



# Sub Regional RTEP Committee PJM Mid-Atlantic Penelec

May 31, 2019

# Solutions

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



Need Number: PN-2019-014

Process Stage: Solutions Meeting 5/31/2019

Previously Presented: Need Meeting 4/26/2019

Supplemental Project Driver:

*Operational Flexibility and Efficiency*

Specific Assumption References:

Reconductor/Rebuild Transmission Lines

- Transmission lines that frequently require operational switching

System Performance Projects

- Substation/line equipment limits

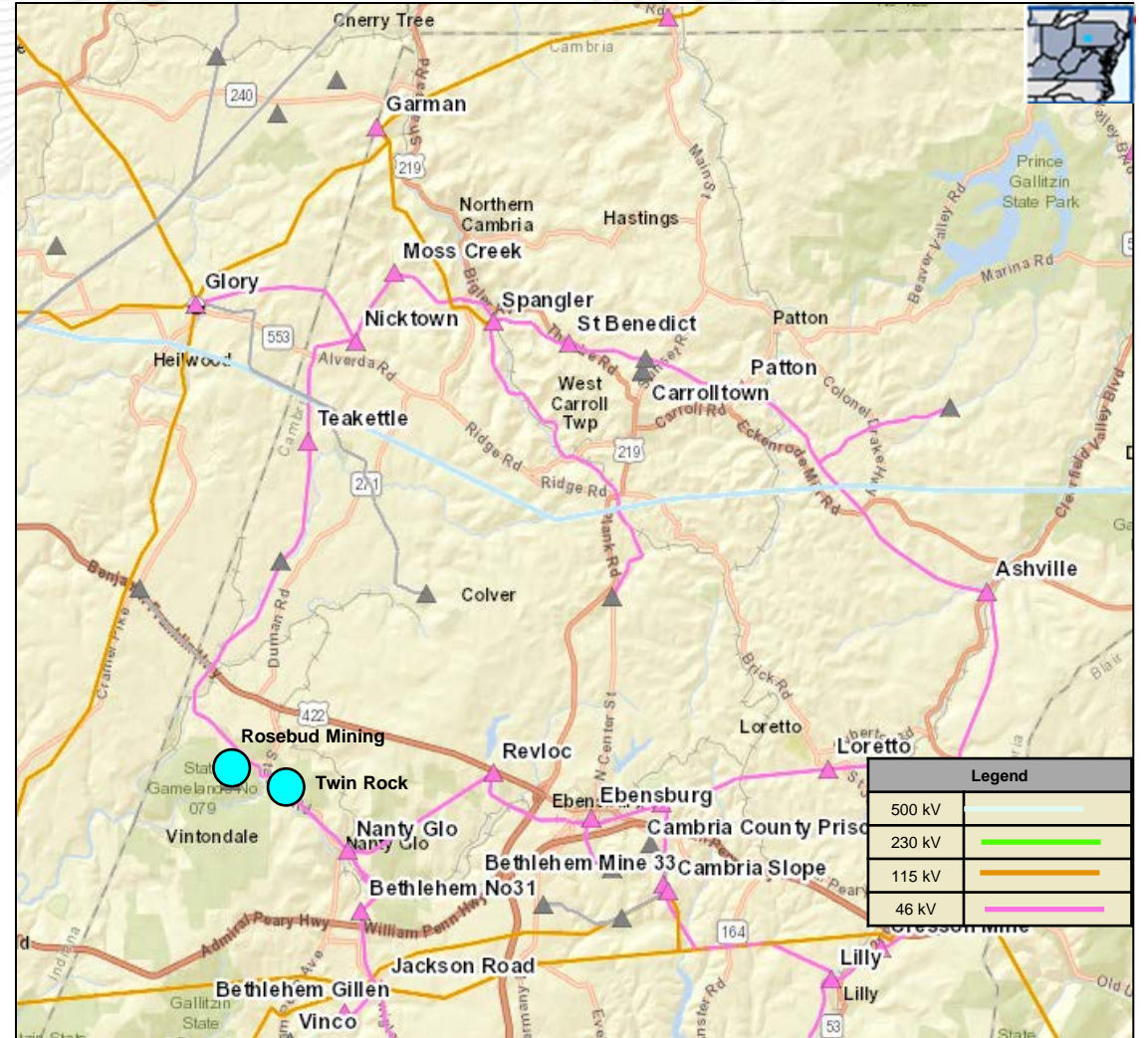
Problem Statement:

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





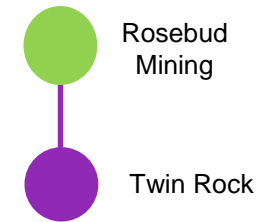
# Penelec Transmission Zone M-3 Process Rosebud Mining – Twin Rock 46 kV Line Rebuild

Need Number: PN-2019-014

Process Stage: Solutions Meeting 5/31/2019

## Potential Solution:

- *Rosebud Mining – Twin Rock 46 kV Line Rebuild*
  - Replace the existing conductor on the approximately 1 mile section of 46 kV line
  - Replace disconnect switches at Twin Rock to exceed loadability of new conductor
- 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)



