reference:
Substation Condition Rebuild/Replacement – Station system protection and controls – Electromechanical relays
System Performance Projects – Substation/Line Equipment Limits Upgrade Relay Schemes

Problem Statement:
Relays on Hunterstown – Gardners 115 kV line evaluated and determined to be obsolete and/or degraded condition.
Transmission line rating limited by terminal equipment. Existing line rating is 163/185 MVA (SN/SE). Existing conductor rating is 232/282 MVA (SN/SE). (line trap, breaker, CTs, relay, and substation conductor)



Gardners – Hunterstown 115 kV Misoperation Relay Replacement

Need Number: ME-2018-018

Process State: Submission of Supplemental Project for inclusion in the Local Plan
7/26/2019

Selected Solution:
Gardners – Hunterstown 115 kV replace relays prone to misoperation (**s1819.1**)
Gardners 115 kV Substation – Terminal equipment to be replaced includes:

- Line relaying, CCVT, line trap, line tuner, coax, arresters, substation conductor, circuit breaker and disconnect switches (**s1819.2**)

Hunterstown 115 kV Substation – Terminal equipment to be replaced includes:

- Line relaying, CCVT, line trap, line tuner, coax, and arresters (**s1819.3**)

Transmission Line Ratings:
Gardners – Texas Eastern Tap 115 kV Line

- Before Proposed Solution: 163/185 MVA (SN/SE)
- After Proposed Solution: 232/282 MVA (SN/SE)

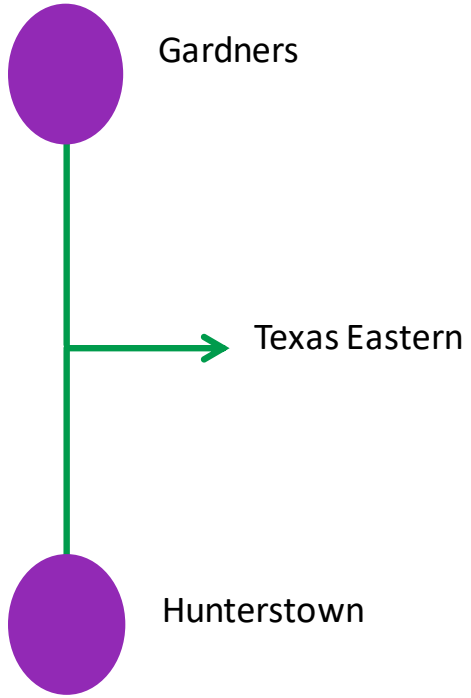
Estimated Cost: $2.6 M

Projected In-Service: 12/31/2019

Supplemental Project ID: s1819.1, s1819.2, s1819.3

Project Status: Conceptual

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Penelec Transmission Zone

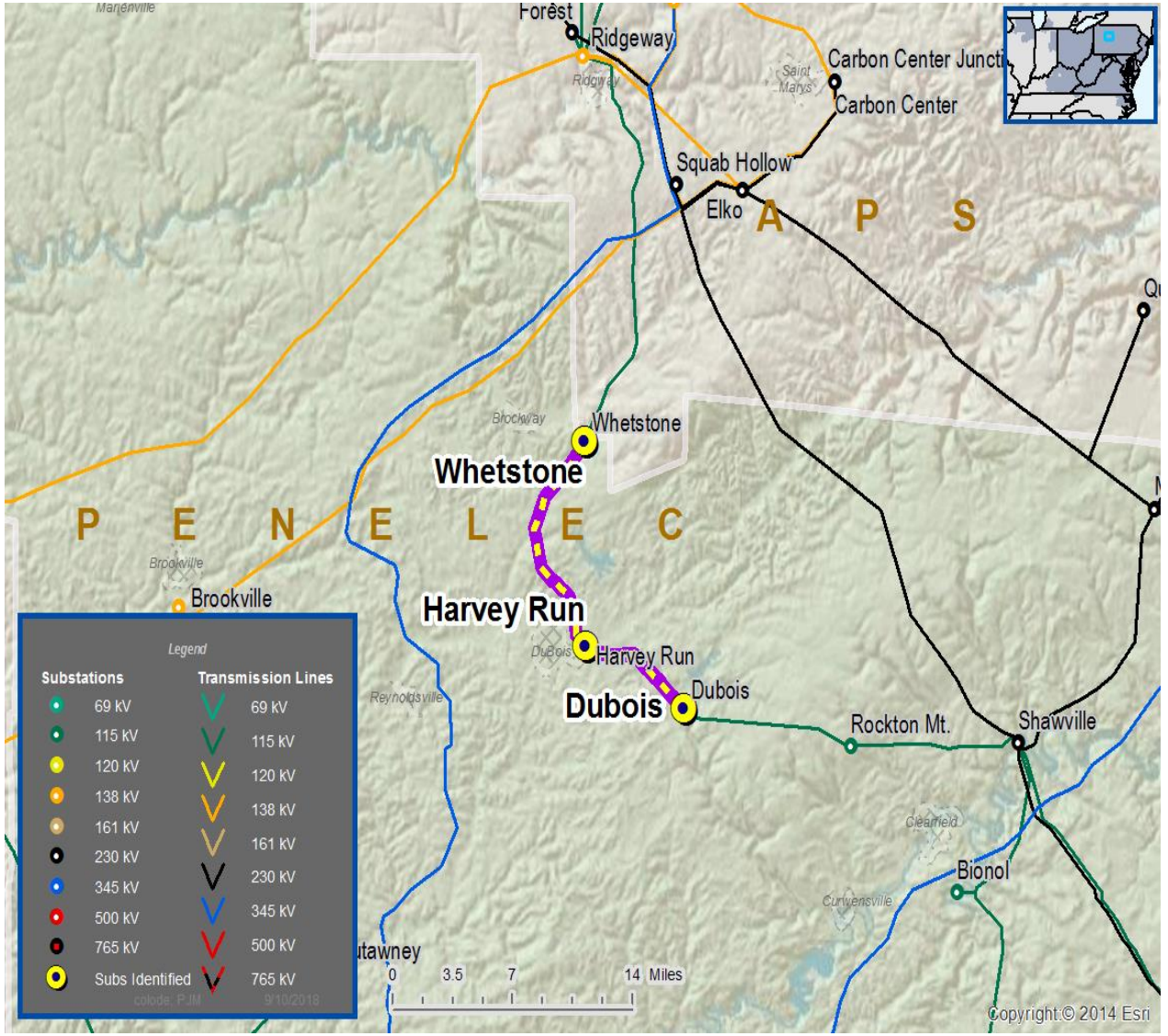
Need Number: PN-2018-001
Process Stage: Local Plan
Need Presented: 9/21/2018
Solution Presented: 10/29/2018

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

Specific Assumption Reference(s)
Substation/Line Equipment Limits
Consider upgrading transmission line equipment (switches, conductor, splices, etc.) as well as terminal and protection equipment to meet or exceed the transmission line conductor rating.

Problem Statement
Maintenance/rehab work will be performed on the Dubois-Harvey Run-Whetstone 115 kV line.

Transmission line rating limited by terminal equipment.
Dubois – Harvey Run 115 kV line: Existing emergency line rating is 179 MVA. Existing conductor emergency rating is 245 MVA.
Harvey Run – Whetstone 115 kV line: Existing emergency line rating is 172 MVA. Existing conductor emergency rating is 245 MVA.



Need Number: PN-2018-001

Selected Solution:

Rehab Dubois – Harvey Run – Whetstone 115 kV

Rehab approximately 14.25 miles of wood pole construction (s1769.1)

Dubois 115 kV Substation – Terminal equipment to be replaced includes:

- Line relaying, line trap, substation conductor, line tuner, CCVT, circuit breaker and breaker disconnects (s1769.2)

Harvey Run 115 kV Substation – Terminal equipment to be replaced includes:

- Substation conductor, disconnect switches and CVTs (s1769.3)

Whetstone 115 kV Substation – Terminal equipment to be replaced includes:

- Line relaying, line trap, substation conductor, line tuner, CCVT, circuit breaker and breaker disconnects (s1769.4)

Transmission Line Ratings:

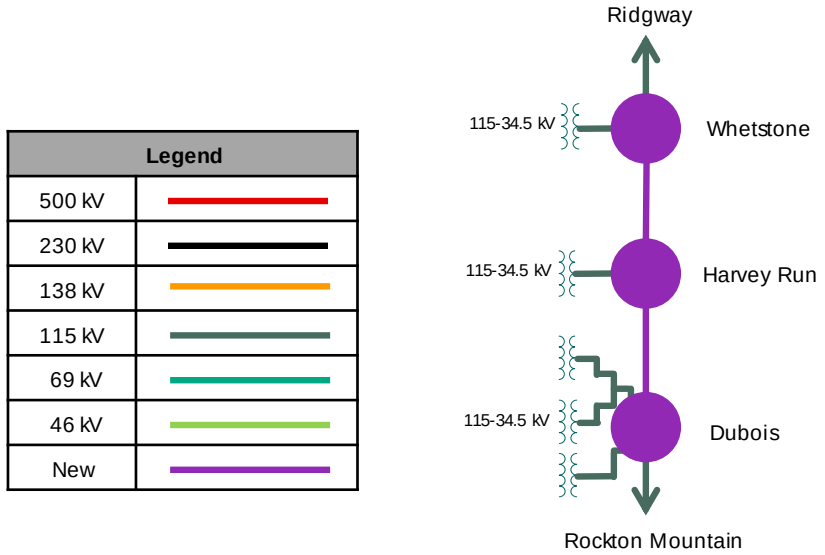
- Dubois – Harvey Run 115 kV Line
  - Before Selected Solution: 164 MVA SN / 179 MVA SE
  - After Selected Solution: 202 MVA SN / 245 MVA SE
- Harvey Run – Whetstone 115 kV Line
  - Before Selected Solution: 137 MVA SN / 172 MVA SE
  - After Selected Solution: 202 MVA SN / 245 MVA SE

Estimated Project Cost: $5.3M

Projected IS Date: 12/31/2021

Status: Conceptual

Supplemental Project Number: s1769.1, s1769.2, s1769.3, s1769.4

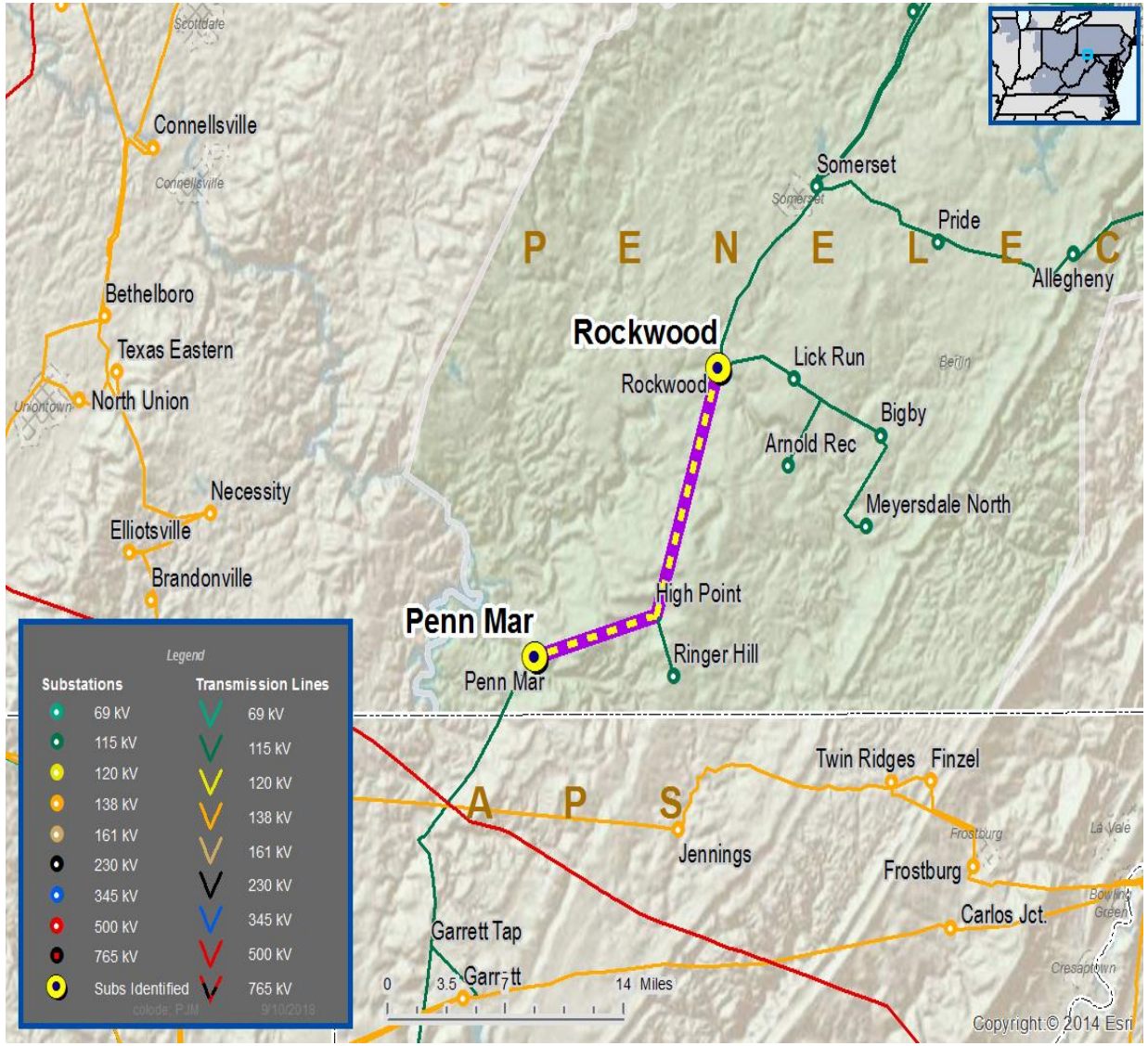


Penelec Transmission Zone

Need Number: PN-2018-002
Process Stage: Local Plan
Need Presented: 9/21/2018
Solution Presented: 10/29/2018

Project Driver(s):
Equipment Material Condition, Performance and Risk
Specific Assumption Reference(s)
Line Condition Rebuild/Replacement
Equipment characteristics are near or beyond existing service life or contain components that are obsolete.
Substation/Line Equipment Limits
Consider upgrading transmission line equipment (switches, conductor, splices, etc.) as well as terminal and protection equipment to meet or exceed the transmission line conductor rating.
Reconductor/Rebuild Transmission Lines
Transmission lines with high loading while factoring in its overall condition assessment.
Problem Statement
Entire Penn Mar-Rockwood 115 kV line is at or beyond service life. Transmission line loading exceeds 90% under N-1 contingency.

Transmission line rating limited by terminal equipment.
Penn Mar – High Point 115 kV line: Existing emergency line rating is 174 MVA. Existing conductor emergency rating is 179 MVA.
High Point – Rockwood 115 kV line: Existing emergency line rating is the existing conductor emergency rating.



Need Number: PN-2018-002

Selected Solution:

Rebuild Penn Mar – High Point – Rockwood 115 kV Line

- Rebuild/reconductor approximately 14.8 miles of wood pole construction (s1770.1)

Rockwood 115 kV Substation

- Adjust CT ratios and replace substation conductor and breaker disconnect (s1770.2)

Penn Mar 115 kV Substation

- Adjust relaying and replace CTs, substation conductor, line drops, circuit breaker and disconnect switches (s1770.3)

Transmission Line Ratings:

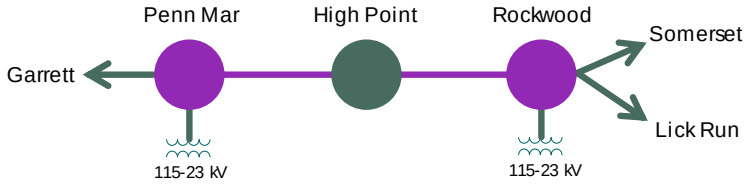
- Penn Mar – High Point 115 kV Line
  - Before Selected Solution: 137 MVA SN / 174 MVA SE
  - After Selected Solution: 273 MVA SN / 333 MVA SE
- High Point – Rockwood 115 kV Line
  - Before Selected Solution: 148 MVA SN / 179 MVA SE
  - After Selected Solution: 260 MVA SN / 311 MVA SE

Estimated Project Cost: $29.3M

Projected IS Date: 6/1/2020

Status: Conceptual

Supplemental Project Number: s1770.1, s1770.2, s1770.3



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

Penelec Transmission Zone

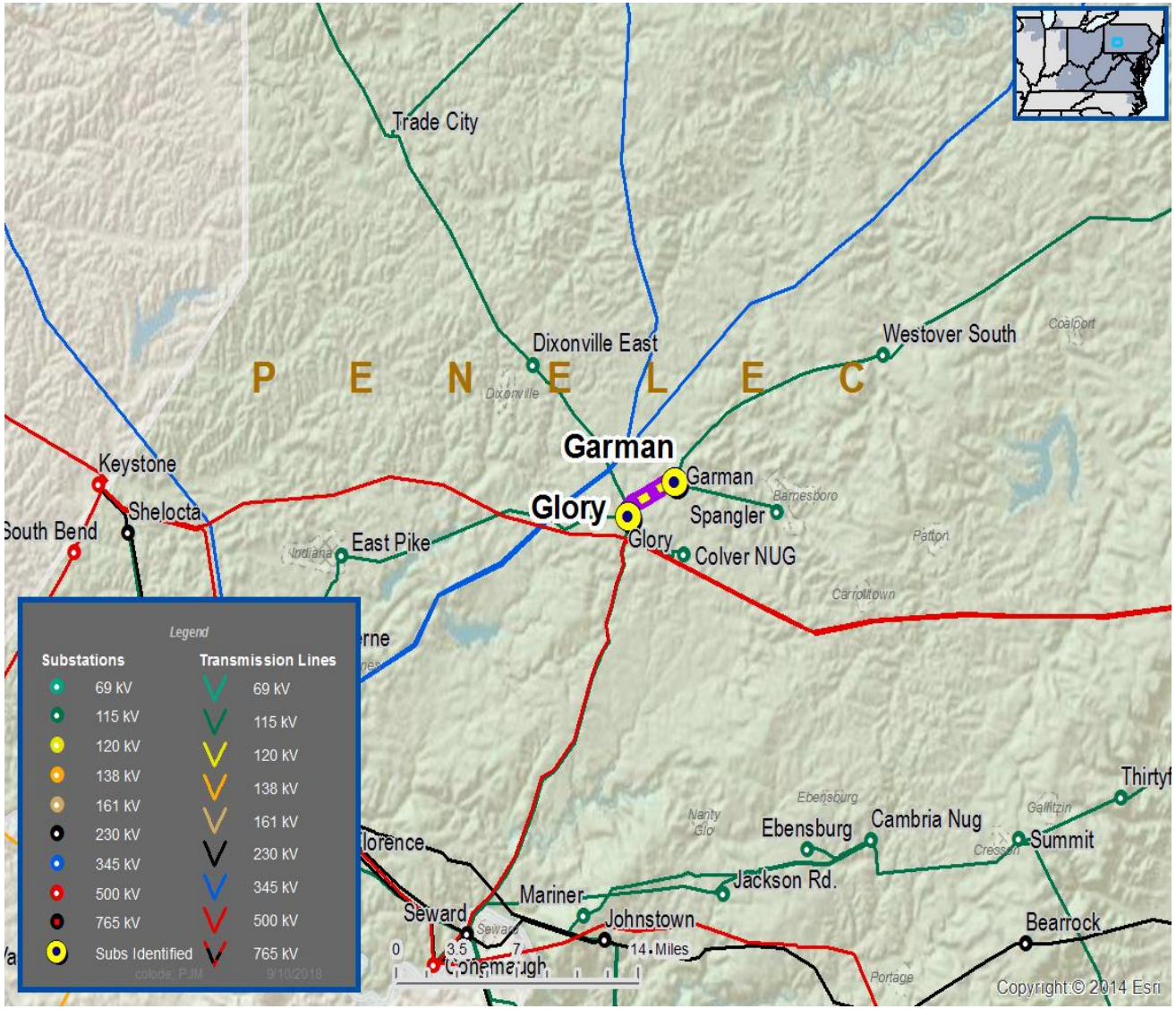
Need Number: PN-2018-003
Process Stage: Local Plan
Need Presented: 9/21/2018
Solution Presented: 10/29/2018

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

Specific Assumption Reference(s)
Upgrade Relay Schemes
Upgrade relay schemes that have historically high percentage of misoperation.
Substation/Line Equipment Limits
Consider upgrading transmission line equipment (switches, conductor, splices, etc.) as well as terminal and protection equipment to meet or exceed the transmission line conductor rating.

Problem Statement
Relays on Garman – Glory 115 kV line evaluated by Transmission Planning and Protection and determined to be obsolete and/or degraded condition.

Transmission line rating limited by terminal equipment. Existing emergency line rating is 233 MVA. Conductor emergency rating is 282 MVA.



Need Number: PN-2018-003

Selected Solution:

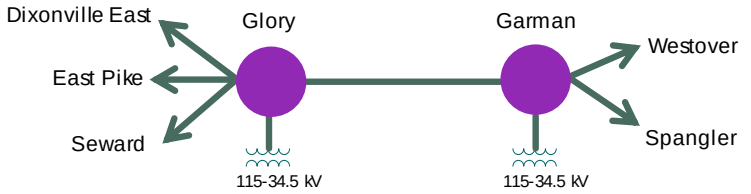
Replace terminal equipment at Garman and Glory 115 kV

Garman 115 kV Substation – Terminal equipment to be replaced includes:

- Line relaying, line drops, CCVT, line trap, line tuner, coax, arresters and bus tie breaker (s1771.1)

Glory 115 kV Substation – Terminal equipment to be replaced includes:

- Line relaying, DFR, CCVT, line trap, line tuner, coax, arresters and breaker (s1771.2)



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

Transmission Line Ratings:

- Garman – Glory 115 kV Line
  - Before Selected Solution: 204 MVA SN / 233 MVA SE
  - After Selected Solution: 232 MVA SN / 282 MVA SE

Estimated Project Cost: $1.1M

Projected IS Date: 10/26/2019

Status: Conceptual

Supplemental Project Number: s1771.1, s1771.2

Penelec Transmission Zone

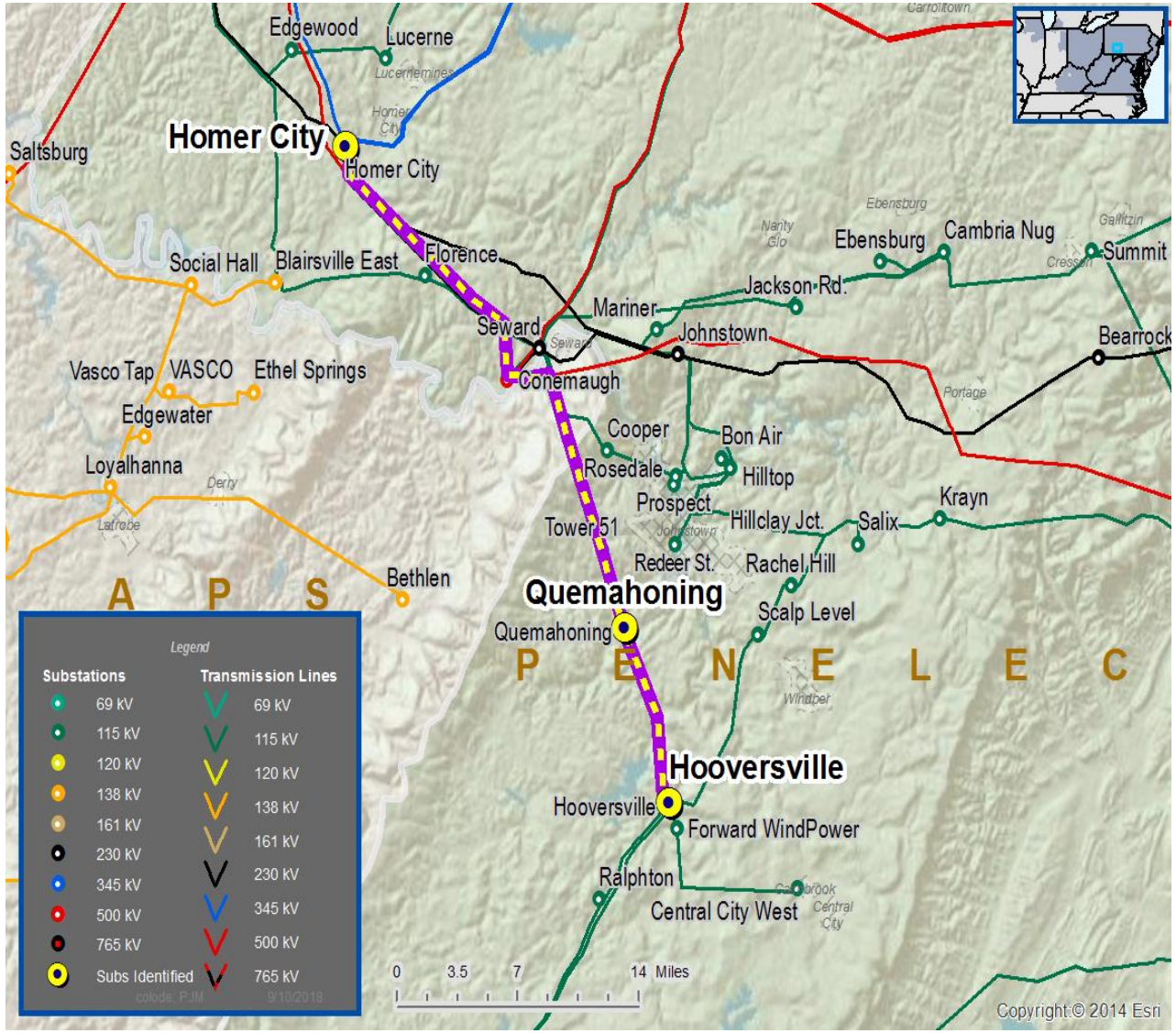
Need Number: PN-2018-004
Process Stage: Local Plan
Need Presented: 9/21/2018
Solution Presented: 10/29/2018

Project Driver(s):
Operational Flexibility and Efficiency

Specific Assumption Reference(s)
Critical Updates to Standards

- Elimination of Ground Switches – Where high-speed ground switches exist, a circuit breaker should be considered for installation to protect the transformer and not trip the line, thereby eliminating outages to customers on the transmission line.
- Line Switches – Switches should be considered for replacement to allow for desired operations (i.e. line charging, loop splitting, etc.).

Problem Statement
Planned maintenance on the Homer City – Hooverville 230 kV line results in the interruption of service for a large industrial customer served out of Quemahoning Substation. The line sectionalizing devices at Quemahoning are inadequate to interrupt charging current on the Homer City side of the substation. At Hooversville, the transformer breaker failure scheme utilizes a ground switch on the high side of the 230/115 kV transformer.



Need Number: PN-2018-004

Selected Solution:

Quemahoning 230 kV SF6 Interrupters

- Install SF6 interrupters on 230 kV network switches (s1772.1)

Hooversville 230 kV Substation

- Eliminate ground switch and install 230 kV breaker on high side of 230/115 kV transformer (s1772.2)

Homer City 230 kV Substation

- Adjust relay settings (s1772.3)

Transmission Line Ratings:

- Homer City – Quemahoning 230 kV Line
  - Before Selected Solution: 548 MVA SN / 688 MVA SE
  - After Selected Solution: 678 MVA SN / 813 MVA SE
- Quemahoning – Hooversville 230 kV Line
  - Before Selected Solution: 488 MVA SN / 488 MVA SE
  - After Selected Solution: 678 MVA SN / 813 MVA SE

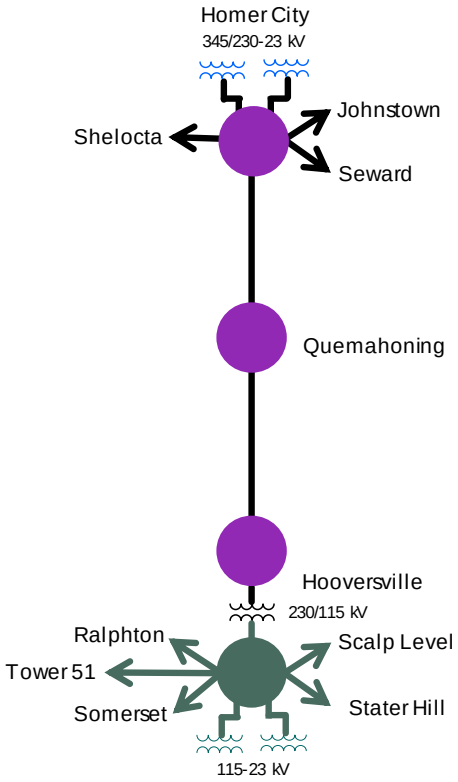
Estimated Project Cost: $1.0 M

Projected IS Date: 12/31/2019

Status: Conceptual

Supplemental Project Number: s1772.1, s1772.2, s1772.3

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



Penelec Transmission Zone

Need Number: PN-2018-005

Process Stage: Local Plan

Need Presented: 9/21/2018

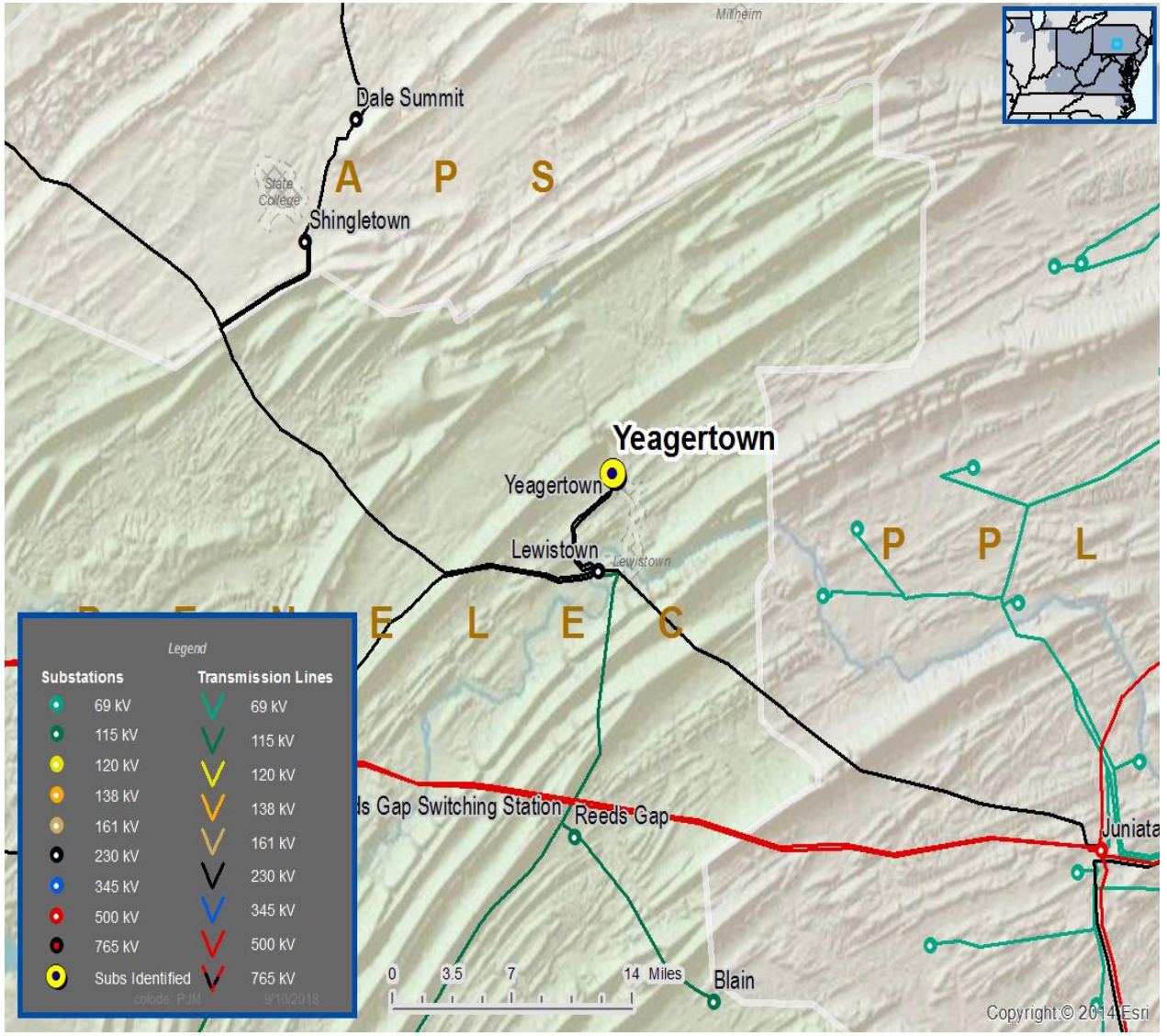
Solution Presented: 10/29/2018

Project Driver(s):
Operational Flexibility and Efficiency

Specific Assumption Reference(s)
Add/Expand Bus Configuration

- Loss of substation bus adversely impacts transmission system performance.
- Reduce the amount of exposed potential local load loss during contingency conditions.
- Eliminate simultaneous outages to multiple networked elements for stuck breakers, bus outages, N-2 events, etc.

Problem Statement
At Yeagertown, in the event of a stuck 230 kV bus tie breaker, both 230 kV feeds from Lewistown are outaged, along with two 230-46 kV transformers feeding a large industrial customer and a 230/34.5 kV transformer.
In the current configuration, the 230 kV feeds the 34.5 kV bus via a 230/34.5 kV transformer. The 34.5 kV bus then feeds the 46 kV system via a 46-34.5 kV transformer. This arrangement creates a transmission path through a distribution facility.



Need Number: PN-2018-005

Selected Solution:

Reconfigure the Yeagertown 230 kV & 46 kV to a Ring Bus and install 3rd 230-46 kV Transformer

- Construct a new five breaker 46 kV ring bus (s1773.2)
- Construct a new six breaker 230 kV ring bus (s1773.1)
- Loop Lewistown – Logan 1LK line into the 46 kV ring bus (s1773.3)
- Tap the Yeagertown – Logan 1YL line and connect to the 46 kV ring bus (s1773.4)
- Install a new 230-46 kV 60/80/100 MVA transformer (s1773.5)
- Install a 46 kV bus tie breaker to be operated as normally open (s1773.6)
- Operate the 46-34.5 kV transformer high side circuit breaker as normally open (s1773.7)

Transformer Ratings:

- New Yeagertown 230-46 kV Transformer
  - Before Selected Solution: N/A
  - After Selected Solution: 120 MVA SN / 130 MVA SE

Transmission Line Ratings:

- Yeagertown – Logan Tap (1YL) 46 kV Line
  - Before Selected Solution: N/A
  - After Selected Solution: 81 MVA SN / 98 MVA SE

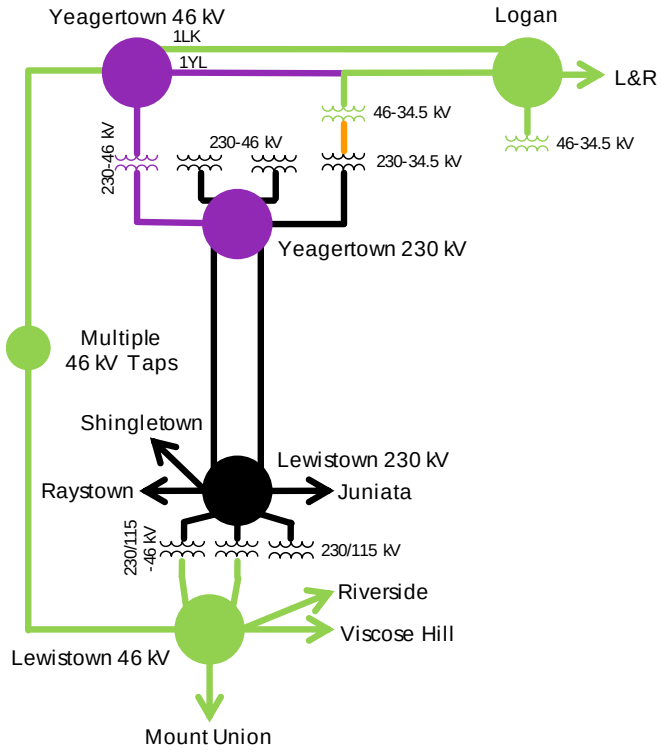
Estimated Project Cost: $20.4M

Projected IS Date: 12/31/2020

Status: Conceptual

Supplemental Project Number: s1773.1, s1773.2, s1773.3, s1773.4, s1773.5, s1773.6, s1773.7

Legend	
500 kV	
345 kV	
230 kV	
115 kV	
69 kV	
46 kV	
Other	
New	



Penelec Transmission Zone

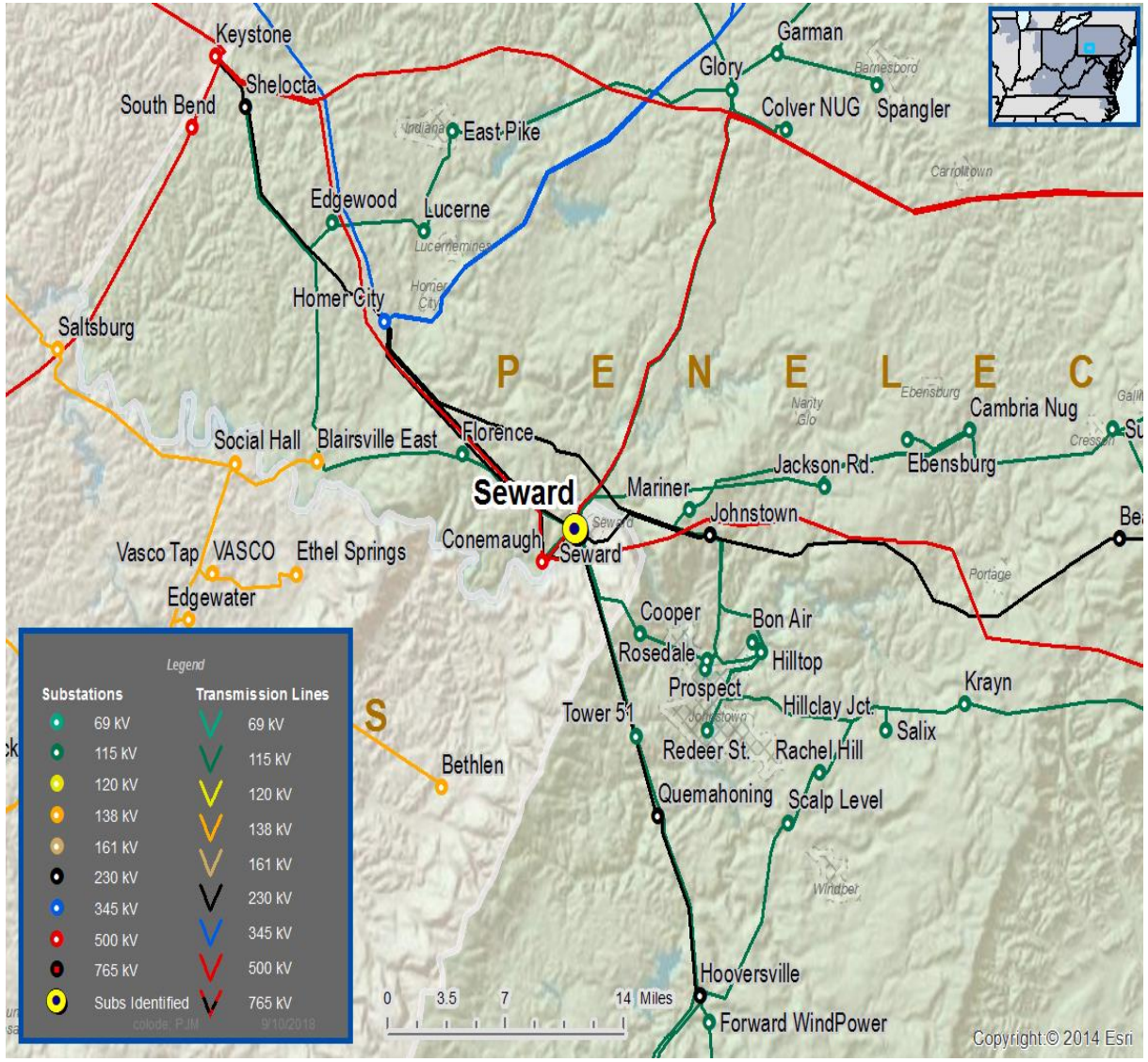
Need Number: PN-2018-006
Process Stage: Local Plan
Need Presented: 9/21/2018
Solution Presented: 10/29/2018

Project Driver(s):
Operational Flexibility and Efficiency

Specific Assumption Reference(s)
Substation Condition Rebuild/Replacement
Show an increasing negative trend in maintenance findings and/or costs.
Are at a higher risk for failure based on asset design characteristics, or historical industry/company performance data, or application design error.
Are near or beyond expected service life or obsolete.
Add/Expand Bus Configuration
Eliminate simultaneous outages to multiple networked elements under N-1 analysis.

Problem Statement
A fault on the Seward #9 230/115 kV transformer outages the Seward #11 230/115 kV transformer or a fault on the Seward #11 230/115 kV transformer outages the Seward #9 230/115 kV transformer.

Seward #9 230/115 kV transformer has an increased failure probability due to aging/deteriorating bushings, components and fluid. The transformer was manufactured in 1971.



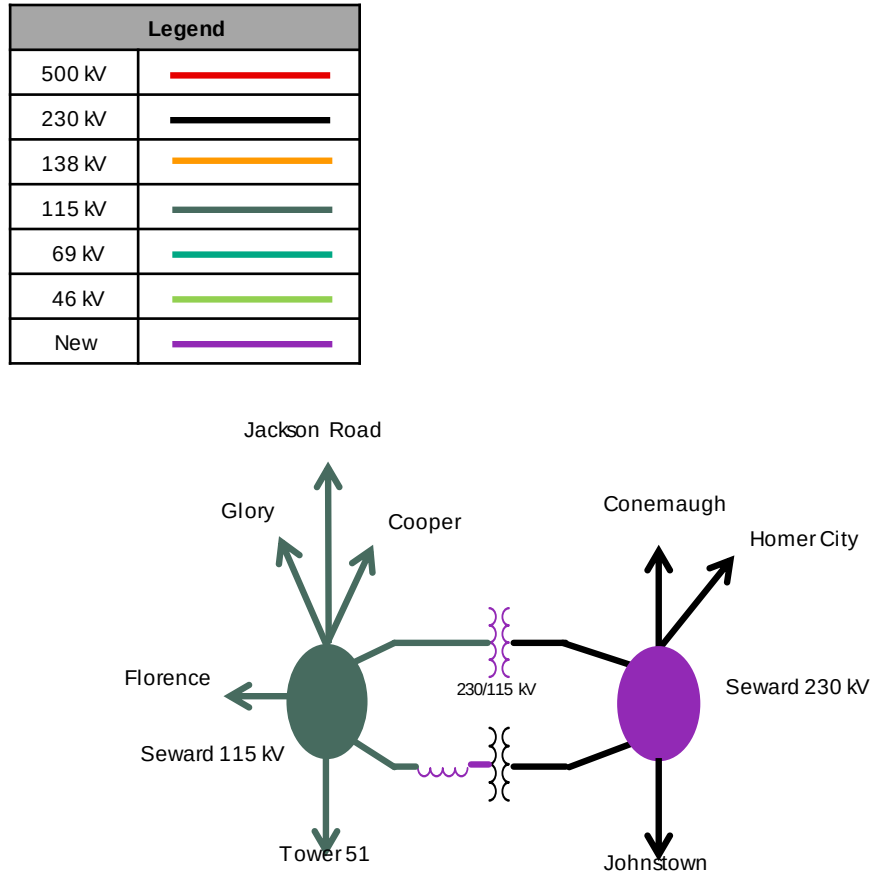
Penelec Transmission Zone

Need Number: PN-2018-006

Selected Solution:
Seward #9 230/115 kV Transformer Replacement & 230 kV Ring Bus
- Expand 230 kV ring bus to a six breaker ring bus (s1774.1)
- Relocate the Homer City – Seward 230 kV and Johnstown – Seward 230 kV line terminals (s1774.2)
- Replace the #9 230/115 kV with a 230/115 kV 180/240/300 MVA transformer (s1774.3)
- Install a 115 kV reactor on the low side of the #11 230/115 kV transformer (s1774.4)

Transformer Rating:
- Seward #9 230/115 kV Transformer
  - Before Selected Solution: 241 MVA SN / 303 MVA SE
  - After Selected Solution: 375 MVA SN / 438 MVA SE

Estimated Project Cost: $15.7M
Projected IS Date: 12/31/2020
Status: Conceptual
Supplemental Project Number: s1774.1, s1774.2, s1774.3, s1774.4



Penelec Transmission Zone

Need Number: PN-2018-007
Process Stage: Local Plan
Need Presented: 9/21/2018
Solution Presented: 10/29/2018
Project Driver(s):
Operational Flexibility and Efficiency
Equipment Material Condition, Performance and Risk

Specific Assumption Reference(s)

Substation Condition Rebuild/Replacement

Show an increasing negative trend in maintenance findings and/or costs.
Are near or beyond expected service life or obsolete.

Add/Expand Bus Configuration

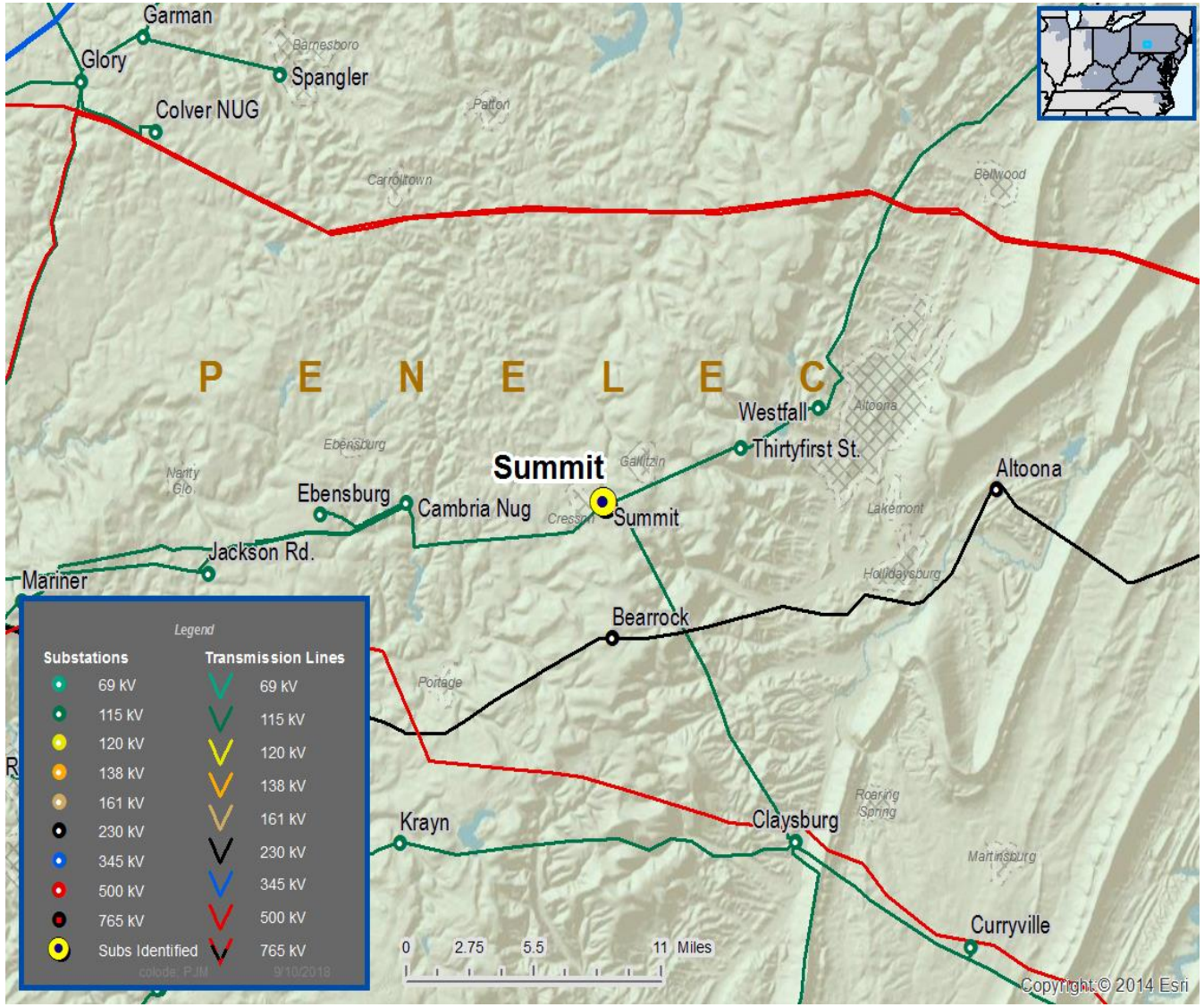
Loss of substation bus adversely impacts transmission system performance.
Eliminate simultaneous outages to multiple networked elements for stuck breakers, bus outages, N-2 events, etc.

Problem Statement

In the event of a Summit #1 or #2 115-46 kV transformer fault, the line exit breakers and the bus tie breaker are relied upon to clear the fault. The corresponding section of the bus is cleared, creating transfer and thermal issues.

A stuck 115 kV bus tie breaker at Summit will clear the entire 115 kV station.

Summit #1 and #2 115-46 kV transformers have an increased failure probability due to aging/deteriorating bushings, components and fluid. The #1 transformer was manufactured in 1937. The #2 transformer was manufactured in 1971.



Need Number: PN-2018-007

Selected Solution:

Summit 115 kV & 46 kV Substation Reconfiguration & Transformer Replacement

- Construct a five breaker 115 kV ring bus (**s1775.1**)
- Construct a 46 kV breaker-and-a-half station with eight breakers (**s1775.2**)
- Replace the #1 and #2 115/46 kV with 115/46 kV 45/60/75 MVA transformers (**s1775.3**)
- Adjust relay settings at remote ends (**s1775.4**)

Eldorado 46 kV Substation – Terminal equipment to be replaced includes:

- CTs, substation conductor, circuit breaker and disconnect switches (**s1775.5**)

Jackson Road 46 kV Substation – Terminal equipment to be replaced includes:

- Line relaying, substation conductor, arresters, line and bus disconnect switches and circuit breaker (**s1775.6**)

Continue on the next slide ……..

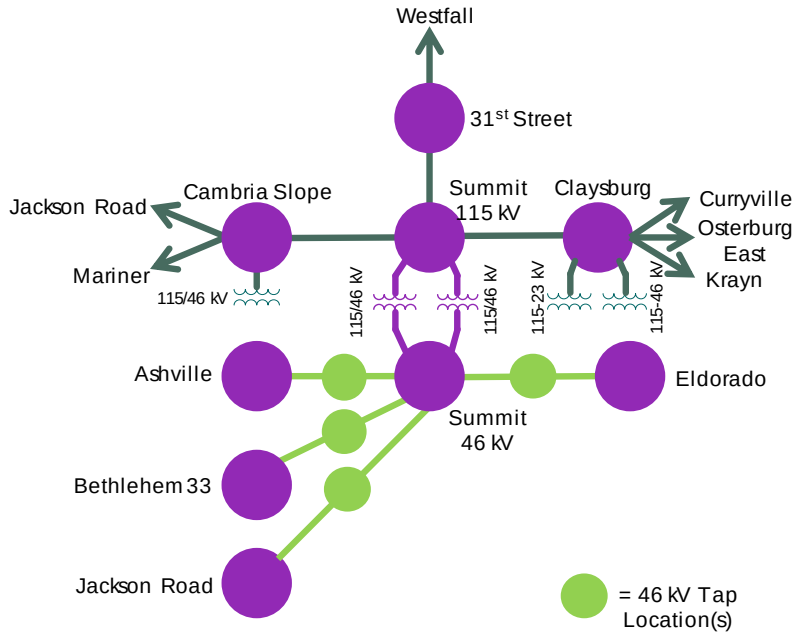
Estimated Project Cost: $26.3M

Projected IS Date: 12/31/2020

Status: Conceptual

Supplemental Project Number: s1775.1, s1775.2, s1775.3, s1775.4, s1775.5, s1775.6

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



Continue from the last slide ……..

