



An AEP Company

BOUNDLESS ENERGY™

SRRTEP Committee Western AEP Supplemental Projects

November 22, 2019

Needs

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

AEP Transmission Zone M-3 Process Western Ft. Wayne, Indiana Area

Need Number: AEP-2019-IM020

Process Stage: Needs Meeting 11/22/19

Supplemental Project Driver: Equipment Material/Condition/Performance/Risk

Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

Problem Statement:

Gateway 69/34.5kV Station

34.5kV CB C.

- 1952 FK Oil breaker
- Fault Ops: C(10) – Recommended:10

69/34kV XFR 1

- 1975 unit with IEEE level 4 CO2 and level 2 CO
- Documented leaks and insulating paper deterioration

Columbia 138/69/34.5kV Station

69 CB's K.

- 1985 FK Oil breaker
- Fault Ops: K(22) – Recommended:10

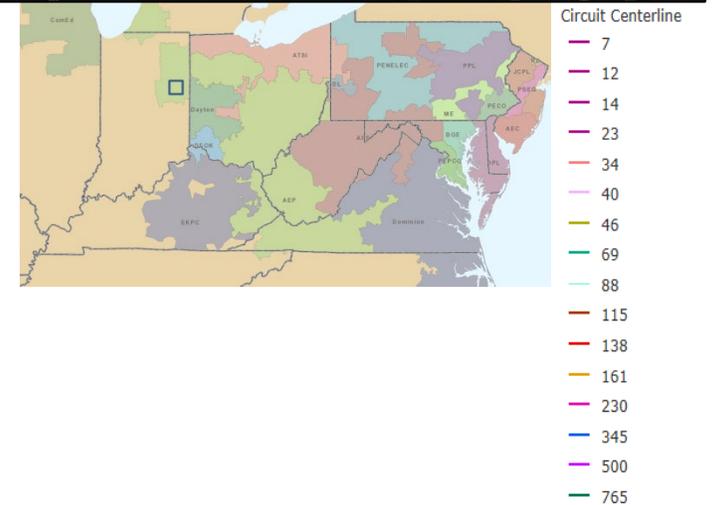
34.5kV CB B

- 1951 FK Oil breaker
- Fault Ops: B(20)– Recommended:10

Whitley 34.5kV Station

34.5kV CB D & B.

- 1954 & 1963 FK Oil breaker
- Fault Ops: D(20) B(69) – Recommended:10



AEP Transmission Zone M-3 Process Western Ft. Wayne, Indiana Area

Need Number: AEP-2019-IM020
Process Stage: Needs Meeting 11/22/19
Supplemental Project Driver: Equipment Material/Condition/Performance/Risk
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

Problem Statement:
Gateway – Columbia 69kV line
 1964 Wood crossarm style line with 13 open conditions across its ~2.5 miles

Richland – Columbia 69kV line
 1959 Wood crossarm style line with 29 open conditions across its ~13 miles.

Churubusco – Whitley 34.5kV line
 1946 Wood crossarm style line with 31 open conditions across its ~10.6 miles

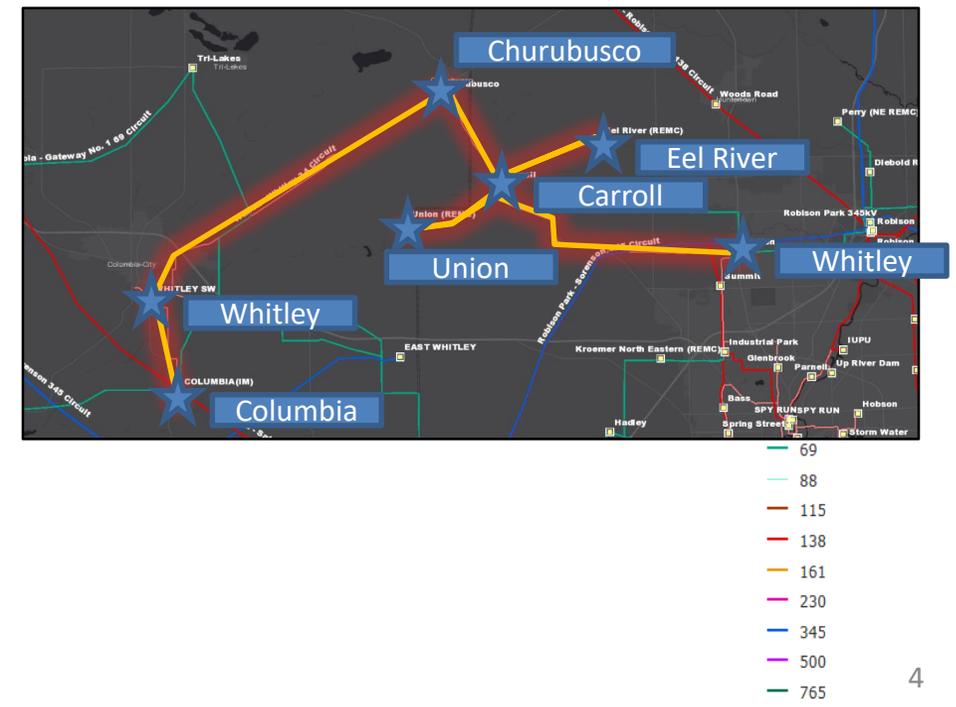
Columbia – Whitley 34.5kV line
 1954 Wood crossarm style line with 2 open conditions across its ~3.4 miles

Churubusco – Wallen 34.5kV line
 1972 Wood crossarm style line with 42 open conditions across its ~11.4 miles

Carroll – Union REMC 34.5kV line
 1968 Wood pole style line with 3 open conditions across its ~3 miles

Carroll – Eel River 34.5kV line
 1964 Wood pole style line with 1 open conditions across its ~3 miles

Gateway – Columbia #1
 Due to the load on this line, it's exposure, and the outages it has sustained in the last 10 years, this line requires additional sectionalization.



Need Number: AEP-2019-AP042

Process Stage: Need Meeting 11/22/2019

Supplemental Project Driver: Equipment Condition/Performance/Risk

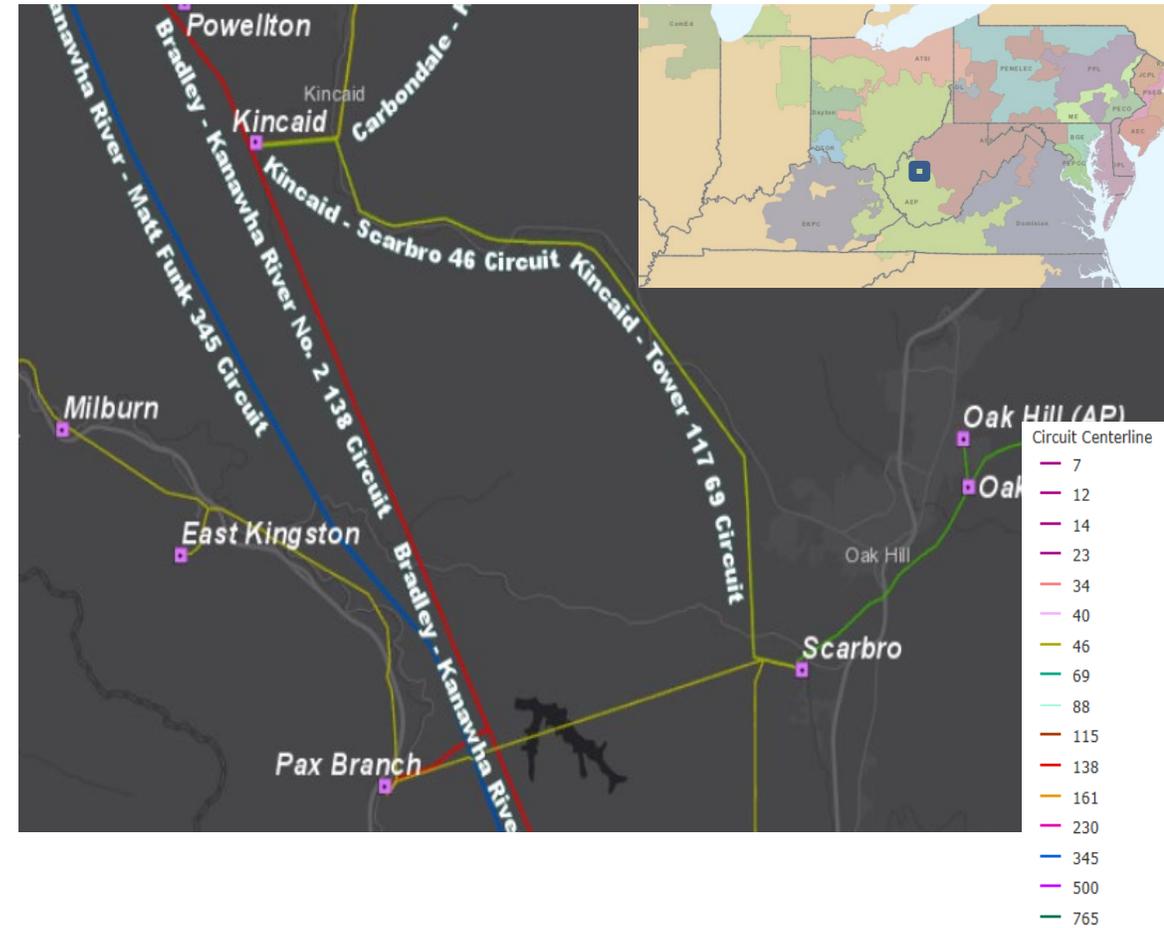
Specific Assumption Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

Problem Statement:

Kincaid – Tower 117 69 kV (22.42 mile), includes Kincaid – Scarbro 46 kV line (10.1 miles)

- The double circuit segment from Kincaid to Scarbro is comprised of a combination of lattice steel and wood poles.
 - Lattice structures utilize direct embed grillage foundation
 - Line originally installed in 1913, primarily with 3/0 Copper conductor
 - The structures failed to meet 2017 NESC 250B and 250D loading criteria
 - The lattice towers show flaking of the galvanized coating with significant section loss and corrosion above and below grade on the tower legs.
 - 4-bell insulators have noticeable wear and tear including rusting
 - The original conductor has visible signs of wear, such as burns and rust.
- Since 2014 there have been 86 momentary and 27 permanent outages on the Kincaid – Tower 117 69 kV and Kincaid – Scarbro 46 kV circuits.
 - Majority of the momentary outages were due to weather including wind/lightning
 - This is indicative of insufficient shielding, and/or insufficient grounding
 - Permanent outages were caused by a vegetation fall-ins due to insufficient ROW and line equipment failures
 - These permanent outages attributed to 1.1M customer minutes of interruption
- There are currently 33 structures with at least one open structural condition, which relates to 29% of the structures on the double circuit segment (10.1 miles).
- There are currently 68 open structural conditions mainly related to heavy rust on lattice steel lacing and rot on poles/crossarms.

Model: N/A SRRTEP-W – AEP Supplemental 11/22/2019



Need Number: AEP-2019-AP043

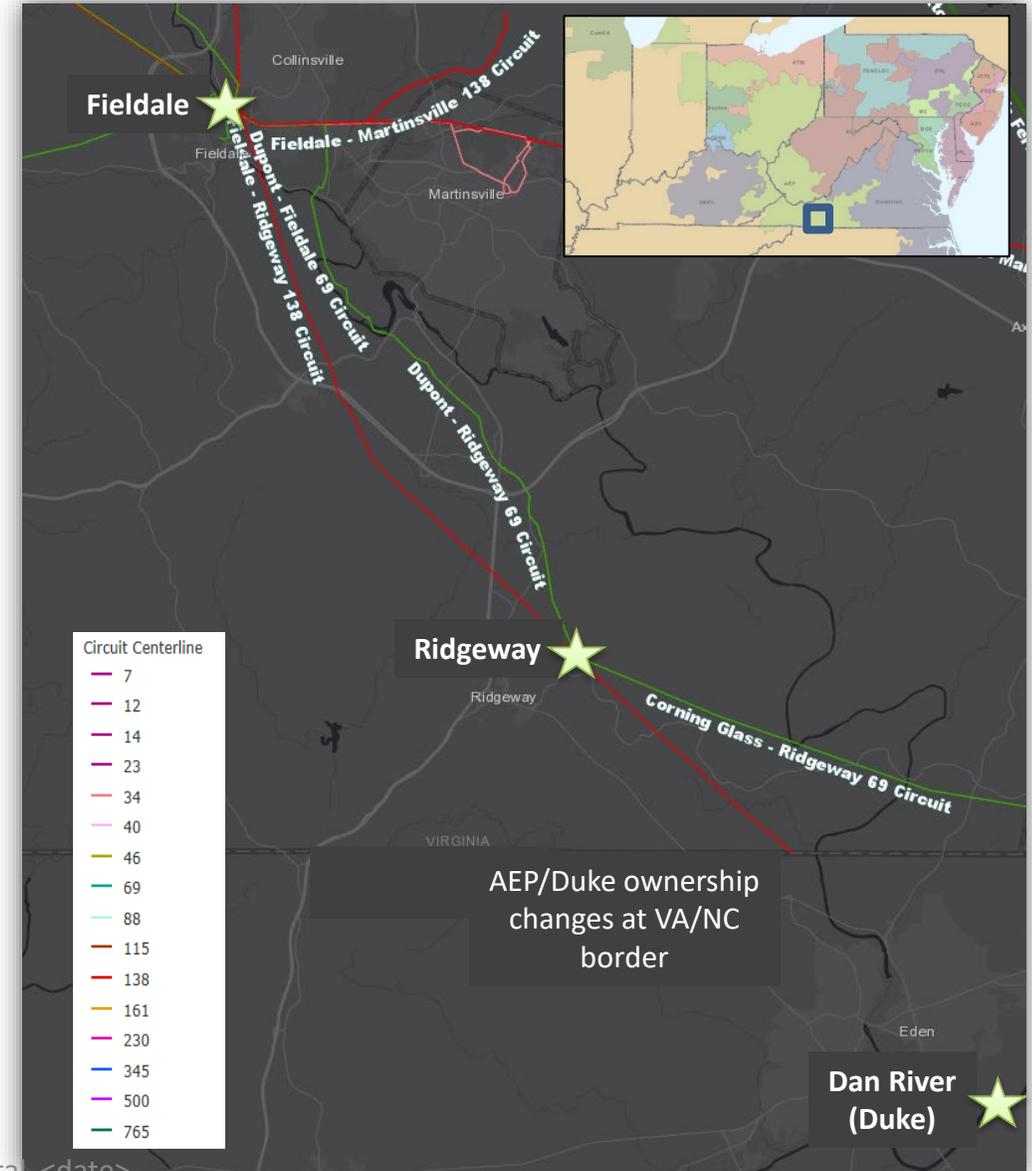
Process Stage: Needs Meeting 11/22/19

Supplemental Project Driver: Equipment Material/Condition/Performance/Risk

Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

Problem Statement:

- **Fieldale-Dan River 138 kV Line Asset (14.8 mi.)**
 - **Fieldale-Ridgeway 138 kV Circuit (10.3 mi.)**
 - 1949 wood H-Frame construction
 - 58 Type A open conditions on 35 unique structures (51% of all structures on circuit)
 - From 2015-2018, a total of 4 permanent outages resulting in 241,094 customer minutes of interruption
 - **Ridgeway-Dan River 138 kV Circuit (4.5 mi.)**
 - 1949 wood H-Frame construction
 - 40 Type A open conditions on 23 unique structures (68% of all structures on circuit (owned by AEP))
 - From 2015-2018, a total of 3 permanent outages occurred



Need Number: AEP-2019-AP045

Process Stage: Needs Meeting 11/22/19

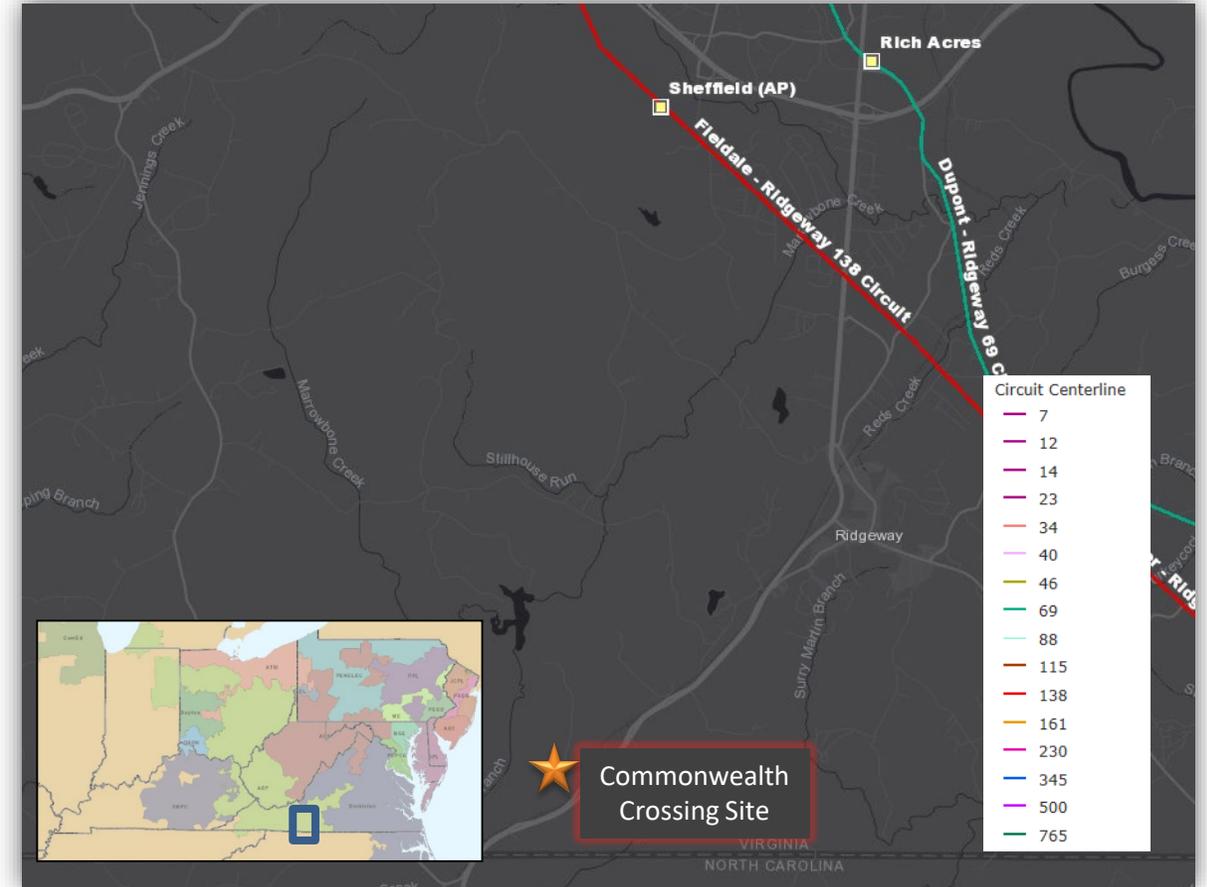
Supplemental Project Driver: Customer Service

Specific Assumptions Reference: AEP Connection Requirements for the AEP Transmission System (AEP Assumptions Slide 7)

Problem Statement:

- Henry County VA has requested a new delivery point in its Commonwealth Crossing Business Centre (CCBC) to initially serve Press Glass (5 MVA). The CCBC is located roughly 5 miles from the Sheffield-Ridgeway 138kV line in Ridgeway VA.

Model: 2024 RTEP



Need Number: AEP-2019-AP046

Process Stage: Needs Meeting 11/22/19

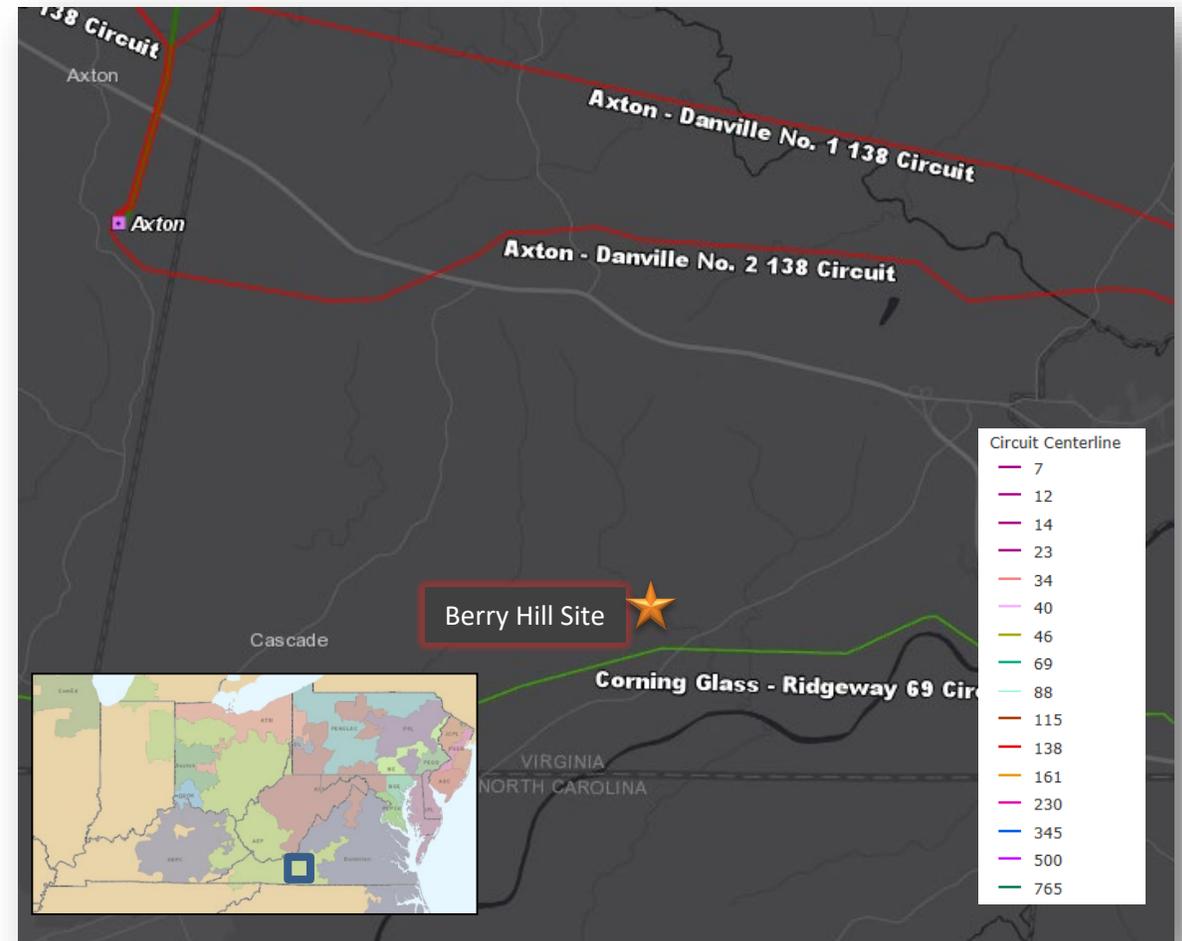
Supplemental Project Driver: Customer Service

Specific Assumptions Reference: AEP Connection Requirements for the AEP Transmission System (AEP Assumptions Slide 7)

Problem Statement:

- A siting assessment has been requested for establishing a new distribution station in anticipation of a future industrial customer(s) located at the Southern Virginia Mega Site at Berry Hill.

Model: 2024 RTEP



AEP Transmission Zone M-3 Process Sullivan County, Tennessee

Need Number: AEP-2019-AP048

Process Stage: Needs Meeting 11/22/2019

Supplemental Project Driver:

Equipment Condition/Performance/Risk

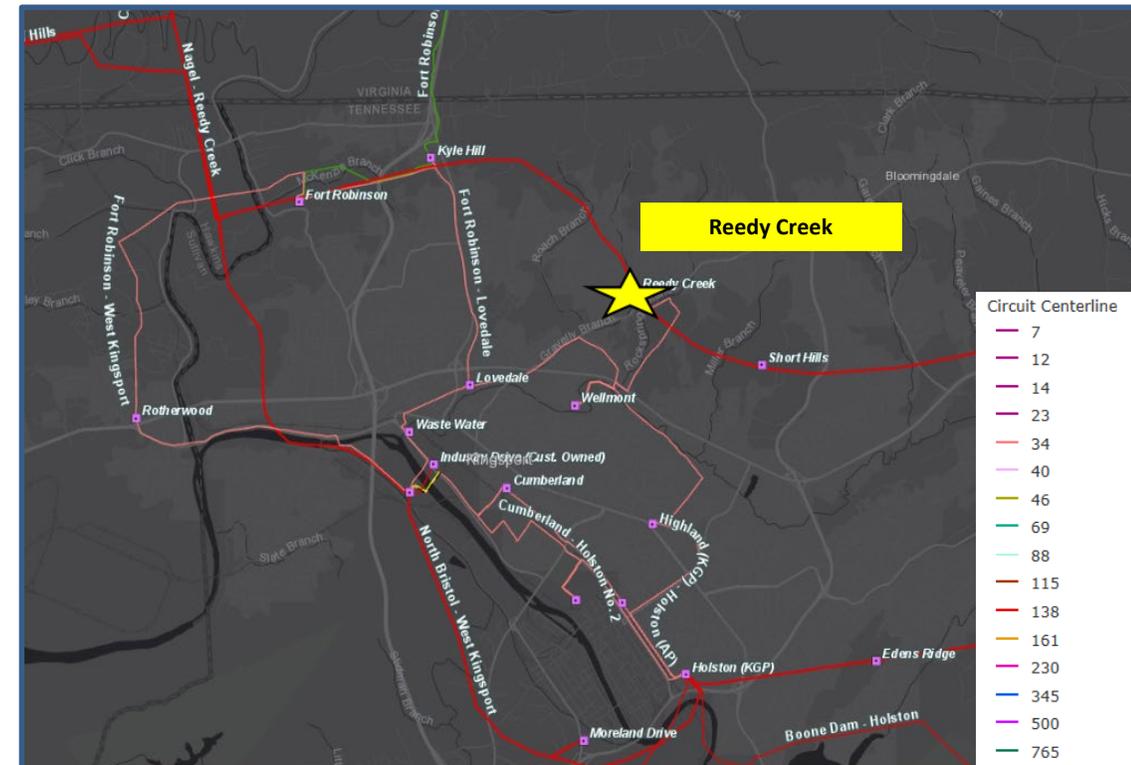
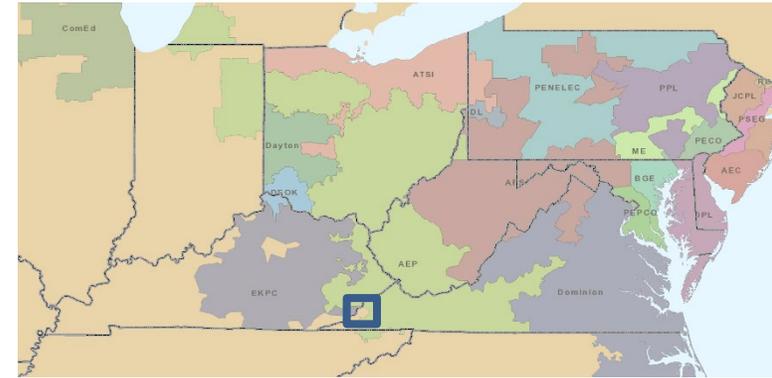
Specific Assumption References:

AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

Model: N/A

Problem Statement:

- Reedy Creek CB A is a 32 year old GCB and it's the only breaker of its kind left on AEP system—there are no longer usable, retired breakers to harvest for spare parts.
- It has 16 malfunction records related to SF6 leaks and 13 fault operations, exceeding the 10 operations recommended by manufacturer.
- Units of similar design demonstrated serious issues relating to the accelerated deterioration of the rubber lines that comprise the hydraulic system. Losing pressure in the hydraulic system is an imminent failure mode and once detected, this failure mode can only be resolved by de-energizing the unit.