## Alternatives Considered:

- Maintain existing condition

Estimated Project Cost: \$1.8M

Projected In-Service: 6/1/2022

Status: Conceptual

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



Need Number: PN-2019-015

Process Stage: Solutions Meeting 5/31/2019

Previously Presented: Need Meeting 4/26/2019

Supplemental Project Driver:

*Operational Flexibility and Efficiency*

Specific Assumption References:

System Performance Projects

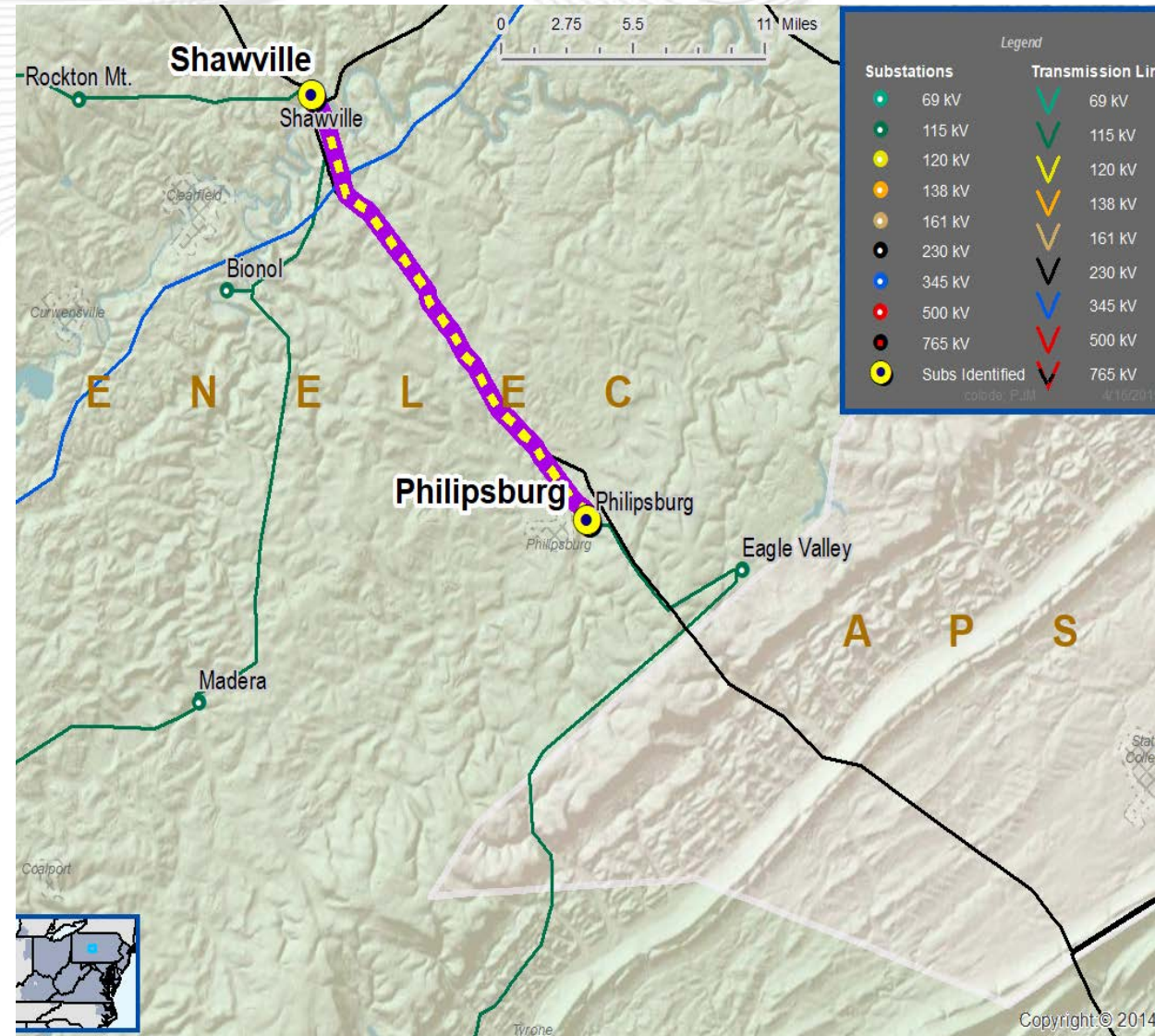
- Substation/line equipment limits
- Load at risk in planning and operational scenarios
- Load and/or customers at risk on single transmission line

### 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)*





Need Number: PN-2019-015

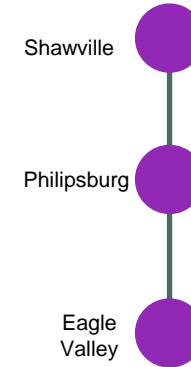
Process Stage: Solutions Meeting 5/31/2019

Potential Solution:

- Construct Philipsburg 115 kV Ring Bus
- At Philipsburg:
  - Construct a four breaker 115 kV ring bus (replace limiting CTs, substation conductor / drop, and circuit breakers on Shawville and Eagle Valley exits)
  - Replace line trap on Shawville line exit
- At Shawville:
  - Replace line trap on Philipsburg line exit
  - 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)

Alternatives Considered:

- Maintain existing condition



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

**Estimated Project Cost: \$4.5M**

**Projected In-Service: 12/1/2021**

**Status: Conceptual**



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

Need Number: PN-2019-016

Process Stage: Solutions Meeting 5/31/2019

Previously Presented: Need Meeting 4/26/2019

Supplemental Project Driver:

*Operational Flexibility and Efficiency*

Specific Assumption References:

System Performance Projects

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

Problem Statement:

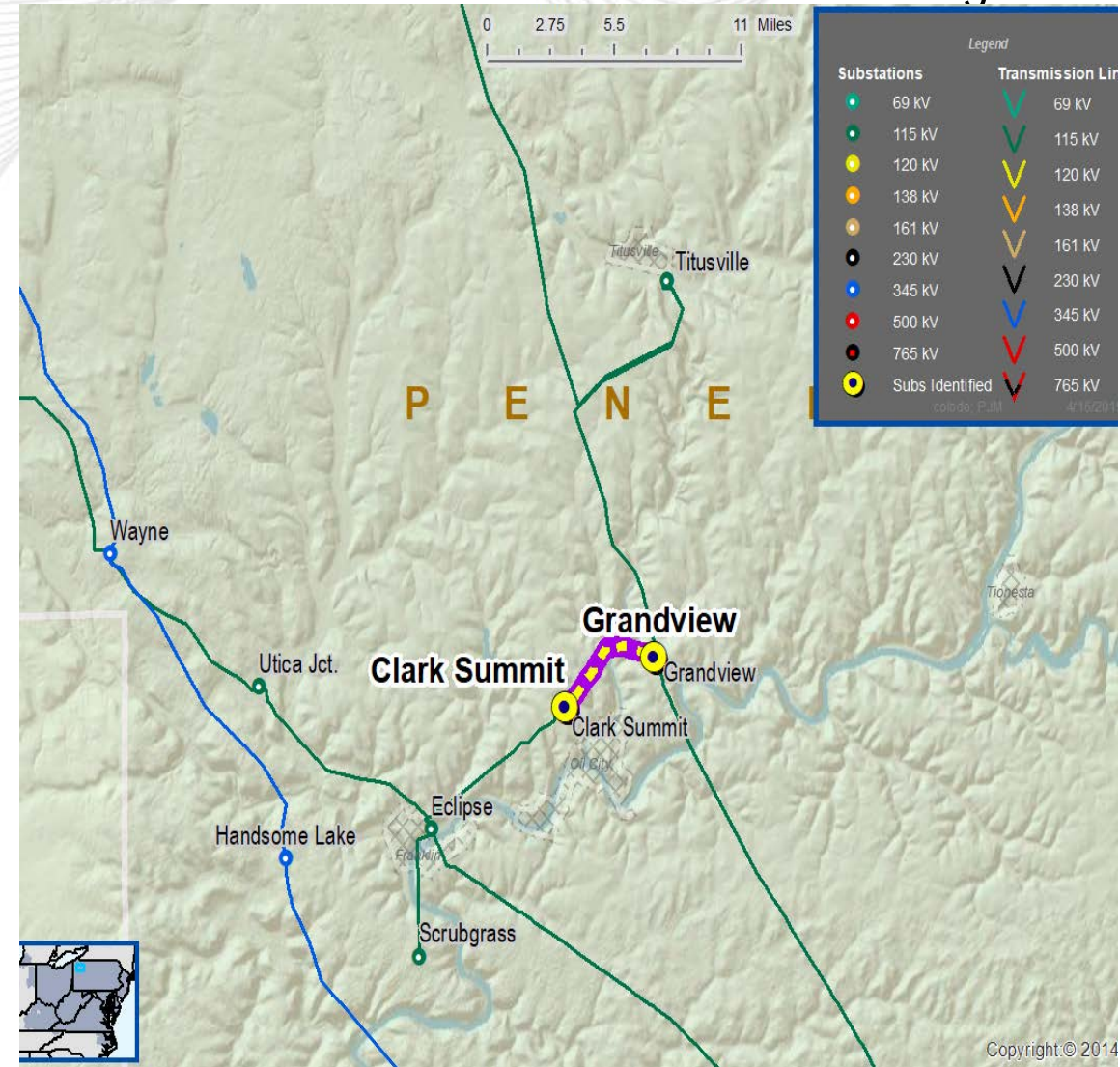
Clark Summit 115 kV substation serves approximately 42 MW of load and 11,200 customers. Substation has two transformers and no breakers. A fault on the Eclipse-Clark Summit-Grandview 115 kV line results in loss of line and both distribution transformers.

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)*





Need Number: PN-2019-016

Process Stage: Solutions Meeting 5/31/2019

**Potential Solution:**

- Construct Clark Summit 115 kV Ring Bus
- At Clark Summit :
  - Construct a new four breaker ring bus
- At Grandview :
  - Replace substation conductor
- 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)

**Alternatives Considered:**

- Maintain existing condition

Estimated Project Cost: \$3.9M

Projected In-Service: 12/1/2021

Status: Conceptual

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



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





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

Need Number: PN-2019-017

Process Stage: Solutions Meeting 5/31/2019

Previously Presented: Need Meeting 4/26/2019

Supplemental Project Driver:

*Operational Flexibility and Efficiency*

Specific Assumption References:

Network Radial Lines

- Radial lines defined by normally open points

Reconductor/Rebuild Transmission Lines

- Three or more terminal transmission lines

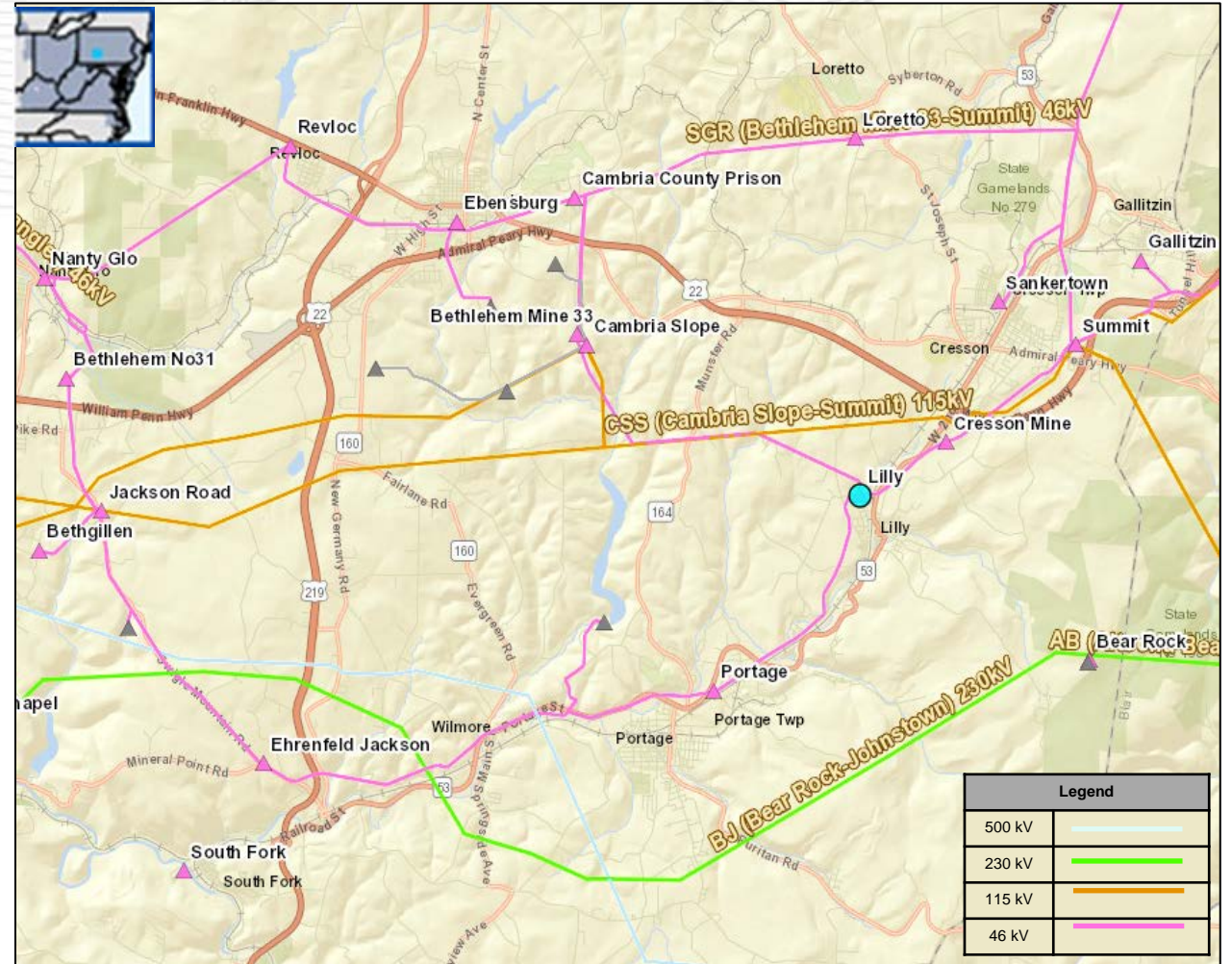
Add/Expand Bus Configuration

- Eliminate simultaneous outages to multiple network elements

System Performance Projects

- Substation/line equipment limits

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Need Number: PN-2019-017

Process Stage: Solutions Meeting 5/31/2019

Previously Presented: Need Meeting 4/26/2019

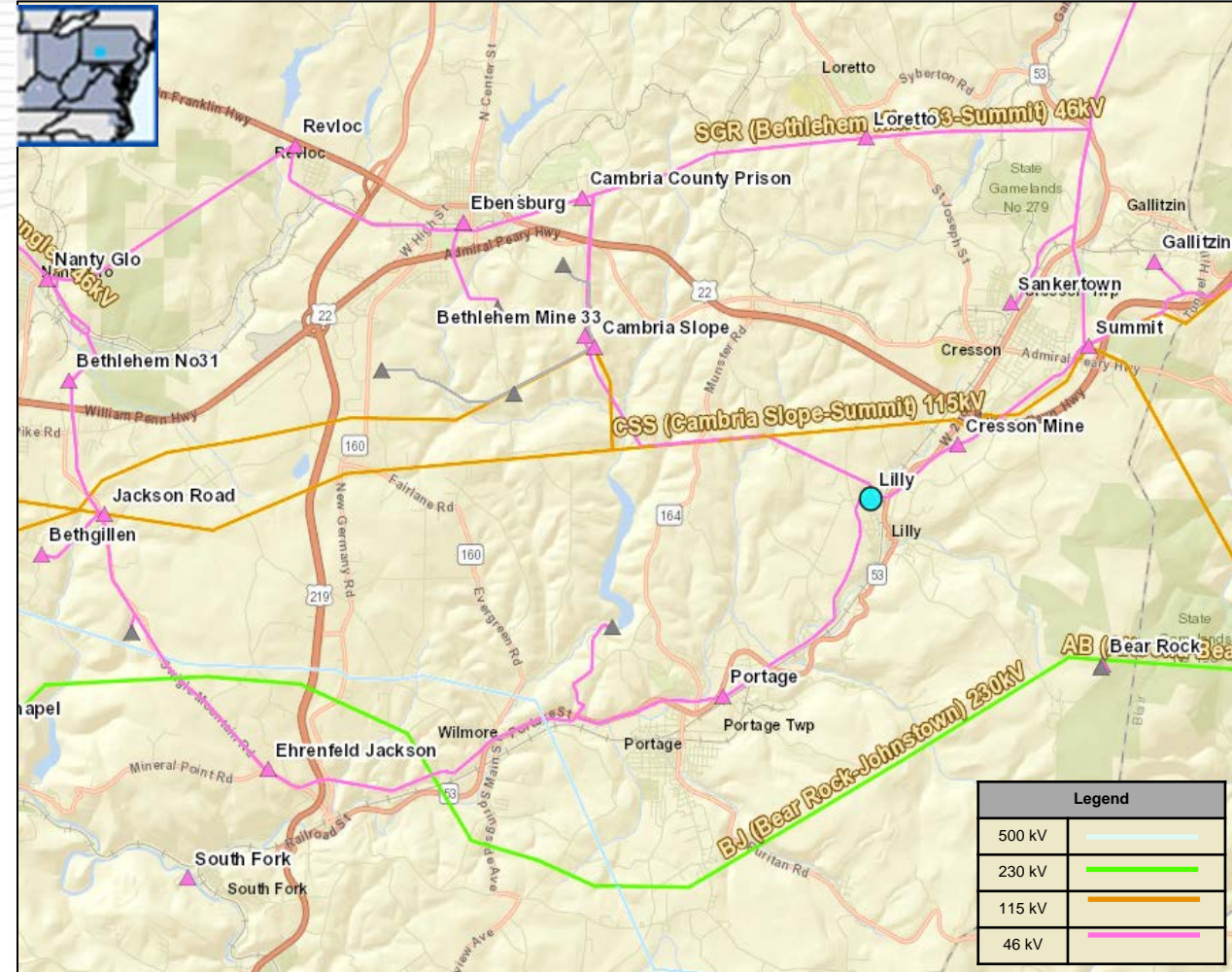
**Problem Statement:**

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 Lilly 46 kV Ring Bus





Need Number: PN-2019-017

Process Stage: Solutions Meeting 5/31/2019

**Potential Solution:**

- Construct Lilly 46 kV Ring Bus
- At Lilly:
  - Construct a four breaker 46 kV ring bus
- At Jackson Road:
  - Replace line relaying, substation conductor, and disconnect switches
- At Bethlehem 33:
  - Replace line relaying and substation conductor
- At Summit :
  - Replace line relaying
- At Portage:
  - Normally open switch to be operated as normally closed
- 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)

# Penelec Transmission Zone M-3 Process

## Lilly 46 kV Ring Bus

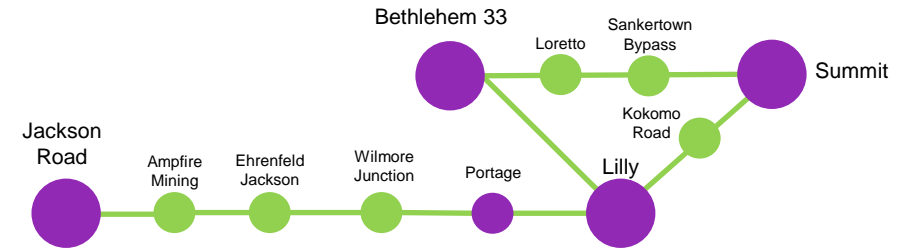
**Alternatives Considered:**

- Construct new 46 kV line from Bethlehem – Lilly

**Estimated Project Cost:** \$4.4M

**Projected In-Service:** 12/1/2021

**Status:** Conceptual



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



# Penelec Transmission Zone M-3 Process 17<sup>th</sup> Street Substation

Need Number: PN-2019-018

Process Stage: Solutions Meeting 5/31/2019

Previously Presented: Need Meeting 4/26/2019

Supplemental Project Driver:

*Operational Flexibility and Efficiency*

Specific Assumption References:

System Performance Projects

- 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.





