



An AEP Company

BOUNDLESS ENERGY™

# SRRTEP Committee Western AEP Supplemental Projects

January 17, 2020

# 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 Kanawha/Fayette, County

**Need Number:** AEP-2020-AP001

**Process Stage:** Need Meeting 1/17/2020

**Supplemental Project Driver:**

Equipment Condition/Performance/Risk, Operational Flexibility and Efficiency

**Specific Assumption Reference:**

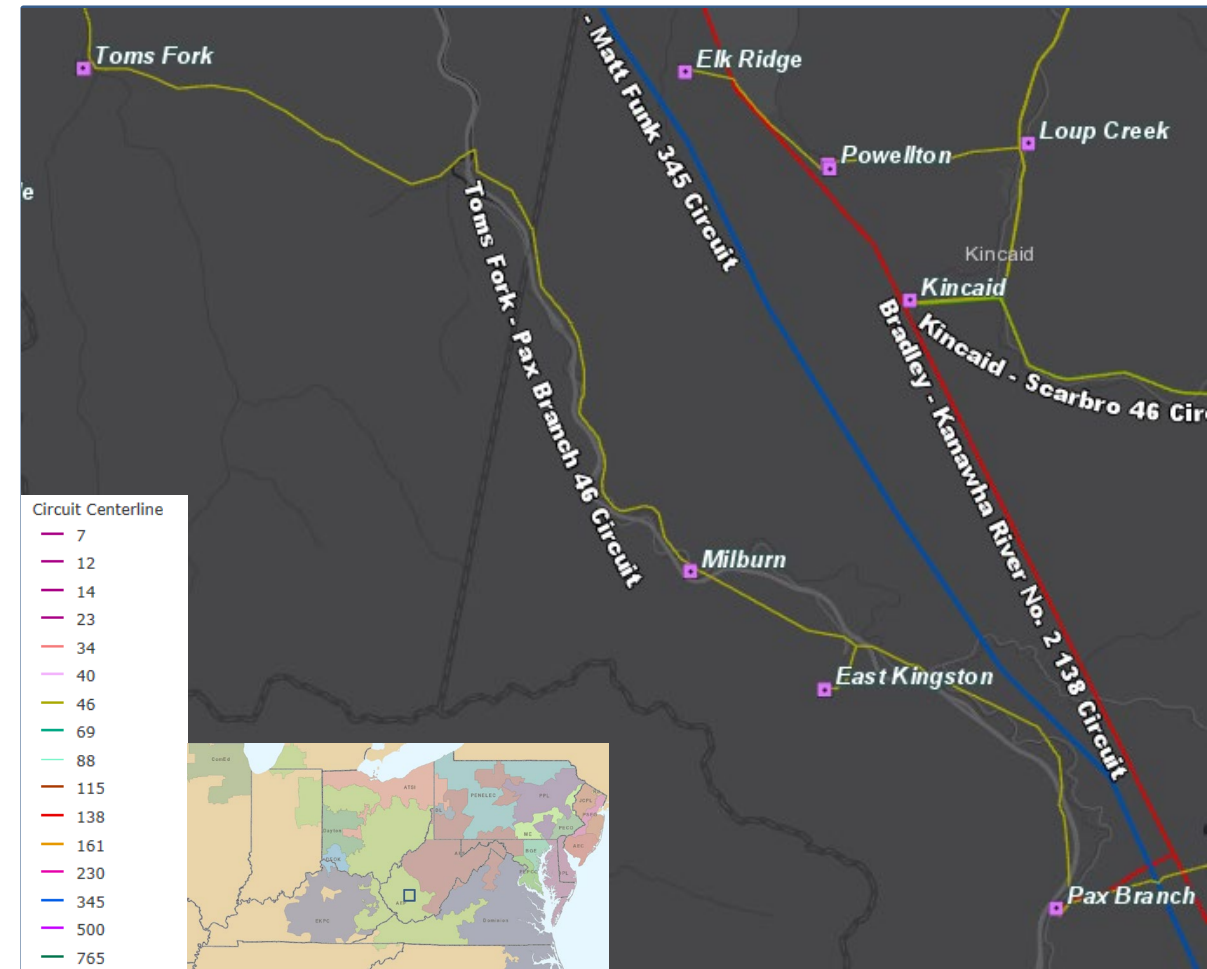
AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

**Problem Statement:**

Pax Branch – Toms Fork 46 kV line (~17.4 miles)

- Majority of the circuit is constructed with wood structures varying in age from 49-106 years old. The circuit also contains some lattice structures that are 50 years old. 85% of the line is constructed with 1950s wood.
  - 55% of the structures on the line have conditions
  - Steel structures show evidence of corrosion on arms and braces as well as hardware rusting
  - Wood structures show evidence of rot, split, and woodpecker damage.
- The line is insulated with 4-bell porcelain insulators originally installed in 1915 and do not meet current AEP standards for CIFO and minimum leakage distance requirements
- Approximately 70% of the line conductor is from 1915.
- Static wire is 104 years old and does not comply with the current material standards.
- Since 2014, the circuit experienced 8 momentary and 27 permanent outages.

**Model:** N/A



**Need Number:** AEP-2020-AP002

**Process Stage:** Needs Meeting 1/17/2020

**Supplemental Project Driver:** Customer Service

**Specific Assumption References:** AEP Connection

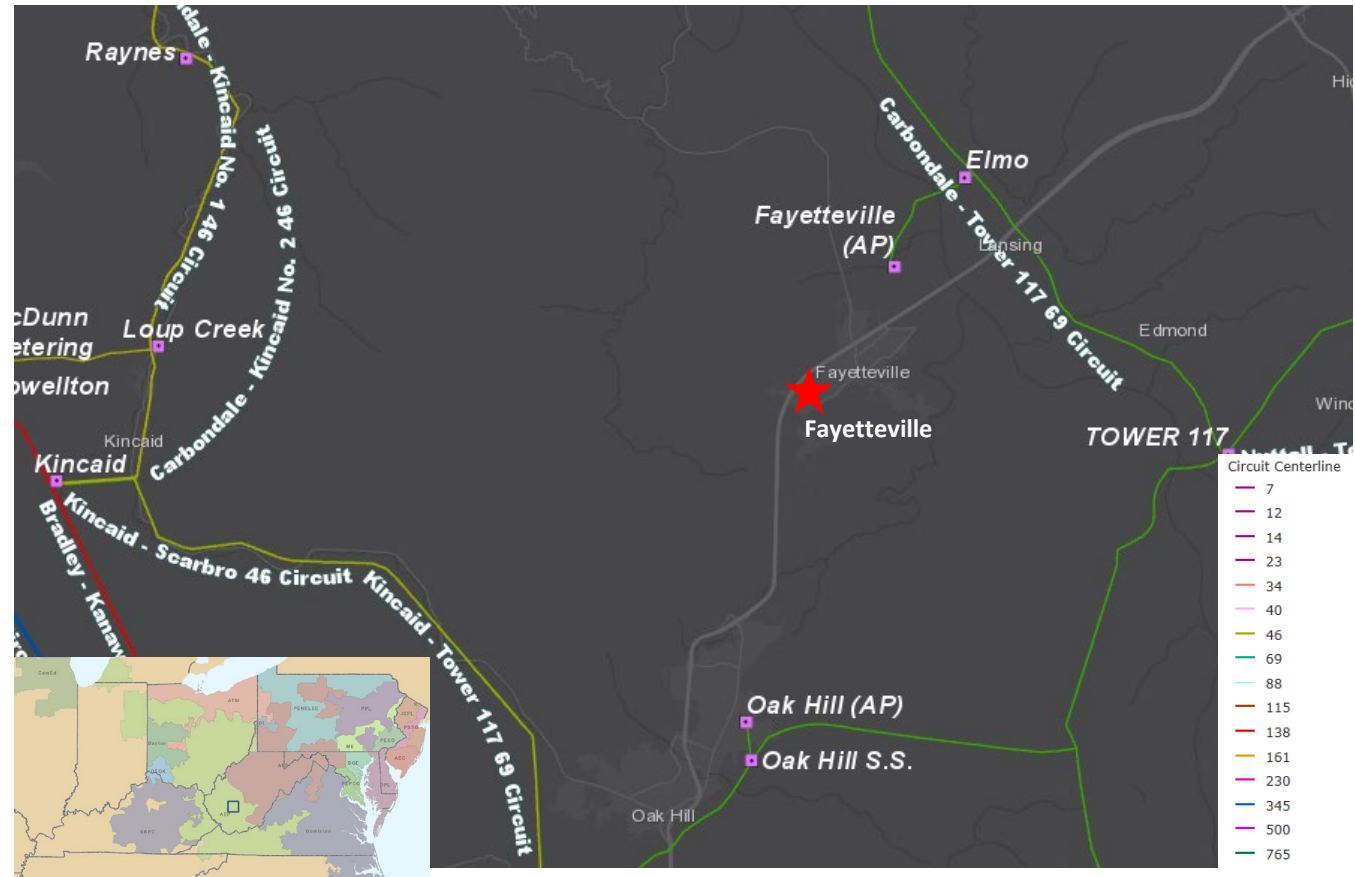
Requirements for the AEP Transmission System (AEP

Assumptions Slide 7)

**Problem Statement:**

APCO Distribution has requested a new distribution station located in Fayetteville, West Virginia. Summer projected load 11 MVA Winter projected load 13 MVA.

**Model:** 2024 RTEP



**Need Number:** AEP-2020-AP003

**Process Stage:** Needs Meeting 01/17/2020

**Process Chronology:** Needs Meeting 01/17/2020

**Supplemental Project Driver:** Equipment Material/ Condition/Performance/Risk, Operational Flexibility and Efficiency

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

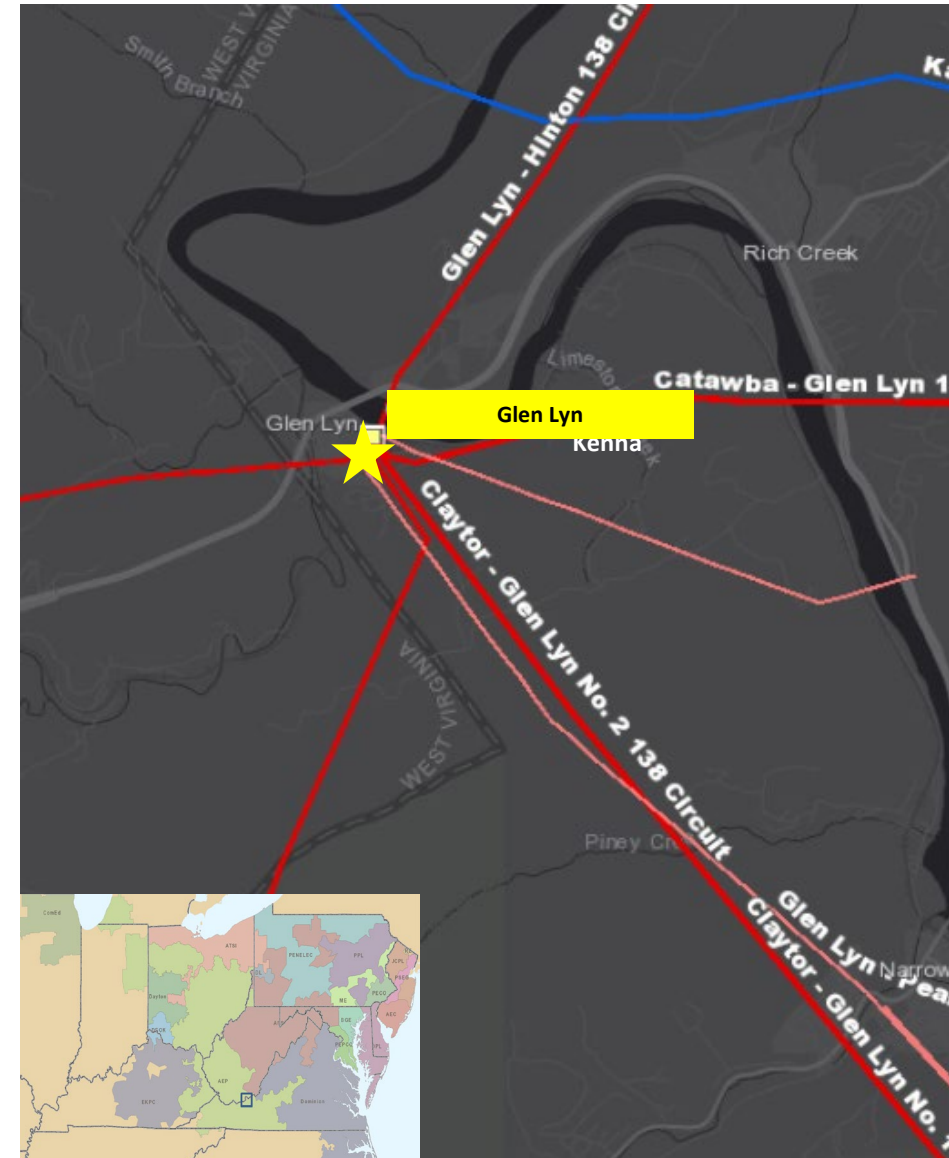
**Problem Statement:**

Station Name: Glen Lyn

Circuit Breakers A, B, D, G, L & N (138 KV) Concerns:

- All of these breakers are 63 years old, oil filled without oil containment; oil filled breakers pose significant environmental risk associated with oil handling and leaks.
- Breakers A, B, D, L have experienced 55, 62, 11, 31 fault operations, respectively —exceeding manufacturer’s recommended number of 10.
- Breakers A, B, D, G, and N are 5 of only 11 in the FGK-138-10000-3 model family remaining on the AEP system.
- Breaker L is 1 of 4 in the FGK-138-10000-7Y model family remaining on the AEP system.

## AEP Transmission Zone: Supplemental Giles County, Virginia



**Station (continued)**

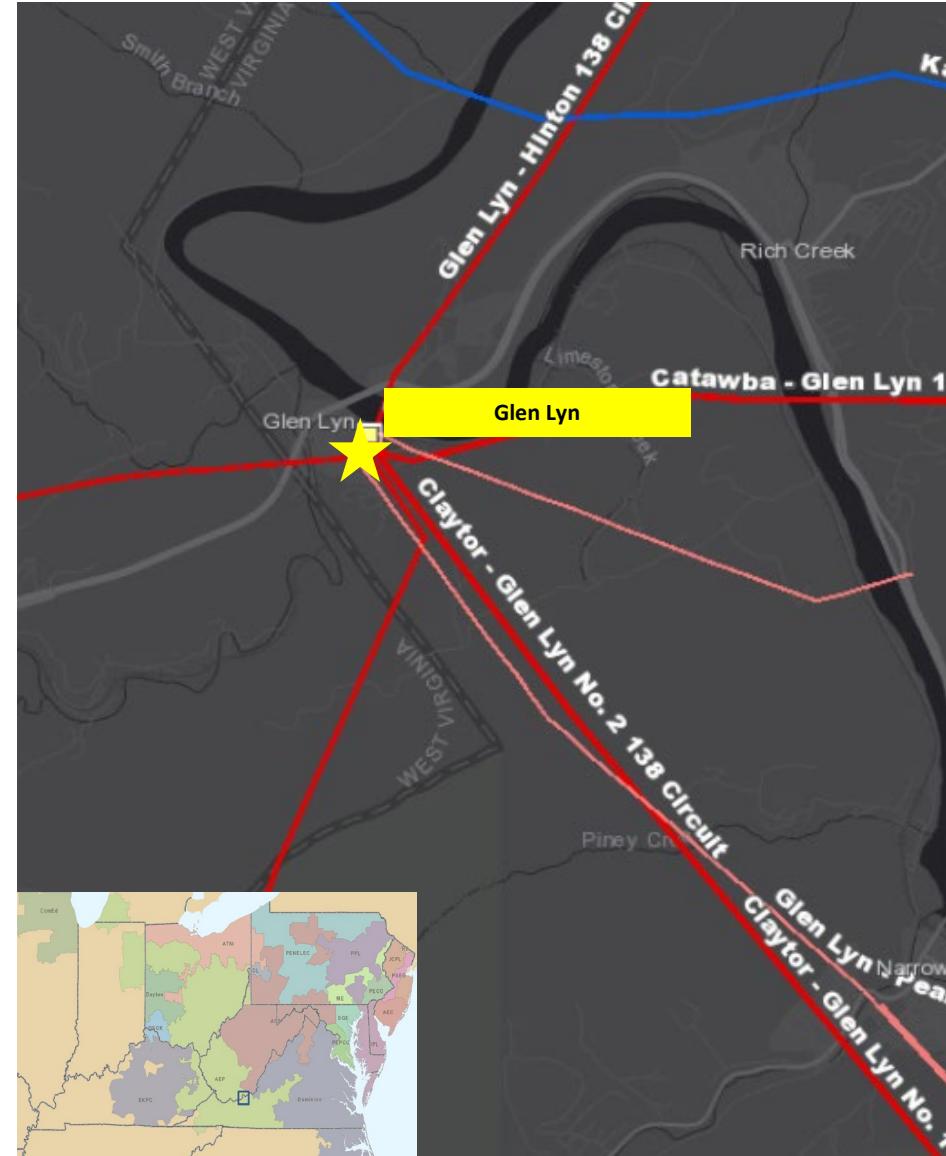
**Circuit Breakers AA, AC, AF (34 KV) Concerns:**

- All of these breakers are oil filled without oil containment; oil filled breakers pose significant environmental risk associated with oil handling and leaks.
- CB AA is 71 years old, and is 1 of only 22 in the FK-339-1000 model family remaining on the AEP system. It has experienced 37 fault operations — exceeding manufacturer’s recommended number of 10.
- CB AC is 42 years old, and is 1 of only 9 in the FK-439-34.5-1000-1 model family remaining on the AEP system. It has experienced 47 fault operations — exceeding manufacturer’s recommended number of 10.
- CB AF is 71 years old, and is 1 of only 10 in the FK-339-1000-2 model family remaining on the AEP system.