Need Number: AEP-2019-AP050

Process Stage: Needs Meeting 11/22/19

Supplemental Project Driver: Equipment Material/Condition/Performance/Risk

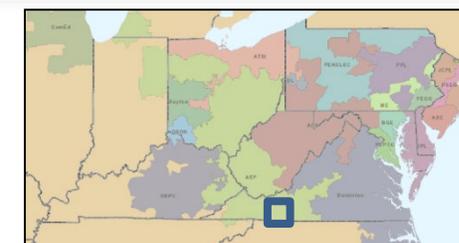
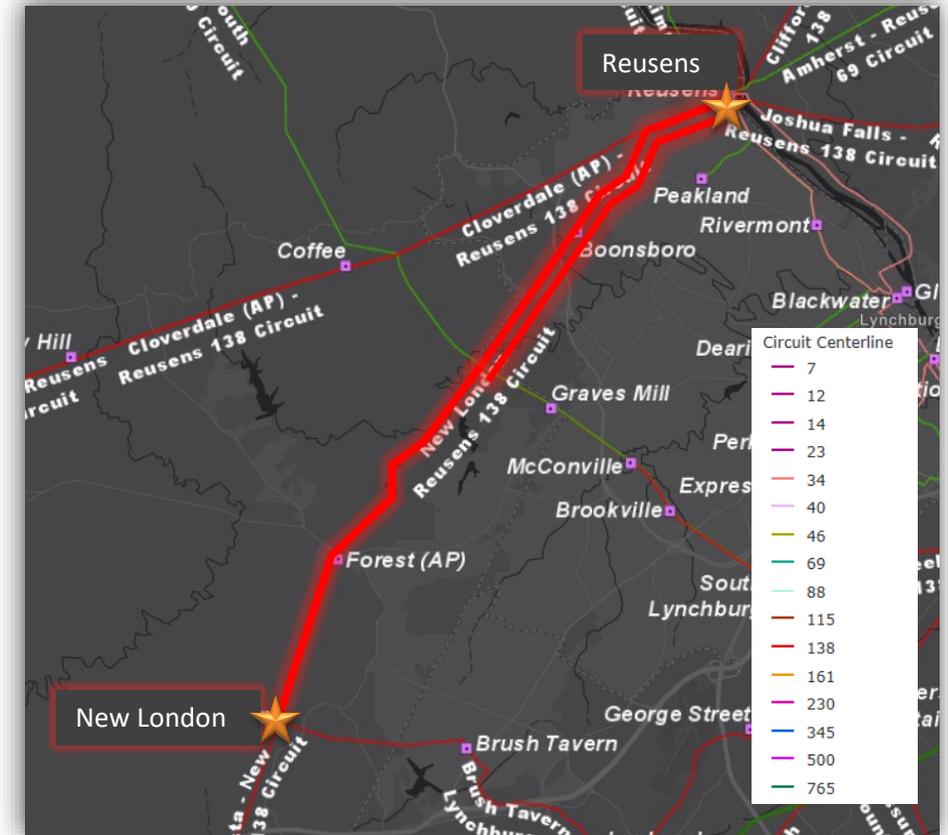
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

Problem Statement:

• **Reusens-Altavista 138 kV Line Asset (11.6 mi.)**

- A total of 16 open conditions on 13 unique structures (comprising 18% of the line asset)
- New London-Reusens 138 kV Circuit: From 2015-2018, a total of 2 permanent and 2 momentary outages occurred
- McConville-Reusens 138 kV Circuit: From 2015-2018, a total of 2 permanent and 2 momentary outages occurred
 - **138 kV Double Circuit Section (5.5 mi.)**
 - 1949 steel lattice structures
 - Structure loading does not comply with the NESC 250B and 250D standards for the line.
 - The current shielding does not comply with the current standards, specifying a maximum of 30 degrees. The current shielding angle is approximately 50 degrees.
 - **138 kV Single Circuit Section (6.1 mi.)**
 - 1949 wood H-Frame construction
 - Structure loading does not comply with the NESC 250B and 250D standards for the line.
 - The current shielding does not comply with the current standards, specifying a maximum of 30 degrees. The current shielding angle is approximately 50 degrees.

Model: N/A



AEP Transmission Zone: Supplemental Ft. Wayne, Indiana

Need Number: AEP-2019-IM018

Meeting Date: Needs Meeting 11/22/19

Supplemental Project Driver: Equipment

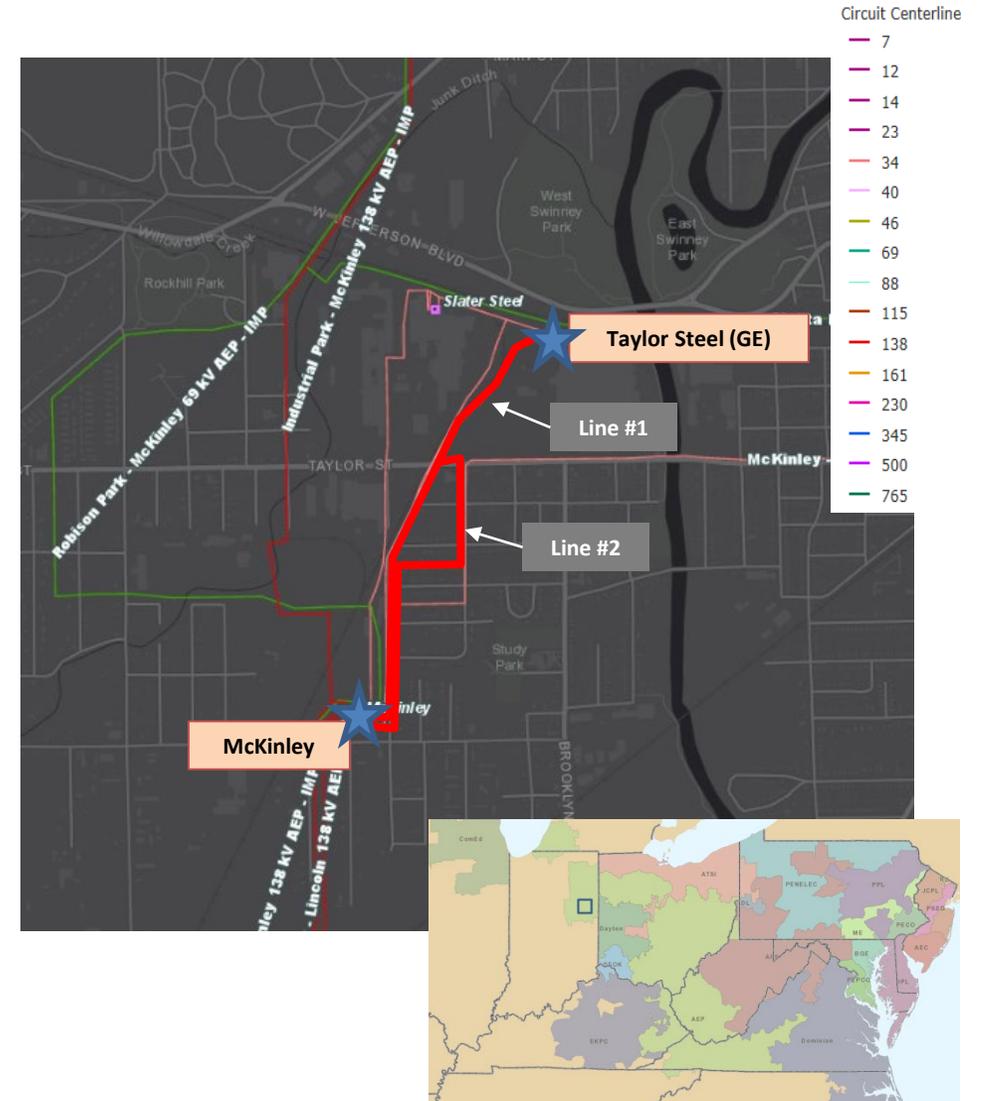
Material/Condition/Performance/Risk

Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

Problem Statement:

1. McKinley – Taylor General Electric Line 34kV Line (~0.9 Miles)
 - 1956 vintage wood pole, crossarm construction
 - There are currently 3 open conditions on this line.
 - Open conditions include: Split pole and stolen ground lead wires.

2. McKinley – General Electric Taylor East 34kV Line (~0.7 Miles)
 - 1960 vintage wood pole, crossarm construction
 - There are currently 9 open conditions on this line.
 - Open conditions include: Damaged, split or rotted structures.



AEP Transmission Zone: Supplemental Ft. Wayne, Indiana

Need Number: AEP-2019-IM018

Meeting Date: Needs Meeting 11/22/19

Supplemental Project Driver: Equipment

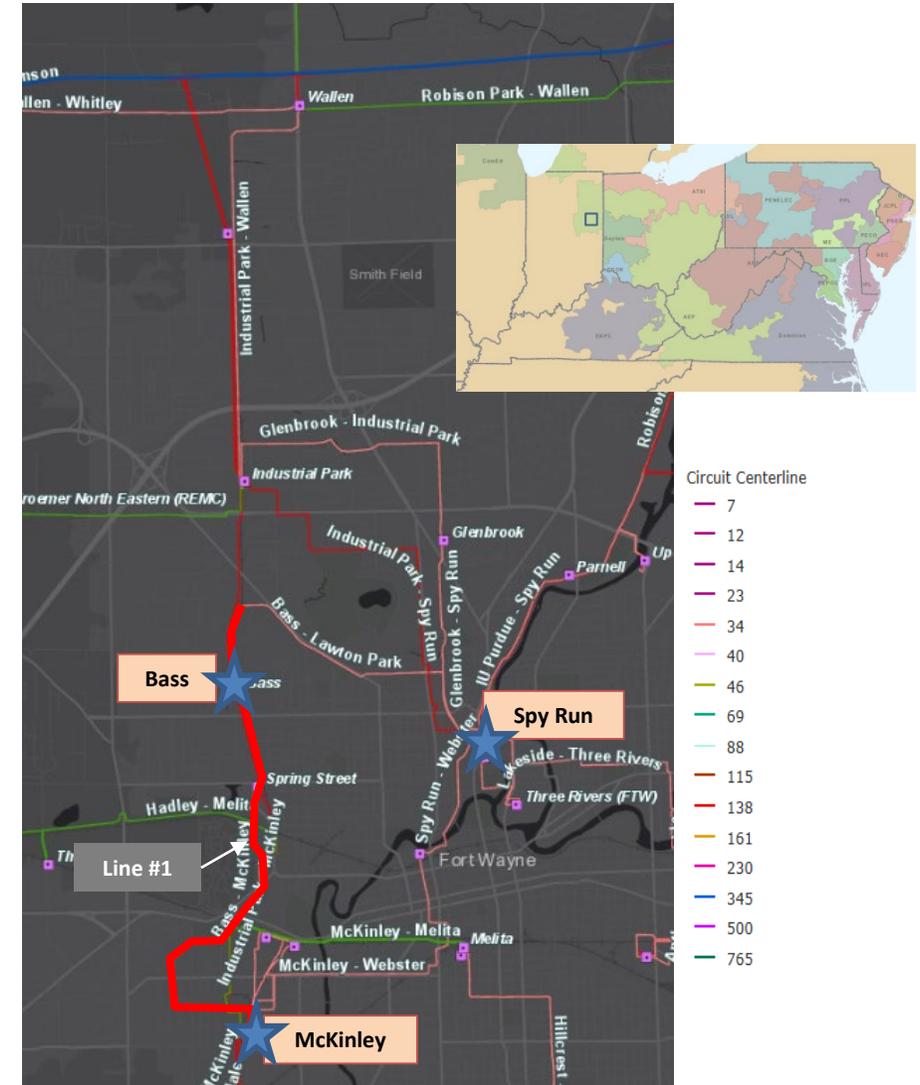
Material/Condition/Performance/Risk

Specific Assumptions Reference: AEP Guidelines for Transmission
Owner Identified Needs (AEP Assumptions Slide 8)

Problem Statement:

1. Bass – McKinley 34.5kV (~3.5 Miles)

- 1930 vintage steel single circuit lattice construction.
- There are currently 4 open conditions on this line.
- Six wired Copper conductor with copper weld shield wire. Copper conductors become brittle with age and Copper weld conductor has long been obsolete



Need Number: AEP-2019-IM018

Meeting Date: Needs Meeting 11/22/19

Supplemental Project Driver: Equipment

Material/Condition/Performance/Risk

Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

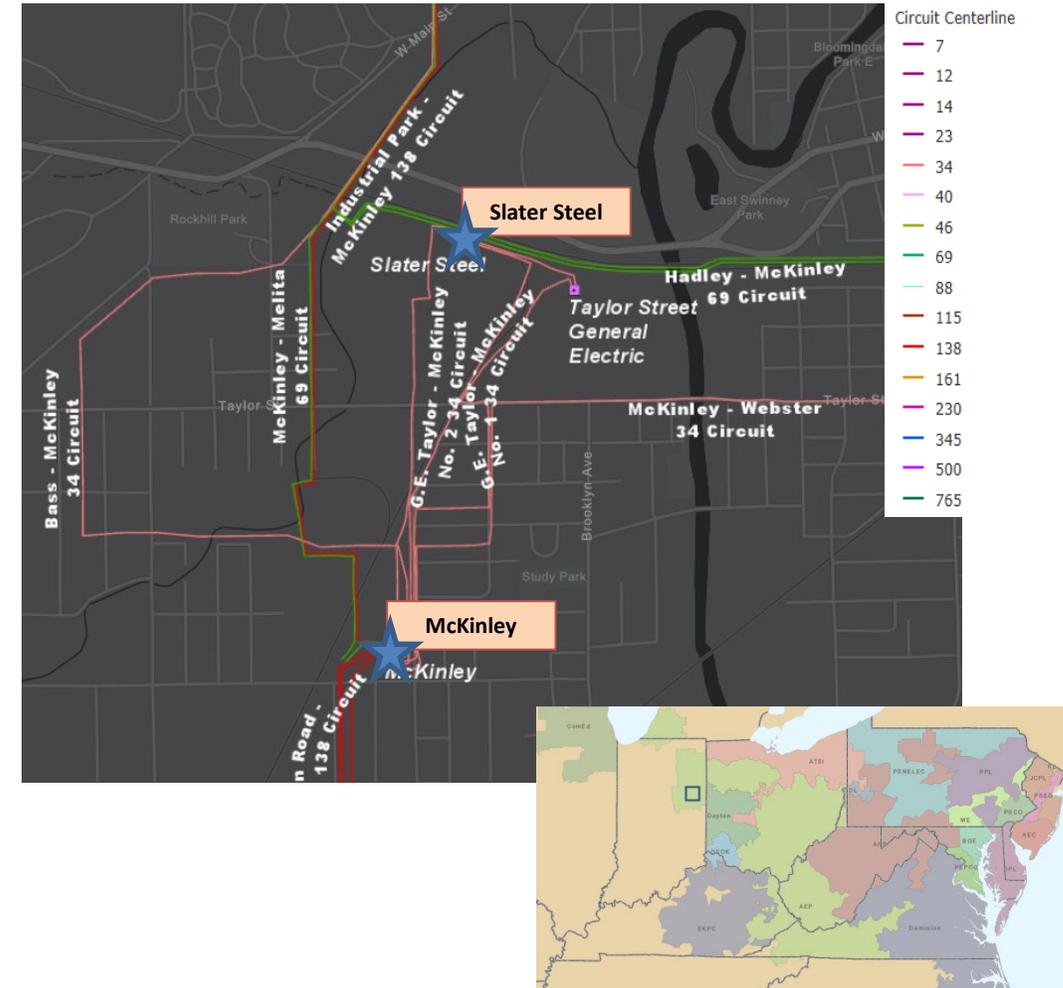
Problem Statement:

McKinley 138/69/34.5kV station

- Breakers F,J,K & M 34kV
 - 1956 vintage FK Oil breakers which have been known to fail violently.
- Breaker DD 34kV
 - 1962 vintage FK Oil breakers which have been known to fail violently.
- Oil filled breakers have much more maintenance required due to oil handling that their modern, vacuum counterparts do not require. Finding spare parts for these units is difficult or impossible, and these models are no longer vendor supported

Slater Steel 34kV station

- Customer-owned 34 kV switching facilities inside Slater Steel Station.
- Concerns about employees safety while switching in the customer station



Need Number: AEP-2019-IM044

Process Stage: Needs Meeting 11/22/2019

Supplemental Project Driver: Equipment Material/Condition/Performance/Risk

Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

Problem Statement:

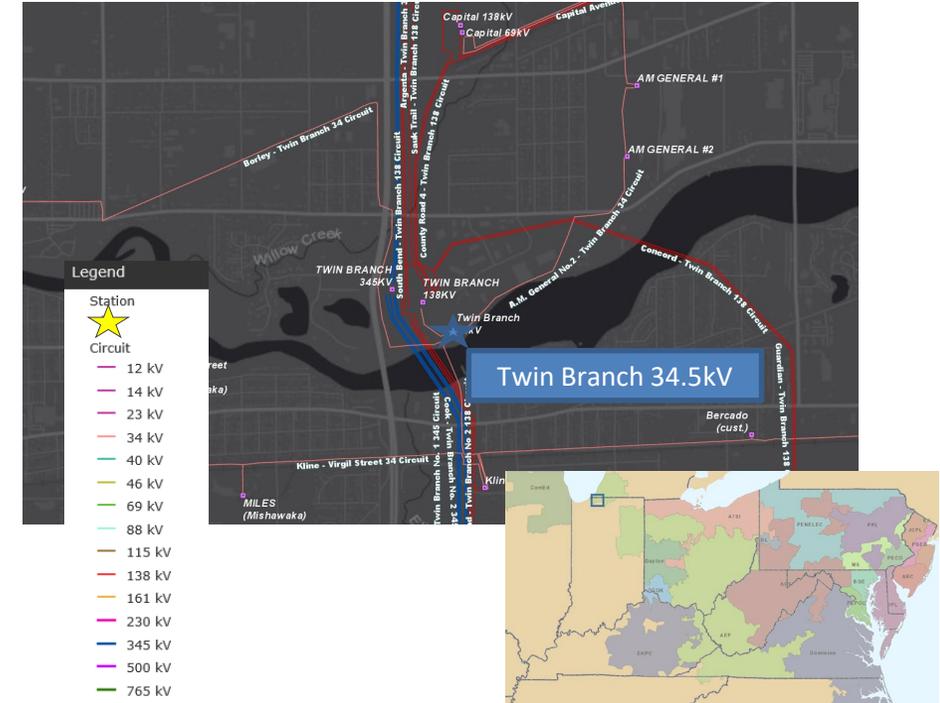
Twin Branch Hydro 34.5kV Station:

34.5kV Breakers:

- The 34.5 kV Circuit Breakers CB, BB, DD, HH, and NN at Twin Branch 34.5kV Station are GE 'FK' oil-filled breaker manufactured in the 1950's. Common failure modes documented in AEP malfunction records for these breaker types are:
 - compressor failures and valve defects, which cause low pressure and oil leaks.
 - trip or reclose failures, caused primarily by spring latching and charging motor component failures.
 - the vacuum oil and oil breakers have a lot of oil contamination from aging gaskets allowing moisture and other particle ingress.
- Oil spills are frequent with failures and routine maintenance, which can also present an environmental hazard
- Because these breaker types are no longer manufactured, spare parts are not available.

34.5/4kV Transformer #4:

- The interfacial tension of the oil is below acceptable limits and the moisture content in the oil relates to a level of relative saturation. These indicate that:
 - sludge has formed in the radiators, core and coil.
 - high moisture levels in the oil and paper insulating materials.
 - the transformer oil is in poor quality to withstand dielectric events.
- Due to the age of this transformer, oil processing is not feasible option to extend the life of the unit.



Need Number: AEP-2019-IM045

Process Stage: Needs Meeting 11/22/2019

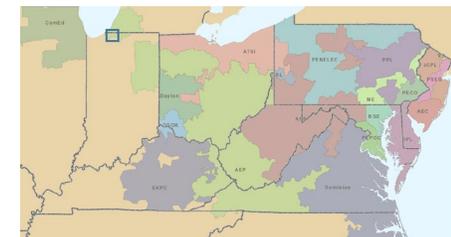
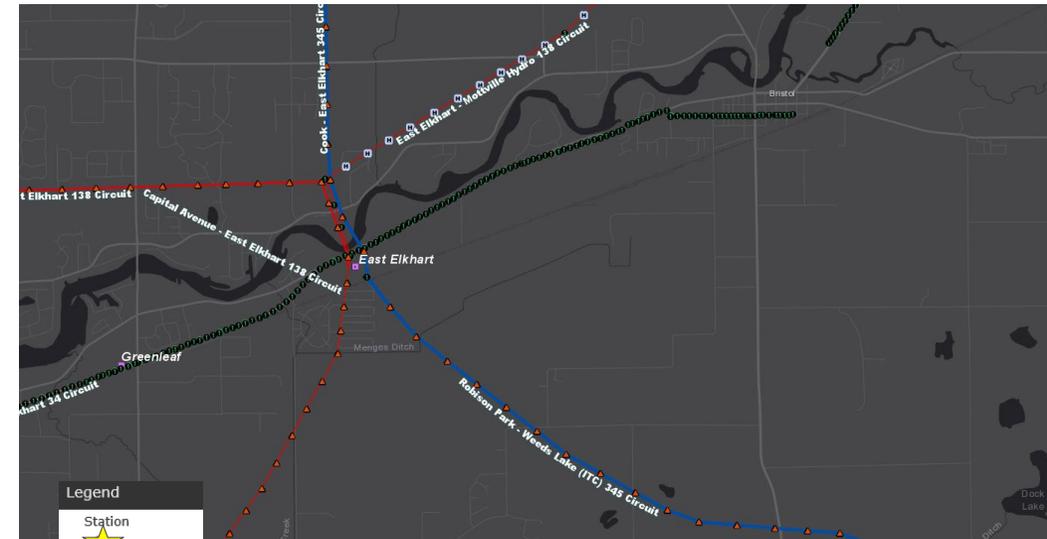
Supplemental Project Driver: Customer Service

Specific Assumptions Reference: AEP Interconnection Guidelines (AEP Assumptions Slide 7)

Problem Statement:

- Request from NIPSCO to serve 100MW of load located approximately 2-3 miles east of East Elkhart station

Model: 2024 RTEP



AEP Transmission Zone M-3 Process Niles Area Load Increase

Need Number: AEP-2019-IM046

Process Stage: Needs Meeting 11/22/2019

Supplemental Project Driver: Customer Service

Specific Assumptions Reference: AEP Interconnection Guidelines (AEP Assumptions Slide 7)

Problem Statement:

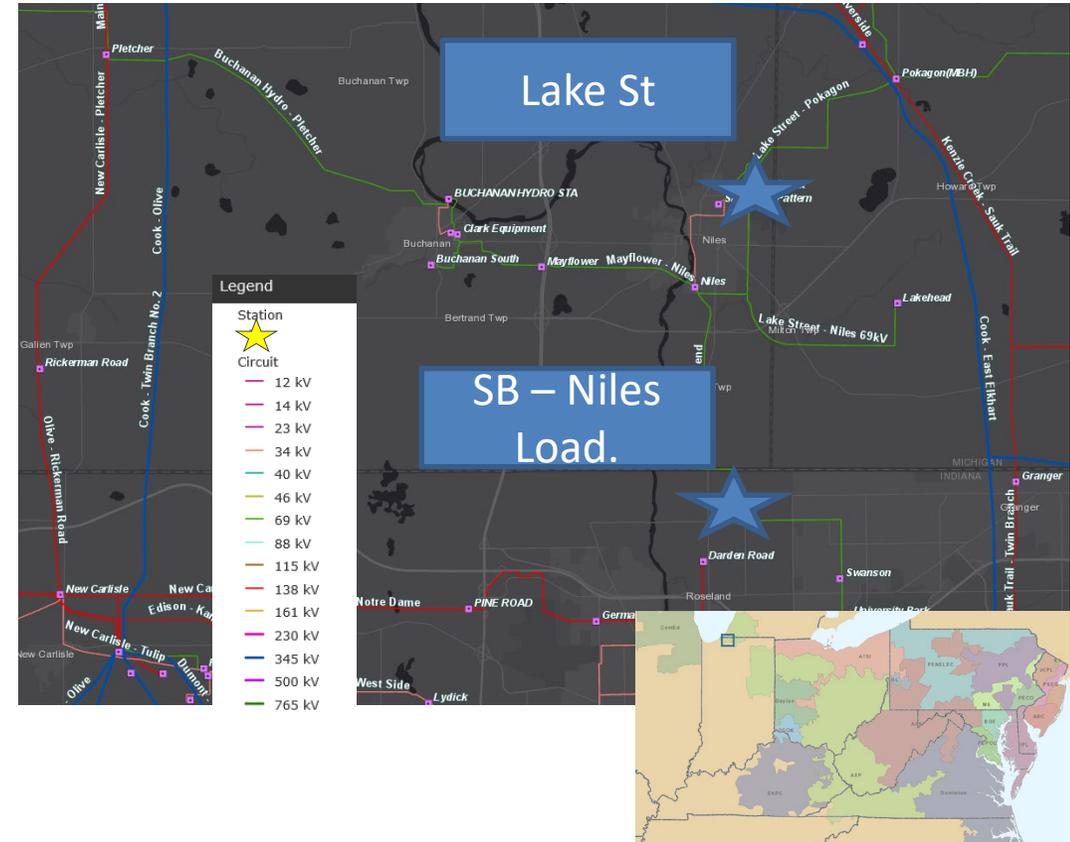
Lake Street 69/34.5kV station

- New load delivery point which will serve ~8MW.

South Bend – Niles 69kV line

- New load delivery point which will serve ~15MW.

Model: 2024 RTEP



AEP Transmission Zone M-3 Process Putnam County, Ohio

Need Number: AEP-2019-OH059

Process Stage: Need Meeting 11/22/2019

Supplemental Project Driver:

Equipment Material/Condition/Performance/Risk:

Specific Assumption Reference:

AEP Guidelines for Transmission Owner Identified Needs

Problem Statement:

Kalida – North Delphos (Original 1914)

- Length: 11.26
- Original Construction Type: Wood
- Original Conductor Type: 4/0 Copper 7
- Momentary/Permanent Outages: 9 Momentary, 3 Permanent (5 year)
- CMI: 206,131 (5 year)
- Total structure count: 268
- Number of open conditions: 58
 - Open conditions include: rot heart, insect damage, broken/missing ground leads, burnt insulators
- Unique structure count with open conditions: 50

Model: N/A



AEP Transmission Zone M-3 Process Dover, Ohio

Need Number: AEP-2019-OH061

Process Stage: Needs Meeting 11/22/2019

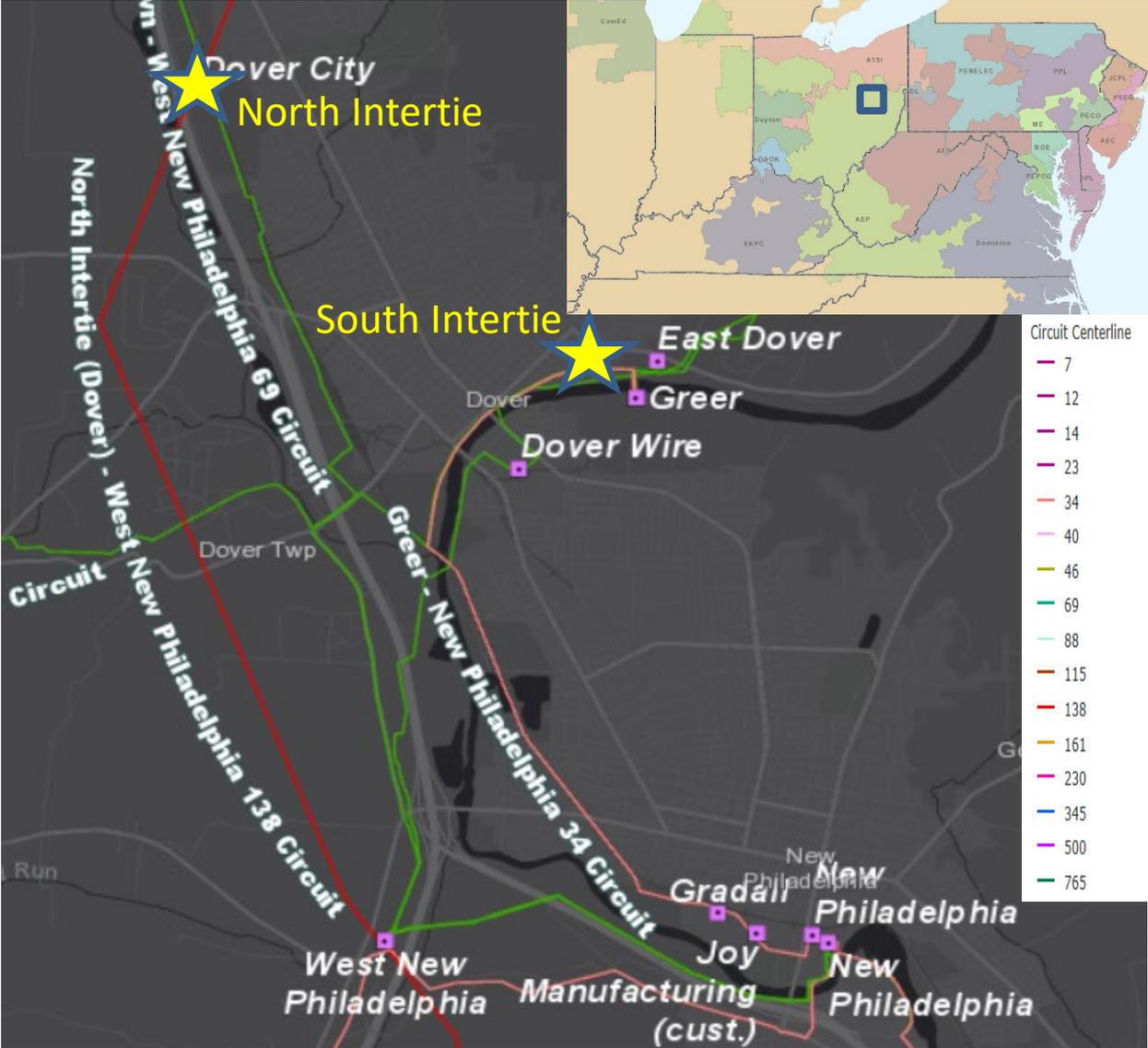
Supplemental Project Driver:
Customer Service

Specific Assumption Reference:
AEP Connection Requirements for the AEP Transmission System
(AEP Assumptions Slide 7)

Problem Statement:

- The City of Dover (municipal customer) has a normally-open 69kV backup delivery point from AEP at South Intertie Switch. Dover is normally served from AEP’s North Intertie 138kV station. Dover has requested that AEP close the normally-open 69kV switch, to provide two parallel points of service. Peak summer load is 45 MW.