Need Number: PN-2019-018

Process Stage: Solutions Meeting 5/31/2019

**Potential Solution:**

- *17th Street 46 kV Substation*
  - Construct a new 46 kV breaker-and-a-half substation to replace the existing Collinsville substation
  - New substation to include terminals for 20th Street, Greenwood, Park Plaza, Altoona F, Altoona AG, and Altoona G 46 kV lines along with terminals for two 46-12.5 kV transformers and a 46 kV capacitor
- 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)

# Penelec Transmission Zone M-3 Process

## 17<sup>th</sup> Street Substation

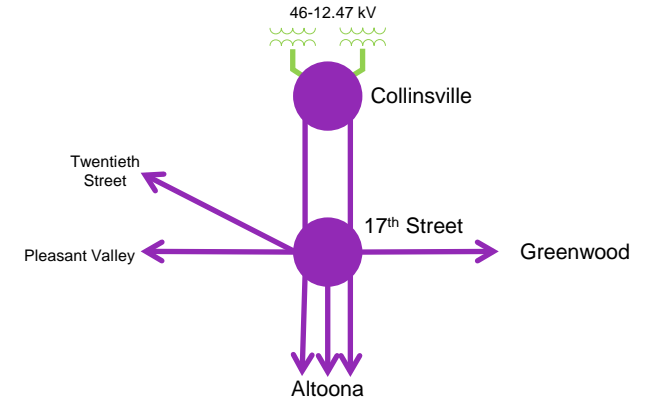
**Alternatives Considered:**

- Maintain existing condition

**Estimated Project Cost:** \$9.0M

**Projected In-Service:** 6/1/2022

**Status:** Conceptual



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



Need Number: PN-2019-019

Process Stage: Solutions Meeting 5/31/2019

Previously Presented: Need Meeting 4/26/2019

Supplemental Project Driver:

*Operational Flexibility and Efficiency*

Specific Assumption References:

System Performance Projects

- Substation/line equipment limits

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

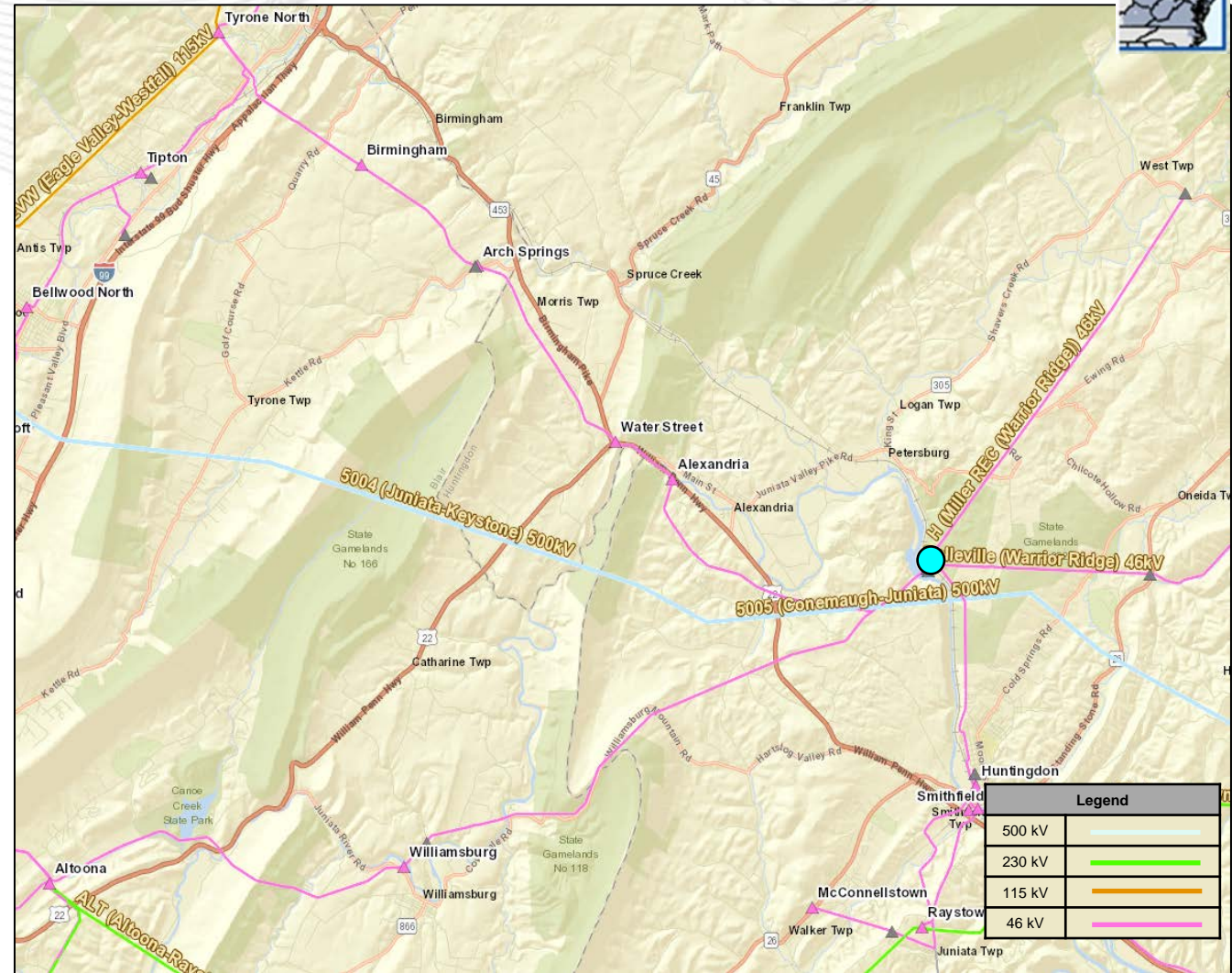
- Eliminate simultaneous outages to multiple networked elements