**Circuit Switchers BB, CC, DD & P (138 KV) Concerns**

- CSs BB, CC, & DD are 40 years old. These circuit switchers belong to Mark V-138 model. There are numerous malfunction records on these units at Glen Lyn related to broken or malfunctioning operation counters. Failed operational components including high contact resistance, gas loss, and interrupter failure represent half of these malfunctions. Parts are expensive, especially because interrupters can only be replaced, not repaired, as they are hermetically sealed.
- CS DD has experienced 55 fault operations —exceeding manufacturer’s recommended number of 10 during its in-service life.
- CS P has experienced 235 fault operations —exceeding manufacturer’s recommended number of 10 during its in-service life.
- There are a total of 5 malfunction records since 2002 for CS CC and DD relating (combined) to loss of SF6.

**AEP Transmission Zone: Supplemental  
Giles County, Virginia**





**Station (continued)**

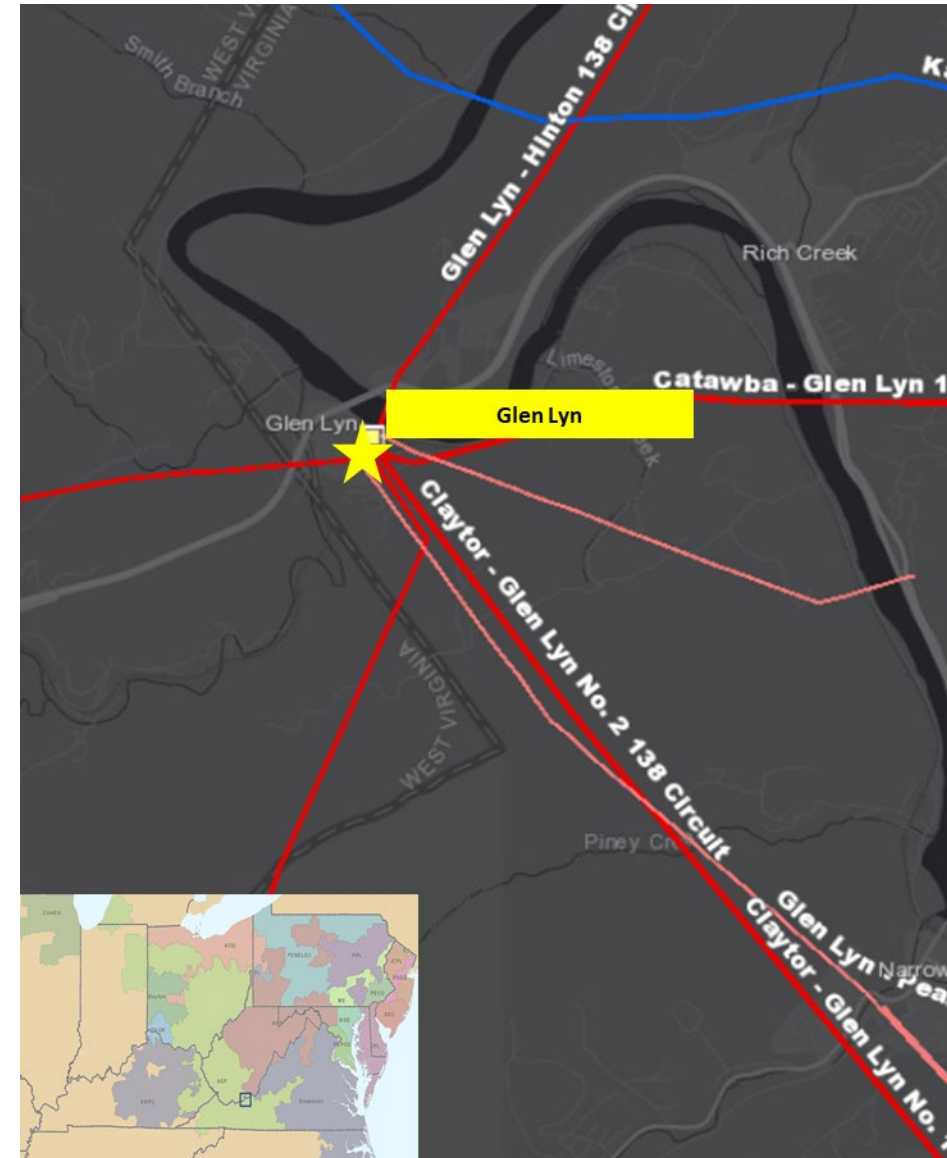
Other station Specific equipment concerns:

- Notable steel member corrosion existing on the 138 kV bay structures constructed in 1944.
- All circuit breakers and circuit switchers foundations, along with station steel present concrete spalling and significant signs of deterioration beyond repair.
- Lower elevation levels in the station yard are in the 100-year flood plain of the nearby New River.
- No HVAC in 34.5 kV building reducing the life of digital equipment. Roof leaks in 34.5 kV building due to age and deterioration. 34.5 kV control house has only one entrance which does not meet current fire hazard protection standards.
- Asbestos and lead paint in both of the control buildings.
- The side of the fence has considerable corrosion and has an elevated risk of a slide occurring.
- The current station access limits vehicle accessibility and is hazardous due to proximity to the neighboring railroad crossing. Accessibility constraints make repairs very difficult and increase outage time.

Relay concerns:

- Currently, 81 of the 115 are in need of replacement. There are 71 electromechanical and 10 static type relays which have significant limitations with regards to spare part availability and fault data collection and retention in addition to lack of vendor support.
- There are 12 microprocessor based relays commissioned in from 1997 to 2008 with unsupported firmware. Two of the microprocessor relays have been previously identified to be replaced due to their elevated risk of failure in addition to obsolescence, lack of vendor support, and being out of warranty.

AEP Transmission Zone: Supplemental  
Giles County, Virginia



# AEP Transmission Zone M-3 Process Sullivan County, Tennessee

**Need Number:** AEP-2020-AP004

**Process Stage:** Needs Meeting 01/17/2020

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

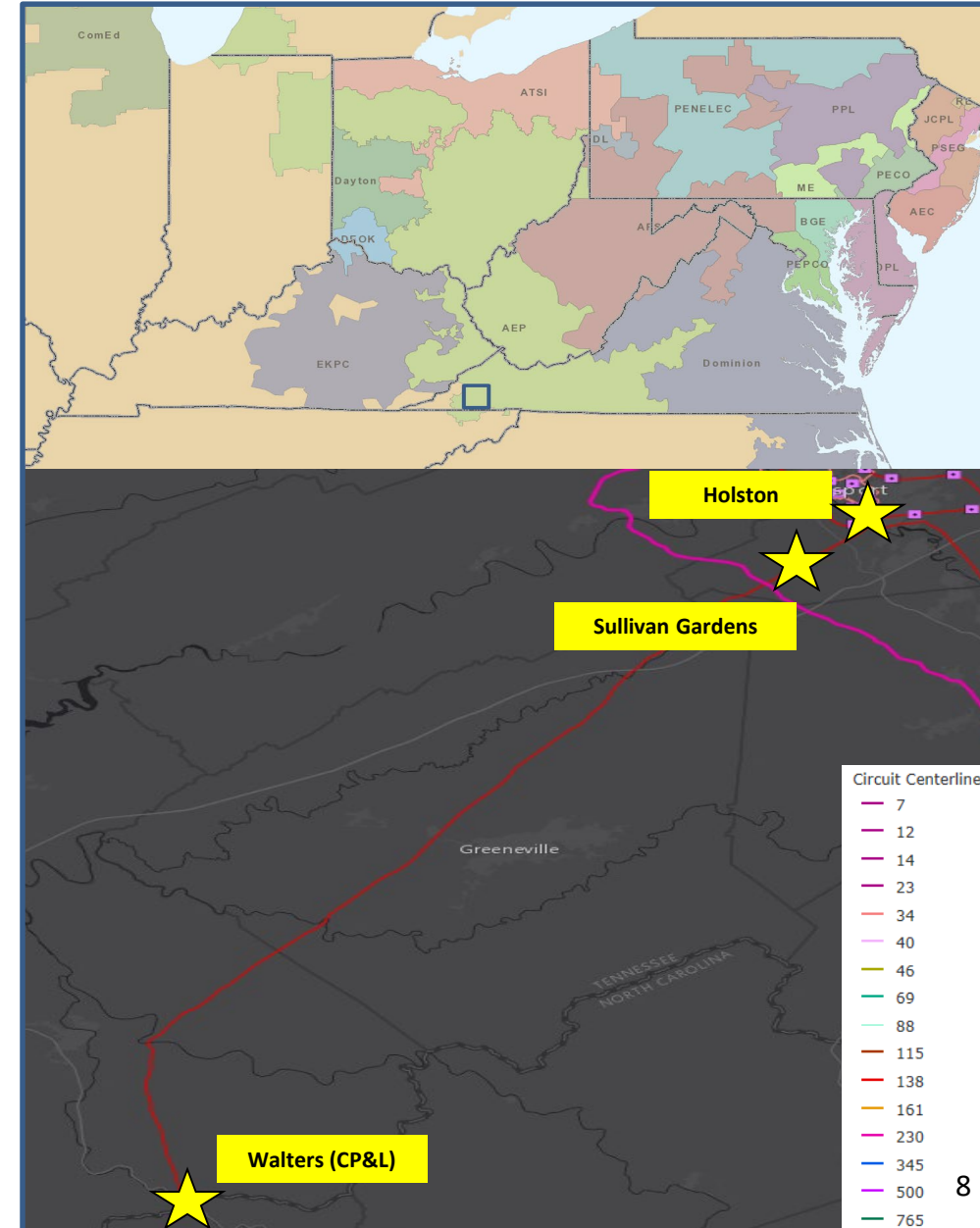
**Specific Assumption Reference:**

AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8), AEP Presentation on Pre-1930s Lines

**Problem Statement:**

Sullivan Gardens - Walters 138 KV (installed in 1927)

- Length: 59.93 Miles
- Original Construction Type: Lattice Steel
- Original Conductor Type: 250,000 CM COPPER 12
- Momentary/Permanent Outages: 54/9 (5 years)
- Total structure count: 448
- Number of open conditions: 91
  - Open conditions include: burnt conductor, broken shield wire, broken hardware, structure rust.
- Unique structure count with open conditions: 88 (20%)
- Additional Info: N/A
- **Model:** N/A





**Need Number:** AEP-2020-AP005

**Process Stage:** Needs Meeting 01/17/2020

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

**Specific Assumption Reference:**

AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8), AEP Presentation on Pre-1930s Lines

**Problem Statement:**

**Line:**

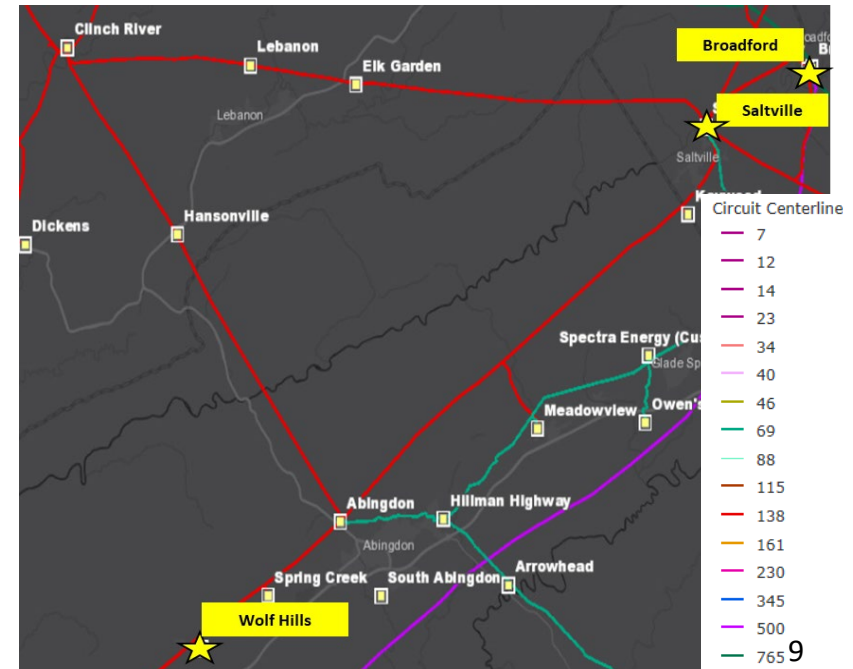
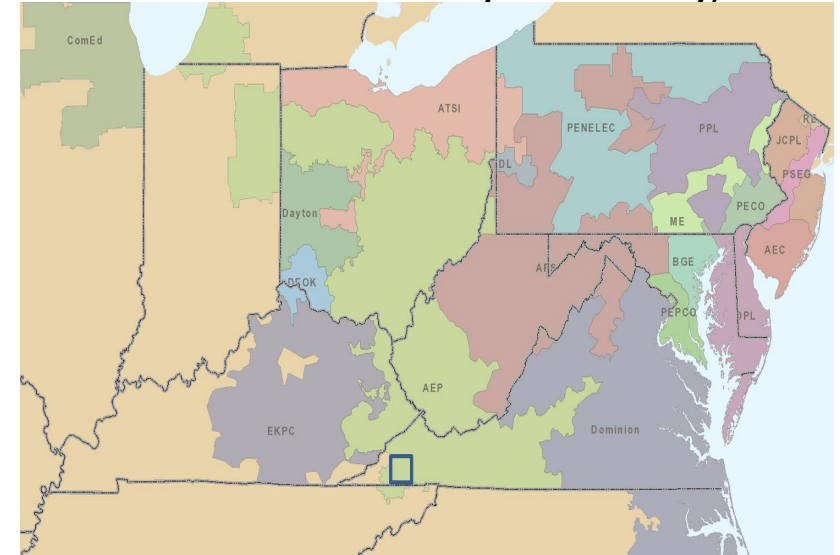
Broadford — Wolf Hills 138 KV (installed in the 1920's)

- Length: 31.54 Miles
- Original Construction Type: Lattice Steel
- Original Conductor Type: 82.5% 397.5 CM ACSR 30/7, 15.2% 795 CM ACSR 45/7
- Momentary/Permanent Outages: 9/1 (5 years)
- Total structure count: 144
- Number of open conditions: 12
  - Open conditions include: broken conductor strands, broken/burnt insulators.
- Unique structure count with open conditions: 6 (7%)
- Additional Info: Insulator & Hardware Corrosion:
  - Section Loss: The connecting elements including the tower attachment hole and the insulator hook have experienced serious section loss due to corrosion and wear. This loss of metal cross-section significantly reduces the capacity of the connection
  - Corrosion: The insulator caps and connecting hardware have experienced heavy to complete loss of galvanizing. When the protective galvanized coating is gone or significantly compromised the bare steel corrodes at an accelerated rate
  - Tower members with corrosion and damage. Lattice tower structures have little structural redundancy. A failure of one member of the structure will impact the integrity of the structure and may cause the entire tower to collapse.