Model: 2024 RTEP



AEP Transmission Zone M-3 Process Delaware County, Ohio

Need Number: AEP-2019-OH062

Process Stage: Needs Meeting 11/22/2019

Supplemental Project Driver: Equipment Condition/Performance/Risk, Operational Flexibility

Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

Problem Statement:

Delaware 138kV Station:

Over the last five years Delaware station has accumulated approximately 2 million minutes of customer interruption associated with 19 outages at the station.

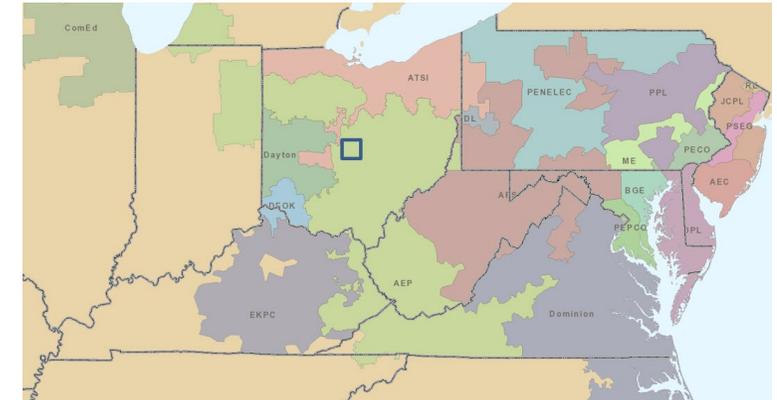
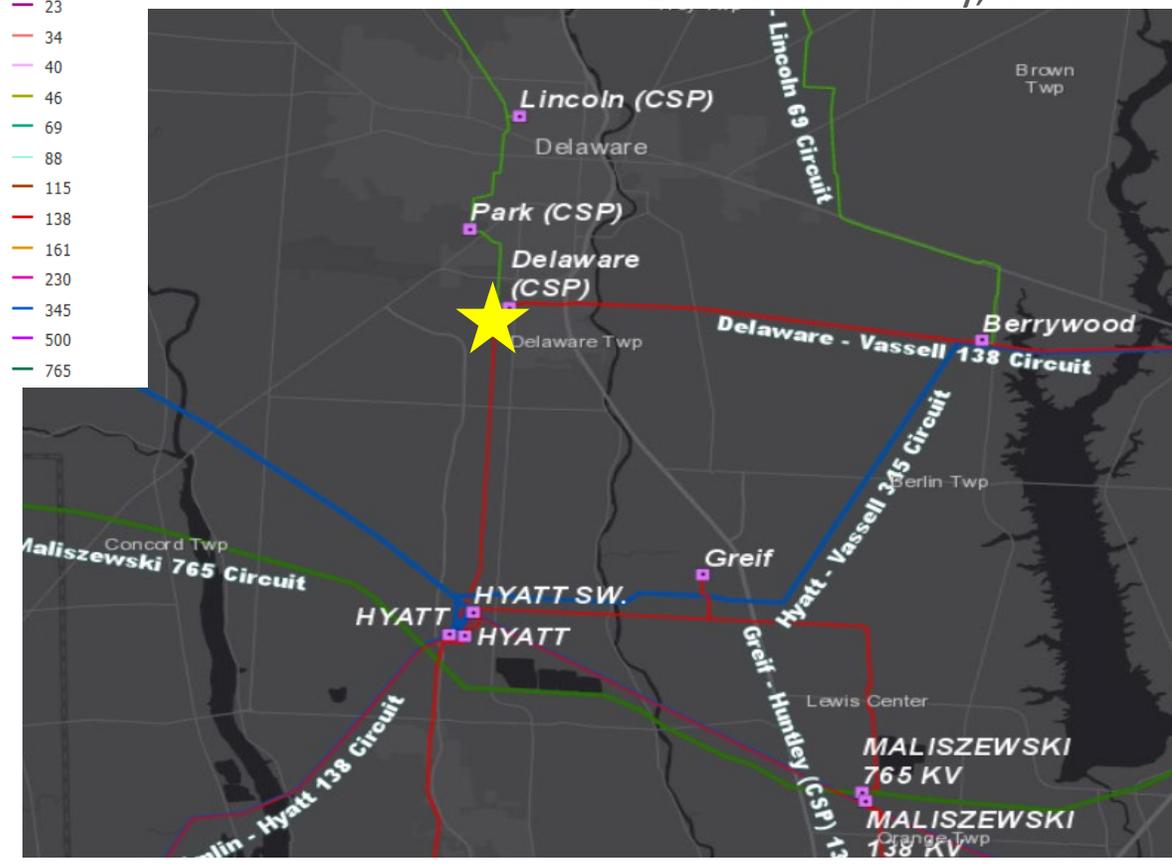
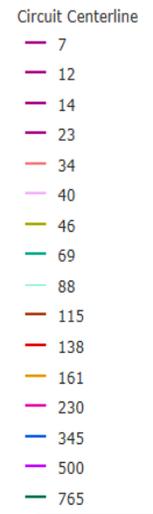
138 kV Circuit Breakers ~~104, 106, and 114~~

- ~~CB's 104 and 106 are GM 5C type oil breakers. CB 114 is an FK type oil breaker. (1963, 1964, and 1964 vintage)~~
- These are oil breakers that are difficult to maintain due to the required oil handling. There is an increased potential for oil spills during routine maintenance and failures with these types of breakers.
- Other drivers include damage to bushings, spare part availability, historical reliability, and lack of vendor support of the breakers.

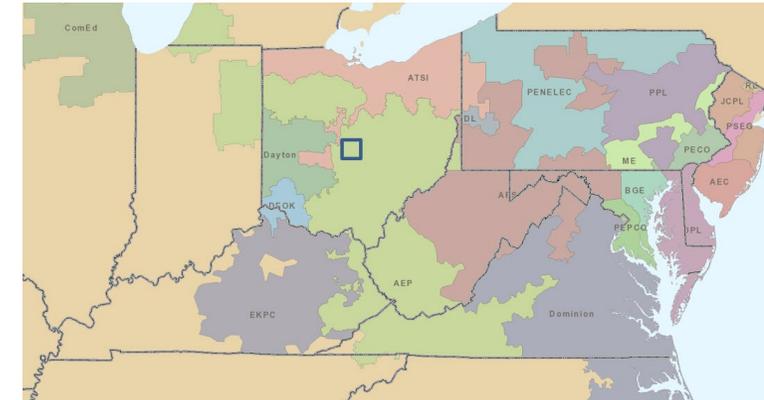
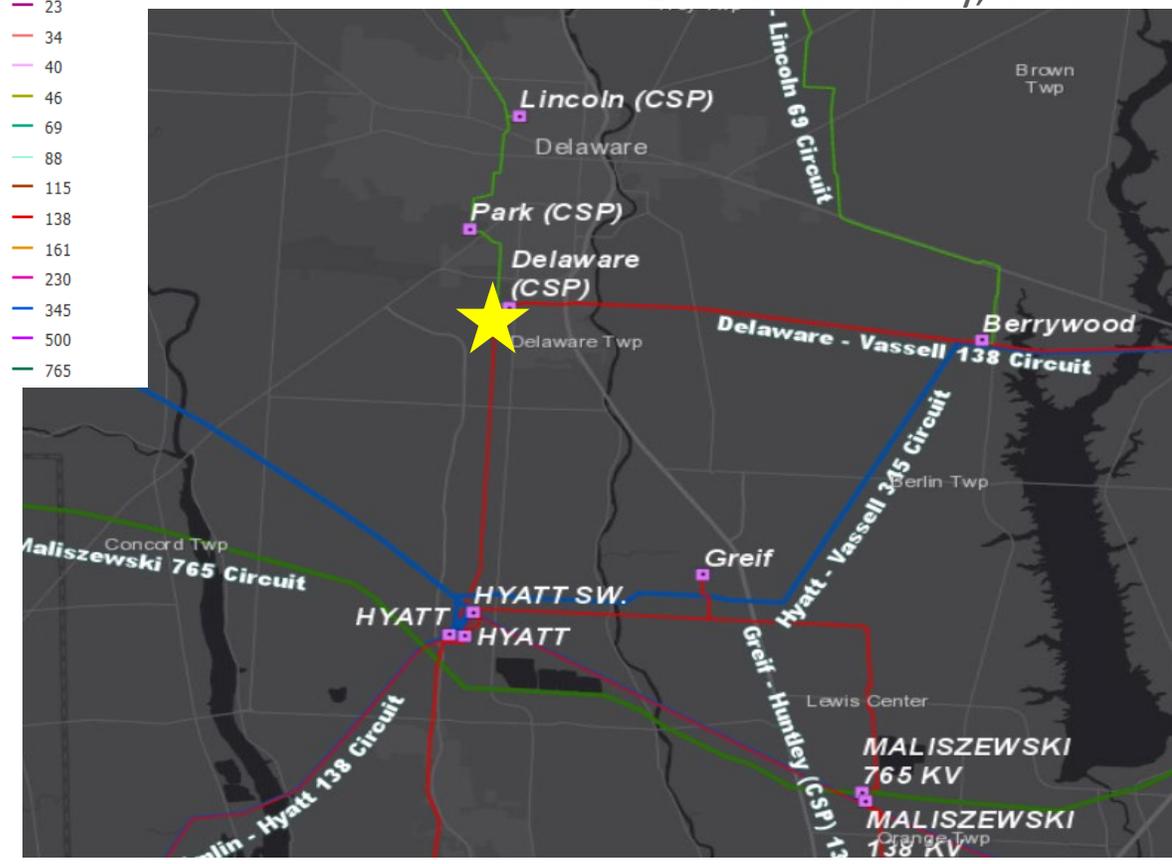
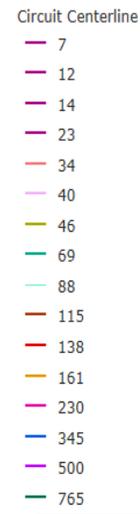
~~138 kV Capacitor Switcher AA~~

- ~~Mark V model which no longer supports modern relaying packages. Mark V's have been historically prone to mechanism failures and are being replaced system wide where possible.~~

The remaining needs at Delaware station will be captured under Need Number: **AEP-2019-OH065**



AEP Transmission Zone M-3 Process Delaware County, Ohio



Need Number: AEP-2019-OH062

Process Stage: Needs Meeting 11/22/2019

Supplemental Project Driver: Equipment Condition/Performance/Risk, Operational Flexibility

Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

Problem Statement:

Delaware 138kV Station:

156/195 of the relays at this station are electromechanical and 12 are static type. These relays have limited spare part availability, a lack vendor support, no SCADA functionality, and no fault data collection ability.

In addition, there is corrosion on the steel structures, deteriorated/cracking foundations, existence of cap and pin insulators, and a non-standard station configuration.

The remaining needs at Delaware station will be captured under Need Number: **AEP-2019-OH065**

AEP Transmission Zone M-3 Process Delaware County, Ohio

Need Number: AEP-2019-OH065

Process Stage: Needs Meeting 11/22/2019

Supplemental Project Driver: Equipment Condition/Performance/Risk, Operational Flexibility

Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

Problem Statement:

Delaware 138kV Station:

Over the last five years Delaware station has accumulated approximately 2 million minutes of customer interruption associated with 19 outages at the station.

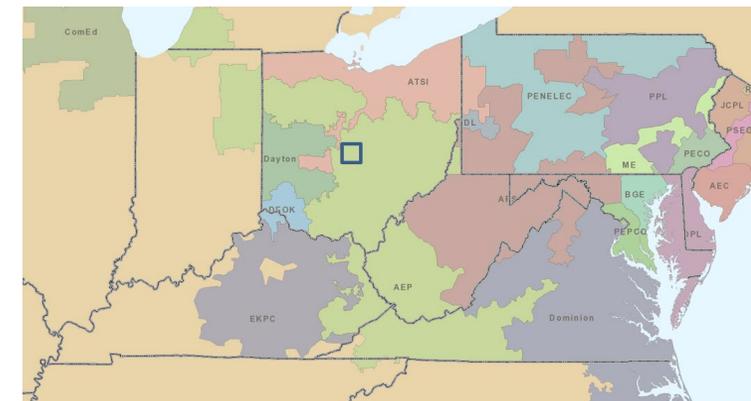
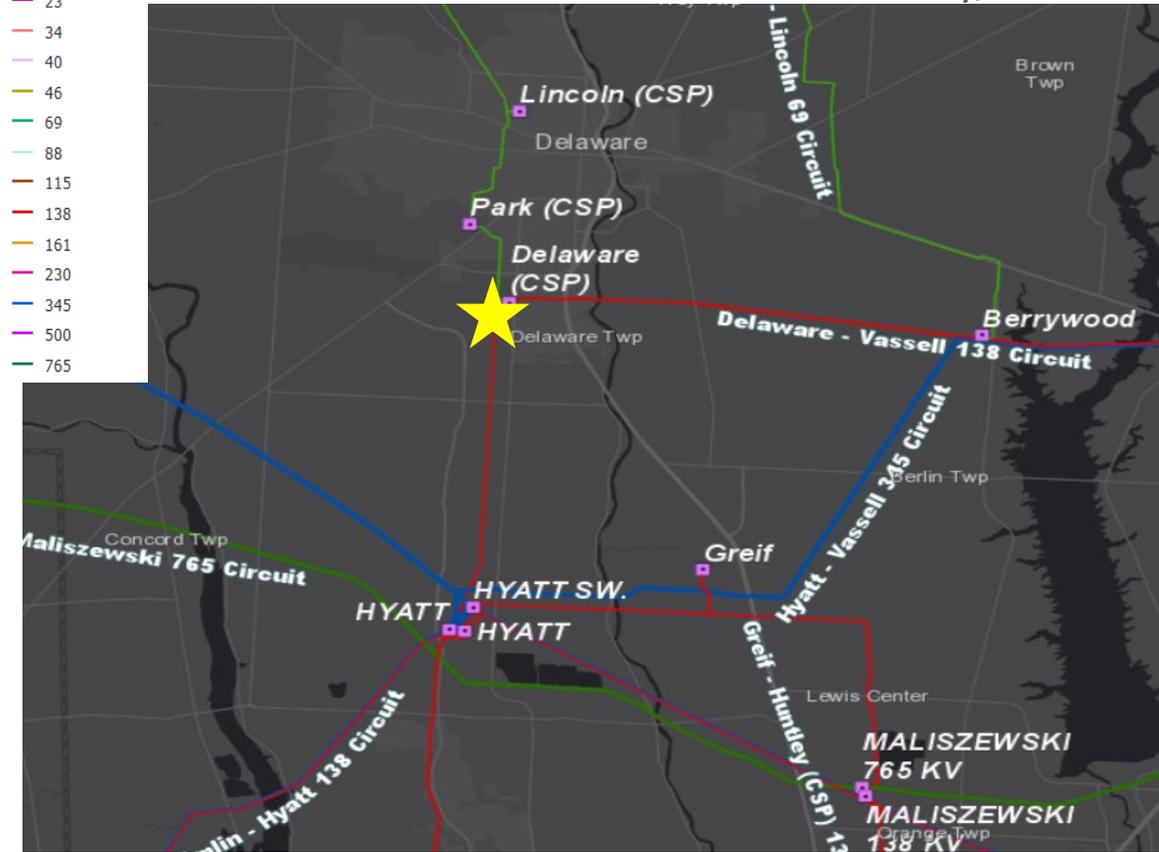
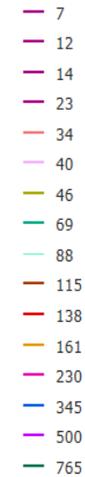
138 kV Circuit Breakers 104,106CB's 104 and 106 are GM-5C type oil breakers. (1963, 1964 vintage)

- These are oil breakers that are difficult to maintain due to the required oil handling. There is an increased potential for oil spills during routine maintenance and failures with these types of breakers.
- Other drivers include damage to bushings, spare part availability, historical reliability, and lack of vendor support of the breakers.

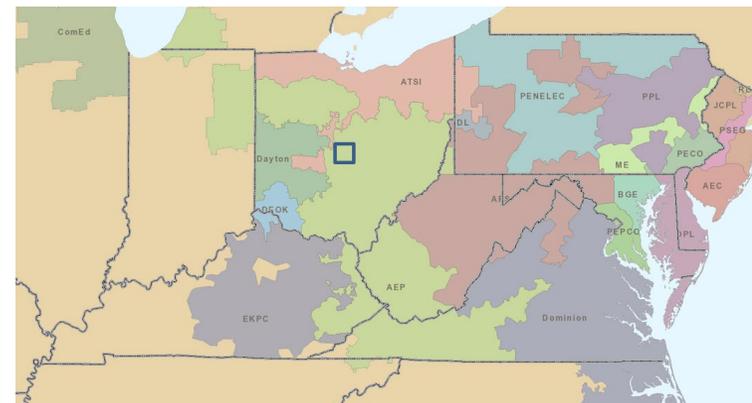
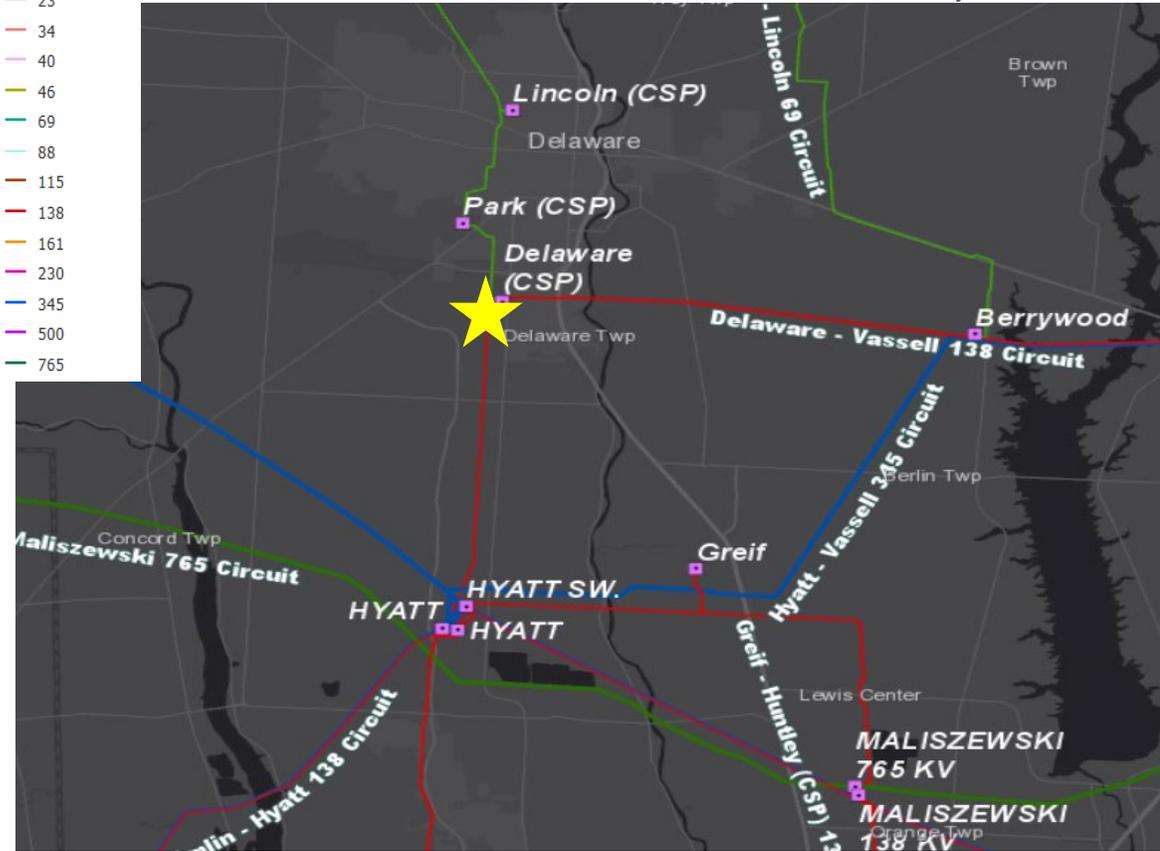
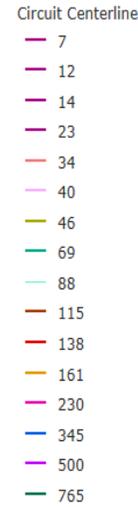
138 kV Capacitor Switcher AA

- Mark V model which no longer supports modern relaying packages. Mark V's have been historically prone to mechanism failures and are being replaced system wide where possible.

Circuit Centerline



AEP Transmission Zone M-3 Process Delaware County, Ohio



Need Number: AEP-2019-OH065

Process Stage: Needs Meeting 11/22/2019

Supplemental Project Driver: Equipment Condition/Performance/Risk, Operational Flexibility

Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

Problem Statement:

Delaware 138kV Station:

156/195 of the relays at this station are electromechanical and 12 are static type. These relays have limited spare part availability, a lack vendor support, no SCADA functionality, and no fault data collection ability.

In addition, there is corrosion on the steel structures, deteriorated/cracking foundations, existence of cap and pin insulators, and a non-standard station configuration.

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

AEP Transmission Zone M-3 Process Anguin Station

Need Number: AEP-2018-OH002

Process Stage: Solution Meeting 11/22/2019

Previously Presented:

Needs Meeting 10/28/2018

Solution Meeting 2/20/2019

Project Driver:

Customer Service

Specific Assumption Reference:

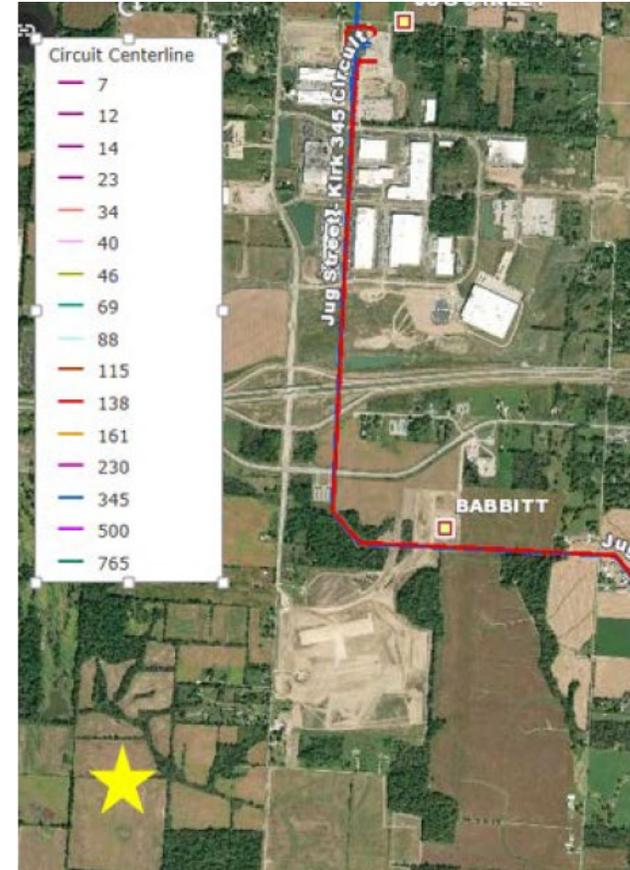
AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 7)

Problem Statement:

A new customer delivery point has been requested.

- Initial load of 150MW with permanent service available by Q1-2020.
- Ultimate load for this customer is projected to reach 720MW as early as Q4 2026.
- 10 MW of distribution construction power for this customer is required in May 2019. 7 MW of distribution construction power for an existing customer planning to expand is also required in 2019. The existing customer has reserved distribution capacity for up to 10 years of expansion activity. As a result, AEP-Ohio has requested a 138kV delivery Point at Babbitt station to serve a “temporary” skid station for up to 10 years.
- Additional large customers are in discussions to take service in this area.
- Facilities will be designed to accommodate anticipated future load but only facilities required to serve committed load will be constructed.

As part of the DNH analysis, PJM has identified a violation of 300 MW of load drop for loss of Jug Street-Babbitt 138 kV line plus Kirk-Babbitt 138 kV line with the addition of this project.



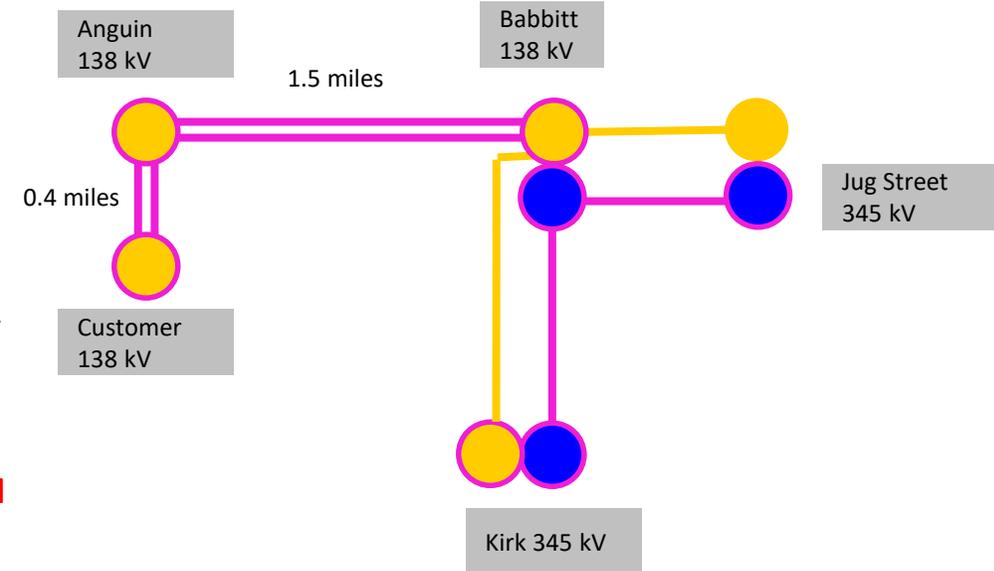
AEP Transmission Zone M-3 Process Anguin Station

Need Number: AEP-2018-OH002

Process Stage: Solution Meeting 11/22/2019

Proposed Solution:

- Construct 2-138 kV circuits (~1.5 miles) from Babbitt Station to a new Anguin Station using 2 bundled 1033 ACSS conductor per circuit. **\$15.2M**
- Construct 2-138 kV circuits (~.4 miles) from Anguin Station to a new customer station using 795 ACSS conductor. **\$2.5M**
- At the existing 138 kV Babbitt Station, install 4-138 kV 4,000A 63kA breakers to accommodate the new 138 kV double circuit to Anguin Station, 2-138kV 4,000A 63kA bus tie breakers, a 57.6MVAR capacitor bank with protection, and a 138kV 4,000A 63kA CB to serve AEP-Ohio’s requested delivery point. **\$6.6M**
- Construct Anguin Station in a breaker and a half arrangement utilizing 8-138 kV 4,000A 63kA breakers and 2-57.6MVAR capacitor banks with protection. **\$24.0M**
- **Cut into existing Jug Street-Kirk 345kV circuit into a new 345 kV yard at Babbitt Station. Relocate Babbitt-Kirk 138kV circuit exit at Babbitt Station. Estimated Cost: \$3.3M**
- **At Babbitt Station, install 3-3,000A, 63kA CB’s in ring bus configuration at the 345 kV yard, a new 345/138kV 675 MVA transformer, and a new control house. Install 1-138 kV capacitor bank (54.7 Mvar) with high side protection. Install 9-138 kV, 4,000A 63kA CB’s including a new 138kV yard and two short lines to connect both yards. Cost includes purchase of land for the required expansion. Estimated Cost: \$39.4M**
- **Kirk 138kV – Update line relaying. Estimated Cost: \$0.3M**



Legend	
500 kV	
345 kV	
138 kV	
69 kV	
34.5 kV	
23 kV	
New	

Need Number: AEP-2018-OH002

Process Stage: Solution Meeting 11/22/19

Alternatives:

- ~~Build two overhead circuits from Babbitt Station, construct one UG circuit from Jug Street Station and one UG circuit from Babbitt Station Anguin Station to serve the initial load.~~
- ~~Build two overhead circuits from Babbitt Station, cut into existing overhead Babbitt-Jug Street 138kV circuit to provide in/out service to Anguin Station.~~
- ~~These two alternates aren't as cost effective as the chosen solution.~~
- Construct two 138 kV lines to Anguin station. One of the lines would come from Babbitt station, the other line would come from Jug Street station. The line from Jug Street would be required to be constructed underground between Jug Street and Babbitt (~2.0 miles) due to development of the surrounding area. From Babbitt the 138 kV lines from Jug Street and Babbitt could utilize common double circuit structures to Anguin station (~1.5 miles). This option would result in the loading of the existing Jug Street 345/138 kV Transformer to 96% of its 544 MVA Summer Emergency rating. With the projected load communicated by the customer and other customers in the area, this was deemed to not be a prudent long term solution. To alleviate this concern a 2nd 345 kV transformer would need to be installed at Jug Street as part of the alternative. This alternative would carry with it significant constructability concerns associated with the limited amount of available space at the existing station and its surrounding footprint. Estimated Cost: \$95M
- Serving Anguin station by looping the Gahanna – West Millersport 138 kV circuit from the south was evaluated, but the alternative was eliminated after siting and constructability reviews of potential line routes revealed the option to be highly infeasible to construct without becoming cost prohibitive and having a significant impact on the surrounding communities due to existing and future development of the area. The future projected load communicated by the customer also brought the prudence of this alternative into question in the long term.

