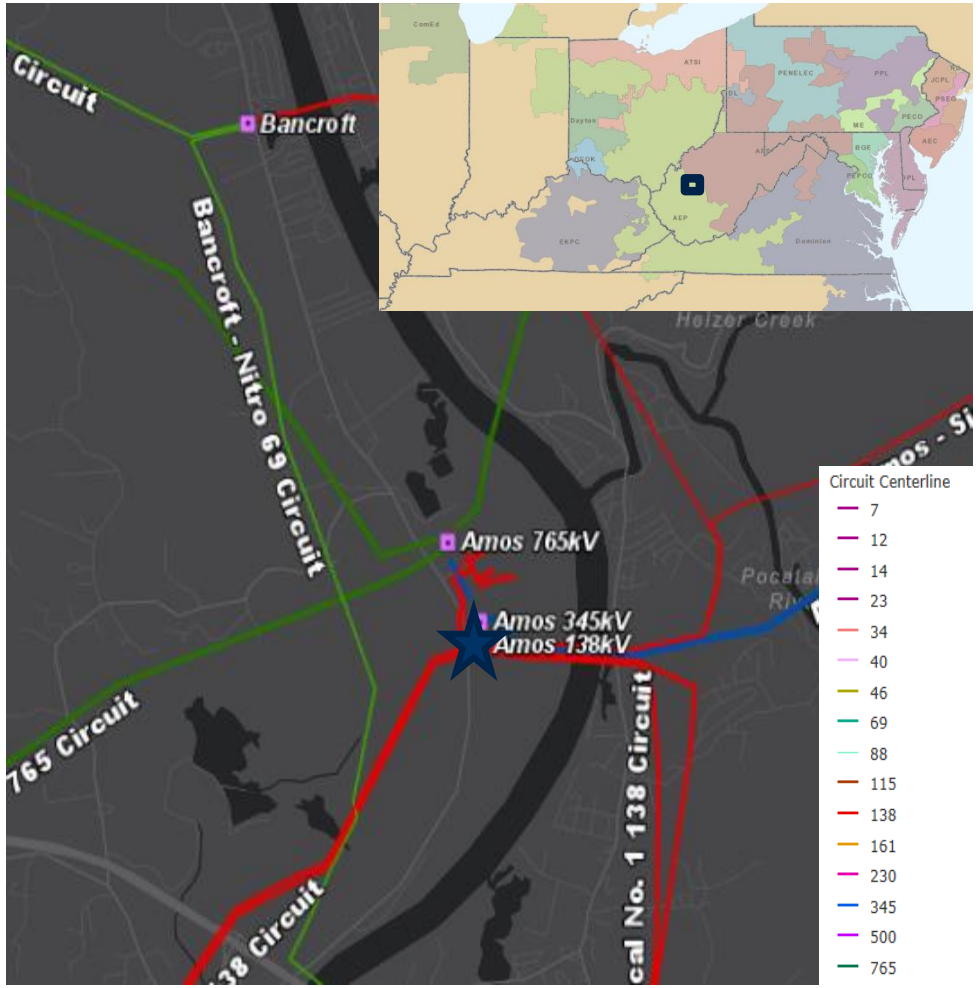
Sub Regional RTEP Committee
Western Region
AEP

January 11, 2019

Needs

AEP Transmission Zone: Supplemental
Winfield, West Virginia

Need Number: AEP-2018-AP012
Process Stage: Needs Meeting
Needs Presented: 12/05/18
Supplemental Project Driver: Equipment Material/Condition/Performance/Risk
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)
Problem Statement:
138kV circuit breakers A, A1, B, B1, B2, D, D1, D2, E, E1, E2 are all PK type air blast breakers that were manufactured between 1971-1975. Air blast breakers are being replaced across the AEP system due to their potential for catastrophic and violent failures. During failures, sharp pieces of porcelain from their bushings are typically expelled from the breakers and can be a safety hazard to field personnel. In addition, breakers A, A1, B, B1, E, E1 have experienced 40, 28, 11, 17, 75, and 96 fault operations, which exceed the manufacturer's designed number of 10 fault operations.



AEP Transmission Zone: Supplemental Mason County, WV

Need Number: AEP-2018-AP013
Process Stage: Needs Meeting 1/11/19
Process Chronology: Needs Meeting 1/11/19
Supplemental Project Driver: Equipment Condition/Performance/Risk
Specific Assumption References: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)
Problem Statement:

The Lakin – Racine 69 kV circuit (~13.2 mi) currently has 125 open conditions on 63/91 structures. These conditions include rot top, woodpecker damage, burnt insulator, broken knee/V braces. The majority of the circuit is constructed with 1960s wood structures. From 2015-2018, the line has experienced 8 momentary and 3 permanent outages which have resulted in 27k customer minutes of interruption.

The 69kV CB F at Lakin is a CF type oil filled breaker. Oil filled breakers have significant maintenance requirements due to oil handling. This CB model family has experienced numerous documented mechanism bearing issues and failures within the AEP population.

Lakin Substation deploys 42 relays implemented to ensure the adequate protection and operation of the substation. Currently 35 of the 42 relays (83% of all station relays) are in need of replacement. There are 32 electromechanical, 2 legacy ABB DPU microprocessor, and 1 static type relays with significant limitations in regards to spare part availability in addition to a lack of vendor support. The electromechanical and static relays have no capability for fault data collection and retention. The ABB DPU relays pose a safety risk to persons performing breaker operation because the DPUs are mounted directly on the circuit breaker without a delay for opening and closing the breaker. If there is any arcing or something goes wrong as the breaker operates, the operator is now in the line of fire. Modern relays can program a delay (10 seconds) after an open or close button is pressed so the operator can have time to walk out of the line of fire.

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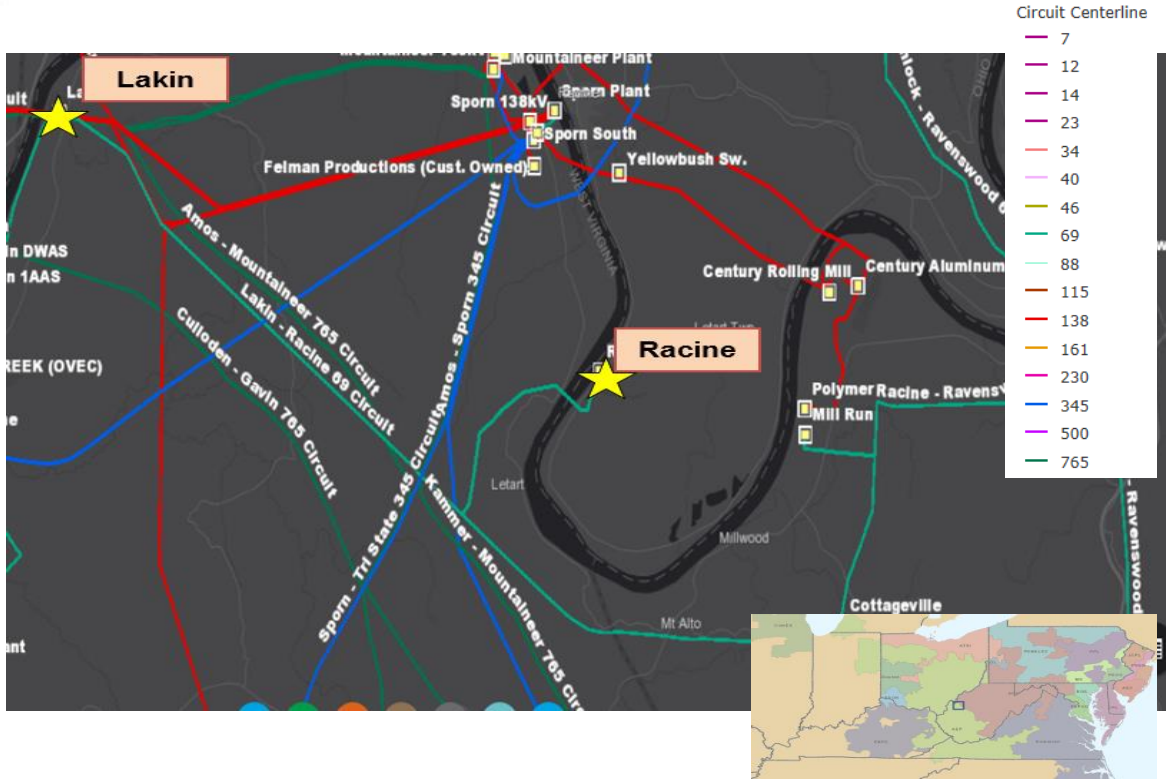

AEP Transmission Zone: Supplemental Mason County, WV

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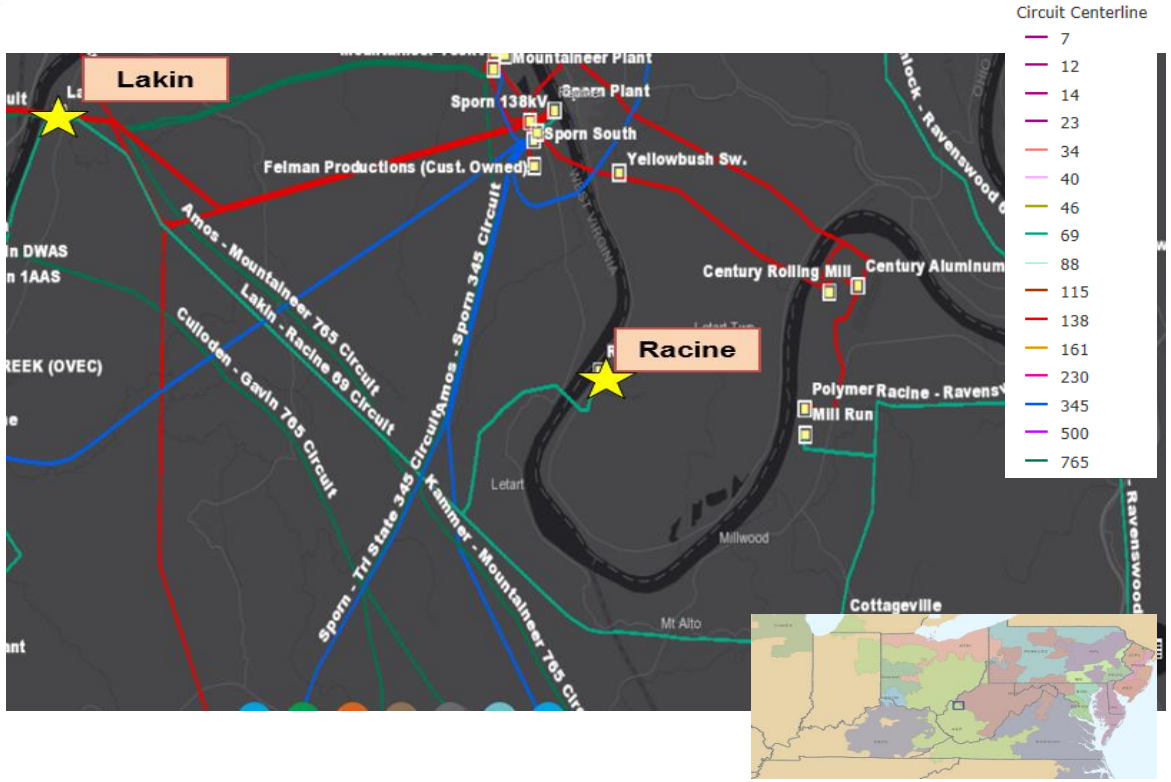
The 138kV line switches are mounted on cap and pin insulators at Lakin.

The current MOAB/Ground SW configurations at Lakin create faults in the station to signal the remote end breakers to open; this results in Transmission lines breakers getting burdened to clear Transformer faults thus reducing their life span.

Lakin 138/69 kV transformer bank #1 CO and CO2 levels have been on the rise since 2004 when all transformer bushings were replaced during minor transformer maintenance activities; the oil was processed at that time, accounting for the rapid decrease in gas concentrations in 2004. The latest CO reading of 493ppm is significantly high. Moisture content had been trending up from 2008 to 2016 and has been in excess of 25ppm since 2016. Dielectric strength is currently trending up, but this rapid and significant 15.1kV increase was unexpected given the minor drop in moisture content levels from 2016 to 2017. Together, these are potential indicators of insulating paper breakdown. In addition, H2 concentrations have been rising since 2004. The presence of H2 indicates the potential for stray gassing in the oil and carbonization of the insulating paper. The above conditions indicate a strong probability of degradation of the integrity of the paper insulation surrounding the transformer windings from carbonization, breakdown in cellulose, or both.

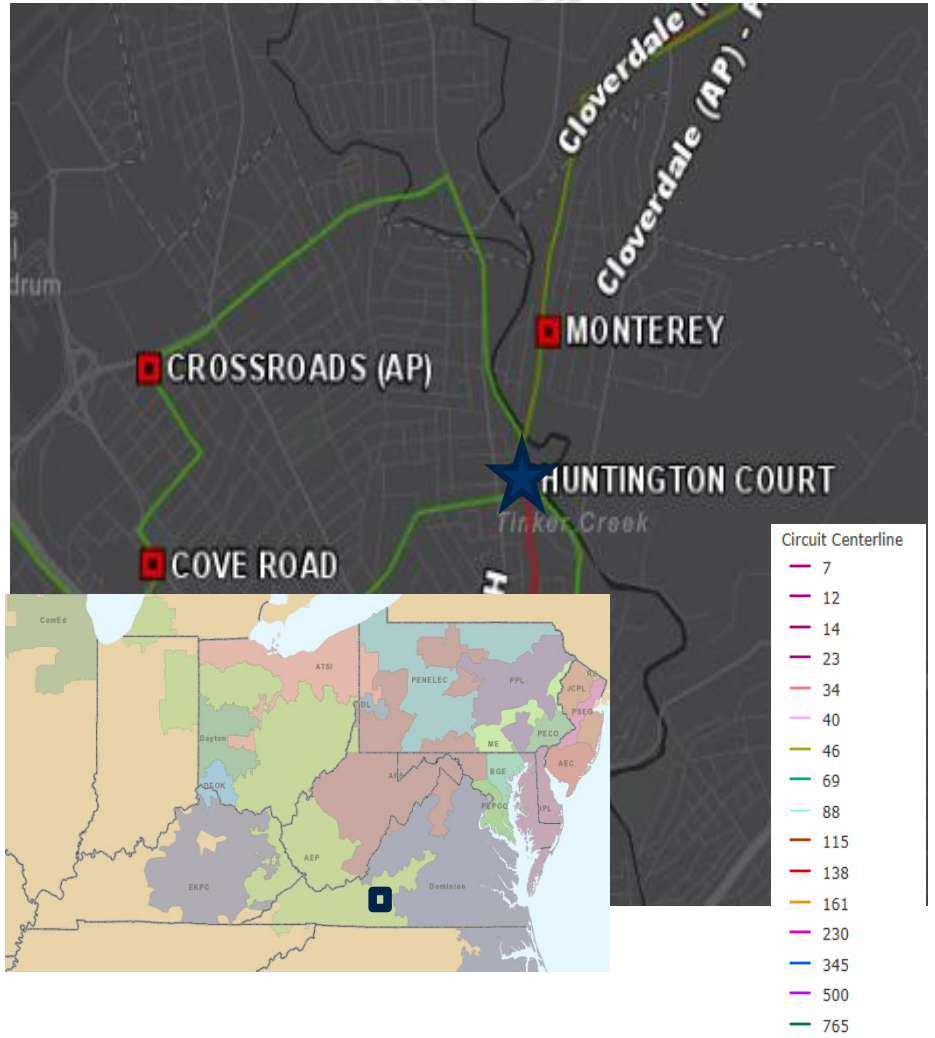


AEP Transmission Zone: Supplemental
Roanoke, Virginia

Need Number: AEP-2018-AP014
Process Stage: Needs Meeting
Needs Presented: 1/11/19
Supplemental Project Driver: Equipment Material/Condition/Performance/Risk
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

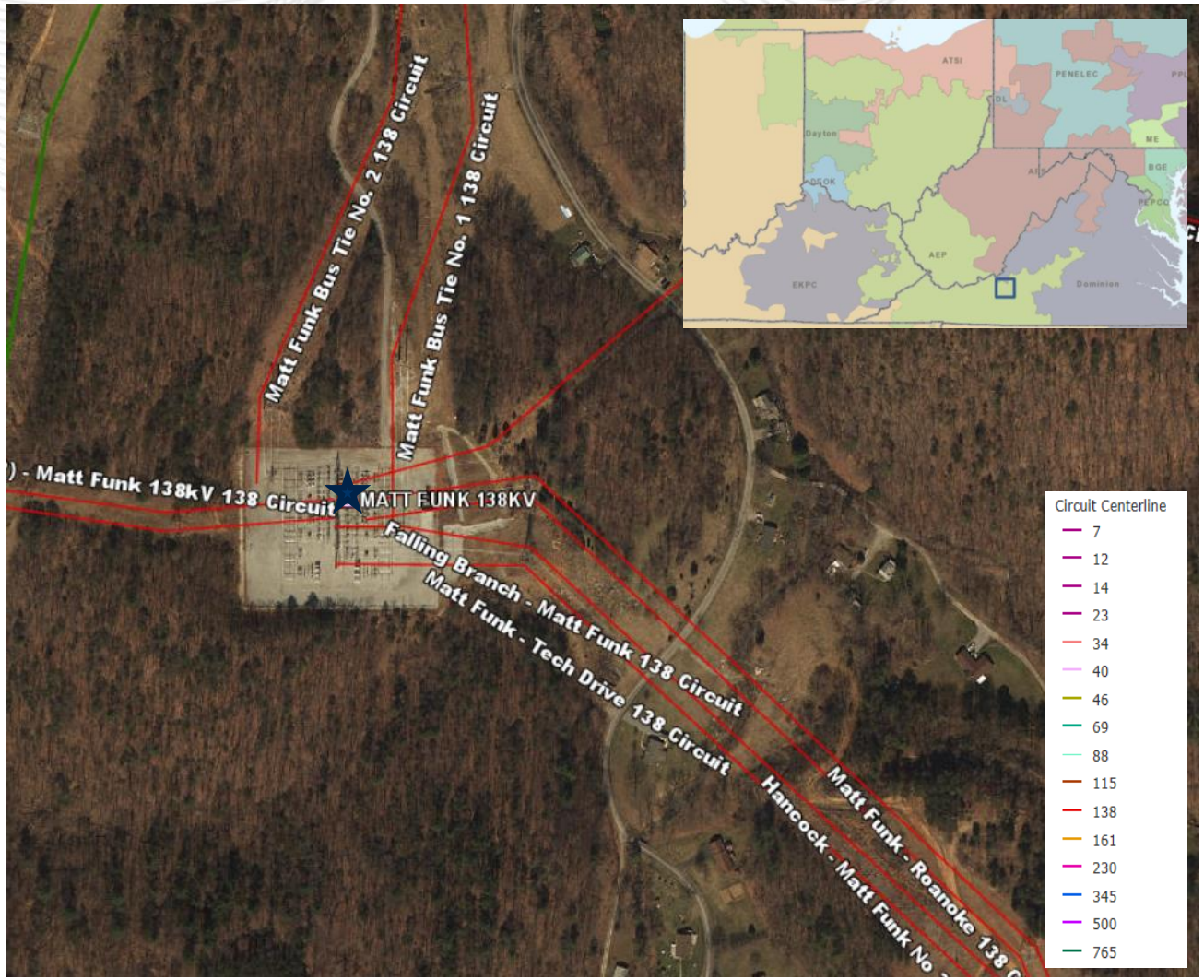
Problem Statement:

Huntington Court 138 kV cap switcher BB is a MARK V type which has experienced significant failures and mis-operations across the AEP system. 69 kV cap switcher AA is an SC-2030 type that has no gas monitor and sister units have experienced numerous gas and interrupter failures.