• **Model:** 2024

SRRTPEP-W – AEP Supplemental 01/17/2020

## AEP Transmission Zone: Supplemental Smyth County, WV



# AEP Transmission Zone M-3 Process Lexington, Ohio

**Need Number:** AEP-2020-OH002

**Process Stage:** Need Meeting 01/17/2020

**Supplemental Project Driver:**

Customer Service

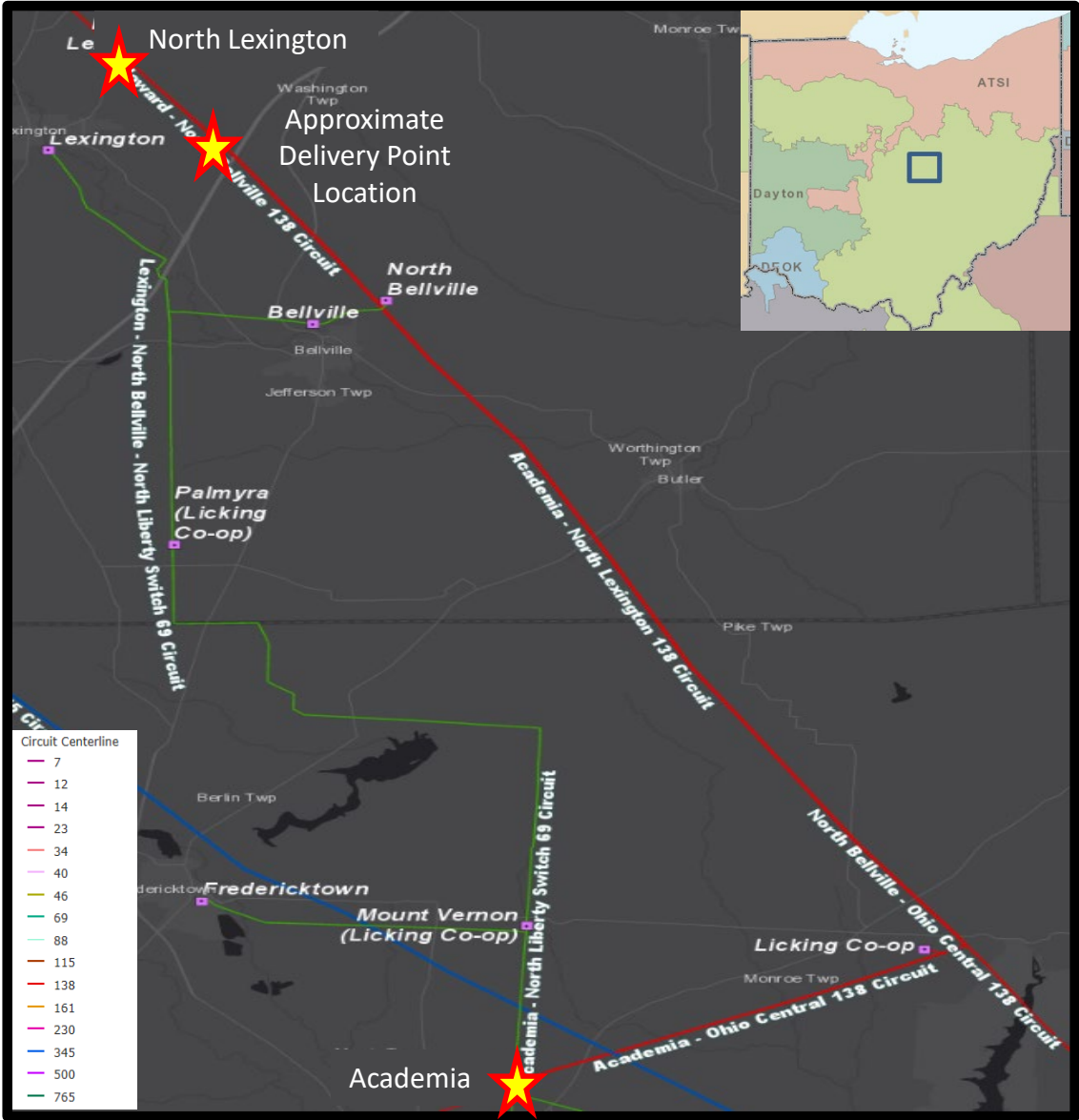
**Specific Assumption Reference:**

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

**Problem Statement:**

- AEP Ohio is requesting a new 138kV delivery point on the Academia – North Lexington 138 kV circuit by May 2023. Anticipated load is approximately 15 MVA.

**Model:** 2024 RTEP



# 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 Fayette County, WV

**Need Number:** AEP-2019-AP026

**Process Stage:** Solution Meeting 1/17/2020

**Previously Presented:** Need Meeting 7/24/2019

**Supplemental Project Driver:**

Equipment Condition/Performance/Risk, Operational Flexibility and Efficiency

**Specific Assumption References:**

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

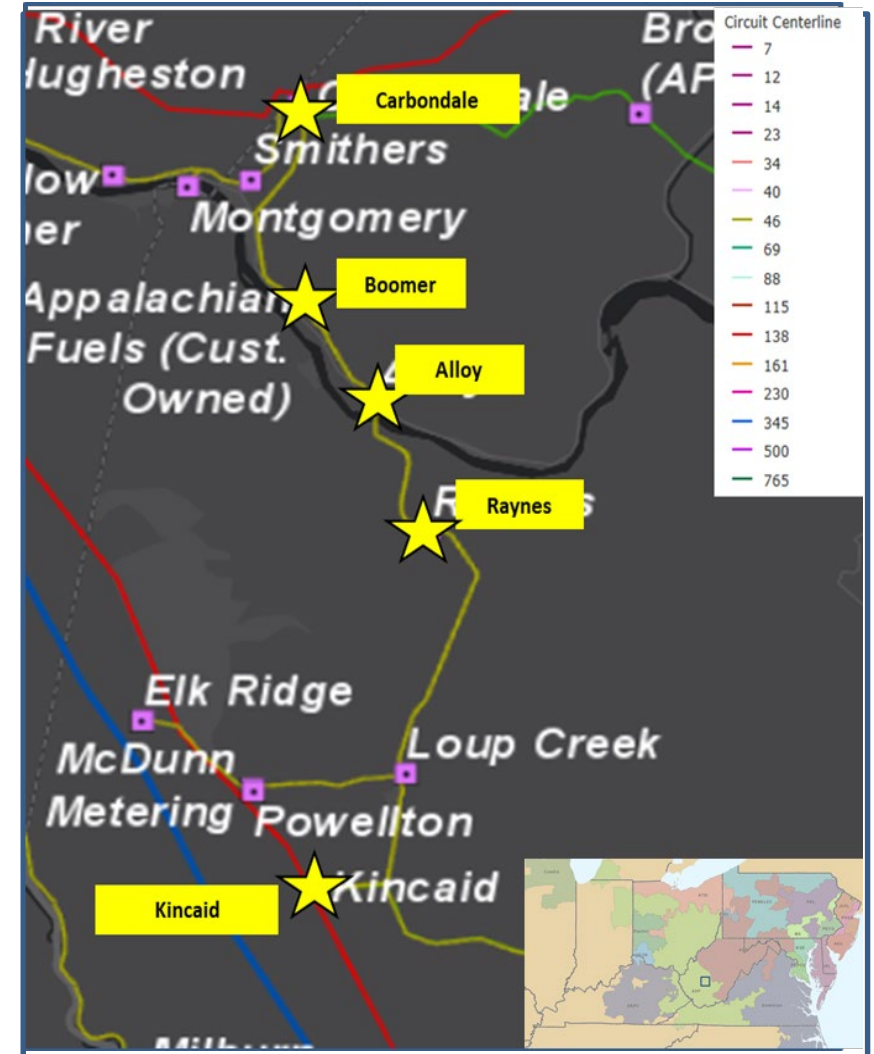
**Problem Statement:**

Carbondale – Kincaid 46 kV #1 (~14.8 miles)

- Majority of the circuit is constructed with 1950s wood and lattice structures
- The conductor is greater than 65 years old. Grounding on this line does not meet current standards.
- Between 2015-2018 the circuit experienced 16 momentary and 6 permanent outage resulting in approximately 140k customer minutes of interruption

Carbondale – Kincaid 46 kV #2 (~18.6miles)

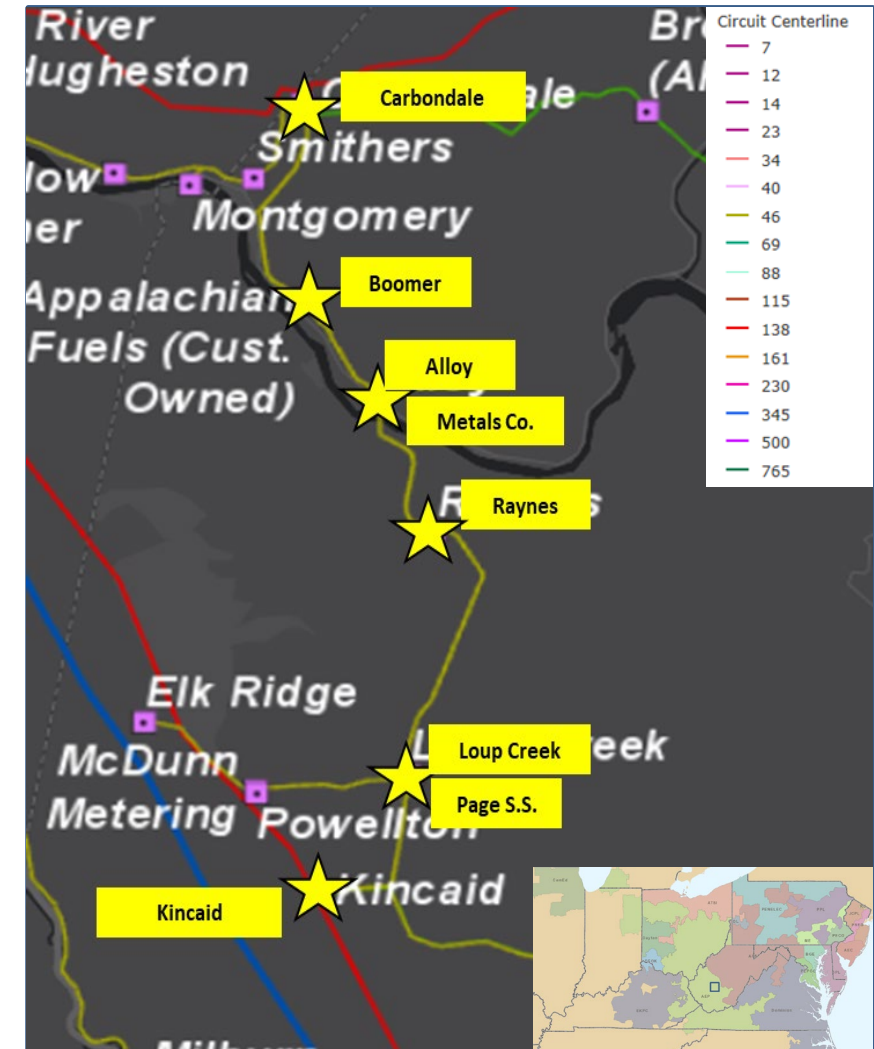
- Majority of the circuit is constructed with 1950s wood and lattice structures
- The conductor is greater than 65 years old. Grounding on this line does not meet current standards.
- From 2015-2018 the circuit has experienced 16 momentary and 7 permanent outages resulting in approximately 390k customer minutes of interruption



## Problem Statement (cont'd):

### Carbondale 138/69/46 kV Station

- 46 kV and 69 kV CBs A, B, C, D, F and G are all 1968, CF-48-69-2500 type breakers.
  - Spare parts for these units are difficult to impossible to obtain, and this model type is no longer vendor supported
  - These breakers are oil filled without oil containment; oil filled breakers have much more maintenance required due to oil handling
  - These breakers have each exceeded the designed number of full fault operations (10). CB-A: 154, CB-B: 49, CB-C: 78, CB-D: 75, CB-F: 94, CB-G: 100
- Carbondale 138/69/46 kV TR-1, manufactured in 1972, has experienced a sharp increase in combustible gas concentrations in January 2016.
  - Numerous gasses have remained at elevated levels, including acetylene at IEEE Condition 4 and ethylene at IEEE Condition 2.
  - The concentrations present are strongly correlated to electrical discharges of high energy and thermal faults in excess of 700°C.
  - Despite declining moisture levels and improving interfacial tension, oil power factor levels are on the rise, and dielectric strength is declining. This supports contamination in the oil from the high energy discharges and thermal faults.
- The current MOAB/Ground SW configuration on TR-1 creates a fault in the station to signal the remote end breakers to open; this is a known safety hazard in legacy station designs.
- The 138 kV line section towards Kanawha River terminates directly into the bus which creates a lack of operational flexibility when switching for faults on the circuit.
- Carbondale Substation currently deploys 64 relays, implemented to ensure the adequate protection and operation of the substation.
  - 36 of the 64 relays (56% of all station relays) are in need of replacement.
  - 36 of the electromechanical which have significant limitations with regards to fault data collection and retention. Spare parts for these relays are difficult to obtain.



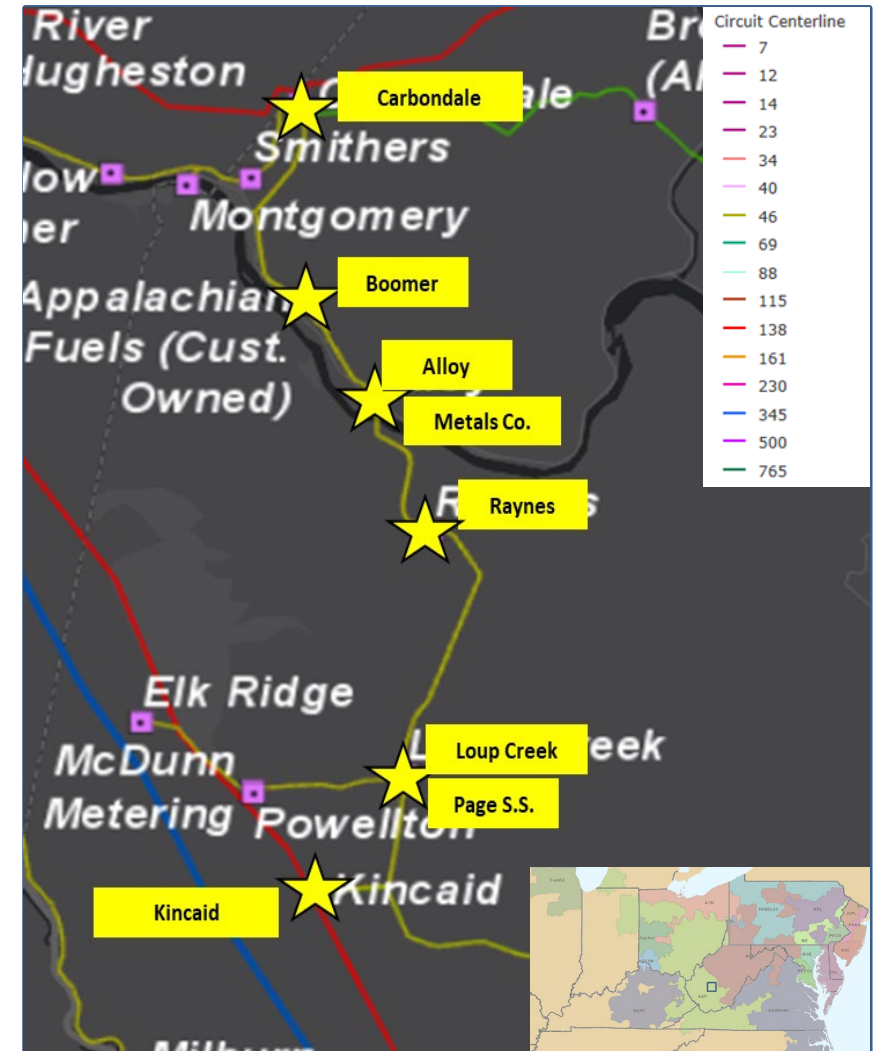


## AEP Transmission Zone M-3 Process Fayette County, WV

### Problem Statement (cont'd):

#### Kincaid 138/69/46 kV Station

- 46kV CBs A, B, and J are all 1972 FK-72.5-27000-9 type breakers, accounting for 3 of 21 remaining of this model remaining on the AEP system.
  - Spare parts for these units are not available and this model type is no longer vendor supported
  - These breakers are oil filled without oil containment; oil filled breakers have much more maintenance required due to oil handling
  - These breakers have each exceeded the designed number of full fault operations (10). CB-A: 61, CB-B: 123, CB-J: 72
- GND TR PH 1-3
  - All three single phase units of GND TR are experiencing similar health deterioration.
  - There are elevated levels of Acetylene at IEEE condition 2 and Carbon Dioxide at IEEE Condition 2 or 3.
  - The presence of excess acetylene may be a product of arcing causing overheating on this unit. High levels of carbon dioxide support this observation.
  - In addition, significantly diminished oil interfacial tension corroborates the frequent overheating events. Sludge has likely developed in the oil from particulate formation during arcing and other fault events. This sludge impairs the natural circulation of oil.
  - Moisture levels are on the rise which can lead to diminished dielectric strength over time.
- The current 138 kV MOAB/Ground SW configuration on TR-1 creates a fault in the station to signal the remote end breakers to open; this is a known safety hazard in legacy station designs.