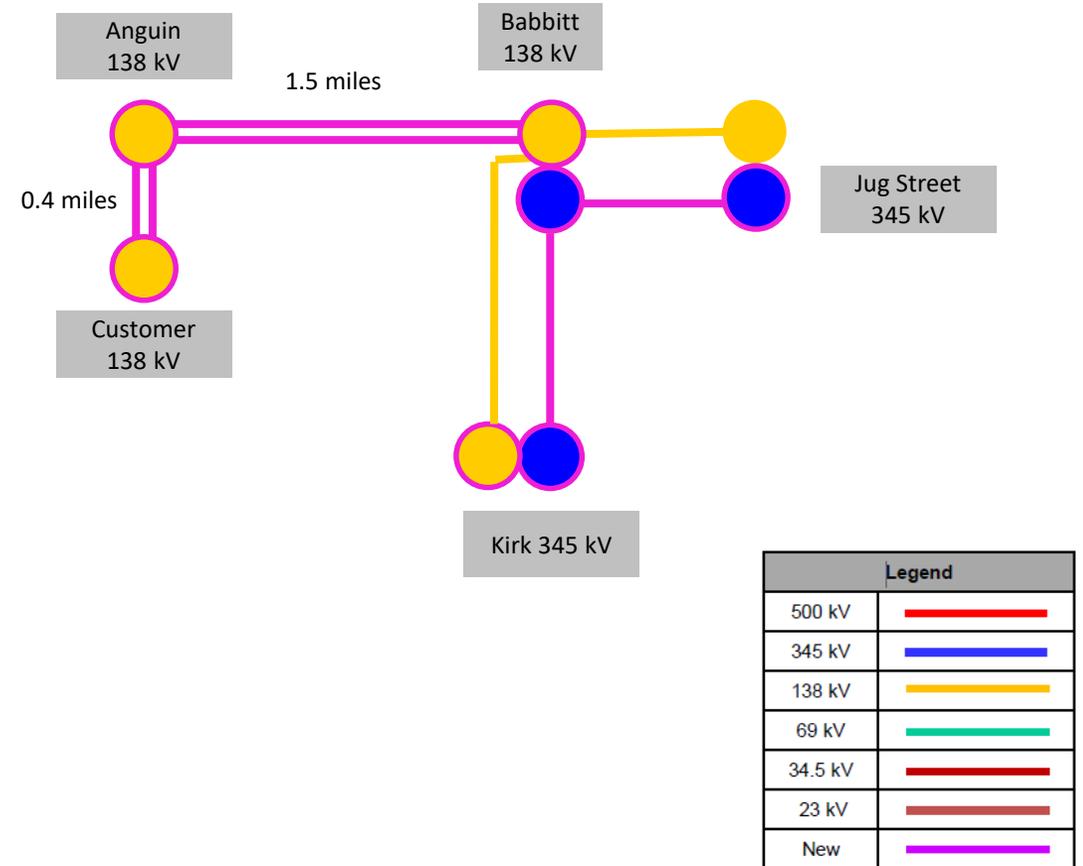
Estimated Cost: \$91.3M

Projected In-Service: ~~5/1/2020~~ 6/1/2021

Project Status: Scoping

Model: 2024 RTEP

AEP Transmission Zone M-3 Process Anguin Station



AEP Transmission Zone M-3 Process Roseville, Ohio

Need Number: AEP-2018-OH016

Process Stage: Solutions Meeting 11/22/2019

Previously Presented:

Needs Meeting 10/26/2018

Supplemental Project Driver:

Equipment Condition

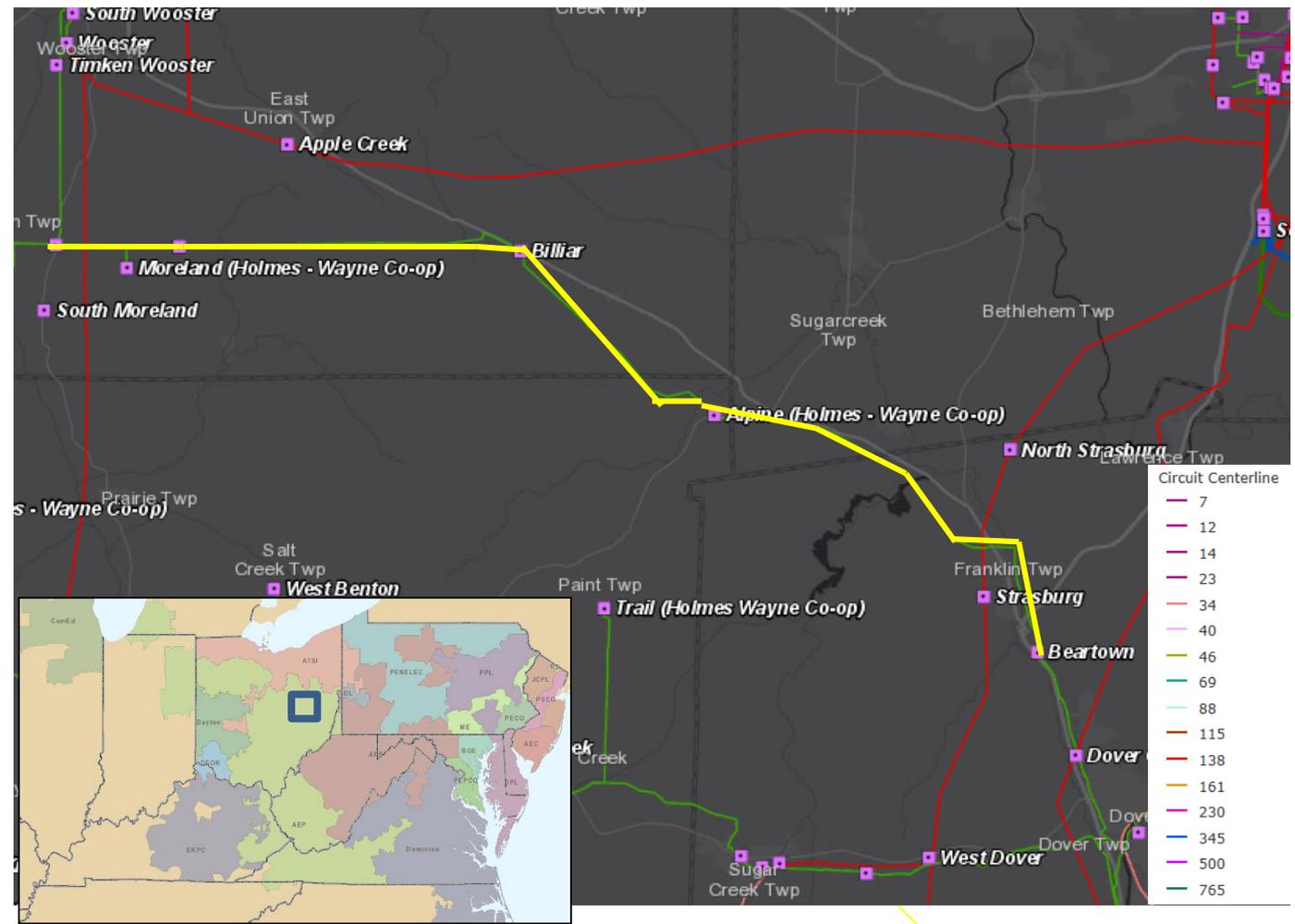
Specific Assumption References:

AEP Guidelines for Owner Identified Needs (AEP Assumptions slide 8)

Problem Statement:

The Beartown- West Wilmont 69kV section is 10.5 miles long and serves 1 AEP Ohio distribution station and 1 Holmes-Wayne Co-op station in northeast Ohio. Over the past several years, the circuit has experienced below-average reliability. For the 2017-2018 YTD period, it has experienced 7 sustained outages, an additional 8 momentary interruptions, and 2 emergency repair incidents on the entire circuit. The majority of the outages were due to T-Line structural issues and forestry. The line section consists of primarily 336 ACSR (1962-64 vintage); it is entirely wood pole construction, with the majority being installed in the 1960's. The section has a reported CMI of 2.0M between 2014 – 2018 and currently has 52 open conditions (25 Category A, 25 Category B, 5 Forestry). Examples of the conditions include: rotted poles, missing ground-leads, and damaged conductor. During the 2010-2018 period, 112 prior conditions were repaired/addressed on the circuit as a whole.

Model: Summer 2023 RTEP



AEP Transmission Zone M-3 Process Roseville, Ohio

Need Number: AEP-2018-OH016

Process Stage: Solutions Meeting 11/22/2019

Potential Solution:

- Rebuild the existing Beartown - Moreland 69kV Transmission line between Beartown and West Wilmot Junction Switch (approx.10.6 miles) using 556 ACSR.

Estimated Cost: \$22.6M

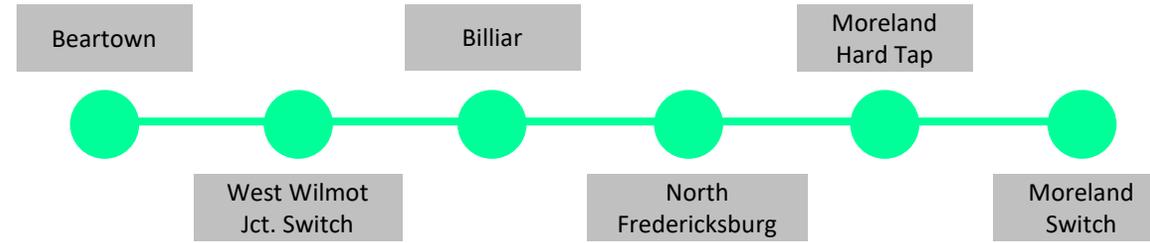
Ancillary Benefits: Improved system and customer reliability.

Alternatives Considered:

- No reasonable alternatives for this asset renewal need were identified.

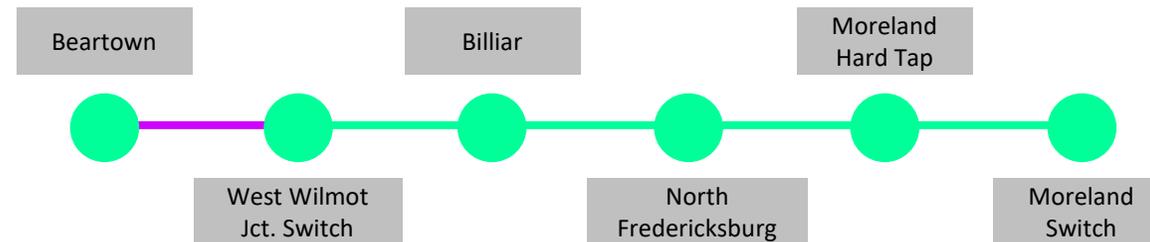
Projected In-Service: 12/01/2021

Existing:



Legend	
500 kV	
345 kV	
138 kV	
69 kV	
34.5 kV	
23 kV	
New	

Future:



AEP Transmission Zone M-3 Process Lynchburg, VA

Need Number: AEP-2019-AP003

Process Stage: Solutions Meeting 11/22/2019

Previously Presented: Needs Meeting 2/20/2019

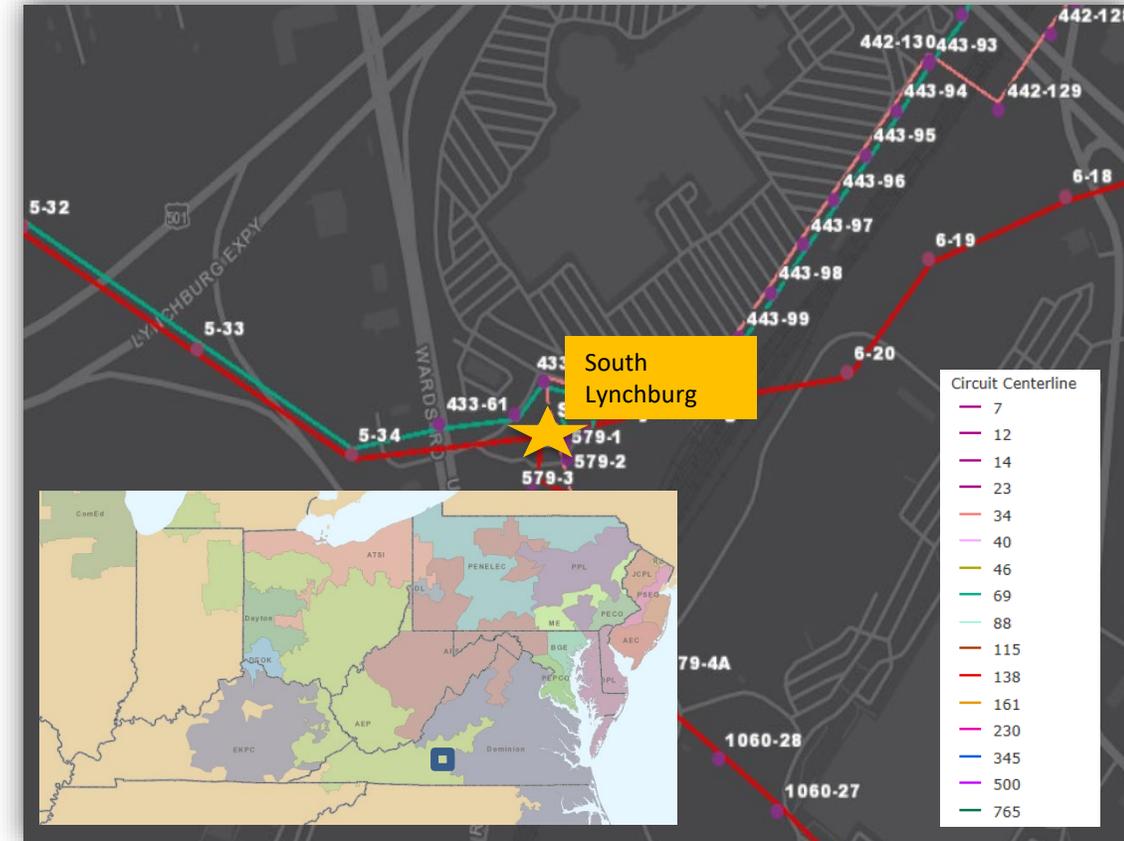
Supplemental Project Driver: Equipment Material/Condition/Performance/Risk

Specific Assumption Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

Problem Statement:

- The 1959 vintage 138/69/34.5 kV transformer #1 at South Lynchburg Substation has elevated levels of carbon dioxide which began increasing in 2004. Additionally, the interfacial tension is steadily decreasing and the oil power factor is steadily increasing indicating that the oil insulation is beginning to degrade as well. This data proves that the transformers insulation is aged and has degraded.
- The 34.5 kV Grounding Bank was manufactured in 1954 and has high concentrations of combustible gases, specifically CO and CH₄, due to various thermal faults and electrical discharges. Short circuit breakdown caused by the amount of through fault events, some greater than 700 degrees Celcius has contributed to the deterioration of the bank.
- 12 kV CBs P, L, K, N, M, and R are oil breakers
- Number of fault operations: P (44), L (42), K (152), N (132), M (34), R (135)
- 34.5 kV CB F has 31 fault operations
- 34.5 kV CB G has 63 fault operations

Model: 2024 RTEP



AEP Transmission Zone M-3 Process Lynchburg, VA

Need Number: AEP-2019-AP003

Process Stage: Solutions Meeting 11/22/2019

Proposed Solution:

At South Lynchburg station, replace existing 138/69/34.5 kV transformer #1 with a new 138/69/34.5 kV, 130 MVA bank and install associated protection. Replace the grounding bank. Replace 12kV CB's P, L, K, N, M and R with new 1200A 25KA CB's and install associated relays. Replace 34.5kV CB G and F with new 3000A 40kA CB. Install 69 kV CB between T1 secondary and 69 kV bus. Estimated Cost: \$5.7M

Line work to relocate the 69 kV and 34.5 kV line entrances due to the larger physical size of the new transformer.
Estimated Cost: \$1M

Total Estimated Transmission Cost: \$6.7 M

Ancillary Benefits: Additional transformer capacity prevents future thermal overloads caused by the loss of Peakview and East Lynchburg 138/69 kV transformers. Future loadings exceed 85% for the existing transformer at South Lynchburg.

Alternatives Considered:

No cost effective alternate solution was identified.

Projected In-Service: 7/1/2021

Project Status: Engineering

No bubble diagram required.
Station work only.

AEP Transmission Zone M-3 Process Ironto Station (Service to CBEC)

Need Number: AEP-2019-AP006

Process Stage: Solutions Meeting 11/22/2019

Previously Presented: Needs Meeting 3/25/2019

Supplemental Project Driver: Customer Service

Specific Assumption Reference: AEP Connection Requirements for the AEP Transmission System (AEP Assumptions Slide 7)

Problem Statement:

Craig-Botetourt Electric Cooperative (CBEC) requested a new delivery point from AEP to be located in Montgomery County, Virginia. The new station will serve approximately 10 MVA.

Model: 2024 RTEP



AEP Transmission Zone M-3 Process Ironto Station (Service to CBEC)

Need Number: AEP-2019-AP006

Process Stage: Solutions Meeting 11/22/2019

Proposed Solution:

Establish a new Ironto 138 kV delivery point by tapping the Catawba-Kimballton 138 kV circuit, installing 2-138 kV MOABs, associated controls, and 138 kV metering in customer’s station.

Estimated Cost: \$2.6 M

Alternatives Considered:

No viable alternatives were found.

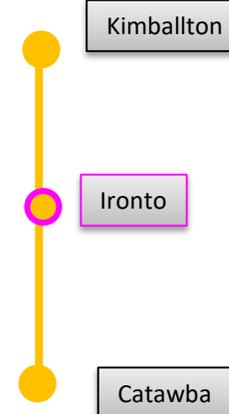
Projected In-Service: 4/13/2020

Project Status: Engineering

Existing



Proposed



Legend	
500 kV	
345 kV	
138 kV	
69 kV	
34.5 kV	
23 kV	
New	

AEP Transmission Zone M-3 Process Danville, VA Area

Need Number: AEP-2019-AP012

Process Stage: Solutions Meeting 11/22/2019

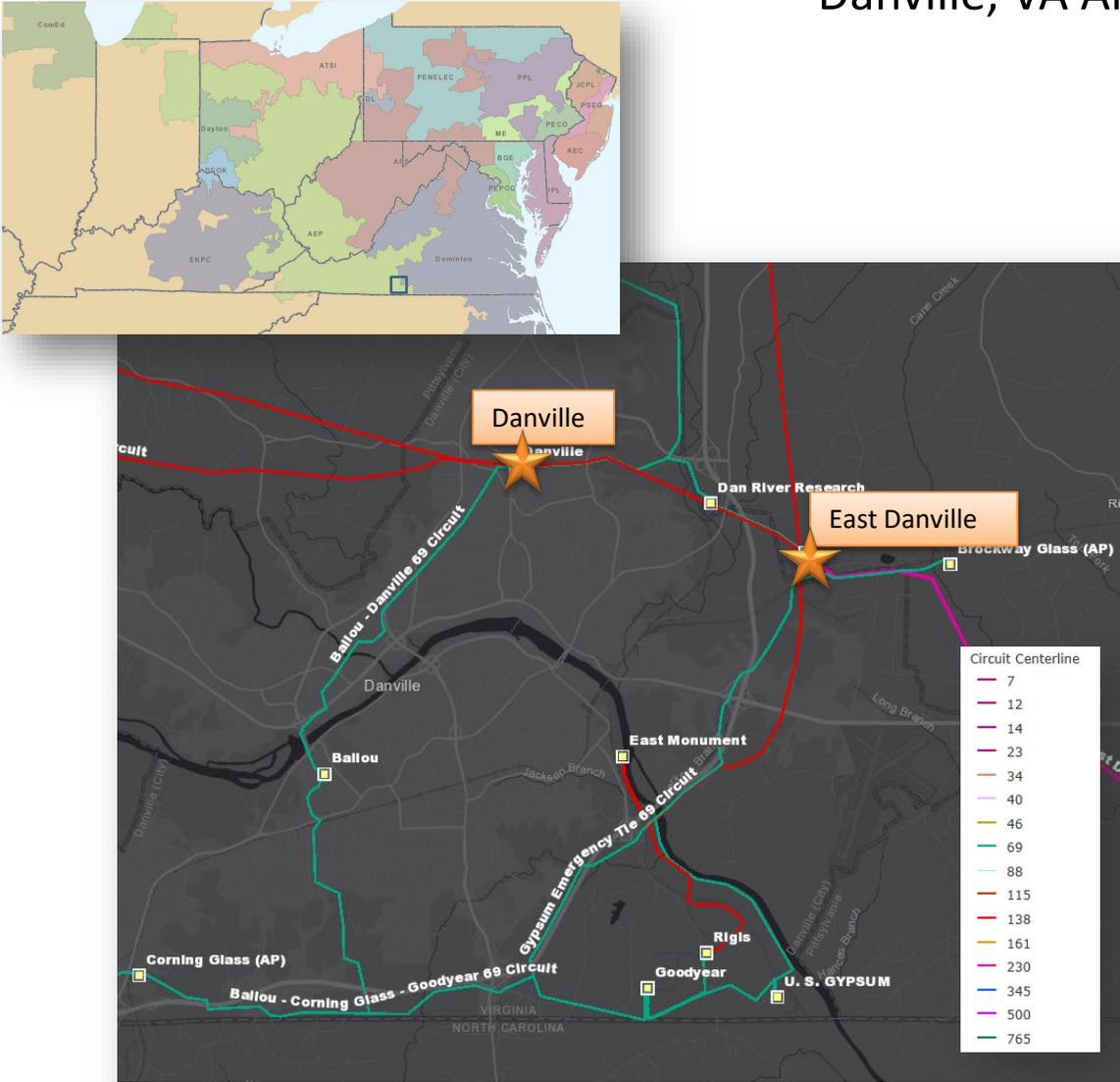
Previously Presented: Needs Meeting 5/20/2019

Supplemental Project Driver: Equipment Material/Condition/Performance/Risk

Specific Assumption Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

Problem Statement:

- Several documented mis-operations have occurred related to defective and disabled pilot wire relaying between Danville, East Danville and the local 69 kV network. Pilot wire maintenance is a known safety concern especially during poor weather conditions throughout the Transmission organization. Elimination of pilot wire in the Danville area will address ground splice concerns reported by TFS management, pilot wire cabinet access issues and low hanging pilot wire on poles. Corrective maintenance continues to be a concern due to the lack of spare relay components and it being an obsolete technology. Due to the abnormal conditions and overall age of the pilot wire in the Danville area, mis-operations have continued to impact several large industrial customers exceeding a total of 15 MW.



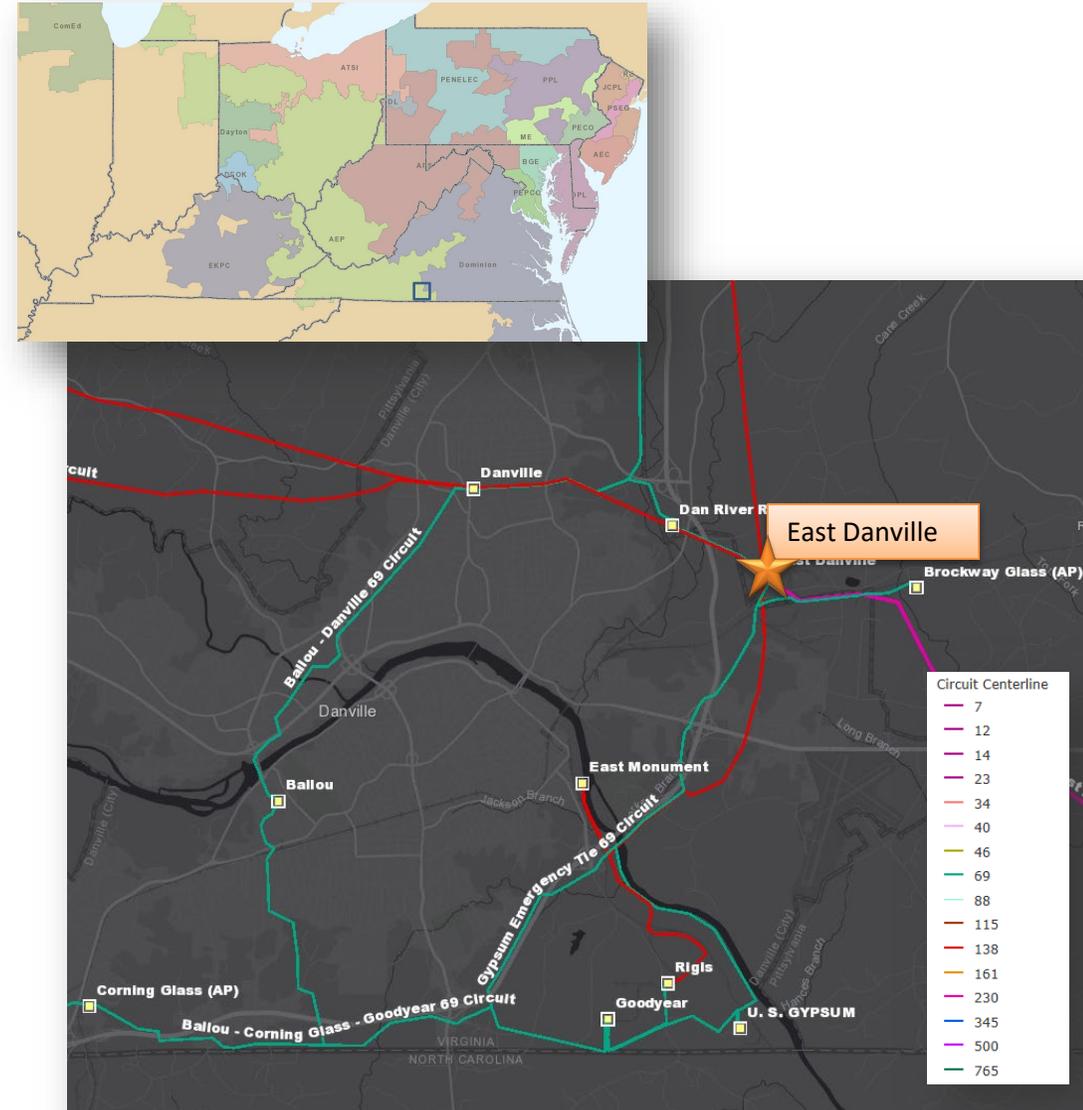
AEP Transmission Zone M-3 Process Danville, VA Area

Continued from previous slide...

Problem Statement:

East Danville Station

- 138 kV Circuit Breakers L and M
 - 12 malfunction records indicating low SF6 gas during cold weather conditions with continued maintenance required
 - Have experienced 19 and 49 fault operations respectively. The manufacturer’s recommendation for this type of breaker is 10.
- 138 kV Circuit Breaker P
 - CB P is FK type oil breaker (1955 vintage)
 - Oil breakers that are difficult to maintain due to the required oil handling. There is an increased potential for oil spills during routine maintenance and failures with these types of breakers.
- 69 kV Circuit Breakers F and H
 - FK type oil breakers (1965 vintage)
 - Malfunction on CB H for an air leak on the control valve
 - Have experienced 46 and 78 fault operations respectively. The manufacturer’s recommendation for this type of breaker is 10.
- 69/12 kV T#3
 - High side MOAB Ground Switch
 - Tapped off of East Danville-US Gypsum 69 kV line, not currently tapped off bus



AEP Transmission Zone M-3 Process Danville, VA Area

Continued from previous slide...