AEP Transmission Zone: Supplemental
Salem, Virginia

Need Number: AEP-2018-AP015
Process Stage: Needs Meeting
Needs Presented: 1/11/18
Supplemental Project Driver: Equipment Material/Condition/Performance/Risk
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)
Problem Statement:
At Matt Funk Station 138 kV circuits breakers H1, K, K1, K2 are PK Air Blast breakers manufactured in 1968. Air blast breakers are being replaced across the AEP system due to their potential for catastrophic and violent failures. Other factors driving the replacement are age and scarce availability of spare parts. In addition, breakers H1, K, K1, K2 have experienced 55, 31, 32, and 26 fault operations, respectively.

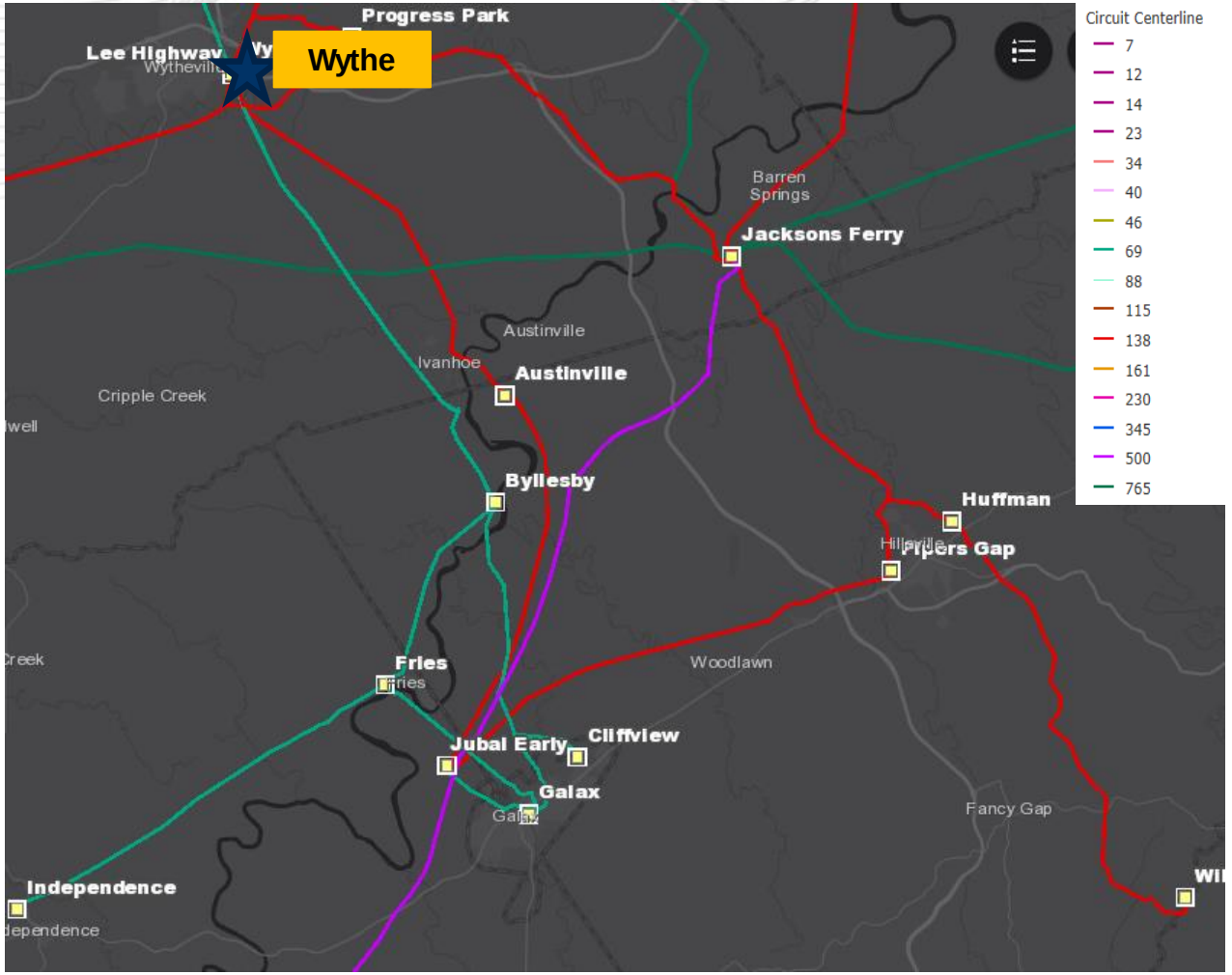


AEP Transmission Zone: Supplemental Wytheville, Virginia

Need Number: AEP-2018-AP016
Process Stage: Needs Meeting
Needs Presented: 1/11/19
Supplemental Project Driver: Equipment Material/Condition/Performance/Risk
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

Problem Statement:

~~Wythe 138/69 kV transformer has experienced thermal through fault events, mostly in excess of 700°C, have led to numerous overheating events, steady increases in gasses including high levels of ethylene and ethane, and carbonization of the insulating paper. The oil's interfacial tension is showing signs of sludge beginning to form due to the carbonization created contaminants. In addition, the moisture content is beginning to climb which has not yet been reflected in a drop in dielectric strength. Wythe circuit breaker F is an FK type oil filled breaker. Oil filled breakers have much more maintenance required due to oil handling that their modern, SF6 counterparts do not require. The FK-439-115-3500-3 is no longer vendor supported and is 1 of 2 remaining on the AEP system, making spare parts difficult or impossible to acquire. Wythe circuit breaker M is a CF type oil filled breaker. Oil filled breakers have much more maintenance required due to oil handling that their modern, SF6 counterparts do not require. This particular unit has a recorded malfunction related to a broken S.S. line on the maintenance valve and pressure switches.~~ MOVE TO AEP-2018_AP023



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AEP Transmission Zone: Supplemental Ivanhoe & Galax, Virginia

Need Number: AEP-2018-AP016 continued
Process Stage: Needs Meeting
Needs Presented: 01/11/19
Supplemental Project Driver: Equipment Material/Condition/Performance/Risk
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

Problem Statement:

~~Byllesby circuit breakers B and D are oil filled breakers manufactured in 1952 and 1965 respectively. Both breakers have exceeded the designed number of fault operations (10). These breakers are GE FK type oil breakers with no oil containment. The GE FK type breakers are known to have an internal operating mechanism that are prone to high failure rates.~~ MOVE TO AEP-2018_AP023

~~Galax circuit breakers G, F, and H are all GE FK type oil breakers with no oil containment. The GE FK type breakers are known to have an internal operating mechanism that are prone to high failure rates. Circuit Breakers G, F, and H are all approximately 50 years old and have exceeded the designed number of fault operations (10).~~ MOVE TO AEP-2018_AP023

~~Jubal Early 138/69kV Transformer has reoccurring bushing damage, dielectric strength breakdown (insulation breakdown) and short circuit breakdown (due to fault events). Recent test reports show oil interfacial tension to be below the minimum acceptable level for a unit of this voltage class. Reduction in oil interfacial tension is related to oil contamination and presence of oxidation byproducts in the oil.~~ MOVE TO AEP-2018_AP023

Huffman – Willis Gap 138 kV is a 15 mile long radial line that serves approximately 25 MVA of load at Willis Gap 138 kV station.

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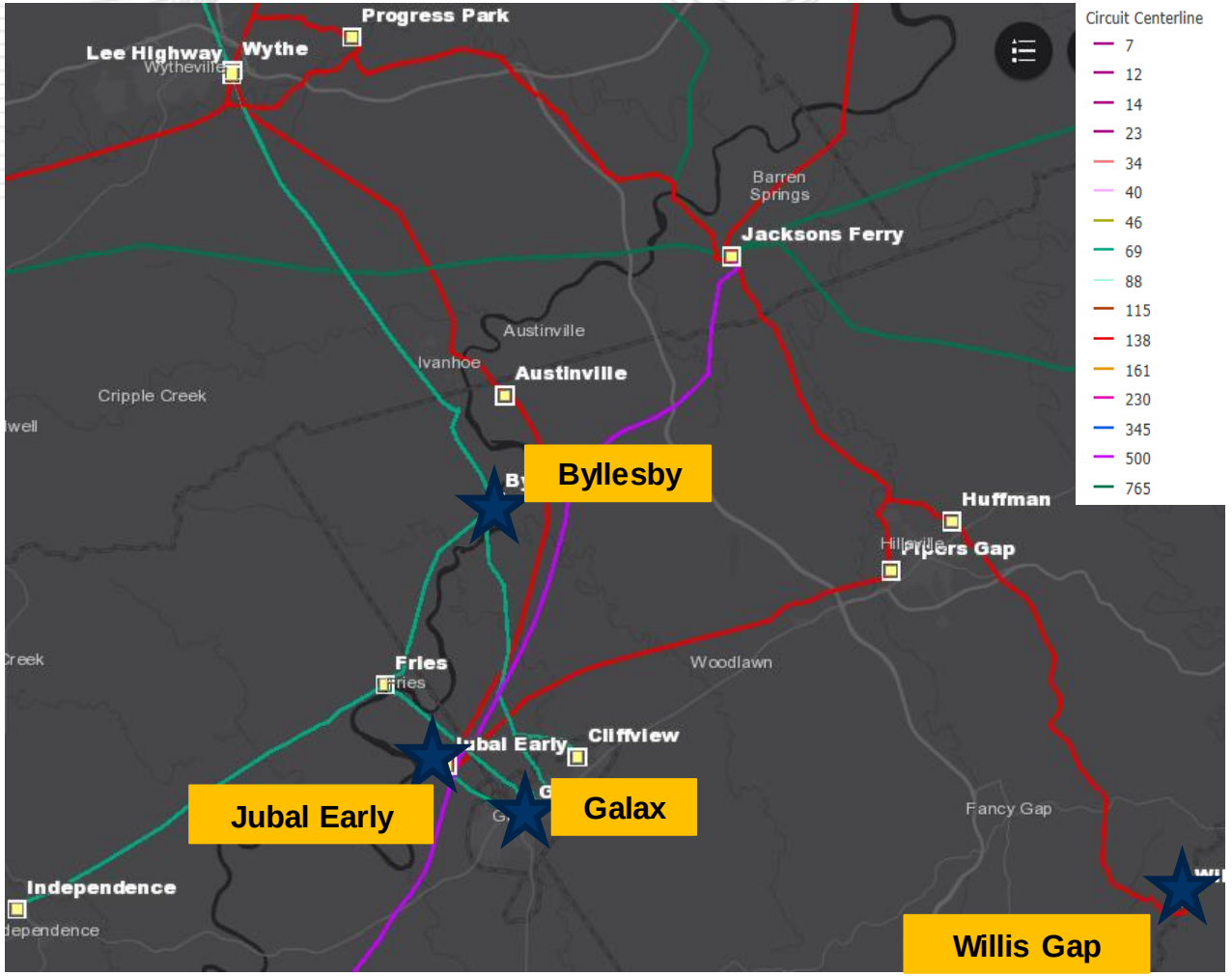


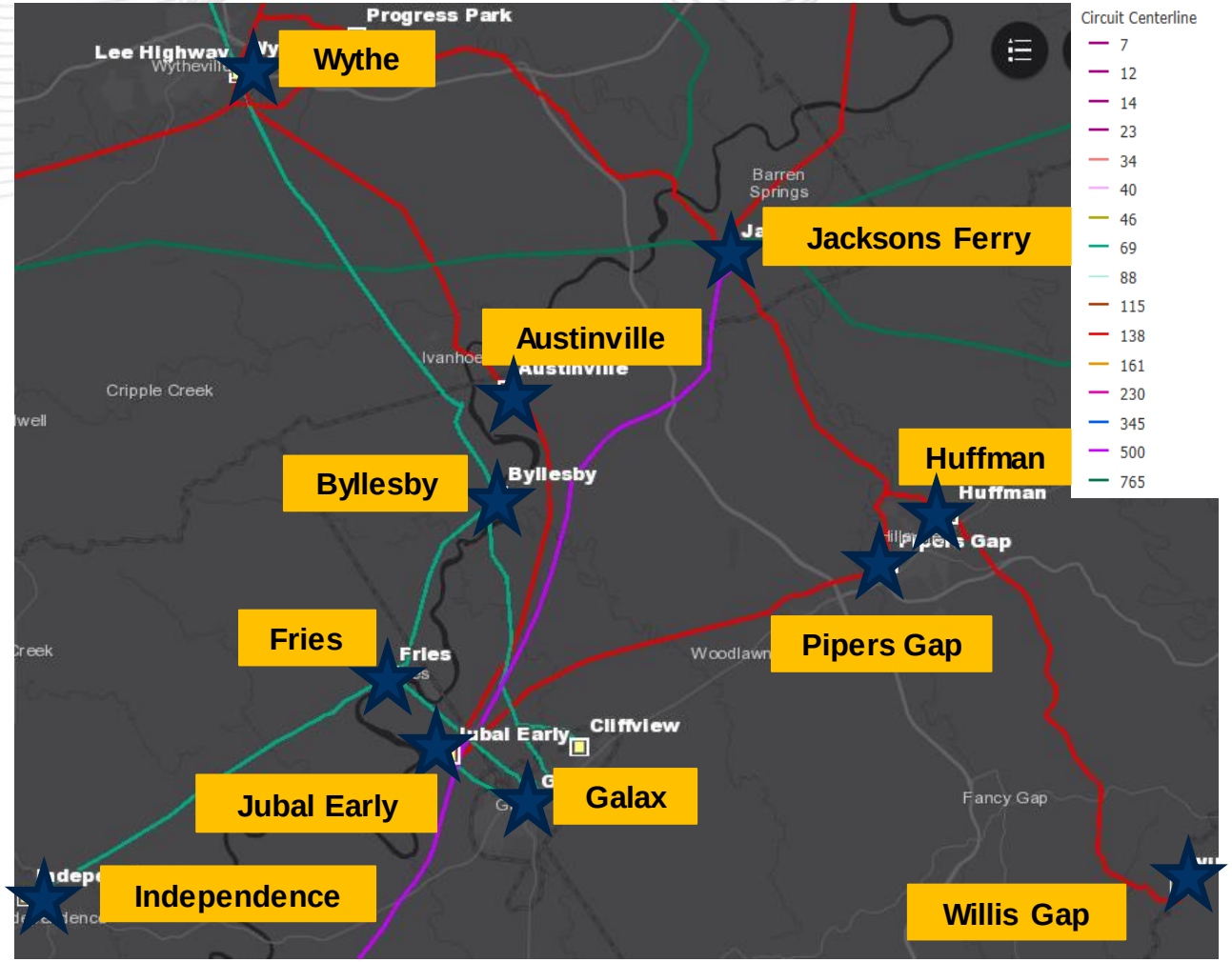
AEP Transmission Zone: Supplemental Carroll/Wythe County, Virginia

Need Number: AEP-2018-AP016 continued
Process Stage: Needs Meeting
Needs Presented: 01/11/19
Supplemental Project Driver: Operational Flexibility and Efficiency
Specific Assumptions 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).



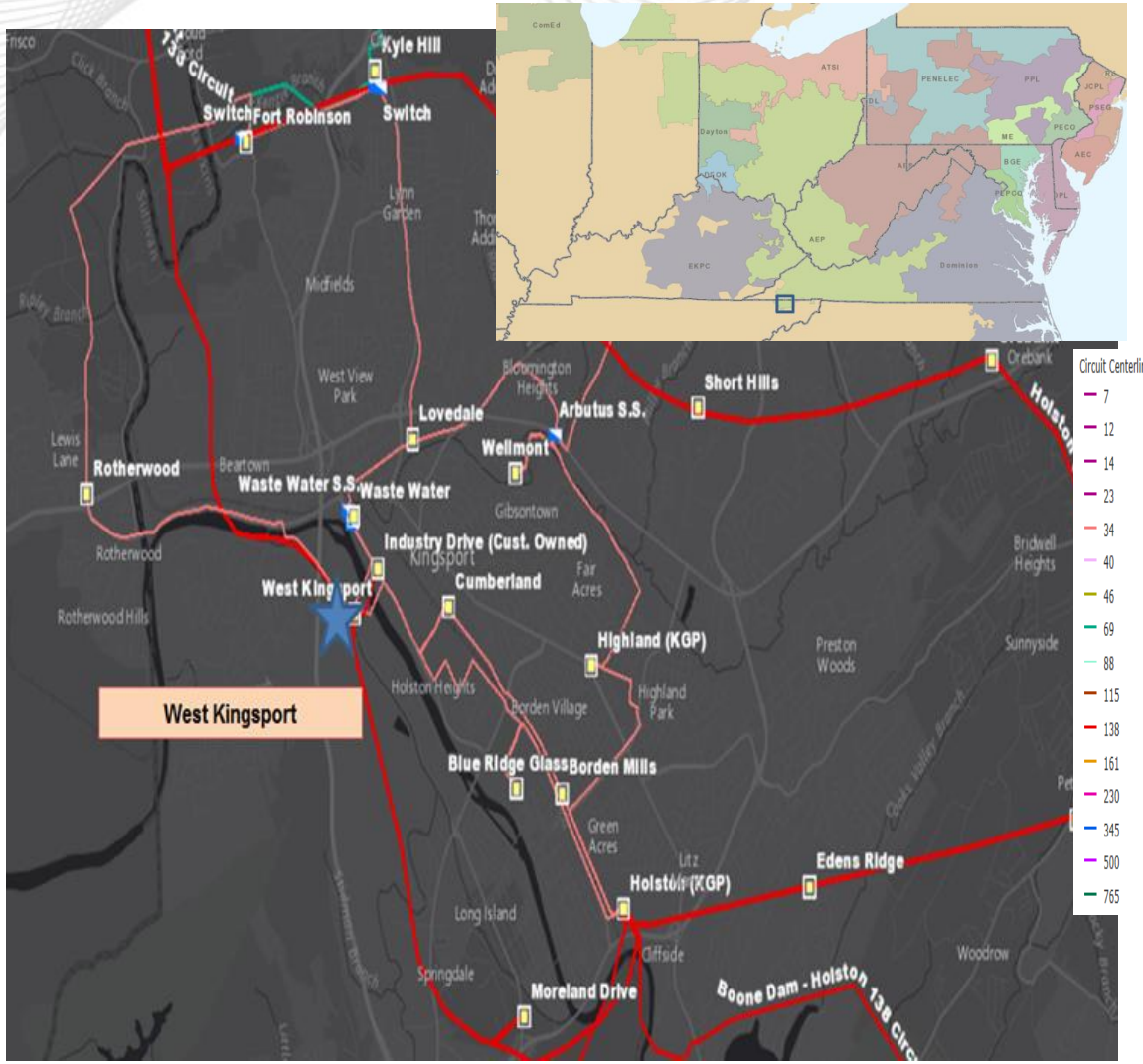
AEP Transmission Zone: Supplemental Kingsport, TN

Need Number: AEP-2018-AP017
Process Stage: Needs Meeting
Needs Presented: 1/11/19
Supplemental Project Driver: Equipment Condition/Performance/Risk
Specific Assumption References: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)
Problem Statement:

138 kV circuit breaker 'E' at West Kingsport station is a type FX-11 breaker, which is one of only two remaining circuit breakers of this class on the AEP system . Due to a lack of spare replacement parts, it is not possible to maintain the breaker in the event of a failure. Breaker 'E' has had historical issues with gas leaks. In addition, this circuit breaker has experienced 30 fault operations exceeding the manufacturers recommendation 10.