## AEP Transmission Zone M-3 Process Fayette County, WV

### Problem Statement (cont'd):

- Kincaid Substation currently deploys 51 relays, implemented to ensure the adequate protection and operation of the substation.
  - Currently, 45 of the 51 relays (88% of all station relays) are in need of replacement.
  - There are 45 of the electromechanical which have significant limitations with regards to fault data collection and retention. Of these relays, 18 are in the top 90<sup>th</sup> percentile of relays on the AEP system targeted for replacement by PCE.
  - There appears to be little room in the existing control house to accommodate a relay replacement of this suggested magnitude.
- The existing RTU installed at Kincaid is a GE D200MEII/Ethernet and has 2 documented malfunction records

### Boomer 46 kV Station

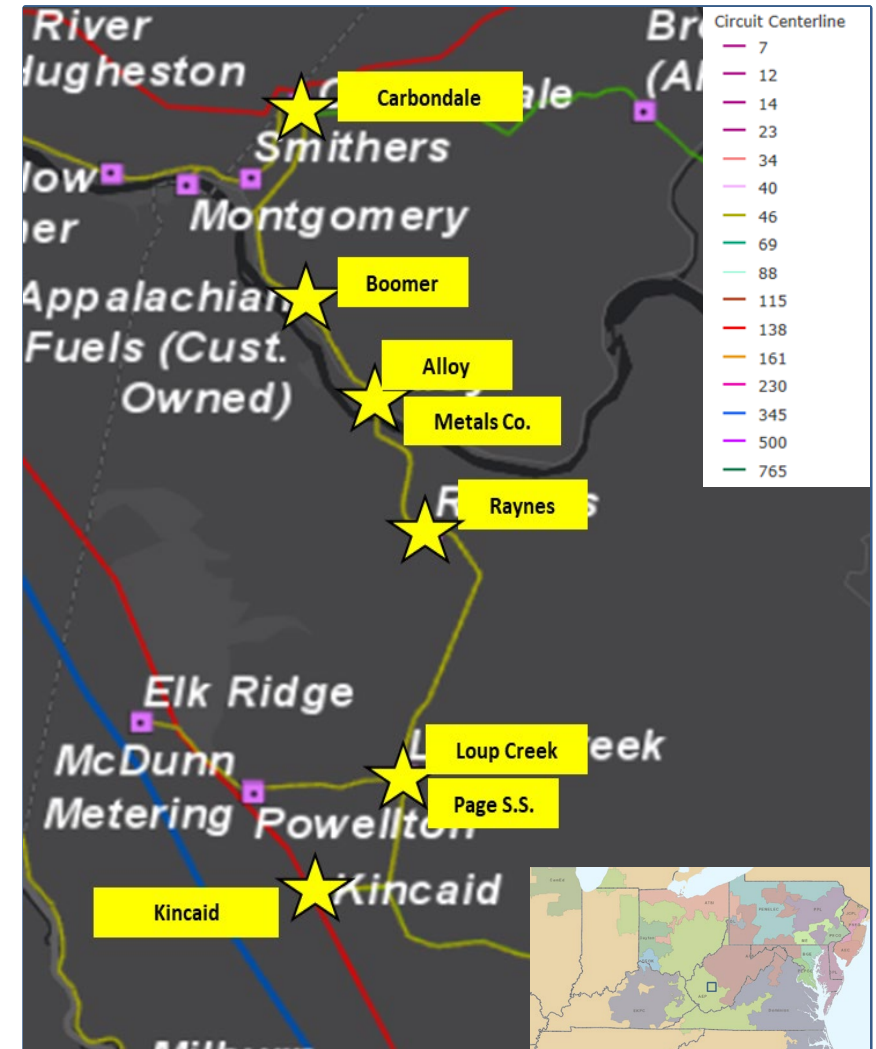
- Customer no longer served from this station, no load at this station.

### Raynes 46 kV Station

- Customer no longer served from this station, no load at this station.

### Alloy 46 kV Station Hard Tap

- Hard taps are difficult to maintain due to required outages or temporary jumper configurations in lieu of a switch.
- Hard taps can also result in extended outages to customers due to the inability to sectionalize faulted facilities.



# AEP Transmission Zone M-3 Process Carbondale – Kincaid Rebuild

**Need Number:** AEP-2019-AP026

**Process Stage:** Solutions Meeting 1/17/2020

**Proposed Solution:**

Rebuild the Carbondale – Kincaid 46 kV lines as a single circuit 46 kV line (~16.3 miles). **Estimated Trans. Cost: \$50.7M**

Retire the Carbondale – Kincaid #1/#2 double circuit 46 kV line. **Estimated Trans. Cost: \$9.1M**

Alloy Station: Install a 2-way switch to address hard tap. **Estimated Trans. Cost: \$0.9M**

Page S.S.: Replace existing switch to accommodate new line. **Estimated Trans. Cost: \$0.3M**

Raynes Meter Station: Remove/retire station. **Estimated Trans. Cost: \$0.3M**

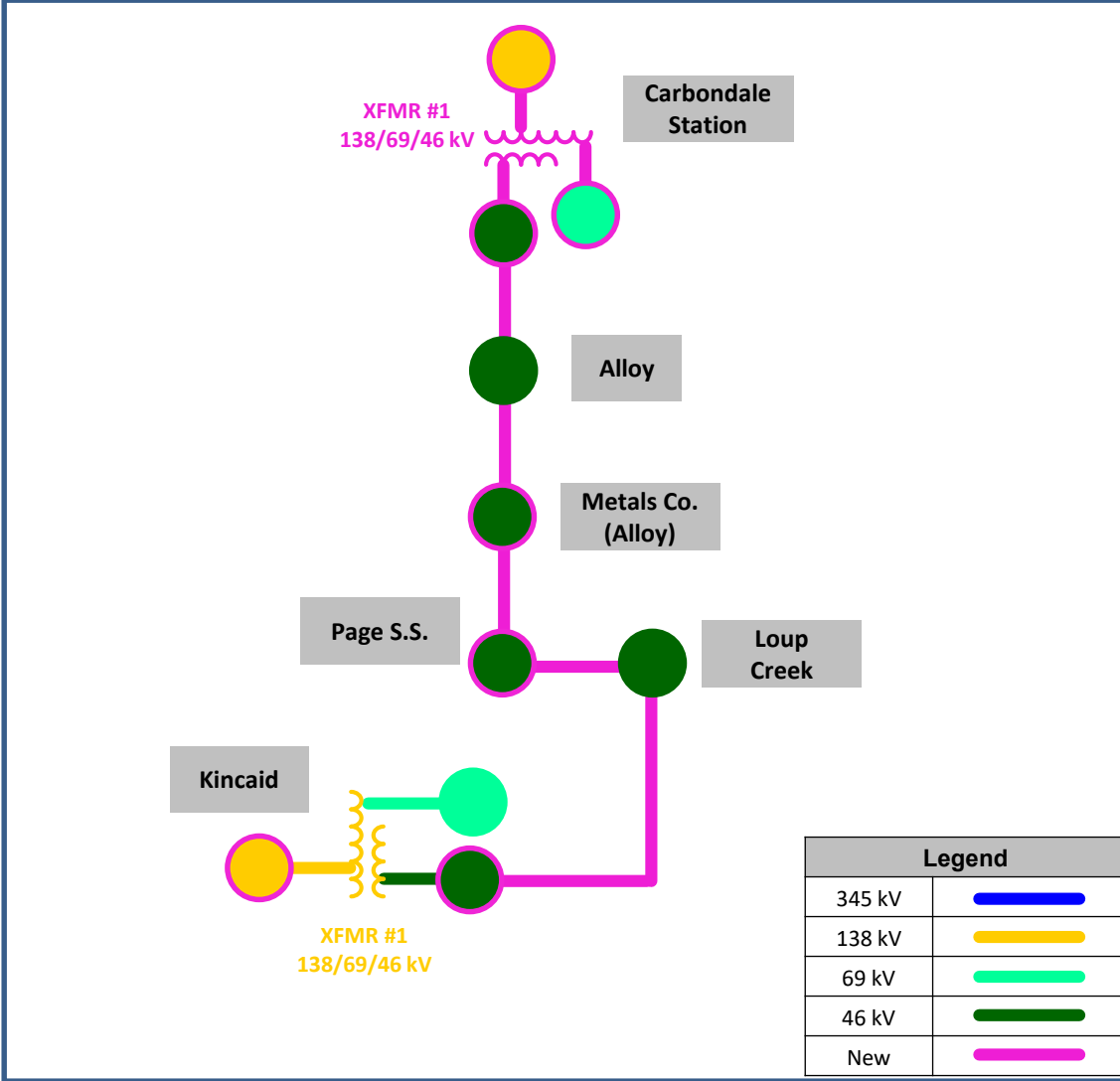
Boomer Station: Remove/retire station. **Estimated Trans. Cost: \$0.1M**

Carbondale Station: Replace existing circuit breakers A and G with two new 69 kV circuit breakers. Replace existing 46 kV circuit breakers B, C and F. Retire 46 kV circuit breaker D. Install two new 138 kV circuit breakers and a high side circuit switcher. Replace existing 138/69/46 kV 115 MVA transformer with a new 138/69/46 kV 130 MVA transformer. 138 kV line work needed to accommodate the station work. **Estimated Trans. Cost: \$11.4M**

Kincaid Station: Replace existing circuit breakers A and B with two new 46 kV circuit breakers. Retire circuit breaker J. Replace existing ground transformer bank with a new ground transformer bank. Install a new high side circuit switcher to replace the existing ground sw. MOAB on the high side of the transformer. **Estimated Trans. Cost: \$3.7M**

**Estimated Total Trans. Cost: \$76.5M**

**Ancillary Benefits:** The single circuit rebuild will eliminate a redundant 46 kV line.



# AEP Transmission Zone M-3 Process Carbondale – Kincaid Rebuild

**Alternatives Considered:**

- Retire the Carbondale – Kincaid #1/#2 double circuit 46 kV line.
- Construct a new in/out 138 kV line (~6 miles) from a cut-in on the Bradley – Kanawha #1 138 kV line, to Alloy Station.
- Convert Alloy Station to 138 kV, install 138 kV XFR, 138 kV switches and bus.
- Convert customer served out of Alloy Station to 138 kV, install new 138 kV transformer, 138 kV switch and bus.
- Construct a new in/out 138 kV line (~0.5 mile) from a cut-in on the Bradley – Kanawha #2 138 kV line, to Elk Ridge Station.
- Convert Elk Ridge station to 138 kV, install 138 kV XFR, 138 kV switches and bus.
- Construct a new in/out 138 kV line (~3 miles) from a cut-in on the Bradley – Kanawha #1 138 kV line, to Powellton then Loup Creek stations.
- Convert Powellton to 138 kV, install 138 kV XFR, 138 kV switches and bus.
- Convert Loup Creek to 138 kV, install 138 kV XFR, 138 kV switches and bus.
- Convert customer out of Page S.S to 138 kV, install 138 kV XFR, 138 kV switches and bus.

Raynes Meter Station: Remove/retire station.  
Boomer Station: Remove/retire station.

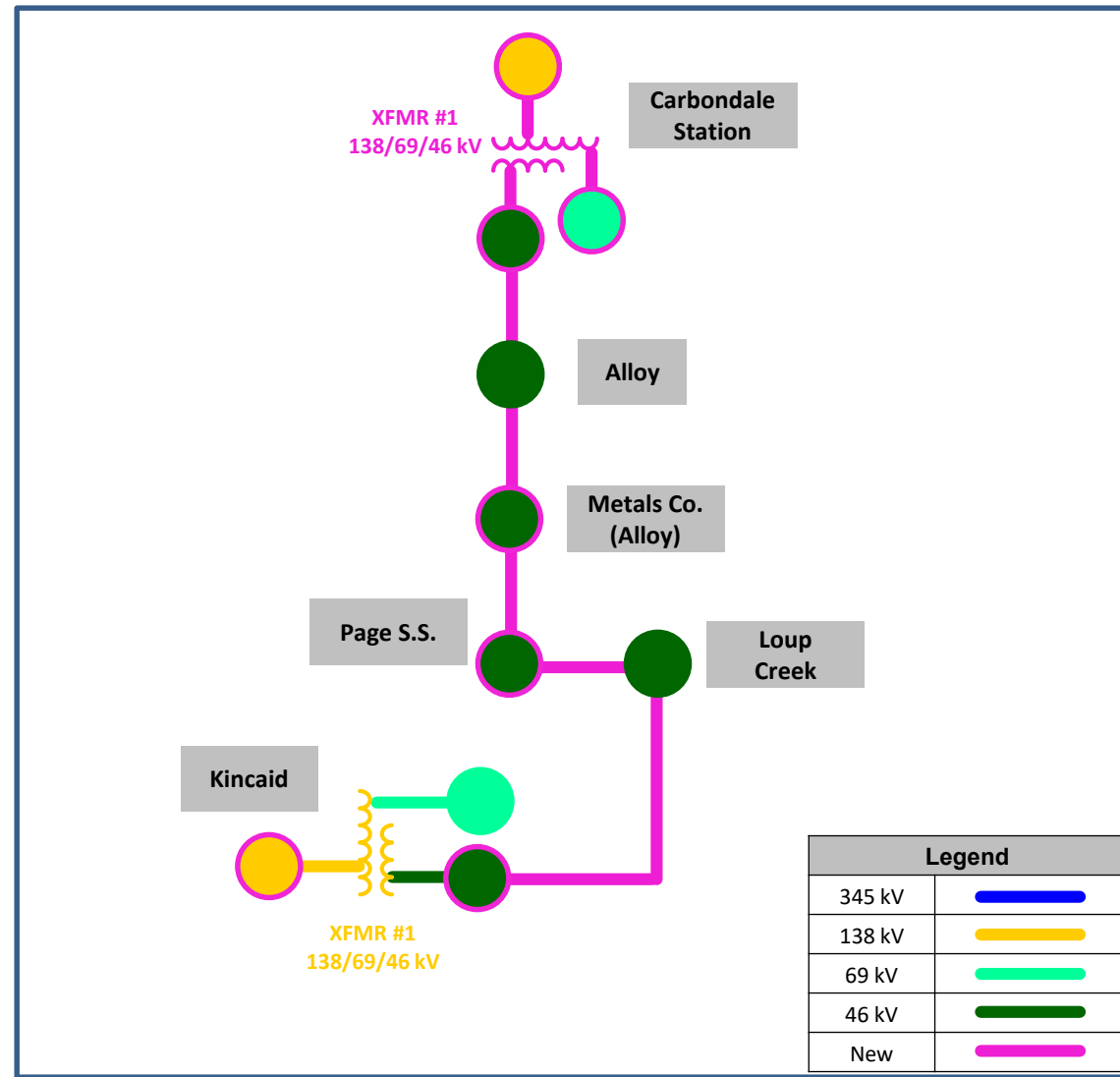
**Carbondale Station:** Replace existing circuit breakers A and G with two new 69 kV circuit breakers. Replace existing 46 kV circuit breakers B and F. Retire 46 kV circuit breaker C and D. Install two new 138 kV circuit breakers and a high side circuit switcher. Replace existing 138/69/46 kV 115 MVA transformer with a new 138/69/46 kV 130 MVA transformer. 138 kV line work needed to accommodate the station work.

**Kincaid Station:** Replace existing circuit breaker A with one new 46 kV circuit breakers. Retire circuit breaker J and B. Replace existing ground transformer bank with a new ground transformer bank. Install a new high side circuit switcher to replace the existing ground sw. MOAB on the high side of the transformer.