Problem Statement:

Goodyear Station

- 69 kV Circuit Breakers A, C and D
 - FK type oil breakers (1959, 1973 and 1972 vintage respectively)
 - Oil breakers that are difficult to maintain due to the required oil handling. There is an increased potential for oil spills during routine maintenance and failures with these types of breakers.
 - Have experienced 18, 9 and 7 fault operations respectively. The manufacturer's recommendation for this type of breaker is 10.
- Customer metering CTs and PTs are over 50 years old and accuracy class below recommended

US Gypsum Station

- Customer metering CTs and PTs are over 50 years old and accuracy class below recommended

Rigis Station

- 138/69 kV T#1
 - High side MOAB ground switch protection

Corning Glass Station

- 69 kV Circuit Breaker B
 - FK type oil breaker (1966 vintage); experienced 80 fault operations
- Circuit Switchers A and AA
 - S&C 2030-69, no gas monitor, model family has numerous documented malfunction records concerning gas loss and interrupter failures

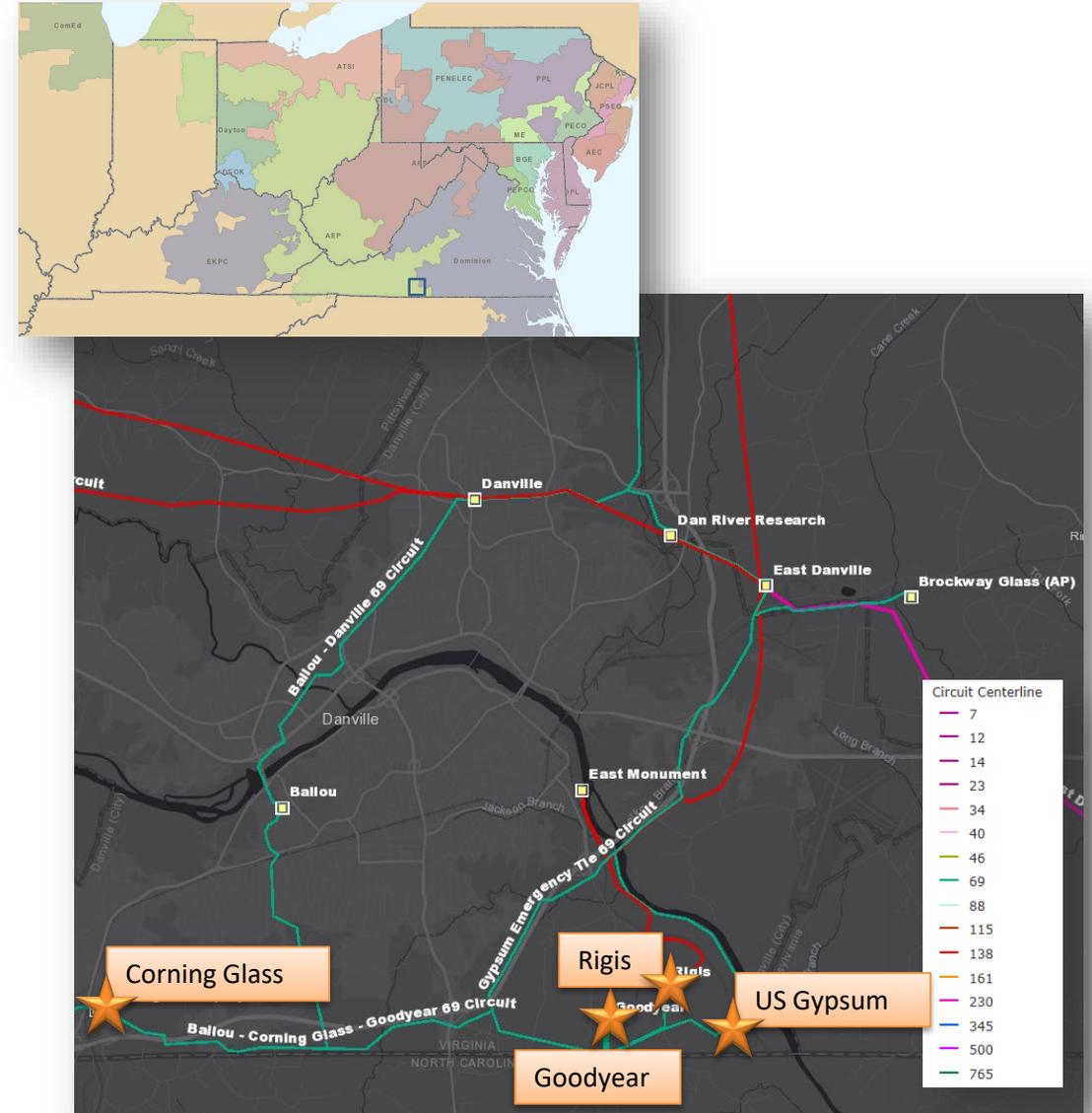
US Gypsum Station

- 69 kV Circuit Breaker A
 - FK type oil breaker (1966 vintage); experienced 21 fault operations

Danville Station

- 69 kV Circuit Breaker J
 - FK type oil breaker (1966 vintage)

Model: 2024 RTEP



AEP Transmission Zone M-3 Process Lynchburg, VA

Need Number: AEP-2019-AP012

Process Stage: Solutions Meeting 11/22/2019

Proposed Solution:

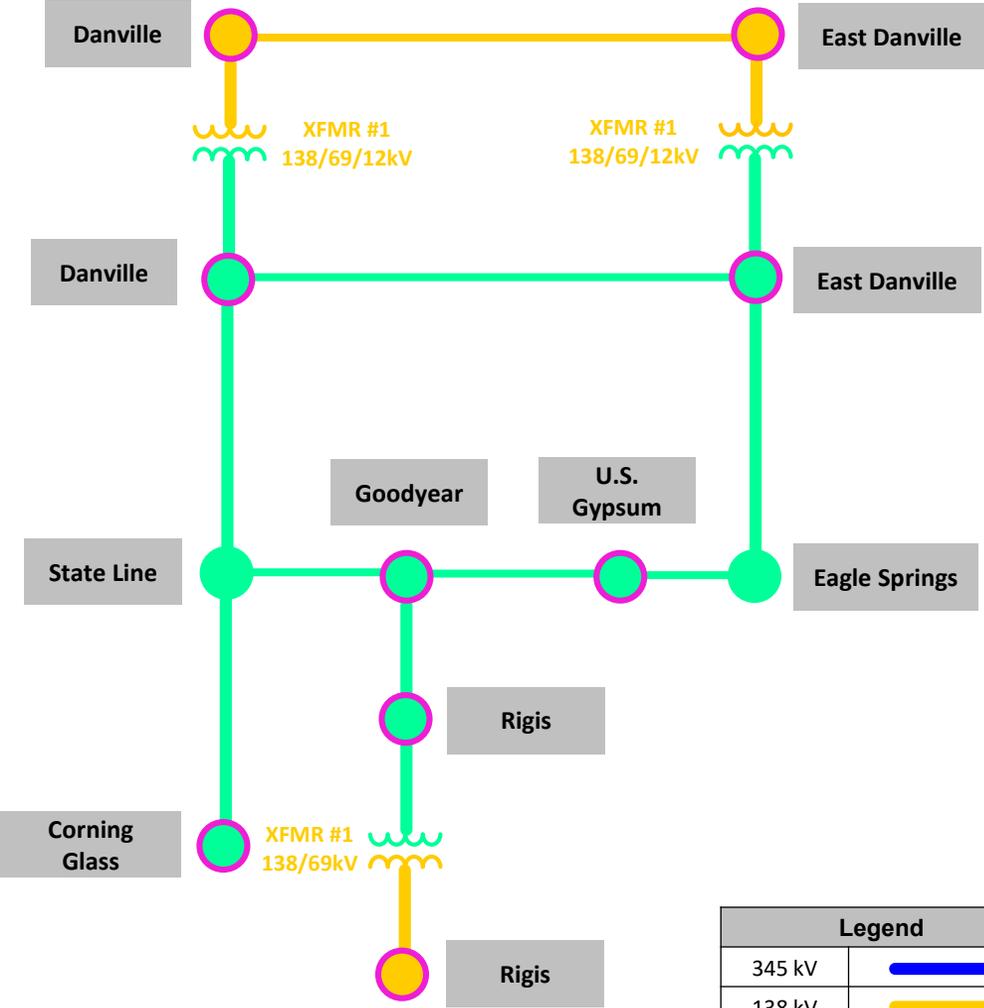
At Danville station, install new 138 kV line relaying and CCVT's/foundations/stands on the East Danville line. Replace 69 kV Bus CCVT's and install required fiber and retire all pilot wire. Replace 69 kV breaker J with a 3000 A, 40 kA breaker. Estimated Cost: \$2.3M

At East Danville station, replace 138 kV circuit breakers L, M, and P and associated disconnect switches with 3000 A, 40 kA breakers and 3000 A disconnect switches. Install 69 kV circuit breaker on low-side of T1. Replace 69 kV breakers F, H and associated disconnect switches with 3000 A, 40 kA breakers and 2000 A switches. Install new 138 kV line relaying and CCVT's/foundations/stands on the Danville line. Install new 69kV line relaying and CCVT's/foundations/stands on both the Danville line and U.S. Gypsum lines. Replace MOAB ground switch on T#3 with circuit switcher and relocate T#3 connection from US Gypsum line to 69 kV bus. Install required fiber and retire all pilot wire. Estimated Cost: \$7.2M

At Rigis station, install new 69 kV line relaying and CCVT's/foundations/stands on the Goodyear line. Install required fiber and retire all pilot wire. Replace MOAB ground switch with circuit breaker on high-side of T#1. Estimated Cost: \$1.4M

At Goodyear station, install new 69 kV line relaying and CCVT's on the Rigis line, U.S. Gypsum line and Corning Glass line. Install required fiber and retire all pilot wire associated with 69 kV US Gypsum, Rigis and Corning Glass circuits. Replace 69 kV breakers A, C and D and associated disconnect switches with 3000 A, 40 kA breakers and 2000 A disconnect switches. Upgrade existing 2-element customer metering at each of the feeds to the customer (3 total). Estimated Cost: \$4.4M

At Ballou station, retire in-line equipment and retire transformer in-place. Estimated Cost: \$0M (Distribution)



Legend	
345 kV	—
138 kV	—
69 kV	—
46 kV	—
New	—

AEP Transmission Zone M-3 Process Lynchburg, VA

Continued from previous slide ...

At US Gypsum station, install 69 kV line relaying and CCVT's on both the East Danville line and Goodyear line. Install required fiber and retire all pilot wire associated with the Goodyear – U.S. Gypsum and East Danville circuits. Replace 69 kV breaker A with 3000 A, 40 kA breaker and 2000 A disconnect switches. Replace 69 kV customer metering with 3 element CT/PT combo. Estimated Cost: \$2.8M

At Corning Glass station, install required fiber and retire all pilot wire. Replace 69 kV breaker B with 3000 A, 40 kA circuit breaker and 2000 A disconnect switches. Replace 69 kV circuit switcher A with 3000 A, 40 kA circuit breaker and 2000 A disconnect switches. Replace 69 kV circuit switcher AA with 600 A, 40 kA capacitor switcher. Estimated Cost: \$0 (Distribution)

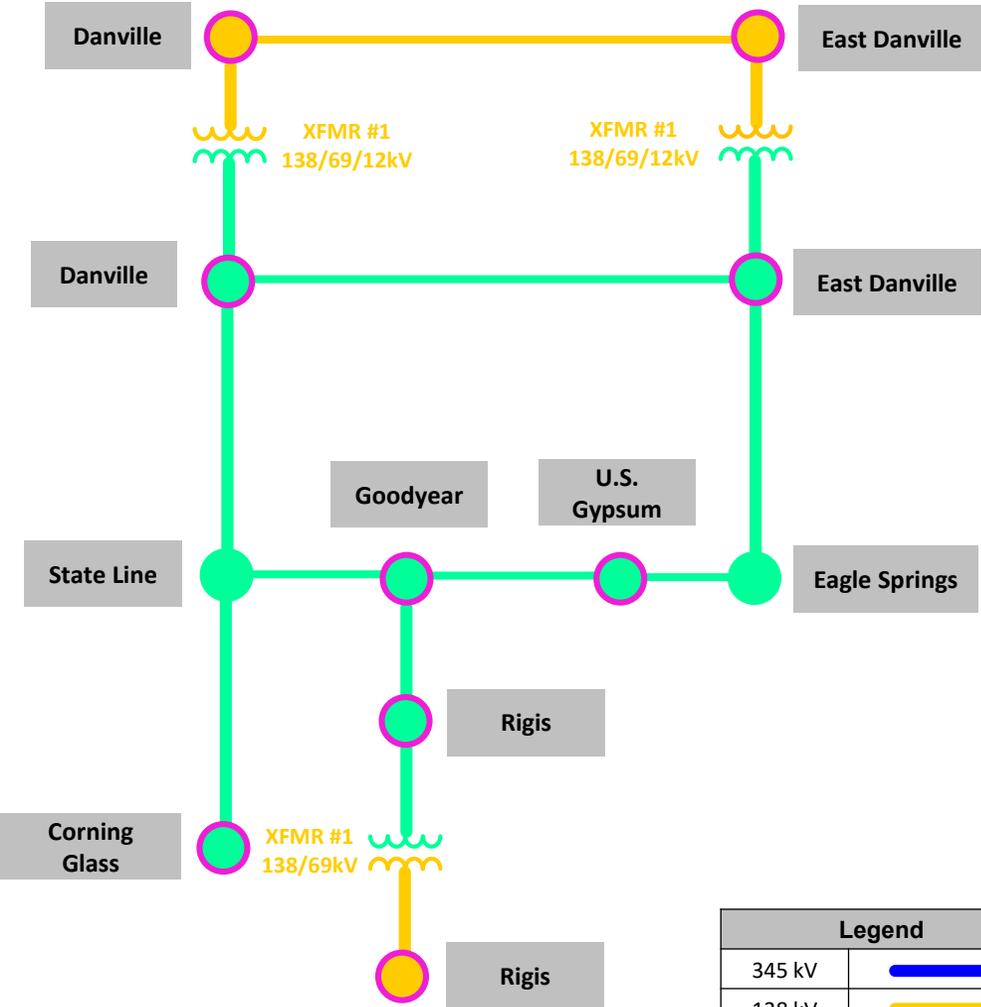
At Ridgeway station, upgrade remote end relaying. Estimated Cost: \$0.6M

At Smith Mountain station, upgrade remote end relaying and replace breaker control cables. Estimated Cost: \$0.9M

On the Danville-East Danville 69 kV line, replace 4 wood structures to accommodate additional loading of new ADSS and install ADSS under-build. Estimated Cost: \$1.1M

On the Corning Glass-Goodyear 69 kV line, replace 13 wood structures to accommodate additional loading of new ADSS and install ADSS under-build. Estimated Cost: \$1.9M

On the Goodyear-Rigis 69 kV line, replace 4 wood structures to accommodate additional loading of new ADSS and install ADSS under-build. Estimated Cost: \$0.9M



Legend	
345 kV	
138 kV	
69 kV	
46 kV	
New	

AEP Transmission Zone M-3 Process Lynchburg, VA

Continued from previous slide ...

On the Ballou-Danville 69 kV line, replace 14 wood structures to accommodate additional loading of new ADSS and install ADSS under-build. Estimated Cost: \$2.0M

On the Ballou-State Line 69 kV line, replace 3 wood structures to accommodate additional loading of new ADSS and install ADSS under-build. Estimated Cost: \$0.8M

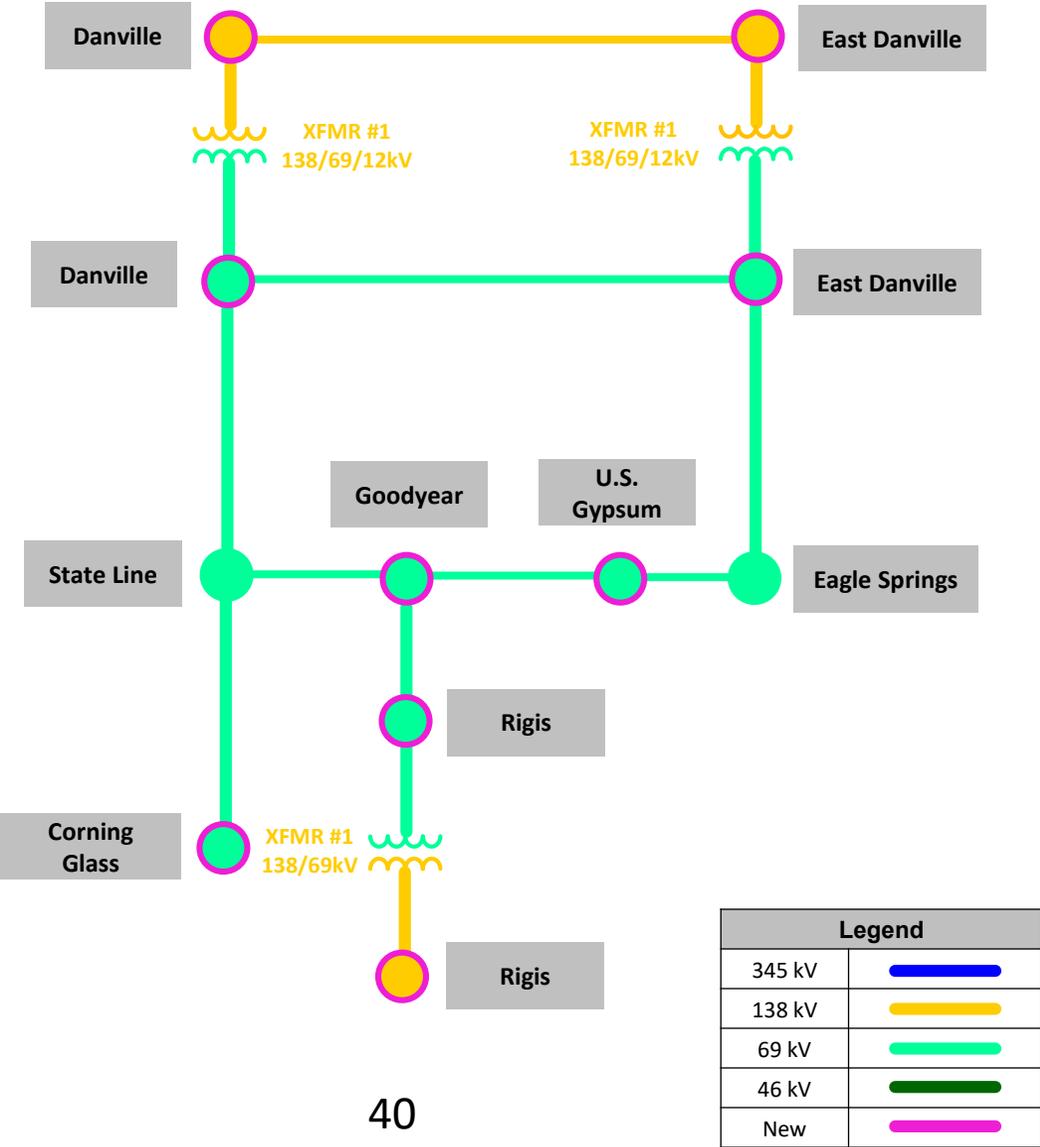
On the Goodyear-US Gypsum 69 kV line, replace 2 wood structures to accommodate additional loading of new ADSS and install ADSS under-build. Estimated Cost: \$0.4M

Total Estimated Transmission Cost: \$26.7 M

Alternatives Considered: Power line carrier was considered as an alternative, however due to the short distances between stations this alternative was eliminated.

Projected In-Service: 10/31/2022

Project Status: Scoping



Need Number: AEP-2019-AP016

Process Stage: Needs Meeting

Needs Presented:

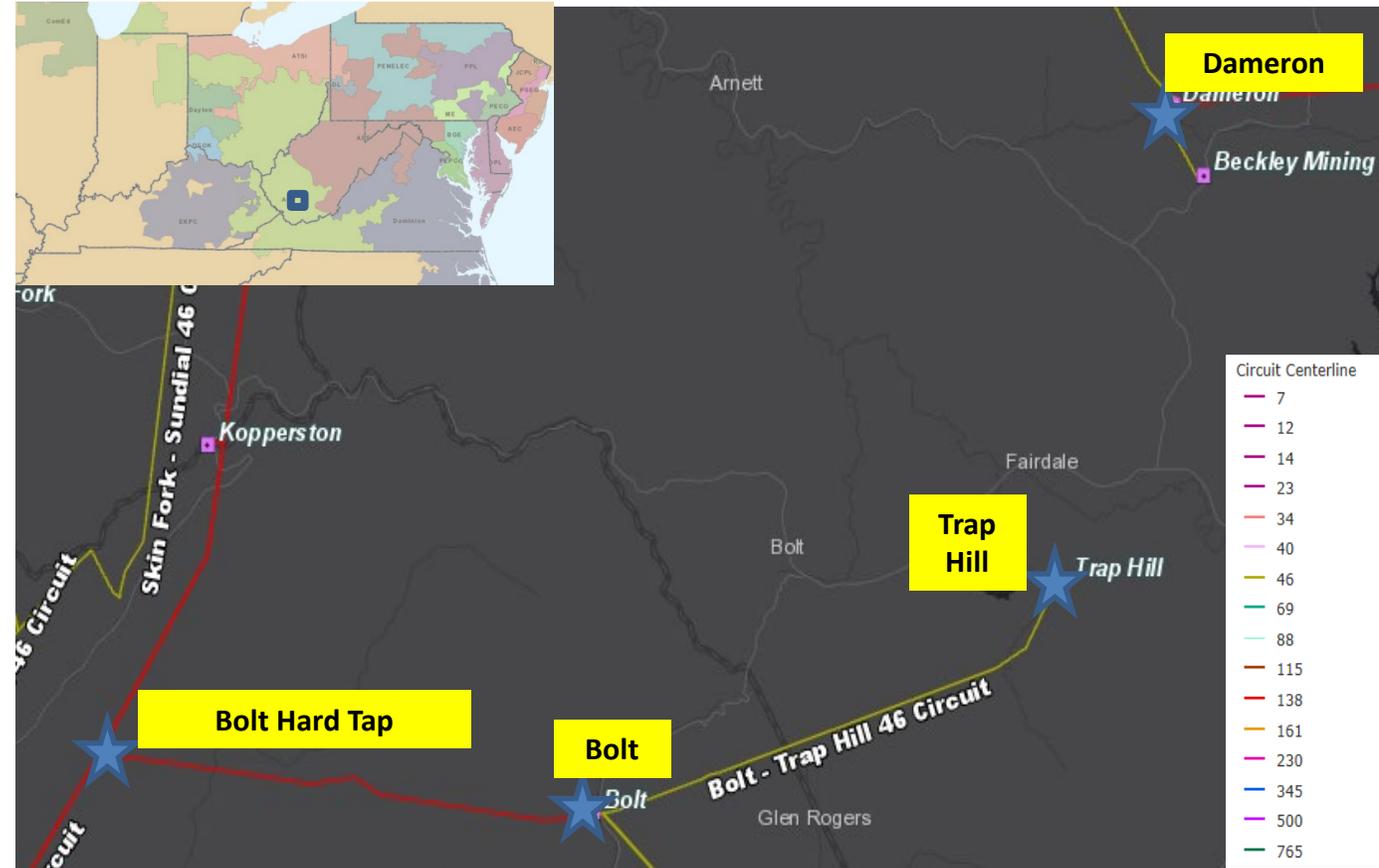
5/20/2019

Supplemental Project Driver: Equipment Material/Condition/Performance/Risk

Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

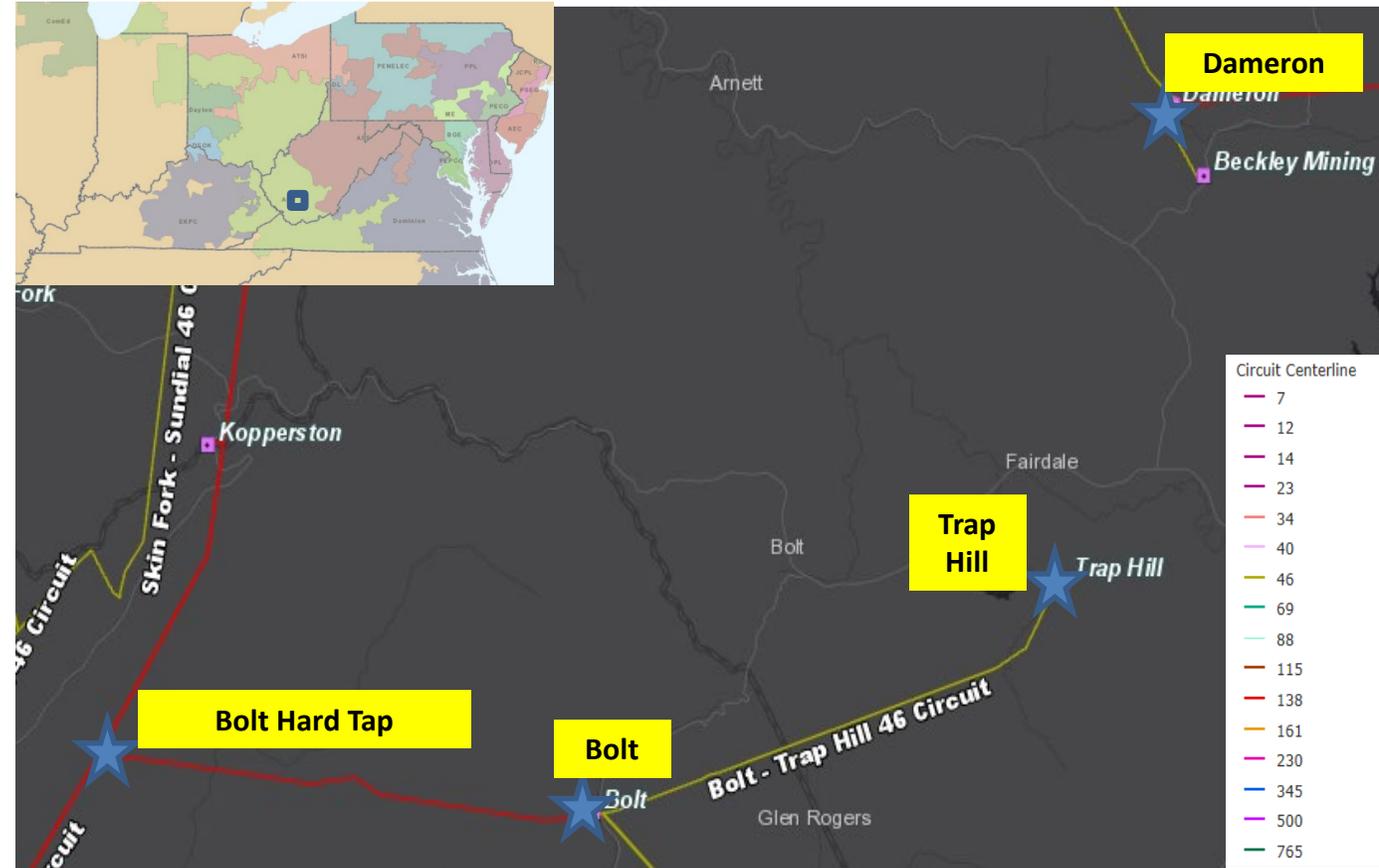
Problem Statement:

- Trap Hill Station serves approximately 20 MVA of load from a 6 mile radial thus exceeding AEP's threshold for looped service of 75 MVA-mile. Long radial line or radial lines serving a significant amount of load are concerning as they age due to:
 - Maintenance of radial facilities being difficult due to the required customer outages.
 - Radial delivery points resulting in extended outages to customers for any loss of the feed due to the lack of looped service and transferability of the load.
- Bolt Tap 138 kV is a hard tap off the Baileysville – Sundial 138 kV #1 circuit.
 - Hard taps are difficult to maintain due to required outages or temporary jumper configurations in lieu of a switch.
 - It can also result in extended outages to customers due to the inability to sectionalize faulted facilities.
- Dameron 46 kV CB-A
 - Oil filled ITE 69KA-2500-12D type breaker, 1 of 13 of this type of model left on the AEP system.
 - These types of breakers experience issues with their parts and maintenance costs due to lack of vendor support.
 - Oil breakers are more difficult to maintain as oil spills have the potential to occur during maintenance which could pose an environmental and safety hazard.



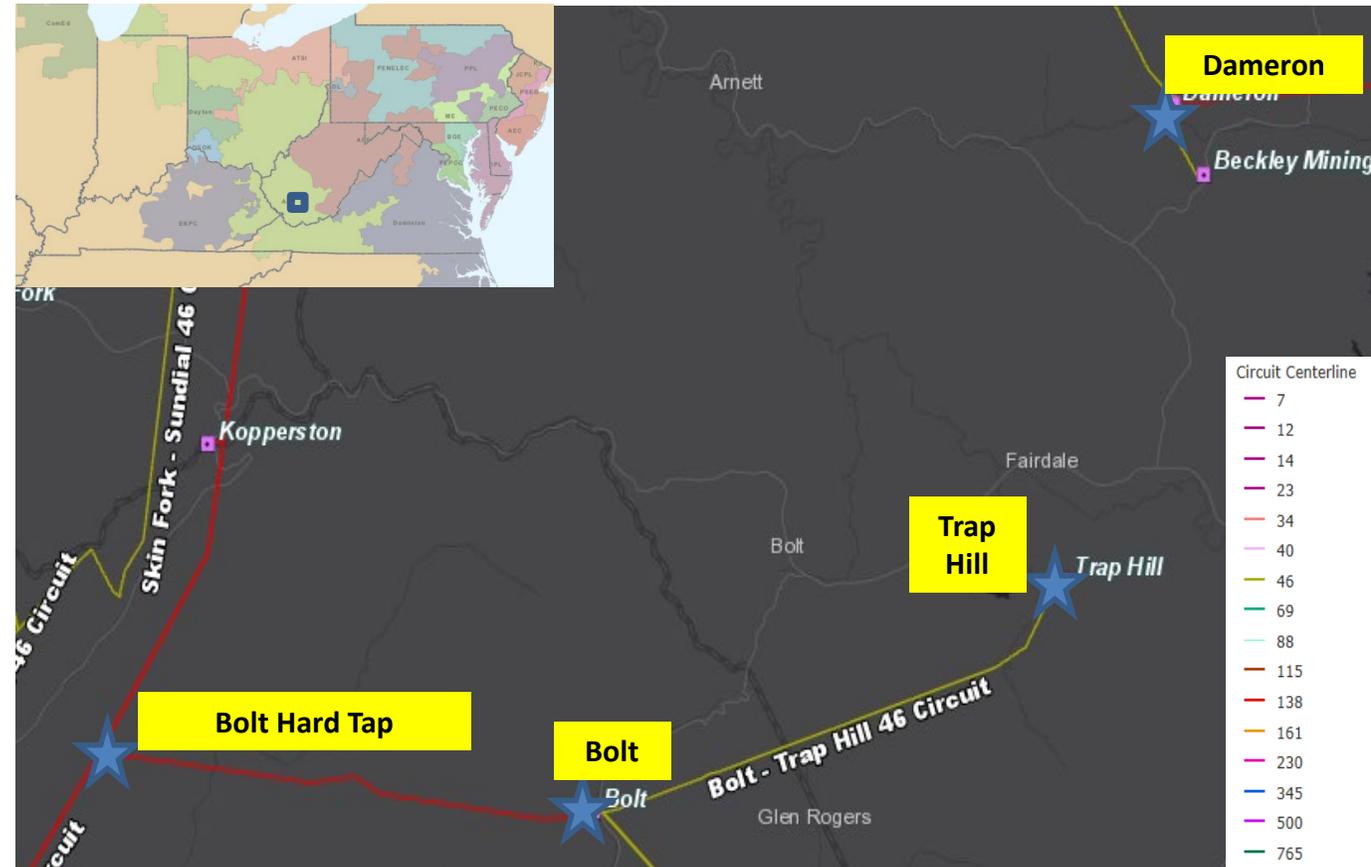
Problem Statement (cont'd):

- Dameron 46 kV Cap switcher AA
 - S&C 2030-69 unit that has no gas monitor and sister units on the AEP system have experienced 62 malfunctions since 1999. Major events include gas loss, interrupter failures, and operating mechanism failures.
- Dameron 138/46 kV Bank #1
 - Rising moisture, carbon monoxide (CO), and carbon dioxide (CO2) levels which indicate a deterioration of the insulating paper.
 - Sustained low levels of interfacial tension also ties to insulation degradation and is an indication of sludge formation. Sludge can impede oil circulation and generate numerous instances of overheating, further accelerating the declining health of the unit.
 - The current MOAB/Ground SW configuration on the high side.
- Dameron grounding transformer
 - 99 year old unit in which all 3 phases are facing similar condition issues.
 - Sustained elevated moisture levels and power factor have led to decreasing dielectric strength.
 - Sustained low levels of interfacial tension is an indication of sludge formation.
 - Sludge can impede oil circulation and generate numerous instances of overheating, further accelerating the declining health of the unit.
- Dameron Substation currently deploys 41 relays, implemented to ensure the adequate protection and operation of the substation.
 - Currently, 36 of the 41 relays (88% of all station relays) are in need of replacement.
 - There are 33 of the electromechanical type and 1 static type which have significant limitations with regards to fault data collection and retention. In addition, 2 microprocessor relays were commissioned in 1997 and 2005, indicative of obsolete firmware that is no longer vendor supported.