Currently dissimilar zones of protection exist at the West Kingsport between the 138 kV bus #1, 138 kV circuit towards North Bristol (~25 miles), and the 138 kV service point towards the Royal Ordnance Ammunitions Plant.

The existing configuration at West Kingsport station results in an outage of the entire 138 kV yard and all customers served from the station for a failure of 138 kV circuit breaker 'G'.



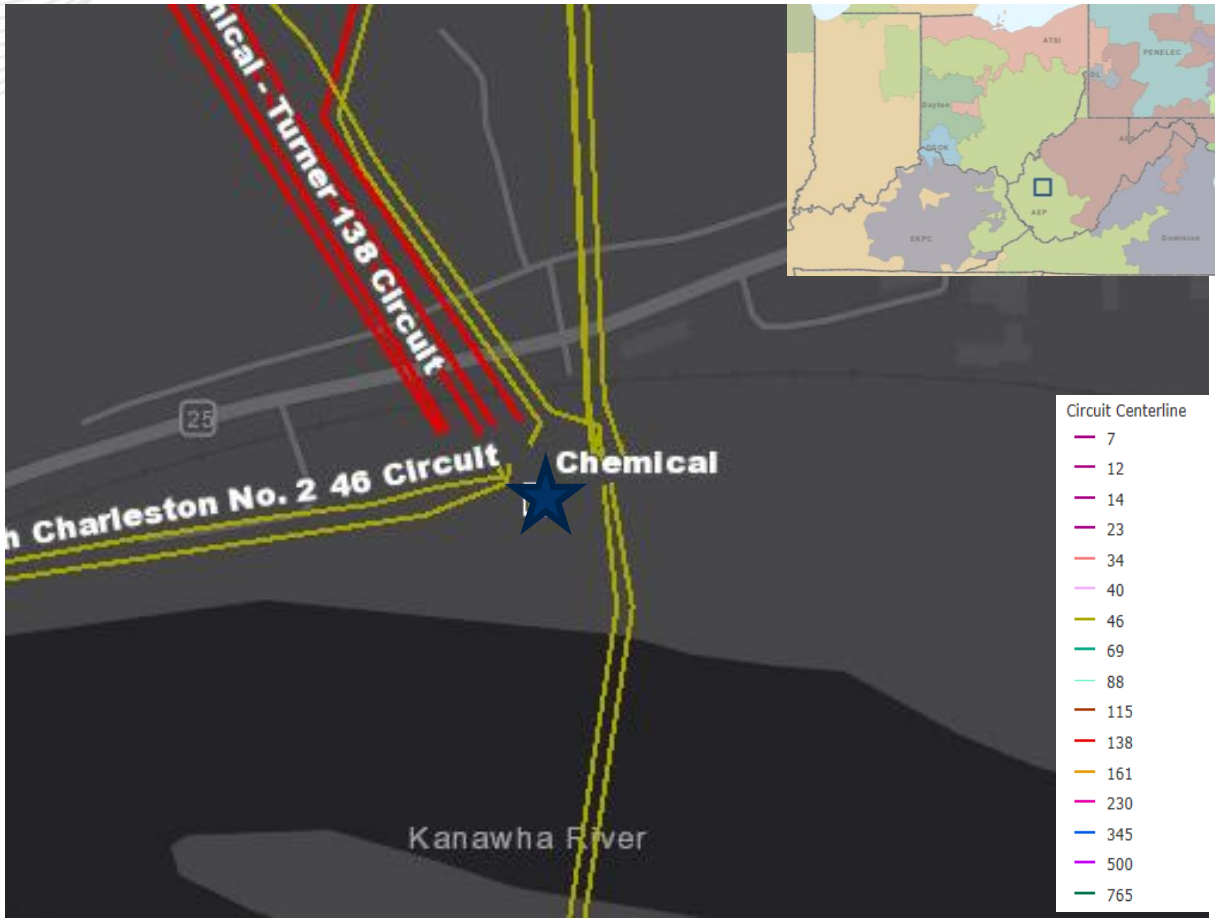
AEP Transmission Zone: Supplemental
Charleston, West Virginia

Need Number: AEP-2018-AP018
Process Stage: Needs Meeting
Needs Presented: 1/11/19
Supplemental Project Driver: Equipment Material/Condition/Performance/Risk
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

Problem Statement:

Chemical 138/46 kV XF #1 has been declared a failure. Operations has noted that Chemical 138/46 kV XF #1 fans and cooling system are not working properly and winding temperature was documented at an extremely hot level of 109°C prior to taking the unit offline in 2017. There are no parts attainable to repair the obsolete cooling system. In addition, interfacial tension has been diminished since 2002. This is an early indication of the development of sludge which can impede oil circulation, further hampering the ability of the unit to cool. Based on dissolved gas analysis, the observed gas concentrations, specifically of ethylene and acetylene, are likely the result of a mixture of thermal and electrical faults along with the carbonization of the insulating paper. The signal of insulation paper carbonization, which generates particles in the oil, highly correlates to the generation of sludge indicated by the interfacial tension.

Chemical 138/46 kV XF #2 moisture levels have recently been increasing, resulting in downward trending dielectric strength. In addition, interfacial tension has been on the decline. This is an early indication of the development of sludge which can impede oil circulation and cooling. Operations has noted numerous conditions with this unit, most critical of which is that the bank was derated to 33.75MVA because only one pump of three is operational for the cooling system. There are no parts attainable to repair the obsolete cooling system.



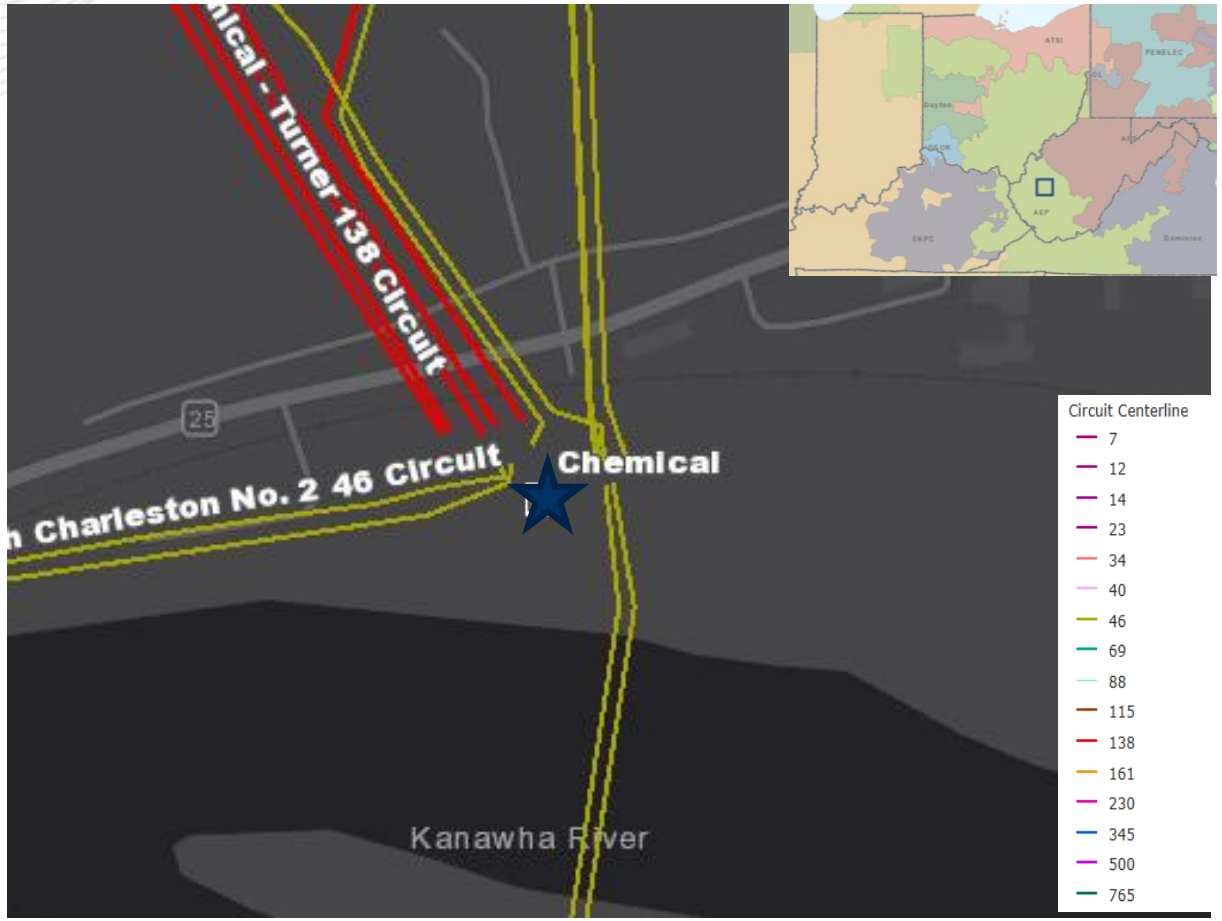
AEP Transmission Zone: Supplemental
Charleston, West Virginia

Need Number: AEP-2018-AP018
Process Stage: Needs Meeting
Needs Presented: 1/11/19
Supplemental Project Driver: Equipment Material/Condition/Performance/Risk
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

Problem Statement:

The 46kV CBs C, G, H, Q, R, and S are oil filled breakers without secondary oil containment. Oil filled breakers have much more maintenance required due to oil handling that their modern, SF6 equivalents do not require. CBs G and H are 2 of 40 in the FK-72.5-27000-10 model family remaining on the AEP system. CB A is the last FK-339-46-1500-Y model on the entire AEP system. CBs B, Q, R, and S are the last 4 in the FK-339-46-1500-5 model family remaining on the entire AEP system. CB C is the last FK-46-1500 model on the entire AEP system. This scarcity of sister units makes finding spare parts for these units difficult to impossible, and these models are no longer vendor supported.

The 46kV CS CC 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; the major ones include gas loss, interrupter failures, and operating mechanism failures.

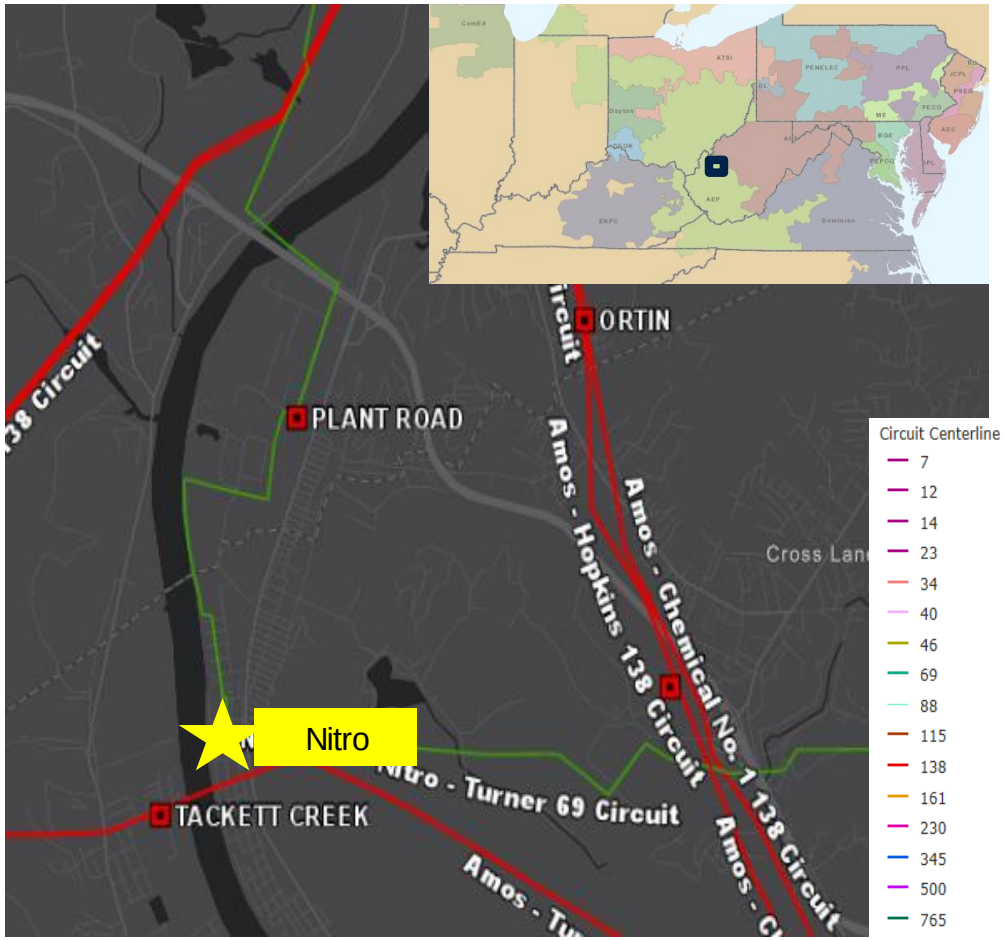


AEP Transmission Zone: Supplemental
Nitro, West Virginia

Need Number: AEP-2018-AP019
Process Stage: Needs Meeting
Needs Presented: 1/11/19
Supplemental Project Driver: Equipment Material/Condition/Performance/Risk
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

Problem Statement:

Nitro 69 kV circuit breakers G and H are CF-48 oil type breakers that were manufactured in the 1960s. In general, oil breakers are more difficult to maintain as oil spills have the potential to occur during maintenance, which could cause environmental and safety hazards. In addition, breakers G and H have experienced 42 and 39 faults of operation, respectively. These both exceed the manufacturer's designed number of fault operations of 10.



AEP Transmission Zone: Supplemental
Floyd County, VA

Need Number: AEP-2018-AP020
Process Stage: Needs Meeting
Needs Presented: 1/11/19
Supplemental Project Driver: Equipment Material/Condition/Performance/Risk
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)
Problem Statement:

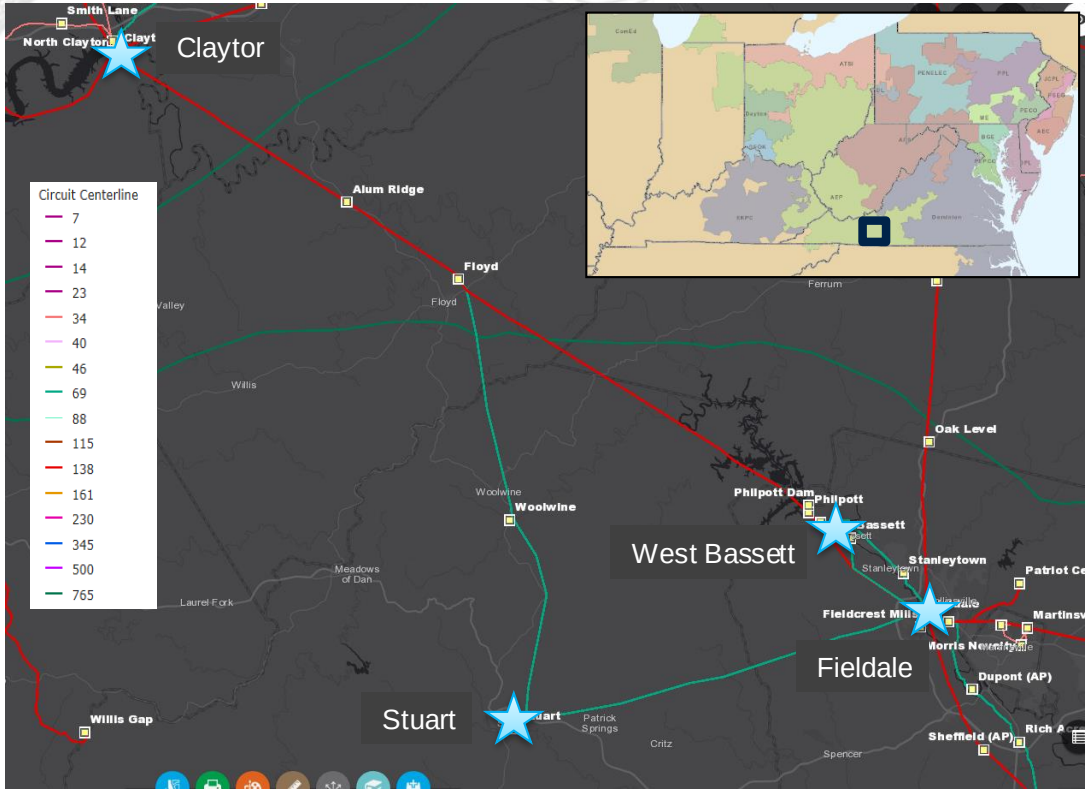
The Claytor – West Bassett 138 kV circuit (38.1 mi.) consists primarily of 1948 vintage wood pole structures with 556 ACSR overhead conductor and currently has 255 open conditions on 126 unique structures including rot top, rot heart, broken insulators and woodpecker/insect damage. From 2015-2018, a 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.