**Estimated total cost: \$80.1M**

**Projected In-Service: 11/1/2022**

**Project Status: Scoping**



**Need Number:** AEP-2019-AP034

**Process Stage:** Solutions Meeting 1/17/2020

**Previously Presented:**

Needs Meeting 9/25/2019

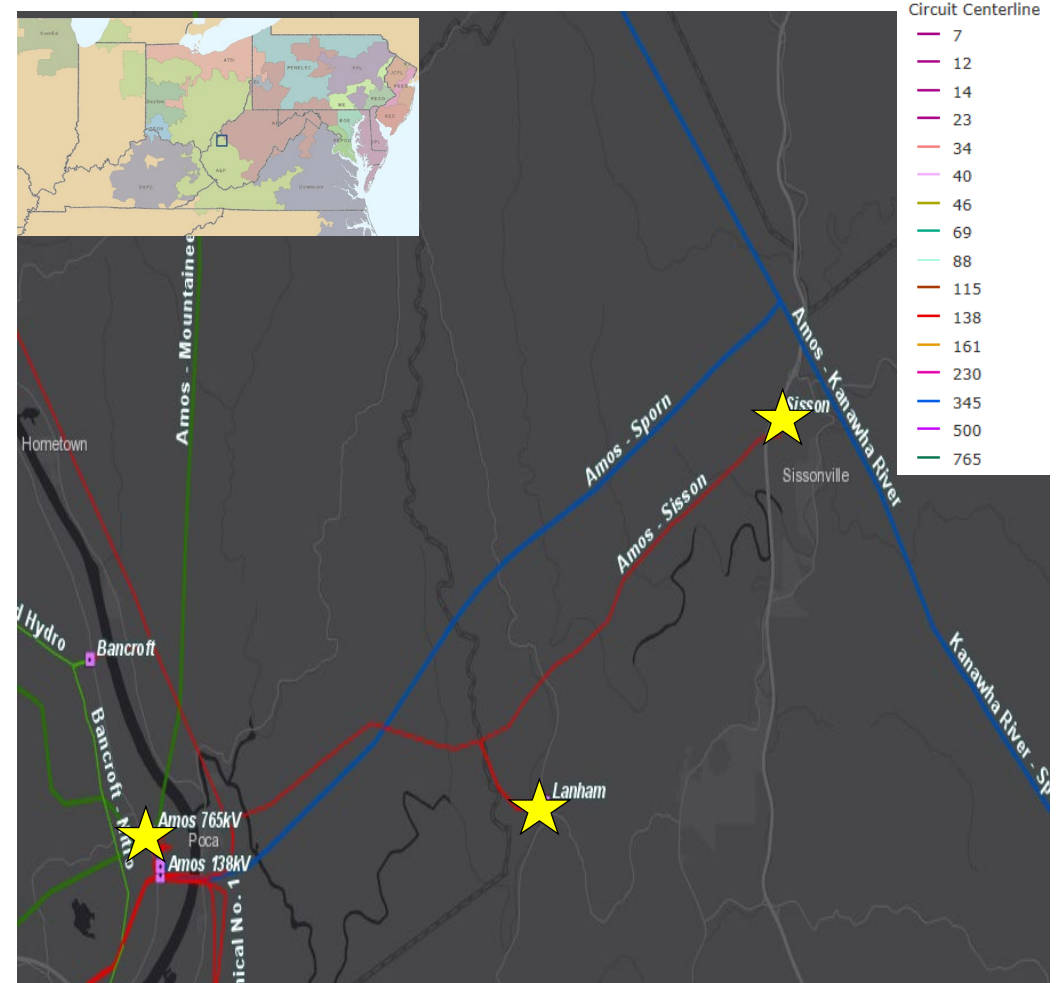
**Supplemental Project Driver:** Equipment Condition/Performance/Risk

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

**Problem Statement:**

The Amos – Sisson 138 kV line is a 16 mile long radial line and maintenance cannot be performed due to length of outages required. Approximately 18 MVA is served out of Lanham and 25 MVA is served out of Sisson during winter peak conditions and will be dropped for outages on this circuit. Customers served out of the area are concerned and are requesting that we take necessary steps to ensure reliability.

**Model:** 2024 RTEP





**Need Number:** AEP-2019-AP035

**Process Stage:** Solutions Meeting 1/17/2020

**Previously Presented:** Needs Meeting 9/25/2019

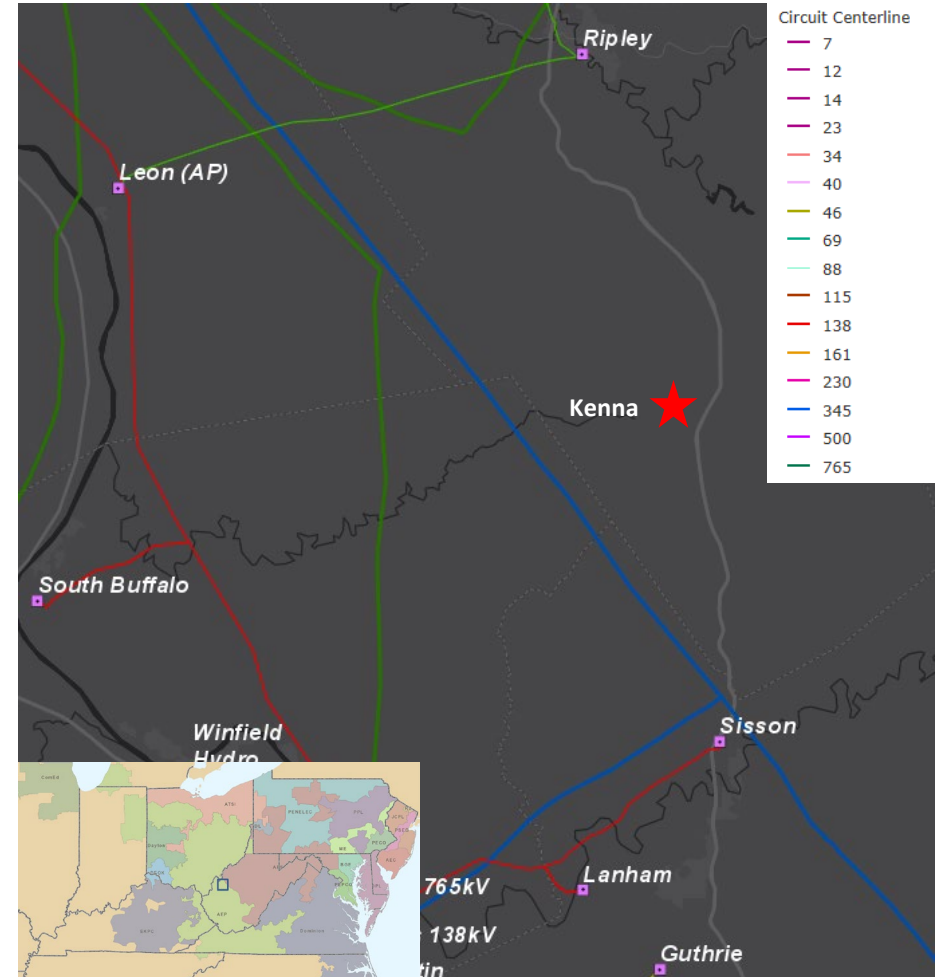
**Supplemental Project Driver:** Customer Service

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

**Problem Statement:**

APCO Distribution has requested a new distribution station located in Kenna, West Virginia. Summer projected load 11 MVA. Winter projected load 18 MVA.

**Model:** 2024 RTEP



# AEP Transmission Zone M-3 Process Kenna Project

**Need Number:** AEP-2019-AP034, AEP-2019-AP035

**Process Stage:** Solutions Meeting 1/17/2020

**Proposed Solution:**

Construct a new 138 kV line (~11.5 mi.) from Kenna to the existing Ripley 138 kV station.

**Estimated Trans. Cost: \$26.5M**

Construct a new 138 kV line (~10 mi.) from Kenna to the existing Sisson 138 kV station.

**Estimated Trans. Cost: \$25.5M**

Install three new 138 kV circuit breakers at Sisson and perform remote end relaying work at Amos Station. **Estimated Trans. Cost: \$4.8M**

Install 138 kV bus and two new 138 kV circuit breakers at Kenna. **Estimated Trans. Cost: \$3.8M**

Install one new 138 kV circuit breaker at Ripley. **Estimated Trans. Cost: \$1.1M**

**Estimated Total Trans. Cost: \$61.7M**

**Alternatives Considered:**

Construct a new in/out double circuit line from Ripley to Kenna (11.5 miles).

Install two 138 kV circuit breakers at Ripley.

Rebuild the existing Chemical – Guthrie 46 kV line (~6 miles) to 138 kV and retire the existing Capitol Hill to Guthrie 46 kV line.

Convert Guthrie Station to 138 kV by installing a new 138 kV bus and transformer.

Construct a new 138 kV line from Guthrie to Sisson (~8 miles).

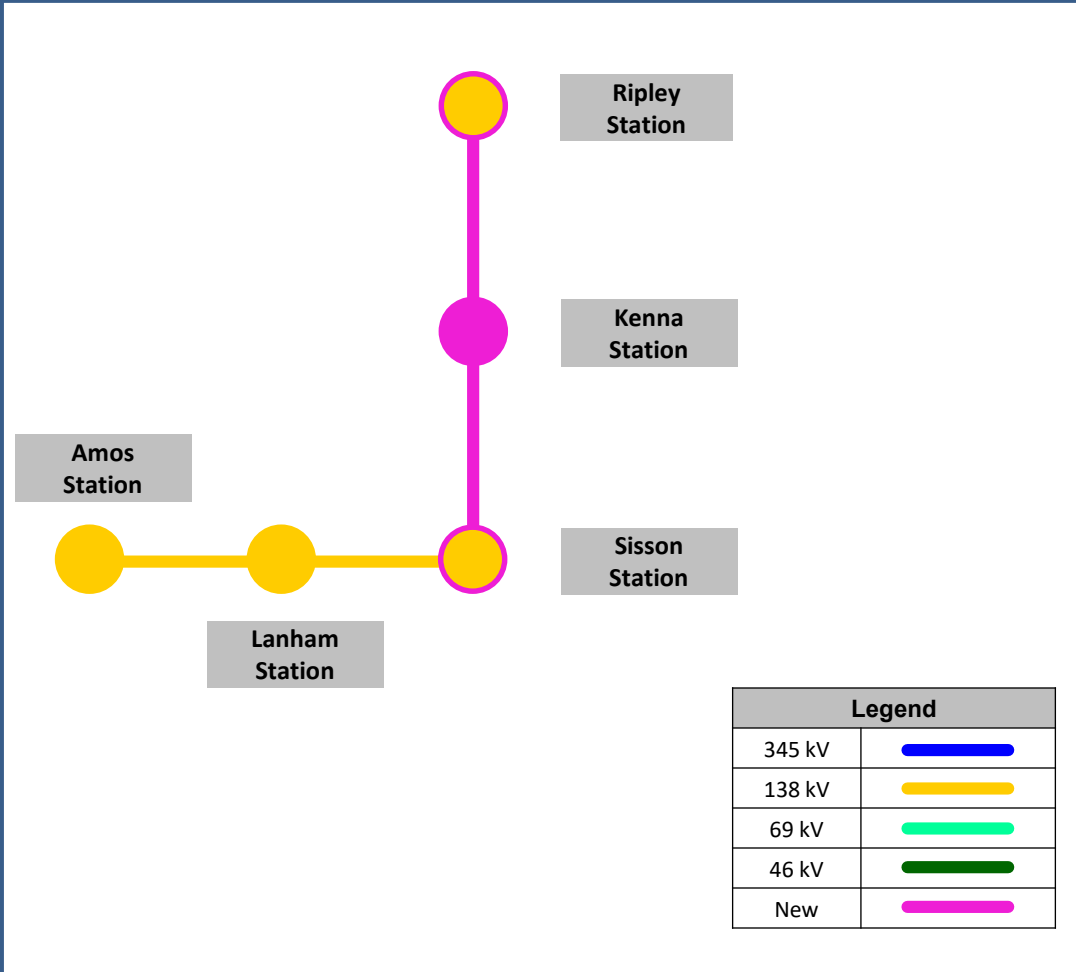
Install three new 138 kV circuit breakers at Sisson.

Install one new 138 kV circuit breaker at Chemical.

**Total Estimated Trans. Cost: \$79.0M**

**Projected In-Service:** 11/1/2022

**Project Status:** Scoping



# AEP Transmission Zone M-3 Process Floyd County, VA

**Need Number:** AEP-2018-AP020

**Process Stage:** Solutions Meeting 1/17/2020

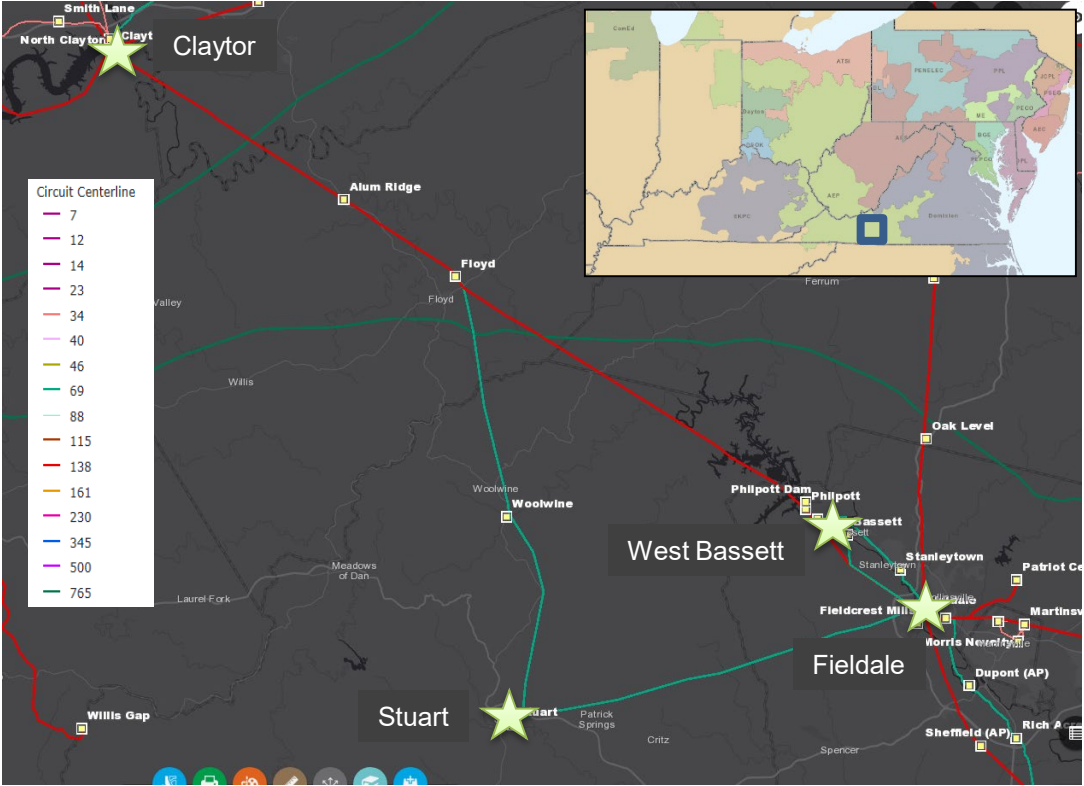
**Previously Presented:** Needs Meeting(s) 1/11/2019

**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 Claytor – West Bassett 138 kV circuit (38.1 mi.) consists primarily of 1948 vintage wood pole structures with 556 ACSR overhead conductor and currently has 255 open conditions on 126 unique structures including rot top, rot heart, broken insulators and woodpecker/insect damage. From 2015-2018, a total of 7 permanent outages resulted in 167,488 customer minutes of interruption.
- The Fieldale – West Bassett 138 kV circuit (6.5 mi.) consists primarily of 1948 vintage wood pole structures with 556 ACSR overhead conductor and currently has 48 open conditions on 29 unique structures which is 71% of the circuit. Conditions include rot top, rot heart and woodpecker damage.
- Fieldale – Stuart 69 kV circuit (19.2 mi.) consists primarily of 1939 vintage wood pole structures and currently has 178 open conditions including broken cross-arms, broken conductor strands, damaged shield wire and woodpecker damage. From 2015-2018, a total of 6 permanent outages and 12 momentary outages were observed.
- Fieldale – West Bassett #1 69 kV circuit (7.1 mi.) consists primarily of 1926 vintage wood pole structures with 4/0 ACSR and 556 ACSR overhead conductor and currently has 23 open conditions on 21 unique structures including rot top, insect damage, broken ground wire, leaning in-line pole and woodpecker damage.
- Fieldale – West Bassett #2 69 kV circuit (6.9 mi.) consists primarily of 1962 vintage wood pole structures with 336 ACSR and 556 ACSR overhead conductor and currently has 20 open conditions on 16 unique structures including rot top, broken cross-arms, insect damage, loose knee brace and woodpecker damage.