Build New Transmission Line

- Three or more terminal lines

- Network radial lines

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Need Number: PN-2019-019

Process Stage: Solutions Meeting 5/31/2019

Previously Presented: Need Meeting 4/26/2019

## 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: Existing 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 Stage: Solutions Meeting 5/31/2019

## Potential Solution:

*Warrior Ridge 46 kV Project*

*At Warrior Ridge:*

- Construct a 46 kV breaker-and-a-half substation

*At Center Union:*

- Replace disconnect switch on Warrior Ridge line exit with motor operated disconnect switch with whip

*At Belleville:*

- Replace disconnect switch on Center Union line exit with motor operated disconnect switch with vacuum bottles

*At New Holland:*

- Replace disconnect switch on Belleville line exit with motor operated disconnect switch with vacuum bottles

*At Huntingdon:*

- Replace line relaying, substation conductor, disconnect switches

*At Altoona:*

- Replace line relaying, disconnect switches

*Altoona – Williamsburg 46 kV line:*

- Rebuild ~0.9 miles of existing line

*At Williamsburg:*

- Replace line relaying, disconnect switches, and substation conductor

*At Williamsburg REC:*

- Replace disconnect switches with motor operated disconnect switches with whips

*Williamsburg – Williamsburg REC 46 kV line:*

- Rebuild ~0.5 miles of line

*Williamsburg REC – Warrior Ridge 46 kV:*

- Eliminate ABW Tap, via a line loop
- Rebuild ~7.5 miles of line

*Alexandria – Warrior Ridge 46 kV line:*

- Rebuild the line from ABW tap

*At Alexandria:*

- Replace disconnect switch on the Warrior Ridge line exit with motor operated disconnect switch with whip

*At Water Street Tap:*

- Replace disconnect switches with motor operated disconnect switches with vacuum bottles

*At Pemberton:*

- Replace disconnect switch on the Sinking Valley REC line exit with a motor operated disconnect switch with vacuum bottles

*At Birmingham:*

- Replace substation conductor

*At Tyrone North:*

- Replace line relaying and substation conductor

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

**Need Number:** PN-2019-019

**Process Stage:** Solutions Meeting 5/31/2019

**Potential Solution (continued):**

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)