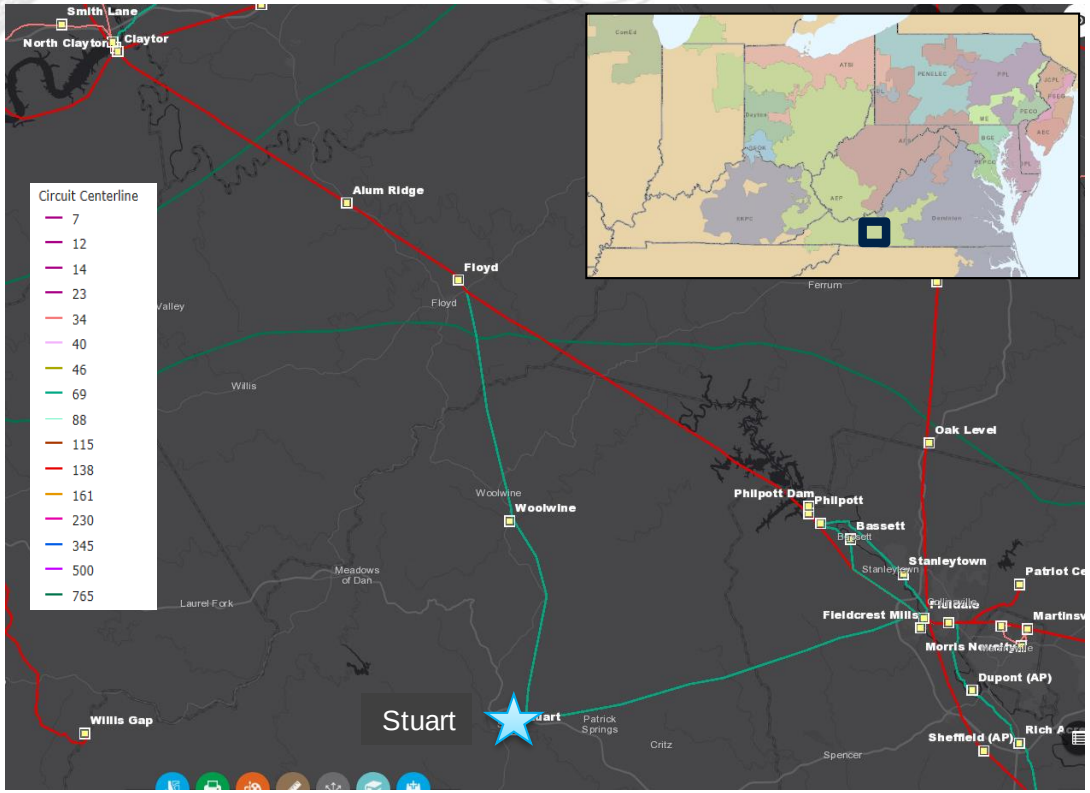
Fieldale – West Bassett #1 69 kV circuit (7.1 mi.) consists primarily of 1926 vintage wood pole structures with 4/0 ACSR and 556 ACSR overhead conductor and currently has 23 open conditions on 21 unique structures including rot top, insect damage, broken ground wire, leaning in-line pole and woodpecker 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: Supplemental
Floyd County, VA

Need Number: AEP-2018-AP020
Process Stage: Needs Meeting
Needs Presented: 1/11/19
Supplemental Project Driver: Equipment Material/Condition/Performance/Risk
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)
Problem Statement:



Stuart Station

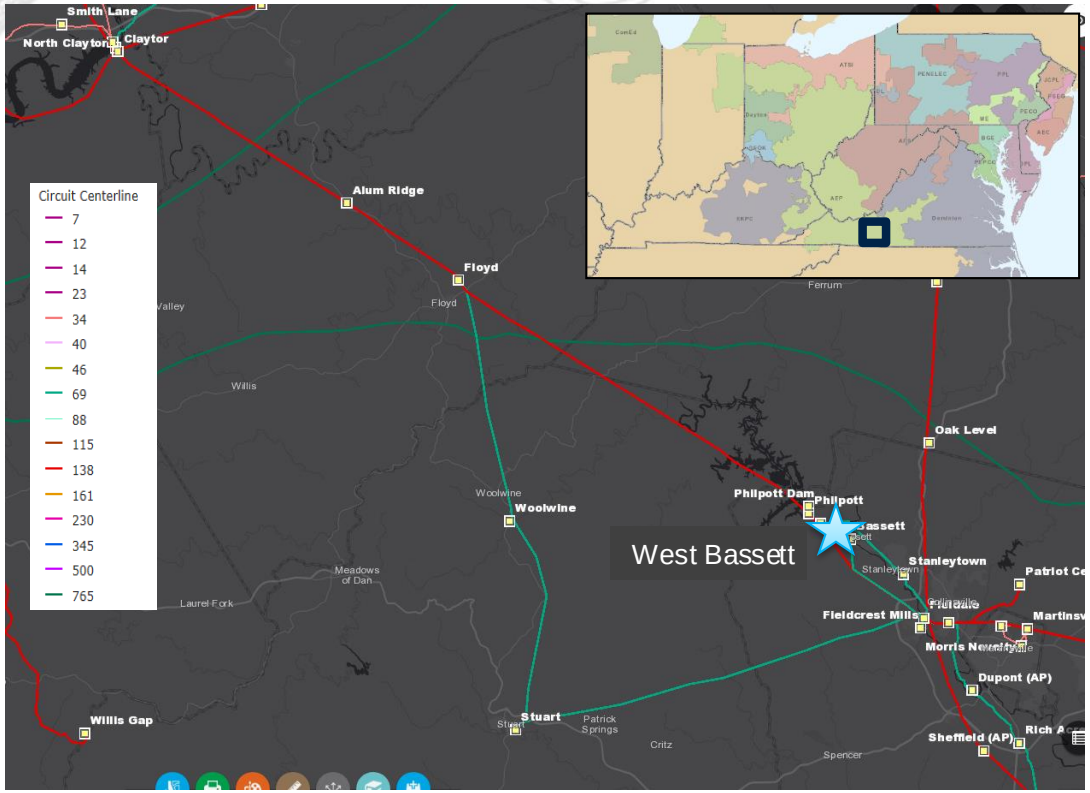
The 69kV CBs D and E are oil filled breakers without secondary oil containment. Oil filled circuit breakers have much more maintenance required due to oil handling that their modern, SF6 counterparts do not require. CBs D and E are 2 of 15 in the FKA-72.5-19000-1 model family remaining on the AEP system. 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: Supplemental
Floyd County, VA

Need Number: AEP-2018-AP020
Process Stage: Needs Meeting
Needs Presented: 1/11/19
Supplemental Project Driver: Equipment Material/Condition/Performance/Risk
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)
Problem Statement:



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 is in-service life. These are three of only 27 remaining of the 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 lead to major gassing of the unit and carbonization of the insulating paper.

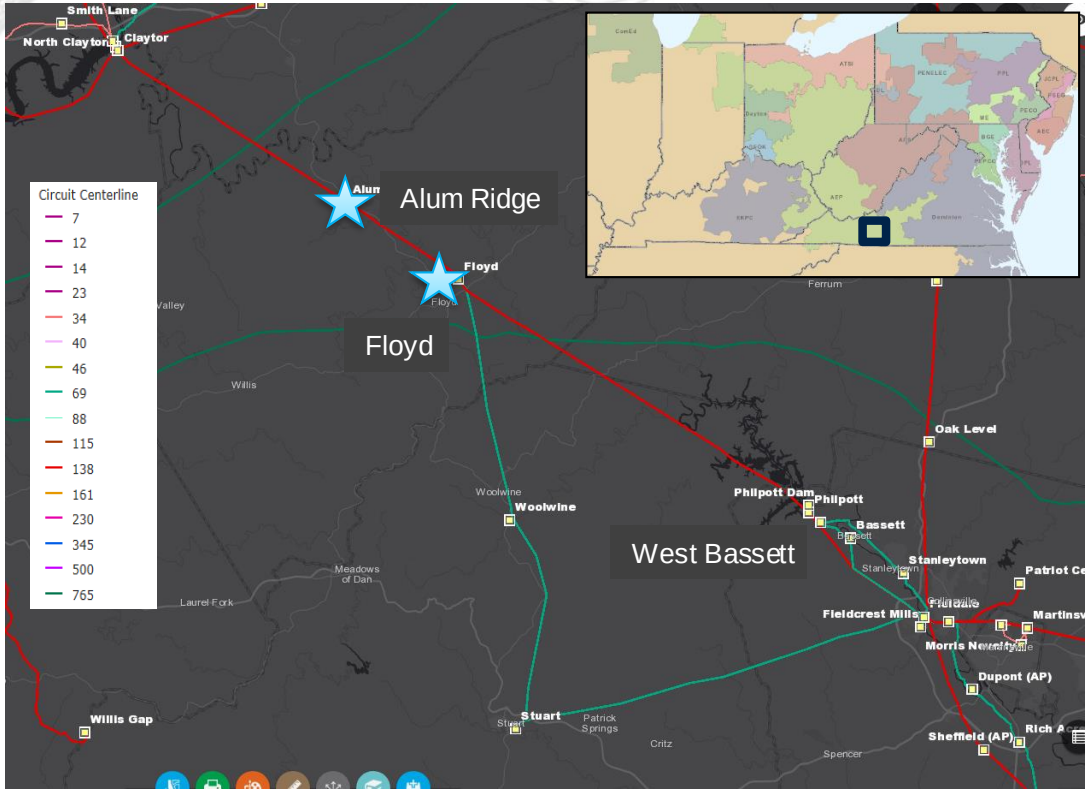
West Bassett Substation currently deploys 62 relays, implemented to ensure the adequate protection and operation of the substation. Currently, 55 of the 62 relays (89% of all station relays) are in need of replacement. There are 53 electromechanical and 2 static type with significant limitations in regards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

AEP Transmission Zone: Supplemental
Floyd County, VA

Need Number: AEP-2018-AP020
Process Stage: Needs Meeting
Needs Presented: 1/11/19
Supplemental Project Driver: Equipment Material/Condition/Performance/Risk
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)
Problem Statement:

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.



Need Number: AEP-2018-IM017
Process Stage: Needs Meeting
Process Chronology: Needs Meeting 1/11/19
Supplemental Project Driver: Equipment Condition/Performance/Risk
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)
Problem Statement:
Deer Creek 34.5kV

- Breakers "K", "F", "M", "H", "V", "W" and ~~"U"~~ Move to AEP-2018-IM025
  - 1949-62 vintage FK oil breakers without containment
  - Fault Operations: CB K(9) CB F(1) CB M(17) CB H(16) CB V(5) CB W(1) CB U(38)– Recommended(10)
  - CB W is over the recommended amount of switching operations.

~~Hummel Creek 34.5kV~~ Move to AEP-2018-IM022

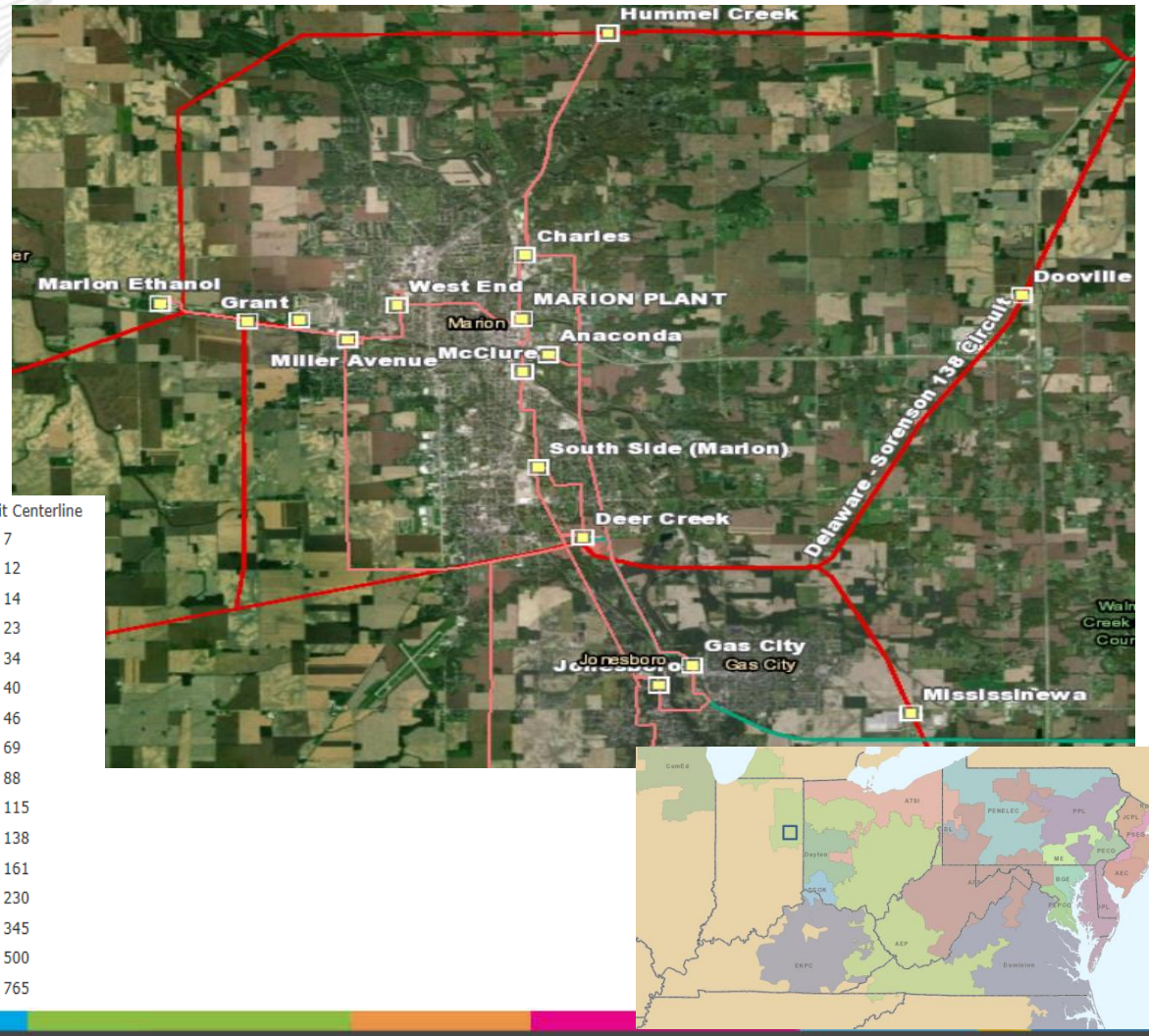
- ~~Breakers "L" and "M"~~
  - ~~1949-1950 vintage FK oil breaker without containment~~
  - ~~Fault Operations: CB M(33) CB L(2) – Recommended(10)~~

~~Gas City 34.5kV~~ Move to AEP-2018-IM022

- ~~Breakers "A"~~
  - ~~1940 vintage FK oil breaker without containment~~
  - ~~Fault Operations: CB A(50) – Recommended(10)~~

~~Miller Avenue 34.5kV~~ Move to AEP-2018-IM024

- ~~Breakers "A" and "B"~~
  - ~~1950 vintage FK oil breaker without containment~~
  - ~~Fault Operations: CB A(10) CB B(16) – Recommended(10)~~



AEP Transmission Zone: Supplemental
Marion, Indiana

Need Number: AEP-2018-IM017
Process Stage: Needs Meeting
Process Chronology: Needs Meeting 1/11/19
Supplemental Project Driver: Equipment Condition/Performance/Risk
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)
Problem Statement:

Deer Creek – Miller Ave 34.5kV (6.1 Miles)

- 1952 wood crossarm construction (age based on age of station)
- 3/0 copper
- Subject to 15 open B conditions
- Subject to 13 open A conditions
- In the past 10 years, 37 structures have had active maintenance performed. This is expected to increase as line ages.