# AEP Transmission Zone M-3 Process Floyd County, VA

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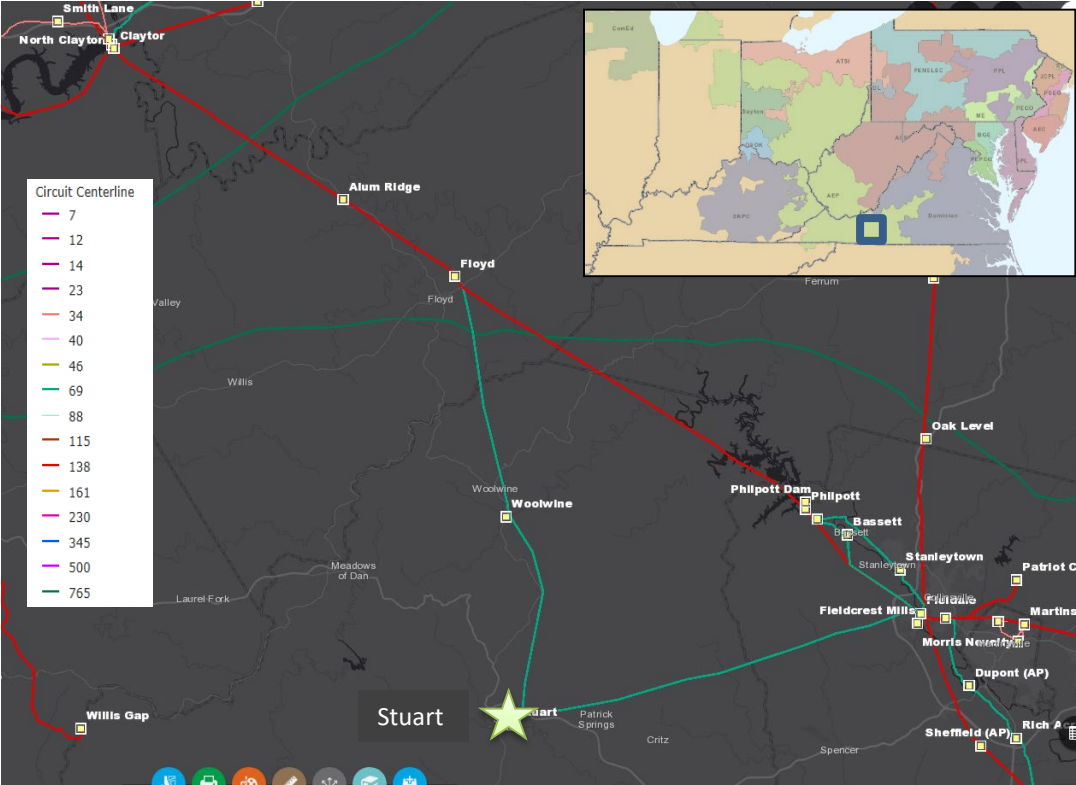
## Problem Statement:

### Stuart Station

The 69kV CBs D and E are oil filled breakers without secondary oil containment. Oil filled circuit breakers have much more maintenance required due to oil handling that their modern, SF6 counterparts do not require. CBs D and E are 2 of 15 in the FKA-72.5-19000-1 model family remaining on the AEP system. This scarcity of sister units makes finding spare parts for these units unviable, and these models are no longer vendor supported. A malfunction report from 2005 documented that CB D was slow to trip on a lightning fault on the Fieldale-Stuart circuit and that CB F at Floyd cleared it; this report also mentioned that this was the second such occurrence of a low trip for CB D.

The 69kV CS AA is an S&C 2030-69 model. The S&C 2030 circuit switcher model family has no gas monitor and sister units on the AEP System have experienced malfunctions since 1999; the major ones include gas loss, interrupter failures, and operating mechanism failures.

Stuart Substation deploys 48 relays, implemented to ensure the adequate protection and operation of the substation. Currently 45 of the 48 relays (94% of all station relays) are in need of replacement. There are 39 electromechanical type and 3 static type relays with significant limitations in regards to spare part availability in addition to a lack of vendor support and no capability for fault data collection and retention.



# AEP Transmission Zone M-3 Process Floyd County, VA

Continued from previous slide...

## Problem Statement:

### West Basset Station

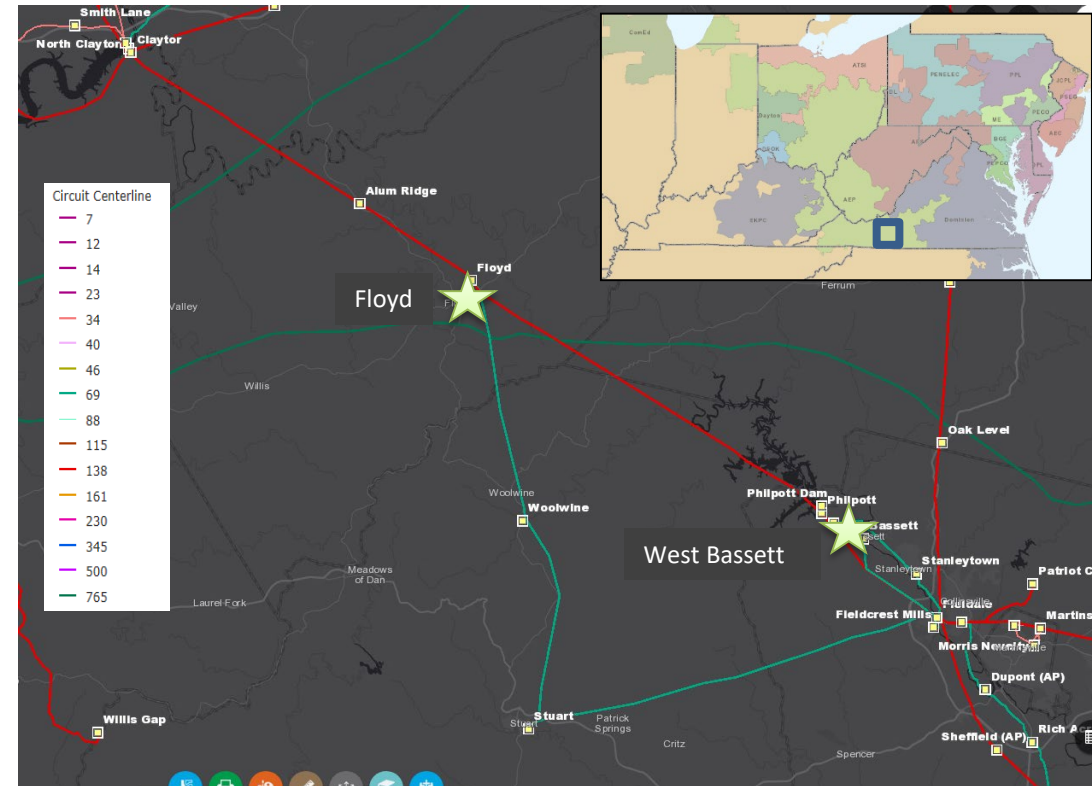
The 138 kV CB A is a GE FK oil type breaker that has seen 77 fault operations over its in-service life. It is one of only 13 remaining of its model type (FK-439-5000) on the entire AEP system; spare parts availability is a major concern. The 72.5 kV CBs J, K, and L are GE FK oil type breakers as well with CB L seeing 40 fault operations over its in-service life. These are three of only 27 remaining of their model type (FK-72.5-27000-1) on the entire AEP system; spare parts availability is a major concern. In addition, these four oil filled breakers have much more maintenance required due to their oil handling that their modern SF6 counterparts do not require.

The 138/69/34 kV transformer #1 has an upward trending of oil moisture content resulting in decreasing oil dielectric strength. Increasing moisture content is a result of water ingress and/or break down of paper insulation of TF windings. The moisture content has since decreased without improvement to the dielectric strength. Short circuit strength breakdown caused by the amount of thermal through fault events, mostly in excess of 700°C, has led to major gassing of the unit and carbonization of the insulating paper.

West Bassett Substation currently deploys 62 relays, implemented to ensure the adequate protection and operation of the substation. Currently, 55 of the 62 relays (89% of all station relays) are in need of replacement. There are 53 electromechanical and 2 static type with significant limitations in regards to spare part availability and fault data collection and retention in addition to a lack of vendor support.

### Floyd Station

The existing MOAB ground switch design on the high side of transformer #2 needs to be replaced with a circuit switcher to improve the protection scheme and safety of personnel in the station. AEP has been strategically targeting ground switch MOABs for replacement due to the burden that these devices place on Transmission circuit breakers for clearing Distribution Transformer faults.





# AEP Transmission Zone M-3 Process Floyd County, VA

**Need Number:** AEP-2018-AP016

**Process Stage:** Solutions Meeting 1/17/2020

**Previously Presented:** Needs Meeting(s) 1/11/2019

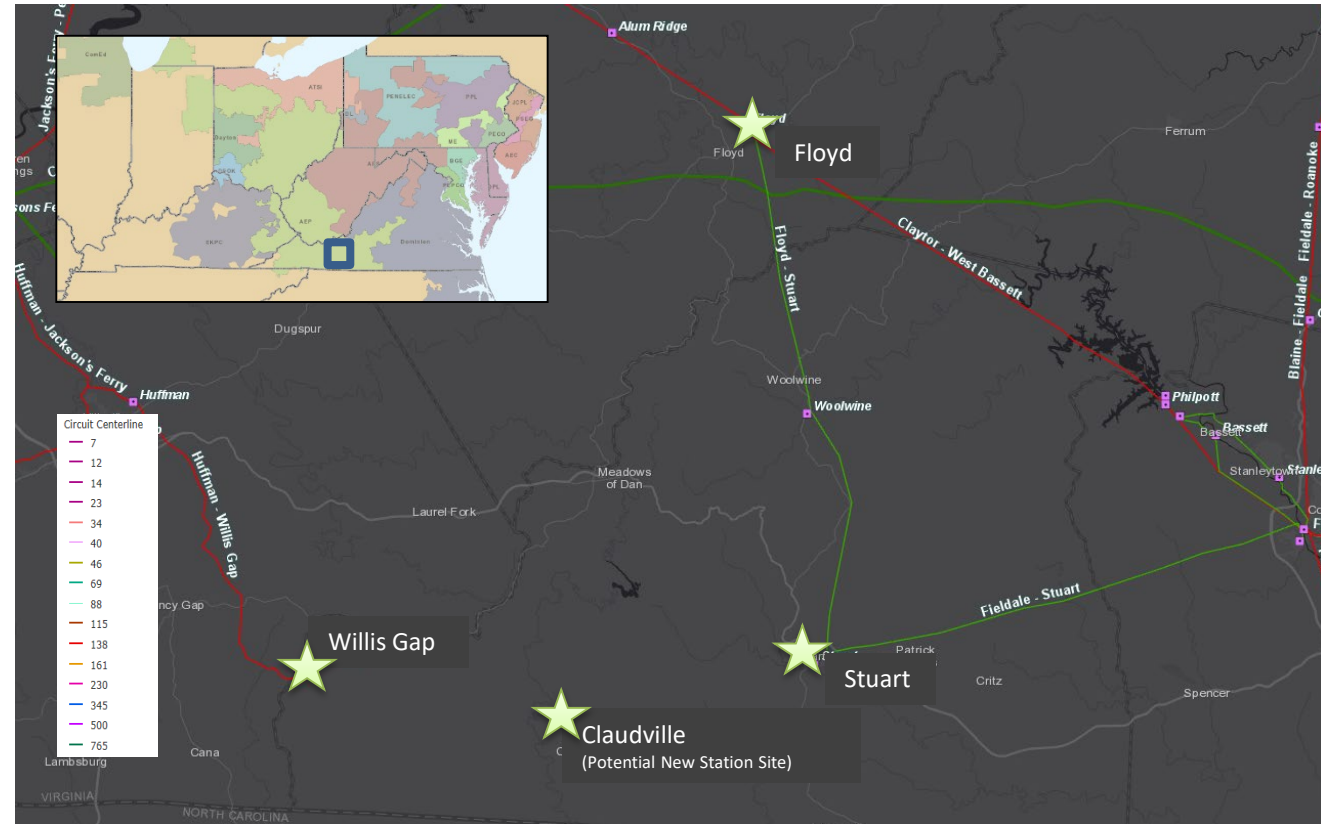
**Supplemental Project Driver:** Operational Flexibility and Efficiency

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

### Problem Statement:

There is approximately a total of 230 MVA of load being served on the 138 kV and 69 kV networks throughout Carroll County, Wythe County, Grayson County and Galax City. Approximately 120 MVA is served off of the 138 kV line from Jacksons Ferry – Huffman – Wythe. The 69 kV network around Cliffview/Galax/Fries serves approximately 110 MVA. Under N-1-1 scenarios involving the 138 kV sources there is the potential to drop all 230 MVA of load.

Originally, AEP proposed supplemental project S1295 to address this concern. Based on recent needs identified in Floyd County VA, AEP believes a more holistic solution exists to resolve these needs collectively. AEP has recommended cancelation of supplemental project S1295 (Presented 5/31/2017 SRTEAC).



# AEP Transmission Zone M-3 Process Floyd County, VA

**Need Number:** AEP-2019-AP036

**Process Stage:** Solutions Meeting 1/17/2020

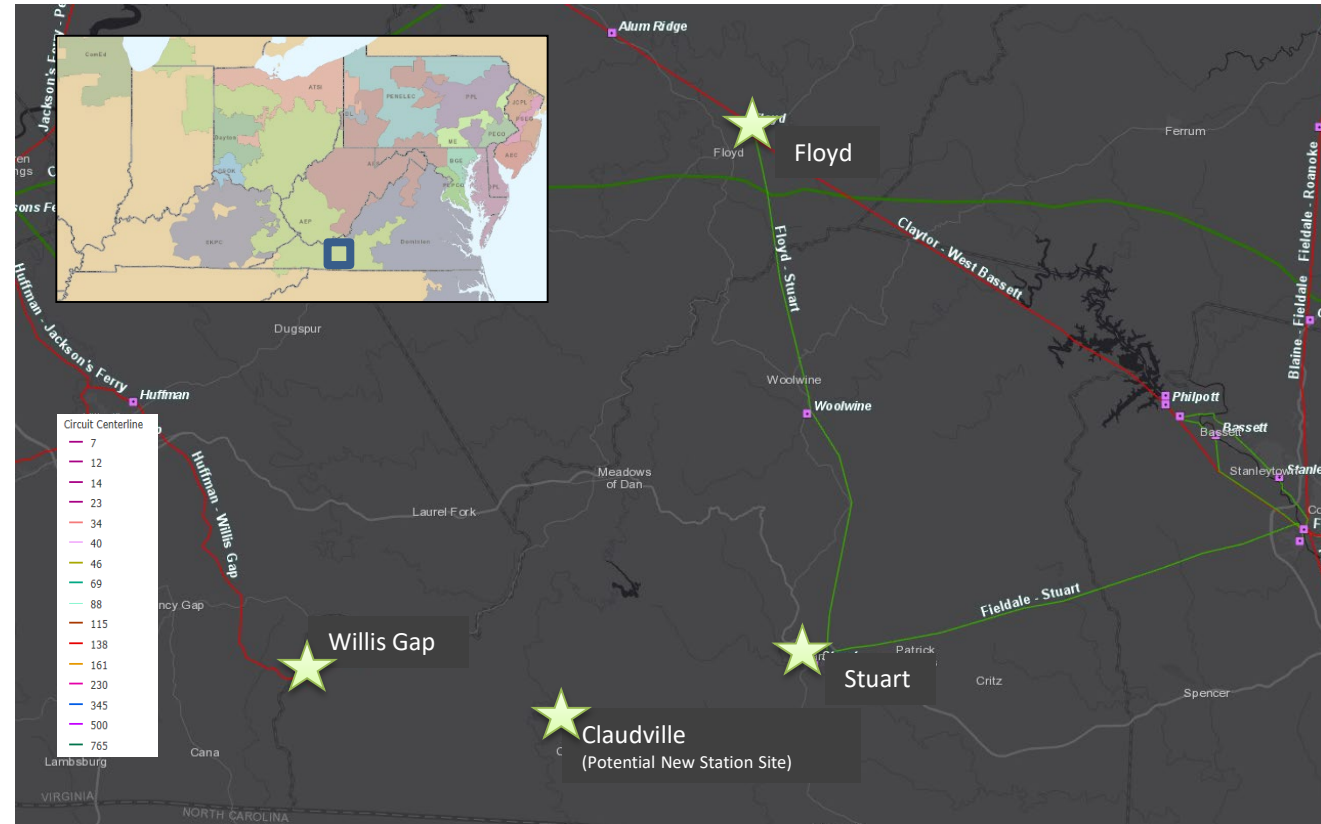
**Previously Presented:** Needs Meeting(s) 9/25/2019

**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 Floyd-Stuart 69 kV circuit (21.0 mi.) was originally built in 1939 consisting of wood pole structures and predominately 4/0 ACSR 4/1 overhead conductor. 88% of the wood poles are 1939 vintage. Core drilling shows significant loss of material in wood poles due to decay and woodpeckers. The overhead conductor and shield wires are greater than 65 years old, exceeding the recommended lifespan of these components. Between January 2014 and March 2019, 9 momentary and 2 permanent outages have occurred on this circuit. There are 52 open conditions mainly from woodpecker and wood rot.