Need Number: PN-2018-007

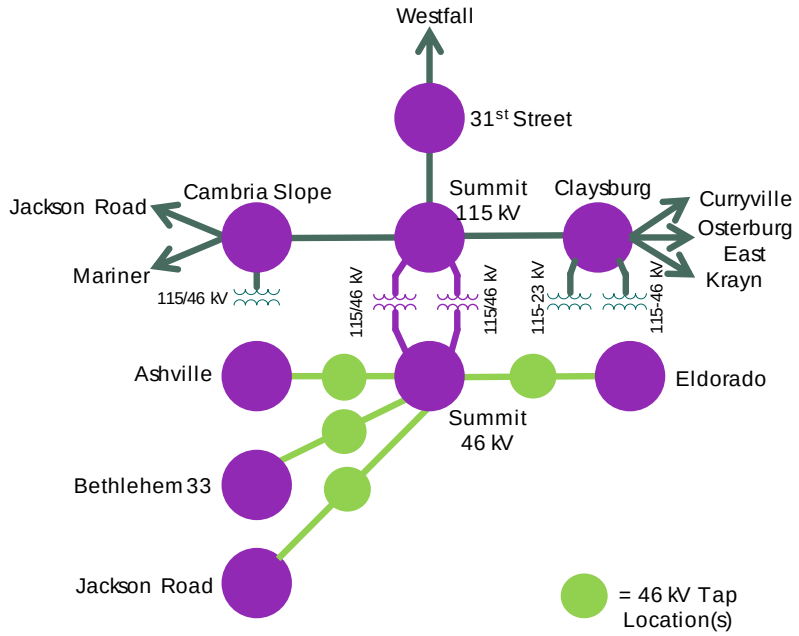
Transmission Line Ratings:

- Summit – Claysburg 115 kV Line
  - Before Selected Solution: 175 MVA SN / 237 MVA SE
  - After Selected Solution: 229 MVA SN / 278 MVA SE
- Summit – 31st Street 115 kV Line
  - Before Selected Solution: 221 MVA SN / 263 MVA SE
  - After Selected Solution: 232 MVA SN / 282 MVA SE
- Summit – Ashville (SGC Tap) 46 kV Line
  - Before Selected Solution: 26 MVA SN / 28 MVA SE
  - After Selected Solution: 37 MVA SN / 37 MVA SE
- Summit – Gallitzin Tap – Eldorado 46 kV Line
  - Before Selected Solution (Summit – Gallitzin Tap): 54 MVA SN / 66 MVA SE
  - Before Selected Solution (Gallitzin Tap – Eldorado): 55 MVA SN / 69 MVA SE
  - After Selected Solution: 81 MVA SN / 98 MVA SE
- Summit – Kokomo Road 46 kV Line
  - Before Selected Solution: 25 MVA SN / 25 MVA SE
  - After Selected Solution: 32 MVA SN / 32 MVA SE
- Jackson Road – Ampfire Mining Tap 46 kV Line
  - Before Selected Solution: 24 MVA SN / 24 MVA SE
  - After Selected Solution: 67 MVA SN / 81 MVA SE

Transformer Ratings:

- Summit #1 115/46 kV Transformer
  - Before Selected Solution: 32 MVA SN / 35 MVA SE
  - After Selected Solution: 97 MVA SN / 97 MVA SE
- Summit #2 115/46 kV Transformer
  - Before Selected Solution: 43 MVA SN / 44 MVA SE
  - After Selected Solution: 97 MVA SN / 97 MVA SE

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



Penelec Transmission Zone

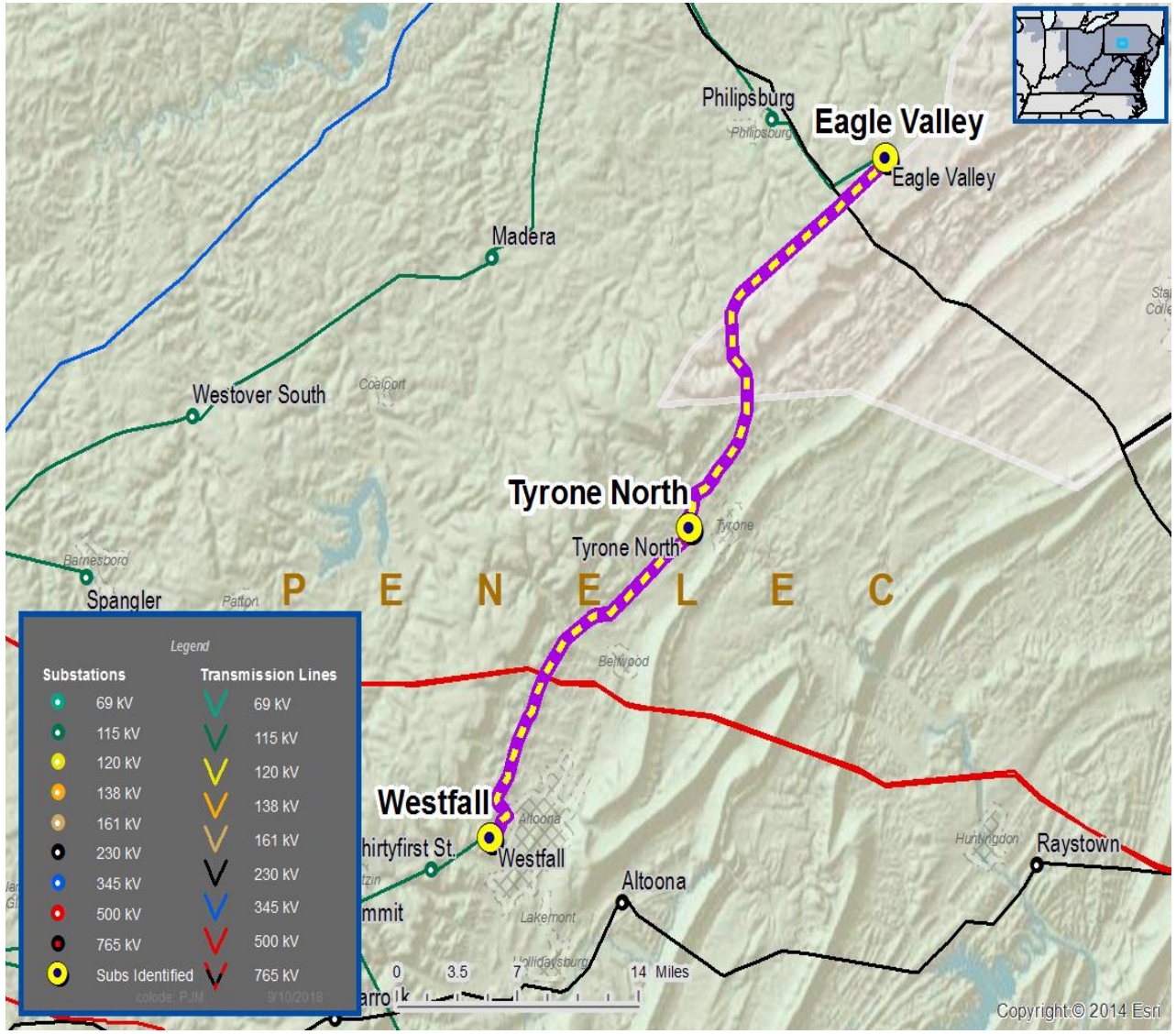
Need Number: PN-2018-008
Process Stage: Local Plan
Need Presented: 9/21/2018
Solution Presented: 10/29/2018
Project Driver(s):
Operational Flexibility and Efficiency
Equipment Material Condition, Performance and Risk

Specific Assumption Reference(s)

Substation Condition Rebuild/Replacement
Show an increasing negative trend in maintenance findings and/or costs.
Are near or beyond expected service life or obsolete.
Add/Replace Transformers
Transformer that if added or replaced would alleviate loading conditions under contingency scenarios.
Add/Expand Bus Configuration
Loss of substation bus adversely impacts transmission system performance.
Reduce the amount of exposed potential local load loss during contingency conditions.
Eliminate simultaneous outages to multiple networked elements under N-1 analysis.

Problem Statement

Tyrone North 115 kV switching station serves ~50 MW of radial load and relies on breakers at Eagle Valley and Westfall 115 kV substations for remote clearing of fault conditions. Transformer or line faults result in interruption of the entire network path and interruption of service to both the #1 and #2 115-46 kV transformers with limited network transfer capability. In the event of a #1 115-46 kV transformer fault, all load cannot be served by the #2 115-46 kV transformer (the transformer loads to 123% of its 41 MVA summer emergency rating during restoration efforts under peak conditions).
Tyrone North #2 115-46 kV transformer has an increased failure probability due to aging/deteriorating bushings, components and fluid. The transformer was manufactured in 1950.



Need Number: PN-2018-008

Selected Solution:

Tyrone North 115 kV Ring Bus & #1 115/46 kV Transformer Replacement

- Construct a four breaker 115 kV ring bus (s1776.1)
- Replace the #2 115/46 kV 45/60/75 MVA transformer (s1776.2)
- Install a 46 kV 1200 A bypass switch between the Tipton and Warrior Ridge 46 kV lines (s1776.3)

Transmission Line Ratings:

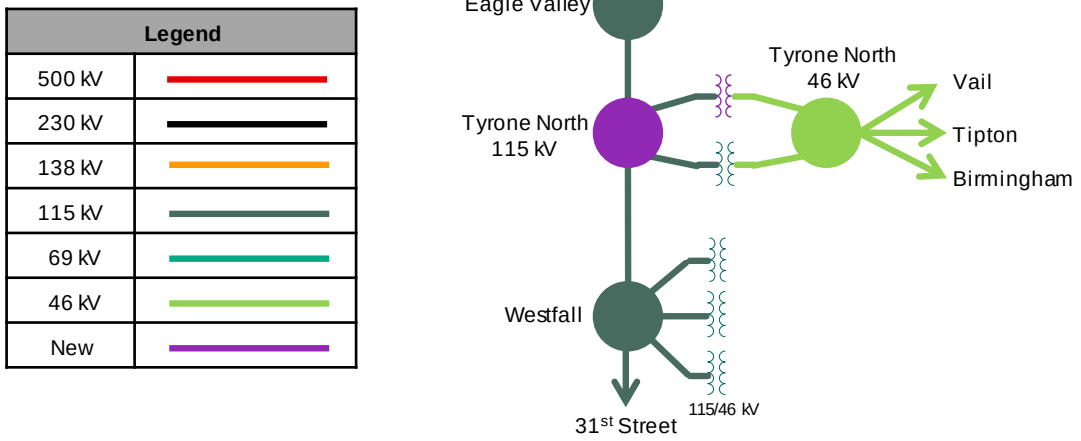
- Tyrone North – Westfall 115 kV Line
  - Before Selected Solution: 175 MVA SN / 237 MVA SE
  - After Selected Solution: 202 MVA SN / 245 MVA SE
- Tyrone North – Eagle Valley 115 kV Line
  - Before Selected Solution: 147 MVA SN / 191 MVA SE
  - After Selected Solution: 202 MVA SN / 245 MVA SE
- Tyrone North #2 115/46 kV Transformer
  - Before Selected Solution: 38 MVA SN / 41 MVA SE
  - After Selected Solution: 97 MVA SN / 97 MVA SE

Estimated Project Cost: $4.8M

Projected IS Date: 12/31/2020

Status: Conceptual

Supplemental Project Number: s1776.1, s1776.2, s1776.3



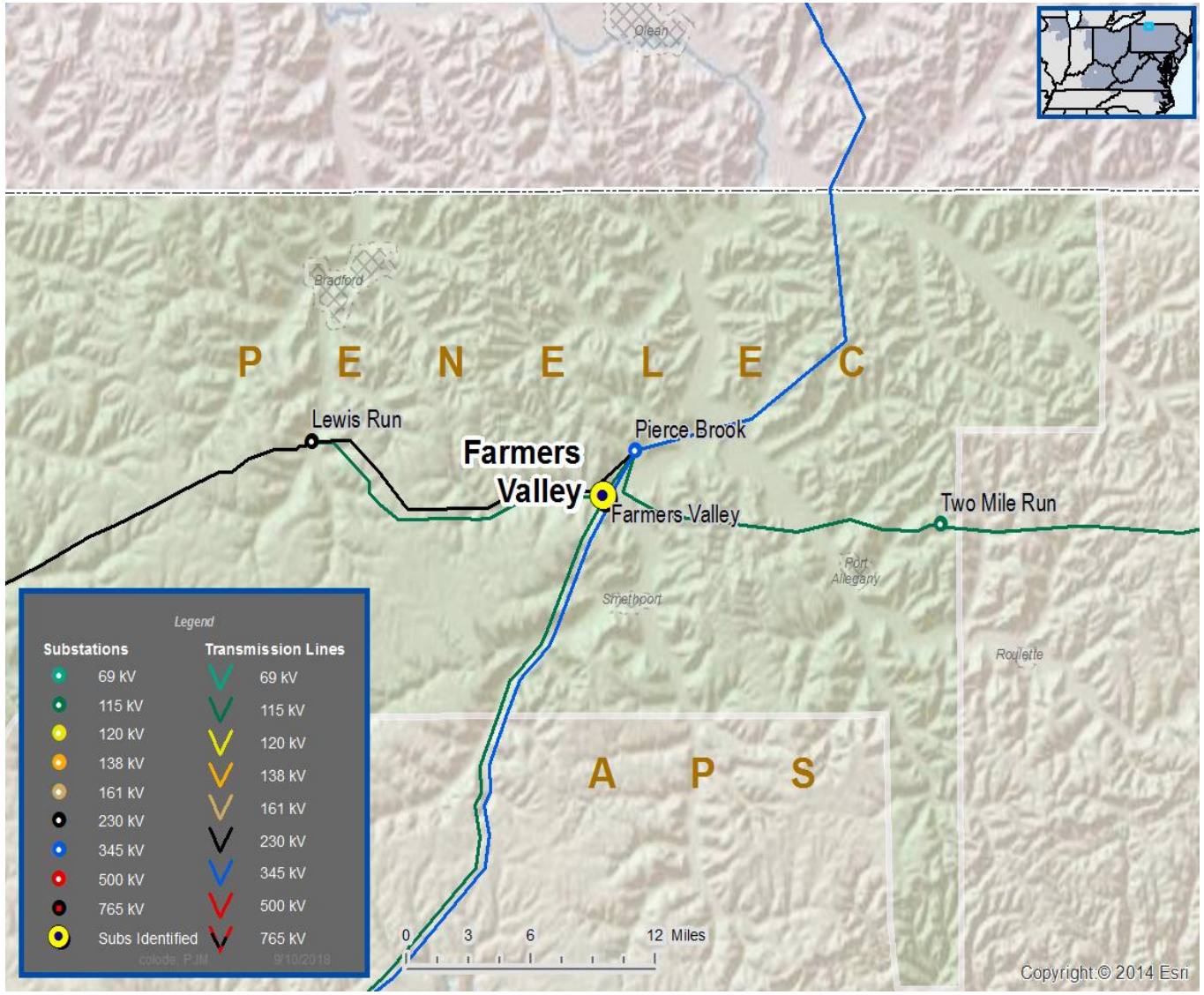
Penelec Transmission Zone

Need Number: PN-2018-009
Process Stage: Local Plan
Need Presented: 9/21/2018
Solution Presented: 10/29/2018

Project Driver(s):
Operational Flexibility and Efficiency

Specific Assumption Reference(s)
Add/Expand Bus Configuration
Reduce the amount of exposed potential local load loss during contingency conditions.
Eliminate simultaneous outages to multiple networked elements (excluding capacitor banks) under N-1 analysis.
If substation bus configurations limit the ability to perform substation maintenance, the substation and/or transmission lines should be evaluated for reconfiguration.

Problem Statement
Farmers Valley 115 kV bus #1 does not have a transmission source, while Farmers Valley 115 kV bus #2 has two sources. Bus maintenance or outages result in loss of both 115-34.5 kV transformers impacting approximately 3,377 customers and approximately 10 MW of load.

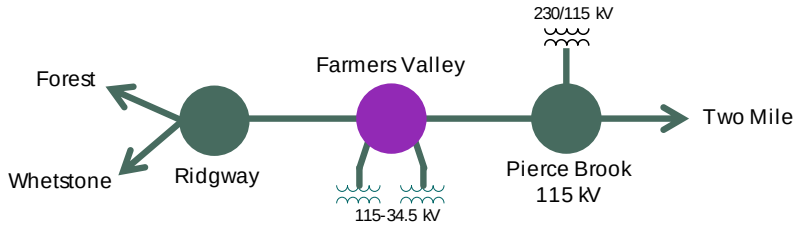


Need Number: PN-2018-009

Selected Solution:

Farmers Valley 115 kV Substation: Relocate Ridgway Line to Lewis Run Terminal

- Relocate the existing Ridgway line to the old Lewis Run terminal (s1777)



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

Estimated Project Cost: $1.3M

Projected IS Date: 6/1/2019

Status: Conceptual

Supplemental Project Number: s1777

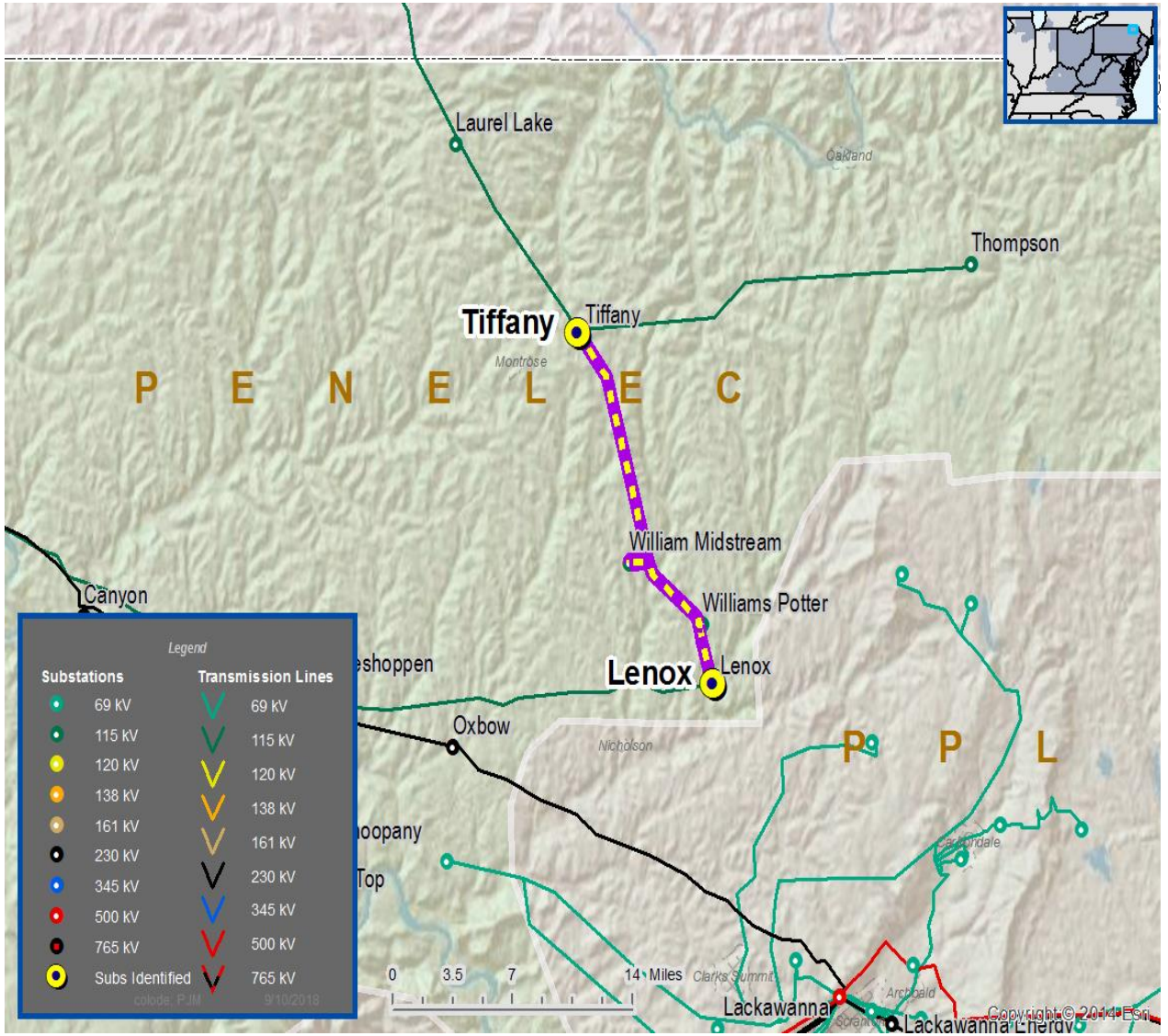
Penelec Transmission Zone

Need Number: PN-2018-010
Process Stage: Local Plan
Need Presented: 9/21/2018
Solution Presented: 10/29/2018

Project Driver(s):
Customer Service

Specific Assumption Reference(s)
New customer connection request will be evaluated per FirstEnergy's "Requirements for Transmission Connected Facilities" document and "Transmission Planning Criteria" document.

Problem Statement
New Customer Connection – A customer requested 115 kV service for load of approximately 16 MW near the Lenox – Tiffany 115 kV line. Requested in-service date is 7/2019.

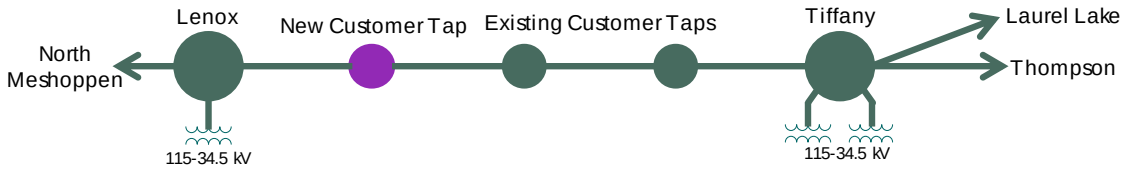


Need Number: PN-2018-010

Selected Solution:

Provide 115 kV Service

- Tap the existing Lenox – Tiffany 115 kV line (s1778.1)
- Install two 115 kV line switches (s1778.2)
- Install 115 kV line trap at tap location (s1778.3)
- Install 115 kV switch on tap (s1778.3)
- Construct ~200 ft of 115 kV line to customer substation



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

Estimated Project Cost: $1.2M

Projected IS Date: 4/1/2019

Status: Conceptual

Supplemental Project Number: s1778.1, s1778.2, s1778.3

Penelec Transmission Zone

Need Number: PN-2018-011
Process Stage: Local Plan
Need Presented: 9/21/2018
Solution Presented: 10/29/2018

Project Driver(s):
Operational Flexibility and Efficiency
Specific Assumption Reference(s)
Substation/Line Equipment Limits

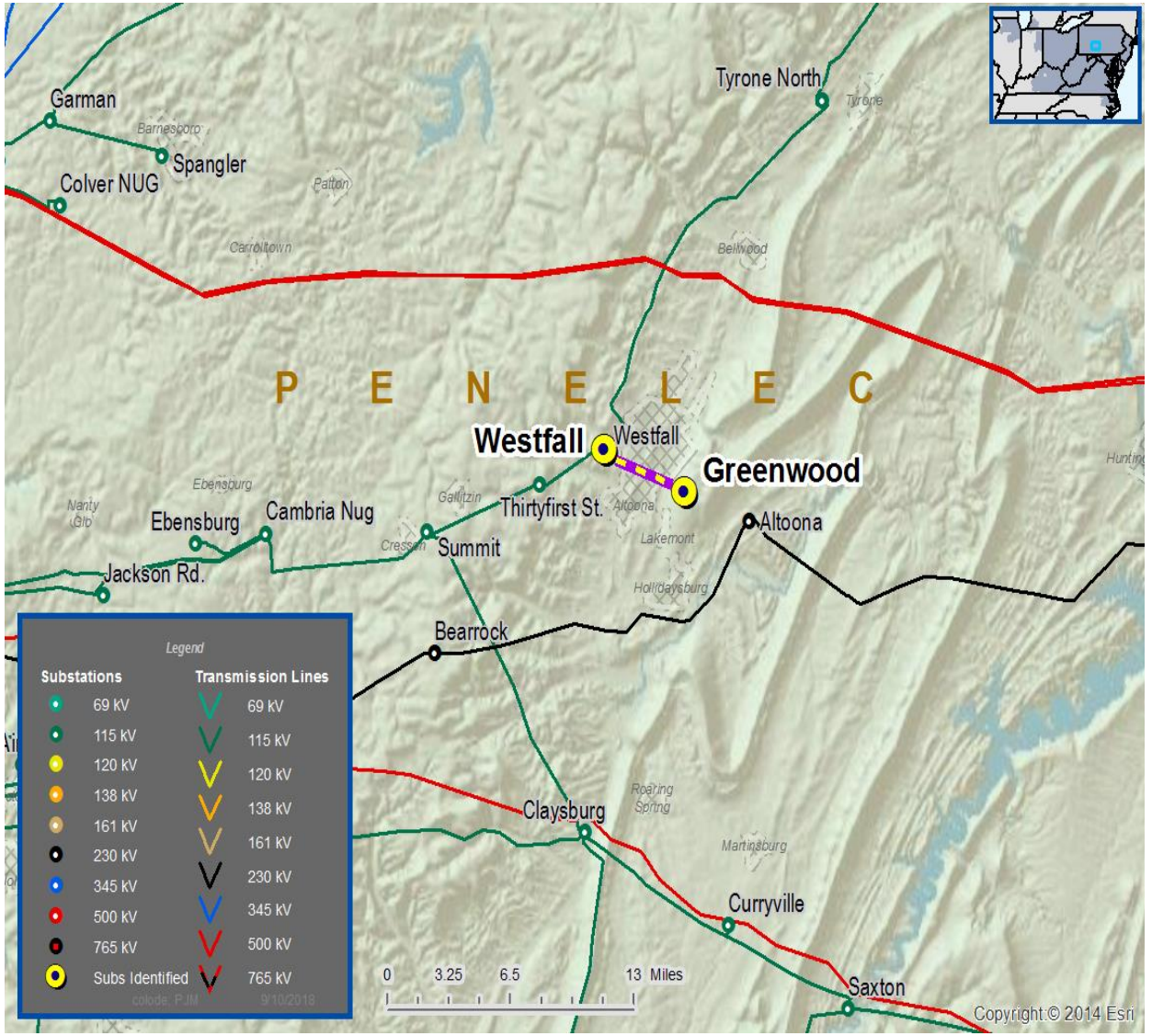
- Consider upgrading transmission line equipment (switches, conductor, splices, etc.) as well as terminal and protection equipment to meet or exceed the transmission line conductor rating.

Critical Upgrade to Standards

- Line Switches – Switches should be considered for replacement to allow for desired operations (i.e. line charging, loop splitting, etc.).

Problem Statement
Existing terminal equipment significantly derate the thermal capability of the Greenwood – Westfall 46 kV line. The line sectionalizing devices at East Altoona and Fairview are not capable of loop splitting.
Transmission line rating limited by terminal equipment.

- Westfall – Fairview 46 kV line: Existing emergency line rating is 64 MVA. Existing conductor emergency rating is 81 MVA
- Fairview – East Altoona 46 kV line: Existing emergency line rating is 69 MVA. Existing conductor emergency rating is 71 MVA.
- East Altoona – Greenwood 46 kV line: Existing emergency line rating is 33 MVA. Existing conductor emergency rating is 81 MVA.



Need Number: PN-2018-011

Selected Solution:

Greenwood – Westfall 46 kV: Upgrade Bus Conductor & Relay Panels

Greenwood 46 kV Substation – Terminal equipment to be replaced includes:

- Line relaying, substation conductor and disconnect switches (s1779.1)

East Altoona 46 kV Substation – Terminal equipment to be replaced includes:

- Disconnect switches (s1779.2)

Fairview 46 kV Substation – Terminal equipment to be replaced includes:

- Disconnect switches (s1779.3)

Westfall 46 kV Substation – Terminal equipment to be replaced includes:

- Line relaying, substation conductor and disconnect switches (s1779.4)

Transmission Line Ratings:

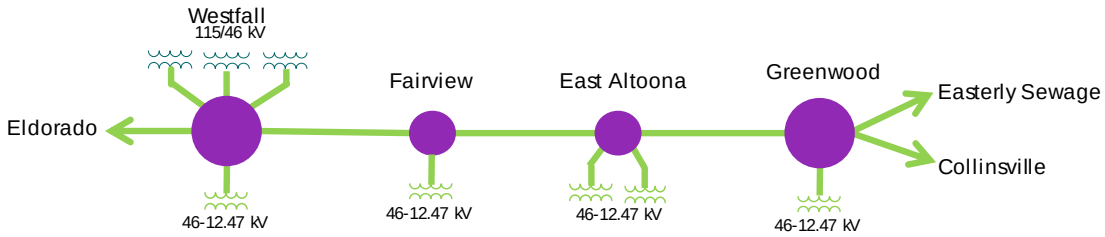
- Greenwood – East Altoona 46 kV Line
  - Before Selected Solution: 33 MVA SN / 33 MVA SE
  - After Selected Solution: 67 MVA SN / 81 MVA SE
- Fairview – East Altoona 46 kV Line
  - Before Selected Solution: 55 MVA SN / 69 MVA SE
  - After Selected Solution: 59 MVA SN / 71 MVA SE
- Westfall – Fairview 46 kV Line
  - Before Selected Solution: 55 MVA SN / 64 MVA SE
  - After Selected Solution: 67 MVA SN / 81 MVA SE

Estimated Project Cost: $1.3 M

Projected IS Date: 6/1/2019

Status: Conceptual

Supplemental Project Number: s1779.1, s1779.2, s1779.3, s1779.4



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

Penelec Transmission Zone

Need Number: PN-2018-012
Process Stage: Local Plan
Need Presented: 9/21/2018
Solution Presented: 10/29/2018

Project Driver(s):
Operational Flexibility and Efficiency

Specific Assumption Reference(s)
Global Consideration

- Assess the risk associated with bus, stuck breaker, and N-2 contingencies to improve FERC tariffed Transmission < 100 kV facilities.

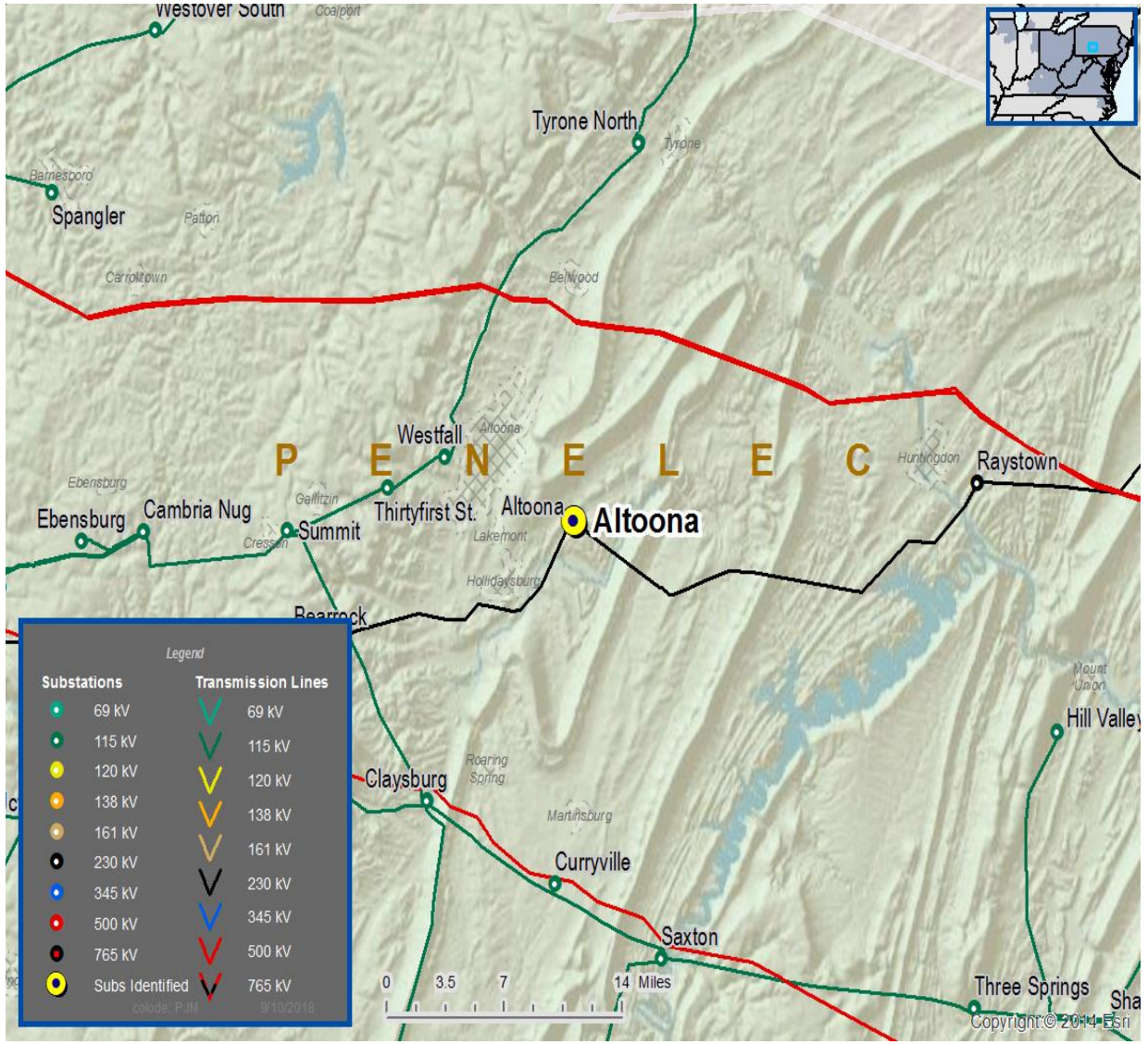
Network Radial Lines

- Radial lines will be evaluated based on load at risk and/or customers impacted along with its proximity to other networked facilities.

Build New Transmission Line

- Network radial lines.

Problem Statement
If the Altoona – Bear Rock and Raystown – Lewistown 230 kV lines or Raystown – Lewistown and Bear Rock – Johnstown 230 kV lines or both Altoona 230/46 kV transformers are out of service (N-1-1), voltage on the surrounding 46 kV system is less than 0.80 p.u.



Need Number: PN-2018-012

Selected Solutions:

Westfall – 20th Street – Collinsville 46 kV Line

- Construct a new 46 kV line between Westfall and 20th Street (~0.82 miles) and reconductor the 20th Street – Collinsville 46 kV line (~1.46 miles) (**s1780.1**)

Westfall 46 kV Substation

- Install one new 46 kV breaker and extend the bus to facilitate a new 46 kV terminal (**s1780.2**)
- Install new standard panels for line relaying (**s1780.3**)

20th Street 46 kV Substation – Terminal equipment to be replaced includes:

- Disconnect switches (**s1780.4**)

Collinsville 46 kV Substation – Terminal equipment to be replaced includes:

- Line relaying, substation conductor and disconnect switches (**s1780.5**)

Collinsville 46 kV Capacitor

- Install one 36 MVAR, 46 kV capacitor (**s1780.6**)

Hollidaysburg 46 kV Capacitor

- Install one 26 MVAR, 46 kV capacitor (**s1780.7**)

Transmission Line Ratings:

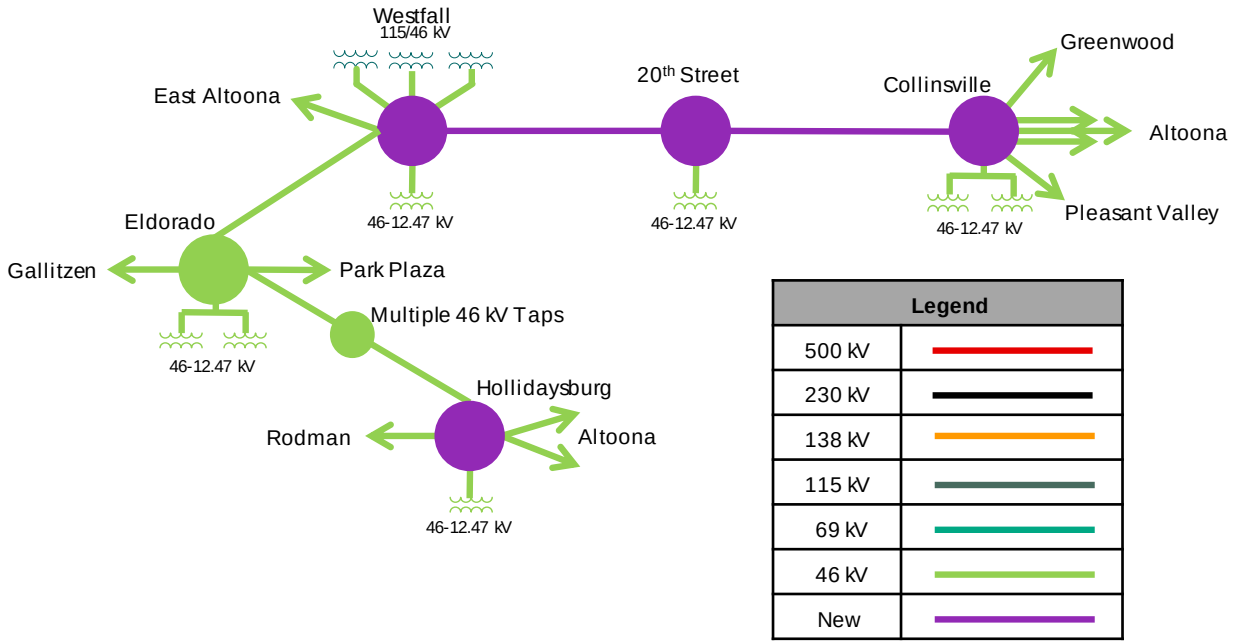
- Westfall – 20th Street 46 kV Line
  - Before Selected Solution: N/A
  - After Selected Solution: 91 MVA SN / 111 MVA SE
- 20th Street – Collinsville 46 kV Line
  - Before Selected Solution: 38 MVA SN / 42 MVA SE
  - After Selected Solution: 91 MVA SN / 111 MVA SE

Estimated Project Cost: $5.3M (Westfall – 20th Street – Collinsville)
$0.9M (Collinsville 46 kV Capacitor)
$0.9M (Hollidaysburg 46 kV Capacitor)

Projected IS Date: 6/1/2020

Status: Conceptual

Supplemental Project Number: s1780.1, s1780.2, s1780.3, s1780.4, s1780.5, s1780.6, s1780.7



Penelec Transmission Zone

Need Number: PN-2018-013

Process Stage: Local Plan

Need Presented: 9/21/2018

Solution Presented: 10/29/2018

Project Driver(s):
Operational Flexibility and Efficiency

Specific Assumption Reference(s)
Global Consideration

- Assess the risk associated with bus, stuck breaker, and N-2 contingencies to improve FERC tariffed Transmission < 100 kV facilities.

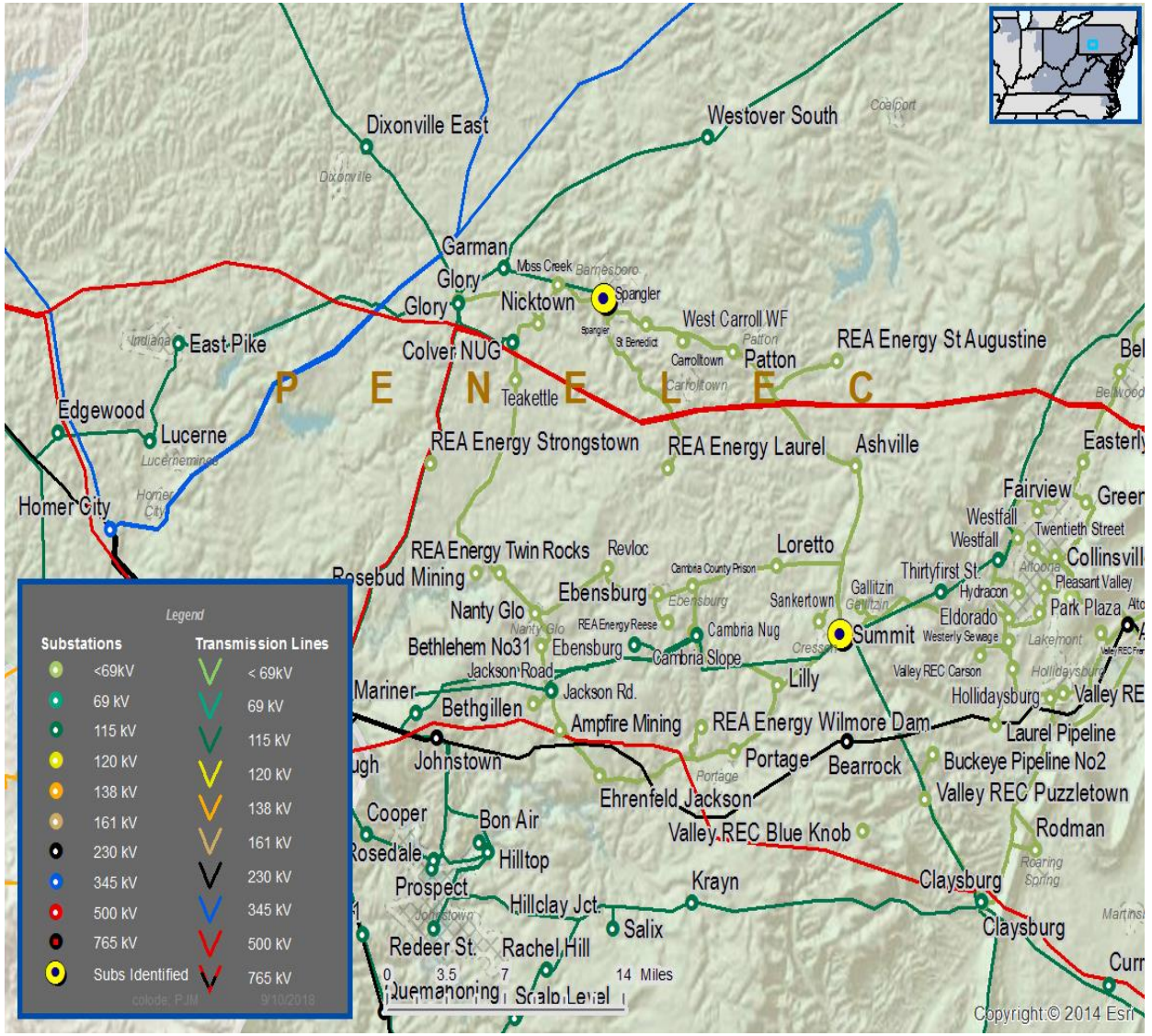
Substation/Line Equipment Limits

- Consider upgrading transmission line equipment (switches, conductor, splices, etc.) as well as terminal and protection equipment to meet or exceed the transmission line conductor rating.

Problem Statement

For the loss of Spangler 115-46 kV transformer and SGC Tap – Summit 46 kV line, the Nanty-Glo – Twin Rock 46 kV line loads to greater than 120% of its 44 MVA STE rating.

Transmission line rating limited by terminal equipment. Existing emergency line rating is 44 MVA. Existing conductor emergency rating is 81 MVA.



Need Number: PN-2018-013

Selected Solution:

Nanty Glo 46 kV: Replace Bus Conductor

- Replace substation conductor, circuit breaker and disconnect switches (**s1781**)

Transmission Line Ratings:

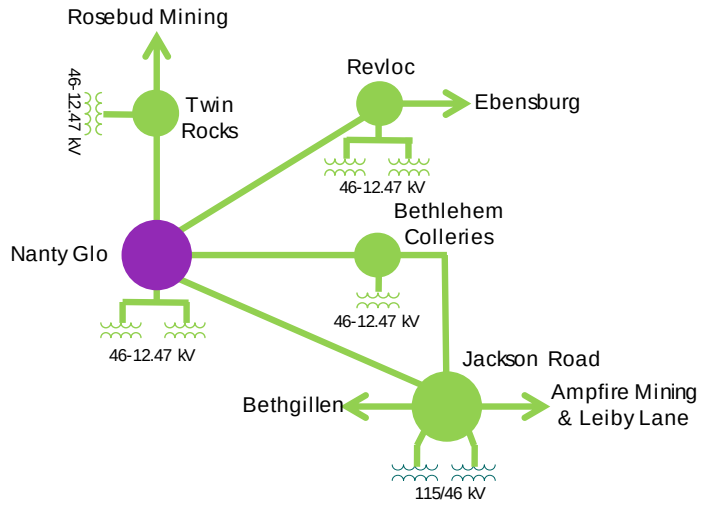
- Nanty Glo – Twin Rock 46 kV Line
  - Before Selected Solution: 34 MVA SN / 44 MVA SE
  - After Selected Solution: 55 MVA SN / 69 MVA SE

Estimated Project Cost: $0.4 M

Projected IS Date: 12/31/2019

Status: Conceptual

Supplemental Project Number: s1781



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

Penelec Transmission Zone M-3 Process
Replace Bus Section Breaker and Upgrade Terminal Equipment at Edinboro South 115 kV

Need Number: PN-2018-014

Process State: Submission of Supplemental Project for inclusion in the Local Plan 7/26/2019

Previously Presented:

Need Meeting 10/29/2018

Solution Meeting 11/28/2018

Project Driver:

Equipment Material Condition, Performance and Risk

Specific Assumption Reference:

Substation Condition Rebuild/Replacement – Circuit Breakers

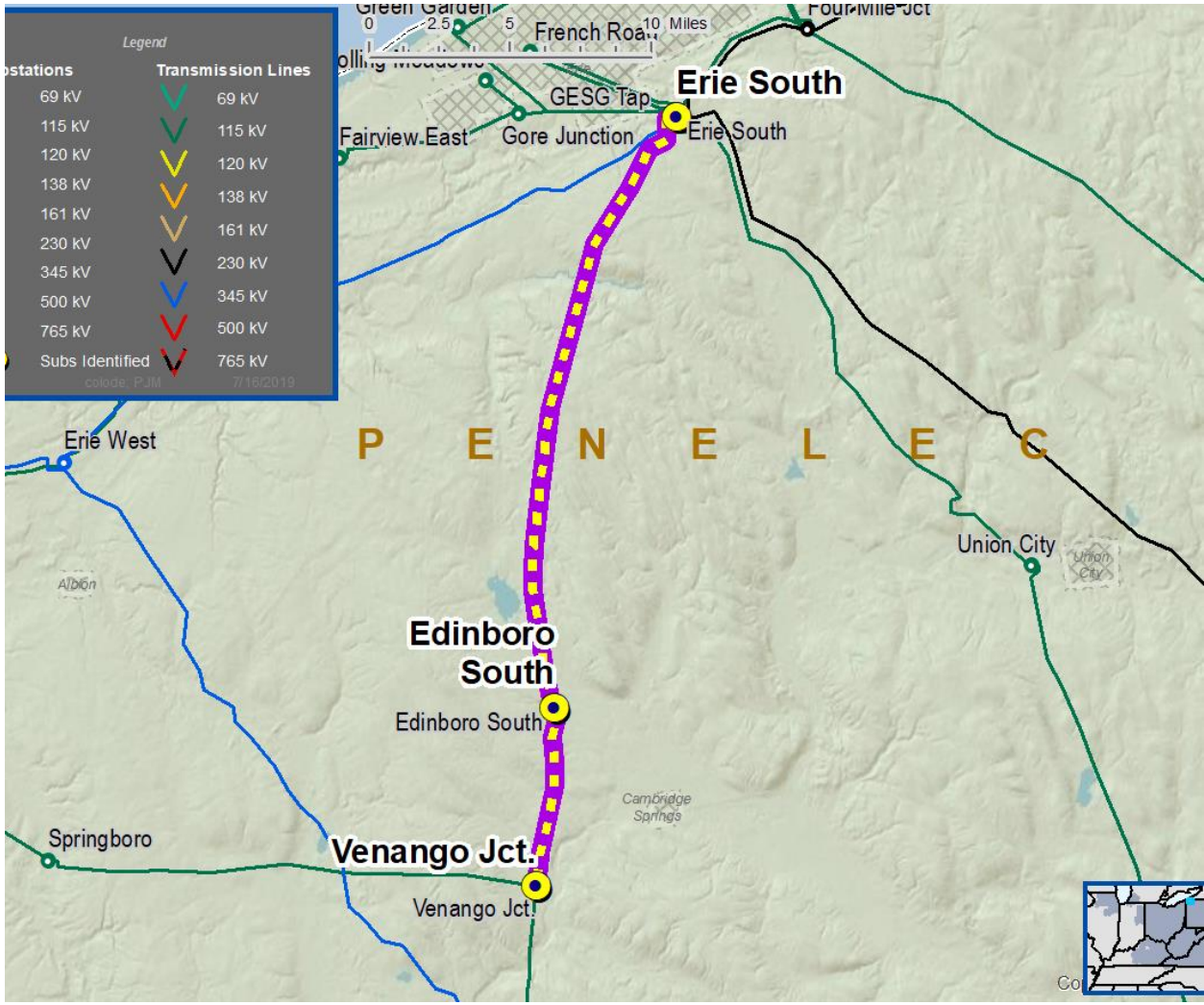
System Performance Projects – Substation/line equipment limits

Problem Statement:

Bus section circuit breaker at Edinboro South 115 kV evaluated and determined to be in degraded condition. Since 2006, there have been 10 maintenance orders on this breaker (interrupting media, compressor, and other issues)

Transmission line rating limited by terminal equipment.

- Edinboro South – Erie South 115 kV line: Existing line rating is 163/185 MVA (SN/SE). Existing conductor rating is 232/282 MVA (SN/SE).
  (line trap, substation conductor, line relaying, CTs)
- Edinboro South – Venango Junction 115 kV line: Existing line rating is 163/179 MVA (SN/SE). Existing conductor rating is 232/282 MVA (SN/SE).
  (line trap, substation conductor, line relaying, CTs)



Penelec Transmission Zone M-3 Process
Replace Bus Section Breaker and Upgrade Terminal Equipment at Edinboro South 115 kV

Need Number: PN-2018-014

Process State: Submission of Supplemental Project for inclusion in the Local Plan 7/26/2019

Selected Solution:

Edinboro South 115 kV: Replace Bus Section Breaker and Upgrade Terminal Equipment (s1820)

- Replace bus section breaker (**s1820.1**)

Edinboro South 115 kV Substation – Terminal equipment to be replaced includes:

- Line traps, substation conductor, line relaying and CCVTs (**s1820.2**)

Venango Junction 115 kV Substation – Terminal equipment to be replaced includes:

- Substation conductor, CCVT and arresters (**s1820.3**)

Erie South 115 kV Substation – Terminal equipment to be replaced includes:

- Circuit breaker, arresters, CCVT, line trap, line relaying and substation conductor (**s1820.4**)

<u>Transmission Line Ratings:</u>

Edinboro South – Erie South 115 kV Line

- Before Proposed Solution: 163/185 MVA (SN/SE)
- After Proposed Solution: 232/282 MVA (SN/SE)

Edinboro South – Venango Junction 115 kV Line

- Before Proposed Solution: 163/179 MVA (SN/SE)
- After Proposed Solution: 232/282 MVA (SN/SE)

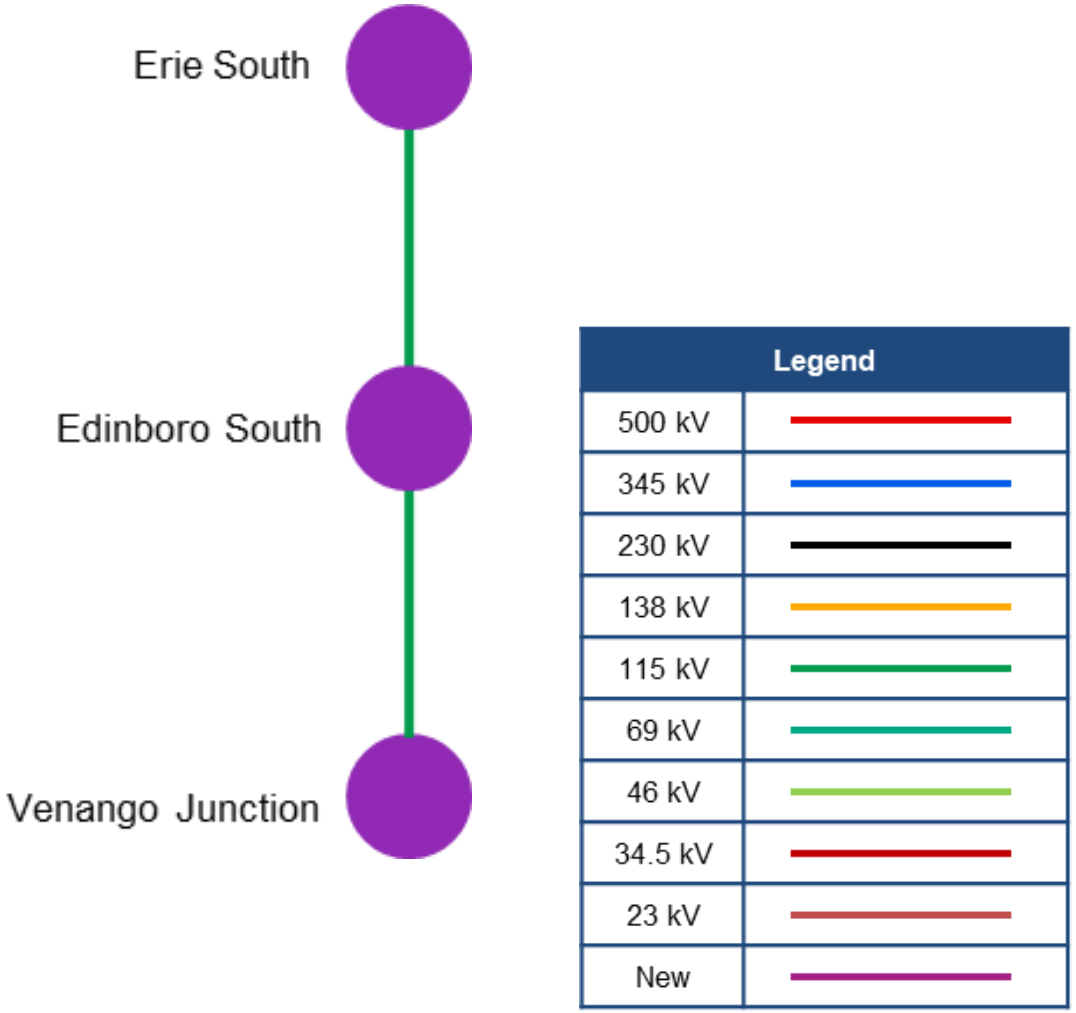
Estimated Cost: $2.1M

Projected In-Service: 6/1/2019

Supplemental Project ID: s1820.1, s1820.2, s1820.3, s1820.4

Status: Conceptual

Model: 2018 Series 2023 Summer RTEP 50/50



Penelec Transmission Zone M-3 Process
Hill Valley #1 115/46 kV Transformer Replacement

Need Number: PN-2018-015

Process State: Submission of Supplemental Project for inclusion in the Local Plan 7/26/2019

Previously Presented:

Need Meeting 10/29/2018

Solution Meeting 11/28/2018

Project Driver:

Equipment Material Condition, Performance and Risk

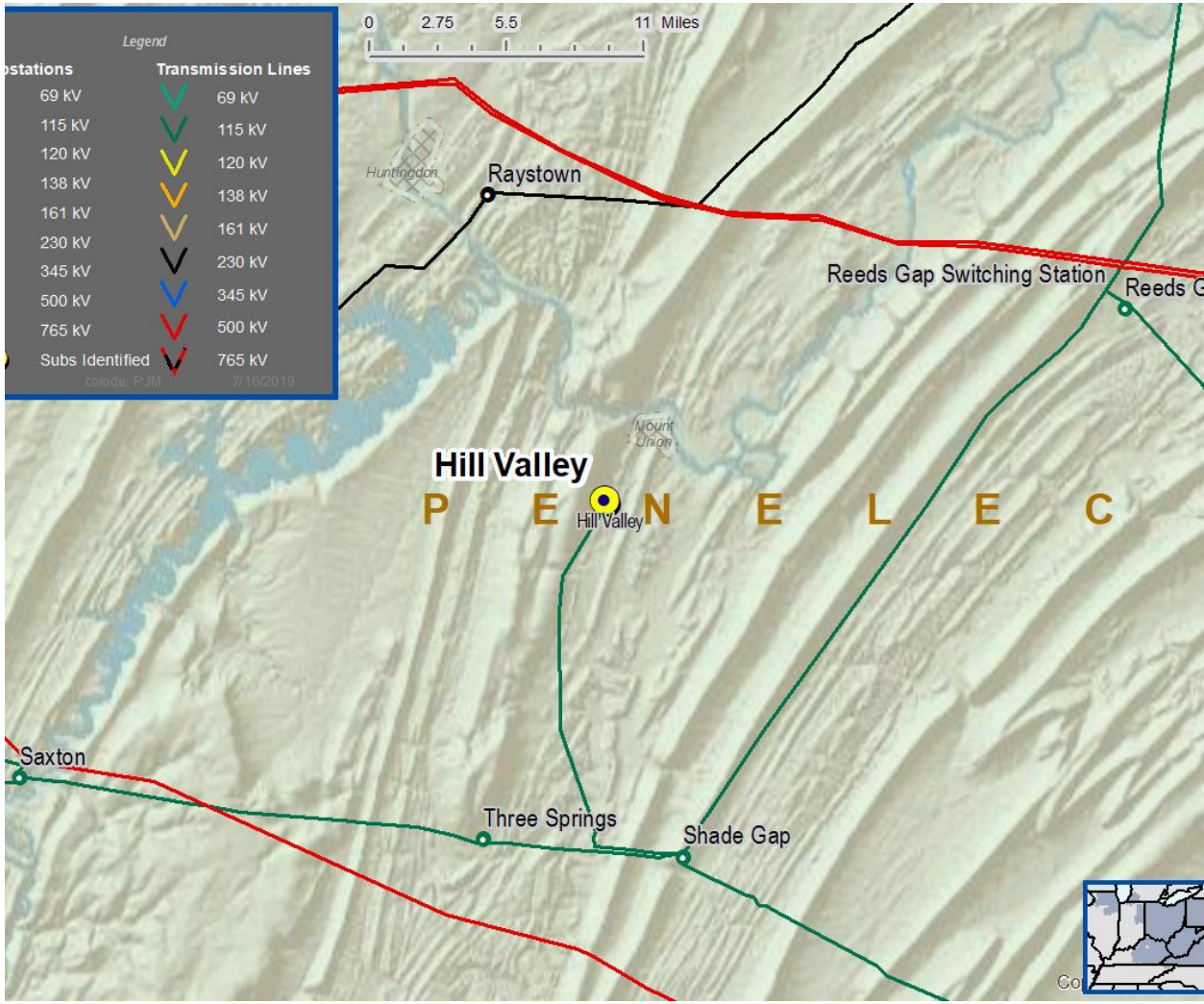
Specific Assumption Reference:

Substation Condition Rebuild/Replacement

Problem Statement:

Hill Valley #1 115/46 kV Transformer

- Transformer has Increased failure probability due to leaks, failed auxiliary equipment and damaged wiring.
- Transformer is 57 years old.
- Since 2004, there have been 25 maintenance orders on this transformer.