Problem Statement (cont'd):

- Bolt 46 kV cap switcher AA
 - 1 of 15 remaining VBM-69 types left on the AEP system.
 - These types of cap switchers perform poorly in cold weather and replacement parts are known to be expensive when they are available per the TFS obsolete list.
- Bolt 46 kV grounding transformer
 - All 3 phases are facing similar condition issues as listed.
 - Sustained elevated moisture levels and power factor have led to decreasing dielectric strength.
 - Sustained low levels of interfacial tension is in indication of sludge formation, in which sludge can impede oil circulation and generate numerous instances of overheating, further decreasing the health of the unit.
- Bolt 138/46 kV XFR
 - Moisture levels and power factor have been on the rise since 2004. These increases correspond to decreasing dielectric strength levels seen over the same period. The most probable causes of moisture in oil for this unit are paper breakdown (aging), moisture ingress through gaskets, and leaks (main tank; pumps; etc.).
 - Interfacial tension has been at a sustained low level since 2008; this is an early indication of the development of sludge from contaminants in the oil. Over time, the sludge can further impede the ability of oil to properly circulate, potentially leading to more frequent unit overheating.



AEP Transmission Zone M-3 Process Trap Hill Area Project

Need Number: AEP-2019-AP016

Process Stage: Solutions Meeting 11/22/2019

Proposed Solution:

Construct a new 138 kV line (~6 miles) from Dameron to Trap Hill. Convert the Bolt – Trap Hill 46kV line to 138kV (line is already built to 138kV standards). **Estimated Cost: 15.1M**

Convert Trap Hill station to 138kV, install two 138 kV 3000 A 40 kA circuit breakers. **Estimated Cost: 2.0M**

At Bolt Station, install 138 kV bus and configure the 138kV station into a ring configuration with three new 138kV 3000A 40kA breakers. Replace the existing ground transformer with a new ground transformer. Replace existing cap switcher AA with a new 46 kV 420 A (capacitive current) 40 kA cap switcher. Replace the existing 138/46 kV 75 MVA XFR with a new 138/46 kV 90 MVA XFR. **Estimated Cost: 6.4M**

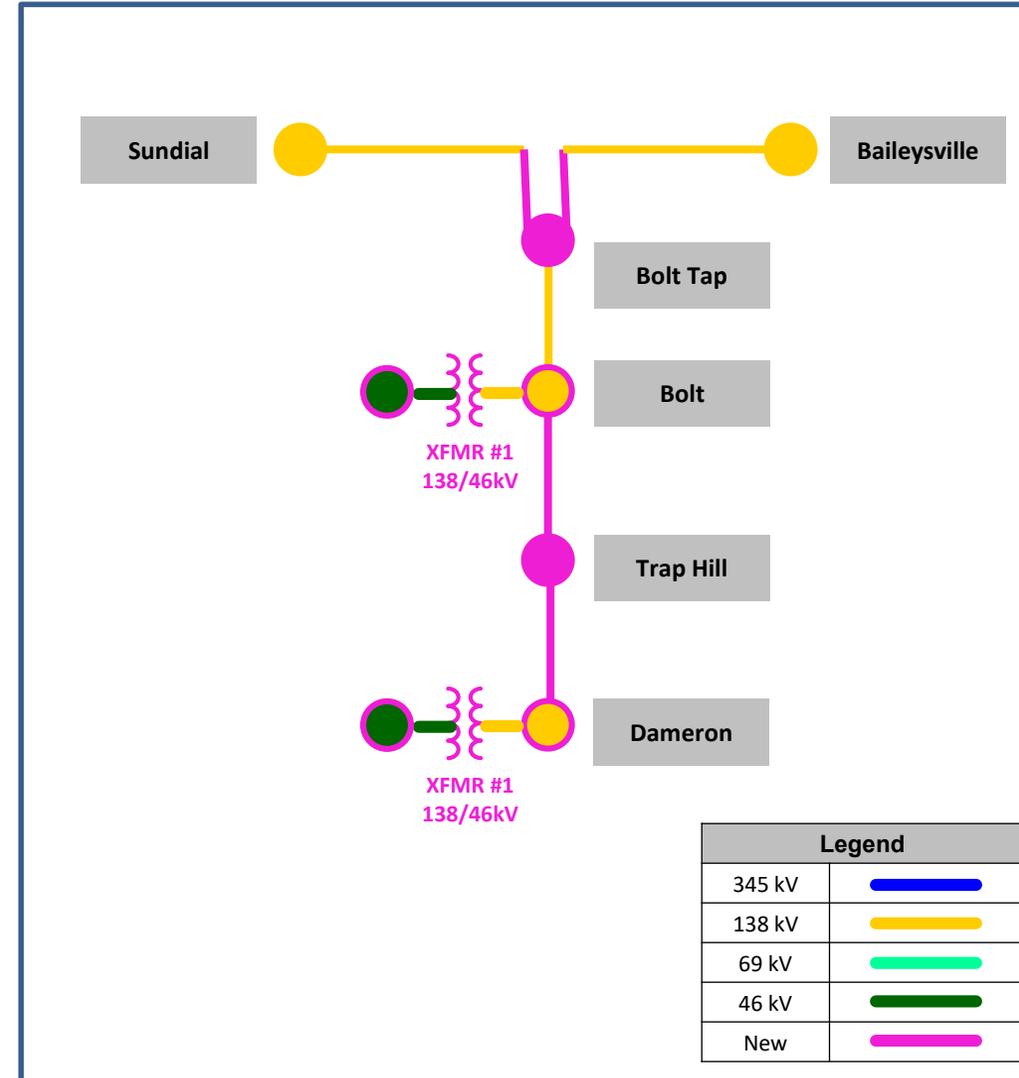
At Dameron Station, Install 138 kV bus and configure the 138kV station into a ring bus layout utilizing four new 138kV 3000A 40kA breakers. Remove the ground switch MOAB scheme from the high side of XF1. Associated line work to accommodate new 138 kV ring configuration. Replace the existing circuit breaker A with a new 46 kV 3000A 40 kA circuit breaker. Replace the existing cap switcher AA with a new 46 kV 450 A (capacitive current) 40 kA cap switcher. Replace the existing 138/46kV 75 MVA XF #1 with a new 138/46kV 75 MVA XF. Replace the existing grounding transformer with a new grounding transformer. Replace existing 46/34.5 kV XFR with a new 138/34.5 kV 30 MVA XFR. Station fence will need expanded to accommodate new 138 kV bus. Retire Beckley Mining 46 kV line out of Dameron and transfer customer to Distribution service. Customer Service is following up with the customer regarding the new service. **Estimated Cost: 10.5M**

Construct an in/out line from the existing Baileysville – Sundial #1 line to the new Bolt Tap Station (~2 miles).

Estimated Cost: 7.4M

At the new Bolt Tap Station install three 138 kV 3000 A 40 kA circuit breakers into a breaker and a half configuration. **Estimated Cost: 8.0M**

Total Estimated Transmission Cost: \$49.4M



AEP Transmission Zone M-3 Process Trap Hill Area Project

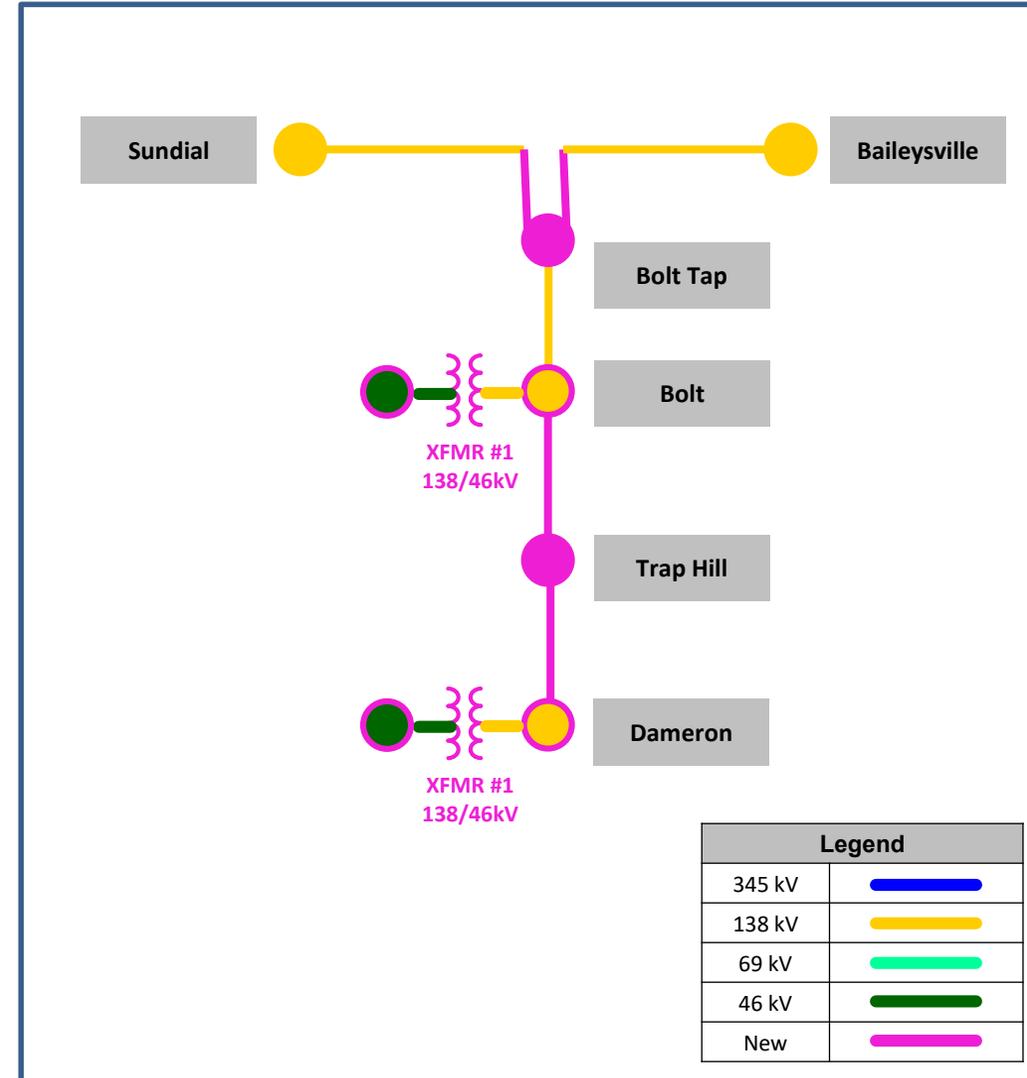
Alternatives Considered:

Alternate 1: Construct a new 138 kV line, approximately 6 miles from Dameron – Trap Hill. Install three new 138 kV circuit breakers at Dameron in a breaker and a half layout. Install 2 new 138 kV circuit breakers at Trap Hill and convert the station to 138 kV. Install three new 138 kV circuit breakers at Bolt in a breaker and a half layout. Convert the existing Bolt – Trap Hill circuit to 138 kV. Retire the existing Bolt Tap 138 kV line to eliminate the hard tap off the Baileysville – Sundial 138 kV #1 circuit. Construct a new station at the existing hard tap location. This is not feasible due to the inability to find a suitable site for the station.

Alternate 2: Replace the existing Shockley Switch with a new 46 kV station, install three new 46 kV CBs (~6.0M). Construct a new 46 kV line from Trap Hill to Shockley (~5.5 miles)(~13.8M). Install two new 46 kV CBs at Trap Hill Station (\$2.0M). Construct double circuit line extension from Baileysville – Sundial #1 line to the new Bolt Tap Station (~7.4M). Rehab work at Bolt (~5.4M), Bolt Tap (~8.0M) and Dameron (~9.5M) would all still need to be performed. This option is not preferred due to the increased loading it would cause on the existing Bradley – Tams Mtn. 46 kV line along with the similar cost to the proposed project. Estimated Cost: \$52.1M

Projected In-Service: 11/1/2022

Project Status: Scoping



Need Number: AEP-2019-AP023

Process Stage: Solutions Meeting 11/22/2019

Previously Presented: Needs Meeting 7/24/2019

Supplemental Project Driver:

Equipment Condition/Performance/Risk

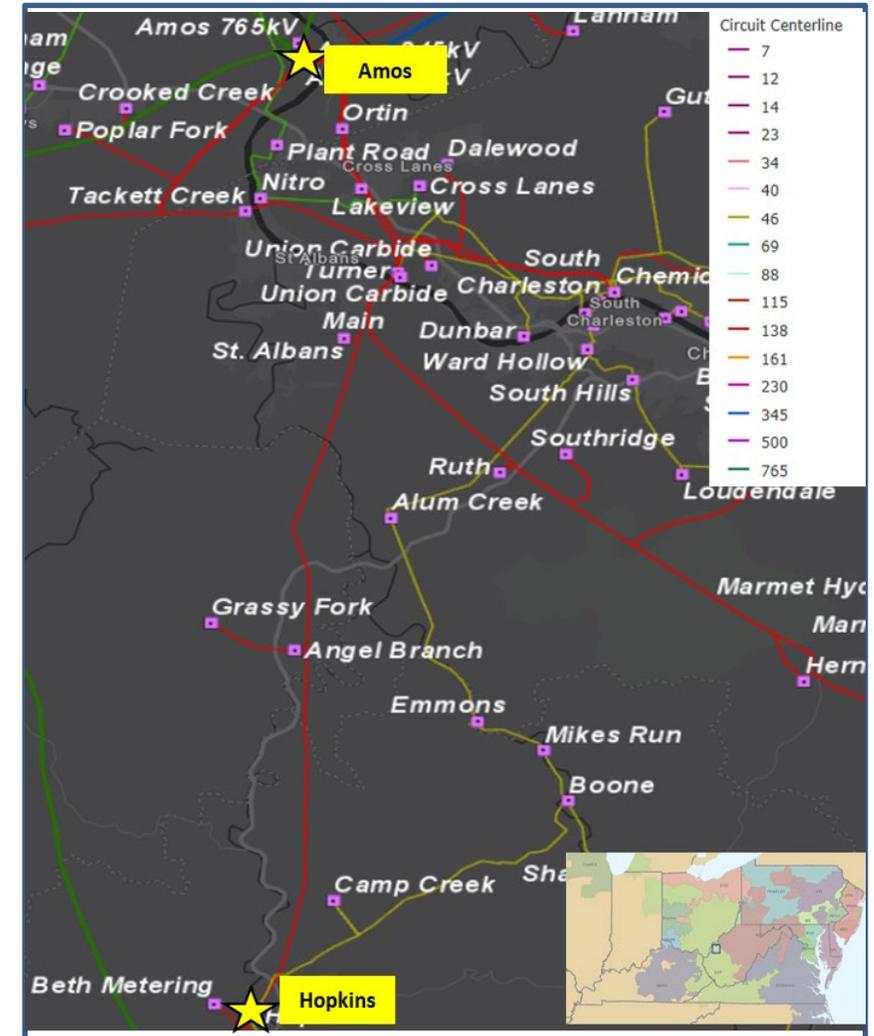
Specific Assumption References:

AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

Problem Statement:

Amos – Hopkins 138 kV (~31.37 miles)

- Majority of the circuit is constructed with 1920s lattice structures
 - The lattice towers used for this line are approximately 94 years old. Structure loading does meet the NESC 250B, 250C and 250D standards for all structures that were analyzed.
 - Steel lattice towers and hardware are currently exhibiting medium to heavy rust
- The shield wire and conductor for this line is 94 years old. Current shielding for the majority of the line does not comply with current standards.



Need Number: AEP-2019-AP023

Process Stage: Solutions Meeting 11/22/2019

Proposed Solution:

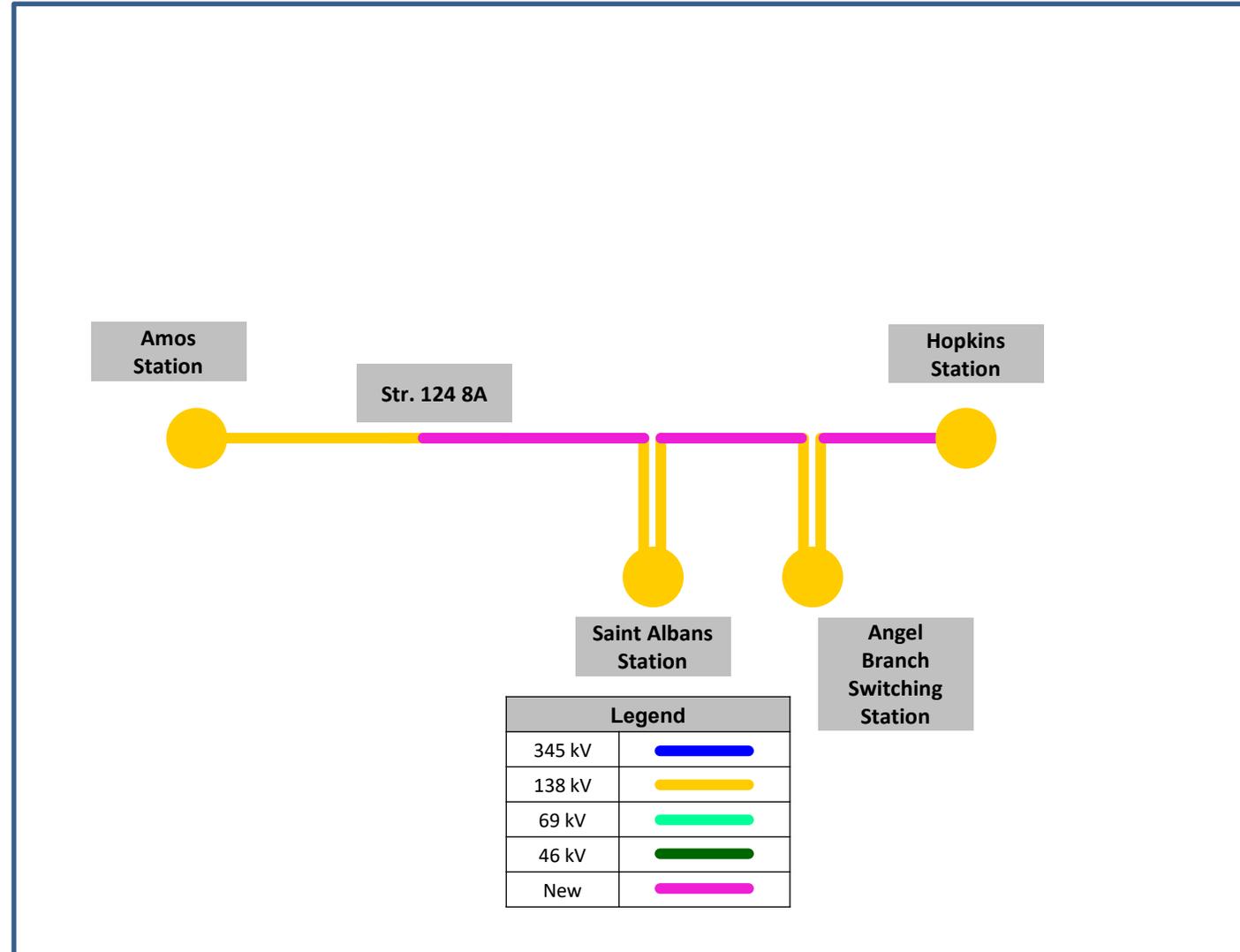
- Rebuild the Amos – Hopkins 138kV circuit from structure 124-8A to Hopkins station as single circuit (~19.6 miles), including structure work near Saint Albans Tap and Angel Branch Tap. **Estimated Trans. Cost: \$61.3M**
- Remote end work at Amos Station. **Estimated Trans. Cost: \$0.1M**

Alternatives Considered:

Re-conductor the line. Engineering analysis indicates that the existing structures need to be replaced in order to accommodate the weight of any new conductor. A re-conductor with 556 ACSR conductor would not meet NESC 250D and a re-conductor with 795 ACSR conductor would not meet NESC 250B or NESC 250D.

Projected In-Service: 12/1/2022

Project Status: Scoping



AEP Transmission Zone M-3 Process Delaware – Kenmore 34.5kV Rebuild

Need Number: AEP-2019-IM024

Process Stage: Solutions Meeting 11/22/2019

Process Chronology: Needs Meeting 06/17/2019

Supplemental Project Driver: Equipment Material/Condition/Risk/Performance/

Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

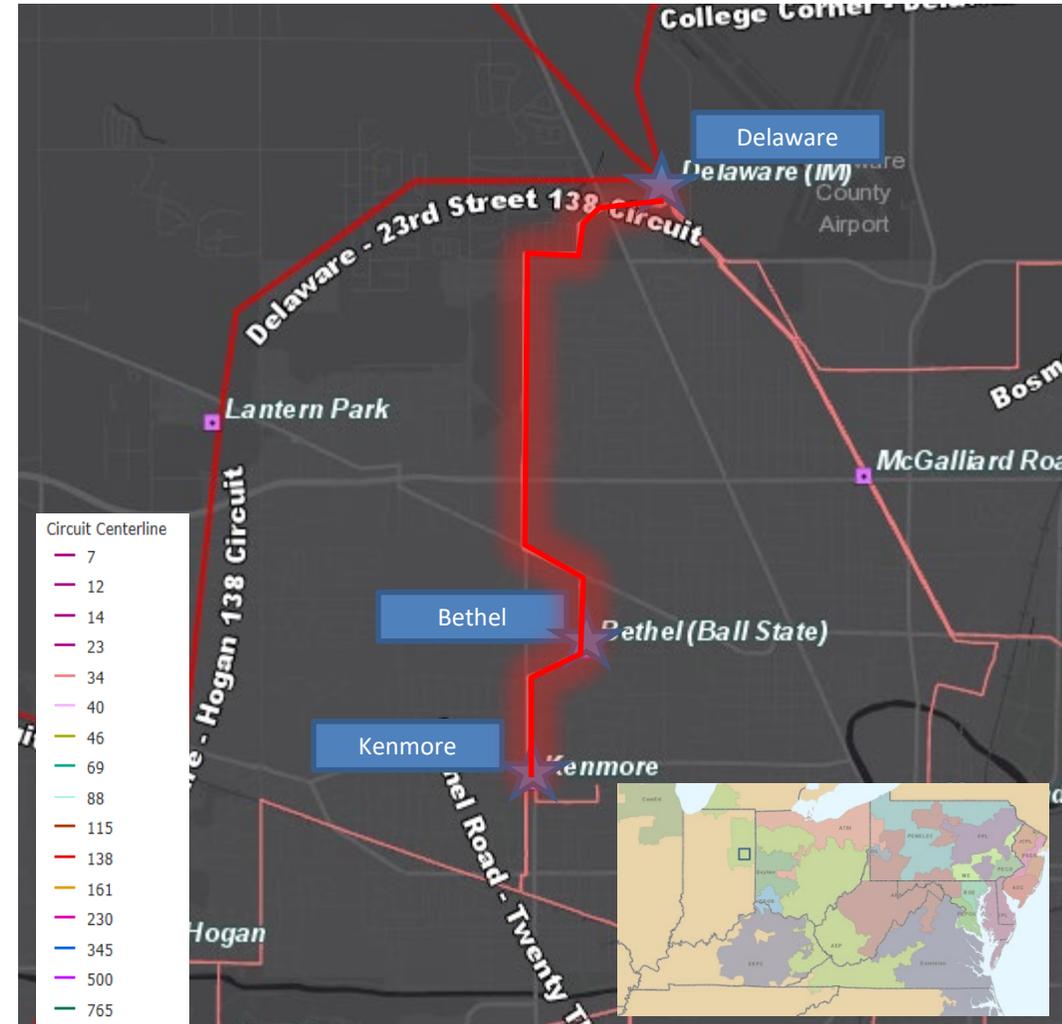
Problem Statement:

Delaware – Bethel overhead 34.5kV Line (2.8 miles)

- 1960's vintage wood construction.
- 16 open conditions all related to structural issues.
- Issues with ROW encroachments.