# AEP Transmission Zone M-3 Process Floyd County, VA

**Need Number:** AEP-2019-AP037

**Process Stage:** Solutions Meeting 1/17/2020

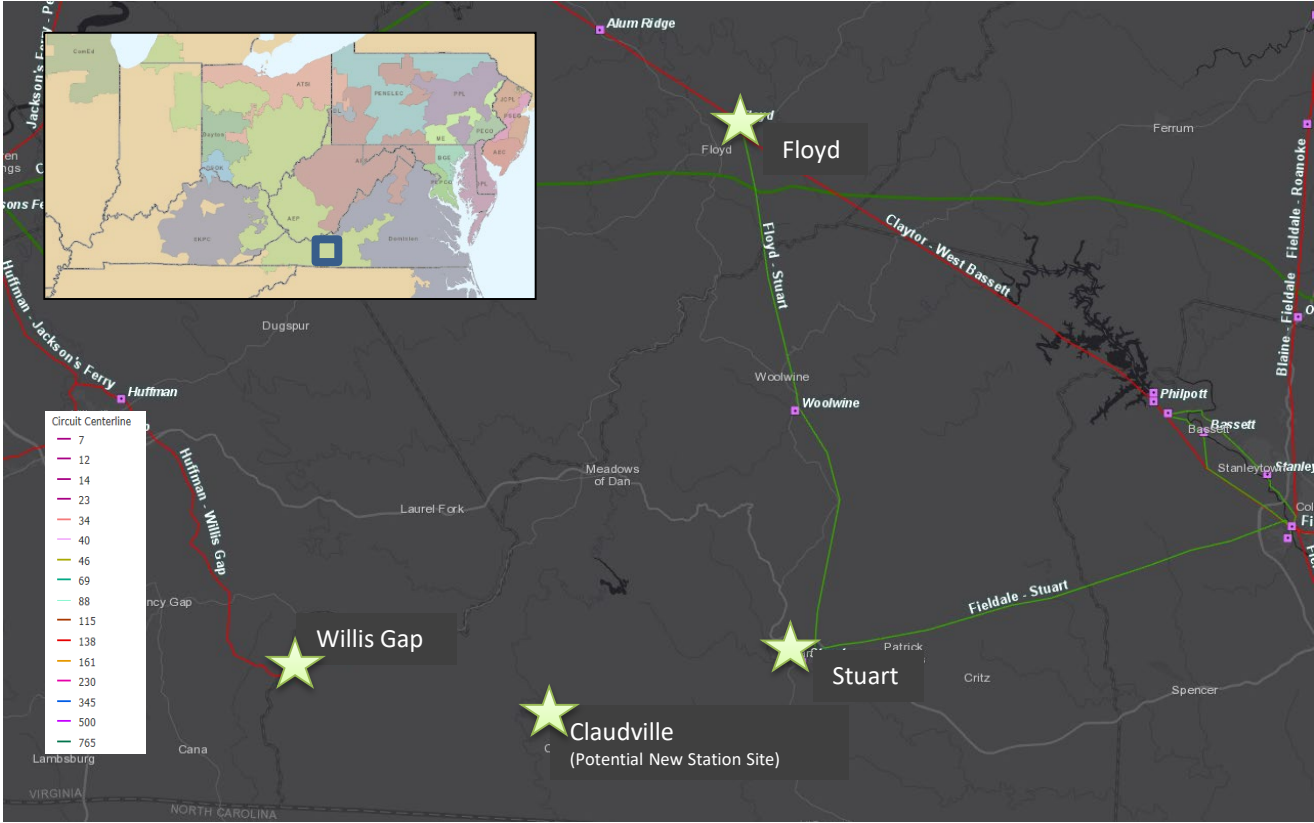
**Previously Presented:** Needs Meeting(s) 9/25/2019

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

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

**Problem Statement:**

- Willis Gap station is served via a radial 14.5 mile, 138 kV line from Huffman Station and serves approximately 25 MVA of peak load.



# AEP Transmission Zone M-3 Process Floyd County, VA

**Need Number:** AEP-2019-AP038

**Process Stage:** Solutions Meeting 1/17/2020

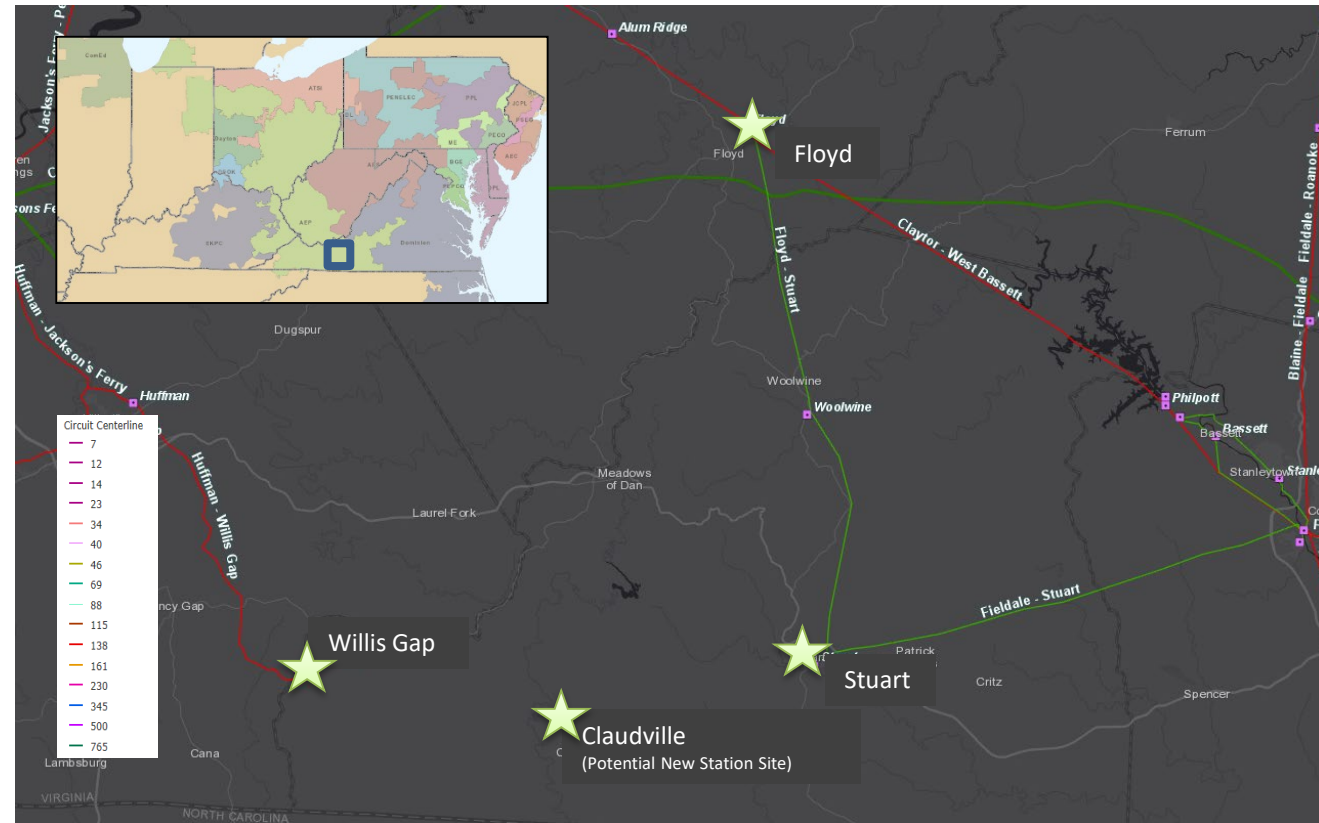
**Previously Presented:** Needs Meeting(s) 9/25/2019

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

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

## Problem Statement:

- Distribution has requested the need for a new Claudville Station located between the existing Willis Gap and Stuart stations in order to decrease the exposure to lengthy 34.5 kV distribution circuits fed from Willis Gap and Stuart stations. A new distribution station source will allow for the opportunity to establish two new 34.5 kV feeders by splitting up the Willis Gap/Ararat (174 line miles) and the Stuart/Carroll (267 line miles) distribution feeders. The Willis Gap 138/34.5 kV #1 transformer is projected to be loaded to 28.4 MVA, or 101% of its 28.0 MVA capability by winter 2022-23. The new Claudville station will alleviate this projected overload.



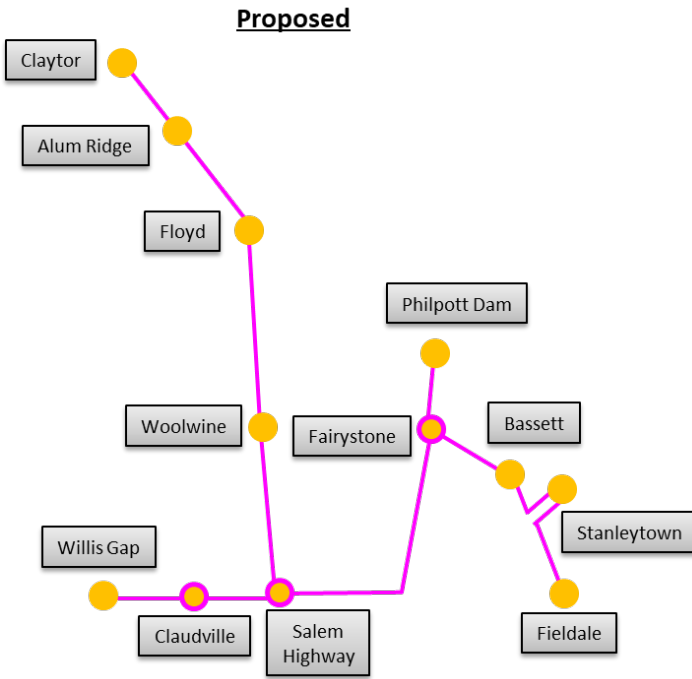
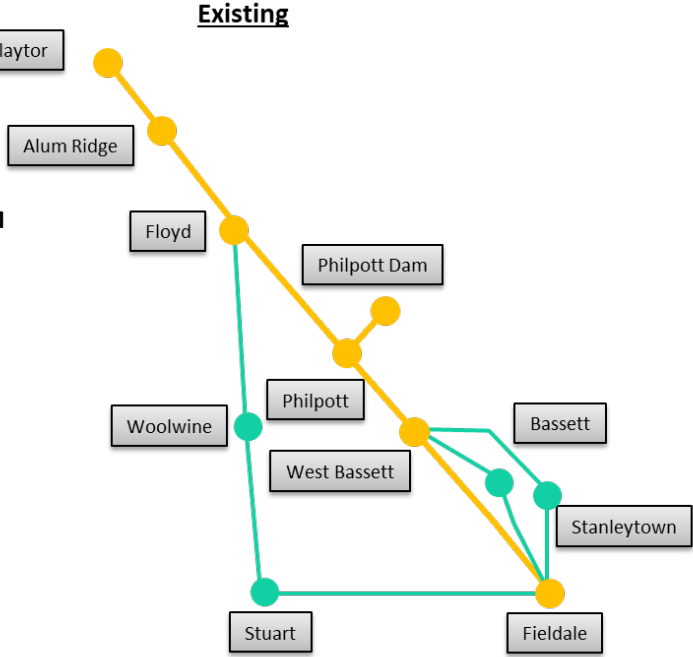
# AEP Transmission Zone M-3 Process Floyd County, VA

**Need Number(s):** AEP-2018-AP016, AEP-2018-AP020, AEP-2019-AP036, AEP-2019-AP037, AEP-2019-AP038

**Process Stage:** Solutions Meeting 1/17/2020

**Proposed Solution:**

- Construct ~12.5 miles 138 kV line from Alum Ridge to Claytor. **Estimated Cost: \$34.3M**
- Construct ~6.5 miles 138 kV line from Alum Ridge to Floyd. **Estimated Cost: \$20.6M**
- Construct ~7 miles of 138 kV line from Fieldale-Fairystone. **Estimated Cost: \$17.6M**
- Construct ~1.25 miles of double circuit 138 kV line to connect Stanleytown. **Estimated Cost: \$5.3M**
- Construct 0.07 miles of 138 kV line from Bassett Switch-Bassett. **Estimated Cost: \$1.5M**
- Construct ~1.2 miles of 138 kV line from Philpott Dam-Fairystone. **Estimated Cost: \$3.6M**
- Construct ~22 miles of 138 kV line from Salem Highway to Willis Gap. **Estimated Cost: \$65.0M**
- Construct ~21 miles of 138 kV line from Salem Highway-Fairystone. **Estimated Cost: \$60.0M**
- Construct ~11 miles of 138 kV line from Floyd-Woolwine. **Estimated Cost: \$29.2M**
- Construct ~10 miles of 138 kV line from Salem Highway to Woolwine. **Estimated Cost: \$29.6M**
- Remove ~11 miles of 69 kV line from Floyd-Woolwine. **Estimated Cost: \$1.3M**
- Remove ~10 miles of 69 kV line from Stuart-Woolwine. **Estimated Cost: \$4.8M**
- Remove ~12.2 miles of 138 kV line from Alum Ridge-Claytor. **Estimated Cost: \$1.2M**
- Remove ~6.25 miles of 138 kV line from Alum Ridge-Floyd. **Estimated Cost: \$0.8M**
- Remove ~19 miles of 138 kV line from Floyd-West Bassett. **Estimated Cost: \$12.1M**
- Remove ~6.4 miles of 138 kV line from Fieldale-West Bassett. **Estimated Cost: \$2.9M**
- Remove ~0.34 miles of 138 kV line from Philpott SS-Philpott. **Estimated Cost: \$0.1M**
- Remove ~19 miles of 69 kV line from Fieldale to Stuart. **Estimated Cost: \$8.3M**
- Remove ~7.1 miles of 69 kV line from Fieldale to West Bassett. **Estimated Cost: \$10.1M**
- Remove ~6.8 miles of 69 kV line from Fieldale to West Bassett. **Estimated Cost: \$9.5M**



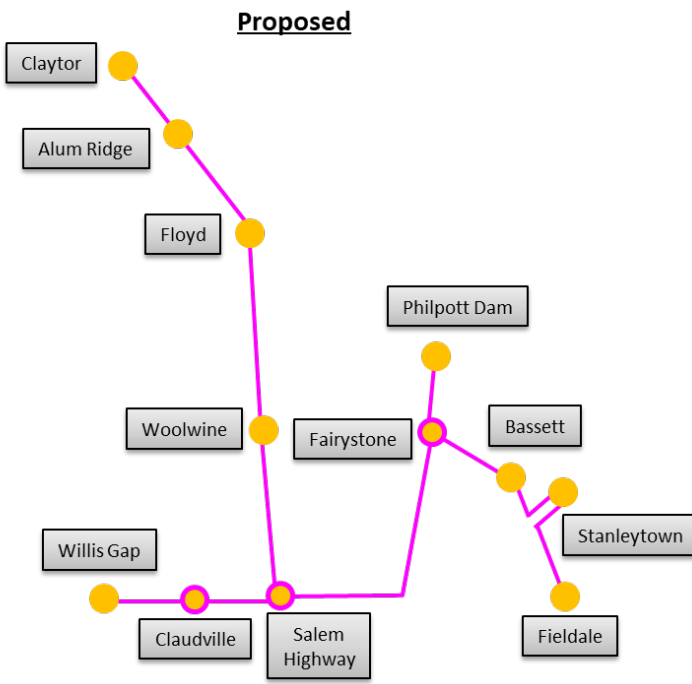
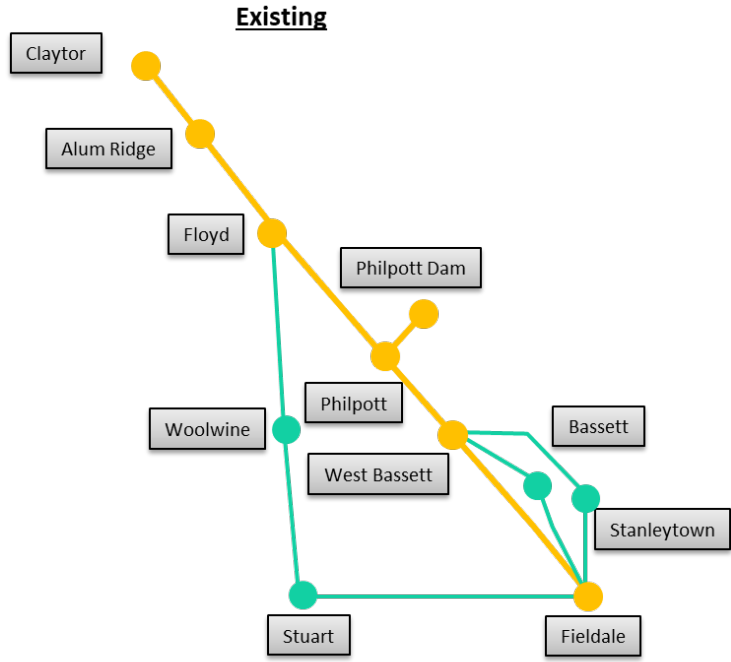
Legend	
500 kV	<span style="color: red;">—</span>
345 kV	<span style="color: blue;">—</span>
138 kV	<span style="color: yellow;">—</span>
69 kV	<span style="color: green;">—</span>
34.5 kV	<span style="color: red;">—</span>
23 kV	<span style="color: brown;">—</span>
New	<span style="color: purple;">—</span>