Penelec Transmission Zone M-3 Process
Hill Valley #1 115/46 kV Transformer Replacement

Need Number: PN-2018-015

Process State: Submission of Supplemental Project for inclusion in the Local Plan 7/26/2019

Selected Solution:

Replace Hill Valley #1 115/46 kV Transformer (**s1821**)

- Replace the #1 115/46 kV transformer and associated equipment with 115/46 kV 45/60/75 MVA transformer

Transformer Rating:

Hill Valley #1 115/46 kV Transformer

- Before Proposed Solution: 32/34 MVA (SN/SE)
- After Proposed Solution: 97/97 MVA (SN/SE)

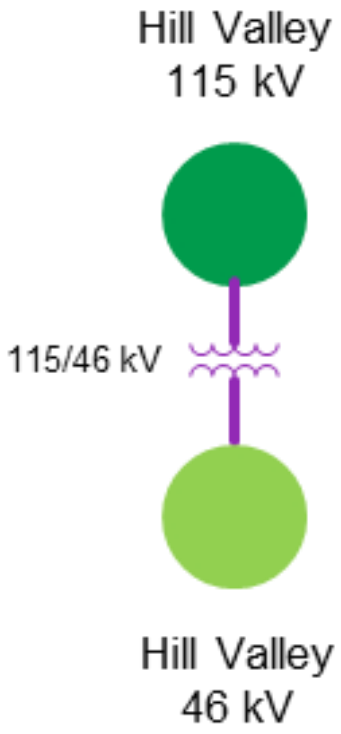
Estimated Cost: $3.0 M

Projected In-Service: 12/1/2019

Supplemental Project ID: s1821

Status: Conceptual

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Penelec Transmission Zone M-3 Process
Lewistown #2 230/115-46 kV Transformer Replacement

Need Number: PN-2018-016

Process State: Submission of Supplemental Project for inclusion in the Local Plan 7/26/2019

Previously Presented:

Need Meeting 10/29/2018

Solution Meeting 11/28/2018

Project Driver:

Equipment Material Condition, Performance and Risk

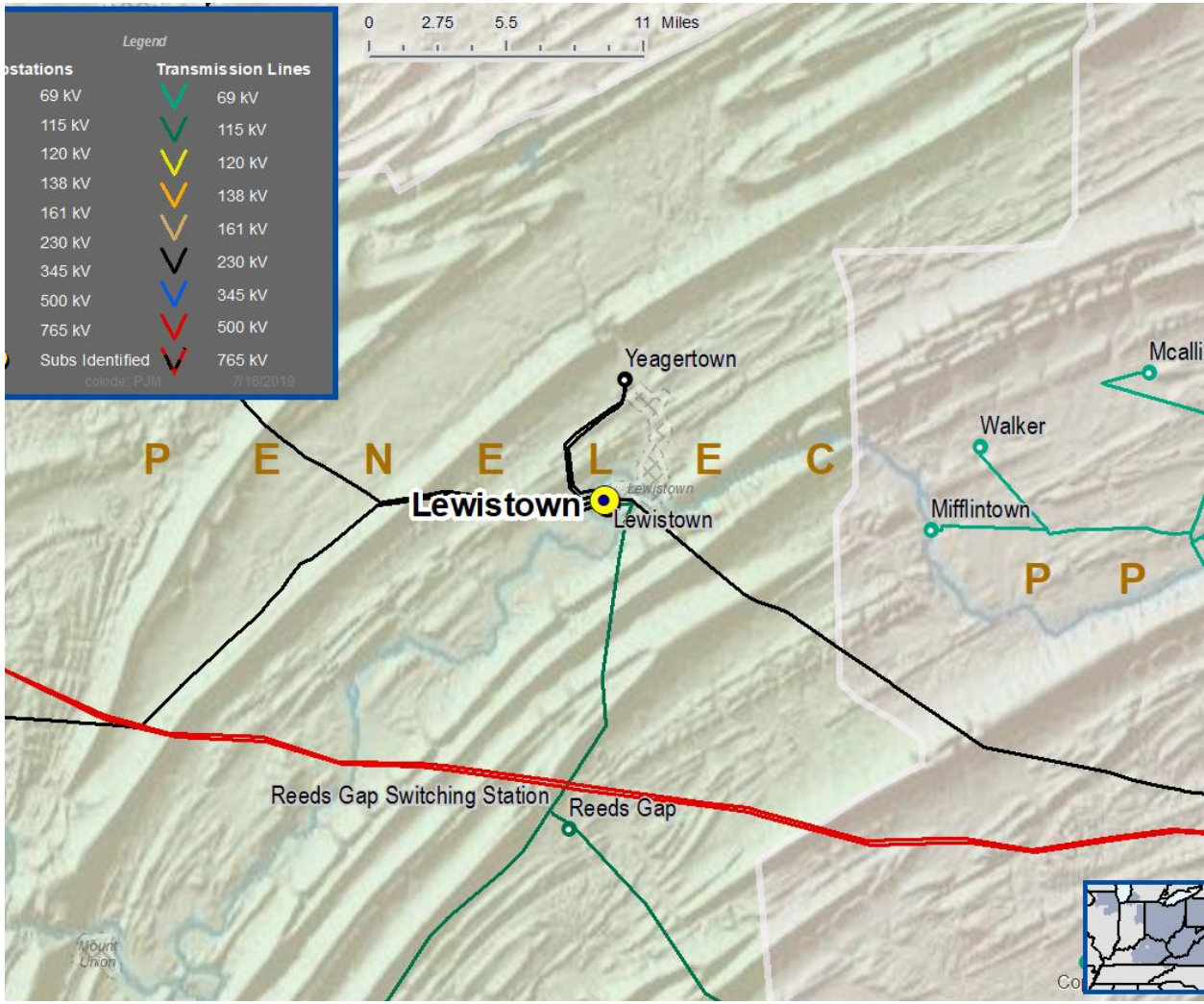
Specific Assumption Reference:

Substation Condition Rebuild/Replacement

Problem Statement:

Lewistown #2 230/115-46 kV Transformer

- Transformer has an increased failure probability due to leaks and failed auxiliary equipment.
- Transformer is 65 years old.
- Since 2004, there have been 96 maintenance orders on this transformer.



Penelec Transmission Zone M-3 Process
Lewistown #2 230/115-46 kV Transformer Replacement

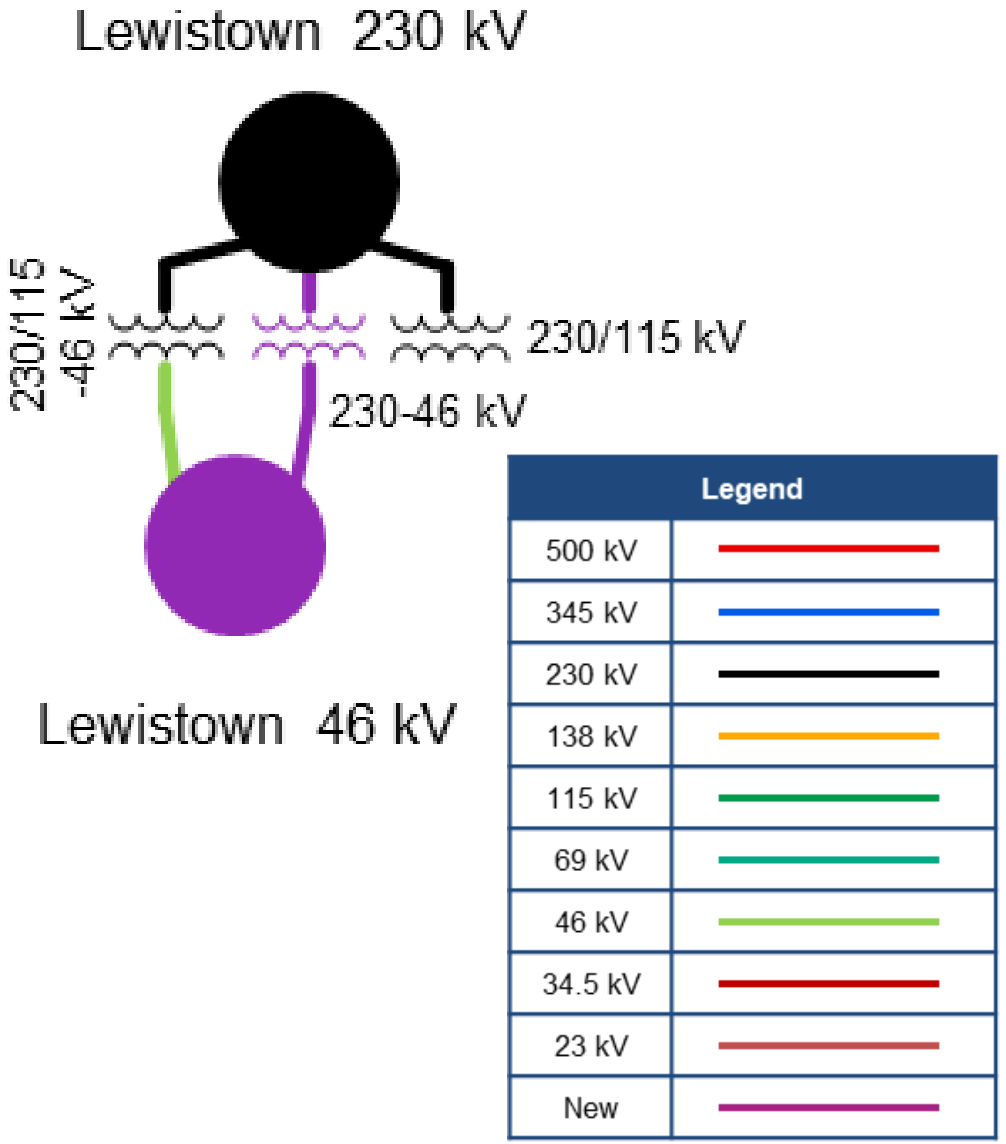
Need Number: PN-2018-016
Process State: Submission of Supplemental Project for inclusion in the Local Plan 7/26/2019
Selected Solution:
Replace Lewistown #2 230/115-46 kV Transformer

- Replace the #2 230/115-46 kV transformer and associated equipment with 230-46 kV 60/80/100 MVA transformer (**s1822.1**)
- Replace Lewistown 46 kV Breakers
- Replace overdutied 46 kV breakers due to transformer replacement (**s1822.2**) (Riverside (1LK), Viscose Hill (2LK), Mt Union, transformer No.2 and bus section breakers)

Transformer Rating:
Lewistown #2 230-46 kV Transformer

- Before Proposed Solution (230/115 kV): 65/72 MVA (SN/SE)
- Before Proposed Solution (115-46 kV): 62/67 MVA (SN/SE)
- Before Proposed Solution (230-46 kV): 55/67 MVA (SN/SE)
- After Proposed Solution (anticipated 230-46 kV): 120/129 MVA (SN/SE)

Estimated Cost: $3.3 M (Transformer Replacement)
$0.6 M (46 kV Breaker Replacements)
Projected In-Service: 12/31/2020
Supplemental Project ID: s1822.1, s1822.2
Status: Conceptual
Model: 2018 Series 2023 Summer RTEP 50/50



Penelec Transmission Zone M-3 Process
East Towanda #4 230/115 kV Transformer Replacement

Need Number: PN-2019-001

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 02/22/2019

Solution Meeting 03/25/2019

Project Driver:

Equipment Material Condition, Performance and Risk

Specific Assumption Reference:

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

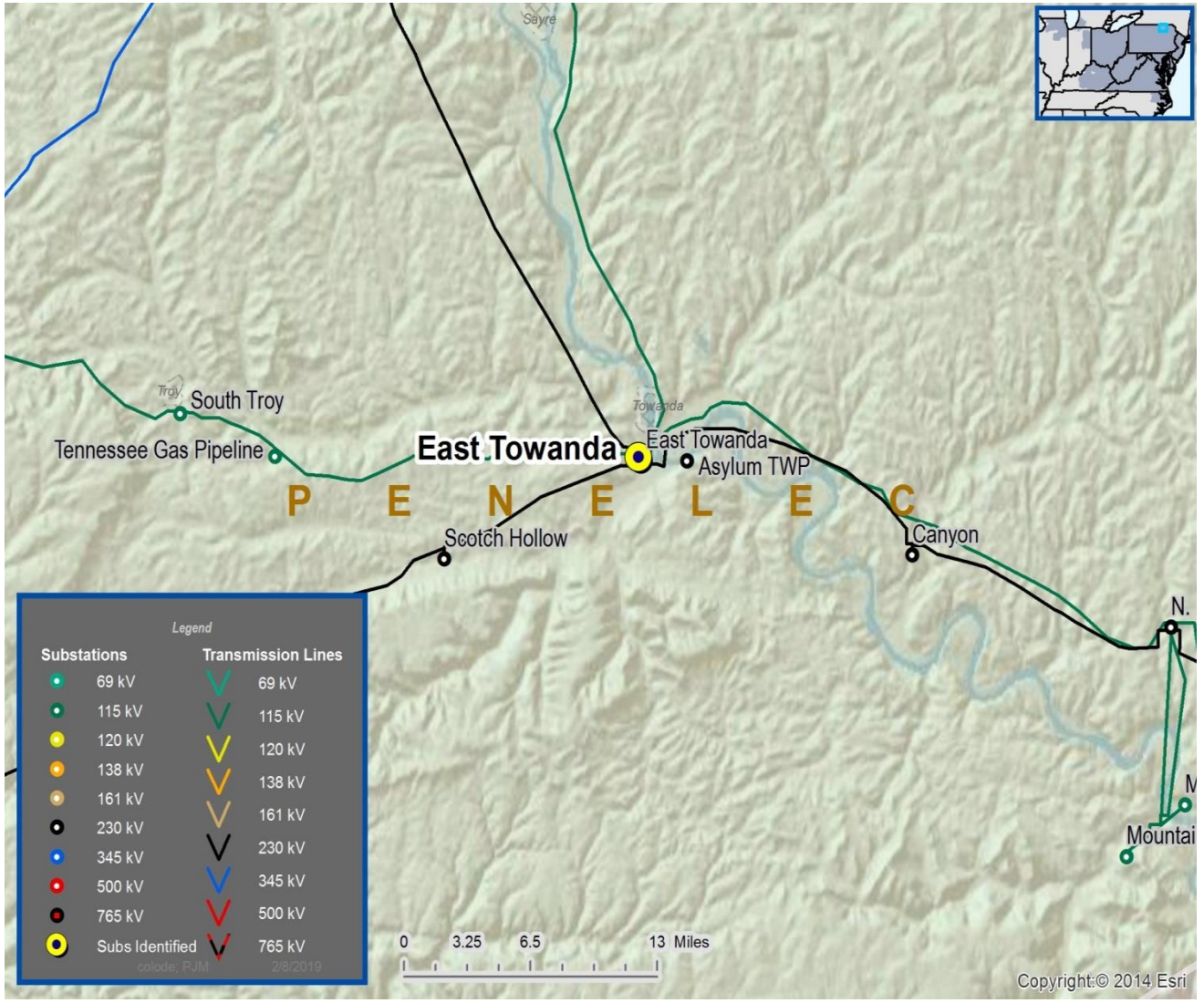
- Transformer has an increased failure probability due to type "U" bushings, dielectric breakdown, and is exhibiting high ethylene gas.
- Transformer is 45 years old.

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 M-3 Process
East Towanda #4 230/115 kV Transformer Replacement

Need Number: PN-2019-001

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

East Towanda #4 230/115 kV Transformer Replacement (s1881)

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

Transformer Rating:

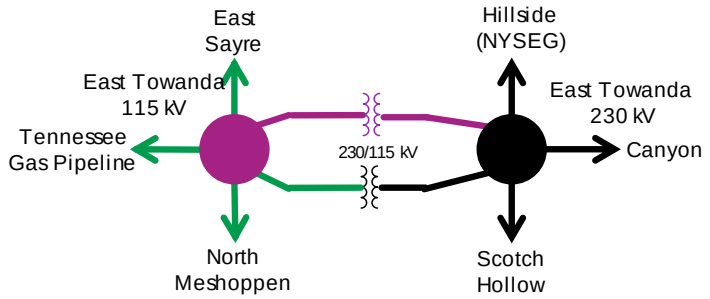
- East Towanda #4 230/115 kV Transformer
  - Before Proposed Solution: 190/226 MVA (SN/SE)
  - After Proposed Solution (anticipated): 375/438 MVA (SN/SE)

Estimated Cost: $5.0M

Projected In-Service: 6/1/2021

Supplemental Project ID: s1881

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Penelec Transmission Zone M-3 Process
Erie South #6 230/115 kV Transformer Replacement

Need Number: PN-2019-002

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 02/22/2019

Solution Meeting 03/25/2019

Project Driver:

Equipment Material Condition, Performance and Risk

Specific Assumption Reference:

Substation Condition Rebuild/Replacement

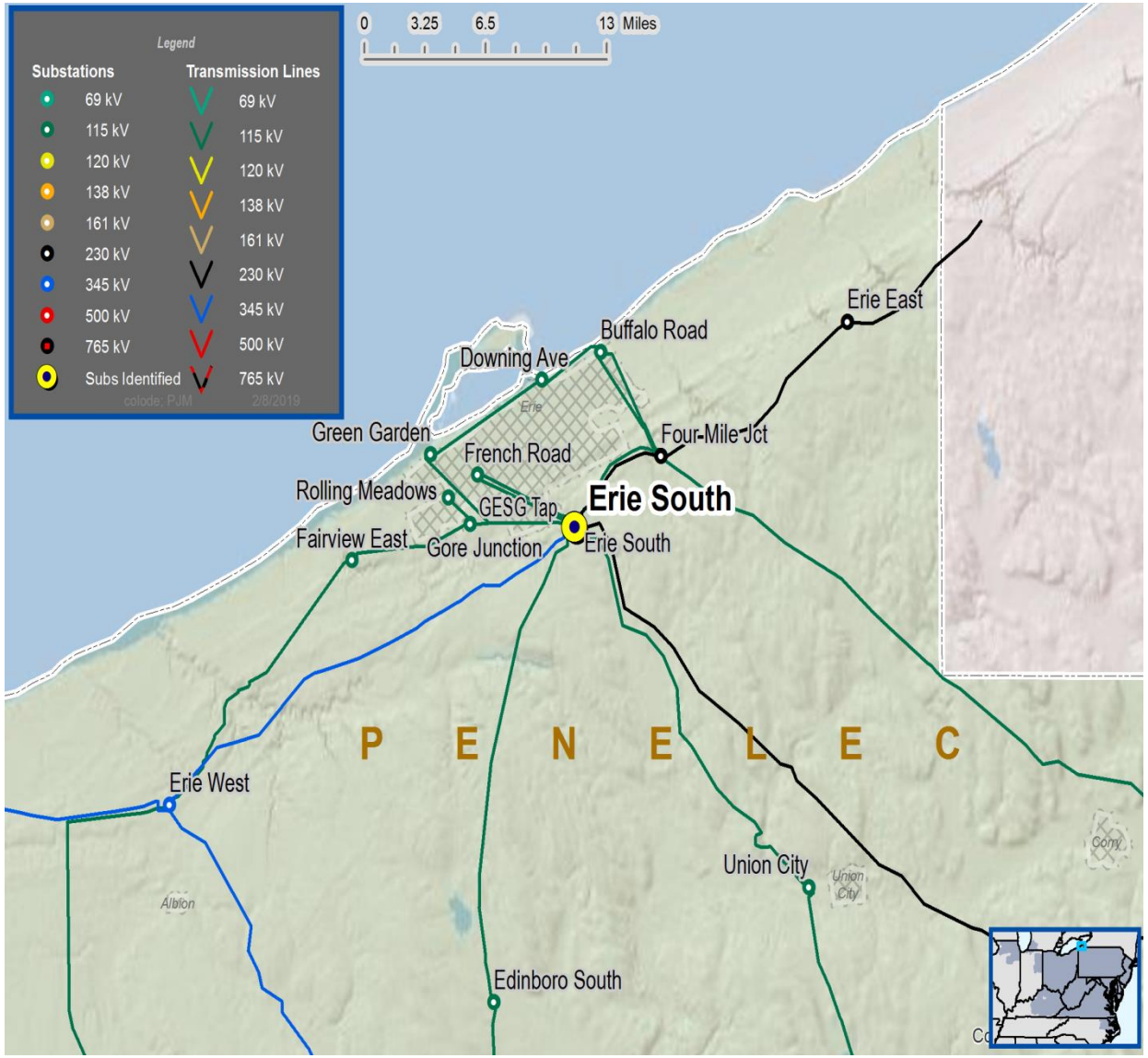
- Power transformers and load tap changers (LTCs)

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.

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



Penelec Transmission Zone M-3 Process
Erie South #6 230/115 kV Transformer Replacement

Need Number: PN-2019-002

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Erie South #6 230/115 kV Transformer Replacement (s1934)

- Replace the #6 230/115 kV transformer with a 230/115 kV 180/240/300 MVA transformer (s1934.1)
- Replace the 230 kV circuit switcher with a circuit breaker (s1934.2)

Transformer Rating:

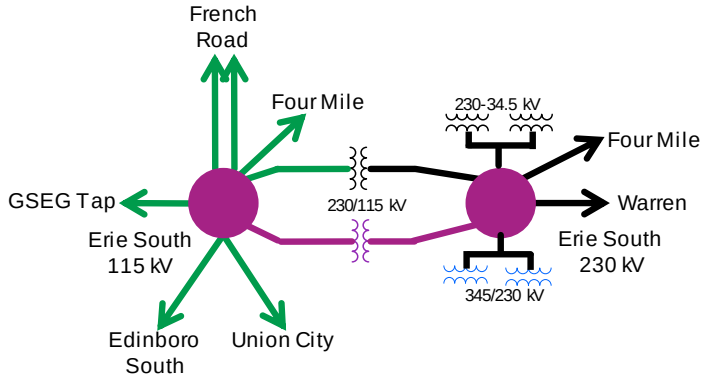
- Erie South #6 230/115 kV Transformer
  - Before Proposed Solution: 262/326 MVA (SN/SE)
  - After Proposed Solution (anticipated): 375/438 MVA (SN/SE)

Estimated Cost: $4.2M

Projected In-Service: 10/1/2021

Supplemental Project ID: s1934, s1934.1, s1934.2

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Penelec Transmission Zone M-3 Process
Lewistown #1 230/115-46 kV Transformer Replacement

Need Number: PN-2019-003

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 02/22/2019

Solution Meeting 03/25/2019

Project Driver:

Equipment Material Condition, Performance and Risk

Specific Assumption Reference:

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

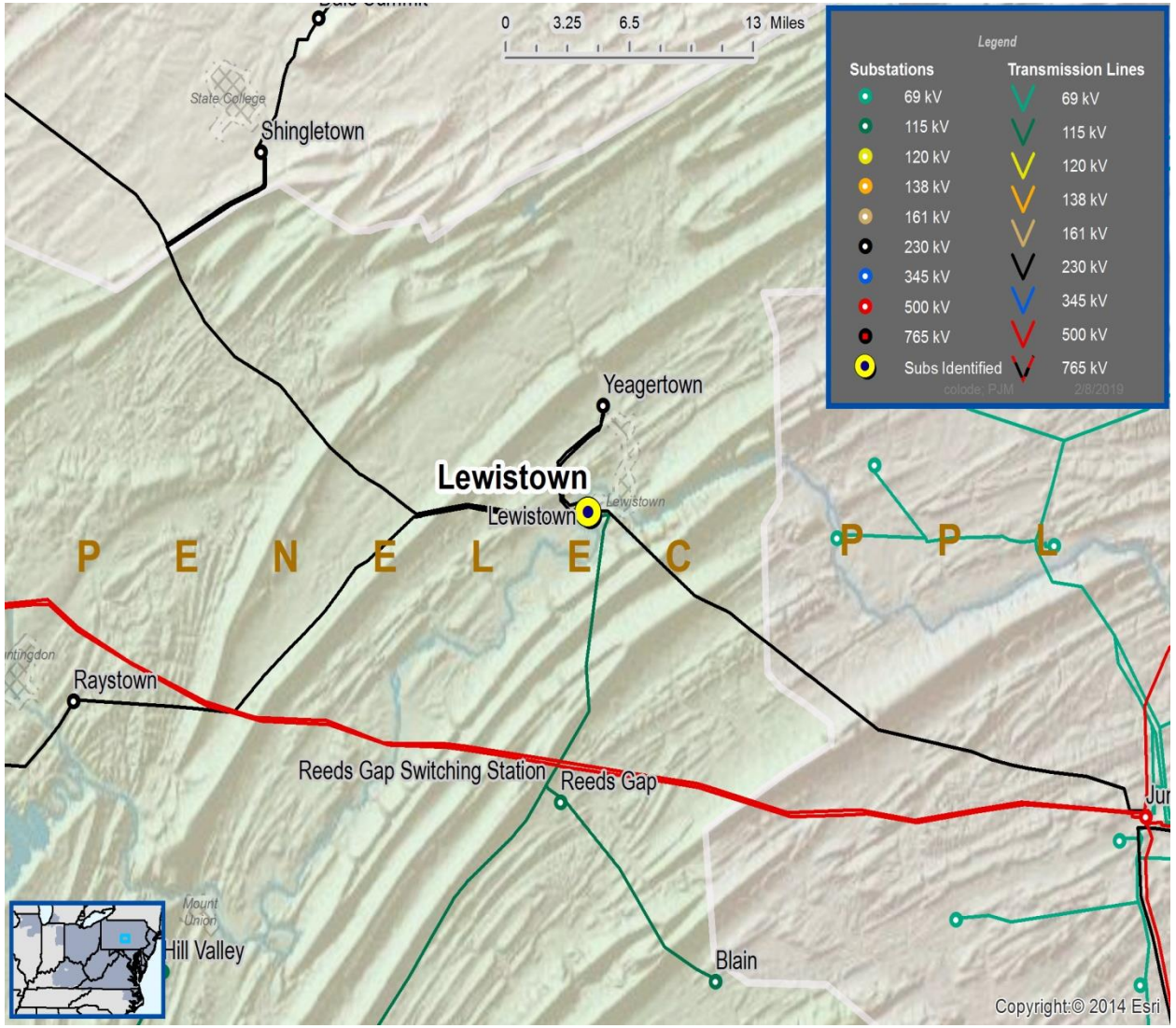
- Transformer has an increased failure probability due to high levels of combustible and ethylene gases and decrease in dielectric strength.
- Transformer is 66 years old.

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)



Penelec Transmission Zone M-3 Process
Lewistown #1 230/115-46 kV Transformer Replacement

Need Number: PN-2019-003

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Replace Lewistown #1 230/115-46 kV Transformer (s1882)

- Replace the #1 230/115-46 kV transformer and with 230-46 kV 60/80/100 MVA transformer (s1882.1)
- Replace relaying and disconnects switches (s1882.1)
- Replace overdutied 46 kV breakers due to transformer replacement (s1882.2)
  (FMC Viscose (2FQ), Lewistown First Quality (1FQ), and #1 Transformer breakers)

Transformer Rating:

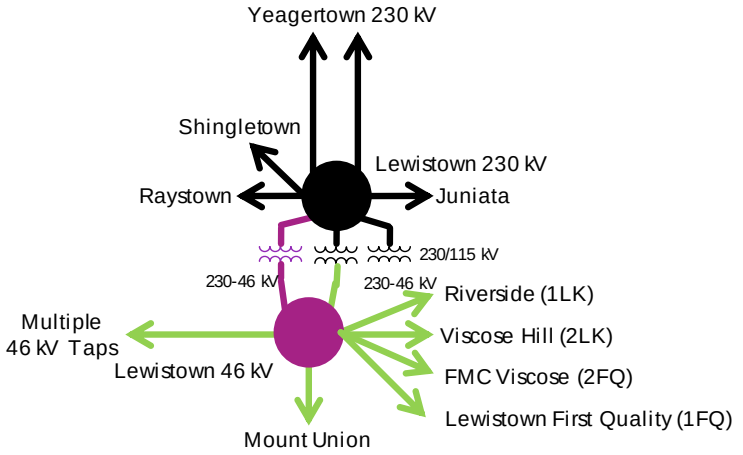
- Lewistown #1 230-46 kV Transformer
  - Before Proposed Solution: 55/67 MVA (SN/SE)
  - After Proposed Solution (anticipated): 120/129 MVA (SN/SE)

Estimated Cost: $3.4M

Projected In-Service: 6/1/2021

Supplemental Project ID: s1882, s1882.1, s1882.2

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Penelec Transmission Zone M-3 Process
Westfall #3 and #4 115/46 kV Transformer Replacements

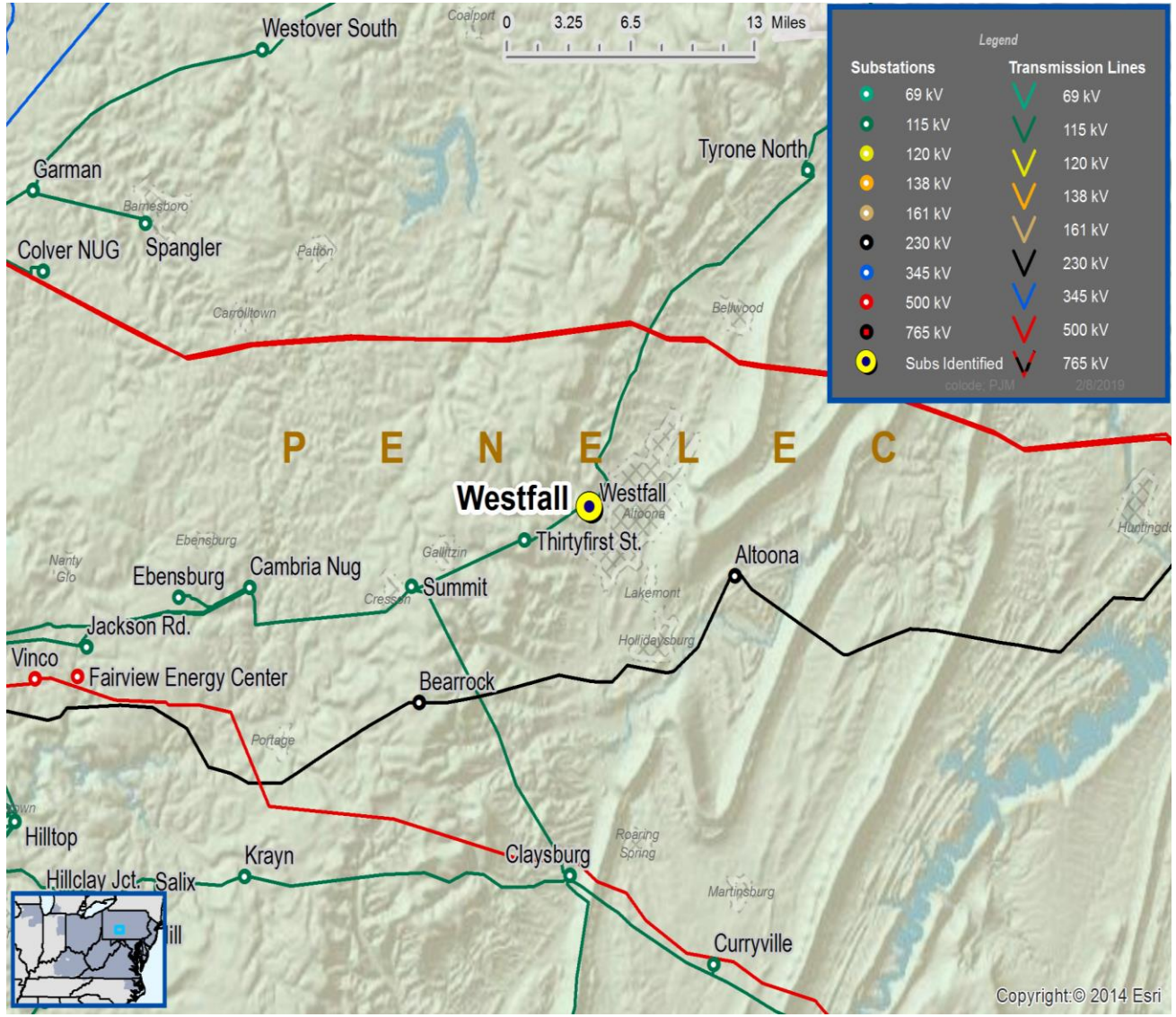
Need Number: PN-2019-004
Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019
Previously Presented:
Need Meeting 02/22/2019
Solution Meeting 03/25/2019
Project Driver:
Equipment Material Condition, Performance and Risk
Specific Assumption Reference:
Substation 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.

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.

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



Penelec Transmission Zone M-3 Process
Westfall #3 and #4 115/46 kV Transformer Replacements

Need Number: PN-2019-004

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Westfall #3 and #4 115/46 kV Transformer Replacements (s1883)

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

Transformer Rating:

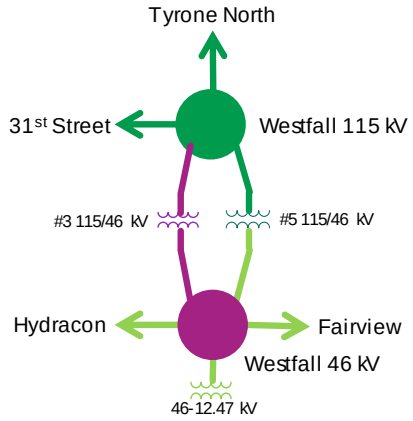
- Westfall #3 115/46 kV Transformer
  - Before Proposed Solution: 38/41 MVA (SN/SE)
  - After Proposed Solution (anticipated): 97/97 MVA (SN/SE)
- Westfall #4 115/46 kV Transformer
  - Before Proposed Solution: 31/34 MVA (SN/SE)
  - After Proposed Solution: N/A – Removed from service

Estimated Cost: $3.9M

Projected In-Service: 12/31/2021

Supplemental Project ID: s1883

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Penelec Transmission Zone M-3 Process
Loretto – Sankertown Bypass – Summit 46 kV Line Rebuild

Need Number: PN-2019-005

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 02/22/2019

Solution Meeting 03/25/2019

Project Driver:

Equipment Material Condition, Performance and Risk

Specific Assumption Reference:

Line Condition Rebuild/Replacement

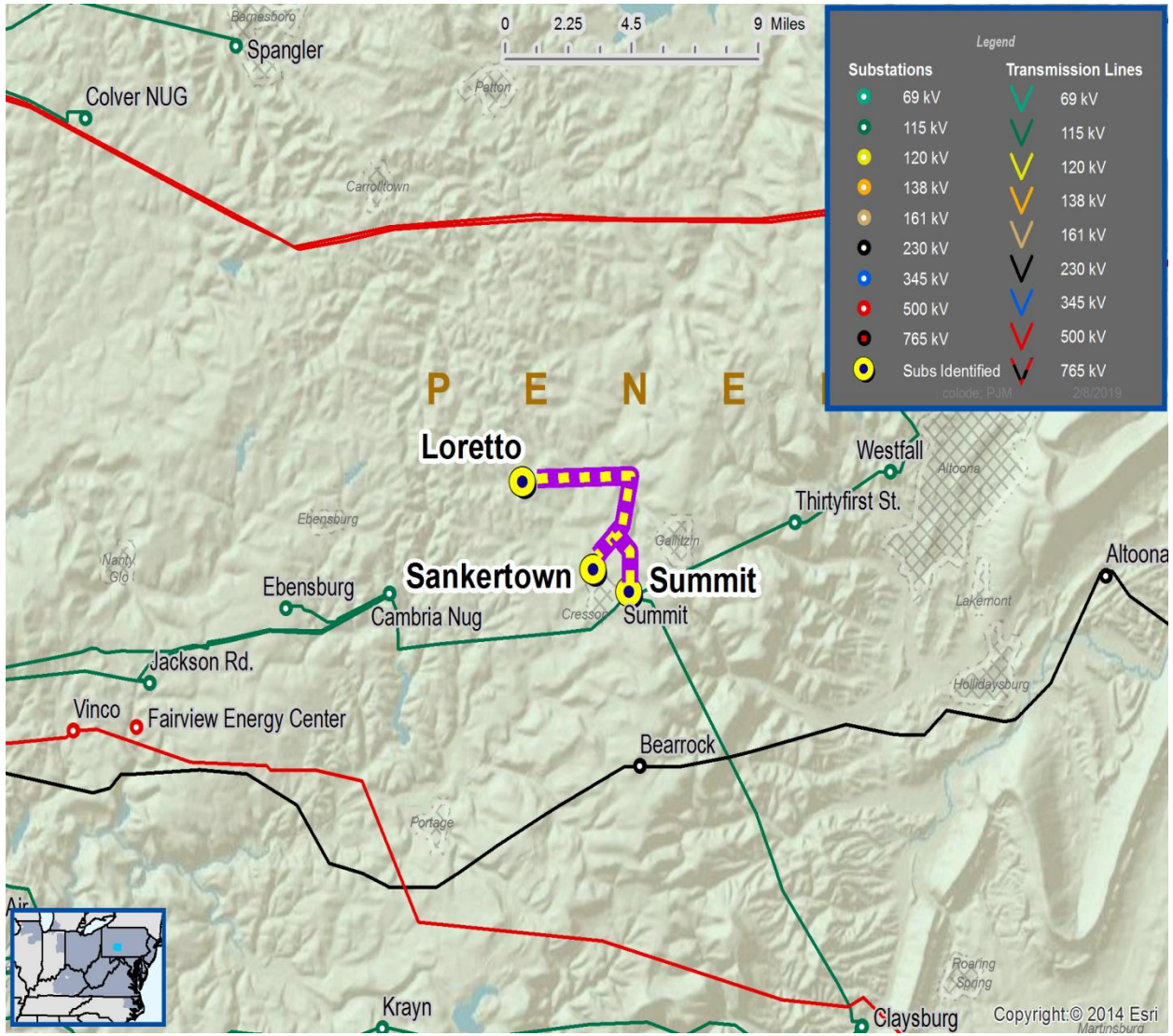
- Age/condition of wood pole transmission line structures

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).



Penelec Transmission Zone M-3 Process
Loretto – Sankertown Bypass – Summit 46 kV Line Rebuild

Need Number: PN-2019-005

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Loretto – Sankertown Bypass – Summit 46 kV Line Rebuild (s1884)

- 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)

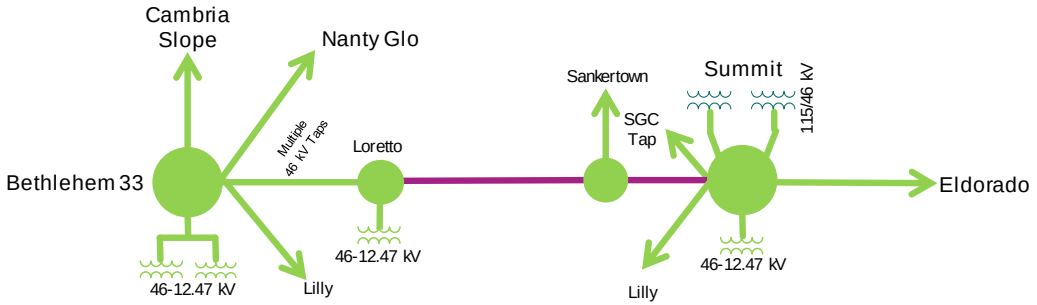
- Sankertown Bypass – Summit 46 kV Line
  - Before Proposed Solution: 32/32 MVA (SN/SE)
  - After Proposed Solution: 54/65 MVA (SN/SE)

Estimated Cost: $6.6M

Projected In-Service: 12/31/2020

Supplemental Project ID: s1884

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Penelec Transmission Zone M-3 Process
East Pike – Glory 115 kV Line: Upgrade Terminal Equipment

Need Number: PN-2019-006
Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019
Previously Presented:
Need Meeting 02/22/2019
Solution Meeting 03/25/2019
Project Driver:
Equipment Material Condition, Performance and Risk
Specific Assumption Reference:
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

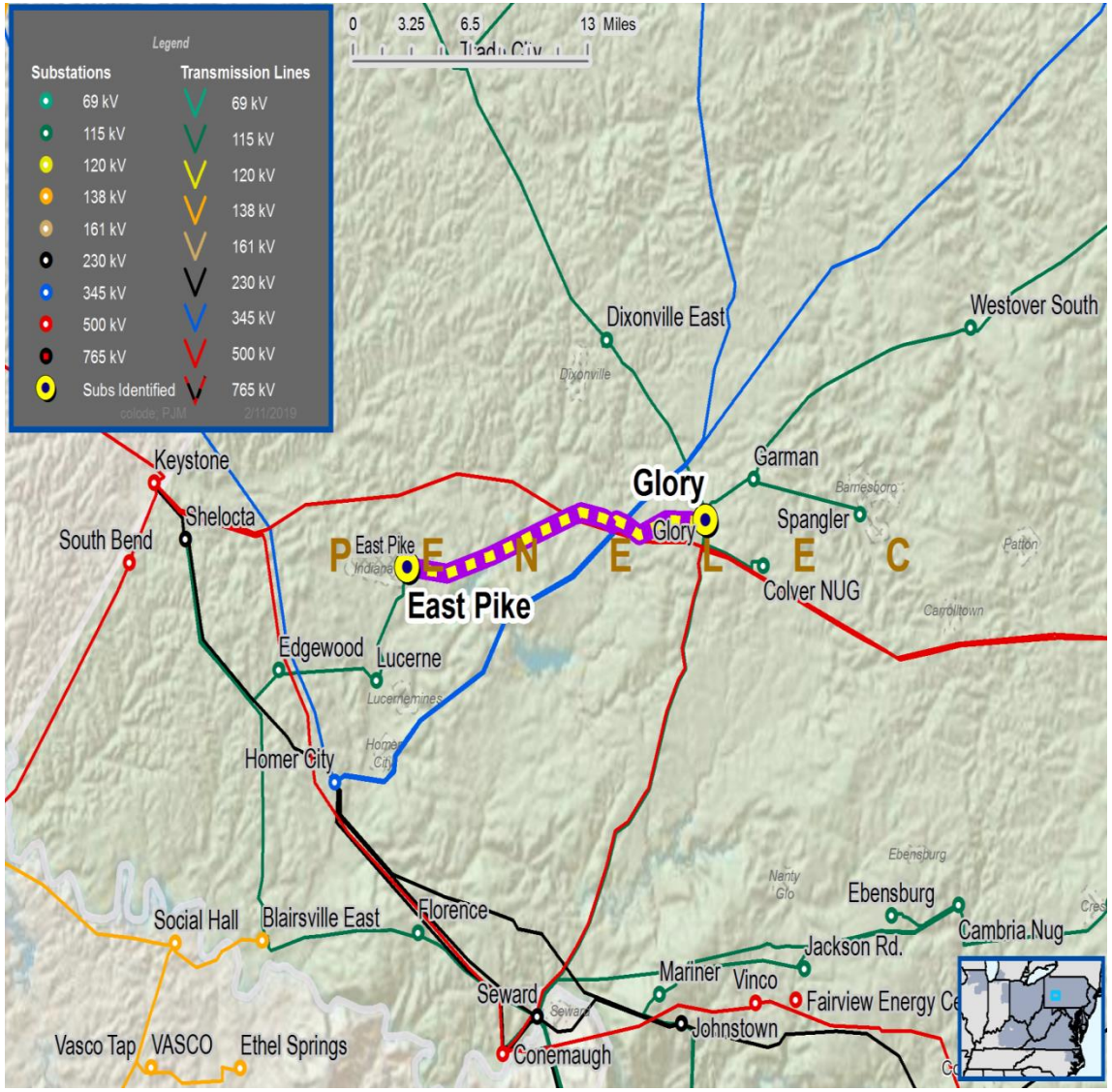
System Performance Projects Global Factors

- 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)



Penelec Transmission Zone M-3 Process
East Pike – Glory 115 kV Line: Upgrade Terminal Equipment

Need Number: PN-2019-006

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

East Pike – Glory 115 kV Line: Upgrade Terminal Equipment (s1935)

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

- Bus section breaker disconnect switches, line trap, and substation conductor (s1935.1)

Glory 115 kV Substation – Equipment to be replaced includes:

- Line side breaker disconnect switch (s1935.2)

Transmission Line Ratings:

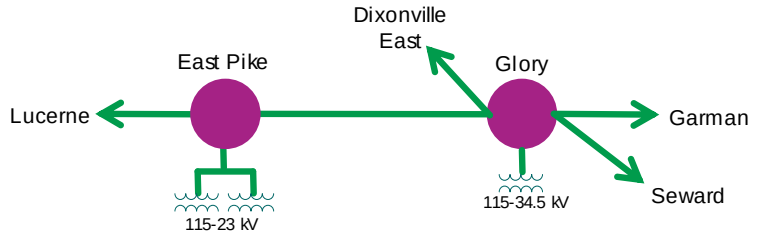
- East Pike – Glory 115 kV Line
  - Before Proposed Solution: 163/185 MVA (SN/SE)
  - After Proposed Solution: 202/245 MVA (SN/SE)

Estimated Cost: $0.5M

Projected In-Service: 6/1/2021

Supplemental Project ID: s1935, s1935.1, s1935.2

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Penelec Transmission Zone M-3 Process

Need Number: PN-2019-007 to 012

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 02/22/2019

Solution Meeting 03/25/2019

Project Driver:

Equipment Material Condition, Performance and Risk

Operational Flexibility and Efficiency

Specific Assumption Reference:

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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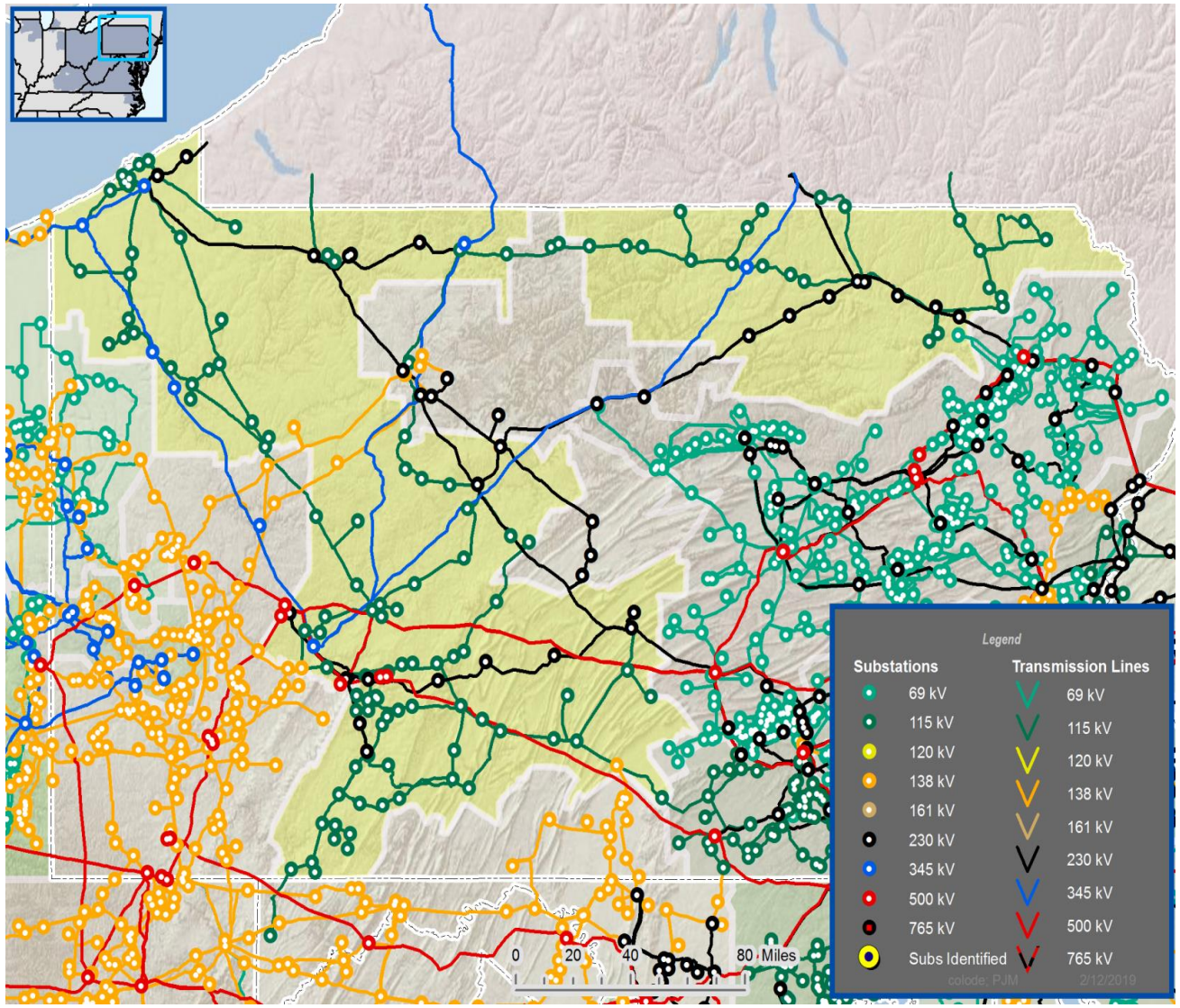


Penelec Transmission Zone M-3 Process
Multiple Misoperation Relay Projects

Need Number: PN-2019-007 to 012

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

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.
- [1]Line 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 M-3 Process
Multiple Misoperation Relay Projects

Need Number: PN-2019-007 to 012

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solutions:

PN-2019-	Transmission Line / Substation Locations	Supplemental Project ID	New MVA Line Rating (SN / SE)	Scope of Work	Estimated Costs ($ M)	Target ISD
007	Lenox – North Meshoppen 115 kV Line	s1885	167 / 202	• Lenox 115 kV Substation: Replace line relaying, line trap, substation conductor and line drops, and circuit breaker (s1885)	$0.6M	12/31/2020
008	Ridgway – Whetstone 115 kV Line	s1886, s1886.1, s1886.2	202 / 245	• Ridgway 115 kV Substation: Replace line relaying and circuit breaker (s1886.1) • Whetstone 115 kV Substation: Replace line relaying (s1886.2)	$1.1M	12/31/2022
009	Union City – Titusville 115 kV Line	s1887, s1887.1, s1887.2	202 / 245	• Union City 115 kV Substation: Replace line relaying and line trap (s1887.1) • Titusville 115 kV Substation: Replace line relaying and line trap (s1887.2) (Note - Limiting substation conductor will be replaced as part of PN-2019-013.)	$0.8M	3/1/2020
010	Grandview – Titusville 115 kV Line	s1888, s1888.1, s1888.2	202 / 245	• Grandview 115 kV Substation: Replace line relaying and line trap (s1888.1) • Titusville 115 kV Substation: Replace line relaying, breaker, and line trap (s1888.2) (Note - Limiting substation conductor will be replaced as part of PN-2019-013.)	$1.1M	10/31/2020
011	Cooper – Seward 115 kV Line	s1889, s1889.1, s1889.2	273 / 333	• Cooper 115 kV Substation: Replace line relaying, circuit breaker, and substation conductor (s1889.1) • Seward 115 kV Substation: Replace line relaying, circuit breaker, substation conductor, and line trap (s1889.2)	$1.7M	12/31/2019
012	Erie South – Union City 115 kV Line	s1890, s1890.1, s1890.2	232 / 282	• Erie South 115 kV Substation: Replace line relaying and line trap (s1890.1) • Union City 115 kV Substation: Replace line relaying, line trap, and substation conductor (s1890.2)	$1.3M	3/31/2022

Model: 2018 Series 2023 Summer RTEP 50/50

Penelec Transmission Zone M-3 Process
Construct Titusville 115 kV Ring Bus

Need Number: PN-2019-013

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 02/22/2019

Solution Meeting 03/25/2019

Project Driver:

Operational Flexibility and Efficiency

Specific Assumption Reference:

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

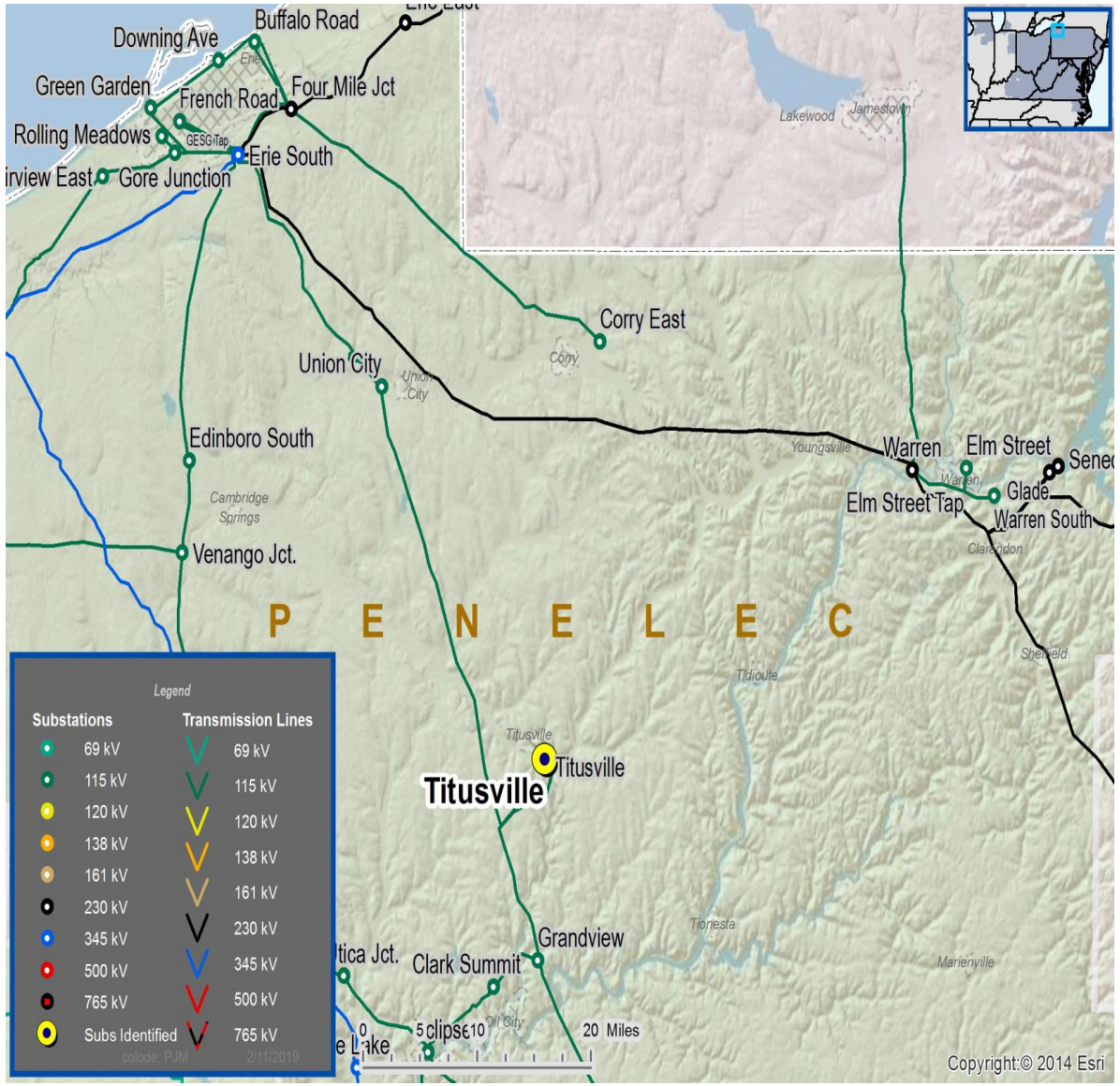
Problem Statement:

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.