**Alternatives Considered:**

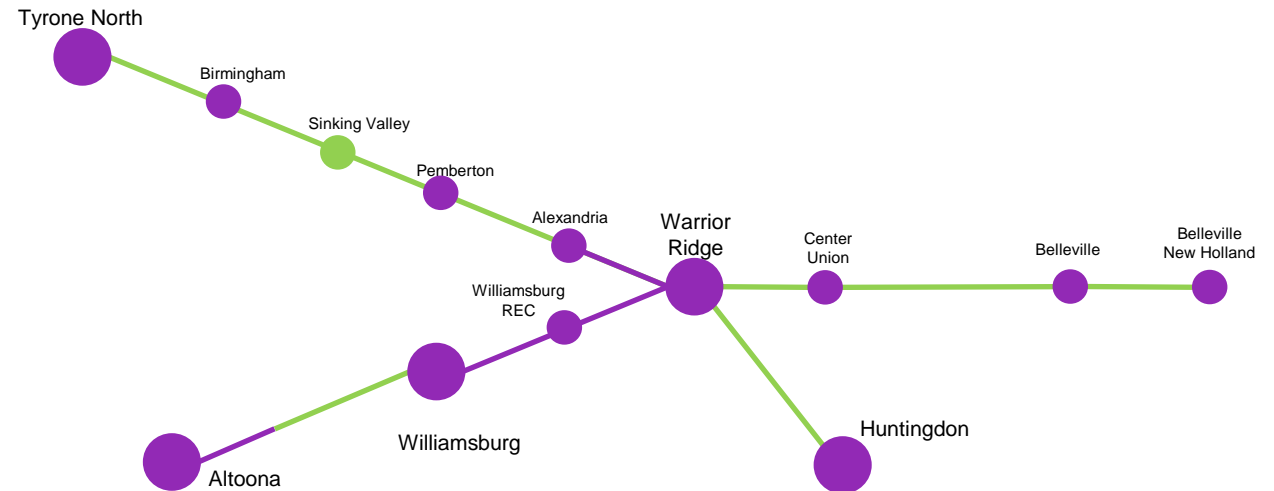
- Maintain existing condition

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

**Estimated Project Cost:** \$26.4M

**Projected In-Service:** 12/1/2021

**Status:** Conceptual



**Need Number:** PN-2019-021

**Process Stage:** Solutions Meeting 5/31/2019

**Previously Presented:** Need Meeting 4/26/2019

**Supplemental Project Driver:**

*Operational Flexibility and Efficiency*

**Specific Assumption References:**

System Performance Projects

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

Add/Expand Bus Configuration

- Eliminate simultaneous outages to multiple networked elements

**Problem Statement:**

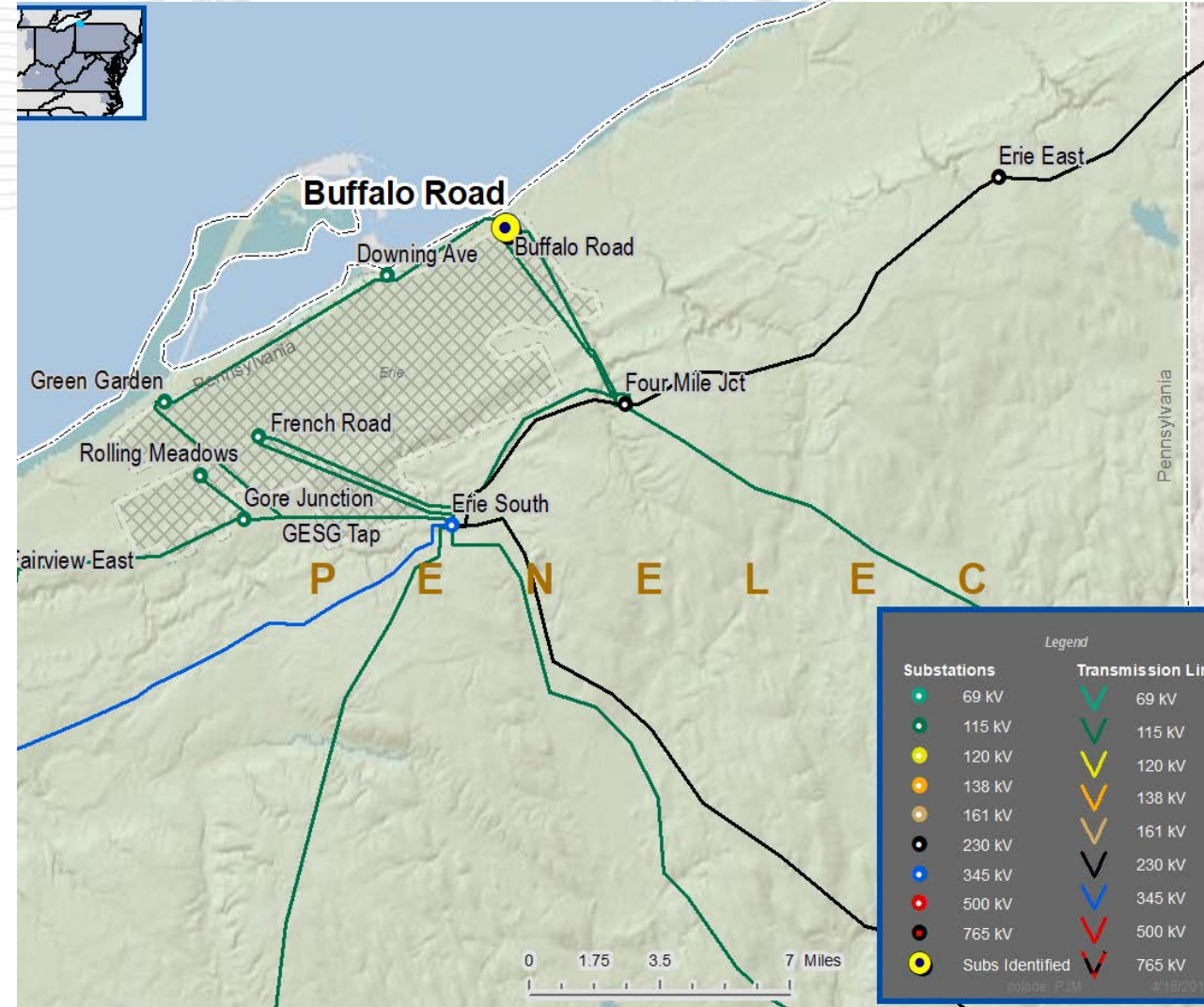
Buffalo Road 115 kV substation serves approximately 106 MW of load and 3,500 customers. A stuck bus tie breaker at Buffalo Road will outage both 115-34.5 kV transformers and three 115 kV lines.

Transmission lines are limited by terminal equipment.

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

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

*(substation conductor)*





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

**Need Number:** PN-2019-021

**Process Stage:** Solutions Meeting 5/31/2019

**Potential Solution:**

*Construct Buffalo Road 115 kV Ring Bus*

*At Buffalo Road:*

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

*At Green Garden:*

- Adjust remote end relaying as necessary

*At Four Mile:*

- Adjust remote end relaying as necessary

**Transmission Line Rating:**

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

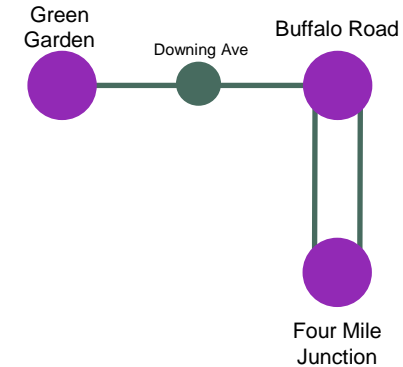
**Alternatives Considered:**

- Maintain existing condition

**Estimated Project Cost:** \$9.0M

**Projected In-Service:** 6/1/2022

**Status:** Conceptual



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

Questions?



# Appendix



## Assumptions

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

## Needs

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

## Solutions

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

## Submission of Supplemental Projects & Local Plan

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



# Revision History

5/21/2019 – V1 – Original version posted to [pjm.com](http://pjm.com)