Bethel – Kenmore underground 34.5kV line (.8 miles)

- 1960's vintage underground construction
- Both cables are through common man-hole ducts, which can present a safety issue. Currently TFS personal will not work on this line unless both northern feeds to Kenmore are de-energized due to this configuration.
- Underground construction makes it difficult to identify and fix outages. This means that as this cable ages, the area will start experiencing prolonged forced outages. This line has already experienced multiple of these type of outages.
- This UG section was out for 14 straight days in June 2010 and 29 straight days in August 2017



AEP Transmission Zone: Supplemental Delaware – Kenmore 34.5kV Rebuild

Need Number: AEP-2019-IM024
Process Stage: Solutions Meeting 11/22/2019

Proposed Solution:

Rebuild the ~3 miles of overhead between Delaware and Bethel station. ~2.5 miles will be rebuilt as overhead and ~.5 miles will be rebuilt as underground. **Estimated Cost: \$16.8M**

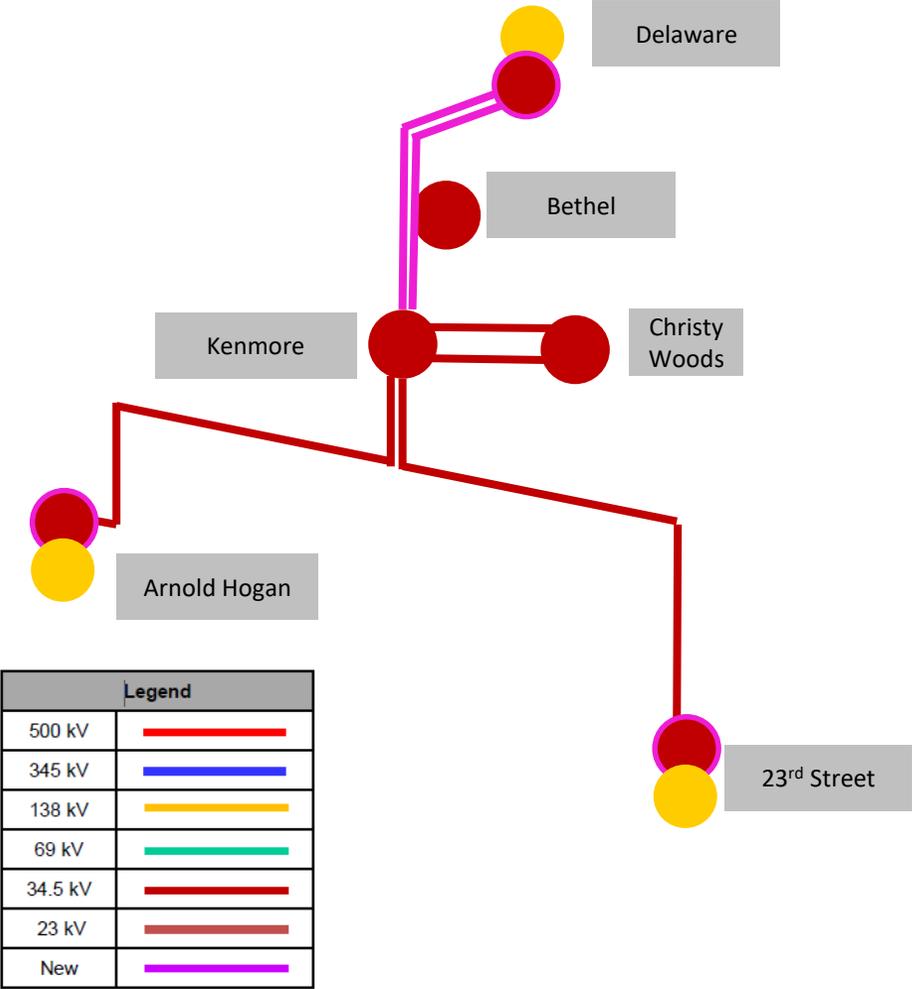
Rebuild the ~1 mile of underground between Kenmore and Bethel stations
Estimated Cost: \$12.8M

At Delaware station, install 2 series reactors to lower short circuit contribution toward Kenmore
Estimated Cost: \$0.85M

At Arnold Hogan station, install 1 series reactor to lower short circuit contribution toward Kenmore
Estimated Cost: \$0.41M

At 23rd Street station, install 1 series reactors to restrict flow and lower short circuit contribution toward Kenmore.
Estimated Cost: \$0.41M

Total Estimated Transmission Cost: \$31.3M



AEP Transmission Zone: Supplemental Delaware – Kenmore 34.5kV Rebuild

Need Number: AEP-2019-IM024
Process Stage: Solutions Meeting 11/22/2019

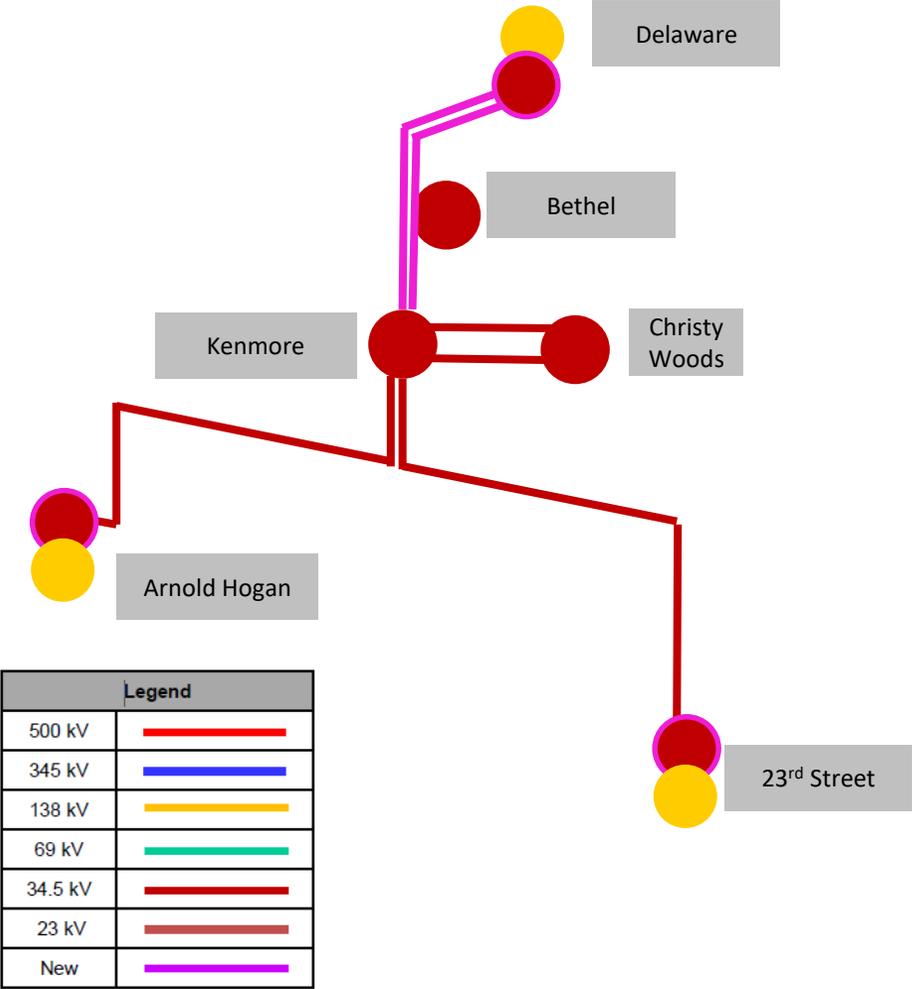
Alternatives Considered:

Alternative 1

Install full line as overhead conductor and buy up the parcels in the line route. ~1 mile of the underground already exists as underground construction going through Ball State’s campus where this would not be feasible. ~.5 miles of the existing overhead line will be rebuilt as underground due to the current route being in close proximity yards and going over peoples houses. No viable alternate route was identified In the siting process so underground was deemed the best option for this ~.5miles.

Alternative 2

Install 2 reactors at Kenmore toward Christy Woods station in lieu of 4 between Delaware, Arnold Hogan and 23rd Street. Kenmore is a GIS station that has no room to expand. The property owners around this station have already indicated that they are not willing to sell any land to us for station expansion.



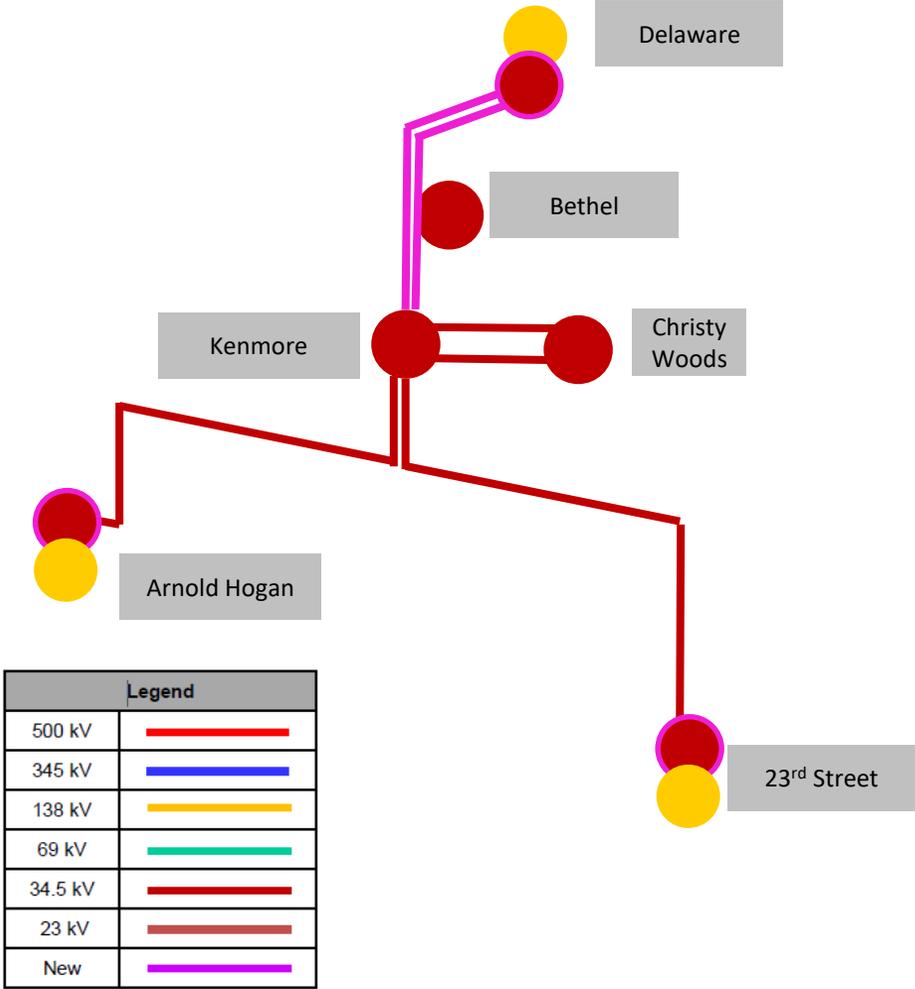
AEP Transmission Zone: Supplemental Delaware – Kenmore 34.5kV Rebuild

Need Number: AEP-2019-IM024
Process Stage: Solutions Meeting 11/22/2019

Alternatives Considered:

Alternative 3
 Replace the breakers at Christy Woods Station in lieu of installing any reactors. This was investigated, and the cost to get larger sized breakers into Christy Woods cost ~2M for material alone. For this reason, the reactors were chosen.

Projected In-Service: 10/01/2023
Project Status: Scoping



AEP Transmission Zone M-3 Process Belmont / Harrison County, Ohio

Need Number: AEP-2019-OH019

Process Stage: Solutions Meeting 11/22/19

Previously Presented: Needs Meeting 4/23/2019

Supplemental Project Driver:

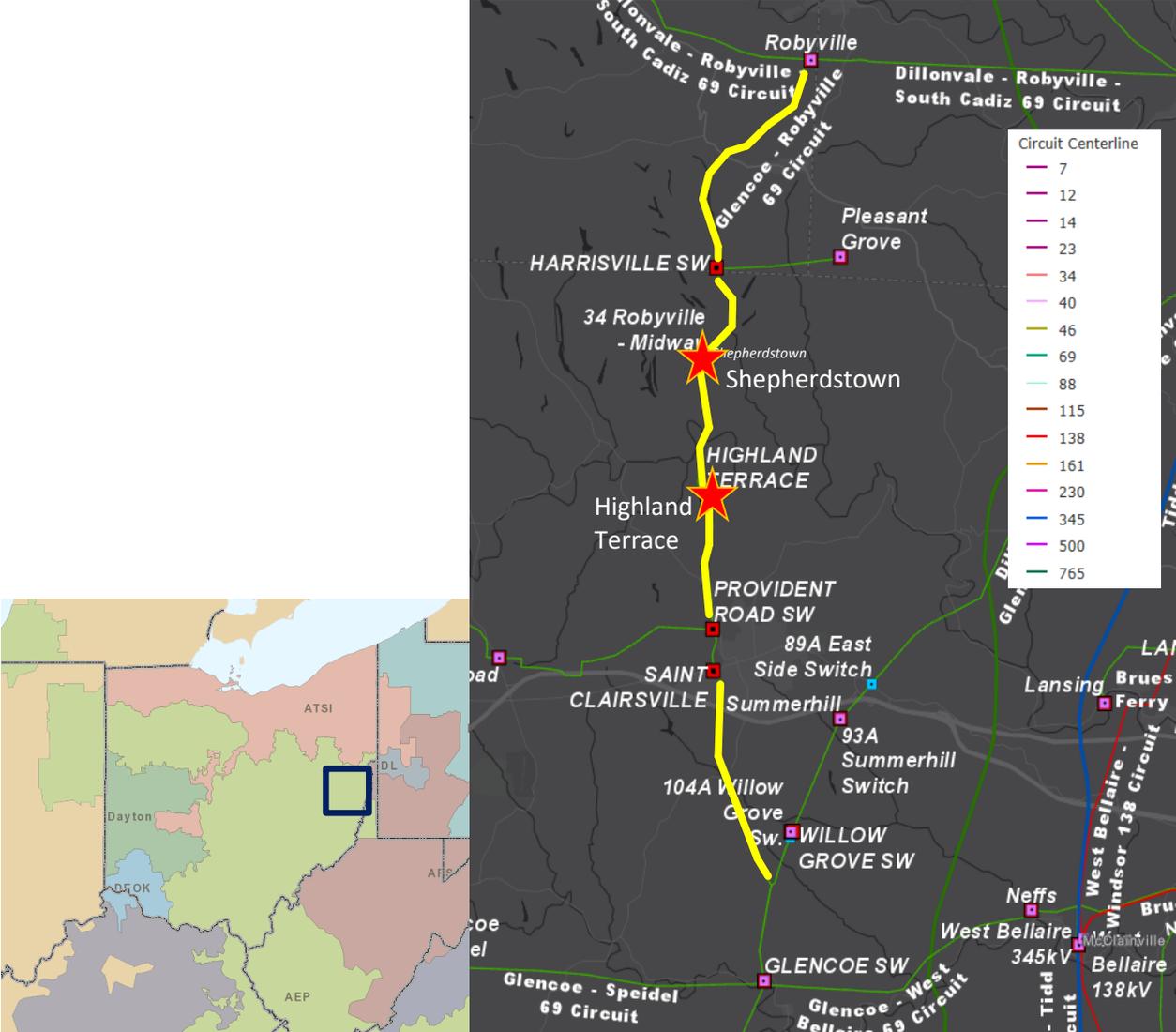
Equipment Material/Condition/Performance/Risk

Specific Assumption References:

AEP Guidelines for Transmission Owner Identified Needs

Problem Statement:

- The Glencoe – Robyville 69kV circuit section of concern is 12.9 miles long and originally constructed in 1915-1925 using wood pole structures. This circuit currently has 556 ACSR 18/1 (Osprey) conductor.
 - The non-standard conductor is single-strand steel core which significantly diminishes conductor strength over time as there is only a single steel strand supporting the aluminum wire.
- The Glencoe – Robyville 69kV circuit has 136 open A conditions which include broken shield/ground wires, heavy structure rot, woodpecker damage, broken insulators, and split cross arms/knee braces.
- This circuit has experienced 789,612 customer-minutes-of-interruption (CMI) between 2013 – 2018.
- The existing switch at Highland Terrace is a two-way wood-pole switch installed in 1979 that restricts our ability to perform routine maintenance and restoration activities in this remote area of our system (compared to a standard three-way switch at a tap point).
- The Shepherdstown Co-op 69kV delivery point is connected via a hard tap (no line switches) which limits operational flexibility and restricts restoration activities, as the customer must take an outage when transmission line maintenance must be performed.



AEP Transmission Zone M-3 Process Belmont / Harrison County, Ohio

Need Number: AEP-2019-OH019

Process Stage: Solutions Meeting 11/22/19

Proposed Solution:

Rebuild the remainder of the Glencoe-Robyville 69kV circuit (12.9 miles) utilizing 795 kcmil ACSR conductor. **Cost: \$27.5 M**

Shepherdstown

- Install a three-way 1200A, 69kV switch. **Cost: \$0.8 M**

Highland Terrace

- Install a three-way 1200A, 69kV switch. **Cost: \$0.7 M**

Total Estimated Cost: \$29.0 M

Alternatives Considered:

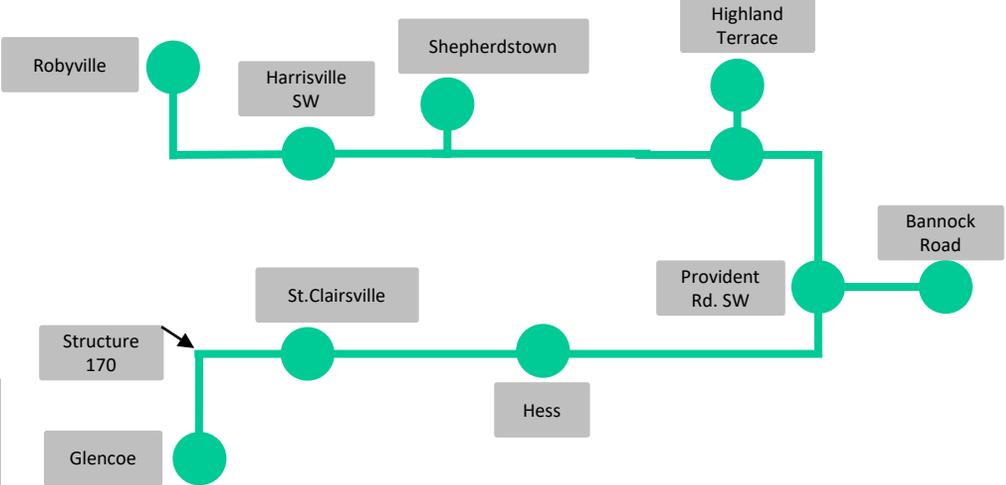
No reasonable alternatives for this asset renewal need. There are a significant number of stations connected to the circuit, preventing the circuit from being retired or significantly re-routed.

Projected In-Service: 12/31/2022

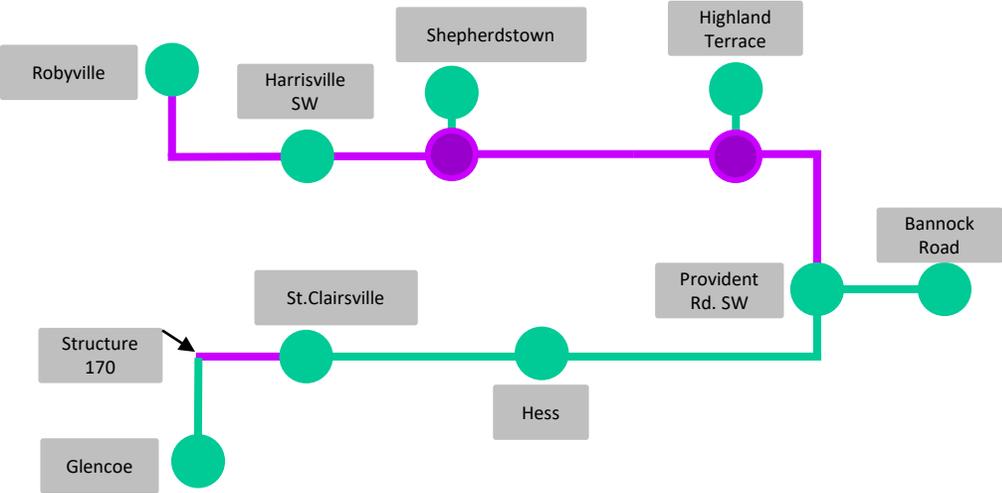
Project Status: Scoping

Existing:

Legend	
500 kV	
345 kV	
138 kV	
69 kV	
34.5 kV	
23 kV	
New	



Proposed:



AEP Transmission Zone: Supplemental South Canton, Ohio

Need Number: AEP-2019-OH055

Process Stage: Solutions Meeting 11/22/2019

Previously Presented: Needs Meeting 10/25/2019

Supplemental Project Driver: Equipment Material/Condition/
Performance/Risk

Specific Assumption References:

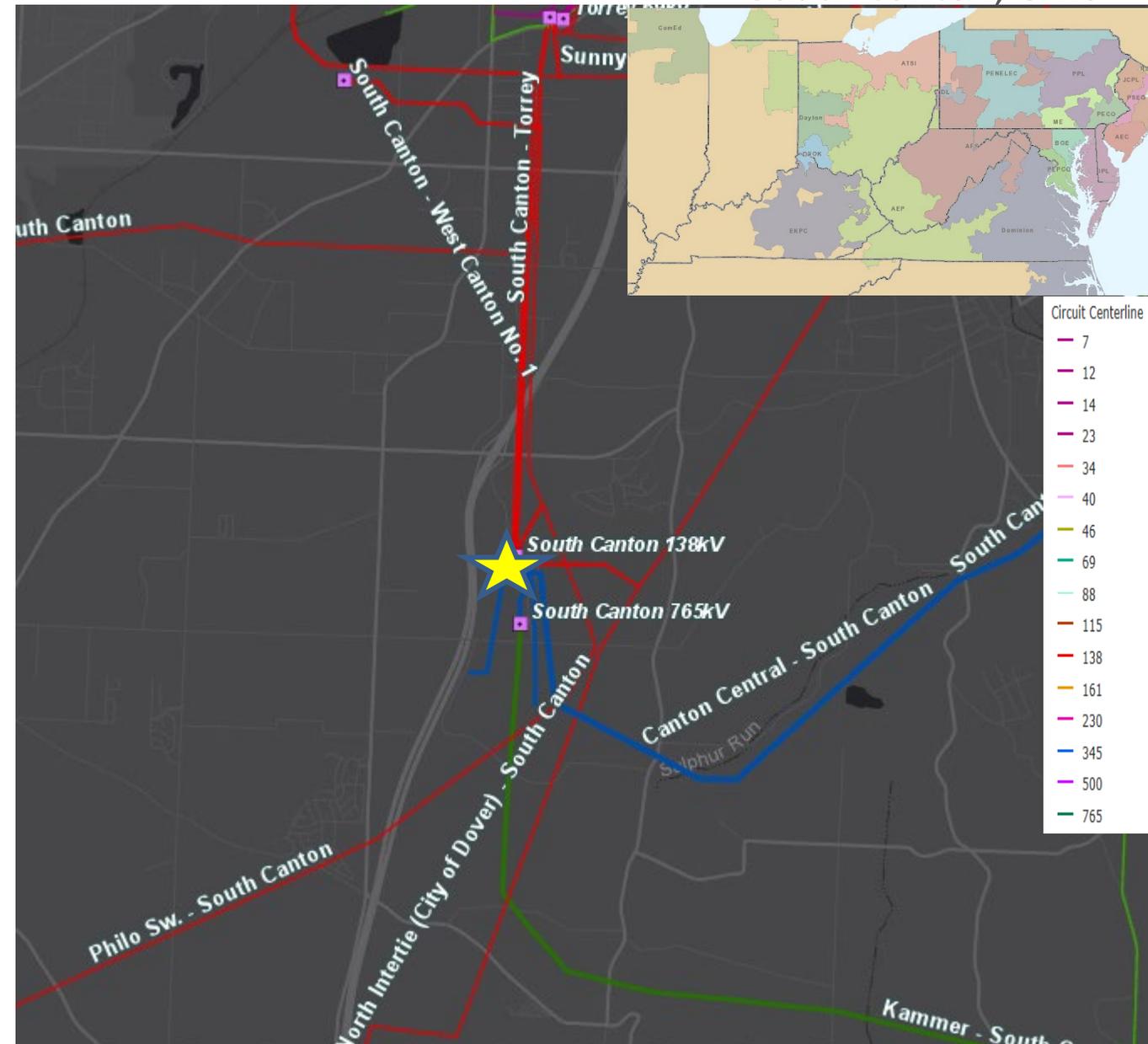
AEP Connection Requirements for the AEP Transmission System
(AEP Assumptions Slide 7)

Problem Statement:

138kV Circuit Breakers: K1, L1, & M1

- Interrupting Medium: SF6
- Additional Info: In addition to the 12 - 138kV overdutied breakers at South Canton, these remaining 3 breakers have fault duty in the 95-99% range.

Model: Summer 2019 RTEP



Need Number: AEP-2019-OH055

Process Stage: Solutions Meeting 11/22/2019

Proposed Solution:

Replace 138kV breakers K1, L1, & M1 (3000A, 63kA) with new units (3000A, 80kA). Note that the 3 existing breakers are in usable condition and will be stored as system spares and reused.

Estimated Cost: \$2.5 Million

Ancillary Benefits: Ensures safety to field personnel, should area transmission system fault levels rise.

Alternatives Considered:

1. Wait for the three nearly-overdutied circuit breakers to potentially cross the threshold to be 100% overdutied and become PJM Baseline upgrades. However, this would be significantly more expensive compared to doing the work as part of the larger South Canton circuit breaker replacement project.

Projected In-Service: 12/1/2021

Project Status: Scoping

Bubble Diagram Not Applicable

Need Number: AEP-2018-OH006

Process Stage: Solutions Meeting 11/22/2019

Previously Presented: Needs Meeting 10/28/2018

Supplemental Project Driver: Equipment Condition/Performance/Risk and Customer Service.

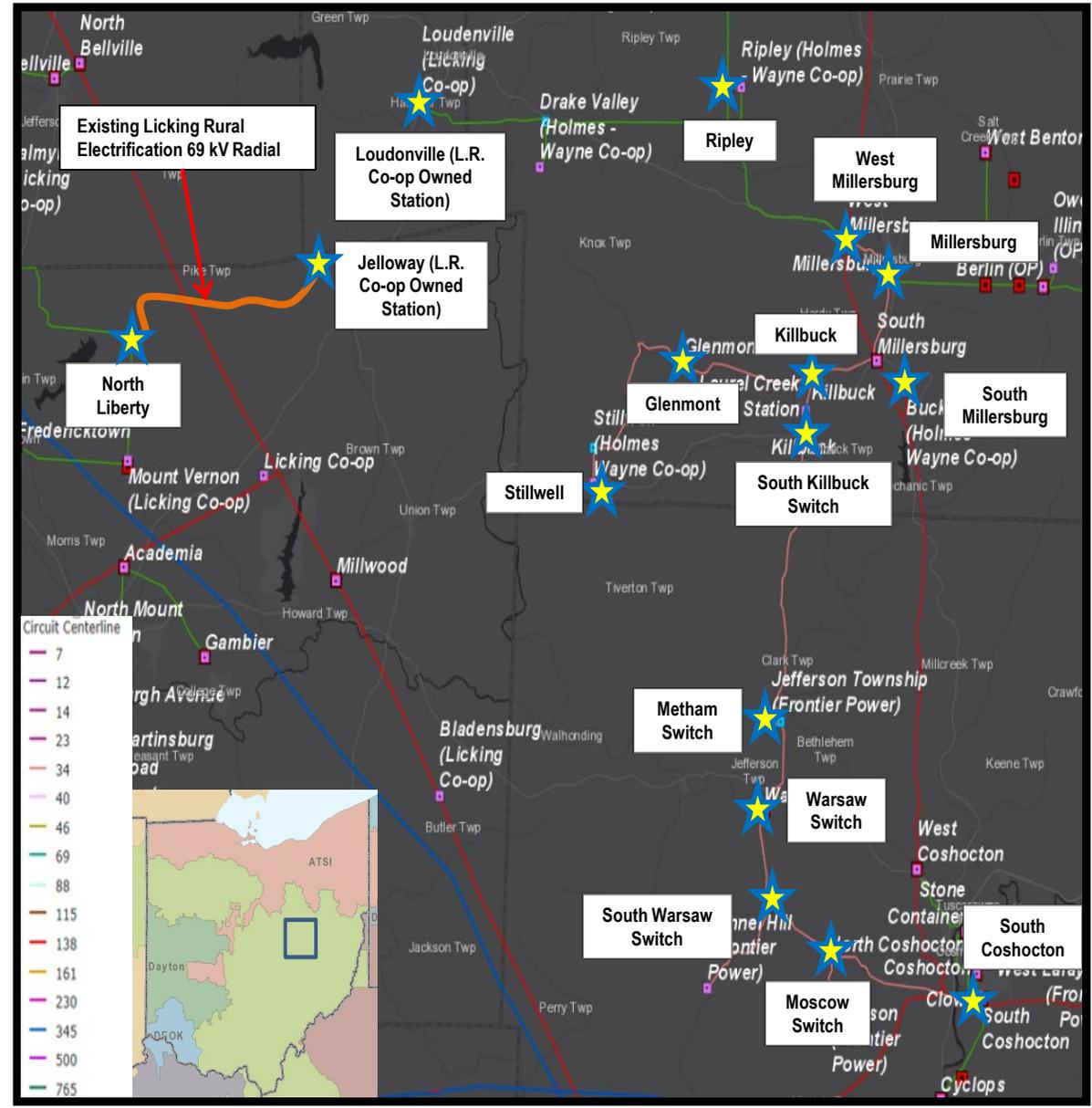
Specific Assumptions Reference: AEP Connection Requirements for the AEP Transmission System (AEP Assumptions Slide 7)

Problem Statement:

Customer Service:

- Customer #2: Holmes-Wayne Co-op (at Stillwell) and AEP Ohio (at Glenmont) are currently served via a radial 34.5 kV (12.58 mi) line. This radial line has consistently been one of the worst performing line over the last 10 years. The Stillwell delivery point has accumulated 1.7 million CMI over the past five years. Over the last 10 years (2008-2017), Stillwell delivery point has averaged nearly 875,000 CMI/ year.
- Customer #3: L.R. and Holmes-Wayne members are currently served via a radial 69 kV (24.1 mi) line. The North Liberty to Jelloway radial line is 9.50 miles and the Ripley to Loudonville radial line is 14.16 miles. Their total load is 8.73 MVA and they have experienced 1.13 million CMI over the last three years.

Problem Statement Continued on Next Slide...



AEP Transmission Zone M-3 Process Coshocton Area Improvements

Process Stage: Solutions Meeting 11/22/2019

Proposed Solution:

All lines will be built 556.5 ACSR conductor unless stated otherwise.

Ravin: Cost \$8.6M

Build a greenfield station at 69kV 2000A 40kA in a 3-breaker ring configuration next to Jelloway (L.R. Co-op).

Jelloway Co-op – Ravin 69kV : Cost \$0.7M

Build ~0.01 miles of greenfield 69kV line to connect Ravin to Jelloway Co-op. Under emergency conditions Jelloway can be fed radially from North Liberty Switch. North Liberty Switch will be normally open towards Jelloway Co-op.

Stillwell Switch: Cost \$0.8M

Install a greenfield 69kV 1200 A 3-way POP switch.

Stillwell Switch – Ravin 69kV : Cost \$26.4M

Build ~11.4 miles of greenfield 69 kV line.

Hanover Switch: Cost: \$0.8M

Install a greenfield 69kV 1200A 3-way POP switch (near existing Loudonville).

Hanover Switch – Ravin 69kV : Cost \$12.9M

Build ~5.17 miles of greenfield 69 kV line.