PJM has issued a PCLLRW to potentially drop 8 MW of load in the Titusville/Union City area to mitigate thermal overloads on the Titusville – Union City 115 kV line for the outage of Erie West – Erie South 345 kV line and Glade – Warren 230 kV line on July 24, 2018 and August 9, 2018.

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)



Penelec Transmission Zone M-3 Process
Construct Titusville 115 kV Ring Bus

Need Number: PN-2019-013

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Construct Titusville 115 kV Ring Bus (s1891)

Titusville 115 kV Substation:*

- Construct a four breaker ring bus (s1891.1)

Union City 115 kV Substation:*

- Replace substation conductor (s1891.2)

Grandview 115 kV Substation:*

- Replace substation conductor (s1891.3)

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)

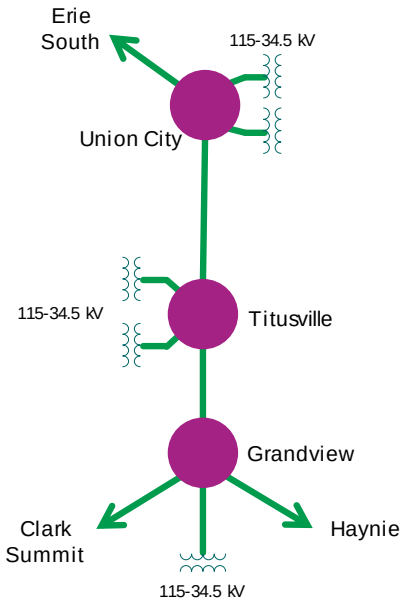
Estimated Cost: $9.3M

Projected In-Service: 12/1/2022

Supplemental Project ID: s1891, s1891.1, s1891.2, s1891.3

Model: 2018 Series 2023 Summer RTEP 50/50

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



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Penelec Transmission Zone M-3 Process
Rosebud Mining – Twin Rock 46 kV Line Rebuild

Need Number: PN-2019-014

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 04/26/2019

Solution Meeting 05/31/2019

Project Driver:

Operational Flexibility and Efficiency

Specific Assumption Reference:

Reconductor/Rebuild Transmission Lines

- Transmission lines that frequently require operational switching

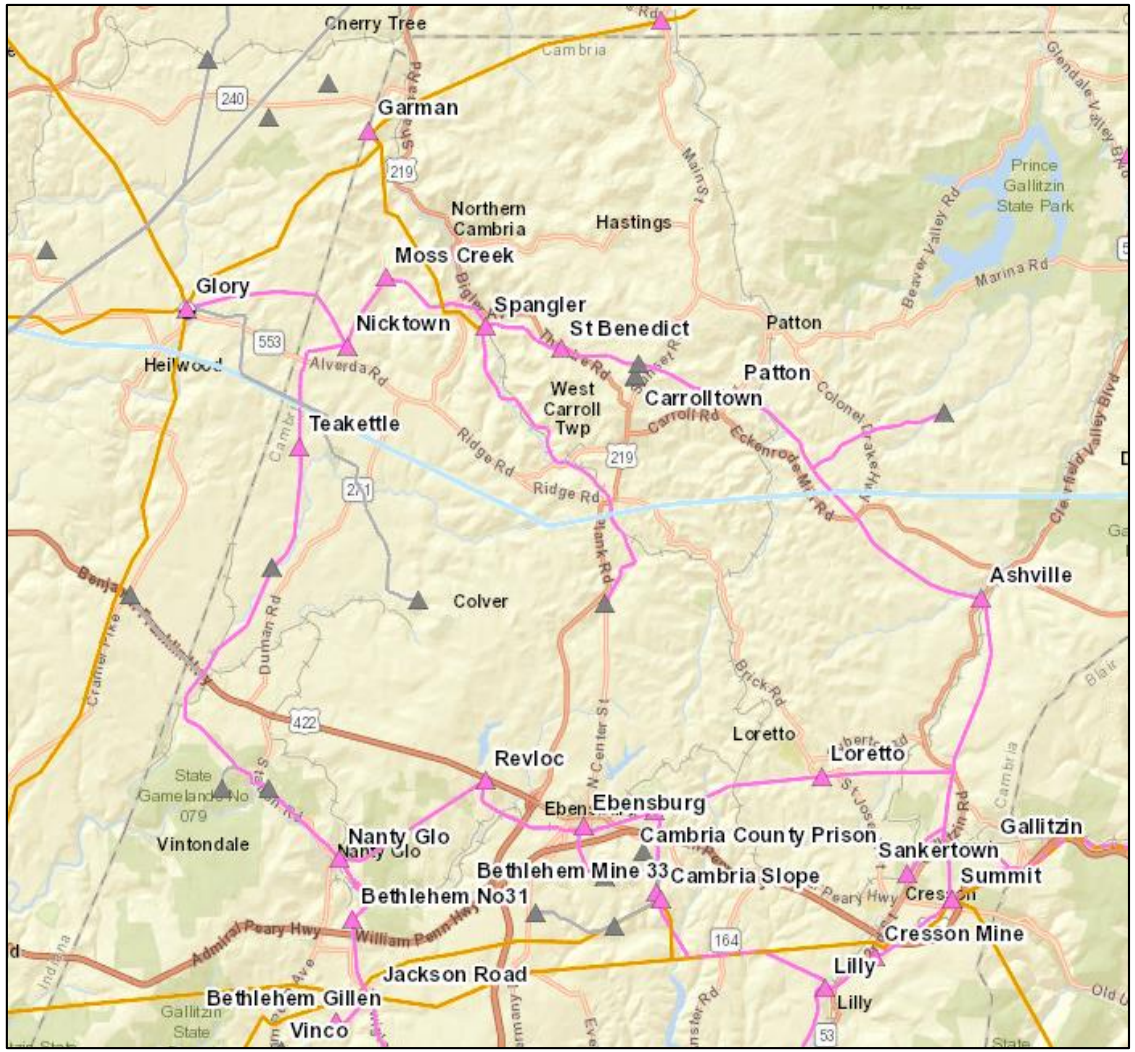
System Performance Projects

- Substation/line equipment limits

Problem Statement:

Loss of the Garman – Spangler 115 kV (PN-P1-2-PN-115-048) and Ashville – Summit 46 kV line (PN-P1-2-PN-46-014) overloads the Rosebud Mining – Twin Rock 46 kV to 138% of its 32 MVA SE rating. *(2018 RTEP Model – 2023 Summer)*

Operations has performed pre-contingency switching to mitigate overloads on this line during peak summer conditions. Line loading is worsened when Shawville generation is offline or reduced. The overloaded line places approximately 15 MW and 1,600 customers at risk.



Penelec Transmission Zone M-3 Process
Rosebud Mining – Twin Rock 46 kV Line Rebuild

Need Number: PN-2019-014

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Rosebud Mining – Twin Rock 46 kV Line Rebuild (s1918)

- Replace the existing conductor on the approximately 1 mile section of 46 kV line (s1918.1)
- Replace disconnect switches at Twin Rock to exceed loadability of new conductor (s1918.2)

Transmission Line Rating:

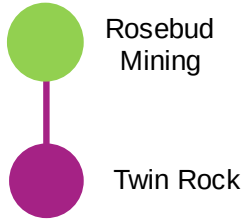
- Rosebud Mining – Twin Rock 46 kV Line:
  - Before Proposed Solution: 32/32 MVA (SN/SE)
  - After Proposed Solution: 67/81 MVA (SN/SE)

Estimated Cost: $1.8M

Projected In-Service: 6/1/2022

Supplemental Project ID: s1918, s1918.1, s1918.2

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Penelec Transmission Zone M-3 Process
Construct Philipsburg 115 kV Ring Bus

Need Number: PN-2019-015

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 04/26/2019

Solution Meeting 05/31/2019

Project Driver:

Operational Flexibility and Efficiency

Specific Assumption Reference:

System Performance Projects

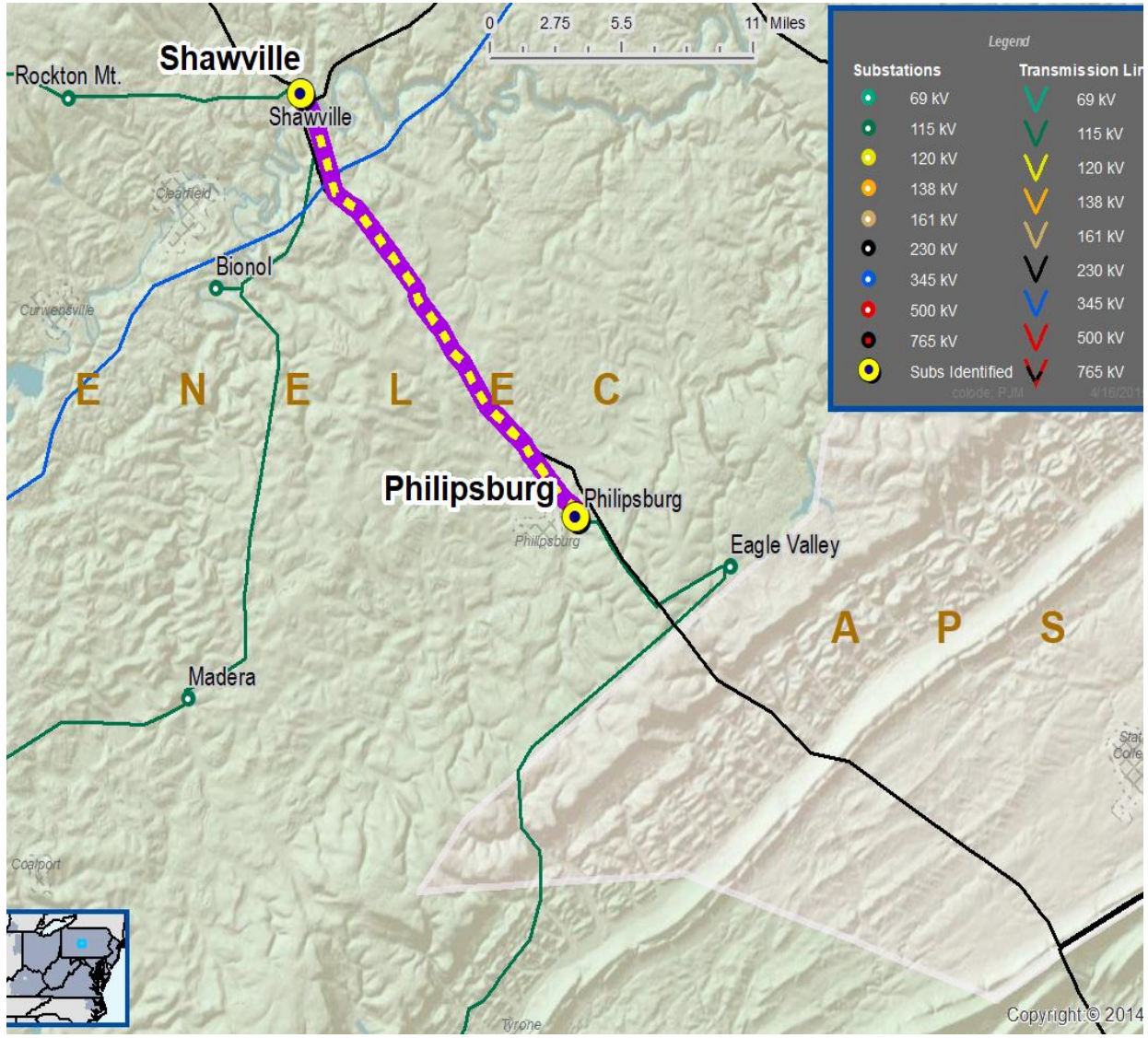
- Substation/line equipment limits
- Load at risk in planning and operational scenarios
- Load and/or customers at risk on single transmission line

Problem Statement:

Philipsburg 115 kV substation serves approximately 42 MW of load and 18,600 customers. A stuck bus tie breaker at Philipsburg will outage both 115-34.5 kV transformers and 115 kV network path. A fault on the Philipsburg – Shawville 115 kV line outages the #2 115-34.5 kV transformer. Over the past five years, the Philipsburg – Shawville 115 kV line has experienced six sustained outages.

Transmission line ratings are limited by terminal equipment.

- Philipsburg – Shawville 115 kV line:
  Existing line rating is 163/185 MVA (SN/SE). Existing conductor rating is 167/202 MVA (SN/SE). *(line trap, circuit breaker)*
- Philipsburg – Eagle Valley 115 kV line:
  Existing line rating is 137/174 MVA (SN/SE). Existing conductor rating is 201/244 MVA (SN/SE). *(CTs, substation conductor / drop, circuit breaker)*



Penelec Transmission Zone M-3 Process
Construct Philipsburg 115 kV Ring Bus

Need Number: PN-2019-015

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Construct Philipsburg 115 kV Ring Bus (s1919)

At Philipsburg:

- Construct a four breaker 115 kV ring bus (s1919.1)
- Replace limiting CTs, substation conductor / drop, line trap, and circuit breakers on Shawville exit (s1919.2)
- Replace limiting CTs, substation conductor / drop, and circuit breakers on Eagle Valley exit (s1919.3)

At Shawville:

- Replace line trap on Philipsburg line exit (s1919.4)
- Adjust line relaying as necessary

At Eagle Valley:

- Adjust line relaying as necessary

Transmission Line Ratings:

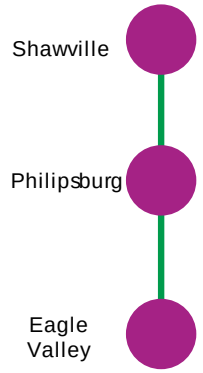
- Philipsburg – Shawville 115 kV Line:
  - Before Proposed Solution: 163/185 MVA (SN/SE)
  - After Proposed Solution: 167/202 MVA (SN/SE)
- Philipsburg – Eagle Valley 115 kV Line:
  - Before Proposed Solution: 137/174 MVA (SN/SE)
  - After Proposed Solution: 201/244 MVA (SN/SE)

Estimated Cost: $4.5M

Projected In-Service: 12/1/2021

Supplemental Project ID: s1919, s1919.1, s1919.2, s1919.3, s1919.4

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Penelec Transmission Zone M-3 Process
Construct Clark Summit 115 kV Ring Bus

Need Number: PN-2019-016

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 04/26/2019

Solution Meeting 05/31/2019

Project Driver:

Operational Flexibility and Efficiency

Specific Assumption Reference:

System Performance Projects

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

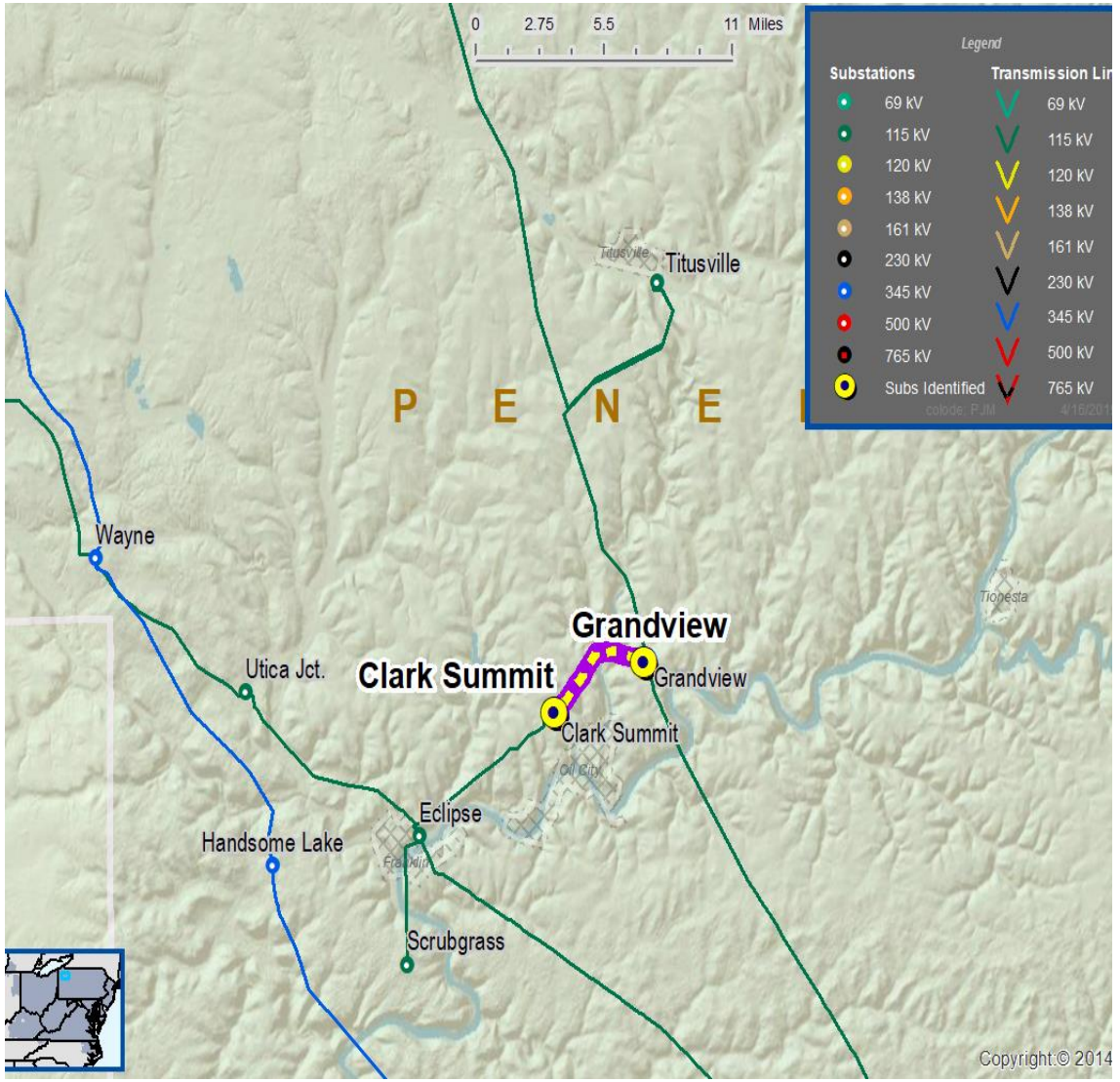
Problem Statement:

Clark Summit 115 kV substation serves approximately 42 MW of load and 11,200 customers. Substation has two transformers and no breakers. A fault on the Eclipse-Clark Summit-Grandview 115 kV line results in loss of line and both distribution transformers.

Transmission line ratings are limited by terminal equipment.

- Clark Summit – Grandview 115 kV line:

  Existing line rating is 147/190 MVA (SN/SE). Existing conductor rating is 202/245 MVA (SN/SE). *(substation conductor)*



Penelec Transmission Zone M-3 Process
Construct Clark Summit 115 kV Ring Bus

Need Number: PN-2019-016

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Construct Clark Summit 115 kV Ring Bus (s1920)

At Clark Summit:

- Construct a new four breaker ring bus (s1920.1)

At Grandview:

- Replace substation conductor (s1920.2)

Transmission Line Rating:

- Clark Summit – Grandview 115 kV Line:
  - Before Proposed Solution: 147/190 MVA (SN/SE)
  - After Proposed Solution: 202/245 MVA (SN/SE)

Estimated Cost: $3.9M

Projected In-Service: 12/1/2021

Supplemental Project ID: s1920, s1920.1, s1920.2

Model: 2018 Series 2023 Summer RTEP 50/50

Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Penelec Transmission Zone M-3 Process
Construct Lilly 46 kV Ring Bus

Need Number: PN-2019-017
Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019
Previously Presented:
Need Meeting 04/26/2019
Solution Meeting 05/31/2019
Project Driver:

Operational Flexibility and Efficiency

Specific Assumption Reference:
Network Radial Lines

- Radial lines defined by normally open points

Reconductor/Rebuild Transmission Lines

- Three or more terminal transmission lines

Add/Expand Bus Configuration

- Eliminate simultaneous outages to multiple network elements

System Performance Projects

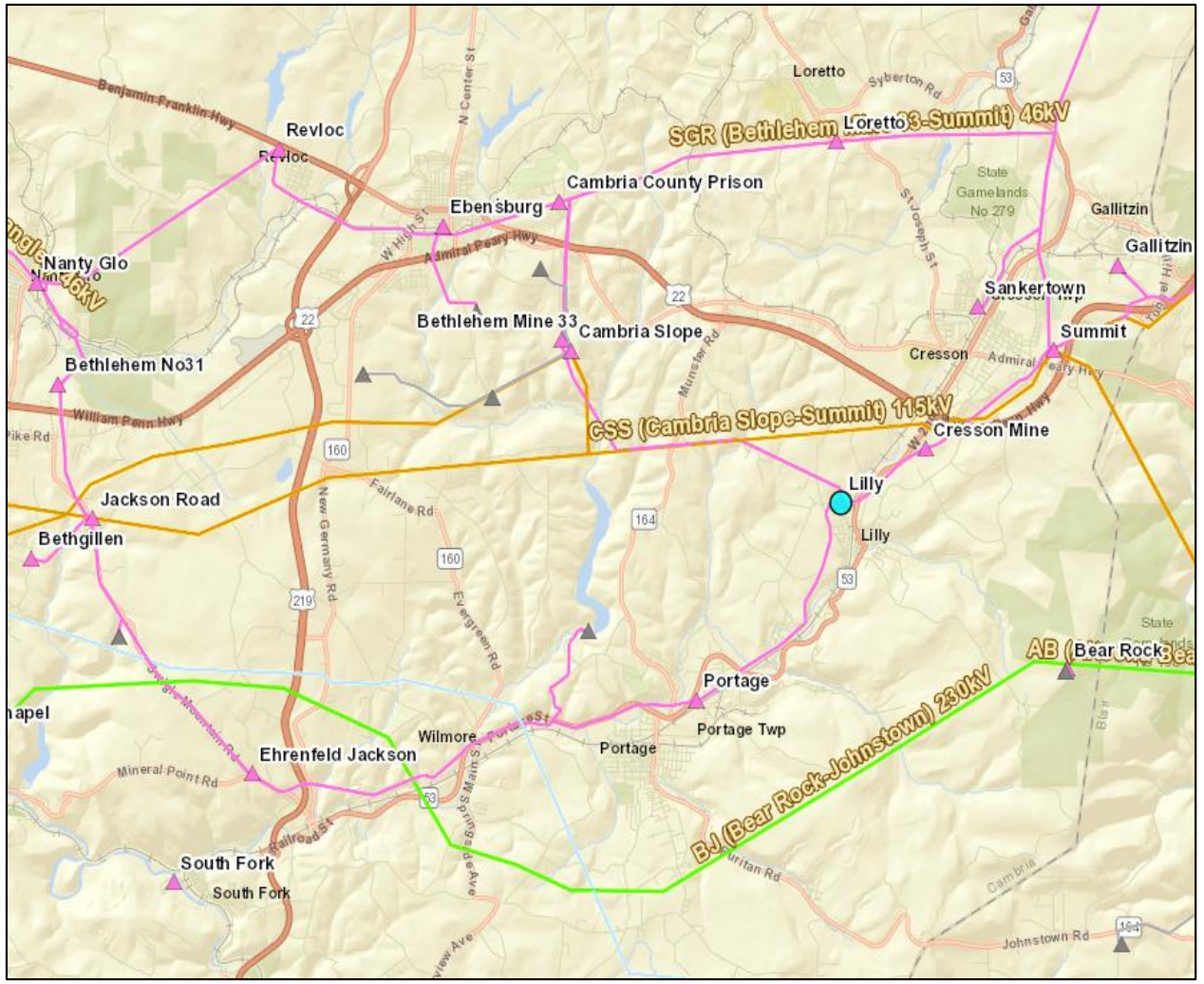
- Substation/line equipment limits

Problem Statement:

A three terminal line exists at Lilly substation (46 kV) with line exits to Summit, Bethlehem 33 and Jackson Road (normally open at Portage). There is approximately 13 MW of load and 3,200 customers served radially from Jackson Road 46 kV substation.

Transmission line ratings are limited by terminal equipment.

- Jackson Road – Ampfire Mining 46 kV line:
  Existing line rating is 24/24 MVA (SN/SE). Existing conductor rating is 67/81 MVA (SN/SE).
  (line relaying, substation conductor, disconnect switches)
- Kokomo Road – Summit 46 kV line:
  Existing line rating is 25/25 MVA (SN/SE). Existing conductor rating is 32/32 MVA (SN/SE).
  (line relaying)
- Bethlehem 33 – Lilly 46 kV line:
  Existing line rating is 25/33 MVA (SN/SE). Existing conductor rating is 53/64 MVA (SN/SE).
  (substation conductor, line relaying)



Penelec Transmission Zone M-3 Process
Construct Lilly 46 kV Ring Bus

Need Number: PN-2019-017

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Construct Lilly 46 kV Ring Bus (s1921)

At Lilly:

- Construct a four breaker 46 kV ring bus (s1921.1)

At Jackson Road:

- Replace line relaying, substation conductor, and disconnect switches on the Jackson Road to Ampfire Mining 46 kV line (s1921.2)

At Summit :

- Replace line relaying on the Kokomo Road – Summit 46 kV Line (s1921.3)

At Bethlehem 33:

- Replace line relaying and substation conductor on the Bethlehem 33 - Lilly 46 kV line (s1921.4)

At Portage:

- Normally open switch to be operated as normally closed on Portage - Lilly 46 kV line (s1921.5)

Transmission Line Ratings:

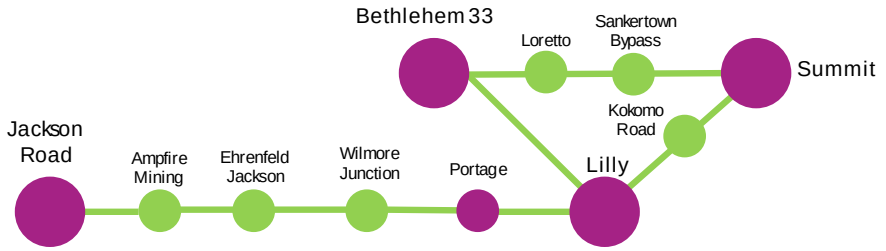
- Jackson Road – Ampfire Mining 46 kV Line:
  - Before Proposed Solution: 24/24 MVA (SN/SE)
  - After Proposed Solution: 67/81 MVA (SN/SE)
- Kokomo Road – Summit 46 kV Line:
  - Before Proposed Solution: 25/25 MVA (SN/SE)
  - After Proposed Solution: 32/32 MVA (SN/SE)
- Bethlehem 33 – Lilly 46 kV Line:
  - Before Proposed Solution: 25/33 MVA (SN/SE)
  - After Proposed Solution: 53/64 MVA (SN/SE)

Estimated Cost: $4.4M

Projected In-Service: 12/1/2021

Supplemental Project ID: s1921, s1921.1, s1921.2, s1921.3, s1921.4, s1921.5

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Penelec Transmission Zone M-3 Process
17th Street Substation

Need Number: PN-2019-018

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 04/26/2019

Solution Meeting 05/31/2019

Project Driver:

Operational Flexibility and Efficiency

Specific Assumption Reference:

System Performance Projects

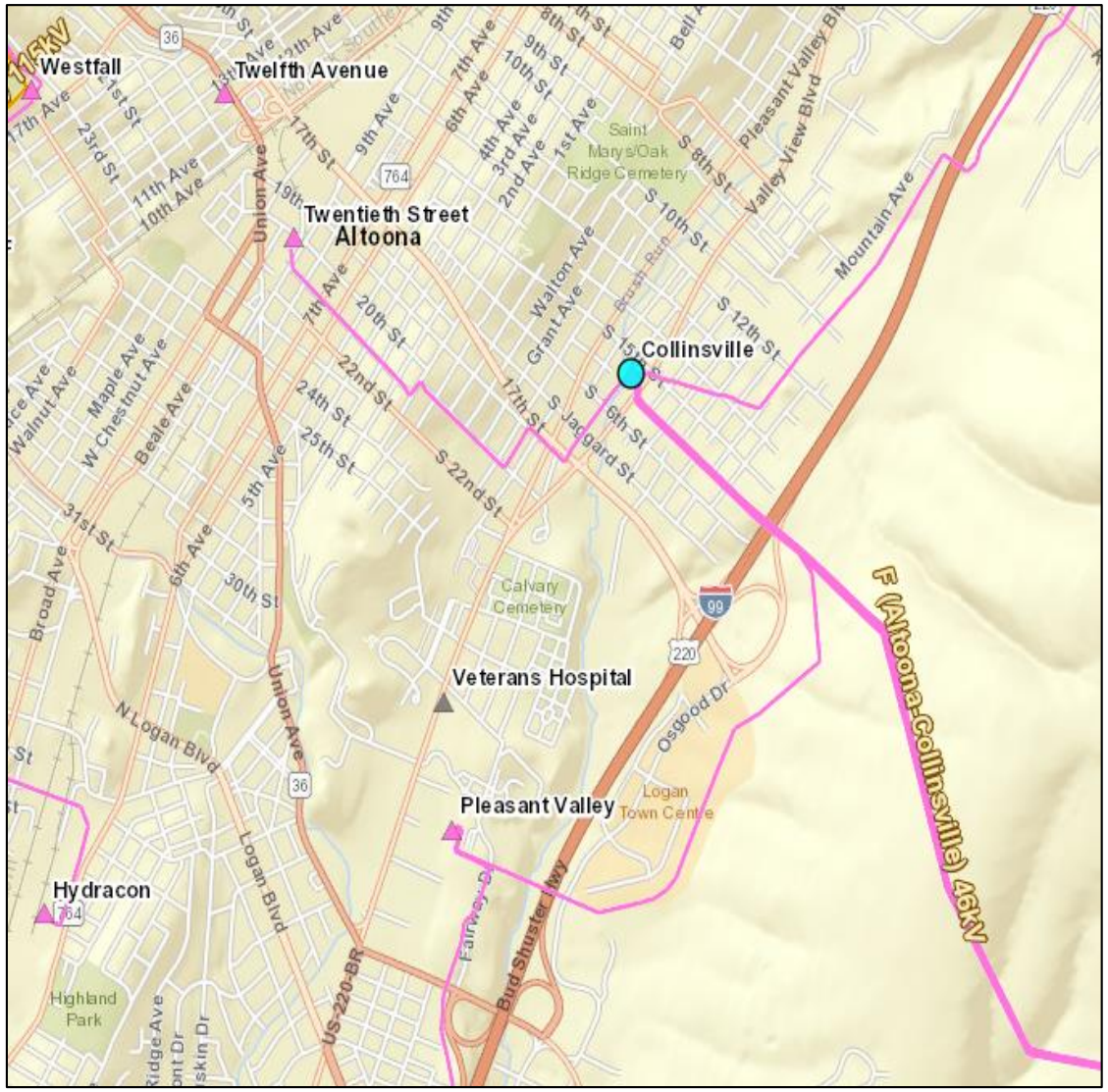
- Reliability of Non-Bulk Electric System (Non-BES) Facilities
- Load and/or customers at risk on single transmission lines

Add/Expand Bus Configuration

- Loss of substation bus adversely affects transmission system performance
- Eliminate simultaneous outages to multiple networked elements

Problem Statement:

Loss of the substation bus at Collinsville substation interrupts ~22 MW of load and 3,290 customers and opens the network connecting sources into the Altoona 46 kV load pocket.



Penelec Transmission Zone M-3 Process
17th Street Substation

Need Number: PN-2019-018

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Build a new 17th Street 46 kV Substation (s1922)

- Construct a new 46 kV breaker-and-a-half substation to replace the existing Collinsville substation (s1922.1)
- Install a new terminal for 20th Street 46 kV (s1922.2)
- Install a new terminal for Greenwood 46 kV (s1922.3)
- Install a new terminal for Pleasant Valley 46 kV (s1922.4)
- Install a new terminal for Altoona F 46 kV (s1922.5)
- Install a new terminal for Altoona AG 46 kV (s1922.6)
- Install a new terminal for Altoona G 46 kV (s1922.7)
- Install a new terminal for #1 46-12.47 kV transformer (s1922.8)
- Install a new terminal for #2 46-12.47 kV transformer (s1922.9)
- Install a new terminal for 46 kV capacitor (s1922.10)

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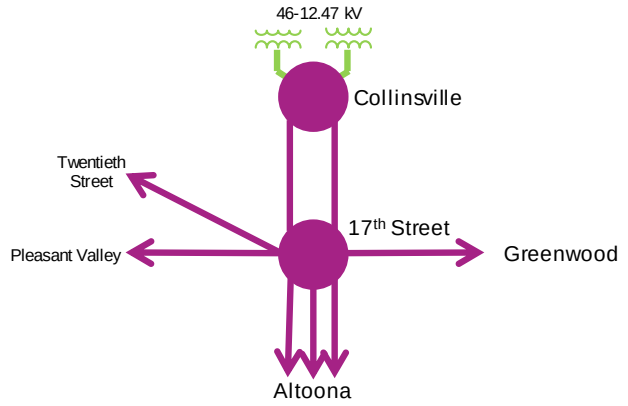


Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Penelec Transmission Zone M-3 Process
17th Street Substation

Need Number: PN-2019-018

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Transmission Line Rating:

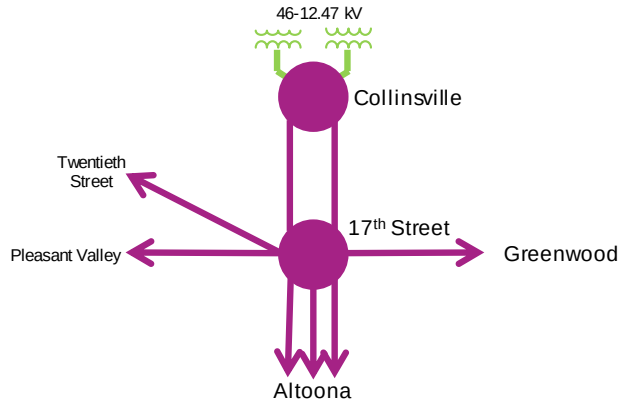
- 17th Street – 20th Street 46 kV Line (s1780.4 and s1780.5):
  - Before Proposed Solution (Collinsville – 20th Street 46 kV Line): 91/111 MVA (SN/SE)
  - After Proposed Solution: 91/111 MVA (SN/SE)
- 17th Street – Greenwood 46 kV Line:
  - Before Proposed Solution (Collinsville – Greenwood 46 kV Line): 38/49 MVA (SN/SE)
  - After Proposed Solution: 67/81 MVA (SN/SE)
- 17th Street – Pleasant Valley 46 kV Line:
  - Before Proposed Solution (Collinsville – Pleasant Valley 46 kV Line): 38/49 MVA (SN/SE)
  - After Proposed Solution: 81/98 MVA (SN/SE)
- 17th Street – Altoona F 46 kV Line:
  - Before Proposed Solution (Collinsville – Altoona F 46 kV Line): 49/50 MVA (SN/SE)
  - After Proposed Solution: 49/50 MVA (SN/SE)
- 17th Street – Altoona AG 46 kV Line:
  - Before Proposed Solution (Collinsville – Altoona AG 46 kV Line): 38/49 MVA (SN/SE)
  - After Proposed Solution: 81/98 MVA (SN/SE)
- 17th Street – Altoona G 46 kV Line:
  - Before Proposed Solution (Collinsville – Altoona G 46 kV Line): 49/50 MVA (SN/SE)
  - After Proposed Solution: 49/50 MVA (SN/SE)

Estimated Cost: $9.0M

Projected In-Service: 6/1/2022

Supplemental Project ID: s1922, s1922.1, s1922.2, s1922.3, s1922.4, s1922.5, s1922.6, s1922.7, s1922.8, s1922.9, s1922.10

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Penelec Transmission Zone M-3 Process
Warrior Ridge 46 kV Expansion

Need Number: PN-2019-019

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 04/26/2019

Solution Meeting 05/31/2019

Project Driver:

Operational Flexibility and Efficiency

Specific Assumption Reference:

System Performance Projects

- Substation/line equipment limits

Equipment/Technology/Design Upgrades

- Line switch limitations

Network Radial Lines

- Radial lines defined by normally open points

Reconductor/Rebuild Transmission Lines

- Transmission line that cannot be utilized for operational switching
- Three or more terminal transmission lines

Add/Expand Bus Configuration

- Eliminate simultaneous outages to multiple networked elements

Build New Transmission Line

- Three or more terminal lines
- Network radial lines

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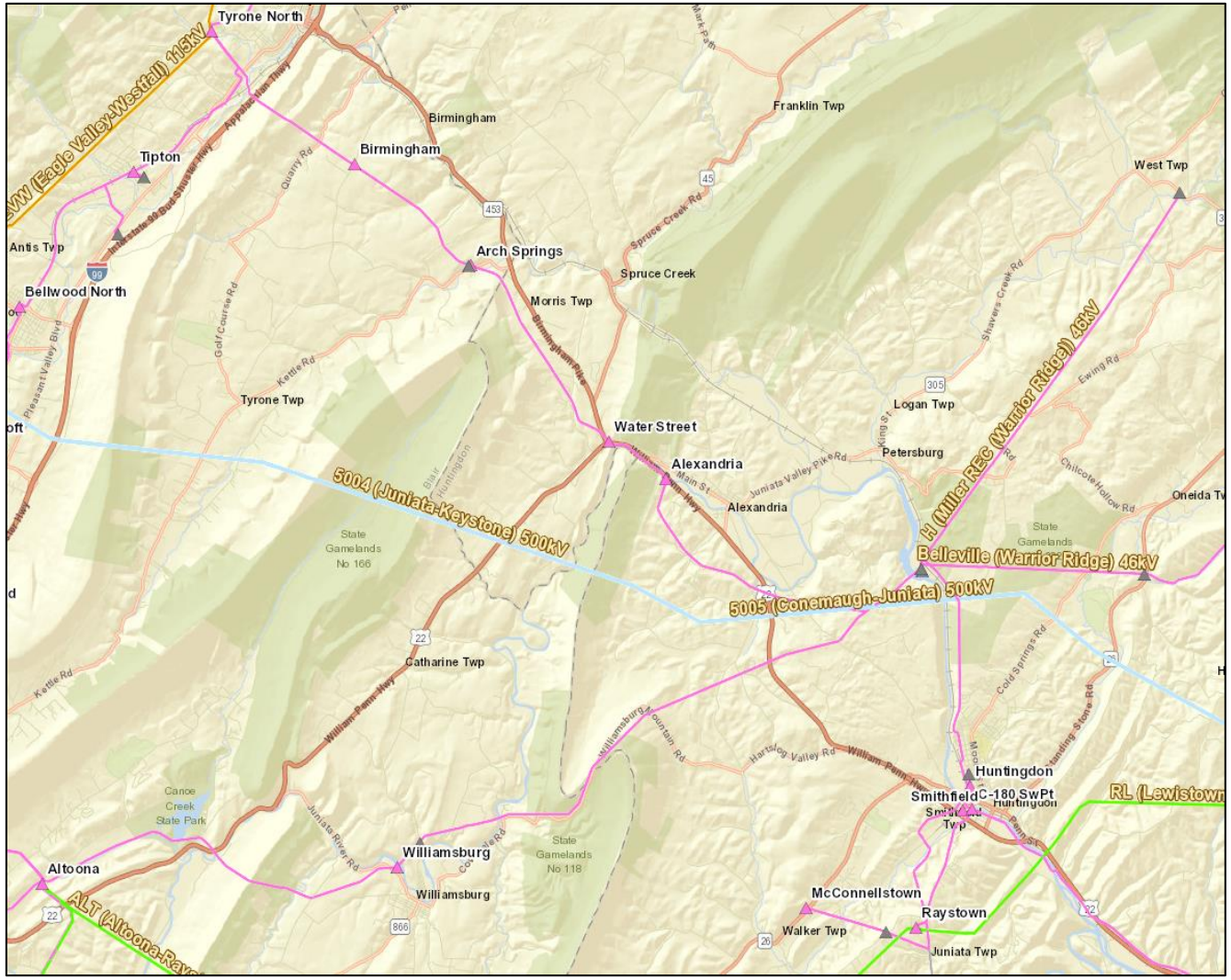


Need Number: PN-2019-019

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 04/26/2019

Solution Meeting 05/31/2019

Problem Statement:

- Warrior Ridge Substation is currently configured as a straight bus. Loss of the bus interrupts ~25 MWs of load with limited transfer capability.
- Normally open points exist at Williamsburg, ABW tap, and MacLane (D-Tap) that are established to prevent network flows from Lewistown, Tyrone North, and Altoona.
- The system is unable to be networked due to thermal limits of line conductor, terminal equipment, and antiquated directional relaying.
- ABW tap is an established three terminal line between Altoona 46 kV, Warrior Ridge 46 kV, and Tyrone North 46 kV substations.
- Line switch interrupters are not capable of operational switching such as loop splitting and/or interrupting line charging current.

Transmission line ratings are limited by terminal equipment.

- Tyrone North – Birmingham 46 kV line: Existing line rating is 33/33 MVA (SN/SE). Existing conductor rating is 53/64 MVA (SN/SE). *(line relaying, substation conductor)*
- Birmingham – Sinking Valley 46 kV line: Existing line rating is 34/44 MVA (SN/SE). Existing conductor rating is 53/64 MVA (SN/SE). *(substation conductor)*
- Alexandria – ABW Tap – Warrior Ridge 46 kV line: Exiting line rating is 55/69 MVA (SN/SE). Existing conductor rating is 59/71 MVA (SN/SE). *(disconnect switches)*
- Williamsburg - ABW Tap – Warrior Ridge 46 kV line: Existing line rating is 25/25 MVA (SN/SE). Existing conductor rating is 49/50 MVA (SN/SE). *(line relaying, substation conductor)*
- Williamsburg REC – Williamsburg 46 kV line: Existing line rating is 25/25 MVA (SN/SE). Existing conductor rating is 49/50 MVA (SN/SE). *(line relaying, substation conductor)*
- Williamsburg – Altoona 46 kV line: Existing line rating is 26/28 MVA (SN/SE). Existing conductor rating is 53/64 MVA (SN/SE). *(substation conductor, line relaying)*
- Warrior Ridge – Center Union 46 kV line: Existing line rating is 17/17 MVA (SN/SE). Existing conductor rating is 59/71 MVA (SN/SE). *(line relaying, substation conductor, disconnect switches)*
- Warrior Ridge – WRH Tap– OC1 Tap – Huntingdon 46 kV: Existing line rating is 22/22 MVA (SN/SE). Existing conductor rating is 93/113 MVA (SN/SE). *(line relaying, disconnect switches, substation conductor)*

Penelec Transmission Zone M-3 Process
Warrior Ridge 46 kV Expansion

Need Number: PN-2019-019

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Warrior Ridge 46 kV Project (s1923)

At Warrior Ridge:

- Construct a 46 kV breaker-and-a-half substation (s1923.1)

At Center Union:

- Replace disconnect switch on Warrior Ridge line exit with motor operated disconnect switch with whip (s1923.2)

At Belleville:

- Replace disconnect switch on Center Union line exit with motor operated disconnect switch with vacuum bottles (s1923.3)

At New Holland:

- Replace disconnect switch on Belleville line exit with motor operated disconnect switch with vacuum bottles (s1923.4)

At Huntingdon:

- Replace line relaying, substation conductor, disconnect switches on the Huntingdon -Warrior Ridge 46 kV line (s1923.5)

At Altoona:

- Replace line relaying, disconnect switches on the Altoona - Williamsburg 46 kV line (s1923.6)

Altoona – Williamsburg 46 kV line:

- Rebuild ~0.9 miles of the existing Altoona – Williamsburg 46 kV line (s1923.7)

At Williamsburg:

- Replace line relaying, disconnect switches, and substation conductor on the Altoona - Williamsburg 46 kV line (s1923.8)

At Williamsburg REC:

- Replace disconnect switches with motor operated disconnect switches with whips on the Williamsburg – Williamsburg REC 46 kV line (s1923.9)

Williamsburg – Williamsburg REC 46 kV line:

- Rebuild ~0.5 miles of Williamsburg – Williamsburg REC 46 kV line (s1923.10)

Williamsburg REC – Warrior Ridge 46 kV:

- Eliminate ABW Tap, via a line loop (s1923.11)
- Rebuild ~7.5 miles of Williamsburg REC – Warrior Ridge 46 kV line (s1923.11)

Alexandria – Warrior Ridge 46 kV line:

- Rebuild the line from ABW tap (s1923.12)

At Alexandria:

- Replace disconnect switch on the Warrior Ridge line exit with motor operated disconnect switch with whip (s1923.13)

At Water Street Tap:

- Replace disconnect switches with motor operated disconnect switches with vacuum bottles on Water Street - Pemberton and Water Street - Alexandria 46 kV lines (s1923.14)

At Pemberton:

- Replace disconnect switch on the Sinking Valley REC line exit with a motor operated disconnect switch with vacuum bottles (s1923.15)

At Birmingham:

- Replace substation conductor on Birmingham - Sinking Valley REC and Tyrone North - Birmingham 46 kV line (s1923.16)

At Tyrone North:

- Replace line relaying and substation conductor on Birmingham - Tyrone North 46 kV line (s1923.17)

Continued on next slide…

Penelec Transmission Zone M-3 Process
Warrior Ridge 46 kV Expansion

Need Number: PN-2019-019

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Transmission Line Ratings:

Tyrone North – Birmingham 46 kV Line:
- Before Proposed Solution: 33/33 MVA (SN/SE)
- After Proposed Solution: 53/64 MVA (SN/SE)

Birmingham – Sinking Valley 46 kV Line:
- Before Proposed Solution: 34/44 MVA (SN/SE)
- After Proposed Solution: 53/64 MVA (SN/SE)

Alexandria – Warrior Ridge 46 kV Line:
- Before Proposed Solution: N/A
- After Proposed Solution: 81/98 MVA (SN/SE)

Warrior Ridge – Williamsburg REC 46 kV Line:
- Before Proposed Solution: N/A
- After Proposed Solution: 81/98 MVA (SN/SE)

Williamsburg REC – Williamsburg 46 kV Line:
- Before Proposed Solution: 25/25 MVA (SN/SE)
- After Proposed Solution: 81/98 MVA (SN/SE)

Williamsburg – Altoona 46 kV Line:
- Before Proposed Solution: 26/28 MVA (SN/SE)
- After Proposed Solution: 81/98 MVA (SN/SE)

Warrior Ridge – Center Union 46 kV Line:
- Before Proposed Solution: 17/17 MVA (SN/SE)
- After Proposed Solution: 59/71 MVA (SN/SE)

Warrior Ridge – WRH Tap 46 kV Line:
- Before Proposed Solution: 22/22 MVA (SN/SE)
- After Proposed Solution: 93/113 MVA (SN/SE)

OC1 Tap – Huntingdon 46 kV Line:
- Before Proposed Solution: 33/33 MVA (SN/SE)
- After Proposed Solution: 93/113 MVA (SN/SE)

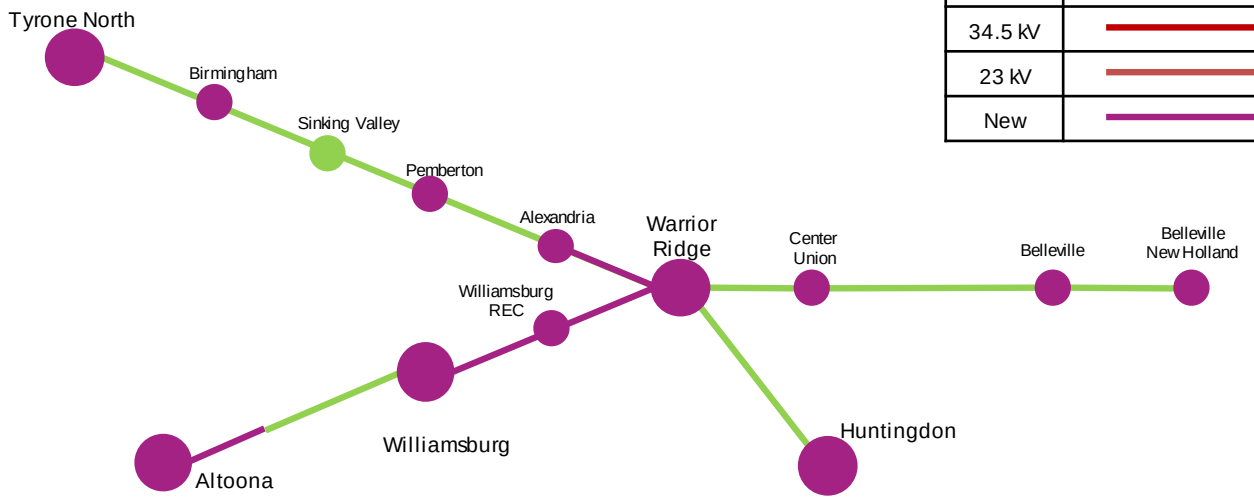
Estimated Cost: $26.4M

Projected In-Service: 12/1/2021

Supplemental Project ID: s1923, s1923.1, s1923.2, s1923.3, s1923.4, s1923.5, s1923.6, s1923.7, s1923.8, s1923.9, s1923.10, s1923.11, s1923.12, s1923.13, s1923.14, s1923.15, s1923.16, s1923.17

Model: 2018 Series 2023 Summer RTEP 50/50

Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	



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

Need Number: PN-2019-021

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 04/26/2019

Solution Meeting 05/31/2019

Project Driver:

Operational Flexibility and Efficiency

Specific Assumption Reference:

System Performance Projects

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

Add/Expand Bus Configuration

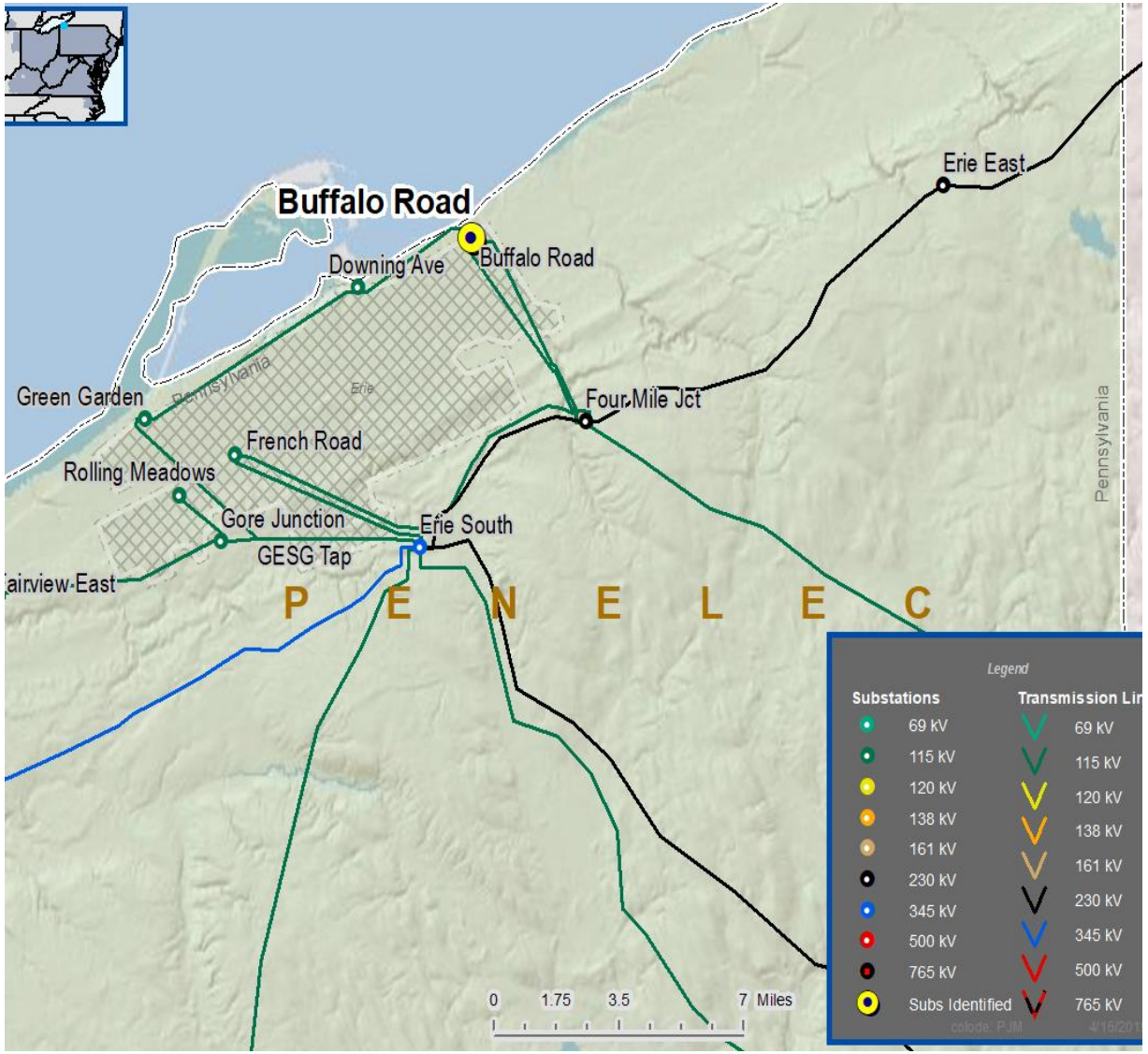
- Eliminate simultaneous outages to multiple networked elements

Problem Statement:

Buffalo Road 115 kV substation serves approximately 100 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
Construct Buffalo Road 115 kV Ring Bus

Need Number: PN-2019-021

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Construct Buffalo Road 115 kV Ring Bus (s1924)

At Buffalo Road:

- Expand the bus configuration to a six breaker ring bus by installing three new 115 kV breakers (s1924.1)
- Replace limiting substation conductor on the Buffalo Road - Four Mile #2 115 kV circuit (s1924.2)

At Green Garden:

- Adjust remote end relaying as necessary

At Four Mile:

- Adjust remote end relaying as necessary

Transmission Line Rating:

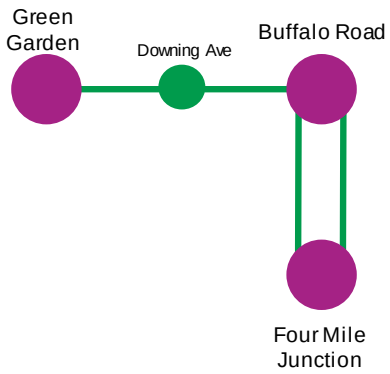
- Buffalo Road – Four Mile Junction BRFM2 115 kV Line:
  - Before Proposed Solution: 190/226 MVA (SN/SE)
  - After Proposed Solution: 202/245 MVA (SN/SE)

Estimated Cost: $9.0M

Projected In-Service: 6/1/2022

Supplemental Project ID: s1924, s1924.1, s1924.2

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Penelec Transmission Zone M-3 Process
Multiple Misoperation Relay Projects

Need Number: PN-2019-022 to PN-2019-025
PN-2019-027 to PN-2019-031
APS-2019-009

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 06/28/2019

Need Meeting 07/24/2019 (APS-2019-009)

Solution Meeting 07/31/2019

Project Driver:

Equipment Material Condition, Performance and Risk

Operational Flexibility and Efficiency

Specific Assumption Reference:

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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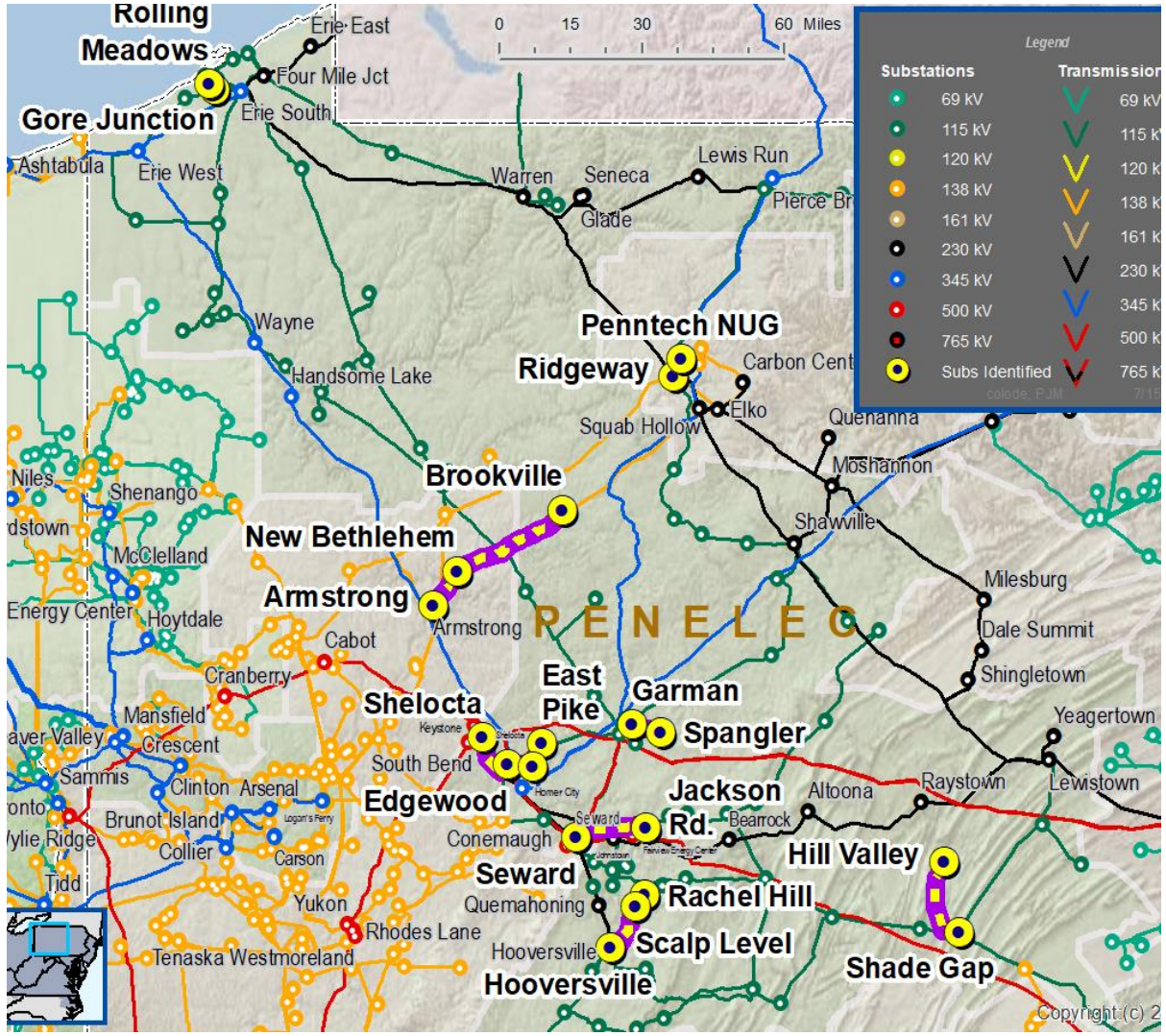

Penelec Transmission Zone M-3 Process
Multiple Misoperation Relay Projects

Need Number: PN-2019-022 to PN-2019-025
PN-2019-027 to PN-2019-031
APS-2019-009

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

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 part and available expertise in the outdated technology.
- Transmission line ratings are limited by terminal equipment.