~~Deer Creek – Hummel Creek 34.5kV (11 miles)~~ Moved to AEP-2018-IM023

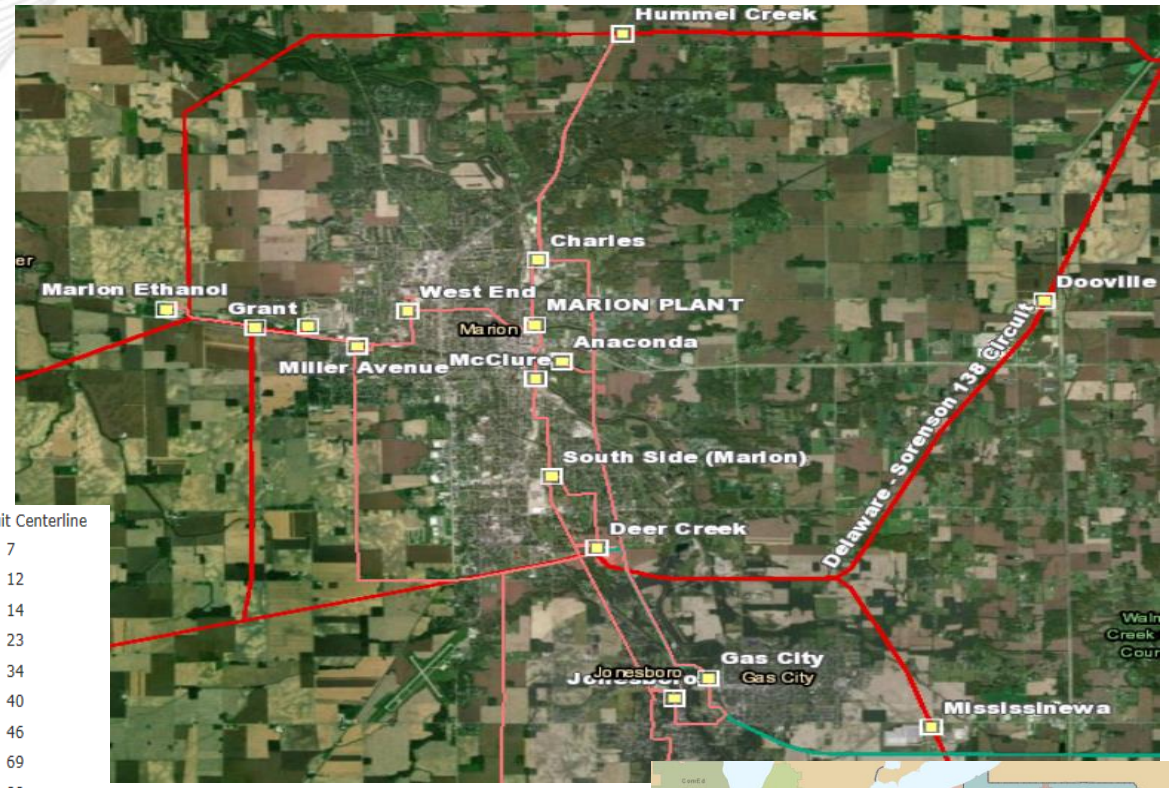
- ~~1940 wood crossarm construction (age based on age of station)~~
- ~~Subject to 16 open A conditions~~
- ~~Subject to 17 open B conditions~~
- ~~In the past 10 years, 16 structures have had active maintenance performed. This is expected to increase as line ages.~~

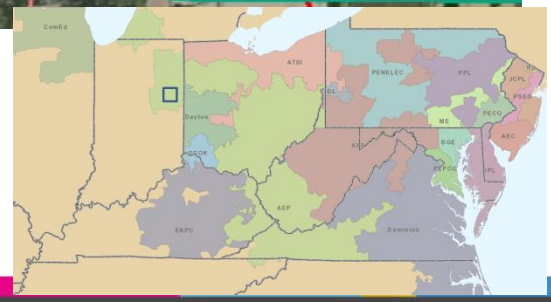
Grant – West End 34.5kV (2.1 Miles)

- 1950 wood crossarm construction (age based on age of West End station)
- Legacy Cap and Pin type insulators
- Subject to 5 open conditions
- In the past 10 years, has had to have 65 open conditions addressed

Deer Creek – Marion 34.5kV (3.6 Miles)

- 1949 wood crossarm construction (age based on age of Deer Creek breaker)
- Legacy Cap and Pin type insulators
- Subject to 5 open conditions
- In the past 10 years, has had to have 26 open conditions addressed





AEP Transmission Zone: Supplemental
Marion, Indiana

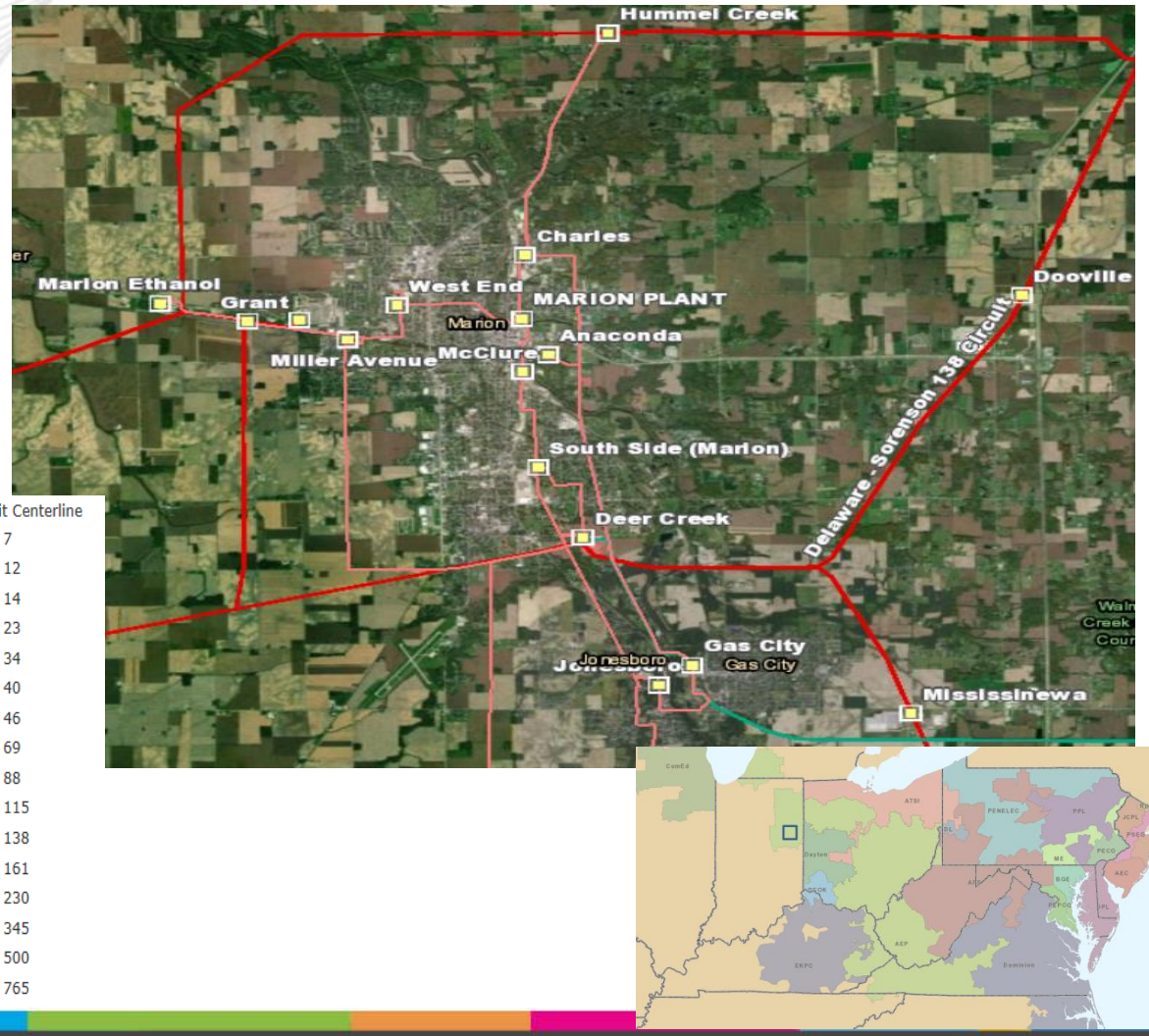
Need Number: AEP-2018-IM017
Process Stage: Needs Meeting
Process Chronology: Needs Meeting 1/11/19
Supplemental Project Driver: Operational Flexibility and Efficiency
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)
Problem Statement:

~~Grant Tap 138kV~~

- ~~3 terminal line outside of Grant Station.~~ Moved to AEP-2018-IM026

Deer Creek – Marion Plant 34.5kV

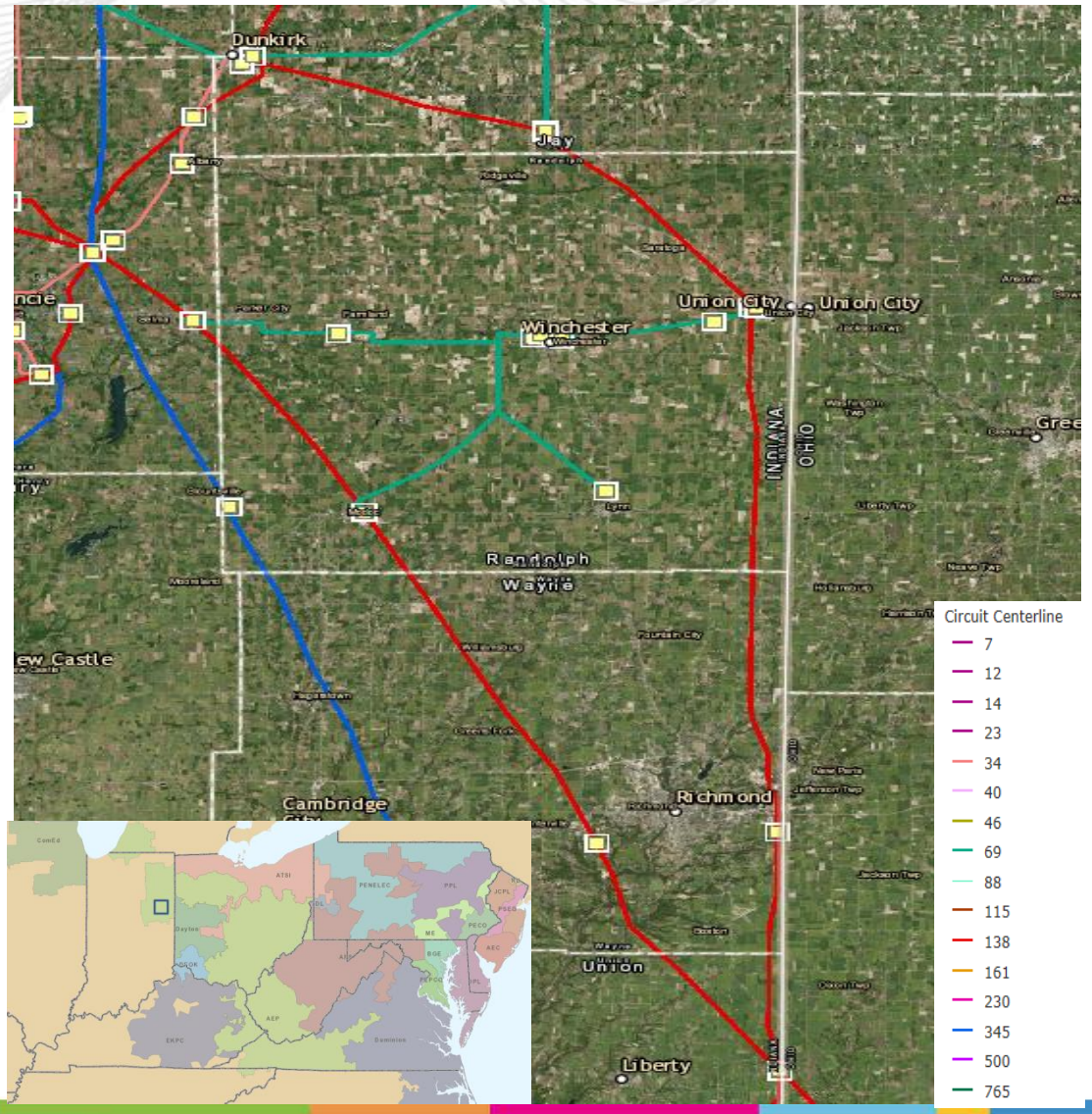
- 4 Moabs in series



AEP Transmission Zone: Supplemental
Jay – College Corner

Need Number: AEP-2018-IM018
Process Stage: Needs Meeting 1/11/19
Process Chronology: Needs Meeting 1/11/19
Supplemental Project Driver: Equipment Condition/Performance/Risk
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)
Problem Statement:
Jay – College Corner 138kV line

- 1941 & 1951 vintage wood H frame line
- Non-standard EHS Steel Shield Wire
- The most recent 6-year inspection showed 91 open conditions (A:52 B:39) with the majority being structural issues.
- In the past 10 years 97 structures have had to have active maintenance on them. This trend is expected to increase as the structures and conductor age.
- In the past 5 years AEP has experienced 13 scheduled outages and 2 forced momentary outages.



AEP Transmission Zone: Supplemental
Sturgis, Michigan Area

Need Number: AEP-2018-IM019
Process Stage: Needs Meeting 1/11/19
Process Chronology: Needs Meeting 1/11/19
Supplemental Project Driver: Equipment Condition/Performance
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)
Problem Statement:

Mottville Hydro Station –
- 1975 vintage 34.5kV grounding transformers carbon dioxide is at IEEE level 3
- PCB's and obsolete bushings

Moore Park Station -
- CB C is a 23 year old 69kV SF6 Breaker (ABB – 72PM31-20)
  - 38 fault operations
  - 38 recorded instances of SF6 additions since 2006

Stubey Road Station –
- Transformer high side ground switch

Sturgis Station –
- CB A and B 63 year old oil CBs with 37 and 28 fault operations, respectively
  - Replacement parts are very difficult to find for these legacy units

Moore Park Tap 69 kV –
- 1960s vintage wood structures
  - 20 poles identified with structural integrity concerns
  - Part of a three terminal line (~9 miles)

Sturgis – Howe (NIPSCO tie) –
- Vintage 1950s wood cross arm construction with suspended insulators (~3 mi)
- low capability 4/0 ACSR

AEP Transmission Zone: Supplemental
Sturgis, Michigan Area

Need Number: AEP-2018-IM019
Process Stage: Needs Meeting 1/11/19
Process Chronology: Needs Meeting 1/11/19
Supplemental Project Driver: Operational
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)
Problem Statement:
HMD Station –

- Permanently jumpered disconnects on main bus

Sturgis – Howe (NIPSCO tie)

- Outage constrained – difficult to outage due to local dependence

AEP Transmission Zone: Supplemental Columbus, OH

Need Number: AEP-2018-OH020

Meeting Date: 01/11/19

Process Chronology: Needs Meeting 01/11/19

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

Specific Assumption References:

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

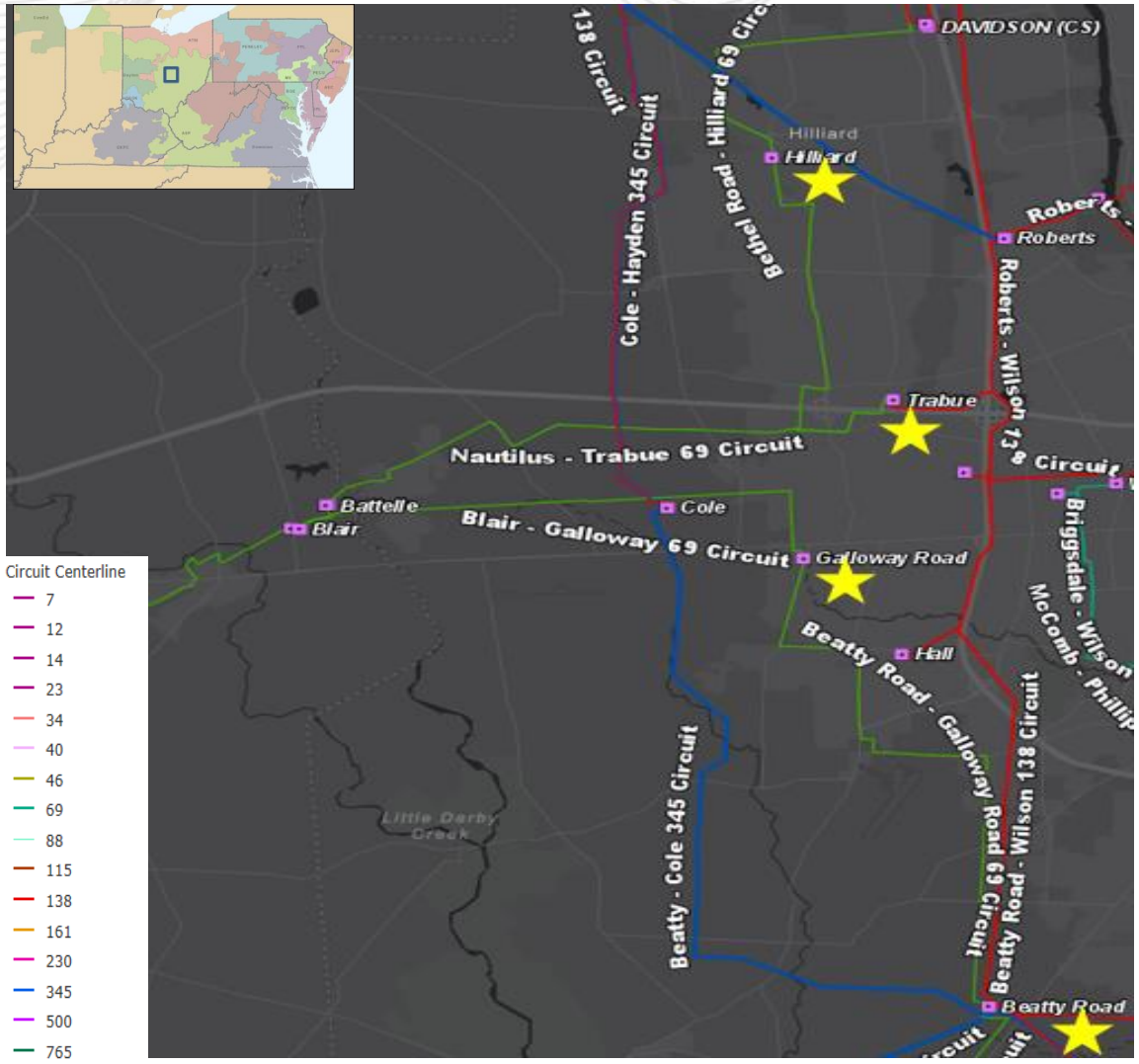
Problem Statement:

Hilliard Station 69kV:

- CB 61, CB 62, and CB 63 are 1960's vintage 69kV oil-filled breakers. Oil type breakers are difficult to maintain due to oil handling requirements, and have had a number of fault operations: CB 61 (15), CB 62 (21) and CB 63 (31).
- 105 of the 119 relays are electromechanical relays. EM relays have limited spare part availability, no vendor support, no SCADA functionality, and no fault data collection ability.
- The RTU is obsolete and does not meet current standards.
- The structure steel is deteriorating due to rust and the foundation supporting the steel shows severe cracking.

Trabue Station 138/69kV:

- The 1960's vintage, 138/69 kV, 115MVA Transformer #3 is recording elevated gas levels due to through fault conditions.
- 60 of the 86 relays are electromechanical relays. EM relays have limited spare part availability, no vendor support, no SCADA functionality, and no fault data collection ability.