Loudonville (L.R. Co-op) Station – Hanover Switch : Cost \$0.7M

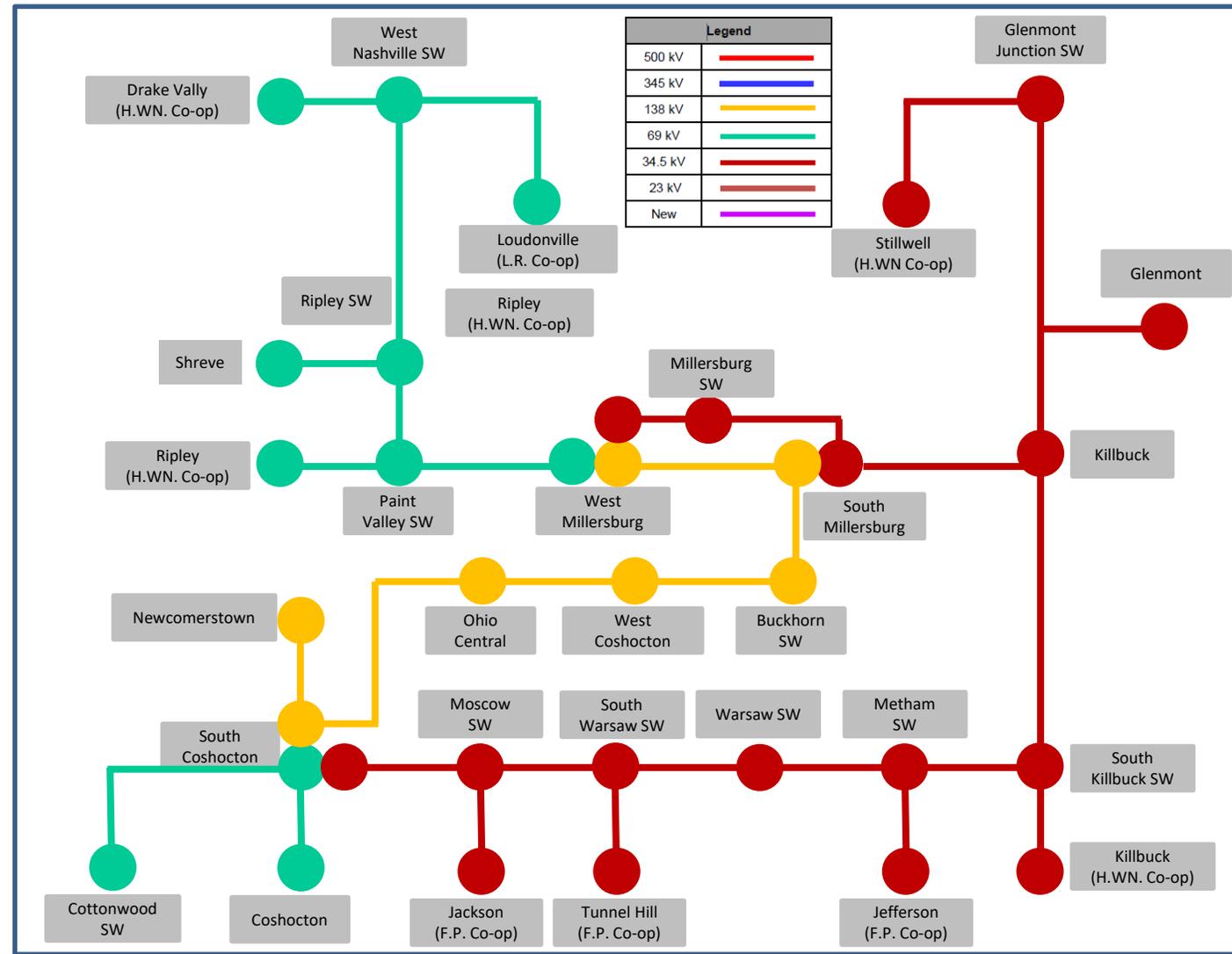
Reconnect the Loudonville (L.R. Co-op) Station to then new Hanover 69 kV Switch.

Fort Fizzle (Replaces Glenmont Junction Sw): Cost \$1.1M

Build a new greenfield 69 kV station in an in/out configuration with 1200A switches to replace Glenmont Junction Switch. Remove existing Glenmont station.

Fort Fizzle – Stillwell 69kV : Cost \$16.7M

Rebuild ~7.07 miles of the existing Glenmont Junction - Stillwell 34.5kV line at 69kV.

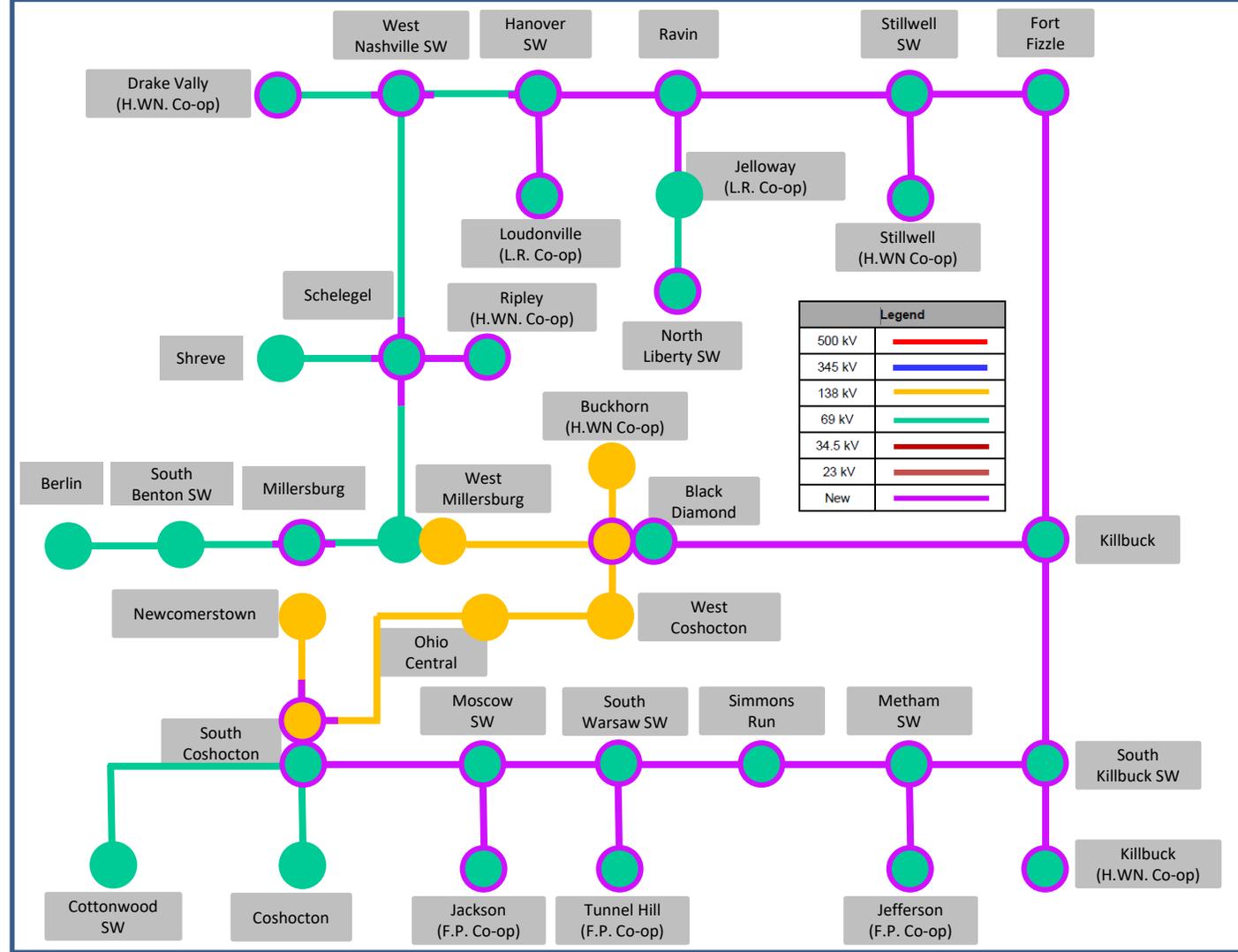


Existing

AEP Transmission Zone M-3 Process Coshocton Area Improvements

Proposed Solution Continued:

- Fort Fizzle – Killbuck 69kV:** Cost \$12.9M
Rebuild ~5.51 miles of the existing Killbuck to Glenmont (Fort Fizzle) 34.5kV line at 69kV.
- Black Diamond (Replaces South Millersburg):** Cost \$10.2M
Build a greenfield station at 138 kV 3000A 40kA in 4-breaker ring configuration. Replace the 138/34.5kV 25MVA transformer with a 138/69kV 90MVA transformer. Remove the 34.5kV circuit breaker “C” and install a new 69kV 2000A 40kA circuit breaker towards Killbuck. Remove the 34.5kV 3000A kVAR Cap bank “AA”. The Buckhorn (H.WN. Co-op) 138 kV delivery point will now connect to Black Diamond station. Remove South Millersburg station and Buckhorn switch.
- Black Diamond – Killbuck 69kV:** Cost: \$6.4M
Rebuild ~4.12 miles of the existing South Millersburg (Black Diamond) to Killbuck 69kV line.
- Black Diamond 138 kV Line Extension:** Cost \$1.7M
Build ~0.56 miles of greenfield 138kV line (556 ACSR) to connect Black Diamond 138 kV to the existing West Millersburg 138 kV line.
- Ohio Central – West Millersburg 138kV circuit:** Cost \$0.7M
Remove ~.9 miles of the Ohio Central – West Millersburg 138 kV circuit and reroute into Black Diamond station.
- Buckhorn (H.WN Co-op) – South Millersburg 138kV line:** Cost \$2.0M
Build a new 138 kV line (~.8 miles) to reconnect the existing Buckhorn (H.WN Coop) into Black Diamond 138 kV station.
- Millersburg:** Cost \$2.8M
Cut the Berlin – West Millersburg 69 kV line into Millersburg station with an in/out configuration with 1200 A line switches.

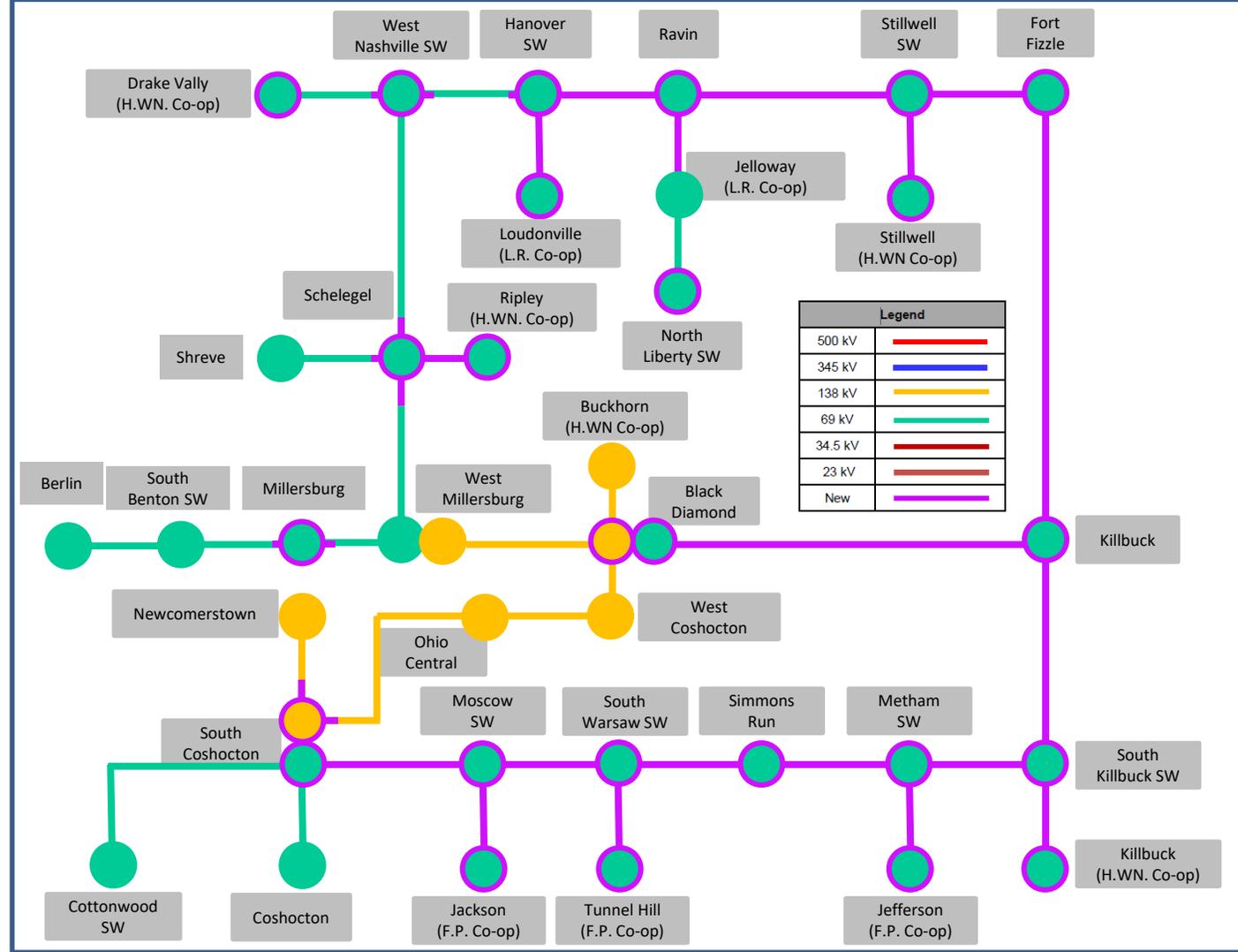


Proposed

AEP Transmission Zone M-3 Process Coshocton Area Improvements

Proposed Solution Continued:

- Schlegel (Replaces Ripley Switch):** Cost \$9.5M
Build a greenfield station at 69kV 40kA 2000A in a 4-breaker ring configuration next to Ripley (H.WN. Co-op)'s station. Remove the existing Ripley and Paint Valley switches and reconnect the lines into the new Schlegel station.
- Shreve – Schlegel 69kV:** Cost \$0.6M
Relocate the existing Shreve to Ripley 69kV line to Schlegel station.
- West Millersburg – Schlegel 69kV:** Cost \$0.6M
Relocate the existing West Millersburg to Paint Valley 69kV line to Schlegel station.
- West Nashville:** Cost \$0.7M
Install a 69kV 1200A 3-way POP switch (near existing Drake Valley (H.WN. Co-op)).
- Millersburg – West Millersburg 34kV:** Cost \$0.1M
Retire ~1.24 miles of the existing Millersburg to West Millersburg 34kV line.
- Millersburg - South Millersburg 34kV:** Cost \$0.9M
Retire ~2.93 miles of the existing Millersburg to South Millersburg 34kV line.
- South Killbuck Switch:** Cost \$0.6M
Replace 2-way POP with a 3-way 69kV 1200A POP switch.
- South Killbuck – Killbuck H.WN. Co-op 69kV:** Cost \$0.7M
Rebuild ~0.05 miles of the South Killbuck to Killbuck Holmes Wayne Co-op 34kV line to 69kV.
- Metham Switch:** Cost \$0.6M
Replace 2-way POP with a 3-way 69kV 1200A POP switch.
- Metham – Jefferson (F.P. Co-op) 69kV:** Cost \$1.2M
Rebuild ~0.38 miles of the Metham to Jefferson (F.P. Co-op) 34.5kV line to 69kV.
- Simmons Run – Killbuck 69kV:** Cost \$31.1M
Rebuild ~10.4 miles of the South Coshocton to Killbuck 34.5 kV line to 69kV.



Proposed

AEP Transmission Zone M-3 Process Coshocton Area Improvements

Simmons Run (Replaces Warsaw Switch): Cost \$8.7M

Build a greenfield station at 69 kV 2000A 40kA in 3-breaker ring configuration. Remove existing Warsaw switching.

South Warsaw – Tunnel Hill (F.P. Co-op) 69kV: Cost \$9.3M

Rebuild ~3.73 miles of the existing South Warsaw to Tunnel Hill (F.P. Co-op) 34.5kV line to 69kV.

Moscow Switch: Cost \$0.6M

Replace 2-way POP with a 3-way 69kV 1200A POP switch.

Moscow – Jackson (F.P Co-op) 69kV: Cost \$3.5M

Rebuild ~1.24 miles of the existing Moscow to Jackson (F.P. Co-op) 34.5 kV line to 69kV.

South Coshocton - Simmons Run 69kV: Cost \$31.7M

Rebuild ~14.4 miles of the existing South Coshocton to Killbuck 34kV line to 69 kV.

South Coshocton: Cost \$10.9M

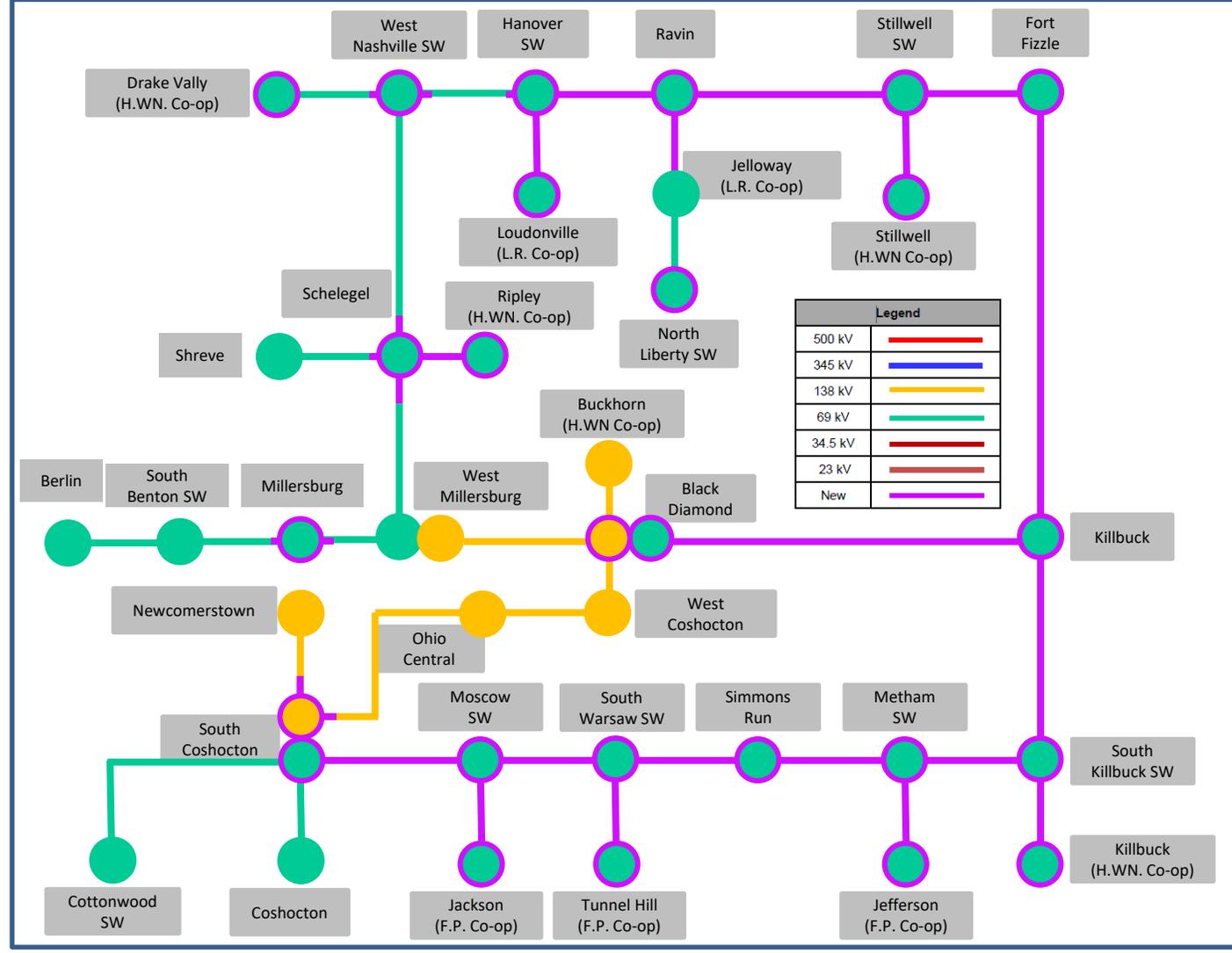
Build a 138 kV 3000 A 40 kA 5-breaker ring bus and install a 138/69 kV 130 MVA transformer. Install 3 new 69 kV 1200A 40 kA circuit breakers on the line towards Simmons Run, towards Coshocton, and on the low side of the transformer. Retire and remove the 138/69kV 75MVA transformer #2, as well as the 69/34.5kV 35MVA transformer #3. Leave the 138/34.5kV 30MVA transformer #1 to serve San Cast customer.

Total Cost: \$216.7M

Ancillary Benefits: Holistic solution to a large area with multiple needs.

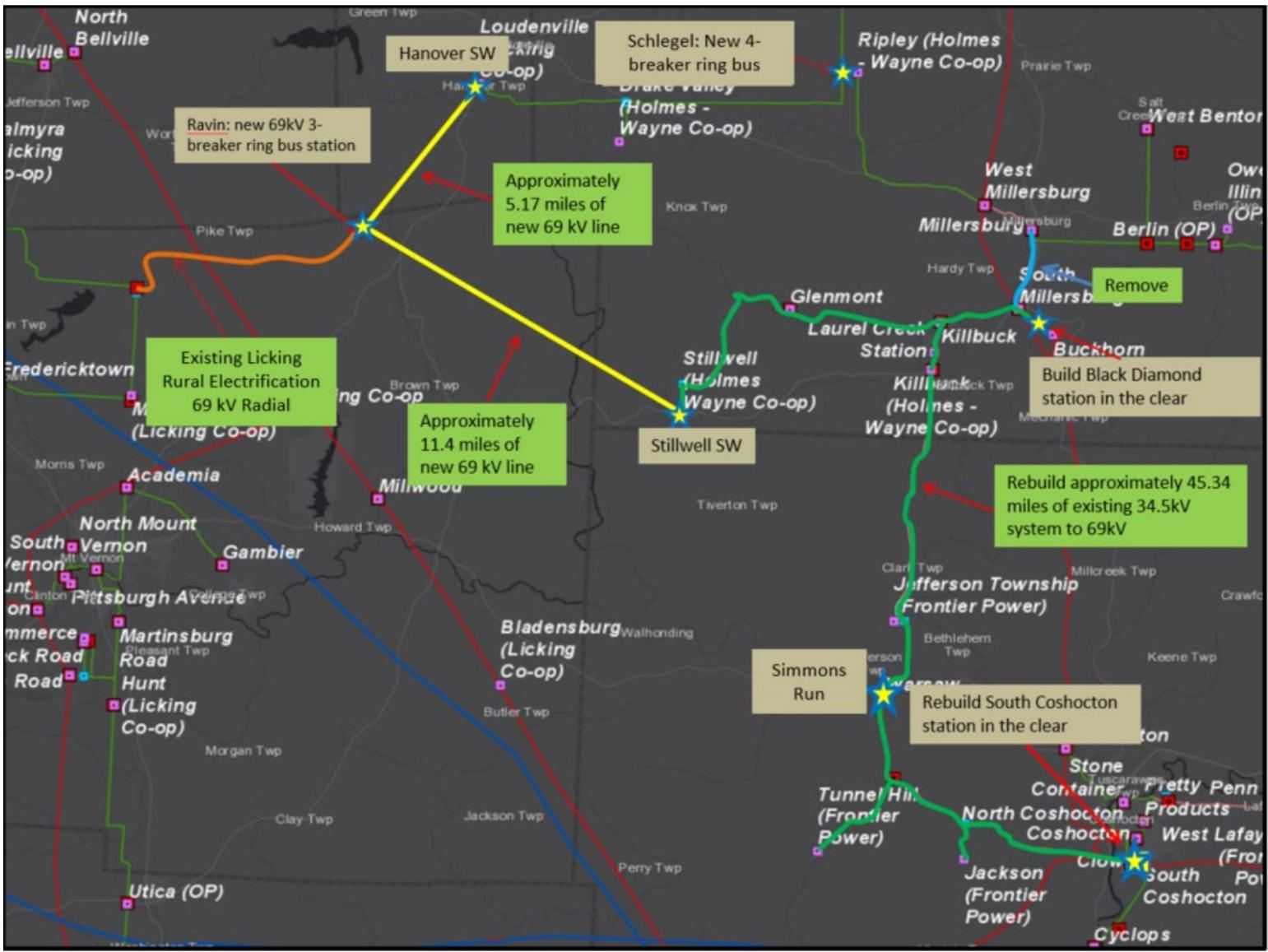
Projected In-Service: August 2025

Project Status: Scoping



Proposed

Proposed Solution

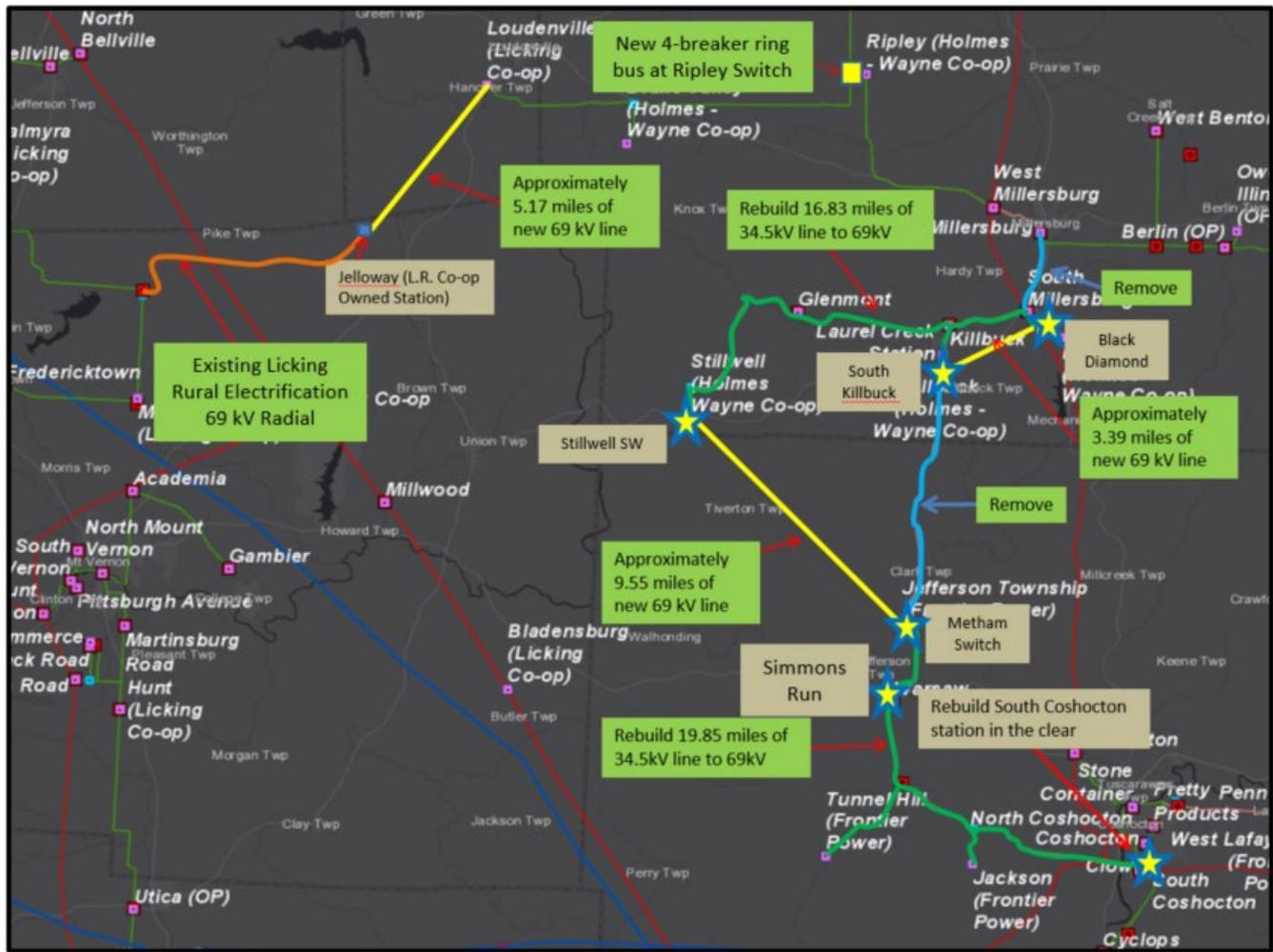


Alternative Considered:

The following items are the differences between the Solution and the Alternative solution. The required rehab remediations are also part of the Alternative solution.

- Retire and remove Metham Switch to South Killbuck Switch ≈ 8.66 miles of line.
- Install ≈ 3.39 miles of 69 kV line from South Killbuck Switch to Black Diamond station.
- Loop Stillwell to Metham Switch ≈ 9.55 miles of 69 kV line.
- Loop Jelloway (which is a 7 mile radial line connected to North Liberty Switch) to Loudonville 69 kV
- Replace North Liberty Switch with a three 69 kV circuit breaker ring bus.

Estimated Cost: \$220M



Appendix

High Level M-3 Meeting Schedule

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

- 11/12/2019 – V1 – Original version posted to pjm.com
- 11/22/2019 – V2 – Slide #27, Updated problem statement
- 12/2/2019 – V3 – Slide #30, Corrected Need number to AEP-2019-AP003
- 12/3/2019 – V4 – Slide #21, #22, Changes are reflected in the slides
 - Slide #23, #24, New Slides
 - Corrected date on title slide