PN-2019-	Transmission Line / Substation Locations	Existing Line Rating (SN / SE)	Existing Conductor Rating (SN / SE)	Limiting Terminal Equipment
022	Lucerne – Edgewood 115 kV Line Edgewood – Shelocta 115 kV Line	147/190 125/143	202/245 202/245	Line Relaying, Line Trap, Substation Conductor Line Relaying, Line Trap, Substation Conductor
023	East Pike – Lucerne 115 kV Line	163/185	202/245	Line Relaying, Line Trap, Substation Conductor
024	Jackson Road – Seward 115 kV Line	175/191	232/282	Line Relaying, Substation Conductor
025 / APS-2019-009	Armstrong – New Bethlehem 138 kV Line New Bethlehem – Brookville 138 kV Line	293/332 295/342	308/376 308/376	Line Trap, Substation Conductor Line Trap, Substation Conductor, Circuit Breaker
027	Hooversville – Scalp Level 115 kV Line Scalp Level – Rachel Hill 115 kV Line	164/190 164/190	202/245 202/245	Line Relaying, Line Trap, Substation Conductor Line Relaying, Line Trap, Substation Conductor
028	Penn Tech – Ridgway 115 kV Line	135/155	232/282	Line Relaying, Substation Conductor
029	Gore Junction – Rolling Meadows 115 kV Line	137/172	202/245	Disconnect Switch, Line Relaying, Substation Conductor
030	Hill Valley – Shade Gap 115 kV Line	55/55	202/245	Line Relaying, Substation Conductor
031	Garman – Spangler 115 kV Line	126/149	232/282	Line Relaying, Substation Conductor

Penelec Transmission Zone M-3 Process
Multiple Misoperation Relay Projects

Need Number: PN-2019-022 to PN-2019-025
PN-2019-027 to PN-2019-031
APS-2019-009

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solutions:

PN-2019-	Transmission Line / Substation Locations	New MVA Line Rating (SN / SE)	Supplemental Project ID	Scope of Work	Estimate Costs ($ M)	Target ISD
022	Lucerne – Edgewood 115 kV Line Edgewood – Shelocta 115 kV Line	202/245 202/245	S2042, s2042.1, s2042.2, s2042.3	• Shelocta 115 kV Substation – Replace line relaying, line trap, and substation conductor (s2042.1) • Edgewood 115 kV Substation – Replace substation conductor (s2042.2) • Lucerne 115 kV Substation – Replace line relaying, line trap, and substation conductor (s2042.3)	$0.9M	6/1/2020
023	East Pike – Lucerne 115 kV Line	202/245	S2043, s2043.1, s2043.2	• East Pike 115 kV Substation – Replace line relaying, line trap, and substation conductor (s2043.1) • Lucerne 115 kV Substation – Replace line relaying, line trap, and substation conductor (s2043.2)	$0.7M	4/1/2020
024	Jackson Road – Seward 115 kV Line	232/282	S2044, s2044.1, s2044.2	• Jackson Road 115 kV Substation – Replace line relaying and substation conductor (s2044.1) • Seward 115 kV Substation – Replace line relaying and substation conductor (s2044.2)	$0.8M	6/1/2020
025 / APS-2019-009	Armstrong – New Bethlehem 138 kV Line New Bethlehem – Brookville 138 kV Line	308/376 308/376	s2045.1	• Brookville 138 kV Substation – Replace line relaying, line trap, substation conductor, and circuit breaker (s2045.1)	$0.5M	4/1/2020
027	Hooversville – Scalp Level 115 kV Line Scalp Level – Rachel Hill 115 kV Line	202/245 202/245	S2046, s2046.1, s2046.2, s2046.3	• Hooversville 115 kV Substation – Replace line relaying and line trap (s2046.1) • Scalp Level 115 kV Substation – Replace substation conductor (s2046.2) • Rachel Hill 115 kV Substation – Replace line relaying, line trap, and substation conductor (s2046.3)	$0.9M	12/1/2020
028	Penn Tech – Ridgway 115 kV Line	232/282	s2047	• Ridgway 115 kV Substation – Replace line relaying and substation conductor (s2047)	$0.2M	12/1/2021
029	Gore Junction – Rolling Meadows 115 kV Line	202/245	S2048, s2048.1, s2048.2	• Gore Junction 115 kV Substation – Replace line relaying and substation conductor (s2048.1) • Rolling Meadows 115 kV Substation – Replace line relaying, substation conductor, and disconnect switch (s2048.2)	$0.5M	4/1/2021
030	Hill Valley – Shade Gap 115 kV Line	202/245	s2049	• Shade Gap 115 kV Substation – Replace line relaying and substation conductor (s2049)	$0.8M	6/1/2021
031	Garman – Spangler 115 kV Line	232/282	S2050, s2050.1, s2050.2	• Garman 115 kV Substation – Replace line relaying and substation conductor (s2050.1) • Spangler 115 kV Substation – Replace line relaying and substation conductor (s2050.2)	$0.9M	4/1/2021

No topology changes, no bubble diagrams required.

Model: 2018 Series 2023 Summer RTEP 50/50

Penelec/APS Transmission Zone M-3 Process
Multiple Misoperation Relay Projects

Need Number: PN-2019-026, PN-2019-034, APS-2019-010, and APS-2019-011

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 07/11/2019

Solution Meeting 08/08/2019

Project Driver:

Equipment Material Condition, Performance and Risk

Operational Flexibility and Efficiency

Specific Assumption Reference:

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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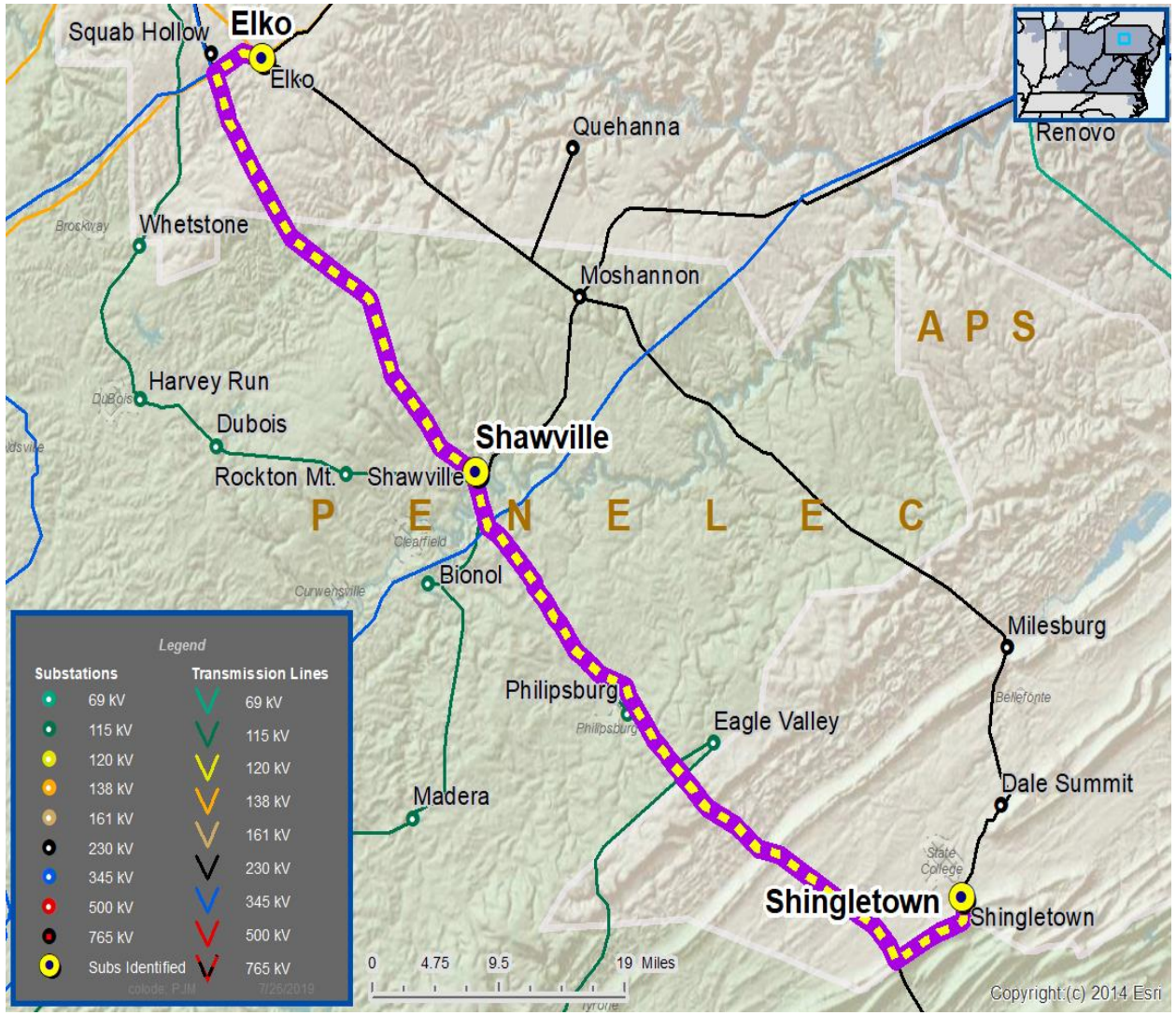


Penelec/APS Transmission Zone M-3 Process
Multiple Misoperation Relay Projects

Need Number: PN-2019-026, PN-2019-034, APS-2019-010, and APS-2019-011

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

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 part and available expertise in the outdated technology.
- Transmission line ratings are limited by terminal equipment.

Need Number	Transmission Line / Substation Locations	Existing Line Rating (SN / SE)	Existing Conductor Rating (SN / SE)	Limiting Terminal Equipment
PN-2019-026 APS-2019-011	Shawville – Shingletown 230 kV Line	489/554	546/666	Line Relaying, Line Trap, Substation Conductor
PN-2019-034 APS-2019-010	Elko – Shawville 230 kV Line	489/554	546/666	Line Relaying, Line Trap, Substation Conductor

Penelec/APS Transmission Zone M-3 Process
Multiple Misoperation Relay Projects

Need Number: PN-2019-026, PN-2019-034, APS-2019-010, and APS-2019-011

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Need Number	Transmission Line / Substation Locations	New MVA Line Rating (SN / SE)	Supplemental Project ID	Scope of Work	Estimated Costs ($ M)	Target ISD
PN-2019-026 APS-2019-011	Shawville – Shingletown 230 kV Line	546/666	S2051, s2051.1, s2051.2	• Shawville 230 kV Substation – Replace line trap and substation conductor (s2051.1) • Shingletown 230 kV Substation – Replace line relaying, line trap, and substation conductor (s2051.2)	$0.9M	12/1/2020
PN-2019-034 APS-2019-010	Elko – Shawville 230 kV Line	546/666	S2052, s2052.1, s2052.2	• Elko 230 kV Substation – Replace line relaying, line trap, and substation conductor (s2052.1) • Shawville 230 kV Substation – Replace line relaying and line trap (s2052.2)	$1.3M	6/15/2020

No topology changes, no bubble diagram required.

Model: 2018 Series 2023 Summer RTEP 50/50

Penelec Transmission Zone M-3 Process
Homer City North 345/230-23 kV Transformer Replacement

Need Number: PN-2019-032

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 07/11/2019

Solution Meeting 08/08/2019

Project Driver:

Equipment Material Condition, Performance and Risk

Specific Assumption Reference:

Substation Condition Rebuild/Replacement

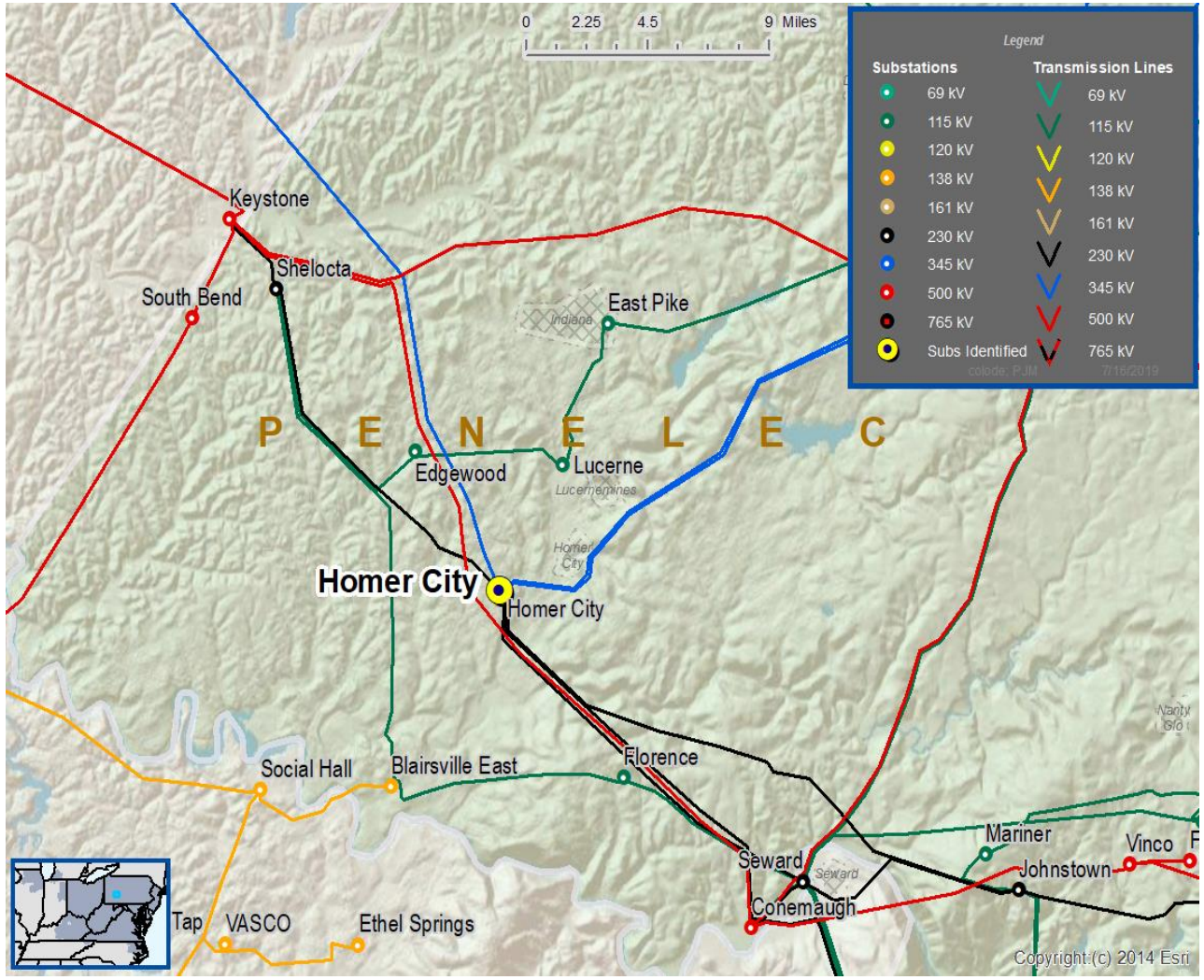
- Power transformers and load tap changers (LTCs)
- Station system protection and controls

Problem Statement:

Homer City North 345/230-23 kV Transformer

- Transformer has increased failure probability due to:
  - Type "U" bushings
  - High level heating gases and moisture
  - Deteriorated control cabinet components
  - Obsolete parts
  - Leaks
  - Transformer is 51 years old.

Transformer circuit rating is the existing transformer rating of 653/697 MVA (SN/SE).



Penelec Transmission Zone M-3 Process
Homer City North 345/230-23 kV Transformer Replacement

Need Number: PN-2019-032

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Replace Homer City North 345/230-23 kV Transformer (s2053)

- Replace the North 345/230-23 kV transformer and associated equipment with 345/230-23 kV 336/448/560 MVA transformer

Transformer Rating:

Homer City North 345/230-23 kV Transformer

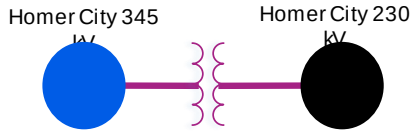
- Before Proposed Solution: 653/817 MVA (SN/SE)
- After Proposed Solution: 691/854 MVA (SN/SE)

Estimated Cost: $6.6 M

Projected In-Service: 12/31/2021

Supplemental Project ID: s2053

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Penelec Transmission Zone M-3 Process
Armstrong – Homer City 345 kV Line Rebuild

Need Number: PN-2019-033

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 07/11/2019

Solution Meeting 08/08/2019

Project Driver:

Equipment Material Condition, Performance and Risk

Specific Assumption Reference:

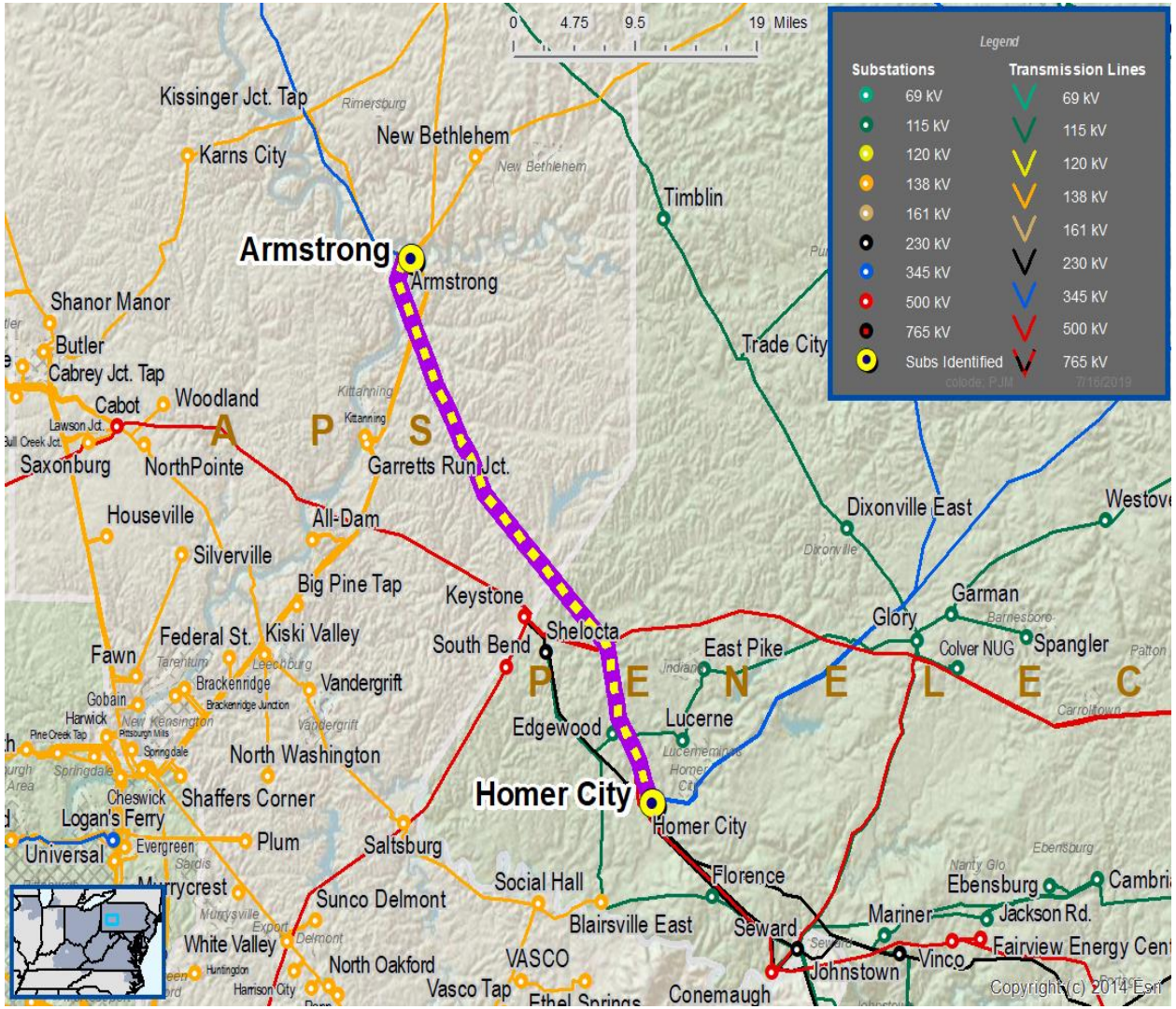
Line Condition Rebuild/Replacement

- Age/condition of wood pole transmission line structures

Problem Statement:

The Armstrong – Homer City 345 kV line is exhibiting deterioration resulting in increased maintenance. The structures are approaching end of life. The line was originally constructed in 1967.

- Total line distance is approximately 34.5 miles
- 167 out of 204 structures failed inspection (82% failure rate)
- Failure reasons include age, woodpecker damage, top rot, bayonet top, and weatherization.



Penelec Transmission Zone M-3 Process
Armstrong – Homer City 345 kV Line Rebuild

Need Number: PN-2019-033

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Armstrong – Homer City 345 kV Line Rebuild (s2054)

- Rebuild and reconductor approximately 33.0 miles of wood pole construction

Transmission Line Rating:

Armstrong – Homer City 345 kV Line

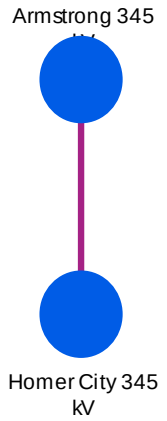
- Before Proposed Solution: 1269/1566 MVA (SN/SE)
- After Proposed Solution: 1269/1566 MVA (SN/SE)

Estimated Cost: $138 M

Projected In-Service: 12/31/2023

Supplemental Project ID: s2054

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
Jackson #5 230/115 kV Transformer Replacement

Need Number: ME-2018-019

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 11/28/2018

Solution Meeting 01/25/2019

Project Driver:

Equipment Material Condition, Performance and Risk

Specific Assumption Reference:

Substation Condition Rebuild/Replacement

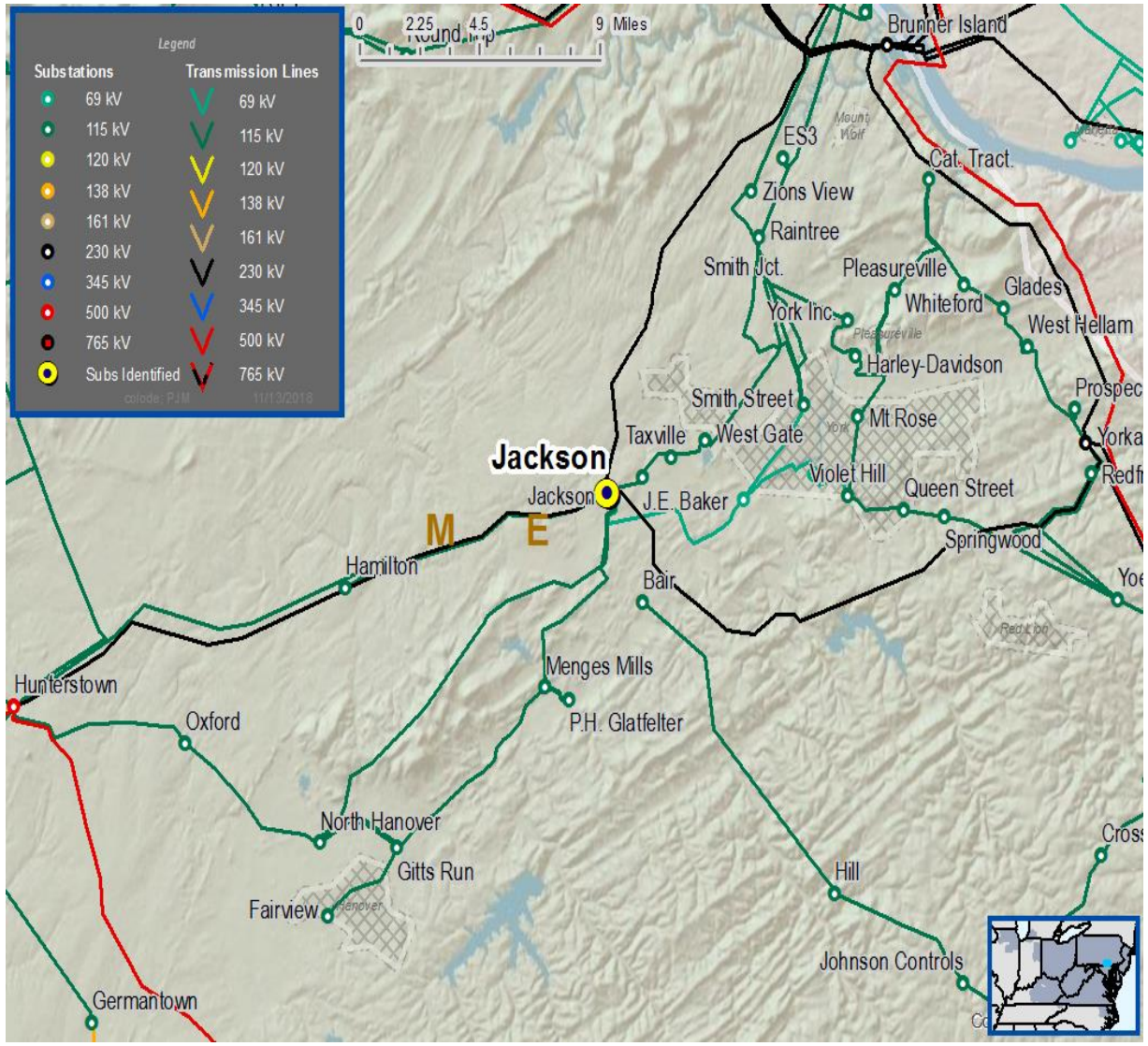
Problem Statement:

Jackson #5 230/115 kV:

- Transformer is 48 years old
- Dissolved gas in oil
- History of oil leaks, compromising oil integrity

Existing transformer circuit rating is 339 / 406 MVA (SN / SE).

Existing transformer rating is 193 / 244 MVA (SN / SE).



Met-Ed Transmission Zone M-3 Process
Jackson #5 230/115 kV Transformer Replacement

Need Number: ME-2018-019

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Jackson #5 230/115 kV transformer replacement (s1878)

- Replace the 230/115 kV 90/120/150 MVA transformer and associated equipment with new 230/115 kV 180/240/300 MVA transformer

Transformer Rating:

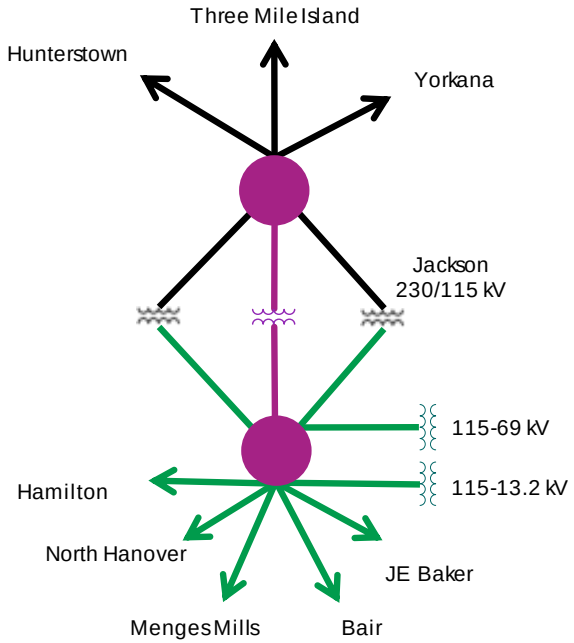
- Jackson #5 230/115 kV Transformer
  - Before Proposed Solution: 193 MVA SN / 244 MVA SE
  - After Proposed Solution (anticipated): 361 MVA SN / 387 MVA SE

Estimated Cost: $4.9 M

Projected In-Service: 12/31/2020

Supplemental Project ID: s1878

Model: 2018 Series 2023 Summer RTEP 50/50



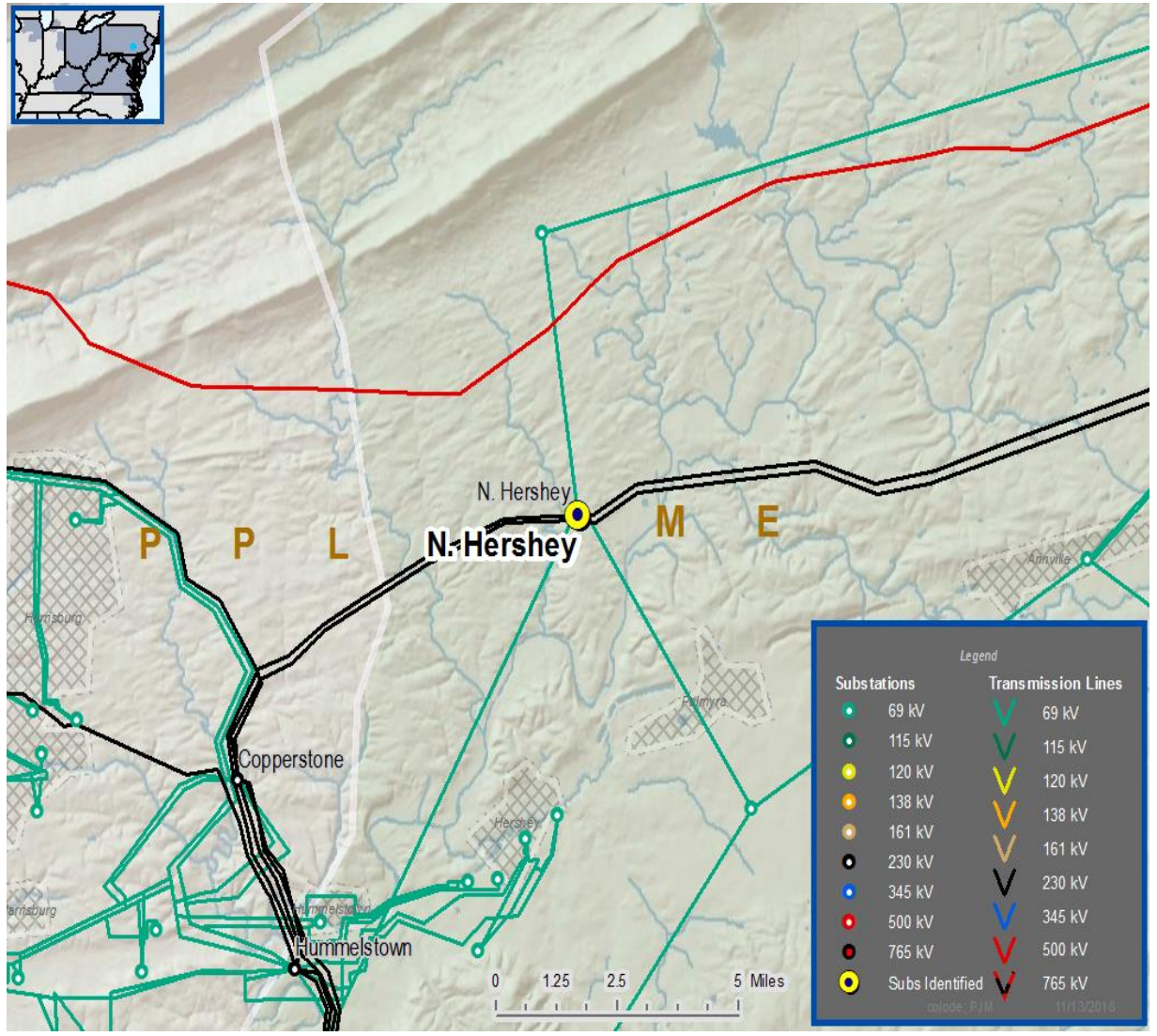
Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
North Hershey #1 230/69 kV Transformer Replacement and 230 kV Ring Bus

Need Number: ME-2018-020
Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019
Previously Presented:
Need Meeting 11/28/2018
Solution Meeting 01/25/2019
Project Driver:
Equipment Material Condition, Performance and Risk
Specific Assumption Reference:
Substation Condition Rebuild/Replacement
Problem Statement:
North Hershey #1 230/69 kV:

- Transformer is over 40 years old
- Critical role in operation of 69 kV
- Transformer leaking

Existing transformer circuit rating is 155 / 184 MVA (SN / SE).
Existing transformer rating is 123 / 137 MVA (SN / SE).



Met-Ed Transmission Zone M-3 Process
North Hershey #1 230/69 kV Transformer Replacement and 230 kV Ring Bus

Need Number: ME-2018-020

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

North Hershey #1 230-69 kV transformer replacement and 230 kV ring bus (s1879)

- Replace the 230-69 kV 60/80/100 MVA transformer and associated equipment with new 230-69 kV 100/134/168 MVA transformer(s1879.1)
- Expand the North Hershey 230 kV bus into a three breaker ring bus (s1879.2)

Transformer Rating:

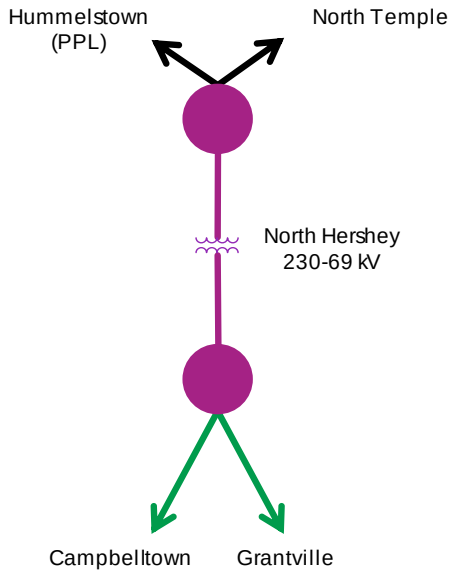
- North Hershey #1 230-69 kV transformer
  - Before Proposed: 123 MVA SN / 137 MVA SE
  - After Proposed Solution (anticipated): 211 MVA SN / 232 MVA SE

Estimated Cost: $9.1M

Projected In-Service: 12/31/2021

Supplemental Project ID: s1879, s1879.1, s1879.2

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process

Construct a new 69 kV transmission line from Shawnee Substation to Walker Substation

Need Number: ME-2018-021

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 11/28/2018

Solution Meeting 01/25/2019

Project Driver:

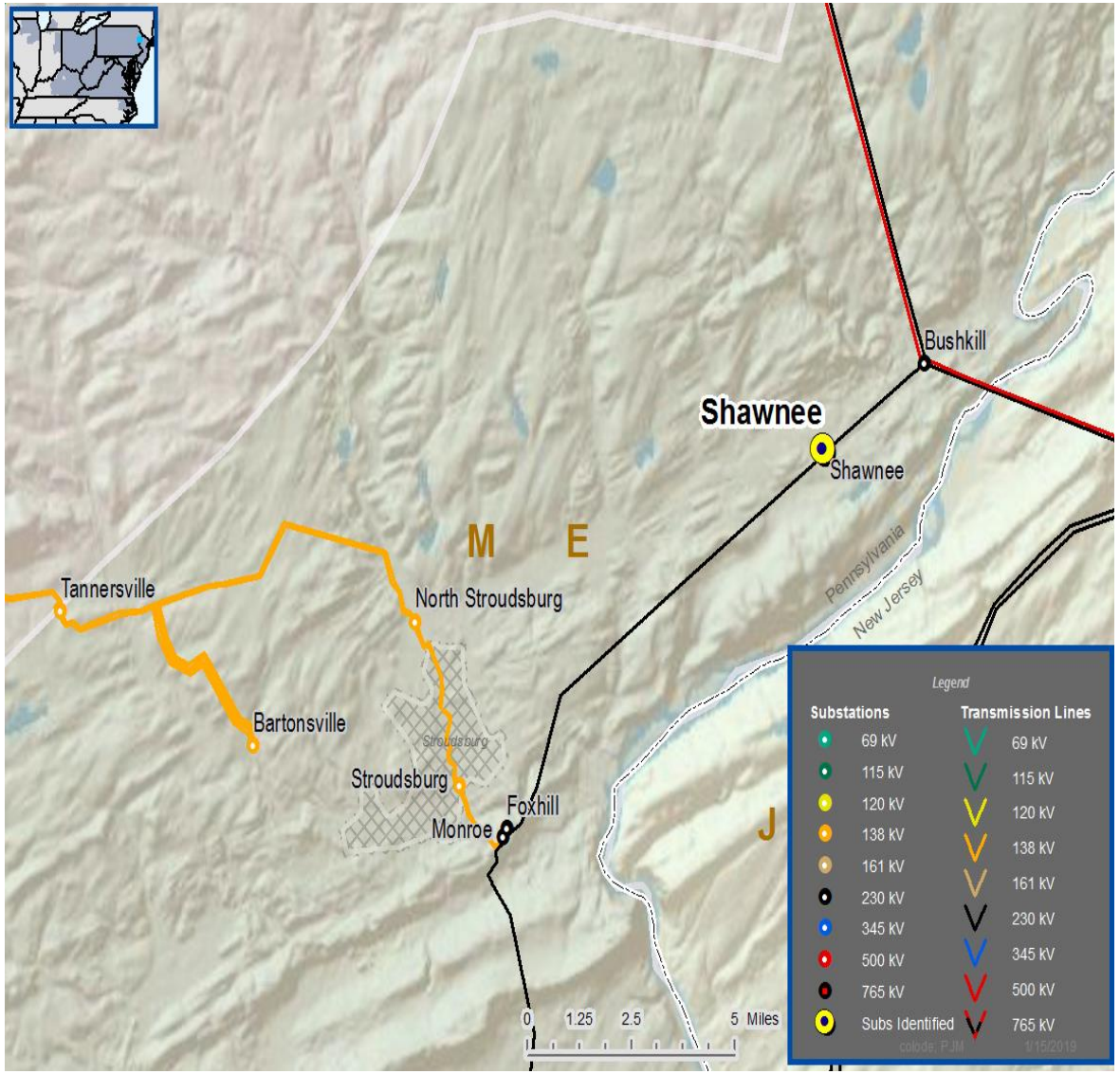
Customer Service (Reliability)

Specific Assumption Reference:

Customer request will be evaluated per FirstEnergy's "Requirements for Transmission Connected Facilities" document and "Transmission Planning Criteria" document.

Problem Statement:

- Customer requested transmission service in the Stroudsburg, PA area due to multiple outages over past several years.
- Limited outage restoration options in the area.
- The area north of Shawnee substation has no transmission system
- Customers in this area are served by three 34.5 kV circuits from Shawnee or from Walker substation which is radial 69 kV.
- 6000 customers directly served by the 34.5 kV circuits
- 7600 customers fed from substations sourced by the 34.5 kV system
- Territory is a narrow corridor bounded by the Delaware river to the east



Met-Ed Transmission Zone M-3 Process
Construct a new 69 kV transmission line from Shawnee Substation to Walker Substation

Need Number: ME-2018-021

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Construct a new 69 kV transmission line from Shawnee Substation to Walker Substation (approximately 31.1 miles) (s1880)

Shawnee Substation

- Expand 230 kV bus into a six breaker ring bus (s1880.1)
- Install a new 100/134/168 MVA 230-69 kV transformer and associated equipment (s1880.2)

Birchwood Lakes Substation

- Provide new 69 kV delivery point (s1880.3)
- Install a new 69 kV 9.6 MVAR capacitor (s1880.4)

Bushkill Falls Substation

- Provide new 69 kV delivery point (s1880.5)
- Install a new 69 kV 9.6 MVAR capacitor (s1880.6)

Walker Substation

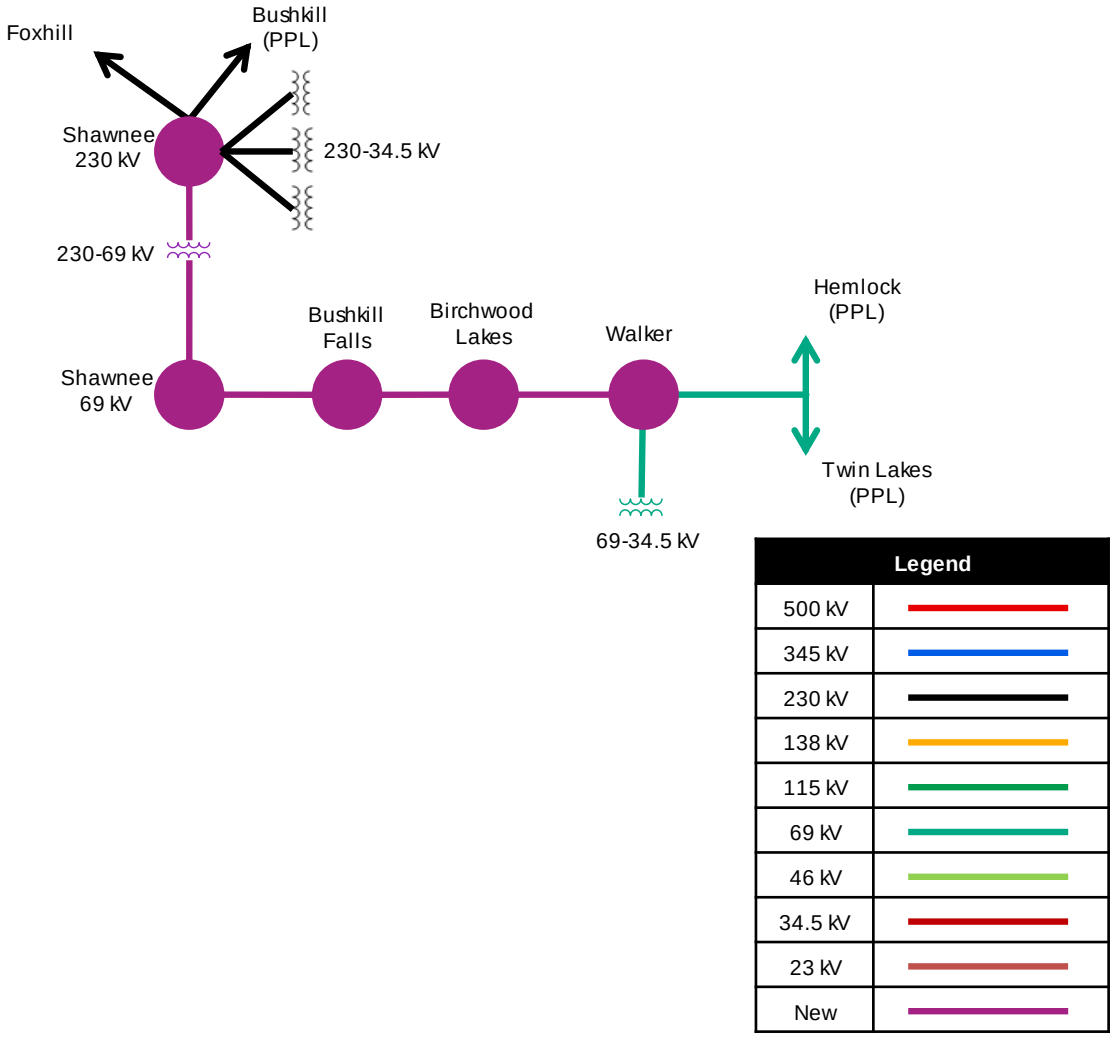
- Expand 69 kV bus into a three breaker ring bus (s1880.7)

Estimated Cost: $60M

Projected In-Service: 12/31/2023

Supplemental Project ID: s1880, s1880.1, s1880.2, s1880.3, s1880.4, s1880.5, s1880.6, s1880.7

Model: 2018 Series 2023 Summer RTEP 50/50



Met-Ed Transmission Zone M-3 Process
Multiple Line Rebuild/Rehab Projects

Need Number: ME-2019-001 to ME-2019-003,
ME-2019-005 to ME-2019-008,
ME-2019-010 to ME-2019-014,
ME-2019-020

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 02/22/2019

Solution Meeting 04/26/2019

Project Driver:

Equipment Material Condition, Performance and Risk

Specific Assumption Reference:

Line Condition Rebuild/Replacement

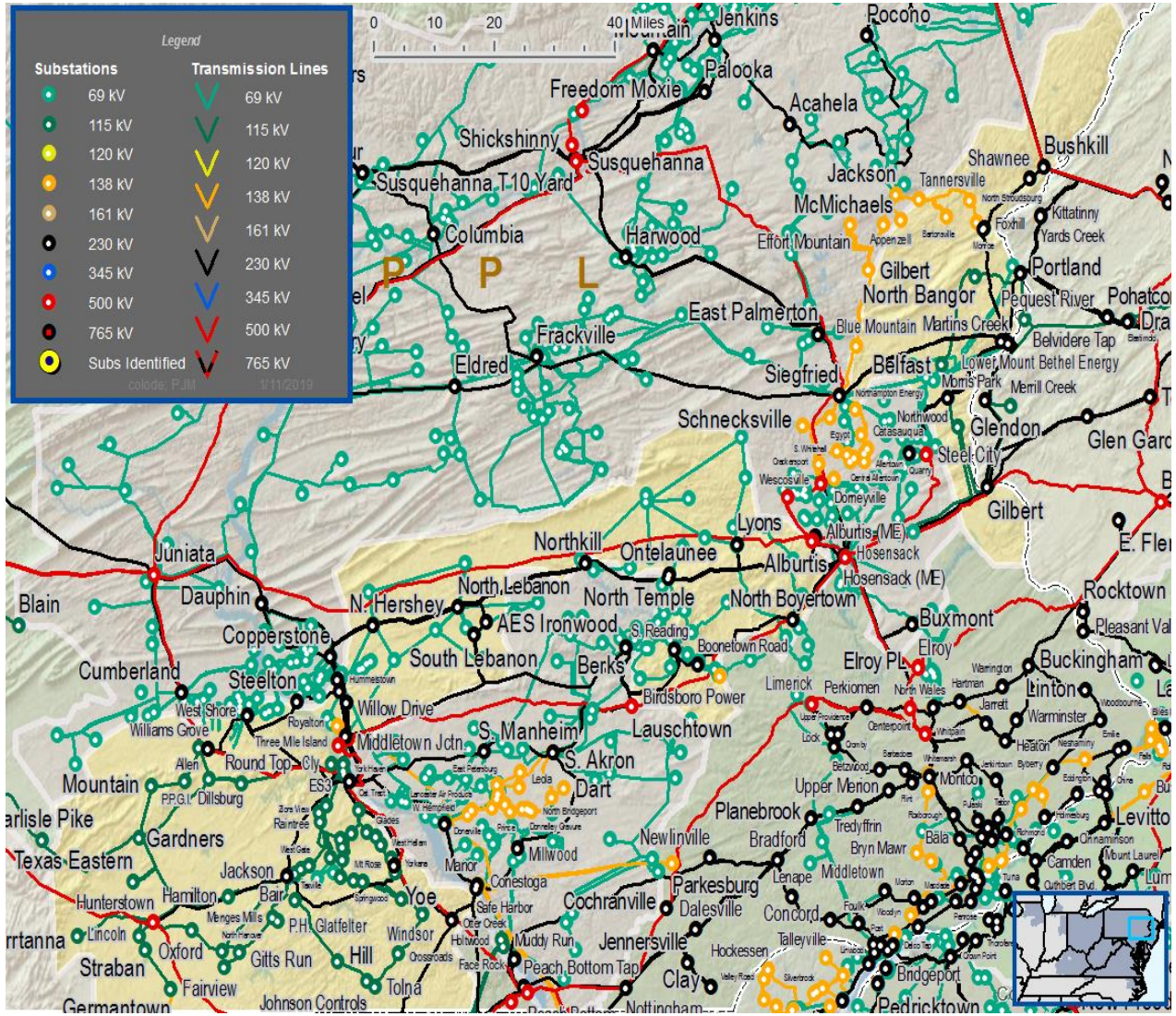
- Age/condition of wood pole transmission line structures
- Age/condition of steel tower or steel pole transmission line structures
- Age/condition of transmission line conductors

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.