AEP Transmission Zone: Supplemental Columbus, OH

Problem Statement Continued:

Galloway Station 69kV:

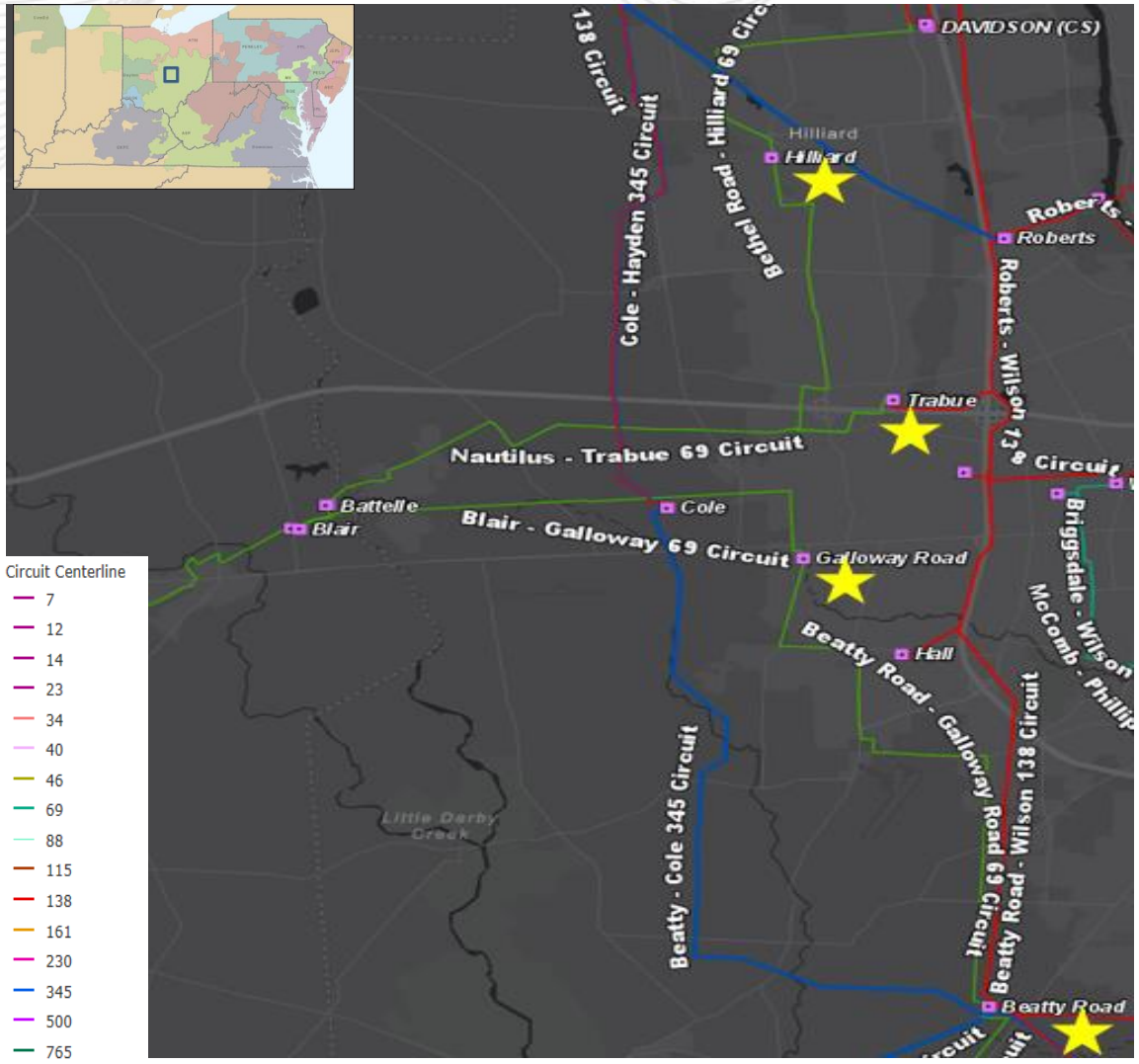
- 104 of the 122 relays are of the electromechanical type. EM relays have limited spare part availability, no vendor support, no SCADA functionality, and no fault data collection ability.
- The RTU is obsolete and does not meet AEP standards.
- The structure steel is deteriorating due to rust and the foundation supporting the steel shows severe cracking.

Beatty-Galloway 69kV:

- The total circuit (~ 8 mi) currently has 51 open A conditions (structure, conductor, shielding grounding, hardware, and other) with a number of deteriorated overhead structures.

Beatty Station 138/69kV:

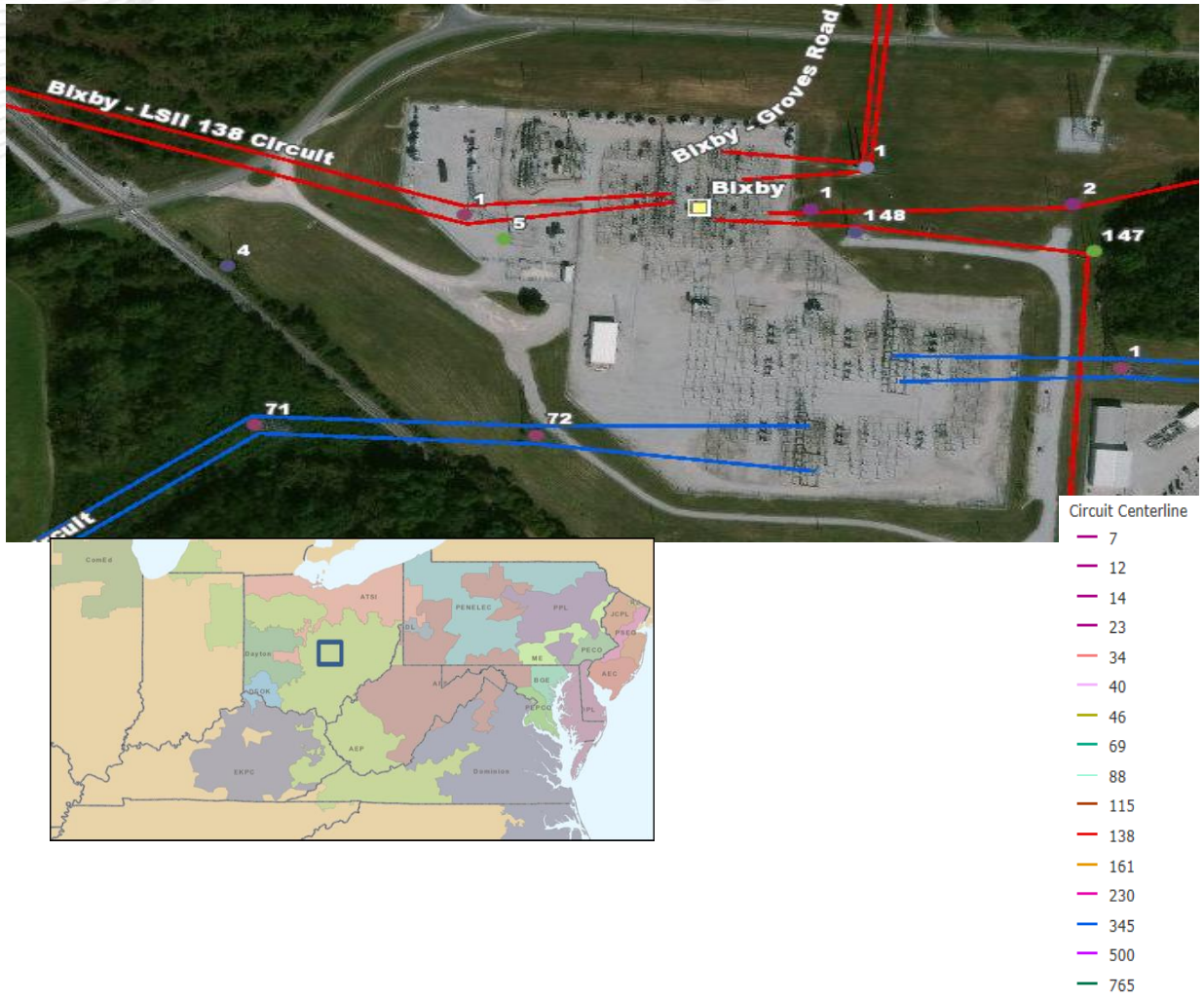
- Three 1960's vintage 69 kV oil breakers, CB 63, CB 64, and CB 65, show signs of bushing damage, lack of available repair parts, and high PCB content. Oil type breakers are difficult to maintain due to oil handling requirements, and have had a number of fault operations: CB 64 has seen 34 fault operations.
- 1960's vintage, 138/69 kV 50 MVA transformers #2 & #4 are showing signs of short circuit strength breakdown due to the amount of through fault events, dielectric strength breakdown, and bushing damage (bushings). Transformer #2 also has a high levels of dissolved gas in the oil.



AEP Transmission Zone: Supplemental Columbus, Ohio

Need Number: AEP-2018-OH028
Meeting Date: 01/11/19
Process Chronology: Needs Meeting 01/11/19
Supplemental Project Driver: Equipment Material/Condition/Performance/Risk
Specific Assumption References:
AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

Problem Statement:
The 345/138kV, 675MVA transformer #1 failed and caught fire at Bixby station. The MOAB switch, and risers cannot be repaired. A replacement is needed to support the load in the area.
Total Estimated Transmission Cost: $5.8M

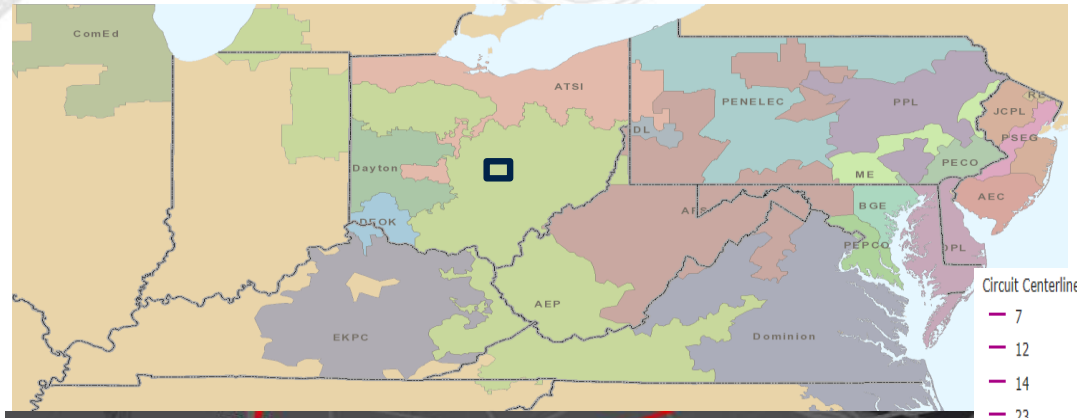


AEP Transmission Zone: Supplemental Columbus, Ohio

Need Number: AEP-2018-OH029
Meeting Date: 01/11/19
Process Chronology: Needs Meeting 01/11/19
Supplemental Project Driver: Equipment Material/Condition/Performance/Risk
Specific Assumption References:
AEP Guidelines for Transmission Owner Identified Needs

Problem Statement:

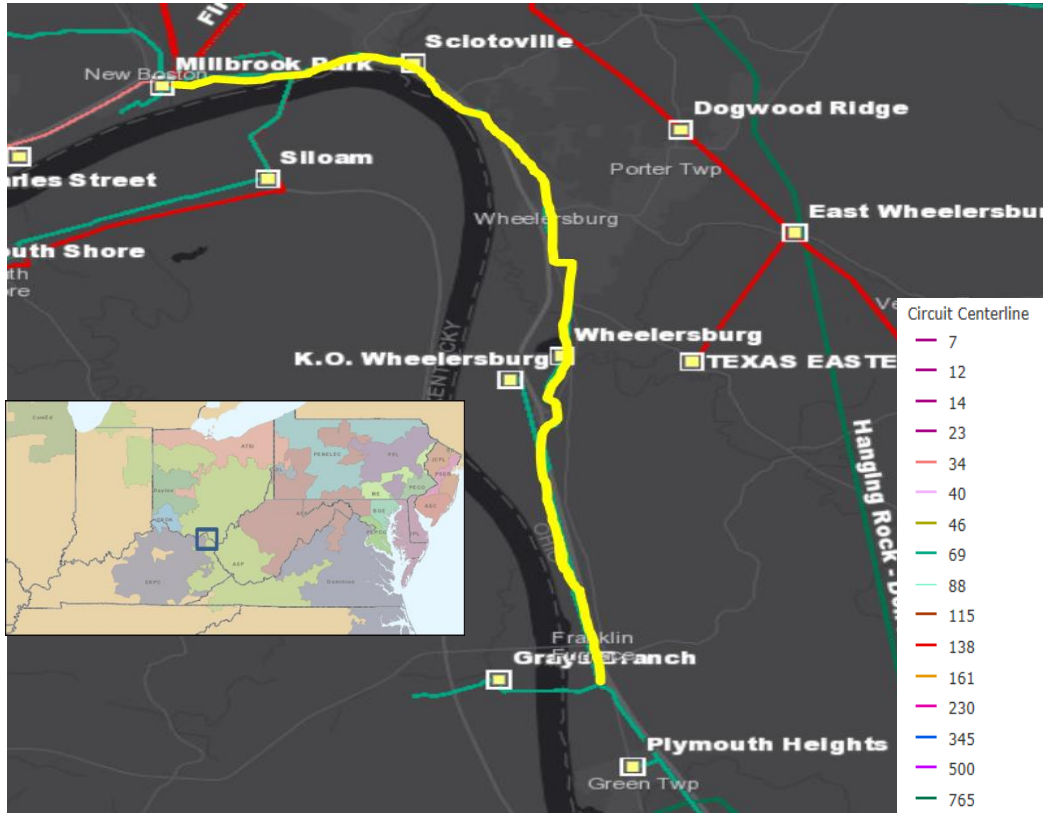
- The Fisher-Hall-Wilson 138kV circuit is a three terminal line. Three-terminal lines cannot be protected adequately and lead to mis-operations including over tripping.
- At Wilson Road station, 138kV CB's 2, 3, 4, 5, 6, 7, 8, & 9 (vintage1960-1970), 46 kV cap switcher AA (vintage 1995), and 40kV CB's 30 & 35 (vintage 1956) are all oil type interrupting devices. Oil type equipment is difficult to maintain due to the oil handling requirements and due to environmental risk associated with spills that are common. In addition, some of these devices have exceeded the manufactures recommended number of fault operations 40kV CB 35 (55) and 138kV CB 4 (17).
- 40kV is considered to be an obsolete voltage technology because of lack of replacement/repair parts and lack of vendor support.
- McComb station is served from two 138kV sources, one of which relies on an underground oil filled pipe type cable. This is a reliability concern because any significant outage will likely require several months to repair, leaving the station radialized. We have experienced several prolonged outages of oil filled cables. These cables are only manufactured by a single manufacturer with a lead time of 8-12 months.
- Two 50MVA transformers at McComb are protected by ground switch MOABs which can cause damage nearby equipment when they operate.
- The 1.7 mile Briggsdale-McComb 40kV line (vintage 1973) has 8 open conditions including hardware, shielding/grounding, and forestry.
- The 5.19 mile Briggsdale-Wilson 40kV line (vintage 1935 – 2011) has 87 open conditions including structures, conductor, shielding/grounding, hardware, and forestry.



AEP Transmission Zone: Supplemental Portsmouth, Ohio

Need Number: AEP-2018- OH030
Meeting Date: 01/11/19
Process Chronology: Needs Meeting 01/11/19
Supplemental Project Driver: Equipment Condition, Performance Risk, Customer Service, Operational Flexibility
Specific Assumption References:
AEP Guidelines for Transmission Owner Identified Needs.
Problem Statement:

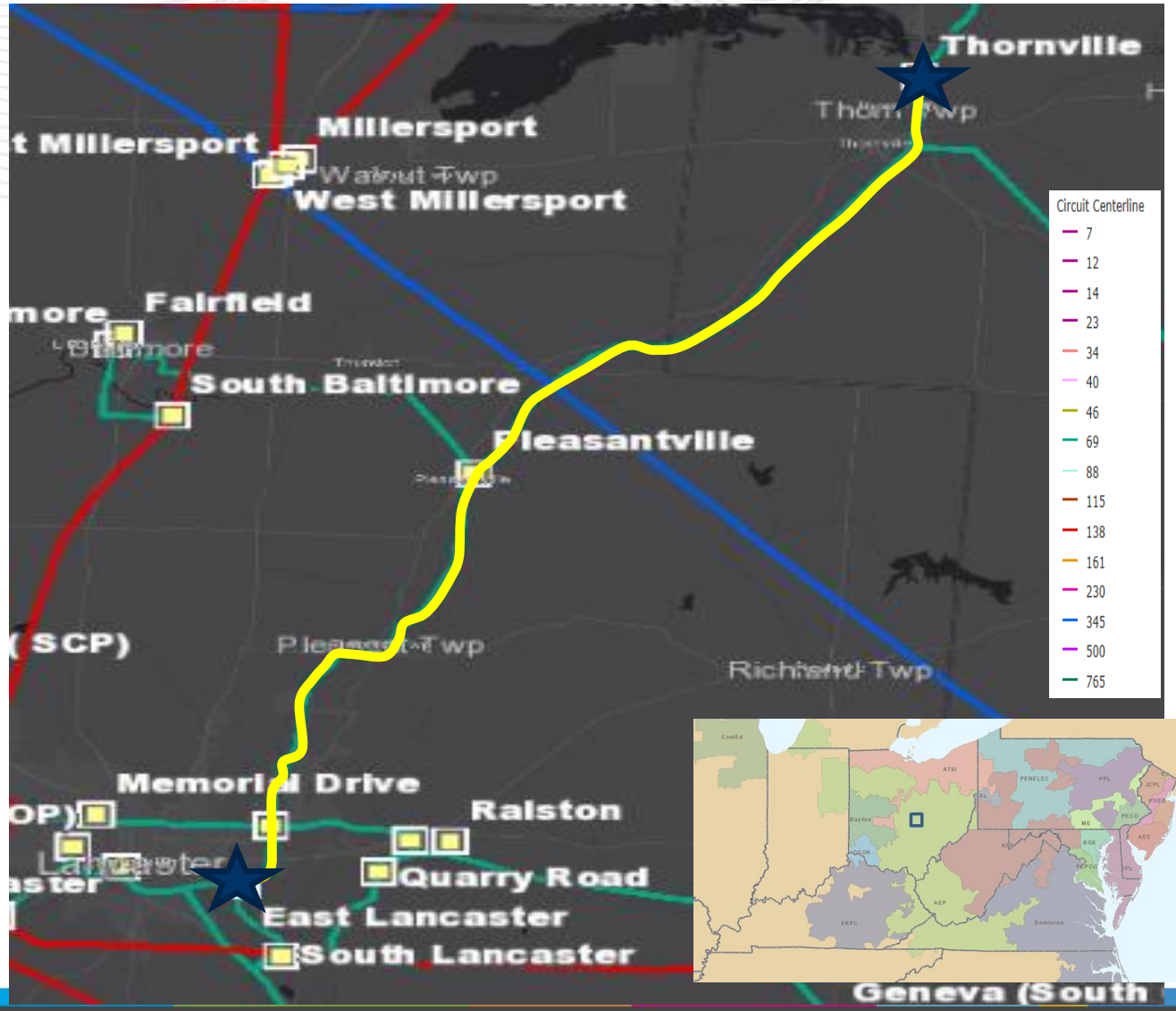
- The 27-mile 69kV Portsmouth-Ironton line (vintage 1915) uses wood pole structures with variety of conductors, mostly 2/0 Cu (40 MVA rating). A 11.9 mile section between Millbrook Park and Franklin Furnace has 73 open A conditions, including rotten cross-arms, burnt/broken insulators, and loose/broken conductor hardware.
- The Millbrook Park-Franklin Furnace-Argentum line is a 3-terminal line. Three-terminal lines cannot be adequately protected due to the complexity of coordination, which, causes misoperations including over-tripping. The Millbrook Park-North Haverhill-Argentum circuit is protected by an impedance based Directional Comparison Blocking (DCB) pilot system, which cannot adequately protect a three terminal lines.
- Over the past several years, the Millbrook Park-Argentum-North Haverhill circuit has experienced reliability issues including 5 sustained outages and 21 momentary outages.
- The Texas Eastern Substation serves a peak load of 26 MW via a 2.1-mile radial line from East Wheelersburg. Also, K.O. Wheelersburg is a 1.2 MVA 69 kV retail load served off a 1.3-mile radial line. These radial loads are at risk of extended outages for line maintenance or repair.
- At Sciotoville, CBs A and B are both oil type breakers with 16 and 10 fault operations respectively. This particular model has no spare parts and a history of poor reliability. Sciotoville has a ground switch MOAB on the transformer. Ground switch MOAB's cause intentional high side faults to clear the transformer faults which cause damage to and reduction in life of nearby equipment.
- Sciotoville and Wheelersburg currently have 8 (of 10) and 10 (of 10) electro-mechanical relays respectively. EM relays have no spare part availability, a lack vendor support, no SCADA functionality, and no fault data collection ability.