# AEP Transmission Zone M-3 Process Floyd County, VA

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- At Floyd station, install 2-138 kV circuit breakers (3000 A, 40 kA). Install high-side circuit switcher on T2 (3000A, 40 kA). Station expansion to accommodate new equipment and DICM. Install 138 kV line relaying, CCVT's, breaker controls, bus differential protection, transformer #2 protection. **Estimated Cost: \$6.0M**
- At Fieldale station, retire 69 kV CB G, D and C. Install CCVTs and arresters on 138 kV West Bassett Line. **Estimated Cost: \$0.7M**
- At Bassett switch, install 138 kV Switch with 2-138 kV MOABs. **Estimated Cost: \$0.5M**
- At Bassett station, convert station from 69 kV to 138 kV. Install 138/12 kV transformer with high-side circuit switcher, transclosure and associated distribution feeders. **Estimated Cost: \$0M**
- At Claytor station, install line relaying. Remove wavetrap, replace 1590 AAC risers. **Estimated Cost: \$0.9M**
- Retire Philpott 138 kV switch structure. **Estimated Cost: \$0.3M**
- At Willis Gap station, install 2-138 kV MOABs. Terminate new Salem Highway-Willis Gap 138 kV line. **Estimated Cost: \$0M**
- At Woolwine station, convert station from 69 kV to 138 kV. Retire/remove 69 kV switch structure, 69 kV MOABs, 69/34.5 kV transformer. Install 138 kV 3-way switch structure with MOABs, 138/34.5 kV transformer with high-side circuit switcher. **Estimated Cost: \$0M**
- At Salem Highway station, establish new 138 kV station replacing Stuart Station. Install 138 kV 5-breaker ring bus, 138/34.5 kV & 138/12 kV transformers with high-side circuit switchers. Terminate Huffman, Floyd and Fairystone 138 kV circuits. **Estimated Cost: \$0M**
- At Stuart station, retire and remove all existing equipment and control house. **Estimated Cost: \$0M**
- At Stanleytown station, convert station from 69 kV to 138 kV. Retire/remove 69 kV switch structure, 69 kV MOABs, 69/12 kV transformer. Install 138 kV 3-way switch structure with MOABs, 138/12 kV transformer with high-side circuit switcher. **Estimated Cost: \$0M**



Legend	
500 kV	<span style="color: red;">—</span>
345 kV	<span style="color: blue;">—</span>
138 kV	<span style="color: orange;">—</span>
69 kV	<span style="color: green;">—</span>
34.5 kV	<span style="color: red;">—</span>
23 kV	<span style="color: brown;">—</span>
New	<span style="color: purple;">—</span>



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**Alternatives Considered:**

Address the asset renewal needs by rebuilding all the transmission lines of concern on existing centerline and replacing the identified station equipment in need of replacement. This would include rebuilding the following lines totaling approximately 99 miles: Claytor-Fielddale 138 kV (~45 mi.), Floyd-Stuart 69 kV (~21 mi.), Fielddale-Stuart 69 kV (~19 mi.), Fielddale-West Bassett 69 kV No. 1 (~7 mi.), Fielddale-West Bassett 69 kV No. 2 (~7 mi.). The station asset replacements include: Stuart (2-69 kV CBs, 69 kV circuit switcher and identified relays) and West Basset (1-138 kV CB, 3-69 kV CBs, 138/69/34 kV transformer #1 and identified relays). In addition, a new 22 mile 138 kV line would be required between Willis Gap, Claudville, and Stuart along with a 138/69 kV transformer at Stuart.

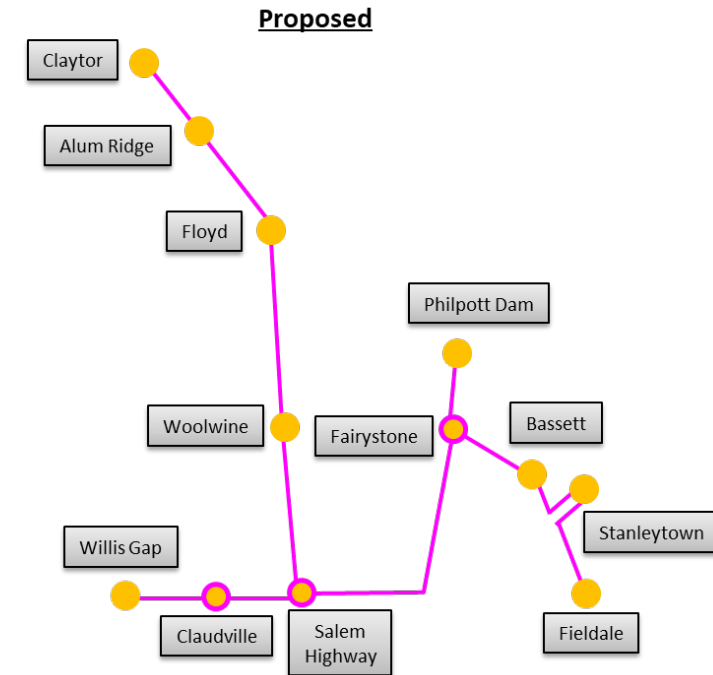
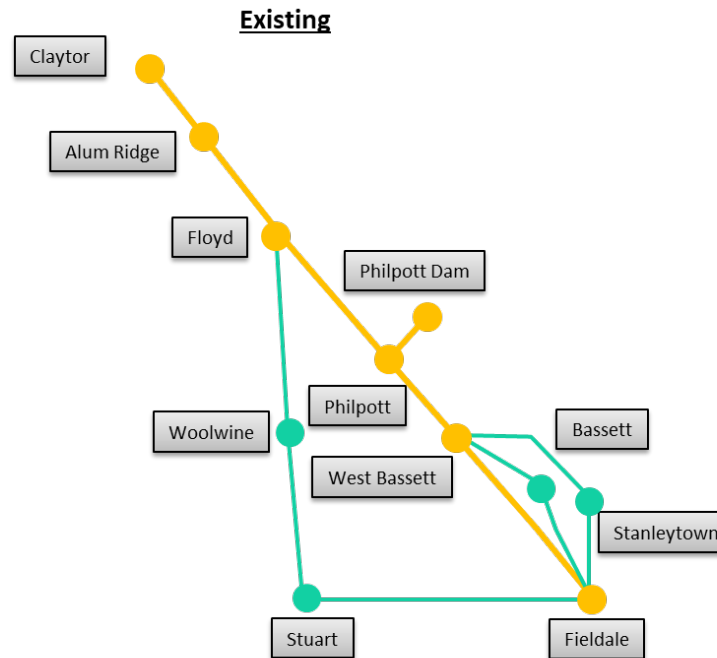
While this alternate plan would address the identified aging infrastructure, it would not provide the additional benefits of the preferred plan, which include: conversion of the local 69 kV system to a more robust and reliable 138 kV system, allow for the retirement of ~18 miles of 138 kV line and ~7 miles of 69 kV line, provide more reliable sectionalizing with ring bus configurations at Stuart (Salem Highway) and West Bassett (Fairystone).

**Estimated Cost: \$375 M**

**Projected In-Service: 10/31/2027**

**Project Status: Scoping**

# AEP Transmission Zone M-3 Process Floyd County, VA



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

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**Need Number:** AEP-2018-AP010

**Process Stage:** Solutions Meeting 1/17/2020

**Previously Presented:** Needs Meeting 11/29/18

**Supplemental Project Driver:**

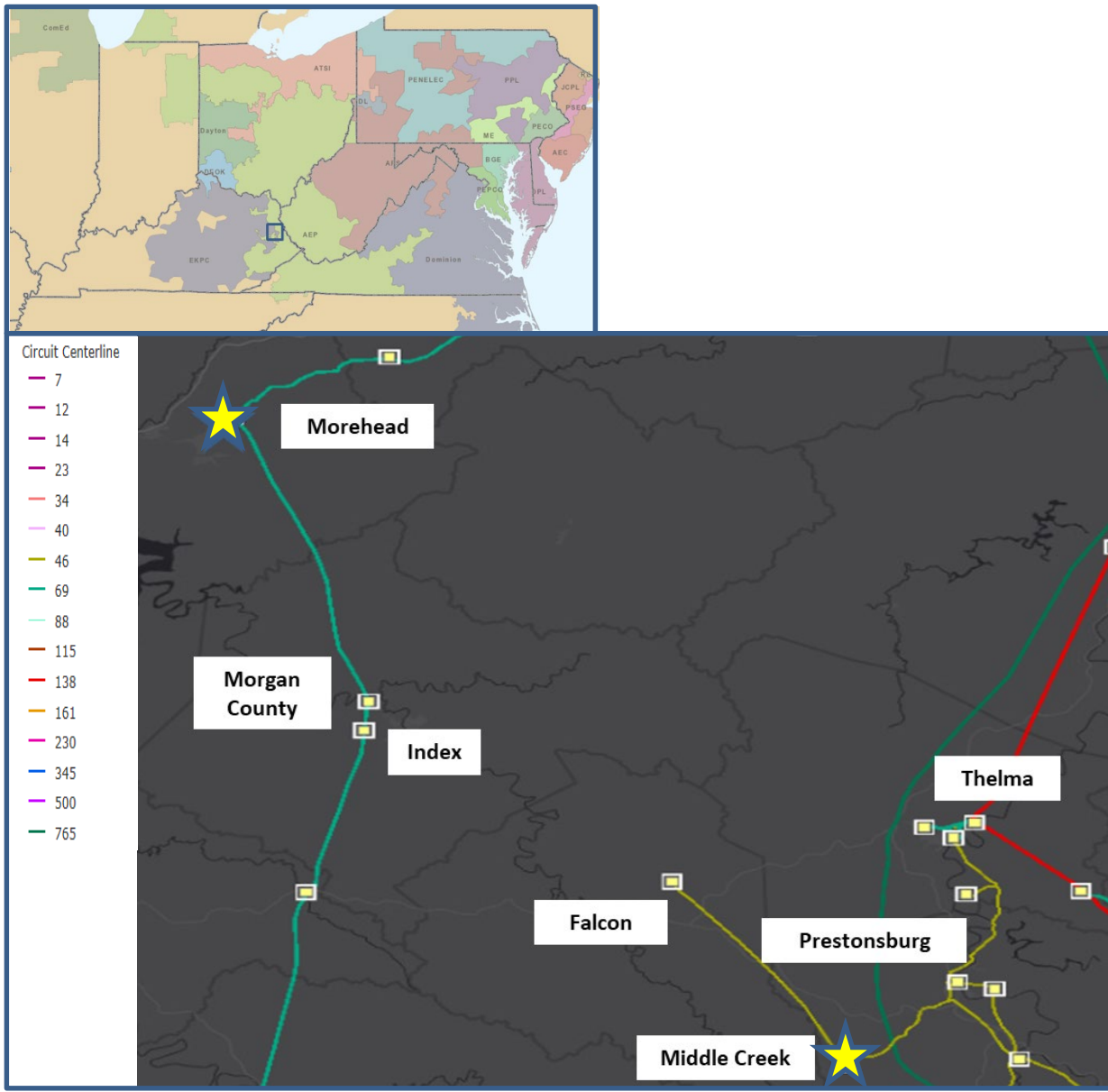
Equipment Condition/Performance/Risk

**Specific Assumption References:**

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

**Problem Statement:**

From 2013-2018 the Falcon –Prestonsburg 46 kV circuit (~ 23 miles) has experienced 19 momentary and permanent outages. Over the last three years the circuit has experienced 1.77 million customer minutes of interruption. The ~14.5 mile 46 kV line section between Falcon and Middle Creek has 84 category A open conditions associated with the structures that make up the line. These conditions include damaged/rotted poles and damaged guy wires, cross arms. The majority of this line utilizes 1950s wood structures and 3/0 ACSR conductor. The ~8.5 mile 46 kV line section between Middle Creek and Prestonsburg has 27 category A open conditions associated with the structures that make up the line. These conditions include damaged/rotted poles and damaged guy wires, cross arms. About half the structures that make up the line are 1940s wood structures with the majority of the line utilizing 1/0 Cu. conductor.





**Need Number:** AEP-2018-AP010

**Process Stage:** Solutions Meeting 1/17/2019

**Proposed Solution:**

- **Phase 1:**
  - Install a 2MW BESS at Middle Creek substation. **Estimated Cost: \$9.7M**
- **Phase 2:**
  - Rebuild ~8.5 miles of 46 kV line between Prestonsburg and Middle Creek station. **Estimated Cost: \$25.5M**
  - Retire ~14.5 miles of 46 kV line between Falcon and Middle Creek. **Estimated Cost: \$6.1M**

**Total Estimated Transmission Cost: \$41.3 M**

**Alternatives Considered:**

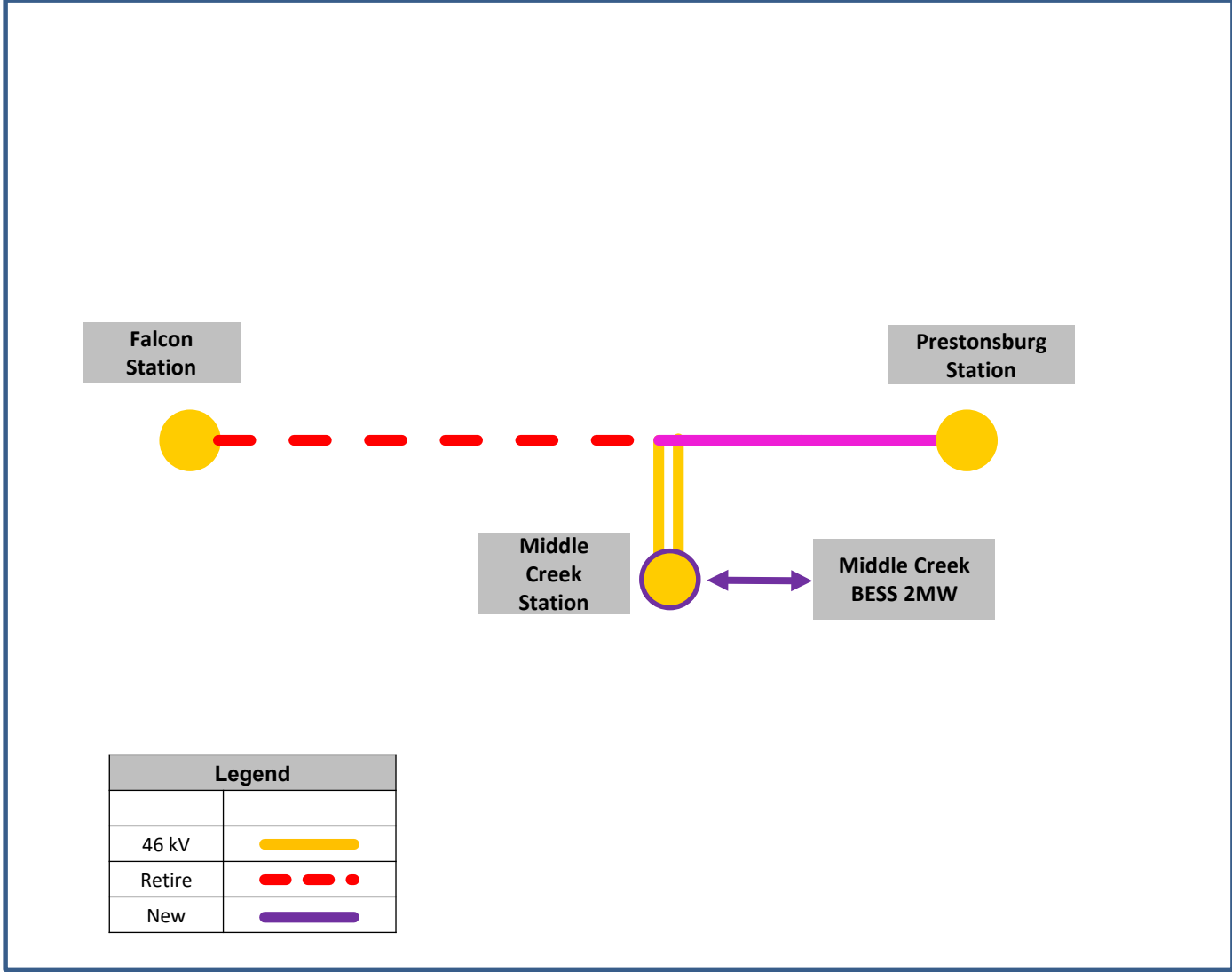
- Rebuild ~23 mi of Falcon – Prestonsburg. **Estimated Trans. Cost: \$70 M**

**Projected In-Service:**

**Phase 1:** 12/1/2020

**Phase 2:** 4/1/2023

**Project Status:** Scoping



Legend	
46 kV	
Retire	
New	

# 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

1/6/2020 – V1 – Original version posted to pjm.com

1/14/2020 – V2 – Slide #25, Corrected need number to AEP-2019-AP036

- Slide #26, Corrected need number to AEP-2019-AP037

- Slide #27, Corrected need number to AEP-2019-AP038

- Slide #28, Corrected need number to AEP-2018-AP016, AEP-2018-AP020, AEP-2019-AP036, AEP-2019-AP037, AEP-2019-AP038

- Slide #32, Removed the slide

1/16/2020 – V3 – Slide #33 and #34, Corrected dates to 1-17-2020