Met-Ed Transmission Zone M-3 Process
Multiple Line Rebuild/Rehab Projects

ME-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
001	Adamstown – Flying Hills 69 kV Line	53 / 64	53 / 64	-	6.6	79 / 92 (86% Failure Rate)	Age, top rot, voids, woodpecker holes, etc.
	Flying Hills – South Reading 69 kV Line	53 / 64	80 / 96	Substation Conductor / Drops	2.4		
002	Baldy – Weisenberg 69 kV Line	62 / 62	80 / 96	Relays, Substation Conductor	9.1	180 / 514 (35% Failure Rate)	Top rot, voids, woodpecker holes, etc.
	Weisenberg – Lynnville 69 kV Line	89 / 107	89 / 107	-	5.0		
	Lynnville – South Hamburg 69 kV Line	51 / 66	74 / 90	Substation Conductor	15.1		
003	North Temple – Berkley Tap 69 kV Line	113 / 148	139 / 169	Substation Conductor	1.0	43 / 150 (29% Failure Rate)	Top rot, voids, woodpecker holes, etc.
	Berkley Tap - Berkley 69 kV Line	51 / 66	55 / 56	Substation Conductor	0.01		
	Berkley Tap – Cambridge Lee 69 kV Line	139 / 169	139 / 169	-	0.1		
	Cambridge Lee – Bern Church 69 kV Line	55 / 56	55 / 56	-	4.8		
	Bern Church – Northkill 69 kV line	80 / 96	80 / 96	-	6.4		
005	Carsonia – South Reading 813 69 kV Line	78 / 94	162 / 198	Substation Conductor / Drops	3.7	3 / 37 (8% Failure Rate)	Top rot
006	East Topton – Huffs Church 69 kV Line	50 / 50	80 / 96	Relays, Substation Conductor	5.3	92 / 227 (41% Failure Rate)	Top rot, bottom rot, woodpecker holes, etc.
	Huffs Church – Barto 69 kV Line	80 / 96	80 / 96	-	5.4		
	Barto – North Boyertown 69 kV Line	80 / 96	80 / 96	-	3.9		

FirstEnergy

Met-Ed Transmission Zone M-3 Process
Multiple Line Rebuild/Rehab Projects

ME-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
007	Alcoa – South Lebanon 69 kV Line	82 / 103	111 / 134	Disconnect Switches, Relays	4.0	93 / 103 (90% Failure Rate)	Age, decay, woodpecker holes
008	Bernville – State Street 69 kV Line	52 / 66	60 / 75	Substation Conductor	10.7	155 / 181 (86% Failure Rate)	Age, sound, woodpecker holes
	State Street – South Hamburg 69 kV Line	88 / 93	139 / 169	Substation Conductor, Relays	0.8		
010	Middletown Junction – York Haven 115 kV Line	129 / 156	129 / 156	-	4.0	100 / 120 (83% Failure Rate)	Age, bad/cut/missing grounds, etc.
	York Haven – Zions View 115 kV Line	129 / 156	129 / 156	-	4.8		
	Zions View – Smith Street 115 kV Line	126 / 149	129 / 156	Substation Conductor	6.6		
011	Allentown Cement – St Peters 69 kV Line	53 / 64	53 / 64	-	2.0	148 / 225 (70% Failure Rate)	Age, bad/cut/missing grounds, sound, woodpecker holes, etc.
	St Peters – South Hamburg 69 kV Line	51 / 64	53 / 64	Substation Conductor	7.5		
	St Peters – Moselem 69 kV Line	132 / 158	139 / 169	Substation Conductor	1.5		
	Moselem – Lyons 69 kV Line	51 / 64	53 / 64	Substation Conductor	4.2		
012	North Temple – Royal Green Tap 69 kV Line	82 / 103	139 / 169	Disconnect Switches, Substation Conductor, Relays	0.4	159 / 208 (76% Failure Rate)	Age, bad/cut/missing grounds, rot, sound, woodpecker holes
	Royal Green Tap – Royal Green 69 kV Line	82 / 103	89 / 107	Disconnect Switch	0.1		
	Royal Green Tap – Berkley Tap 69 kV Line	82 / 103	139 / 169	Disconnect Switch	0.6		
	Berkley Tap – Berkley 69 kV Line	51 / 64	53 / 64	Substation Conductor	0.01		
	Berkley Tap – Leesport 69 kV Line	53 / 64	53 / 64	-	3.6		
	Leesport – South Hamburg 69 kV Line	51 / 64	53 / 64	Substation Conductor	7.2		

Met-Ed Transmission Zone M-3 Process
Multiple Line Rebuild/Rehab Projects

ME-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
013	Alcoa – North Cornwall 69 kV Line	82 / 103	102 / 124	Disconnect Switches	3.1	126 / 164 (77% Failure Rate)	Age, bad/cut/missing grounds, top rot/decay, woodpecker holes, etc.
	North Cornwall – Broad Street 69 kV Line	82 / 103	111 / 134	Disconnect Switches, Substation Conductor	2.0		
014	North Hershey – Grantville 69 kV Line	80 / 96	80 / 96	-	1.5	79 / 91 (87% Failure Rate)	Age, bad/cut/missing grounds, decay, woodpecker holes, etc.
	Grantville – Turf Club 69 kV Line	64 / 65	64 / 65	-	3.0		
020	South Lebanon – Bayer Labs 69 kV Line	51/56	55/56	Substation Conductor	5.9	163 / 203 (80% Failure Rate)	Age, bad/cut/missing grounds, decay, split top, static bayonet, woodpecker holes, etc.
	Bayer Labs – Myerstown 69 kV Line	55/56	55/56	-	1.1		

Met-Ed Transmission Zone M-3 Process
Adamstown – South Reading 69 kV Line Rehab/Rebuild

Need Number: ME-2019-001

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Adamstown – South Reading 69 kV line Rehab/Rebuild (s1892)

- Rehab/Rebuild Adamstown – South Reading. Reconductor 7.2 miles of the 9 mile line.
  - 5.4 miles of reconductoring on Adamstown-Flying Hills (s1892.1)
  - 1.8 miles of reconductoring on Flying Hills-South Reading (s1892.2)
- Replace substation conductor and drops at Flying Hills on the Adamstown – Flying Hills 69 kV Line (s1892.3)

Transmission Line Ratings:

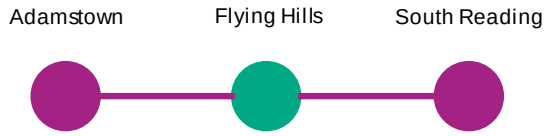
- Adamstown– Flying Hills 69 kV Line:
  - Before Proposed Solution: 53/64 MVA (SN/SE)
  - After Proposed Solution: 80/96 MVA (SN/SE)
- Flying Hills – South Reading 69 kV Line:
  - Before Proposed Solution: 53/64 MVA (SN/SE)
  - After Proposed Solution: 80/96 MVA (SN/SE)

Estimated Cost: $9.4M

Projected In-Service: 12/31/2019

Supplemental Project ID: s1892, s1892.1, s1892.2, s1892.3,

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
Baldy – South Hamburg 69 kV Line Rehab/Rebuild

Need Number: ME-2019-002

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Baldy - South Hamburg 69 kV line Rehab/Rebuild (s1893)

- Rehab/Rebuild Baldy – South Hamburg (~29.3 miles) (s1893.1)
- Replace line relaying and substation conductor at Baldy on the Baldy– Weisenberg 69 kV Line (s1893.2)
- Replace substation conductor at South Hamburg on the Lynnville– South Hamburg 69 kV Line (s1893.3)

Transmission Line Ratings:

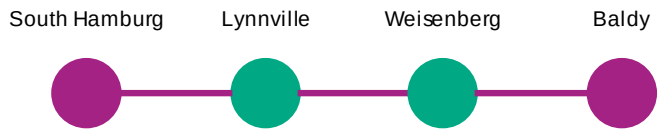
- Baldy– Weisenberg 69 kV Line:
  - Before Proposed Solution: 62/62 MVA (SN/SE)
  - After Proposed Solution: 80/96 MVA (SN/SE)
- Weisenberg– Lynnville 69 kV Line:
  - Before Proposed Solution: 89/107 MVA (SN/SE)
  - After Proposed Solution: 89/107 MVA (SN/SE)
- Lynnville– South Hamburg 69 kV Line:
  - Before Proposed Solution: 51/66 MVA (SN/SE)
  - After Proposed Solution: 74/90 MVA (SN/SE)

Estimated Cost: $12.3M

Projected In-Service: 12/31/2019

Supplemental Project ID: s1893, s1893.1, s1893.2, s1893.3

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
North Temple – North Kill 69 kV Line Rehab/Rebuild

Need Number: ME-2019-003

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

North Temple - Northkill 69 kV line Rehab/Rebuild (s1894)

- Rehab/Rebuild North Temple – Northkill. Reconductor ~5.8 miles on Cambridge Lee-Bern Church section (s1894.1)
- Replace substation conductor at North Temple on the North Temple – Berkley Tap 69 kV Line (s1894.2)

Transmission Line Ratings:

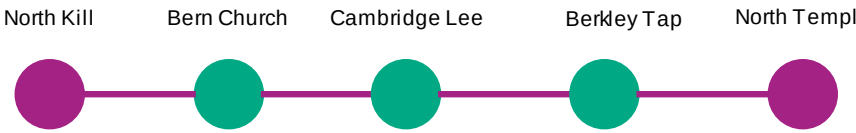
- North Temple – Berkley Tap 69 kV Line:
  - Before Proposed Solution: 113/148 MVA (SN/SE)
  - After Proposed Solution: 139/169 MVA (SN/SE)
- Berkley Tap – Cambridge Lee 69 kV Line:
  - Before Proposed Solution: 139/169 MVA (SN/SE)
  - After Proposed Solution: 139/169 MVA (SN/SE)
- Cambridge Lee – Bern Church 69 kV Line:
  - Before Proposed Solution: 55/56 MVA (SN/SE)
  - After Proposed Solution: 80/96 MVA (SN/SE)

Estimated Cost: $14.2M

Projected In-Service: 06/01/2020

Supplemental Project ID: s1894, s1894.1, s1894.2

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
Carsonia – South Reading 69 kV Line Rehab/Rebuild

Need Number: ME-2019-005

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Carsonia – South Reading 69 kV line Rehab/Rebuild (s1895)

- Rehab/Rebuild Carsonia – South Reading 69 kV Line (s1895.1)
- Replace substation conductor and line drops at Carsonia on the Carsonia – South Reading 69 kV Line (s1895.2)

Transmission Line Ratings:

- Carsonia – South Reading 69 kV Line:
  - Before Proposed Solution: 78/94 MVA (SN/SE)
  - After Proposed Solution: 162/198 MVA (SN/SE)

Estimated Cost: $8.3M

Projected In-Service: 12/31/2019

Supplemental Project ID: s1895, s1895.1, s1895.2

Model: 2018 Series 2023 Summer RTEP 50/50

Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
East Topton – North Boyertown 69 kV Line Rehab/Rebuild

Need Number: ME-2019-006

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

East Topton – North Boyertown 69 kV line Rehab/Rebuild (s1896)

- Rehab/Rebuild East Topton – North Boyertown 69 kV line (s1896.1)
- Replace line relaying and substation conductor at East Topton on the East Topton – Huffs Church 69 kV line (s1896.2)

Transmission Line Ratings:

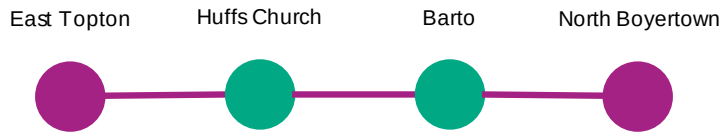
- Huffs Church – East Topton 69 kV Line:
  - Before Proposed Solution: 50/50 MVA (SN/SE)
  - After Proposed Solution: 80/96 MVA (SN/SE)

Estimated Cost: $18.2M

Projected In-Service: 12/31/2019

Supplemental Project ID: s1896, s1896.1, s1896.2

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
Alcoa – South Lebanon 69 kV Line Rehab/Rebuild

Need Number: ME-2019-007

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Alcoa – South Lebanon 69 kV line Rehab/Rebuild (s1897)

- Rehab/Rebuild Alcoa – South Lebanon 69 kV Line (s1897.1)
- Replace disconnect switches and relays at Alcoa on the Alcoa – South Lebanon 69 kV Line (s1897.2)
- Replace disconnect switches and relays at South Lebanon on the Alcoa – South Lebanon 69 kV Line (s1897.3)

Transmission Line Ratings:

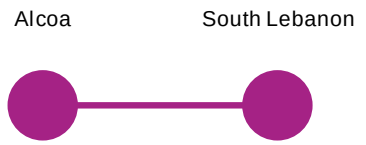
- Alcoa – South Lebanon 69 kV Line:
  - Before Proposed Solution: 82/103 MVA (SN/SE)
  - After Proposed Solution: 111/134 MVA (SN/SE)

Estimated Cost: $3.2M

Projected In-Service: 12/31/2020

Supplemental Project ID: s1897, s1897.1, s1897.2, s1897.3

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
Bernville – South Hamburg 69 kV Line Rehab/Rebuild

Need Number: ME-2019-008

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Bernville – South Hamburg 69 kV line Rehab/Rebuild

- Rehab/Rebuild Bernville – South Hamburg (s1898)
- Reconductor Bernville – State Street section (s1898.1)
- Replace substation conductor and relays at South Hamburg on the State Street – South Hamburg 69 kV Line (s1898.2)
- Replace substation conductor at Bernville 69 kV on the Bernville – State Street 69 kV Line (s1898.3)

Transmission Line Ratings:

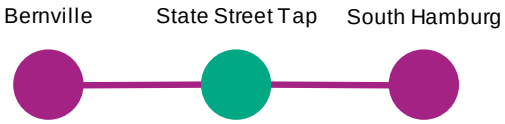
- Bernville – State Street Tap 69 kV Line:
  - Before Proposed Solution: 52/66 MVA (SN/SE)
  - After Proposed Solution: 82/103 MVA (SN/SE)
- State Street Tap – South Hamburg 69 kV Line:
  - Before Proposed Solution: 88/93 MVA (SN/SE)
  - After Proposed Solution: 139/169 MVA (SN/SE)

Estimated Cost: $14.9M

Projected In-Service: 06/01/2020

Supplemental Project ID: s1898, s1898.1, s1898.2, s1898.3

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
Middletown Junction – Smith Street 115 kV Line Rehab/Rebuild

Need Number: ME-2019-010

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Middletown Junction – Smith Street 115 kV line Rehab/Rebuild (s1899)

- Rehab/Rebuild Middletown Junction – Smith Street (s1899.1)
- Replace substation conductor at Smith Street (s1899.2)

Transmission Line Ratings:

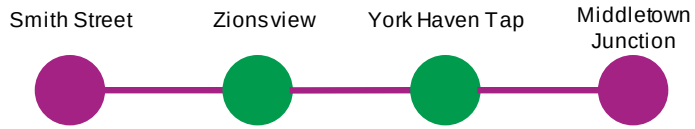
- Zions view – Smith Street 115 kV Line:
  - Before Proposed Solution: 126/149 MVA (SN/SE)
  - After Proposed Solution: 129/156 MVA (SN/SE)

Estimated Cost: $2.1M

Projected In-Service: 12/31/2022

Supplemental Project ID: s1899, s1899.1, s1899.2

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
Allentown Cement – Lyons – South Hamburg 69 kV Line Rehab/Rebuild

Need Number: ME-2019-011

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Allentown Cement – Lyons – South Hamburg 69 kV line Rehab/Rebuild (s1900)

- Rehab/Rebuild Allentown – Lyons – South Hamburg 69 kV Line, Reconductor ~15.2 miles (s1900.1)
- Replace substation conductor at South Hamburg 69 kV station (s1900.2)
- Replace substation conductor at Moselem 69 kV station (s1900.3)
- Replace substation conductor at Lyons 69 kV station (s1900.4)

Transmission Line Ratings:

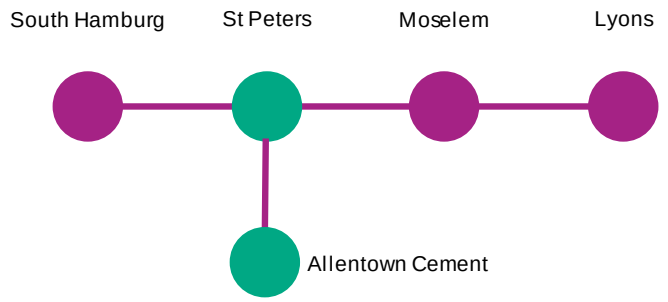
- Lyons – Moselem 69 kV Line:
  - Before Proposed Solution: 51/64 MVA (SN/SE)
  - After Proposed Solution: 139/169 MVA (SN/SE)
- Moselem – St Peters 69 kV Line:
  - Before Proposed Solution: 132/158 MVA (SN/SE)
  - After Proposed Solution: 139/169 MVA (SN/SE)
- St Peters – Allentown Cement 69 kV Line:
  - Before Proposed Solution: 53/64 MVA (SN/SE)
  - After Proposed Solution: 139/169 MVA (SN/SE)
- St Peters – South Hamburg 69 kV Line:
  - Before Proposed Solution: 51/64 MVA (SN/SE)
  - After Proposed Solution: 139/169 MVA (SN/SE)

Estimated Cost: $15.7M

Projected In-Service: 12/31/2021

Supplemental Project ID: s1900, s1900.1, s1900.2, s1900.3, s1900.4

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
North Temple – South Hamburg 69 kV Line Rehab/Rebuild

Need Number: ME-2019-012

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

North Temple – South Hamburg 69 kV line Rehab/Rebuild (s1901)

- Rehab/Rebuild North Temple – Royal Green Tap - Berkley Tap - Leesport - South Hamburg 69 kV line. Reconductor ~11.86 miles (s1901.1)
- Replace Substation Conductor and Switches at North Temple 69 kV station (s1901.2)
- Replace Switches at Royal Green Tap 69 kV station (s1901.3)
- Replace Substation Conductor at South Hamburg 69 kV station (s1901.4)

Transmission Line Ratings:

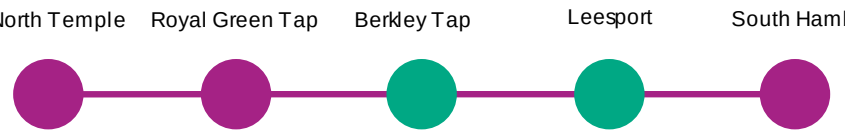
- North Temple – Royal Green Tap 69 kV Line:
  - Before Proposed Solution: 82/103 MVA (SN/SE)
  - After Proposed Solution: 139/169 MVA SE (SN/SE)
- Royal Green Tap – Berkley 69 kV Line:
  - Before Proposed Solution: 82/103 MVA (SN/SE)
  - After Proposed Solution: 139/169 MVA (SN/SE)
- Berkley – Leesport 69 kV Line:
  - Before Proposed Solution: 53/64 MVA (SN/SE)
  - After Proposed Solution: 139/169 MVA (SN/SE)
- Leesport – South Hamburg 69 kV Line:
  - Before Proposed Solution: 51/64 MVA (SN/SE)
  - After Proposed Solution: 139/169 MVA (SN/SE)

Estimated Cost: $13.8M

Projected In-Service: 12/31/2021

Supplemental Project ID: s1901, s1901.1, s1901.2, s1901.3, s1901.4

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
Alcoa – Broad Street 69 kV Line Rehab/Rebuild

Need Number: ME-2019-013

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Alcoa – Broad Street 69 kV line Rehab/Rebuild (s1902)

- Rehab/Rebuild Alcoa – North Cornwall - Broad Street 69 kV line (s1902.1)
- Replace Substation Conductor and Switches at Broad Street on the North Cornwall - Broad Street 69 kV line (s1902.2)
- Replace Switches at Alcoa on the Alcoa – North Cornwall 69 kV line (s1902.3)

Transmission Line Ratings:

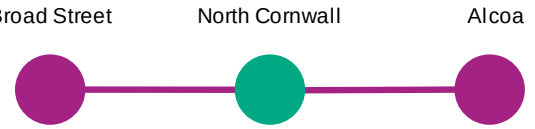
- Alcoa – North Cornwall 69 kV Line:
  - Before Proposed Solution: 82/103 MVA (SN/SE)
  - After Proposed Solution: 102/124 MVA (SN/SE)
- North Cornwall – Broad Street 69 kV Line:
  - Before Proposed Solution: 82/103 MVA (SN/SE)
  - After Proposed Solution: 111/134 MVA (SN/SE)

Estimated Cost: $6.5M

Projected In-Service: 12/31/2021

Supplemental Project ID: s1902, s1902.1, s1902.2, s1902.3

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
North Hershey – Turf Club 69 kV Line Rehab/Rebuild

Need Number: ME-2019-014

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

North Hershey – Turf Club 69 kV line Rehab/Rebuild (s1903)

- Rehab/Rebuild North Hershey – Turf Club. Reconductor ~4.5 miles.

Transmission Line Ratings:

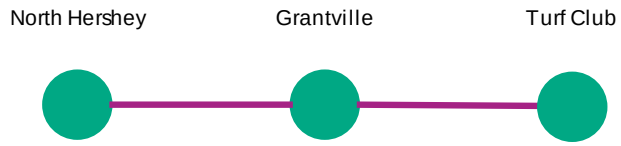
- North Hershey – Grantville 69 kV Line:
  - Before Proposed Solution: 80/96 MVA (SN/SE).
  - After Proposed Solution: 111/134 MVA (SN/SE).
- Grantville – Turf Club 69 kV Line:
  - Before Proposed Solution: 64/65 MVA (SN/SE).
  - After Proposed Solution: 111/134 MVA (SN/SE).

Estimated Cost: $6.4M

Projected In-Service: 12/31/2021

Supplemental Project ID: s1903

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
South Lebanon – Myerstown 69 kV Line Rehab/Rebuild

Need Number: ME-2019-020

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

South Lebanon – Myerstown 69 kV line Rehab/Rebuild (s1909)

- Rehab/Rebuild South Lebanon – Bayer Labs - Myerstown 69 kV line. Reconductor ~7 miles (s1909.1)
- Replace substation conductor at South Lebanon on the South Lebanon – Bayer Labs 69 kV line (s1909.2)

Transmission Line Ratings:

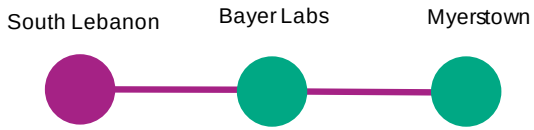
- South Lebanon – Bayer Labs 69 kV Line:
  - Before Proposed Solution: 51/56 MVA (SN/SE)
  - After Proposed Solution: 111/134 MVA (SN/SE)
- Bayer Labs – Myerstown 69 kV Line:
  - Before Proposed Solution: 55/56 MVA (SN/SE)
  - After Proposed Solution: 111/134 MVA (SN/SE)

Estimated Cost: $10.4M

Projected In-Service: 12/31/2021

Supplemental Project ID: s1909, s1909.1, s1909.2

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
Birdsboro – South Reading 69 kV Line Rebuild/Rehab

Need Number: ME-2019-015

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 02/22/2019

Solution Meeting 04/26/2019

Project Driver:

Equipment Material Condition, Performance and Risk

Specific Assumption Reference:

- Line Condition Rebuild/Replacement – Age/condition of transmission line conductors, wood pole transmission line structures
- System Performance Projects – Substation/Line Equipment Limits
- Reconductor/Rebuild Transmission Lines – Transmission lines with high loading

Problem Statement:

The South Reading-Painted Sky-Lorane-Pioneer Crossing-Birdsboro 69 kV line is exhibiting deterioration resulting in increased maintenance. The Transmission line is approaching end of life

- 28 out of 125 structures failed inspection (22% Failure Rate).
- Failure reasons include bad/cut/missing grounds, static bayonet, broken guy, woodpecker damage, etc.
- Total line distance is approximately 7.5 miles.

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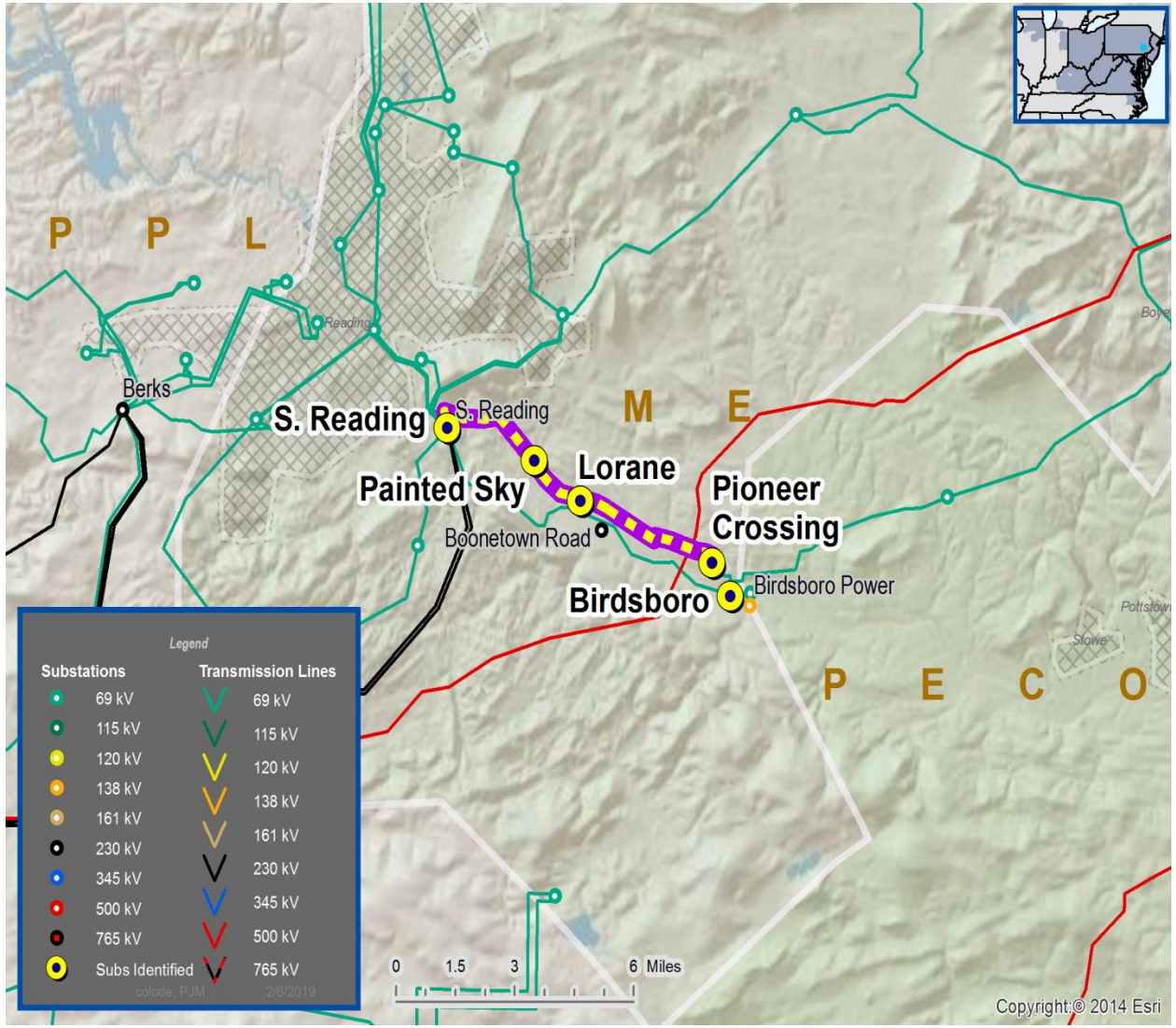


Met-Ed Transmission Zone M-3 Process
Birdsboro – South Reading 69 kV Line Rebuild/Rehab

Need Number: ME-2019-015

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 02/22/2019

Solution Meeting 04/26/2019

Problem Statement (Continued):

Thermal loading on the Lorane-Pioneer Crossing 69 kV section is ~115% of the SE rating for loss of the N. Boyertown 230-69 kV transformer & S. Reading-Birdsboro 828 69 kV line.

(2018 RTEP Model – 2023 Summer)

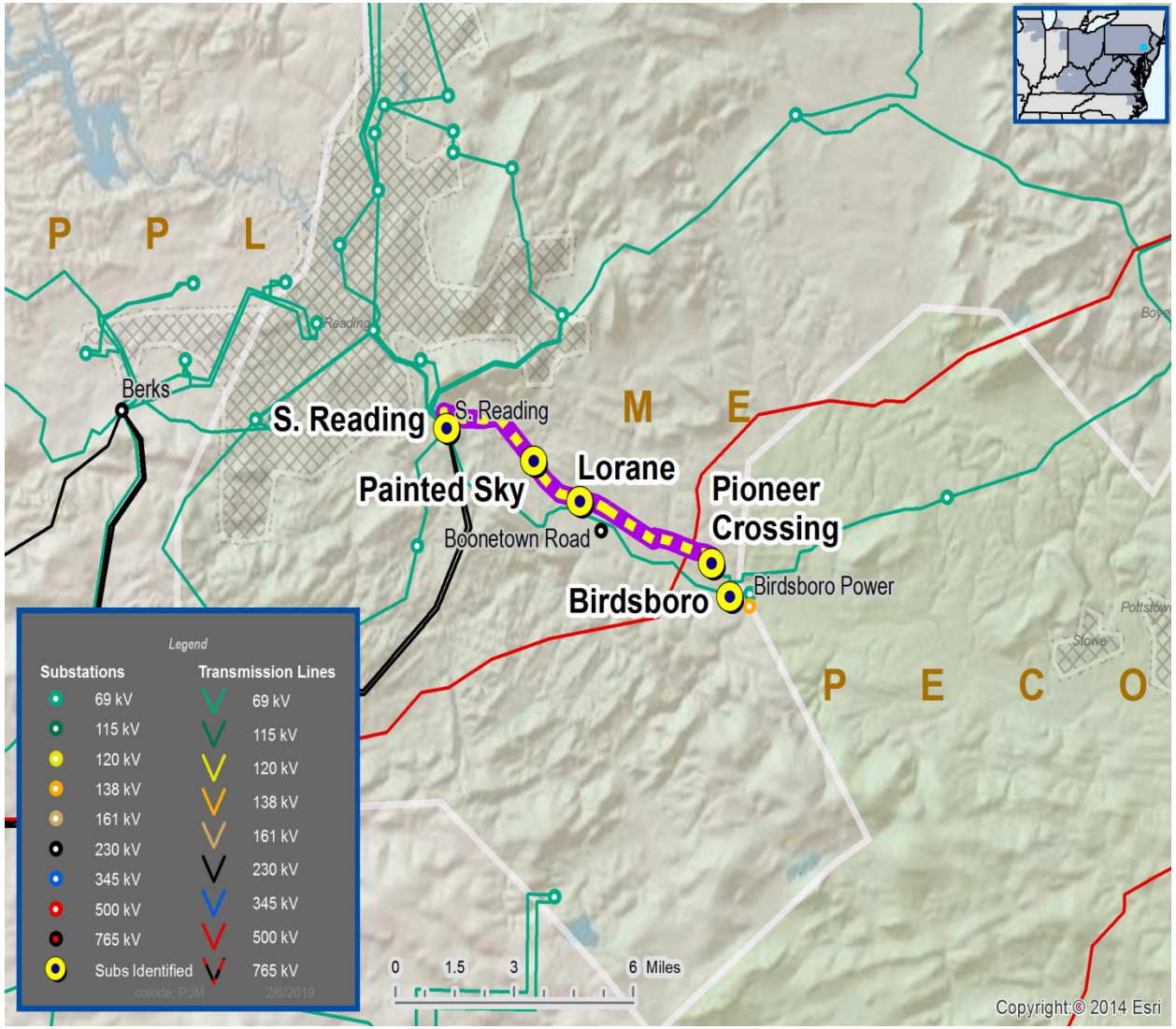
Transmission line rating is limited by terminal equipment.

South Reading-Painted Sky 69 kV line: *(substation conductor)*

- Existing line rating is 88 / 114 MVA (SN / SE).
- Existing conductor rating is 139 / 169 MVA (SN / SE).

Painted Sky-Lorane 69 kV line: *(substation conductor)*

- Existing line rating is 137 / 169 MVA (SN / SE).
- Existing conductor rating is 139 / 169 MVA (SN / SE).



Met-Ed Transmission Zone M-3 Process
Birdsboro – South Reading 69 kV Line Rebuild/Rehab

Need Number: ME-2019-015

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Birdsboro – South Reading 69 kV line Rehab/Rebuild

- Rehab/Rebuild Birdsboro – South Reading (s1904)
- Reconductor 2.68 miles of 69 kV Line
  - 2.23 miles on Lorane-Pioneer Crossing (s1904.1)
  - 0.45 miles on Pioneer Crossing-Birdsboro (s1904.2)
- Replace substation conductor at Lorane 69 kV station (1904.3)
- Replace substation conductor at South Reading 69 kV station (1904.4)

Transmission Line Ratings:

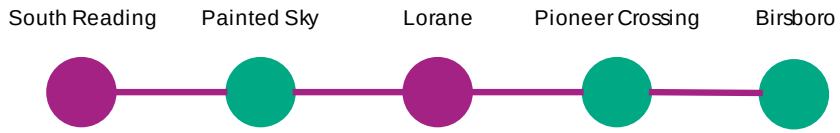
- South Reading – Painted Sky 69 kV Line:
  - Before Proposed Solution: 88/114 MVA (SN/SE)
  - After Proposed Solution: 139/169 MVA (SN/SE)
- Painted Sky – Lorane 69 kV Line:
  - Before Proposed Solution: 137/169 MVA (SN/SE)
  - After Proposed Solution: 139/169 MVA (SN/SE)
- Lorane – Pioneer Crossing 69 kV Line:
  - Before Proposed Solution: 55/56 MVA (SN/SE)
  - After Proposed Solution: 139/169 MVA (SN/SE)
- Pioneer Crossing – Birdsboro 69 kV Line:
  - Before Proposed Solution: 74/90 MVA (SN/SE)
  - After Proposed Solution: 139/169 MVA (SN/SE)

Estimated Cost: $4.1M

Projected In-Service: 12/01/2019

Supplemental Project ID: s1904, s1904.1, s1904.2, s1904.3, s1904.4

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

North Boyertown – Ringing Rocks 69 kV Line Rebuild/Rehab

Need Number: ME-2019-016

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 02/22/2019

Solution Meeting 04/26/2019

Project Driver:

Equipment Material Condition, Performance and Risk

Specific Assumption Reference:

- Line Condition Rebuild/Replacement – Age/condition of transmission line conductors, wood pole transmission line structures, and steel pole transmission line structures
- System Performance Projects – Substation/Line Equipment Limits
- Reconductor/Rebuild Transmission Lines – Transmission lines with high loading

Problem Statement:

The N. Boyertown-Cabot-County Line-Middle Creek-Ringing Rocks 69 kV line is exhibiting deterioration resulting in increased maintenance. The Transmission line is approaching end of life

- 41 out of 147 structures failed inspection (28% Failure Rate).
- Failure reasons include split top, cracking, etc.
- Total line distance is approximately 7.7 miles.

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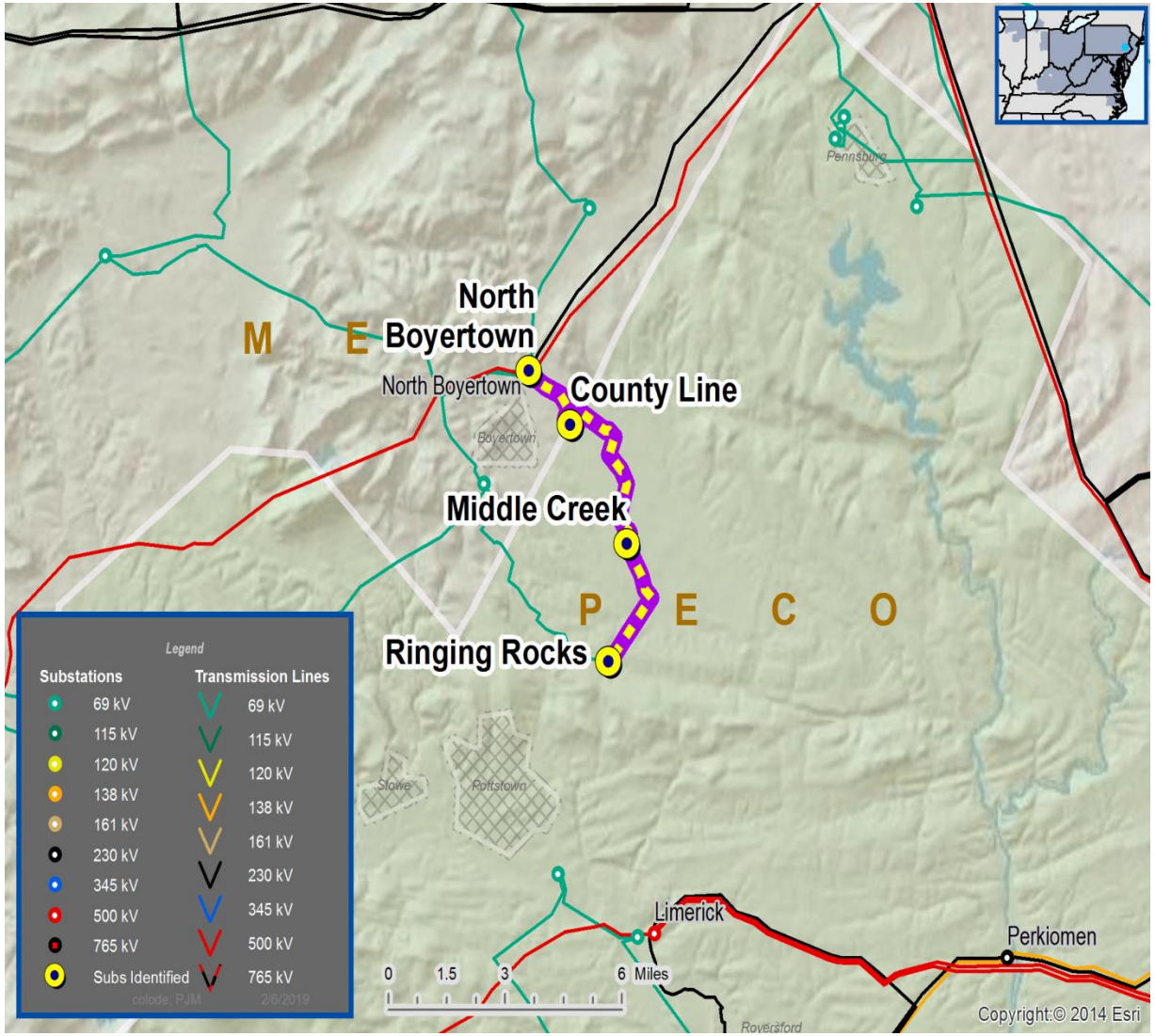


Met-Ed Transmission Zone M-3 Process
North Boyertown – Ringing Rocks 69 kV Line Rebuild/Rehab

Need Number: ME-2019-016

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 02/22/2019

Solution Meeting 04/26/2019

Problem Statement (Continued):

Thermal loading on North Boyertown-Cabot 69 kV section and Cabot-County Line 69 kV sections are loaded to approximately 112% and 100% of their SE ratings respectively for loss of the North Boyertown-West Boyertown 69 kV line & Birdsboro-West Boyertown 69 kV line.

(2018 RTEP Model – 2023 Summer)

Transmission line rating is limited by terminal equipment.

North Boyertown – Cabot Tap 69 kV line: *(relay and substation conductor)*

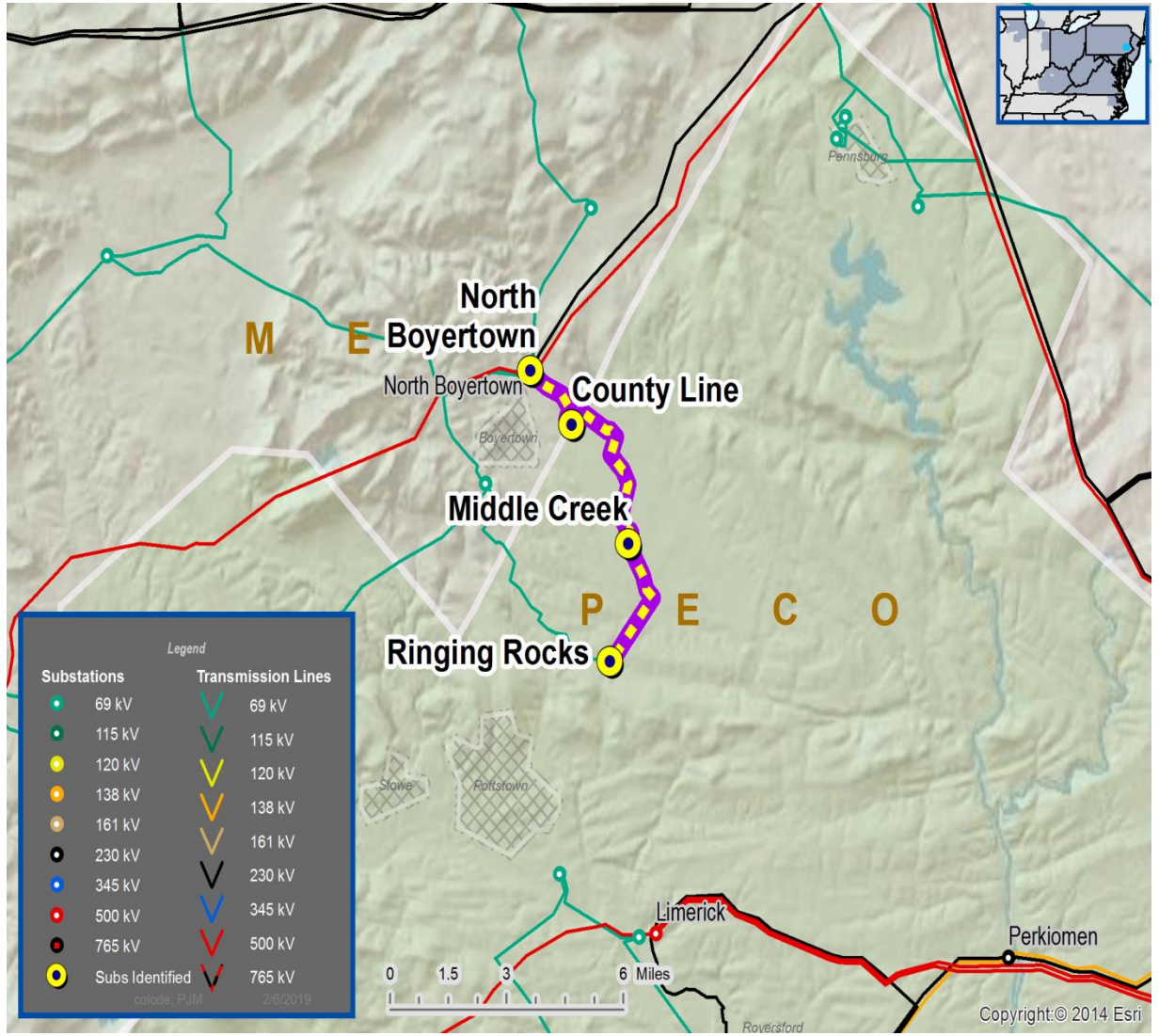
- Existing line rating is 62 / 72 MVA (SN / SE).
- Existing conductor rating is 72 / 72 MVA (SN / SE).

County Line – Middle Creek 69 kV line: *(substation conductor)*

- Existing line rating is 132 / 158 MVA (SN / SE).
- Existing conductor rating is 139 / 169 MVA (SN / SE).

Middle Creek – Ringing Rocks 69 kV line: *(relay, disconnect switch)*

- Existing line rating is 62 / 62 MVA (SN / SE).
- Existing conductor rating is 99 / 99 MVA (SN / SE).



Met-Ed Transmission Zone M-3 Process
North Boyertown – Ringing Rocks 69 kV Line Rebuild/Rehab

Need Number: ME-2019-016

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

North Boyertown – Ringing Rocks 69 kV line Rehab/Rebuild

- Rehab/Rebuild North Boyertown – Ringing Rocks (s1905)
- Reconductor approximately 1.5 miles on North Boyertown-County Line section 69 kV line (s1905.1)
- Replace Substation Conductor and Relay at North Boyertown on the North Boyertown – Cabot Supermetals 69 kV line (s1905.2)
- Replace Substation Conductor at County Line on the County Line - Middle Creek 69 kV line (s1905.3)
- Replace Relay and Disconnect at Ringing Rocks on the Middle Creek - Ringing Rocks 69 kV line (s1905.4)

Transmission Line Ratings:

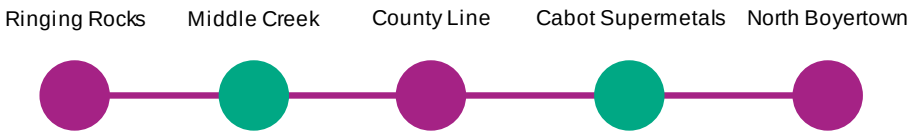
- North Boyertown – Cabot Supermetals 69 kV Line:
  - Before Proposed Solution: 62/72 MVA (SN/SE)
  - After Proposed Solution: 139/169 MVA (SN/SE)
- Cabot Supermetals – County Line 69 kV Line:
  - Before Proposed Solution: 62/77 MVA (SN/SE)
  - After Proposed Solution: 139/169 MVA (SN/SE)
- County Line – Middle Creek 69 kV Line:
  - Before Proposed Solution: 132/158 MVA (SN/SE)
  - After Proposed Solution: 139/169 MAV (SN/SE)
- Middle Creek – Ringing Rocks 69 kV Line:
  - Before Proposed Solution: 62/62 MVA (SN/SE)
  - After Proposed Solution: 139/169 MVA (SN/SE)

Estimated Cost: $4.5M

Projected In-Service: 12/31/2020

Supplemental Project ID: s1905, s1905.1, s1905.2, s1905.3, s1905.4,

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
Cleona – West Lebanon 69 kV Line Rebuild/Rehab

Need Number: ME-2019-017

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 02/22/2019

Solution Meeting 04/26/2019

Project Driver:

Equipment Material Condition, Performance and Risk

Specific Assumption Reference:

- Line Condition Rebuild/Replacement – Age/condition of transmission line conductors, wood pole transmission line structures
- System Performance Projects – Substation/Line Equipment Limits
- Reconductor/Rebuild Transmission Lines – Transmission lines with high loading

Problem Statement:

The N. Lebanon-Cleona-W. Lebanon 69 kV line is exhibiting deterioration resulting in increased maintenance. The Transmission line is approaching end of life

- 58 out of 73 structures failed inspection (79% Failure Rate).
- Failure reasons include top rot, voids, woodpecker holes, etc.
- Total line distance is approximately 7.1 miles.

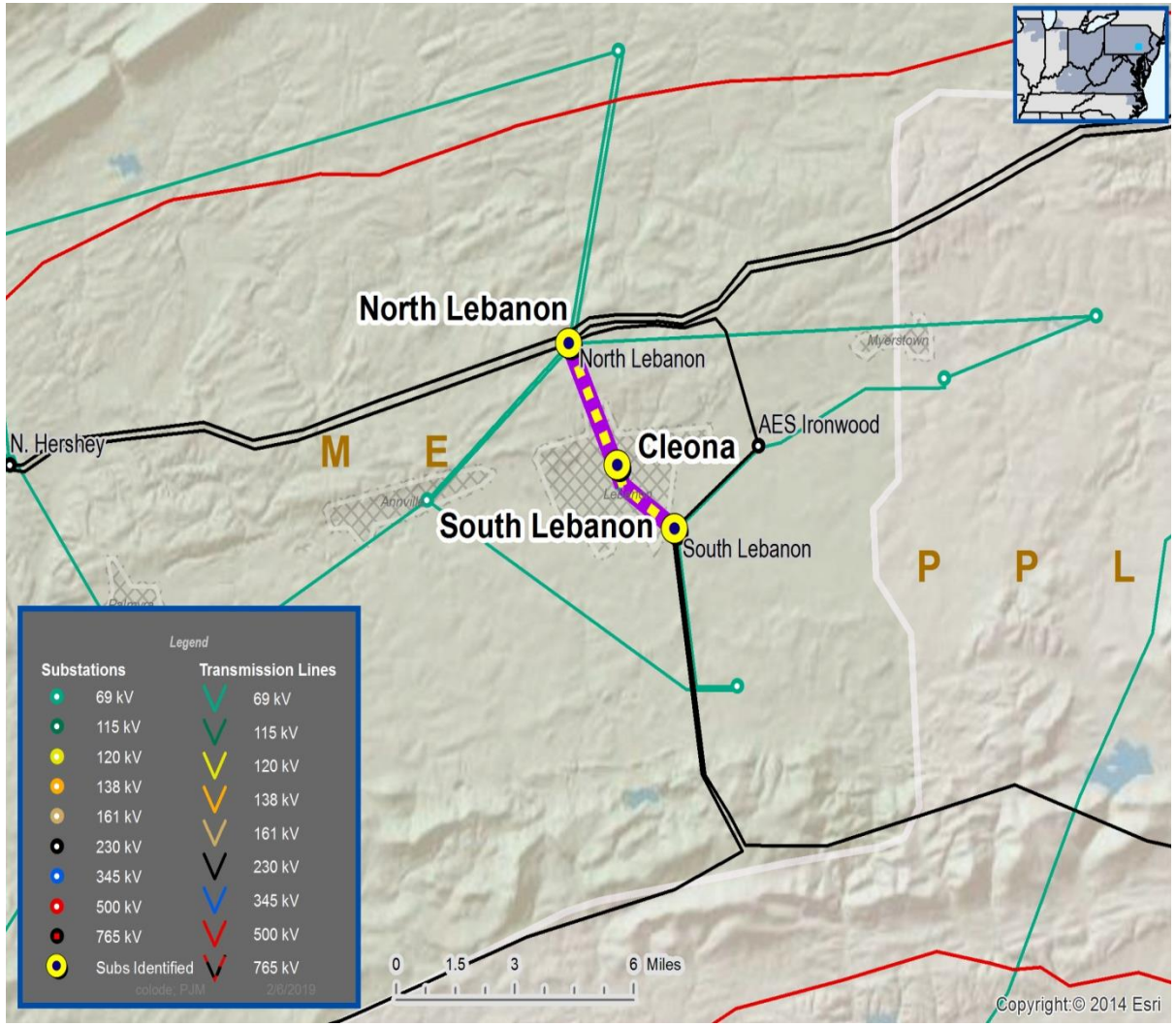
Thermal loading on Cleona-West Lebanon 69 kV section is approximately 98% of the SE rating for loss of the South Lebanon 230-69 kV #1 & #2 transformers.

(2018 RTEP Model – 2023 Summer)

Transmission line rating is limited by terminal equipment.

North Lebanon – Cleona 69 kV line: *(relay and disconnect switches)*

- Existing line rating is 78 / 82 MVA (SN / SE).
- Existing conductor rating is 111/134 MVA (SN / SE).



Met-Ed Transmission Zone M-3 Process
Cleona – West Lebanon 69 kV Line Rebuild/Rehab

Need Number: ME-2019-017

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Cleona - West Lebanon 69 kV line Rehab/Rebuild

- Rehab/Rebuild Cleona – West Lebanon (s1906)
- Reconductor ~2.4 miles of Cleona-West Lebanon 69 kV section (s1906.1)
- Replace relay and switches at North Lebanon on the Cleona - North Lebanon 69 kV line (s1906.2)

Transmission Line Ratings:

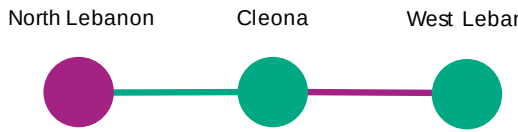
- North Lebanon – Cleona 69 kV Line:
  - Before Proposed Solution: 78/82 MVA (SN/SE)
  - After Proposed Solution: 111/134 MVA (SN/SE)
- Cleona – West Lebanon 69 kV Line:
  - Before Proposed Solution: 55/56 MVA (SN/SE)
  - After Proposed Solution: 111/134 MVA (SN/SE)

Estimated Cost: $3.1M

Projected In-Service: 12/31/2019

Supplemental Project ID: s1906, s1906.1, s1906.2

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
South Lebanon #1 and #2 230/69 kV Transformer Replacement and 230 kV Ring Bus

Need Number: ME-2019-018
Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019
Previously Presented:
Need Meeting 02/22/2019
Solution Meeting 04/26/2019
Project Driver:
Equipment Material Condition, Performance and Risk
Specific Assumption Reference:
- Substation Condition Rebuild/Replacement
- Add/Expand Bus Configuration

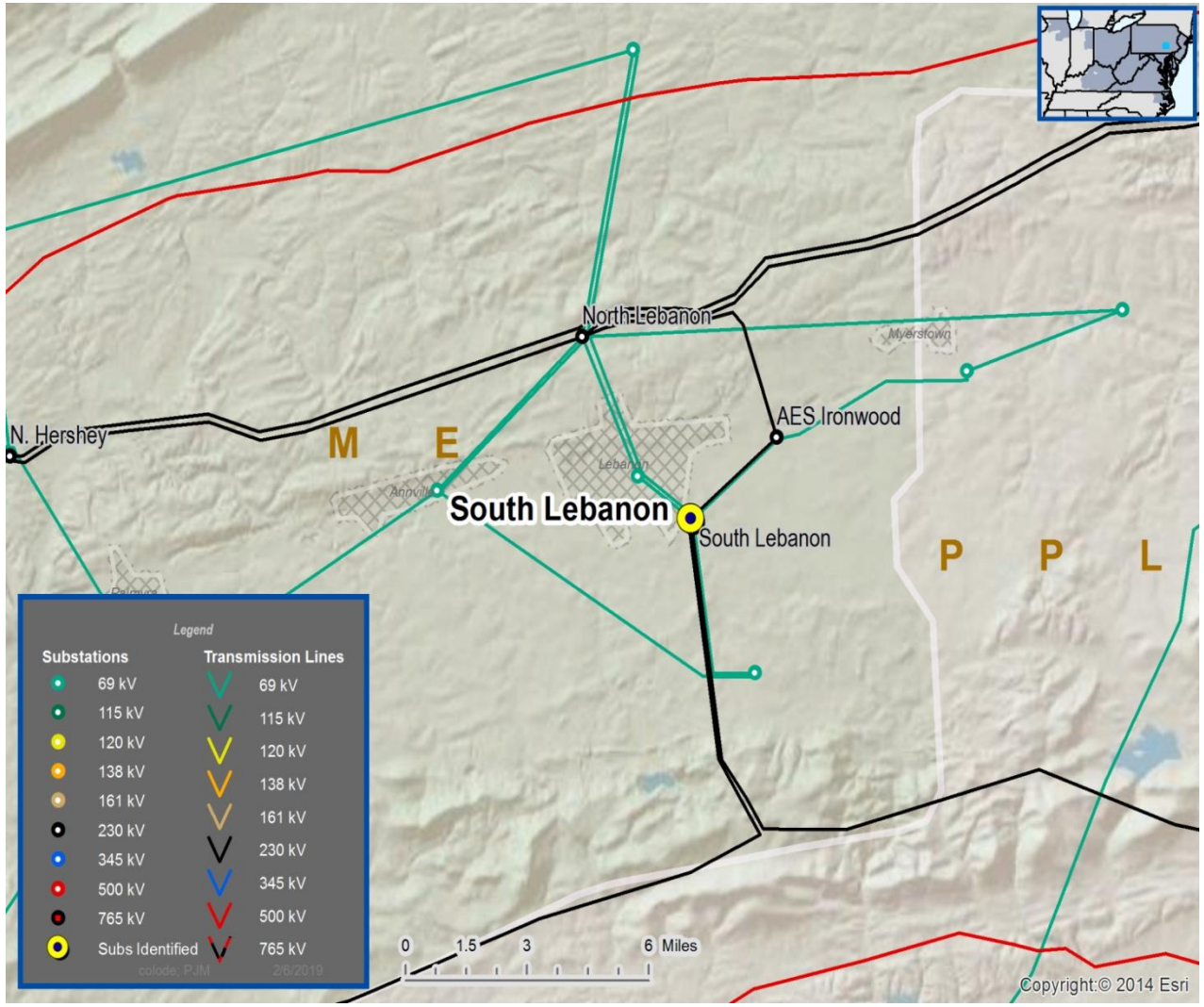
- Eliminate simultaneous outages to multiple networked elements for stuck breakers, bus outages, N-2 events, etc...

Problem Statement:
South Lebanon #1 230-69 kV:
- Transformer is 49 years old
- Experiencing dissolved gasses in oil
- Analysis shows breaking down of paper insulation

South Lebanon #2 230-69 kV:
- Transformer is 50 years old and at end of life
- History of oil leaks
- Analysis shows breaking down of paper insulation
- Broken fans and deteriorating bushings
- Tank temp has to be read with a thermal gun

Existing #1 transformer circuit rating is 137 / 172 MVA (SN / SE).
Existing #1 transformer rating is 131 / 139 MVA (SN / SE).

Existing #2 transformer circuit rating is 133 / 171 MVA (SN / SE).
Existing #2 transformer rating is 127 / 135 MVA (SN / SE).



Met-Ed Transmission Zone M-3 Process
South Lebanon #1 and #2 230/69 kV Transformer Replacement and 230 kV Ring Bus

Need Number: ME-2019-018

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

South Lebanon #1 and #2 230-69 kV transformer replacement and 230 kV ring bus $13.9M (s1907)

- Replace the 230-69 kV 60/80/100 MVA #1 transformer and associated equipment with a new 230-69 kV 100/134/168 MVA transformer (s1907.1)
- Replace the 230-69 kV 60/80/100 MVA #2 transformer and associated equipment with a new 230-69 kV 100/134/168 MVA transformer (s1907.2)
- Expand the South Lebanon 230 kV bus into a 5 breaker ring bus (s1907.3)

Transformer Ratings:

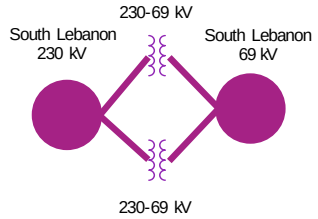
- South Lebanon #1 230/69 kV transformer:
  - Before Proposed Solution: 131/139 MVA (SN/SE)
  - After Proposed Solution (anticipated): 211/232 MVA (SN/SE)
- South Lebanon #2 230/69 kV transformer:
  - Before Proposed Solution: 127/135 MVA (SN/SE)
  - After Proposed Solution (anticipated): 211/232 MVA (SN/SE)

Estimated Cost: $13.9M

Projected In-Service: 12/31/2021

Supplemental Project ID: s1907, s1907.1, s1907.2, s1907.3

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

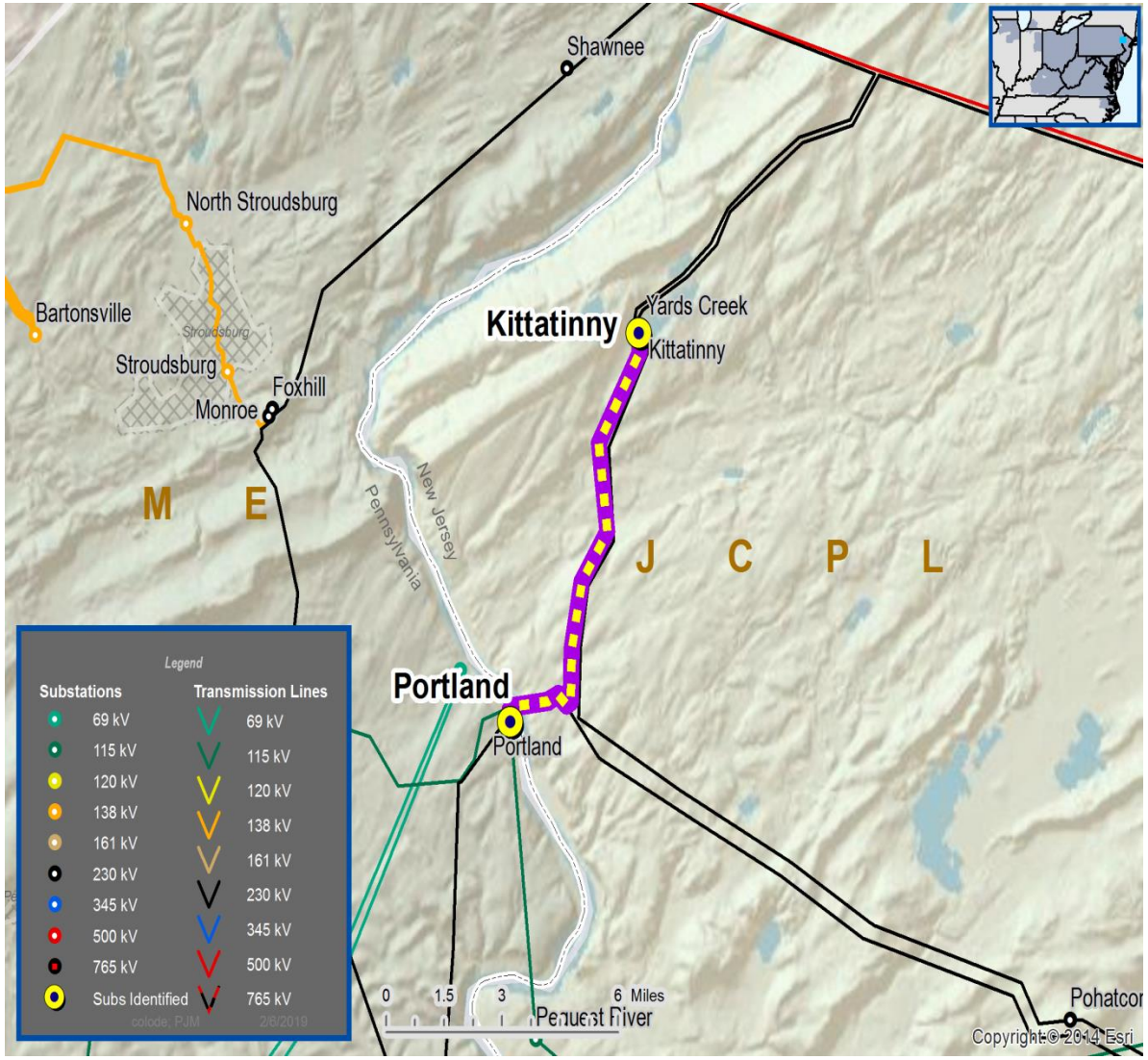
Met-Ed Transmission Zone M-3 Process
Kittatinny – Portland 230 kV Relay Replacement

Need Number: ME-2019-019
Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019
Previously Presented:
Need Meeting 02/22/2019
Solution Meeting 04/26/2019
Project Driver:
Equipment Material Condition, Performance and Risk
Operational Flexibility and Efficiency
Specific Assumption Reference:
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:
Relays on Kittatinny – Portland 230 kV line have been identified as 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.

- Kittatinny – Portland 230 kV line:
  Existing line rating: 1114 / 1195 MVA (SN / SE).
  Existing conductor rating: 1114 / 1285 MVA (SN / SE).
  (relaying)



Met-Ed Transmission Zone M-3 Process
Kittatinny – Portland 230 kV Relay Replacement

Need Number: ME-2019-019

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Kittatinny – Portland 230 kV Relay Replacement (s1908)

- Replace line relaying at Portland

Transmission Line Ratings:

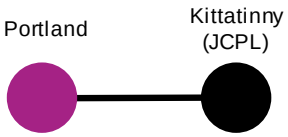
- Kittatinny – Portland 230 kV Line:
  - Before Proposed Solution: 1114/1195 MVA (SN/SE)
  - After Proposed Solution: 1114/1285 MVA (SN/SE)

Estimated Cost: $1.0M

Projected In-Service: 12/31/2019

Supplemental Project ID: s1908

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
North Lebanon – Turf Club 69 kV Line Rehab/Rebuild

Need Number: ME-2019-021

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 02/22/2019

Solution Meeting 04/26/2019

Project Driver:

Equipment Material Condition, Performance and Risk

Specific Assumption Reference:

- Line Condition Rebuild/Replacement – Age/condition of transmission line conductors, wood pole transmission line structures, and steel pole transmission line structures
- System Performance Projects – Substation/Line Equipment Limits
- Reconductor/Rebuild Transmission Lines – Transmission lines with high loading

Problem Statement:

The North Lebanon – Turf Club 69 kV line is exhibiting deterioration resulting in increased maintenance. The Transmission line is approaching end of life

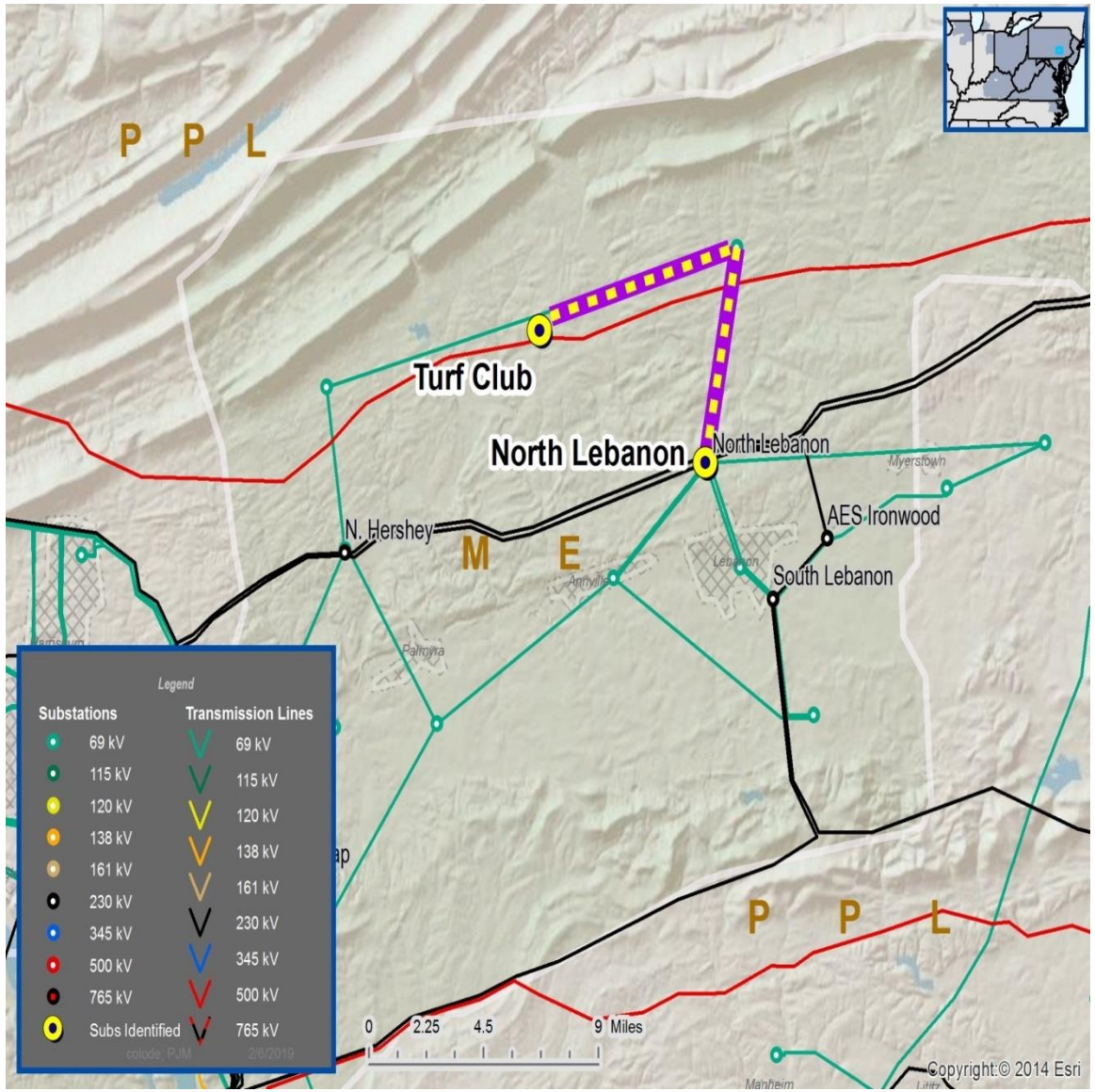
- 236 out of 360 structures failed inspection. (66% Failure Rate)
- Failure reasons include decay, woodpecker holes, cracking, bad/cut/missing ground wires, etc.
- Total line distance is approximately 23 miles.

Thermal loading on Turf Club – Indiantown Gap 69 kV and Indiantown Gap – Lickdale 69 kV line sections are approximately 97% and 86% of their SE ratings respectively for loss of North Lebanon – Fredericksburg 69 kV line section.

(2018 RTEP Model – 2023 Summer)

Transmission line ratings limited by terminal equipment.

- North Lebanon – Fredericksburg 69 kV line:
  - Existing line rating: 82 / 103 MVA (SN / SE).
  - Existing conductor rating is 139 / 169 MVA (SN / SE).
  - *(disconnect switches)*



Met-Ed Transmission Zone M-3 Process
North Lebanon – Turf Club 69 kV Line Rehab/Rebuild

Need Number: ME-2019-021

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

North Lebanon – Turf Club 69 kV line Rehab/Rebuild

- Rehab/Rebuild North Lebanon – Turf Club 69 kV line (s1910)
- Reconductor approximately 18.5 miles of Frystown – Turf Club 69 kV line (s1910.1)
- Replace switches at North Lebanon on the North Lebanon – Fredericksburg Tap 69 kV (s1910.2)

Transmission Line Ratings:

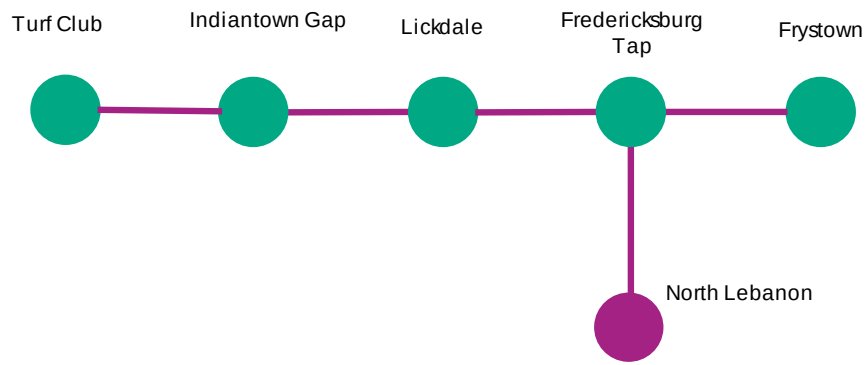
- North Lebanon – Fredericksburg 69 kV Line:
  - Before Proposed Solution: 82/103 MVA (SN/SE)
  - After Proposed Solution: 139/169 MVA (SN/SE)
- Fredericksburg – Frystown 69 kV Line:
  - Before Proposed Solution: 80/96 MVA (SN/SE)
  - After Proposed Solution: 111/134 MVA (SN/SE)
- Fredericksburg – Lickdale 69 kV Line:
  - Before Proposed Solution: 80/96 MVA (SN/SE)
  - After Proposed Solution: 111/134 MVA (SN/SE)
- Lickdale – Indiantown Gap 69 kV Line:
  - Before Proposed Solution: 64/65 MVA (SN/SE)
  - After Proposed Solution: 111/134 MVA (SN/SE)
- Indiantown Gap – Turf Club 69 kV Line:
  - Before Proposed Solution: 64/65 MVA (SN/SE)
  - After Proposed Solution: 111/134 MVA (SN/SE)

Estimated Cost: $21.1M

Projected In-Service: 12/31/2021

Supplemental Project ID: s1910, s1910.1, s1910.2

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
Hokes – Smith Street 69 kV Line Rehab/Rebuild

Need Number: ME-2019-022

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 02/22/2019

Solution Meeting 04/26/2019

Project Driver:

Equipment Material Condition, Performance and Risk

Specific Assumption Reference:

- Line Condition Rebuild/Replacement – Age/condition of transmission line conductors, wood pole transmission line structures
- Reconductor/Rebuild Transmission Lines – Transmission lines with high loading

Problem Statement:

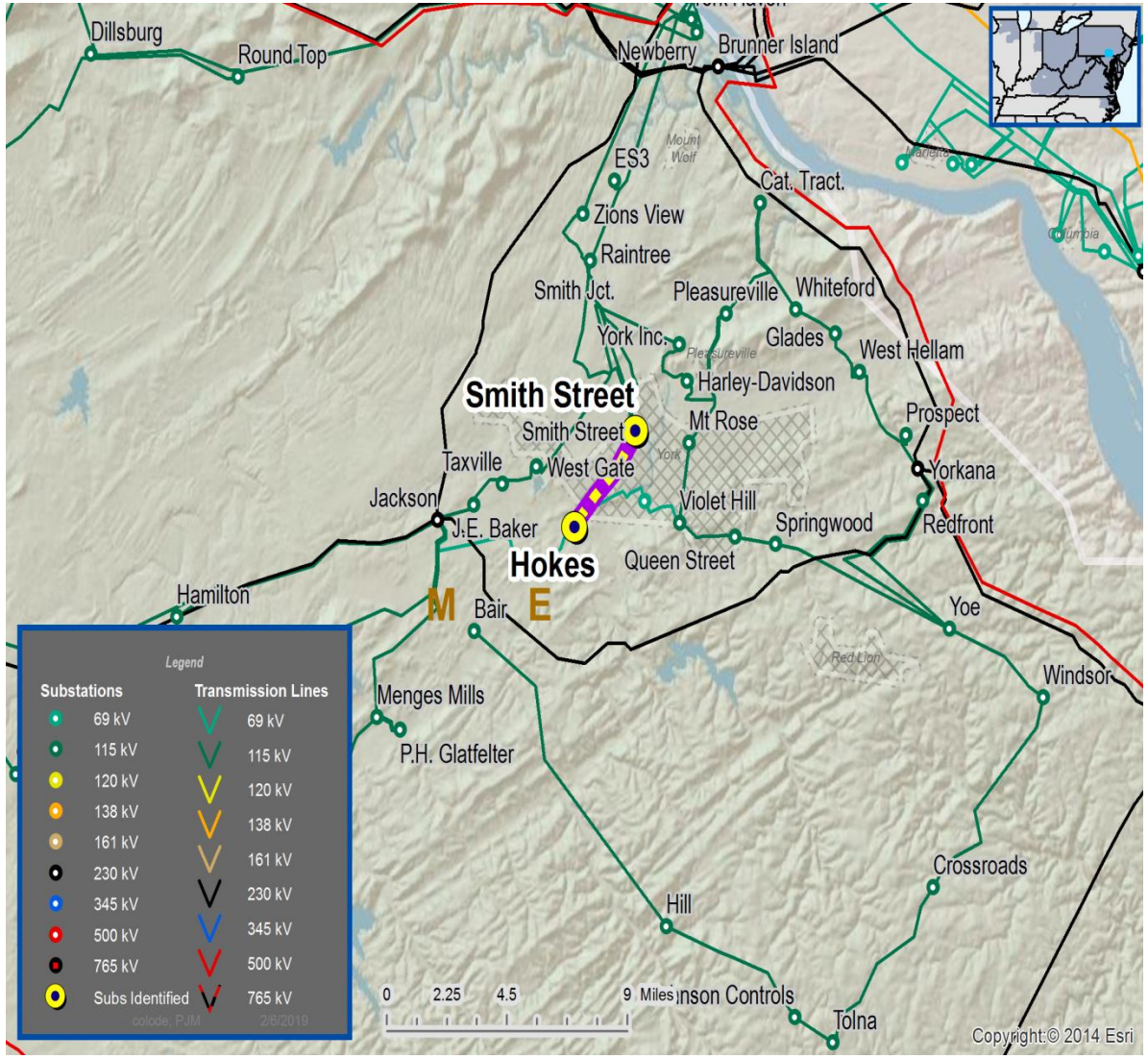
The Hokes – Smith St 69 kV is exhibiting deterioration resulting in increased maintenance. The Transmission line is approaching end of life.

- 83 out of 122 structures failed inspection. (68% Failure Rate)
- Failure reasons include contamination, sound, bad/cut/missing ground wires, etc.
- Total line distance is approximately 5.4 miles.

Thermal loading on Hokes-Smith Street 69 kV line is loaded to approximately 158% of the SE rating for loss of the Jackson-Hokes 69 kV line & the Violet Hill 69 kV transformer.

(2018 RTEP Model – 2023 Summer)

Transmission line rating is currently limited by the conductor: 43 / 44 MVA (SN / SE).



Met-Ed Transmission Zone M-3 Process
Hokes – Smith Street 69 kV Line Rehab/Rebuild

Need Number: ME-2019-022

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Hokes – Smith Street 69 kV line Rehab/Rebuild (s1911)

- Rehab/Rebuild Hokes – Smith Street.
- Reconductor 5.4 miles.

Transmission Line Ratings:

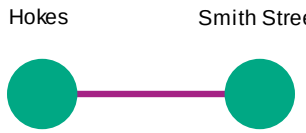
- Hokes – Smith Street 69 kV Line:
  - Before Proposed Solution: 43/44 MVA (SN/SE)
  - After Proposed Solution: 139/169 MVA (SN/SE)

Estimated Cost: $5.8M

Projected In-Service: 12/31/2021

Supplemental Project ID: s1911

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
Tap the Carpenter Technology-West Reading 69 kV Line

Need Number: ME-2019-038

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 05/31/2019

Solution Meeting 06/28/2019

Project Driver:

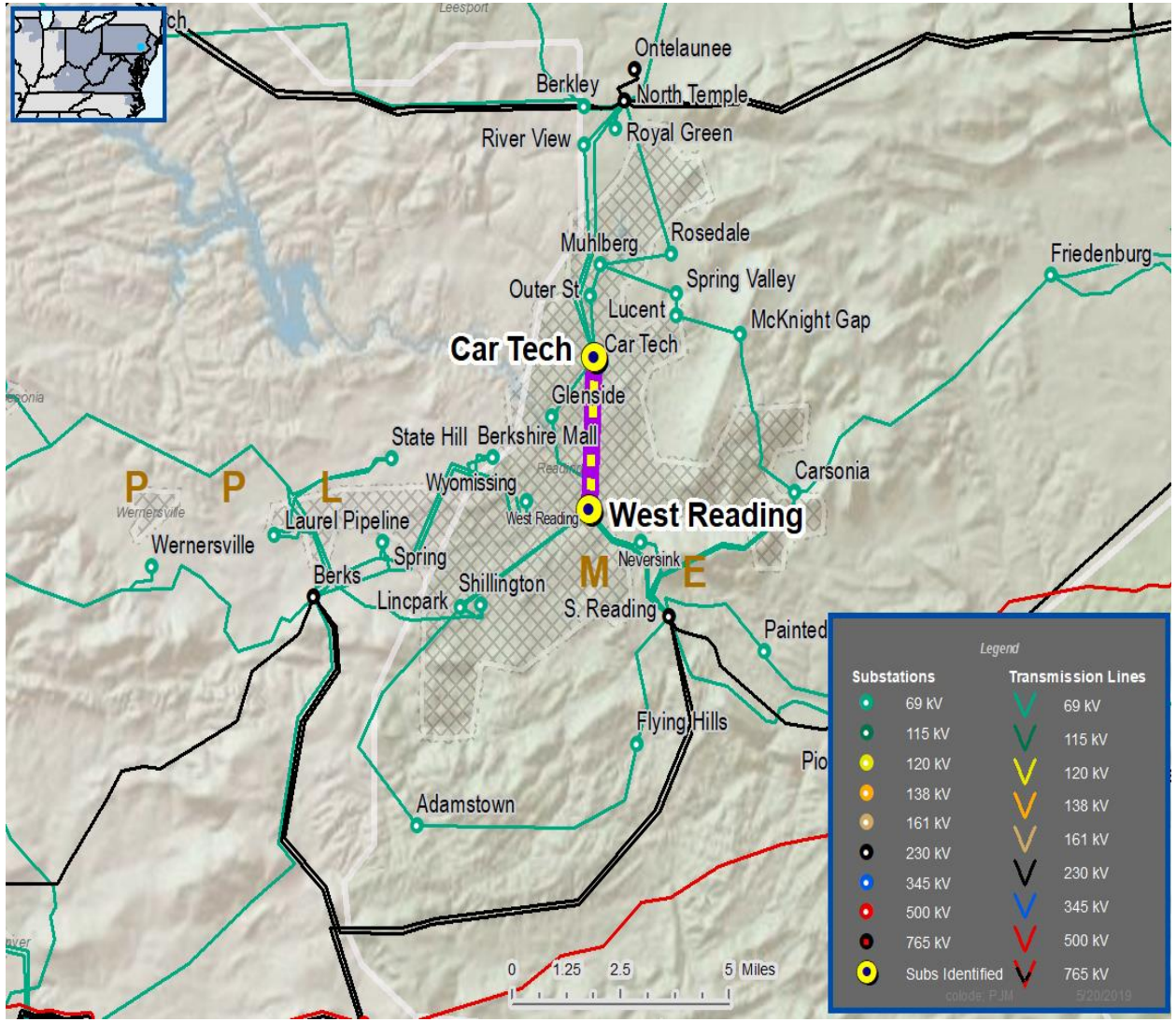
Customer Service

Specific Assumption Reference:

Customer request will be evaluated per FirstEnergy's "Requirements for Transmission Connected Facilities" document and "Transmission Planning Criteria" document.

Problem Statement:

New Customer Connection - A customer requested 69 kV service; anticipated load is 22 MVA; location is near the Carpenter Technology-West Reading 69 kV line.



Met-Ed Transmission Zone M-3 Process
Tap the Carpenter Technology-West Reading 69 kV Line

Need Number: ME-2019-038

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

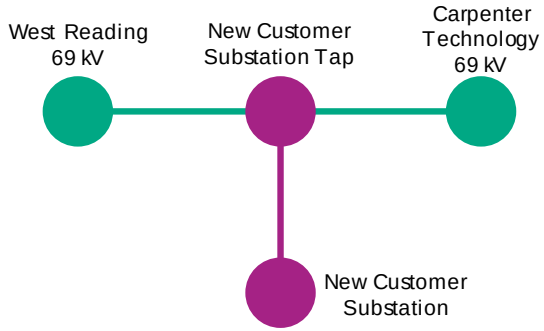
- Tap the Carpenter Technology-West Reading 69 kV line (s1925)
- Install three 69 kV switches (s1925)
- Construct ~2 spans of 69 kV to customer substation (s1925)

Estimated Cost: $0.8M

Projected In-Service: 10/01/2019

Supplemental Project ID: s1925

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
Glendon 115 kV Ring Bus

Need Number: ME-2019-023

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 05/31/2019

Solution Meeting 07/31/2019

Project Driver:

Operational Flexibility and Efficiency

Specific Assumption Reference:

System Performance Projects

- Load at risk in planning and operational scenarios

Add/Expand Bus Configuration

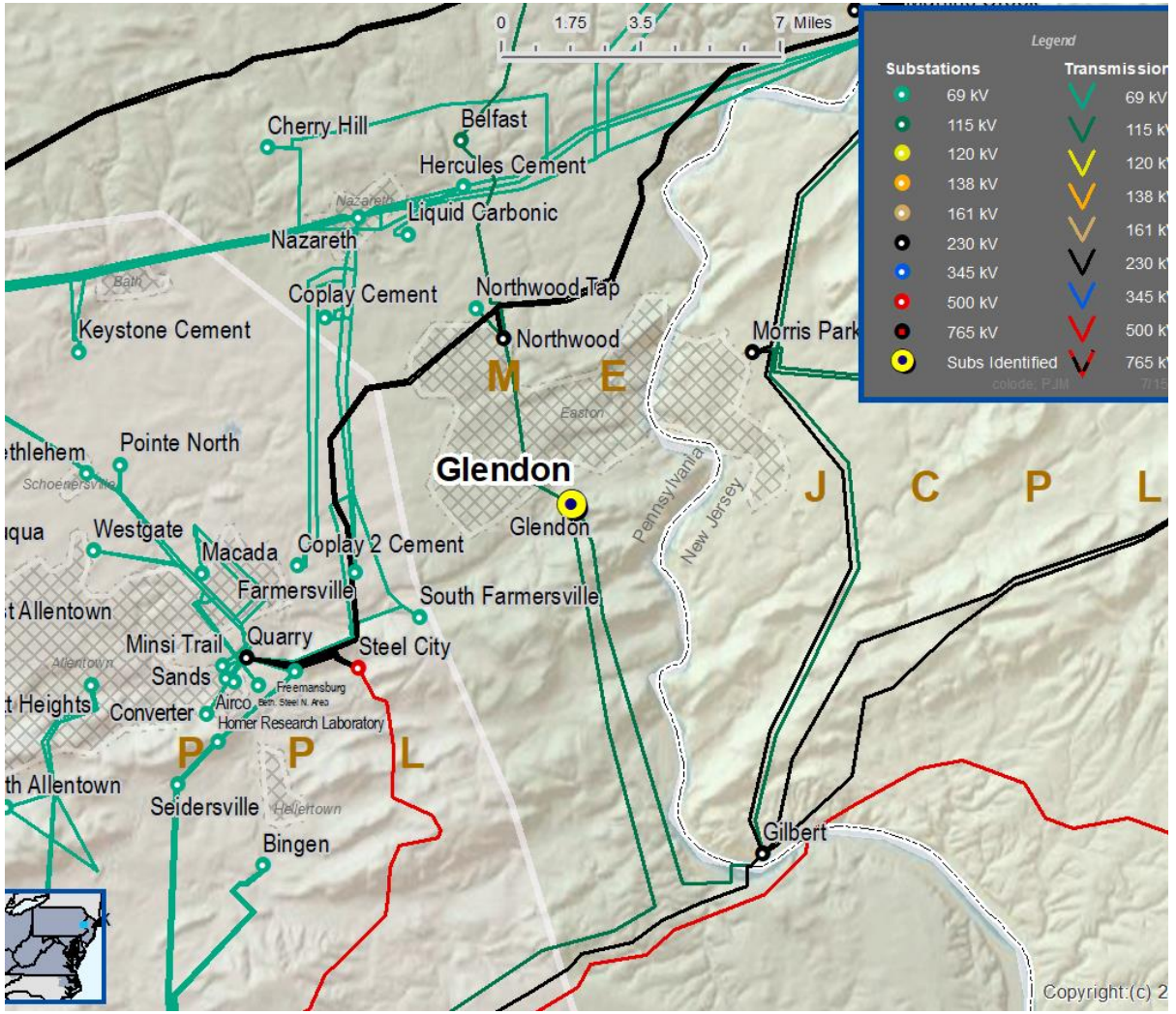
- Reduce the amount of exposed potential local load loss during contingency conditions
- Eliminate simultaneous outages to multiple networked elements

Problem Statement:

The loss of Glendon substation results in loss of approximately 39 MW of load and approximately 5,464 customers.

Substation consists of:

- Three networked 115 kV lines
- Two distribution transformers connected to transmission via switch.
- No bus tie breaker



Met-Ed Transmission Zone M-3 Process
Glendon 115 kV Ring Bus

Need Number: ME-2019-023

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Glendon 115 kV Ring Bus (s2033)

- Construct a six breaker 115 kV ring bus.

Transmission Line Rating:

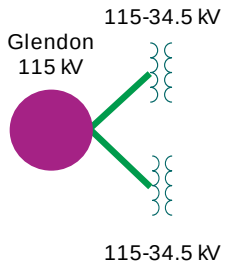
- Glendon – Northwood 115 kV Line
  - Before Proposed Solution: 181/218 MVA (SN/SE)
    - Substation conductor
  - After Proposed Solution: 232/282 MVA (SN/SE)
    - Transmission line conductor

Estimated Cost: $9.9 M

Projected In-Service: 12/31/2023

Supplemental Project ID: s2033

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
Lincoln 115 kV Ring Bus

Need Number: ME-2019-024

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 05/31/2019

Solution Meeting 07/31/2019

Project Driver:

Operational Flexibility and Efficiency

Specific Assumption Reference:

System Performance Projects

- Load at risk in planning and operational scenarios

Add/Expand Bus Configuration

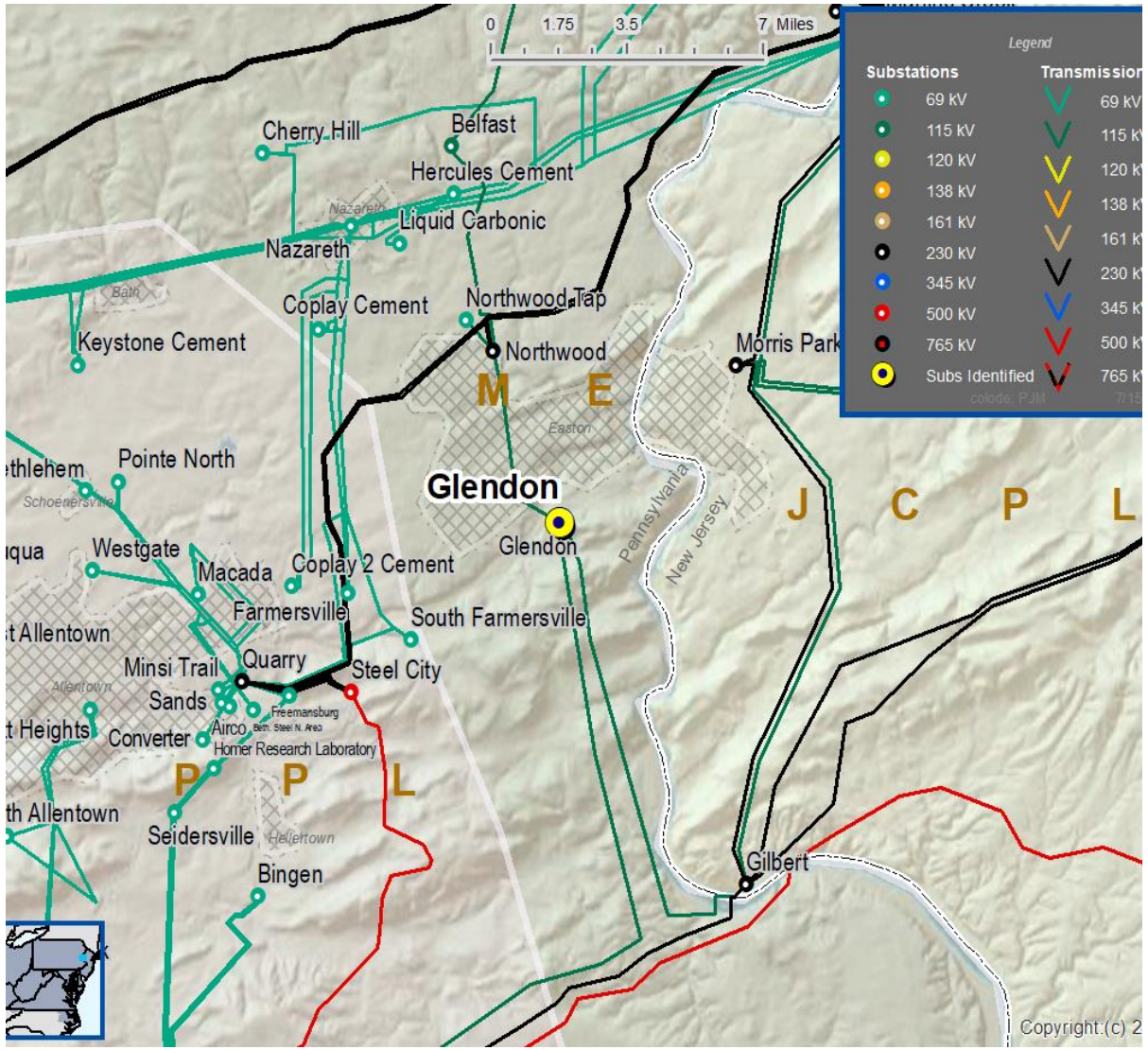
- Reduce the amount of exposed potential local load loss during contingency conditions
- Eliminate simultaneous outages to multiple networked elements

Problem Statement:

The loss of Lincoln substation results in loss of approximately 39 MW of load and approximately 5,688 customers.

Substation consists of:

- Three networked 115 kV lines
- Two distribution transformers in substation and one tapped off line. All transformer connected to transmission with switches.
- No bus tie breaker



Met-Ed Transmission Zone M-3 Process
Lincoln 115 kV Ring Bus

Need Number: ME-2019-024

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Lincoln 115 kV Ring Bus (s2034)

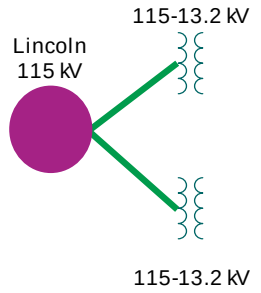
- Convert Lincoln 115 kV to a six breaker ring bus.

Estimated Cost: $6.9 M

Projected In-Service: 12/31/2022

Supplemental Project ID: s2034

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
Westgate 115 kV Tie Breaker

Need Number: ME-2019-025

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 05/31/2019

Solution Meeting 07/31/2019

Project Driver:

Operational Flexibility and Efficiency

Specific Assumption Reference:

System Performance Projects

- Load at risk in planning and operational scenarios

Add/Expand Bus Configuration

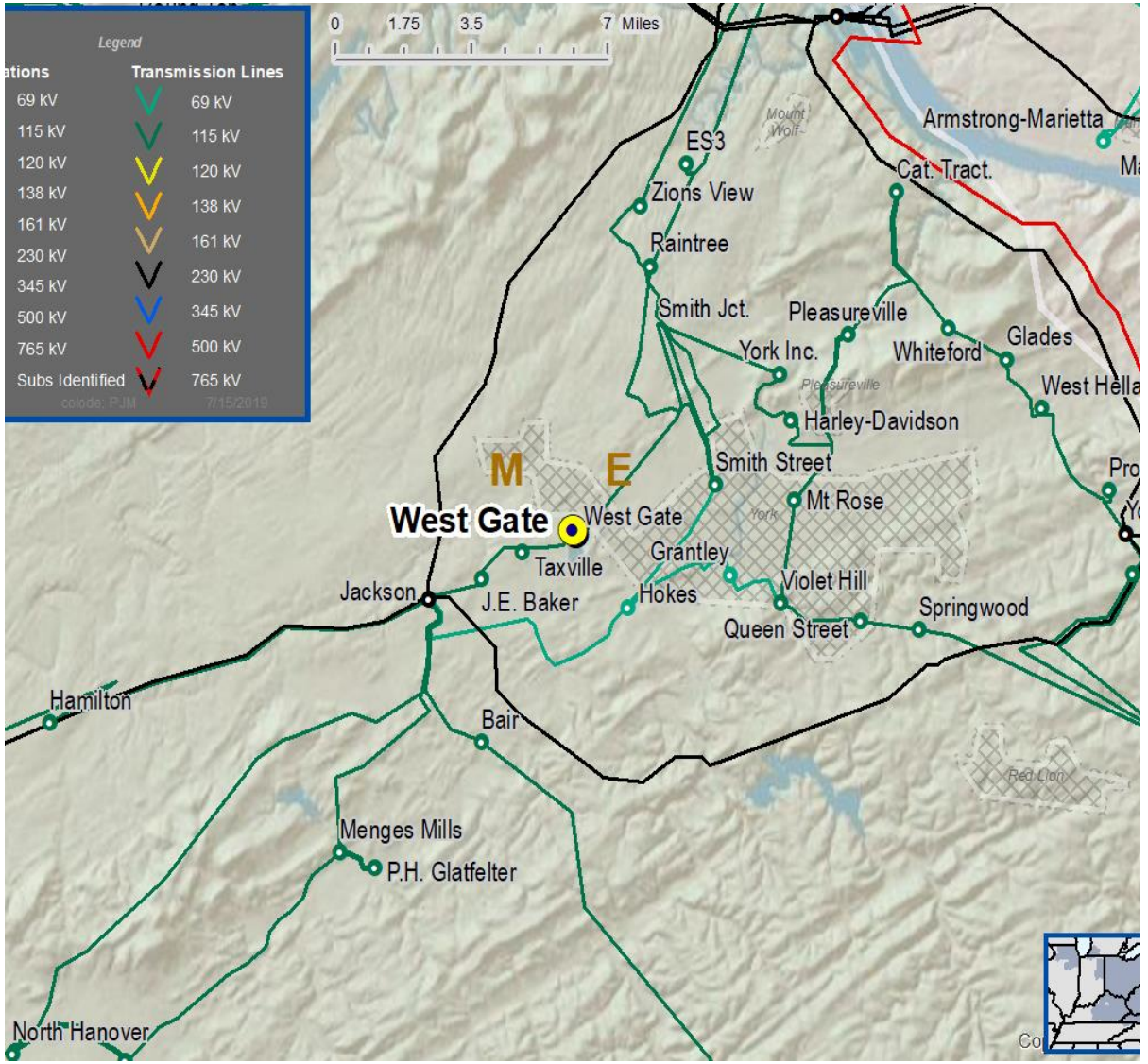
- Reduce the amount of exposed potential local load loss during contingency conditions
- Eliminate simultaneous outages to multiple networked elements

Problem Statement:

The loss of Westgate substation results in loss of approximately 34 MW of load and approximately 5,768 customers.

Substation consists of:

- Two networked 115 kV transmission lines
- Two distribution transformers connected to transmission via switch



Met-Ed Transmission Zone M-3 Process
Westgate 115 kV Tie Breaker

Need Number: ME-2019-025

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Westgate 115 kV Tie Breaker (s2035)

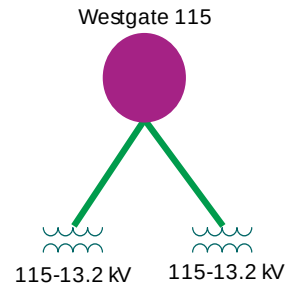
- Install a tie breaker at Westgate 115 kV

Estimated Cost: $0.6 M

Projected In-Service: 12/01/2020

Supplemental Project ID: s2035

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
Northwood 230 kV Ring Bus

Need Number: ME-2019-026

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 05/31/2019

Solution Meeting 07/31/2019

Project Driver:

Operational Flexibility and Efficiency

Specific Assumption Reference:

System Performance Projects

- Load at risk in planning and operational scenarios

Add/Expand Bus Configuration

- Loss of substation bus adversely impacts transmission system performance
- Reduce the amount of exposed potential local load loss during contingency conditions
- Eliminate simultaneous outages to multiple networked elements

Problem Statement:

Two networked 230 kV lines

One 230/115 kV transformer connected via circuit switcher

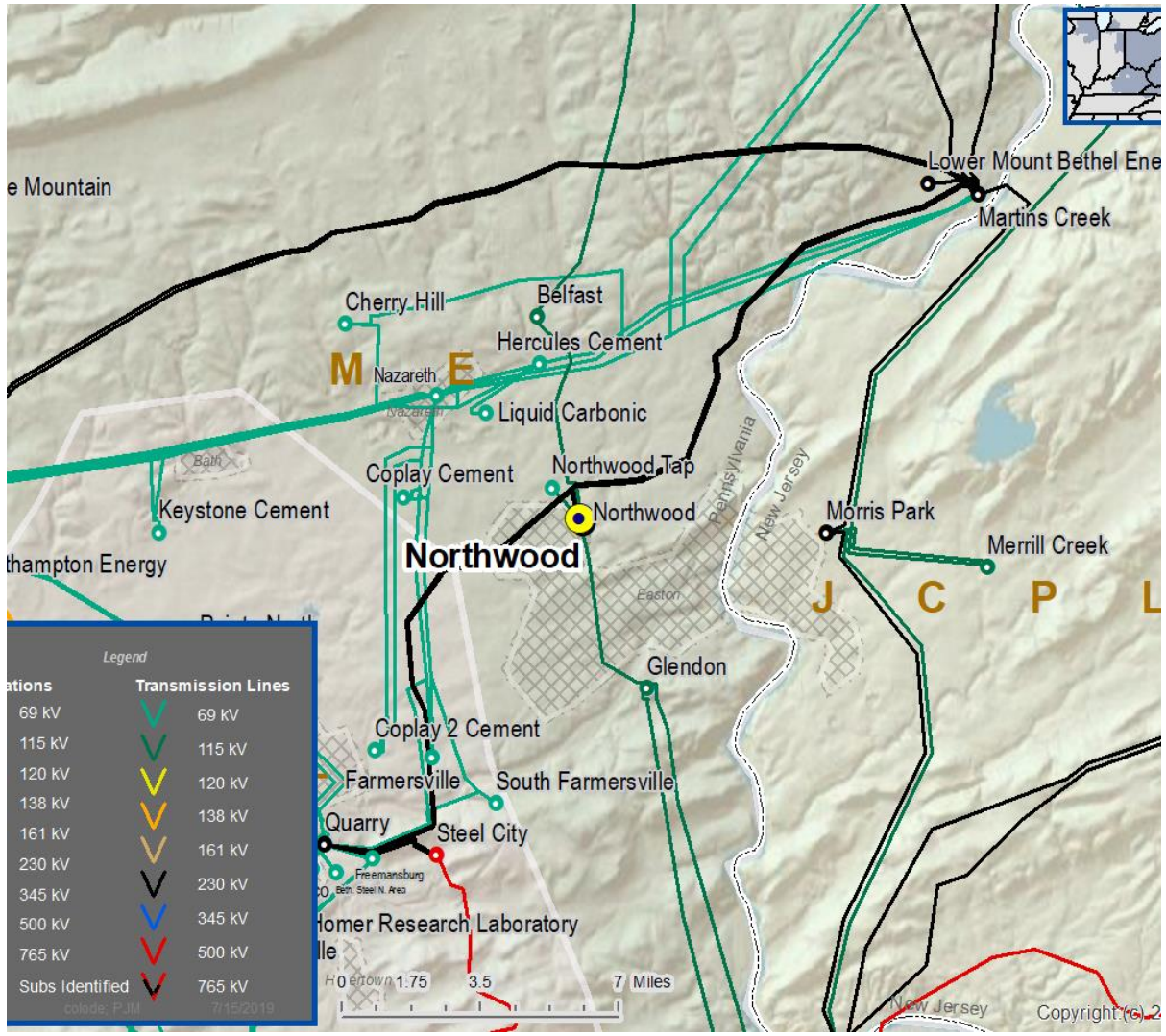
Two 230-34.5 kV distribution transformer connect with circuit switchers

One bus tie breaker

The loss of the Northwood 230 kV Substation sheds approximately 145 MW of load to 9,000 customers. Northwood has a historical peak load of 163 MW.

A fault on the line Quarry(PPL) – Northwood 230 kV line results in the loss of the #3 and #6 transformers.

A stuck breaker results in a loss of the Northwood 230 kV substation.



Met-Ed Transmission Zone M-3 Process
Northwood 230 kV Ring Bus

Need Number: ME-2019-026

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Northwood 230 kV Ring Bus (s2036)

- Convert Northwood 230 kV into a five breaker ring bus.

Transformer Rating:

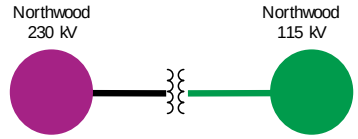
- Martins Creek – Northwood 230 kV Line
  - Before Proposed Solution: 520/621 MVA (SN/SE)
  - After Proposed Solution: 542/666 MVA (SN/SE)

Estimated Cost: $4.5 M

Projected In-Service: 12/31/2021

Supplemental Project ID: s2036

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
Pleasureville Breaker-and-a-Half

Need Number: ME-2019-027

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 05/31/2019

Solution Meeting 07/31/2019

Project Driver:

Operational Flexibility and Efficiency

Specific Assumption Reference:

System Performance Projects

- Load at risk in planning and operational scenarios

Add/Expand Bus Configuration

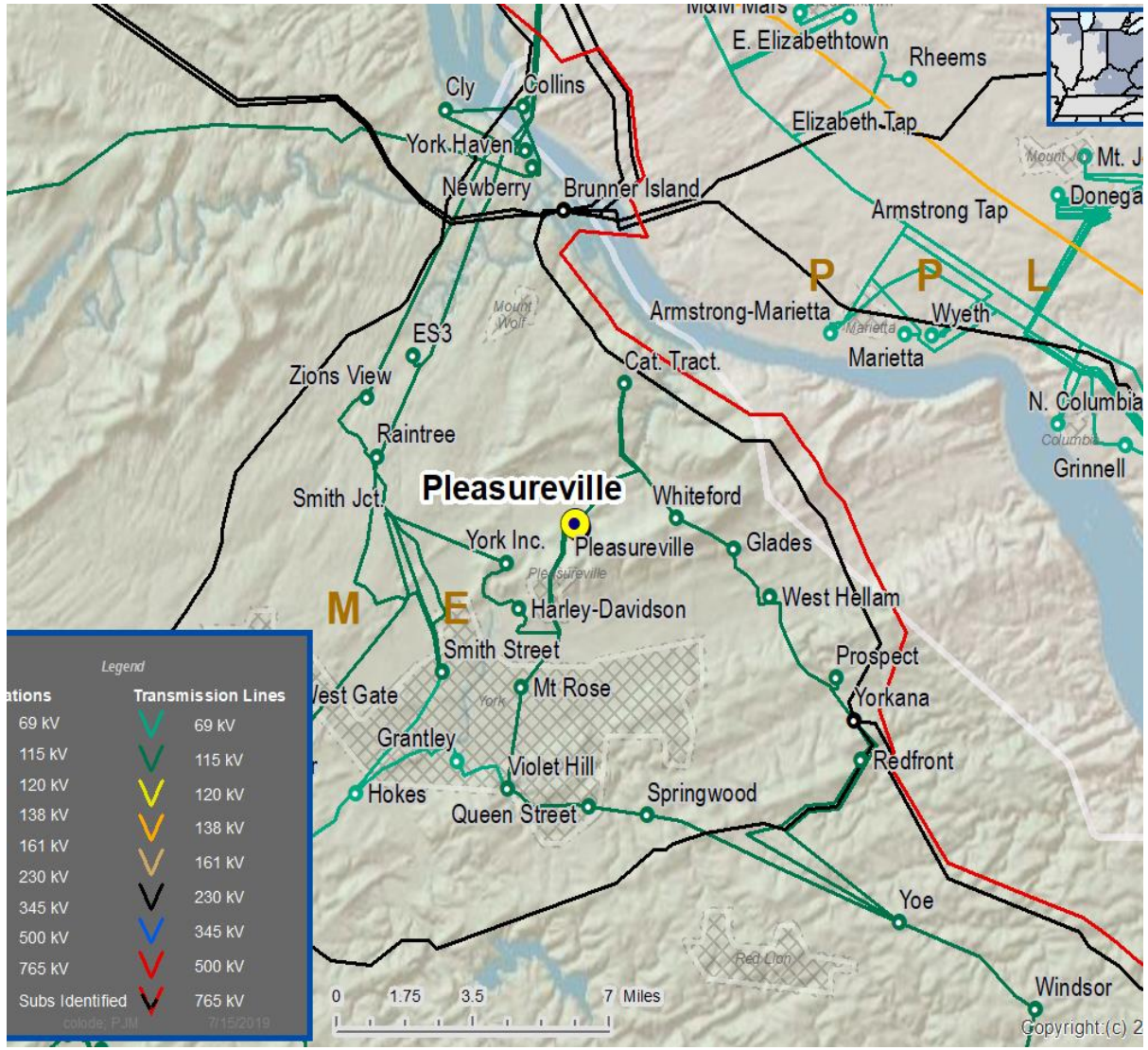
- Reduce the amount of exposed potential local load loss during contingency conditions
- Eliminate simultaneous outages to multiple networked elements

Problem Statement:

The loss of Pleasureville substation results in loss of approximately 39 MW of load and approximately 5,817 customers.

Substation consists of:

- Three networked 115 kV lines connected to a straight bus with no tie breaker.



Met-Ed Transmission Zone M-3 Process
Pleasureville Breaker-and-a-Half

Need Number: ME-2019-027

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Pleasureville 115 kV Breaker-and-a-Half Configuration (s2037)

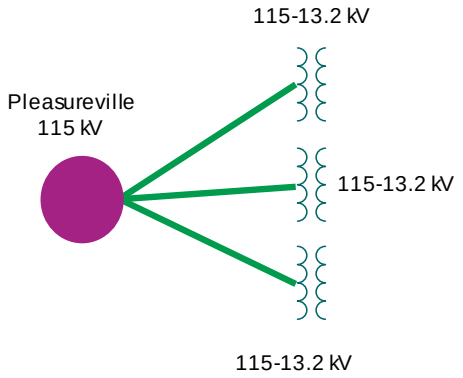
- Expand Pleasureville 115 kV substation into a breaker-and-a-half configuration (8 breakers).

Estimated Cost: $10.0 M

Projected In-Service: 12/31/2022

Supplemental Project ID: s2037

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
Northwood 115 kV Ring Bus

Need Number: ME-2019-028

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 05/31/2019

Solution Meeting 07/31/2019

Project Driver:

Operational Flexibility and Efficiency

Specific Assumption Reference:

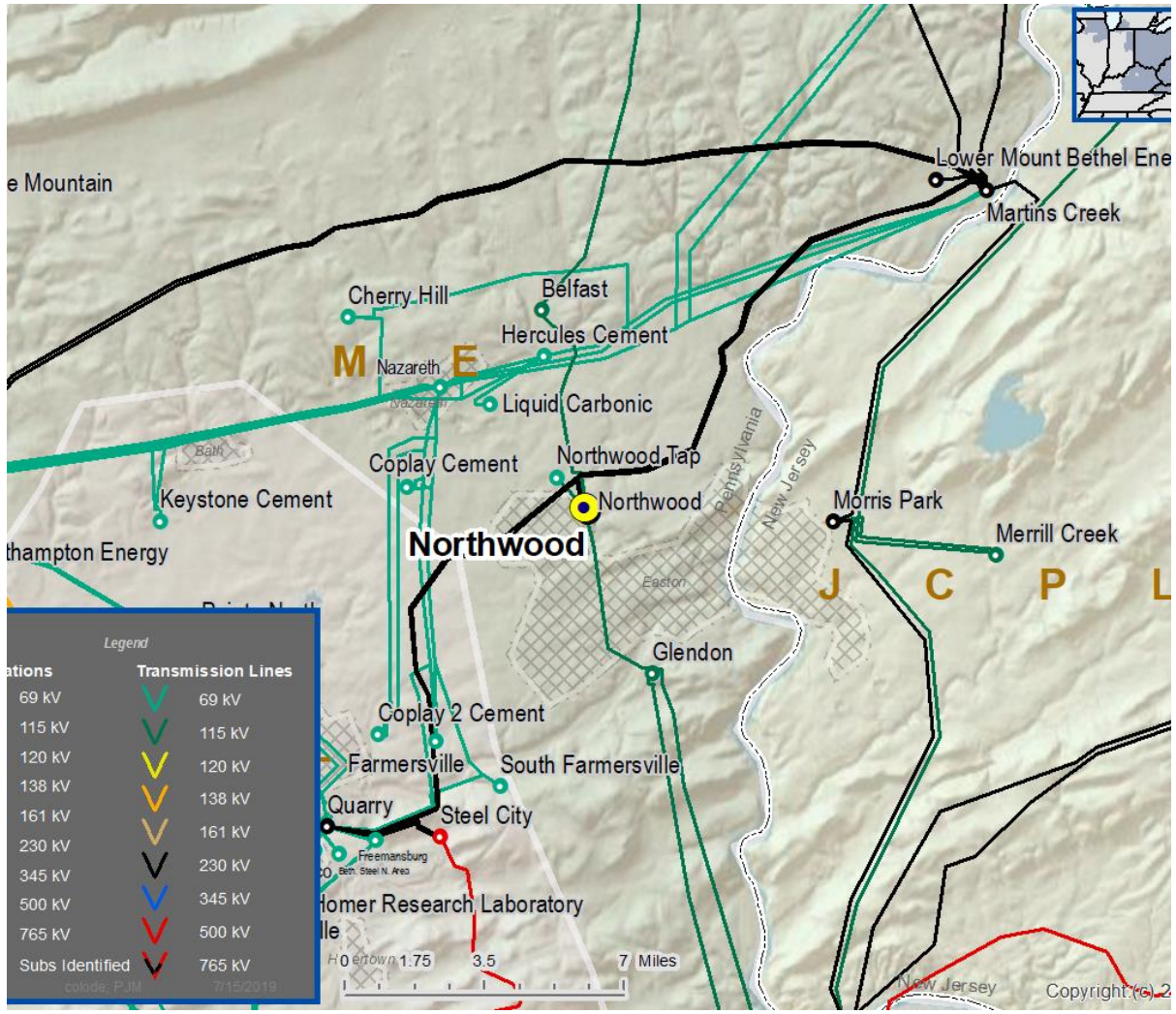
Add/Expand Bus Configuration

- Eliminate simultaneous outages to multiple networked elements

Problem Statement:

The Northwood 115 kV bus is a three terminal line consisting of two 115 kV lines and 230/115 kV transformer.

An N-1 outage results in the loss of all three networked elements.



Met-Ed Transmission Zone M-3 Process
Northwood 115 kV Ring Bus

Need Number: ME-2019-028

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Northwood 115 kV Ring Bus (s2038)

- Convert Northwood 115 kV into a three breaker ring bus.

Transmission Line Rating:

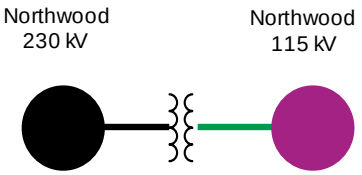
- Belfast – Northwood 115 kV Line
  - Before Proposed Solution: 232/277 MVA (SN/SE)
  - After Proposed Solution: 232/282 MVA (SN/SE)

Estimated Cost: $4.3 M

Projected In-Service: 12/31/2023

Supplemental Project ID: s2038

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
Fredericksburg 69 kV Ring Bus

Need Number: ME-2019-029

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 05/31/2019

Solution Meeting 07/31/2019

Project Driver:

Operational Flexibility and Efficiency

Specific Assumption Reference:

System Performance Projects

- Load at risk in planning and operational scenarios

Network Radial Line

- Radial lines defined by normally open points

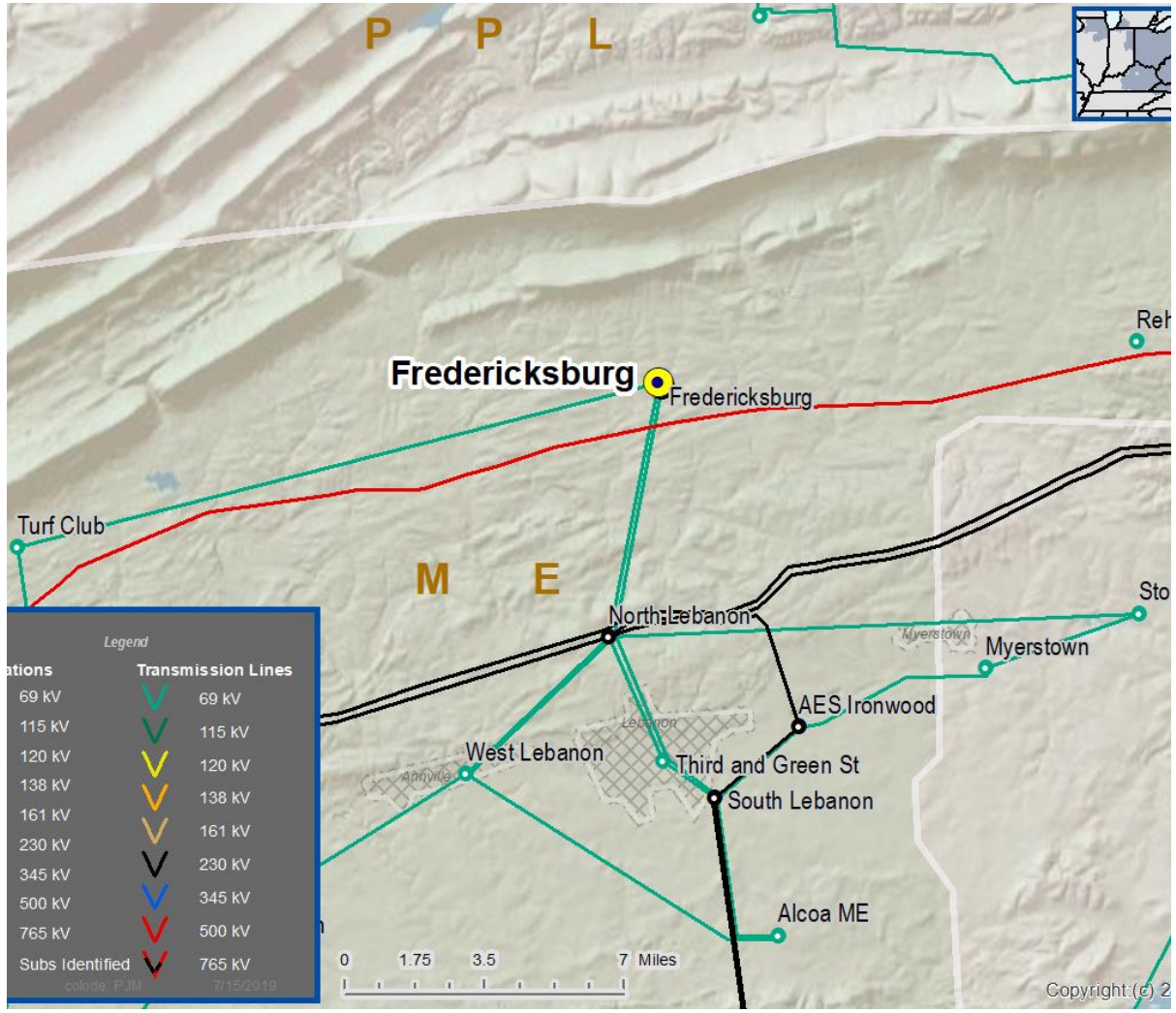
Problem Statement:

The North Lebanon – Turf Club – South Lebanon is operated normally opened at Frystown to prevent a 3-terminal line.

Substations impacted by normally open point are as follows:

- Fredericksburg – 12 MW & 1,433 Customers
- Lickdale – 24 MW & 3,302 Customers
- Indiantown Gap – 7 MW & 1 Customer (Wholesale)
- Frystown – 16 MW & 1,696 Customers
- Rehrersburg – 5 MW & 1,217 Customers

These substations total to approximately 64 MW and 7,649 customers.



Met-Ed Transmission Zone M-3 Process
Fredericksburg 69 kV Ring Bus

Need Number: ME-2019-029

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Fredericksburg 69 kV Ring Bus (s2039)

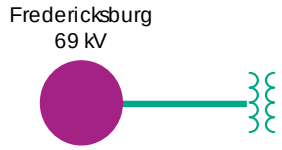
- Convert Fredericksburg 69 kV into a four breaker ring bus.

Estimated Cost: $6.0 M

Projected In-Service: 12/31/2024

Supplemental Project ID: s2039

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
Windsor 115 kV Tie Breaker

Need Number: ME-2019-032

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 05/31/2019

Solution Meeting 07/31/2019

Project Driver:

Operational Flexibility and Efficiency

Specific Assumption Reference:

System Performance Projects

- Load at risk in planning and operational scenarios

Add/Expand Bus Configuration

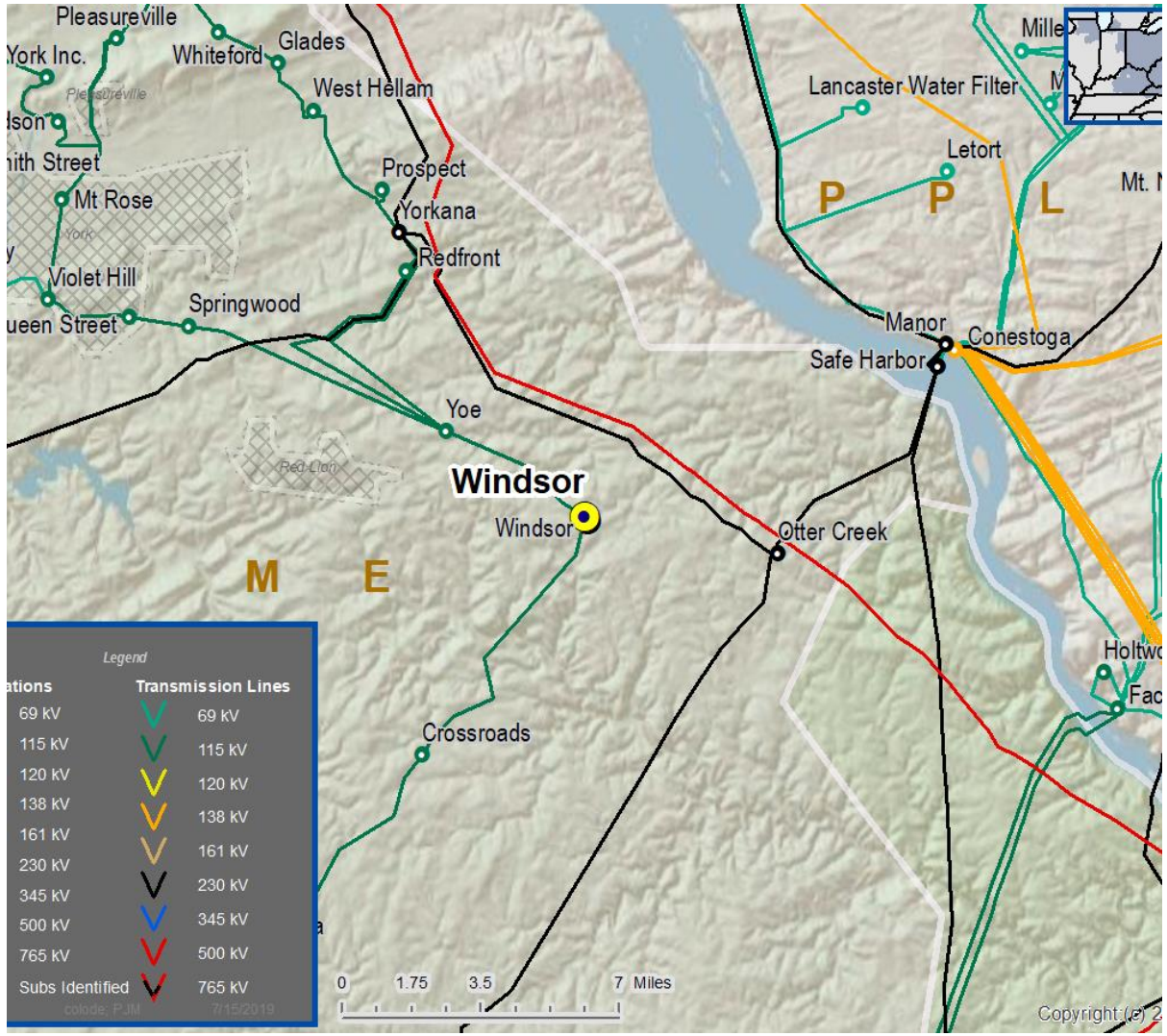
- Reduce the amount of exposed potential local load loss during contingency conditions
- Eliminate simultaneous outages to multiple networked elements

Problem Statement:

The loss of Windsor substation results in the loss of approximately 31 MW of load and approximately 5,874 customers.

Substation consists of:

- Two networked 115 kV transmission lines
- Two distribution transformers connected to bus with switches.



Met-Ed Transmission Zone M-3 Process
Windsor 115 kV Tie Breaker

Need Number: ME-2019-032

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Windsor 115 kV Tie Breaker (s2040)

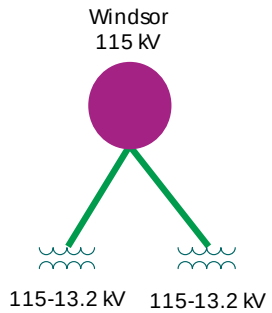
- Install a new 115 kV tie breaker at Windsor.

Estimated Cost: $0.6 M

Projected In-Service: 06/01/2021

Supplemental Project ID: s2040

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Met-Ed Transmission Zone M-3 Process
Hill 115 kV Ring Bus

Need Number: ME-2019-037

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 05/31/2019

Solution Meeting 07/31/2019

Project Driver:

Operational Flexibility and Efficiency

Specific Assumption Reference:

System Performance Projects

- Load at risk in planning and operational scenarios

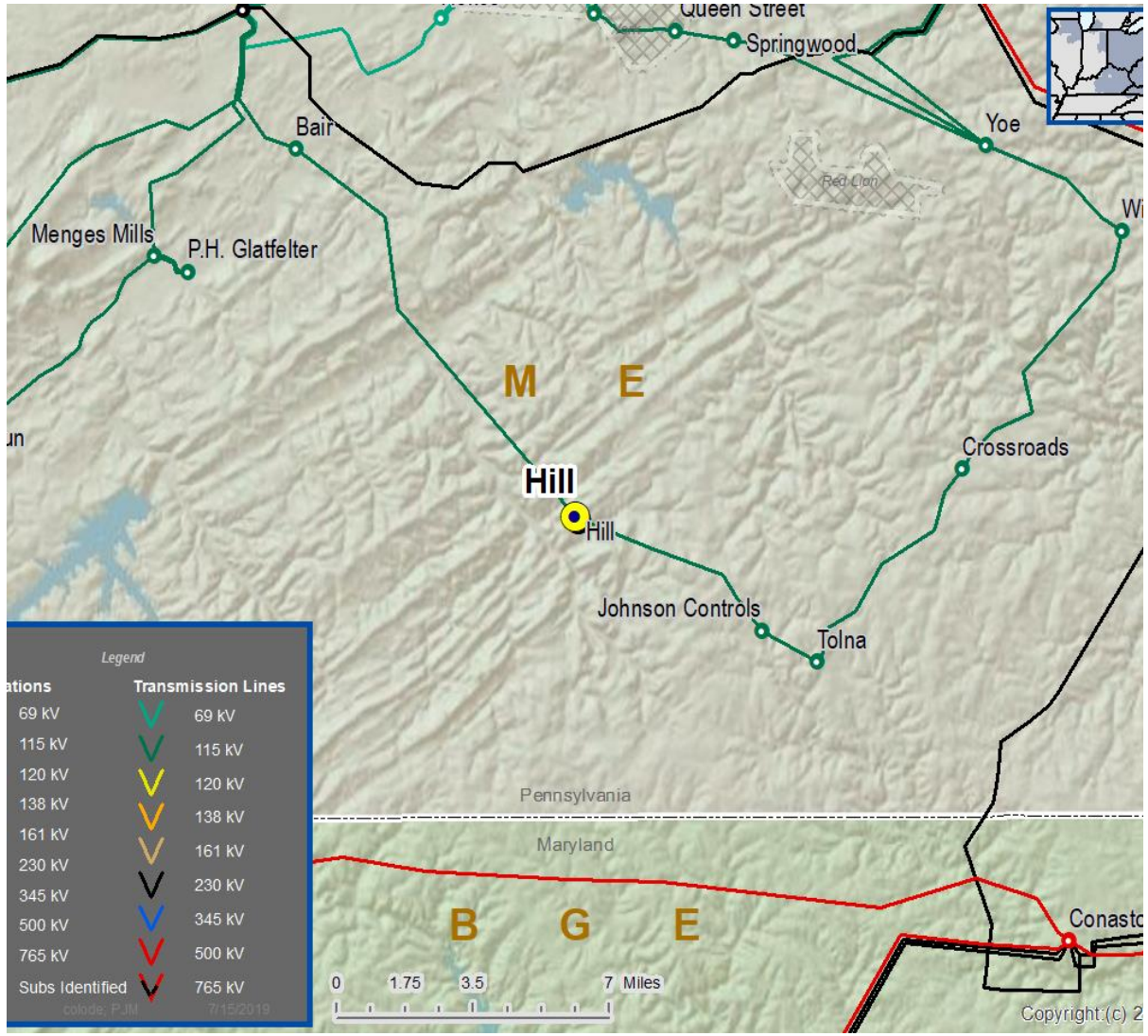
Add/Expand Bus Configuration

- Reduce the amount of exposed potential local load loss during contingency conditions
- Eliminate simultaneous outages to multiple networked elements

Problem Statement:

The loss of Hill substation results in loss of approximately 34 MW of load and approximately 7,800 customers.

- Two 115 kV lines
- Two distribution transformers connected to transmission via switch



Met-Ed Transmission Zone M-3 Process
Hill 115 kV Ring Bus

Need Number: ME-2019-037

Process State: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Hill 115 kV Ring Bus (s2041)

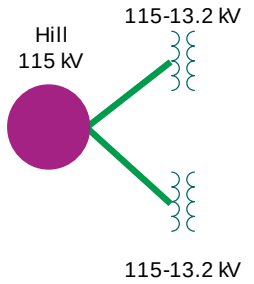
- Convert Hill 115 kV into a four breaker ring bus.

Estimated Cost: $4.4 M

Projected In-Service: 06/01/2022

Supplemental Project ID: s2041

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

East Windsor – Windsor 230 kV 6-Wire Conversion and 3rd Windsor Transformer

Need Number: JCPL-2018-001

Process Stage: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 09/21/2018

Solution Meeting 11/28/2018

Project Driver:

Operational Flexibility and Efficiency

Specific Assumption Reference:

Global Consideration

- Assess the risk associated with bus, stuck breaker, and N-2 contingencies to improve FERC tariffed Transmission < 100 kV facilities.

Add/Replace Transformers

- Transformer that if added or replaced would alleviate loading conditions under contingency scenarios.

Add/Expand Bus Configuration

- Reduce the amount of exposed potential local load loss during contingency conditions.

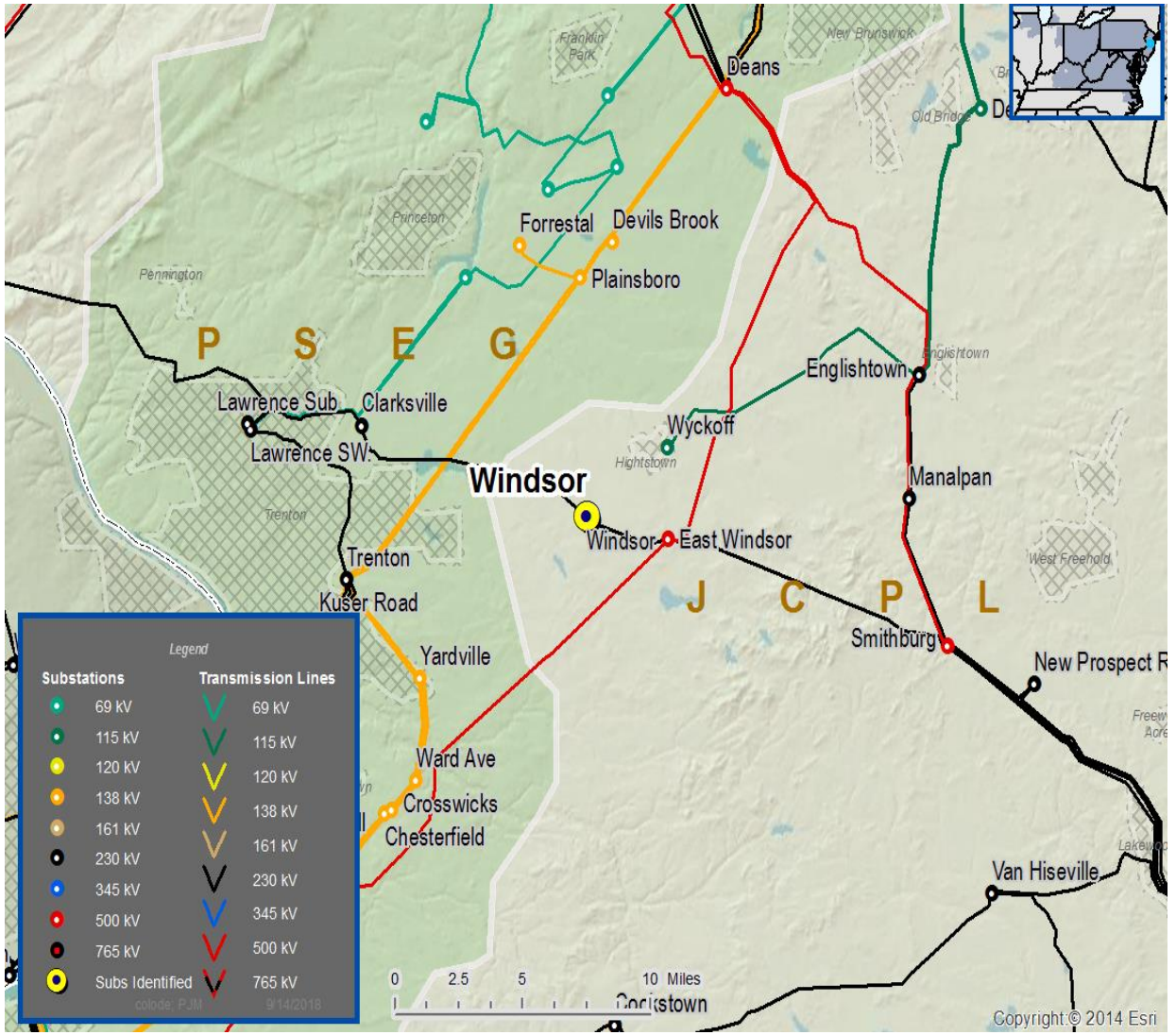
Reconductor/Rebuild Transmission Lines

- Transmission lines that are presently six-wired. Line should be evaluated to create two separate transmission circuits.

Problem Statement:

At Windsor for the event of a stuck 230 kV bus tie breaker, both 230 kV feeds are outaged, along with two 230-34.5 kV transformers feeding the Windsor area distribution load.

In the current configuration, the 230 kV feeds the 34.5 kV bus via a 230-34.5 kV transformer. The 34.5 kV bus then feeds into the local 34.5 kV network. This arrangement creates a transmission path through lower voltage facilities.



East Windsor – Windsor 230 kV 6-Wire Conversion and 3rd Windsor Transformer

Need Number: JCPL-2018-001

Process Stage: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

East Windsor-Windsor 230 kV

- Convert 2.6 miles 1590 ACSR 6-wire circuit to (2) 3-wire circuits

Windsor 230 kV Substation and 3rd 230-34.5 kV Transformer

- Expand 230 kV bus to a 8 breaker-and-a-half 230 kV station
- Install four (4) new 34.5 kV breakers and one (1) new 230-34.5 kV transformer

East Windsor Substation

- Install one (1) new 230 kV breaker

Transmission Lines Ratings:

- East Windsor-Windsor 230 kV Line
  - Before Proposed Solution: 709 MVA SN / 869 MVA SE
  - After Proposed Solution: 709 MVA SN / 869 MVA SE
- East Windsor-Windsor #2 230 kV Line
  - Before Proposed Solution: N/A
  - After Proposed Solution: 709 MVA SN / 869 MVA SE

Transformer Ratings:

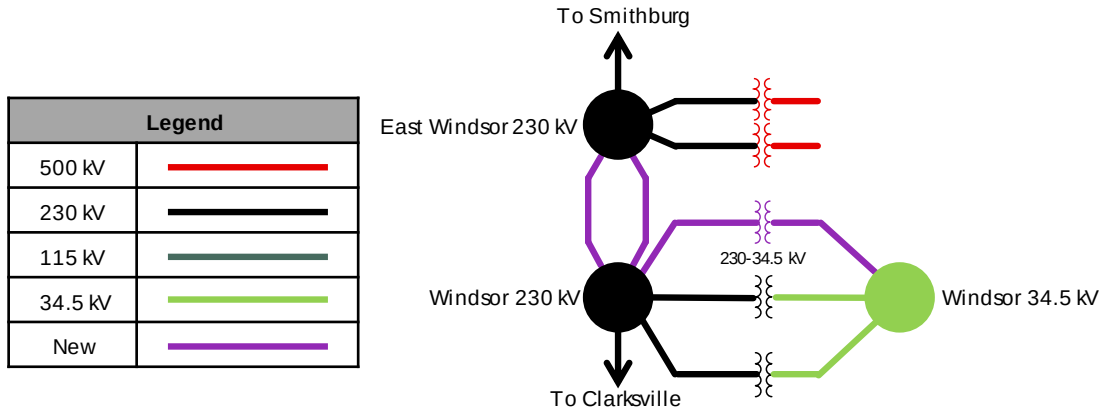
- Windsor 230-34.5 kV #3 Transformer
  - Before Proposed Solution: N/A
  - After Proposed Solution (Anticipated): 140 MVA SN / 150 MVA SE

Estimated Cost: $32.4M

Projected In-Service: 12/31/2020

Supplemental Project ID: s1806, s1806.1, s1806.2, s1806.3, s1806.4

Model: 2018 Series 2023 Summer RTEP 50/50



JCP&L Transmission Zone M-3 Process
Construct Pequest River 115 kV Ring Bus

Need Number: JCPL-2018-002

Process Stage: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 09/21/2018

Solution Meeting 11/28/2018

Project Driver:

Operational Flexibility and Efficiency, Performance and Risk

Specific Assumption Reference:

Global Consideration

- Assess the risk associated with bus, stuck breaker, and N-2 contingencies to improve FERC tariffed Transmission < 100 kV facilities.

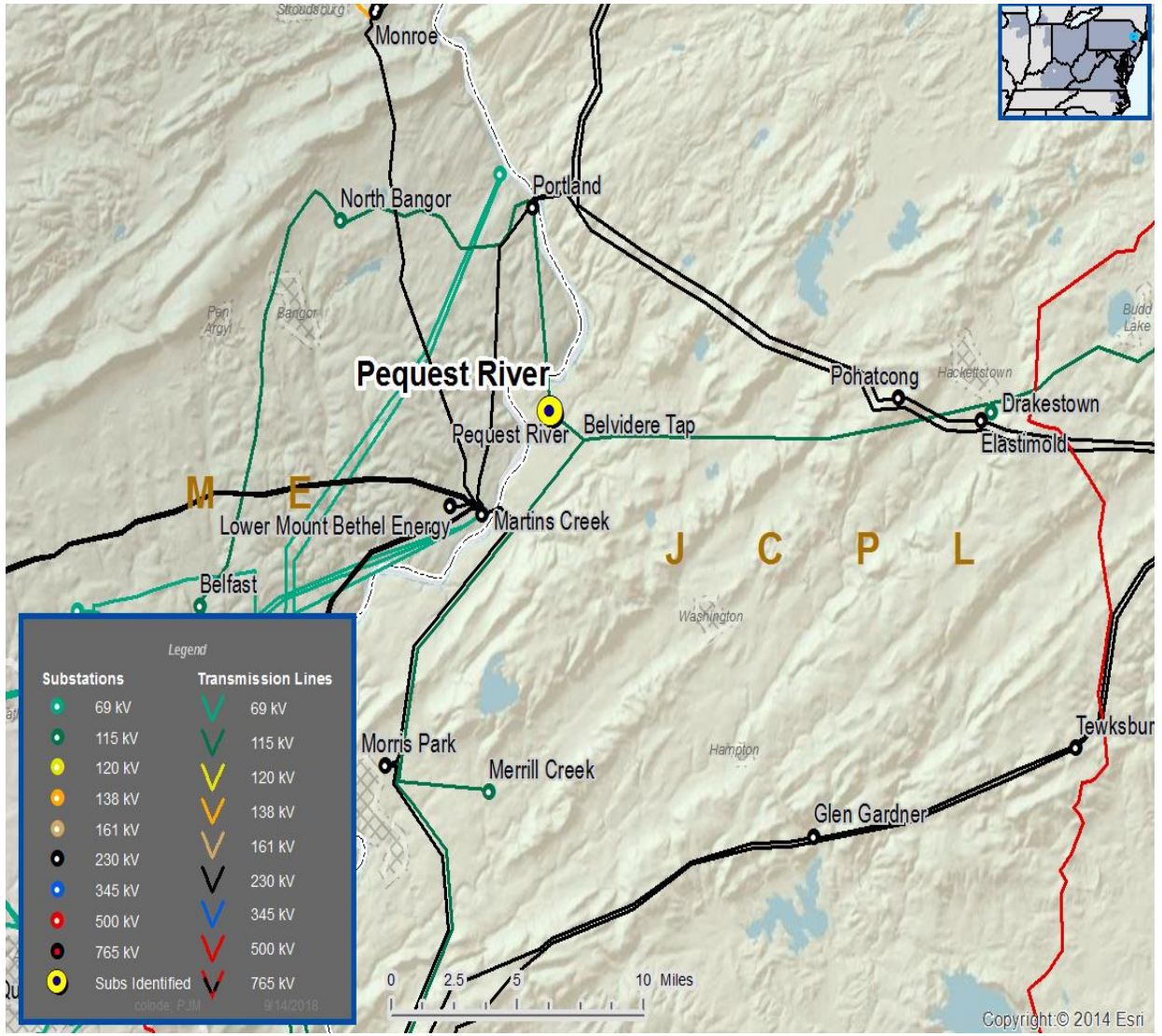
Add/Expand Bus Configuration

- Loss of substation bus adversely impacts transmission system performance.
- Reduce the amount of exposed potential local load loss during contingency conditions.
- Eliminate simultaneous outages to multiple networked elements (excluding capacitor banks) under N-1 analysis.
- Eliminate simultaneous outages to multiple networked elements for stuck breakers, bus outages, N-2 events, etc.

Problem Statement:

In the event of a Pequest #1 115-34.5 kV transformer fault, the S919 line (3-terminal line) and the bus tie breaker are relied upon to clear the fault resulting in an additional loss of the Drakestown, Flanders, and Morris Park transformers.

At Pequest River, in the event of a stuck 115 kV bus tie breaker, both 115 kV feeds into Pequest River are outaged, along with two 115-34.5 kV transformers feeding the Pequest River area 34.5 kV network, the Drakestown #1, Flanders #2, and Morris Park #1 transformers.



JCP&L Transmission Zone M-3 Process
Construct Pequest River 115 kV Ring Bus

Need Number: JCPL-2018-002

Process Stage: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Pequest River 115 kV Ring Bus

- Expand Pequest River substation to a five breaker ring bus
- Loop in the Gilbert-Pequest River-Flanders (S919) 115 kV line into the 115 kV Ring bus

Transmission Lines Ratings:

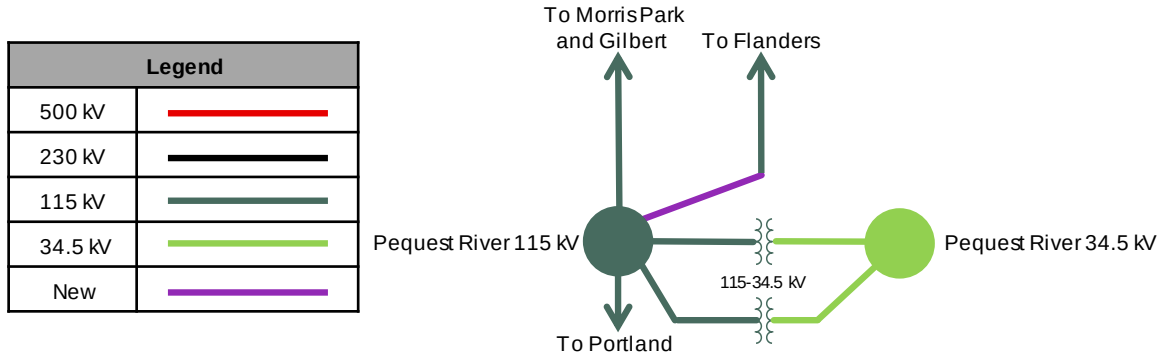
- Pequest River-Flanders 115 kV Line
  - Before Proposed Solution: N/A
  - After Proposed Solution: 205 MVA SN / 245 MVA SE
- Pequest River-Gilbert 115 kV Line
  - Before Proposed Solution: N/A
  - After Proposed Solution: 184 MVA SN / 223 MVA SE

Estimated Cost: $17.5M

Projected In-Service: 06/01/2020

Supplemental Project ID: s1807, s1807.1, s1807.2

Model: 2018 Series 2023 Summer RTEP 50/50



JCP&L Transmission Zone M-3 Process
Construct Livingston 34.5 kV Ring Bus

Need Number: JCPL-2018-003

Process Stage: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 09/21/2018

Solution Meeting 11/28/2018

Project Driver:

Operational Flexibility and Efficiency

Specific Assumption Reference:

Global Consideration

- Assess the risk associated with bus, stuck breaker, and N-2 contingencies to improve FERC tariffed Transmission < 100 kV facilities.

Network Radial Lines

- Radial lines will be evaluated based on load at risk and/or customers impacted along with its proximity to other networked facilities.

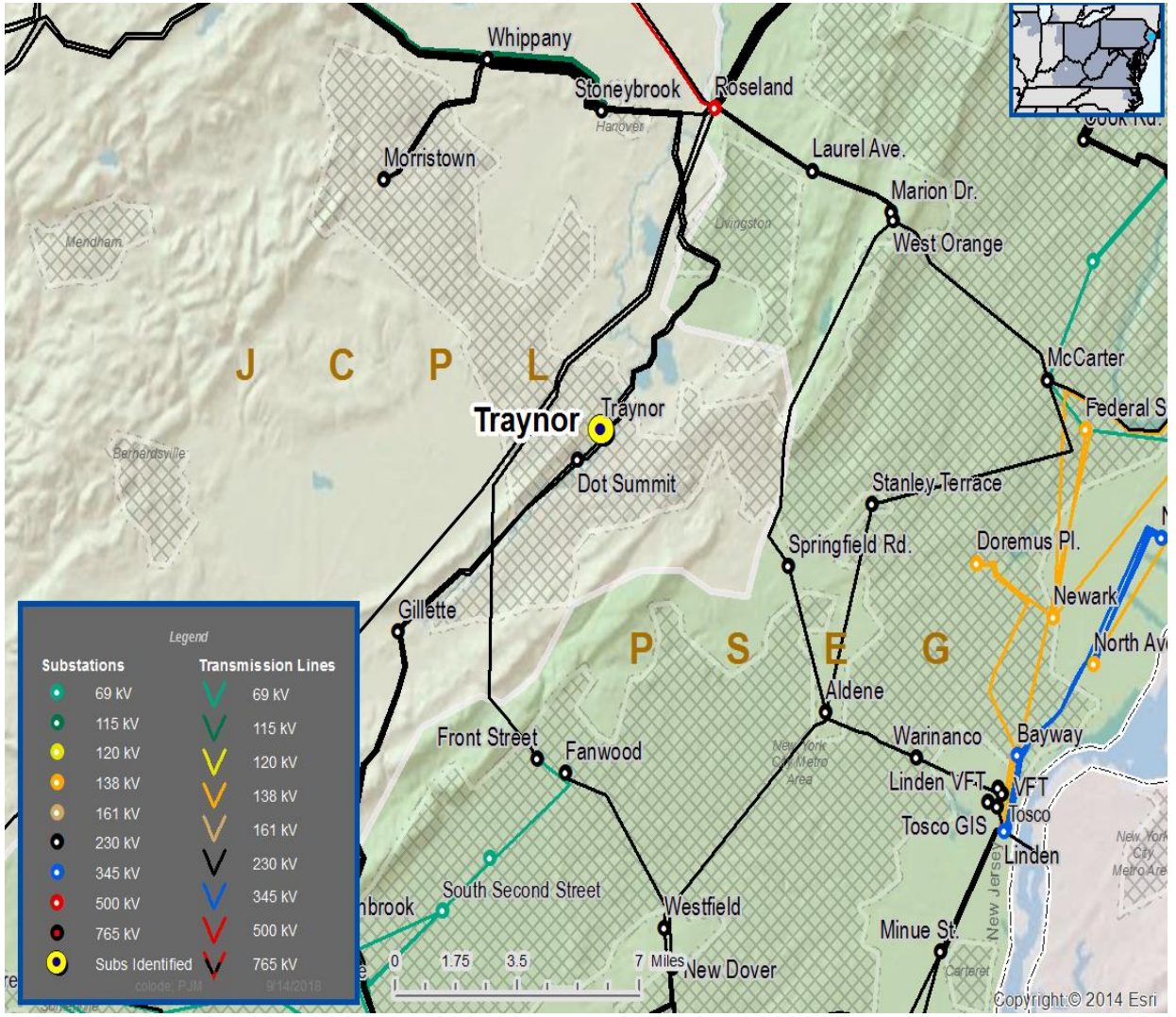
Add/Expand Bus Configuration

- Reduce the amount of exposed potential local load loss during contingency conditions.
- Eliminate simultaneous outages to multiple networked elements under N-1 analysis.

Problem Statement:

N-1-1 outages result in loss of the 34.5 kV lines serving the area impacting approximately 7,700 customers and approximately 33 MW of load.

N-1-1 outage of the Traynor-Madison 34.5 kV and the Traynor-Livingston Switch Point 34.5 kV lines, thermal loading on the Traynor-Madison (N14) 34.5 kV line is greater than 105% of its 50 MVA limit.



JCP&L Transmission Zone M-3 Process
Construct Livingston 34.5 kV Ring Bus

Need Number: JCPL-2018-003

Process Stage: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Livingston 34.5 kV Five-Breaker Ring Bus

- Create a five breaker ring bus at the Livingston Switch Point to network the T72, N14, and C81 34.5 kV Lines.
- Loop the N14 Line into the new Livingston Substation Ring Bus

Transmission Lines Ratings:

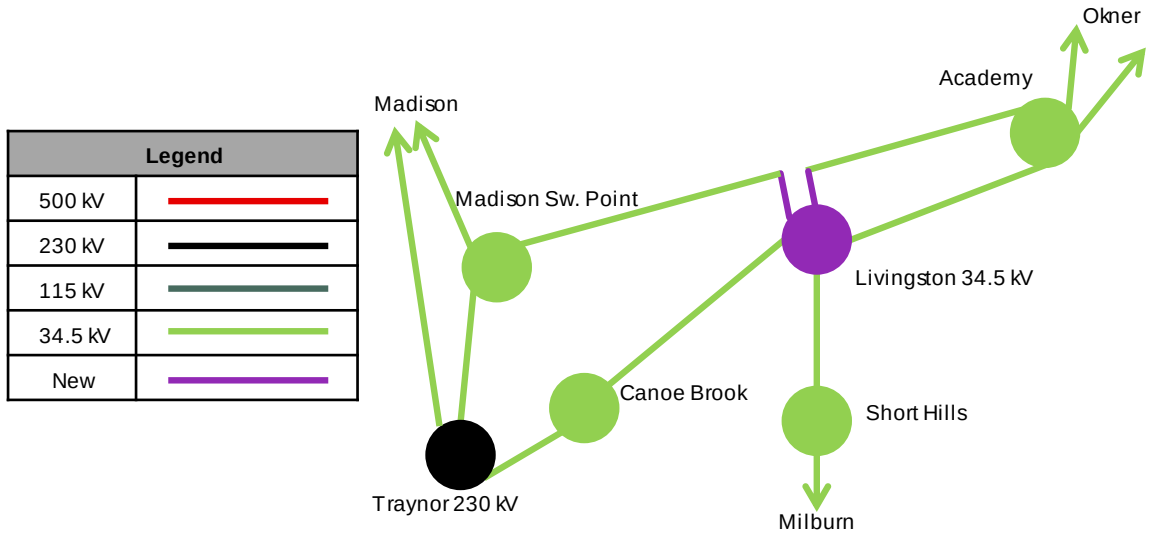
- Academy-Livingston 34.5 kV (N14) Line
  - Before Proposed Solution: N/A
  - After Proposed Solution: 35 MVA SN / 44 MVA SE
- Livingston-Madison Sw. Point 34.5 kV (N14) Line
  - Before Proposed Solution: N/A
  - After Proposed Solution: 35 MVA SN / 44 MVA SE
- Academy-Livingston 34.5 kV (C81) Line
  - Before Proposed Solution: 41 MVA SN / 50 MVA SE
  - After Proposed Solution: 41 MVA SN / 50 MVA SE
- Canoe Brook-Livingston 34.5 kV (C81) Line
  - Before Proposed Solution: 41 MVA SN / 52 MVA SE
  - After Proposed Solution: 44 MVA SN / 53 MVA SE
- Livingston-Short Hills 34.5 kV (T72) Line
  - Before Proposed Solution: 41 MVA SN / 50 MVA SE
  - After Proposed Solution: 41 MVA SN / 50 MVA SE

Estimated Cost: $5.8M

Projected In-Service: 12/31/2020

Supplemental Project ID: s1808, s1808.1, s1808.2

Model: 2018 Series 2023 Summer RTEP 50/50



JCP&L Transmission Zone M-3 Process
Morristown 230 & 34.5 kV Reconfiguration

Need Number: JCPL-2018-004

Process Stage: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 09/21/2018

Solution Meeting 11/28/2018

Project Driver:

Operational Flexibility and Efficiency, Performance and Risk

Specific Assumption Reference:

Global Consideration

- Assess the risk associated with bus, stuck breaker, and N-2 contingencies to improve FERC tariffed Transmission < 100 kV facilities.

Add/Expand Bus Configuration

- Loss of substation bus adversely impacts transmission system performance
- Reduce the amount of exposed potential local load loss during contingency conditions.
- Eliminate simultaneous outages to multiple networked elements for stuck breakers, bus outages, N-2 events, etc.

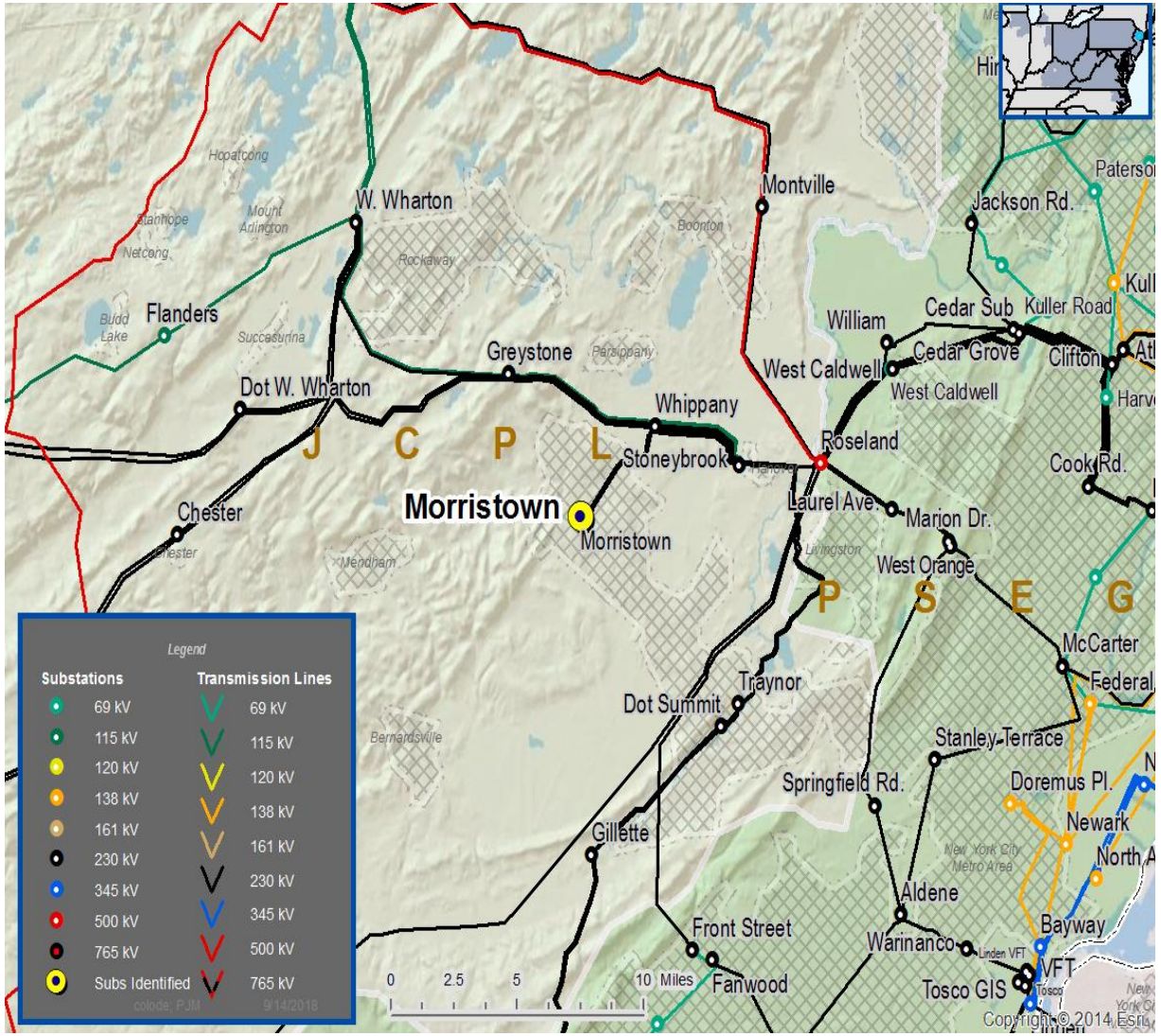
Network Radial Lines

- Radial lines will be evaluated based on load at risk and/or customers impacted along with its proximity to other networked facilities.

Problem Statement:

At Morristown, in the event of a stuck 230 kV bus tie breaker, both 230 kV feeds are outaged, along with two 230-34.5 kV transformers feeding the Morristown area 34.5 kV network impacting approximately 23,100 customers and approximately 155 MW of load.

In the current configuration, the 230 kV feeds the 34.5 kV bus via 230-34.5 kV transformers. The 34.5 kV bus then feeds into the local 34.5 kV network which is operated in a radial configuration due to overdutied 34.5 kV breakers.



JCP&L Transmission Zone M-3 Process
Morristown 230 & 34.5 kV Reconfiguration

Need Number: JCPL-2018-004

Process Stage: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Morristown 230 & 34.5 kV Substation Reconfiguration

- Construct a four breaker 230 kV ring bus
- Construct a 34.5 kV breaker-and-a-half station with 18 breakers
- Replace the #5 and #6 230-34.5 kV with 230-34.5 kV 168 MVA transformers
- Replace all overdutied breakers at Whippany substation

Transformer Ratings:

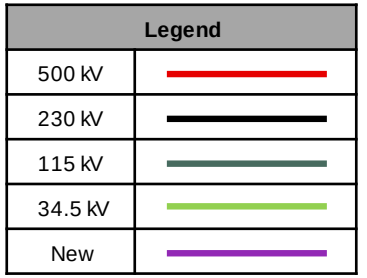
- Morristown 230-34.5 kV #5 Transformer
  - Before Proposed Solution: 138 MVA SN / 150 MVA SE
  - After Proposed Solution (Anticipated): 194 MVA SN / 194 MVA SE
- Morristown 230-34.5 kV #6 Transformer
  - Before Proposed Solution: 138 MVA SN / 150 MVA SE
  - After Proposed Solution (Anticipated): 194 MVA SN / 194 MVA SE

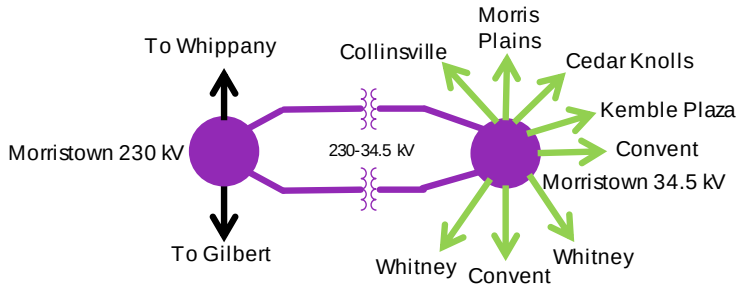
Estimated Cost: $22.6M

Projected In-Service: 06/01/2021

Supplemental Project ID: s1809, s1809.1, s1809.2, s1809.3, s1809.4

Model: 2018 Series 2023 Summer RTEP 50/50





JCP&L Transmission Zone M-3 Process
Construct Readington-Old York 34.5 kV Line

Need Number: JCPL-2018-005

Process Stage: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 09/21/2018

Solution Meeting 11/28/2018

Project Driver:

Operational Flexibility and Efficiency

Specific Assumption Reference:

Network Radial Lines

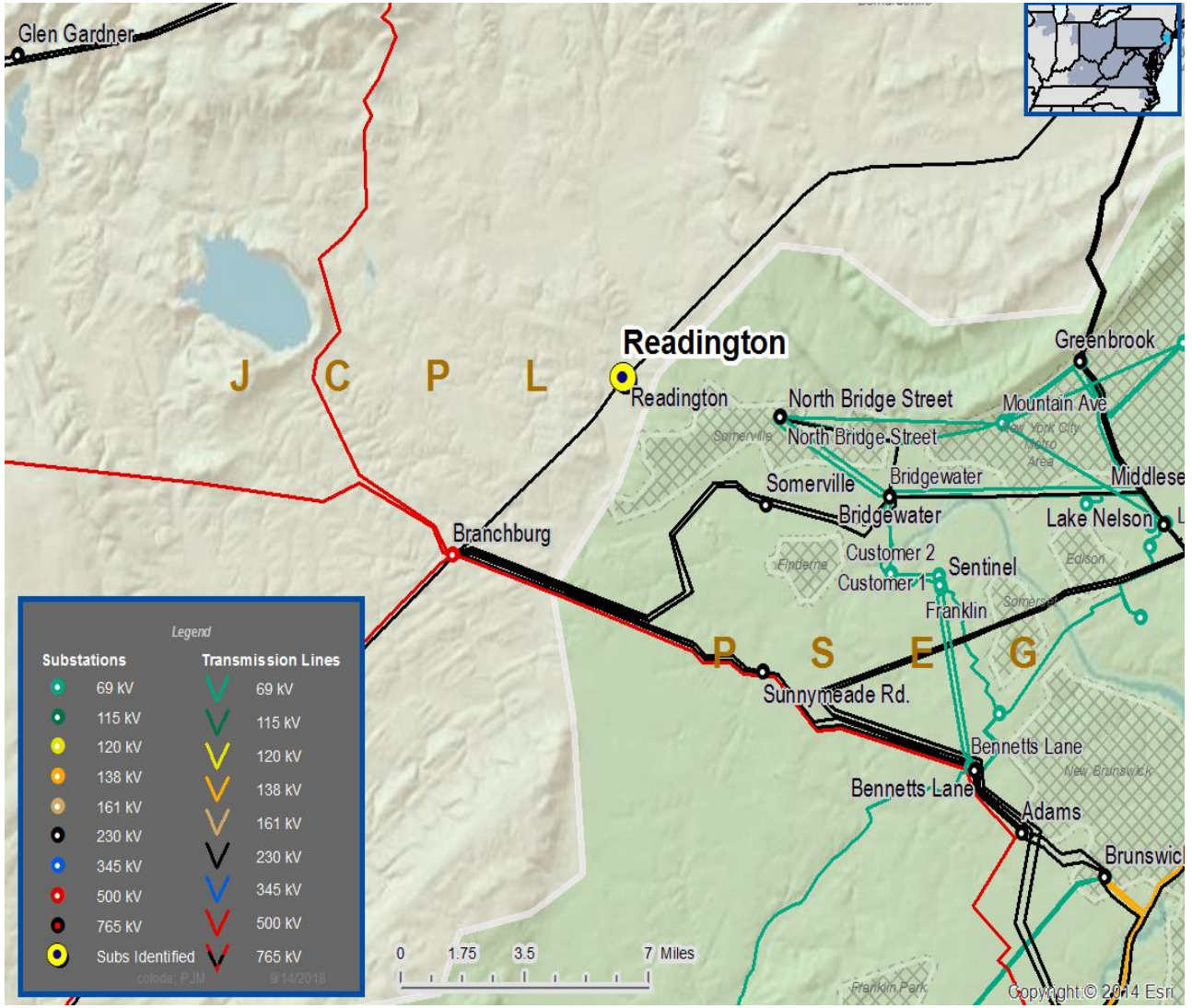
- Radial lines will be evaluated based on load at risk and/or customers impacted along with its proximity to other networked facilities.

Build New Transmission Line

- Network radial lines.

Problem Statement:

Readington T774 34.5 kV line is radial. Line outage or contingency as well as 34.5 kV bus maintenance or outages result in loss of the T774 impacting approximately 1,700 customers and approximately 35 MW of load.



JCP&L Transmission Zone M-3 Process
Construct Readington-Old York 34.5 kV Line

Need Number: JCPL-2018-005

Process Stage: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solution:

Readington-Old York 34.5 kV Line

- Extend Readington-Old York T774 34.5 kV line to East Flemington Substation
- Install SCADA switch at Imclone

East Flemington Substation new 34.5 kV Terminal

- Install new 34.5 kV terminal in breaker-and-a-half configuration with 3-34.5 kV breakers

Transmission Line Ratings:

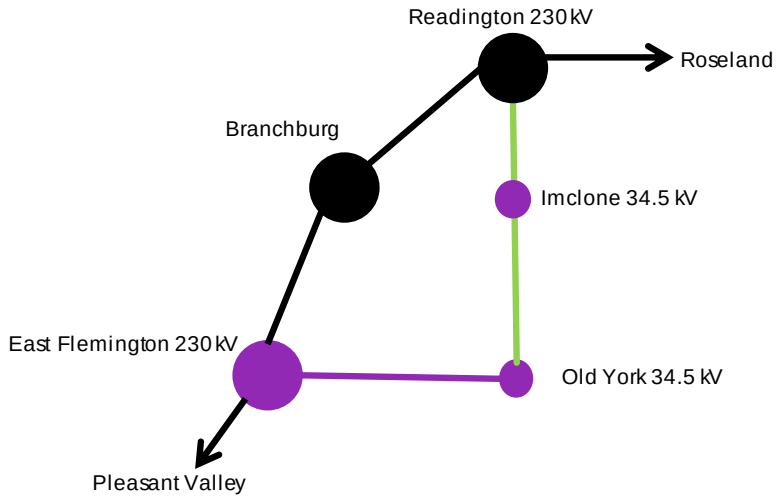
- East Flemington-Old York 34.5 kV Line
  - Before Proposed Solution: N/A
  - After Proposed Solution: 39 MVA SN / 48 MVA SE

Estimated Cost: $7.01M

Projected In-Service: 12/31/2020

Supplemental Project ID: s1810, s1810.1, s1810.2, s1810.3

Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
230 kV	
115 kV	
34.5 kV	
New	

Need Number: JC-2019-001 to 005 and 007

Process Stage: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Previously Presented:

Need Meeting 02/22/2019

Solution Meeting 03/25/2019

Project Driver:

Equipment Material Condition, Performance and Risk

Operational Flexibility and Efficiency

Specific Assumption Reference:

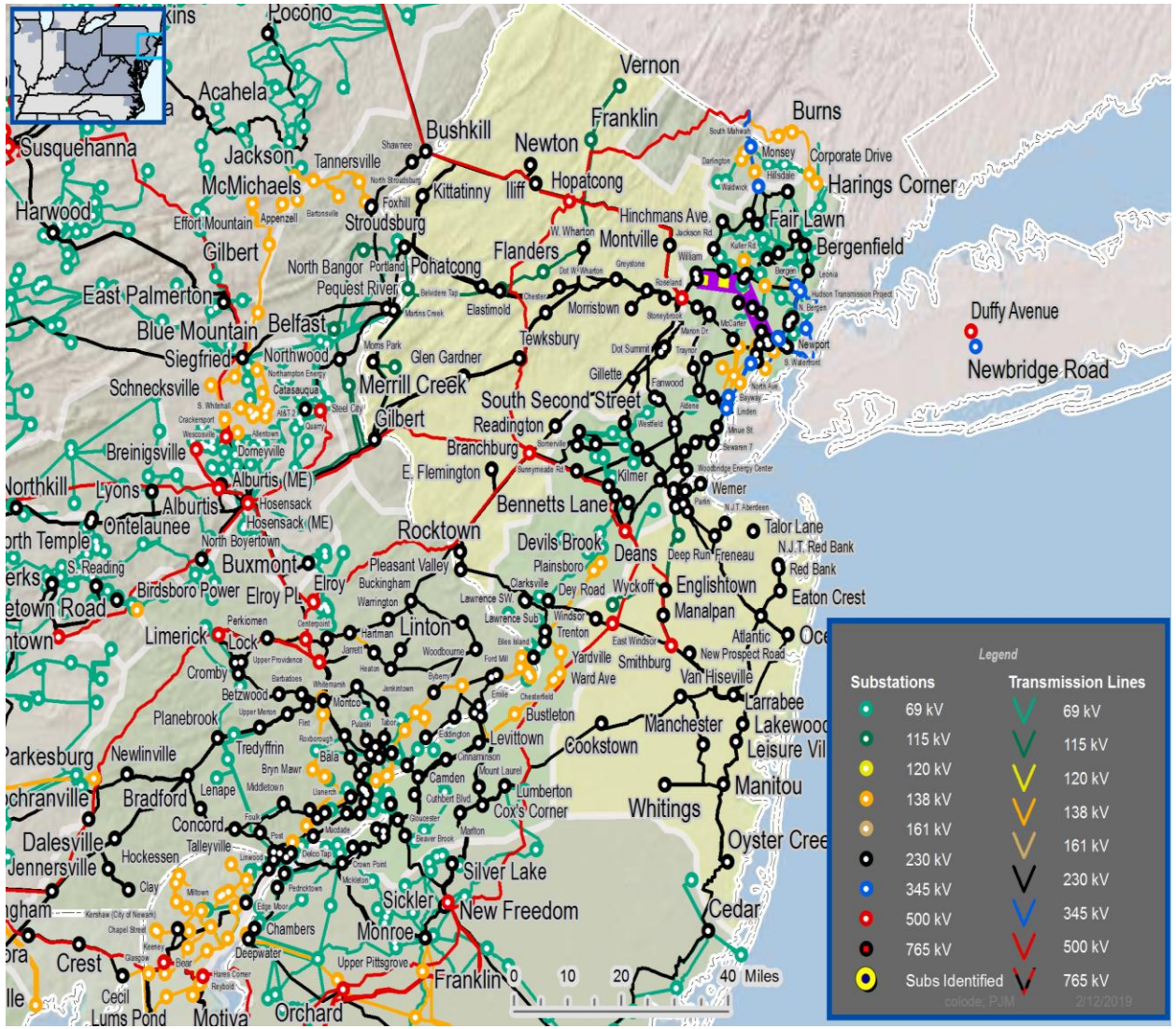
System Performance Projects Global Factors

- 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…



JCP&L Transmission Zone M-3 Process
Multiple Misoperation Relay Projects

Need Number: JC-2019-001 to 005 and 007

Process Stage: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

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 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 M-3 Process
Multiple Misoperation Relay Projects

Need Number: JC-2019-001 to 005 and 007

Process Stage: Submission of Supplemental Project for inclusion in the Local Plan 11/19/2019

Selected Solutions:

JCP L-2019 -	Transmission Line / Substation Locations	Supplemental Project ID	New MVA Line Rating (SN / SE)	Scope of Work	Estimated Costs ($ M)	Target ISD
001	Atlantic – Freneau 230 kV Line	s1912, s1912.1, s1912.2	709 / 869	• 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	s1913, s1913.1, s1913.2	709 / 869	• 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	S1914.1, s1914.2	1114 / 1285	• 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	s1915, s1915.1, s1915.2	709 / 869	• 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	s1916, s1916.1, s1916.2	709 / 869	• 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	s1917, s1917.1, s1917.2	709 / 869	• 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

Questions?

Revision History

1/30/2019 – V1 – Original version posted to pjm.com

7/26/2019 – V2 – Submission of Supplemental Project for inclusion in the Local Plan for s1811 ~ s1822

11/19/2019 – V3 – Submission of Supplemental Project for inclusion in the Local Plan (added slide # 69-184)