AEP Transmission Zone: Supplemental Lancaster, Ohio

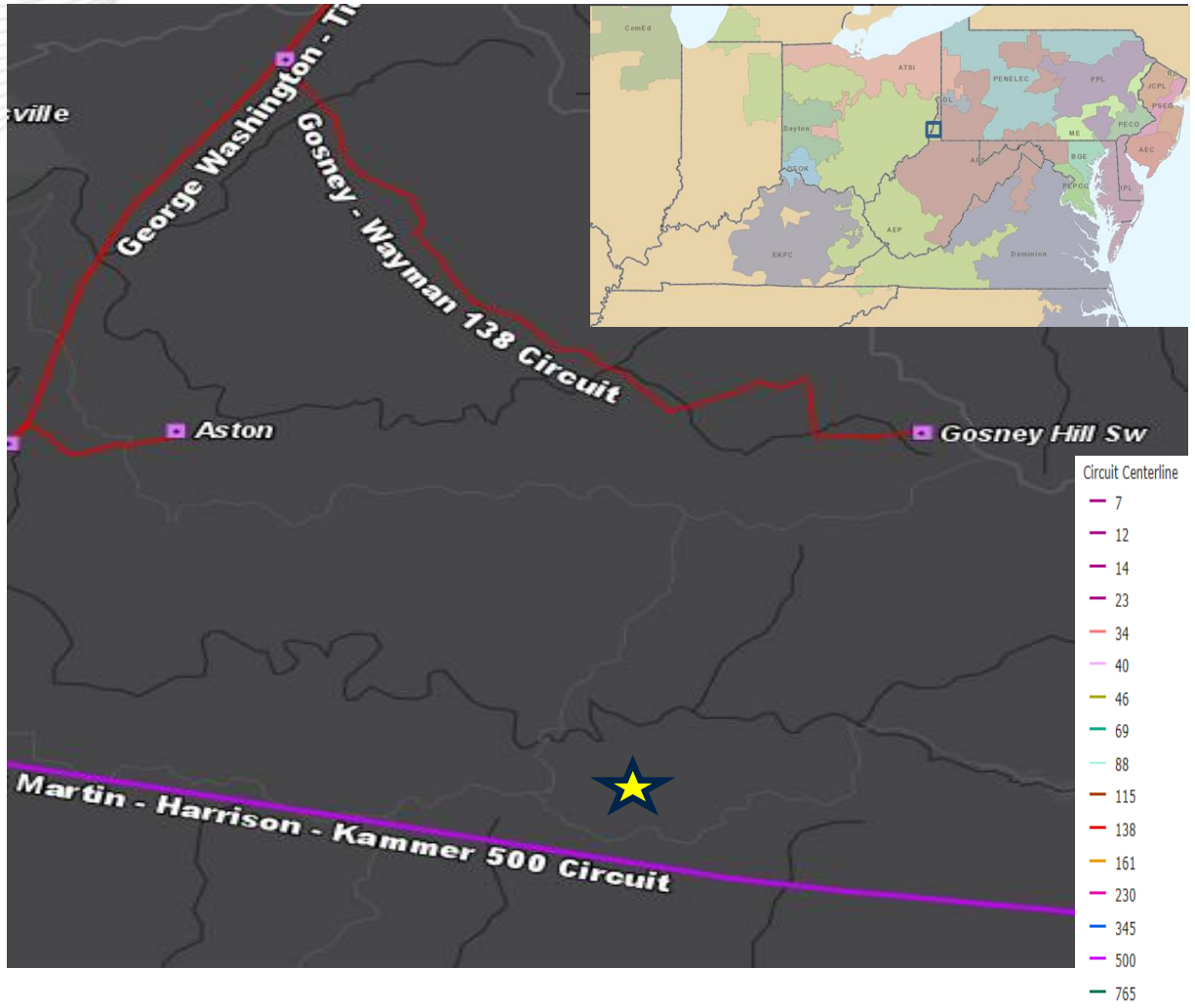
Need Number: AEP-2018-OH031
Meeting Date: 01/11/19
Process Chronology: Needs Meeting 01/11/19
Supplemental Project Driver: Equipment Material/Condition/Performance/Risk
Specific Assumption References:
AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)
Problem Statement:

- The existing 18.4 mile 69 kV section between Thornville –Lancaster 69 kV line was constructed in 1915 using wood pole structures with copper conductors (mostly 1/0 Cu).
- There are currently 228 open A conditions along this line. The Baltimore-East Lancaster 69 kV circuit section has experienced over 350,000 customer minutes of interruption over the past three years. The majority of outages were due to conductor failures, shielding failures, structure washouts, and insulators failures.



AEP Transmission Zone: Supplemental Cameron, West Virginia

Need Number: AEP-2018-OH032
Meeting Date: 01/11/19
Process Chronology: Needs Meeting 01/11/19
Supplemental Project Driver: Customer Service
Specific Assumption References:
AEP Connection Requirements for the AEP Transmission System (AEP Assumptions Slide 7)
Problem Statement:
A customer has requested new service west of Cameron, West Virginia. The forecasted peak demand is 30 MVA.



AEP Transmission Zone: Supplemental Bluffton, OH

Need Number: AEP-2018-033
Meeting Date: 1/11/2019
Process Chronology: Needs Meeting 1/11/2019
Supplemental Project Driver: Equipment/Material/ Condition/Performance/Risk, Operational Flexibility and Efficiency, Other.
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs
Problem Statement:

Equipment Material/Condition/Performance/Risk:

AEP's North Woodcock 138/69/34.5 kV, 50 MVA Transformer #1 (1966 vintage) is recommended for replacement due to dielectric strength breakdown, short circuit strength breakdown, and bushing damage. The 1200A/21kA, 69kV CB "A" (1966 vintage) and the 1200A/17kA,34.5kV CB "E" (1952 vintage), are in need of replacement due to bushing damage, excess numbers of fault operations (143), and a lack of spare part availability.

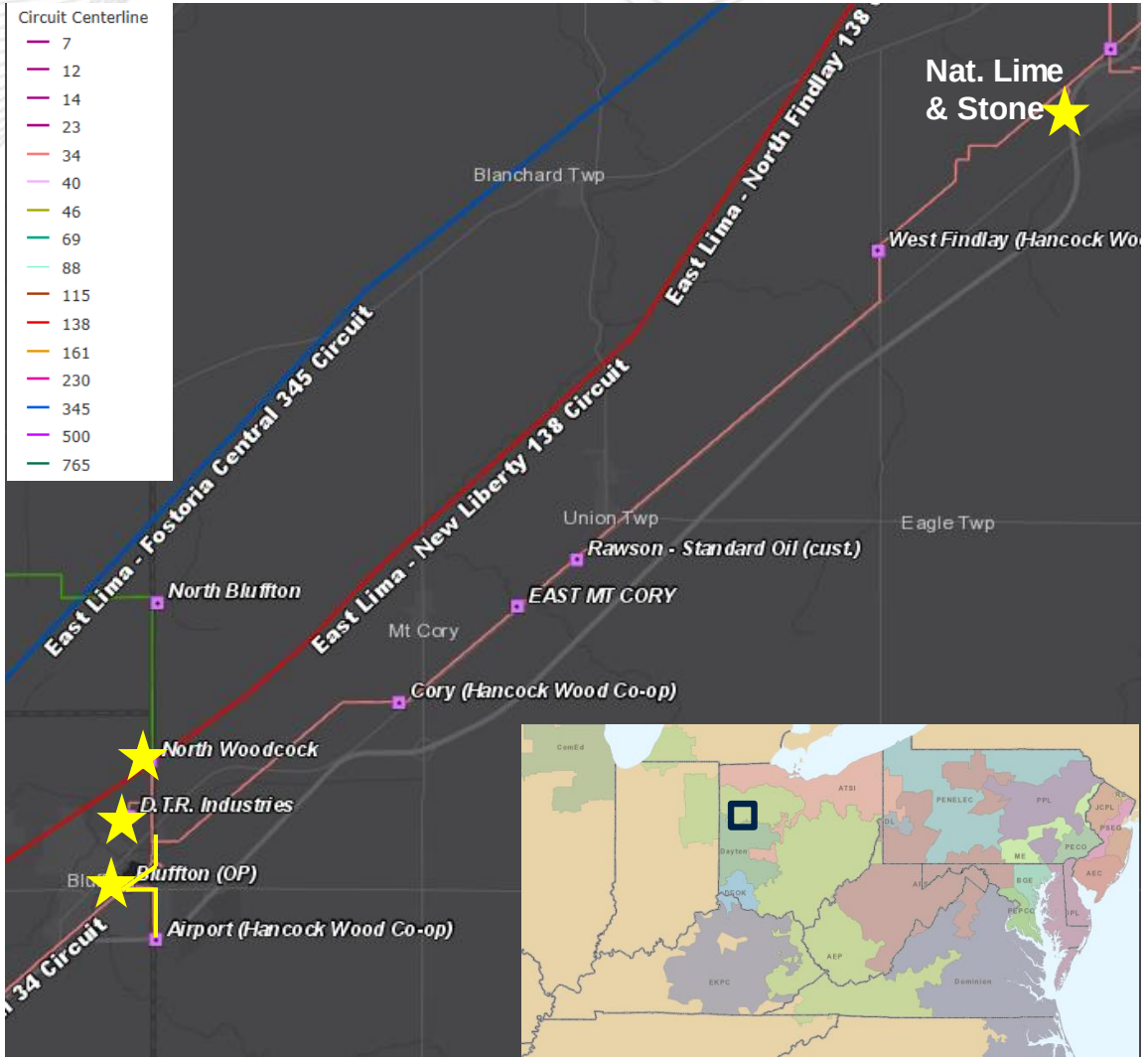
The ~~Bluffton – Rockhill~~ Bluffton – Str. 97 line section (~10 miles) of the Bluffton – Rockhill 34.5 kV line (~14 miles) has ~~55~~ 35 open conditions. Most of the wood poles on this circuit are pre 1980-vintage. This line has experienced ~~9~~ 1 momentary and ~~4~~ 1 permanent outages in the last 10 years. 0.93 miles of this 34.5 kV line section between Hancock Wood Airport Delivery Point- Bluffton Station is nearing it's thermal capacity under N-1-1 conditions.

The Morrical – N. Woodcock 34.5 kV line has 77 open conditions. Half of the wood poles on this circuit are pre-1980 vintage. This line has experienced 16 momentary and 3 permanent outages in the last 10 years. The 0.64 mile 34.5 kV line section between Bluffton Station - Woodcock Switch is nearing it's thermal capacity under N-1-1 conditions.

Operational Flexibility and Efficiency:

Bluffton Sw 34.5 kV is currently N.O. (towards Woodcock). This switch is open to prevent thermal overloads on the 34.5 kV system (~17 miles) under N-1-1 conditions.

Hard taps currently exist for customers at both DTR and National Lime and Stone. Hard taps limit sectionalizing and often cause misoperations and over tripping



AEP Transmission Zone: Supplemental Hummel Creek & Gas City, Indiana

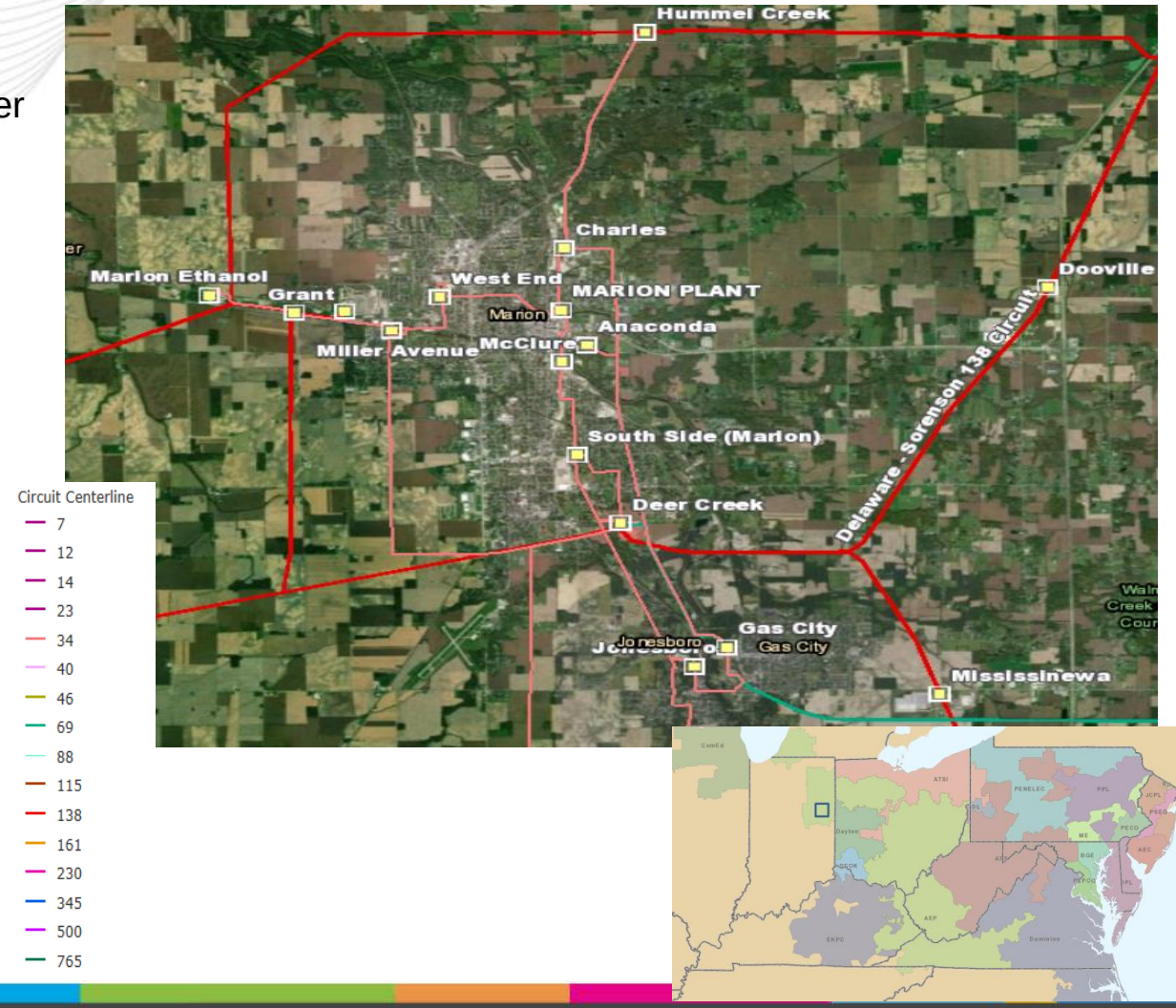
Need Number: AEP-2018-IM022
Process Stage: Needs Meeting 1/11/2019
Process Chronology: Needs Meeting 1/11/2019
Supplemental Project Driver: Equipment Condition/Performance/Risk
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)
Problem Statement:

Hummel Creek 34.5kV

- Breakers "L" and "M"
  - 1949-1950 vintage FK oil breaker without containment
  - Fault Operations: CB M(33) CB L(2) – Recommended(10)

Gas City 34.5kV

- Breakers "A"
  - 1940 vintage FK oil breaker without containment
  - Fault Operations: CB A(50) – Recommended(10)

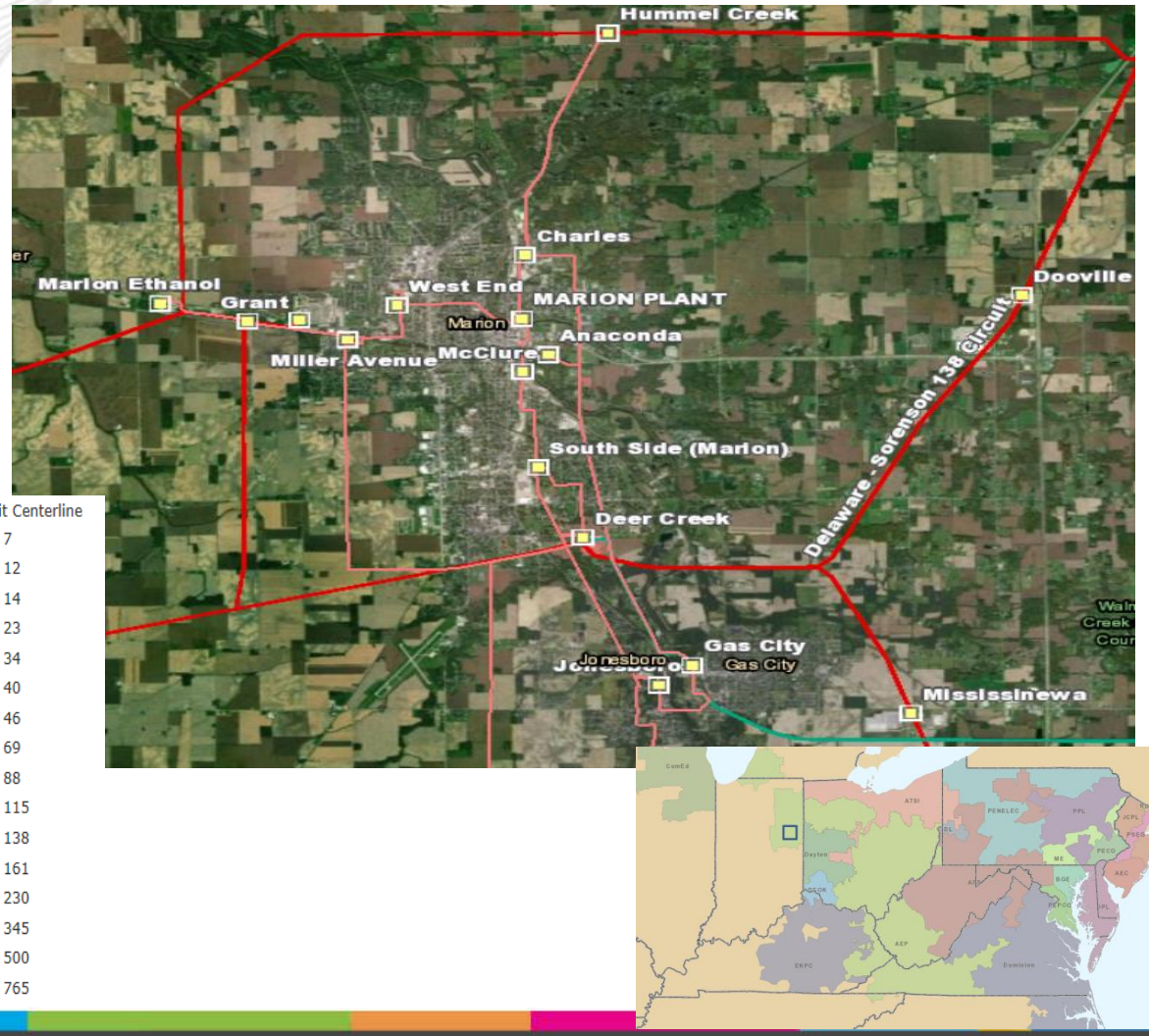


AEP Transmission Zone: Supplemental Hummel Creek – Deer Creek, Indiana

Need Number: AEP-2018-IM023
Process Stage: Needs Meeting 1/11/2019
Process Chronology: Needs Meeting 1/11/2019
Supplemental Project Driver: Equipment Condition/Performance/Risk
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)
Problem Statement:

Deer Creek – Hummel Creek 34.5kV (11 miles)

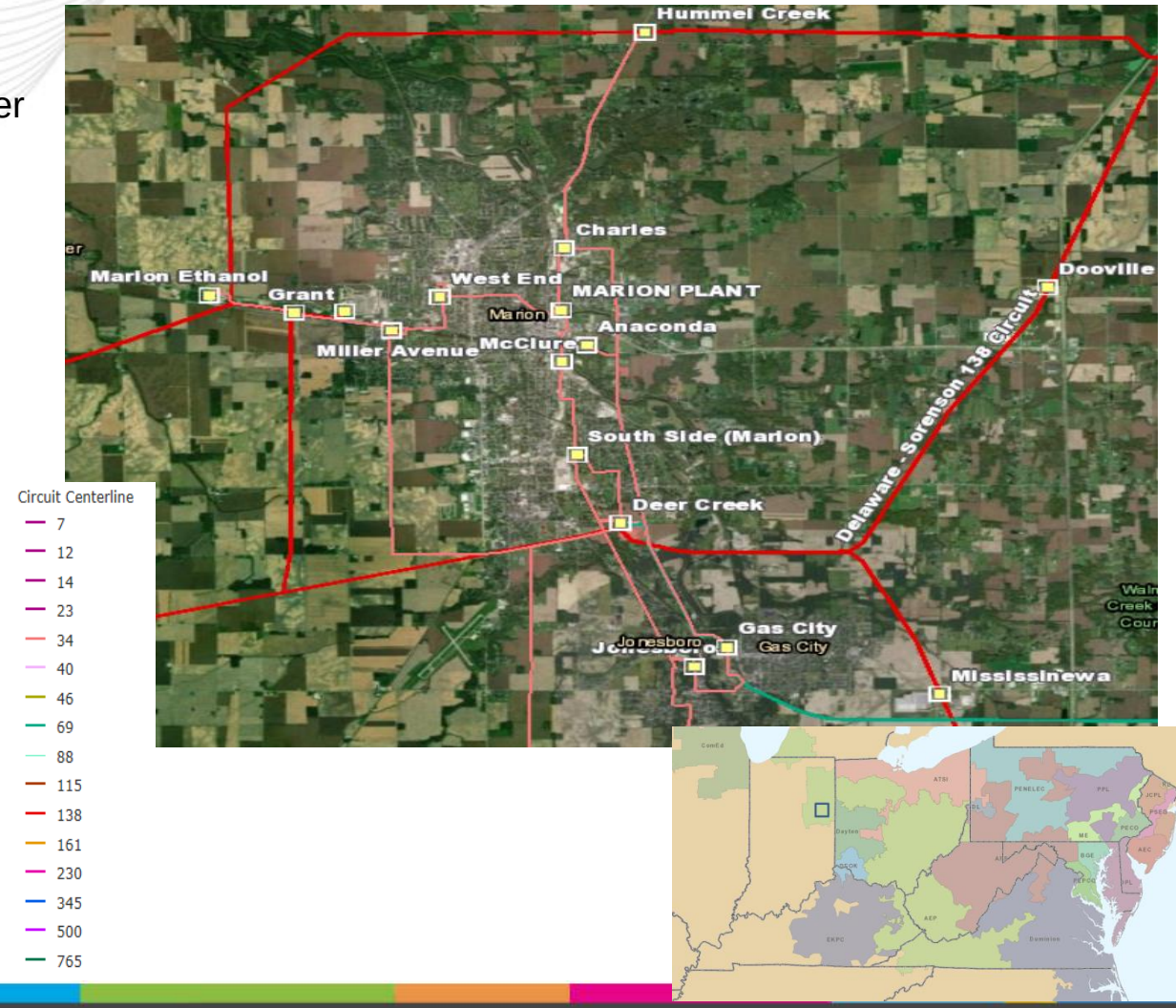
- 1940 wood crossarm construction (age based on age of station)
- Subject to 16 open A conditions
- Subject to 17 open B conditions
- In the past 10 years, 16 structures have had active maintenance performed. This is expected to increase as line ages.



AEP Transmission Zone: Supplemental
Miller Ave, Indiana

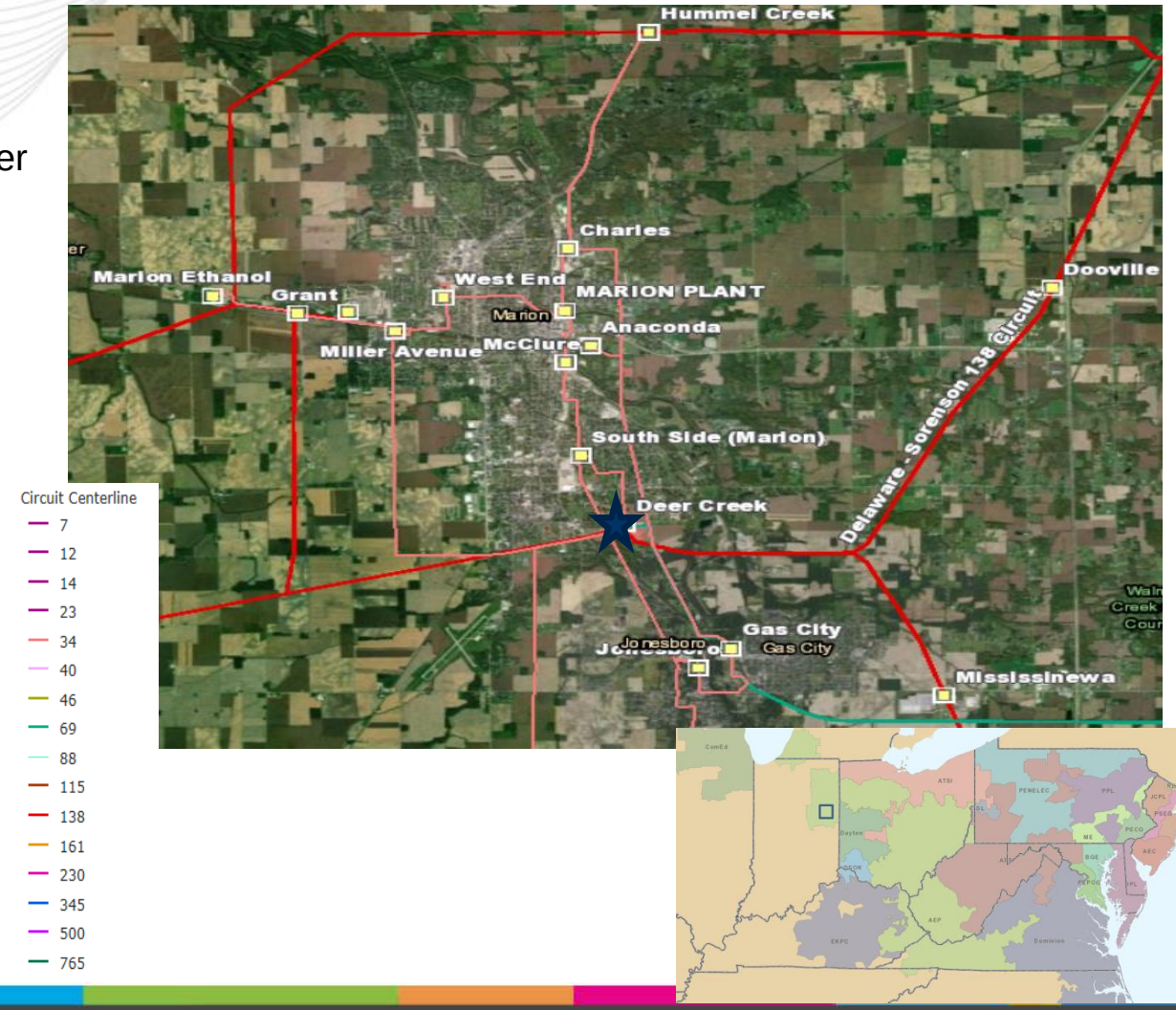
Need Number: AEP-2018-IM024
Process Stage: Needs Meeting 1/11/2019
Process Chronology: Needs Meeting 1/11/2019
Supplemental Project Driver: Equipment Condition/Performance/Risk
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)
Problem Statement:
Miller Avenue 34.5kV

- Breakers "A" and "B"
  - 1950 vintage FK oil breaker without containment
  - Fault Operations: CB A(10) CB B(16) – Recommended(10)



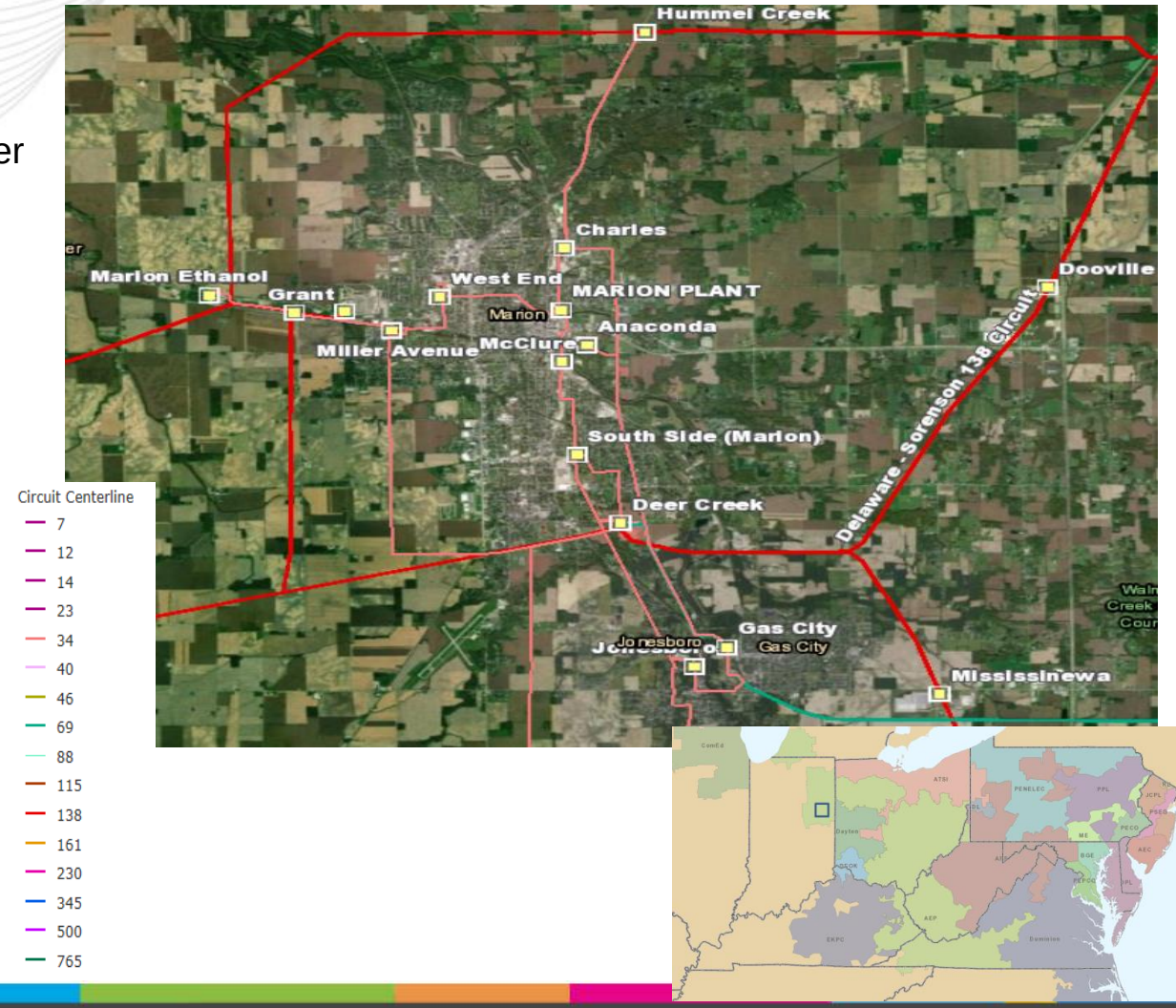
Need Number: AEP-2018-IM025
Process Stage: Needs Meeting 1/11/2019
Process Chronology: Needs Meeting 1/11/2019
Supplemental Project Driver: Equipment Condition/Performance/Risk
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)
Problem Statement:
Deer Creek 34.5kV

- Breakers "U"
  - 1949-62 vintage FK oil breakers without containment
  - Fault Operations: CB U(38)– Recommended(10)



AEP Transmission Zone: Supplemental
Grant Tap, Indiana

Need Number: AEP-2018-IM026
Process Stage: Needs Meeting 1/11/2018
Process Chronology: Needs Meeting 1/11/2018
Supplemental Project Driver: Operational Flexibility and Efficiency
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)
Problem Statement:
Grant Tap 138kV
There is a three terminal line about 4 miles outside Deer Creek station.



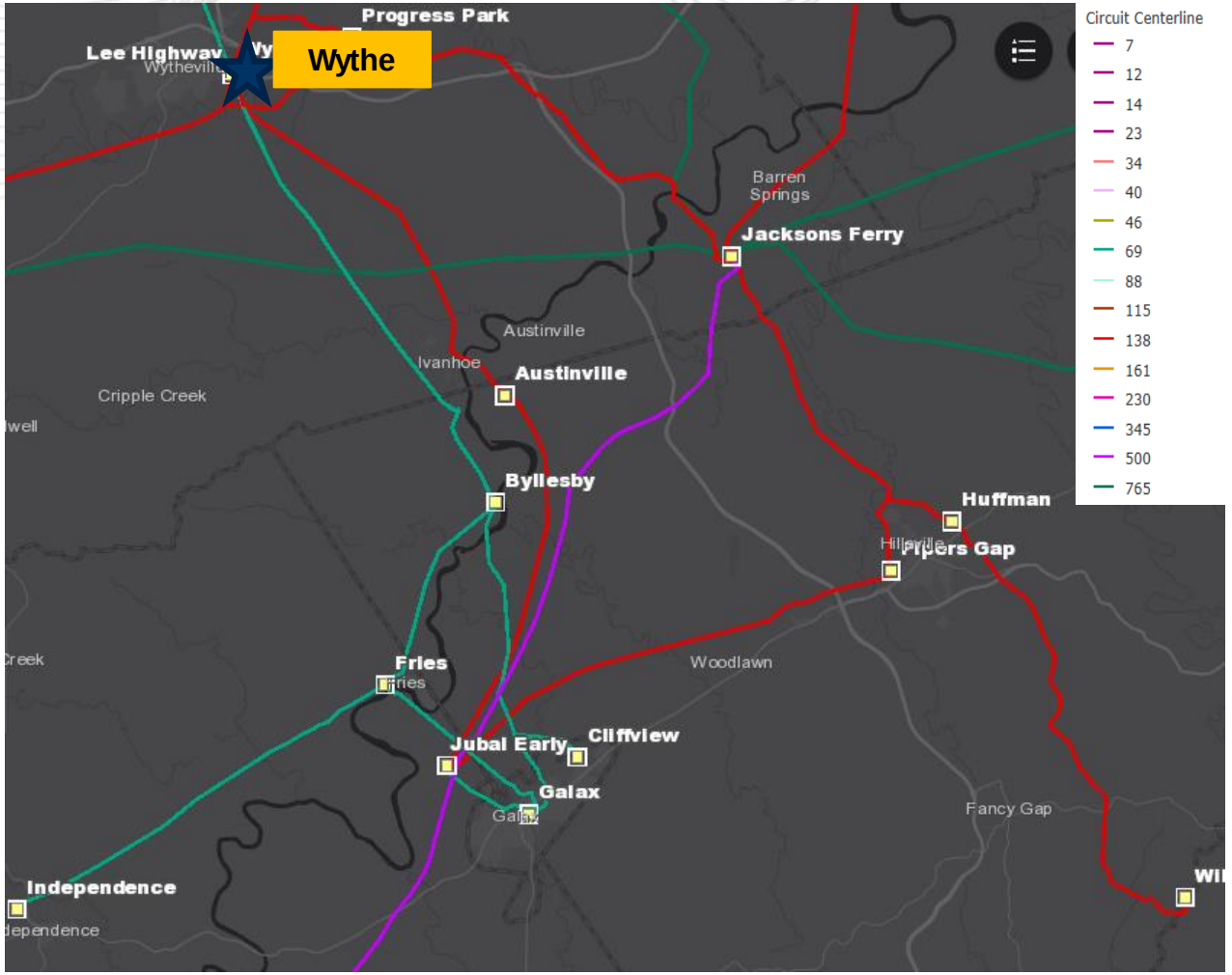
AEP Transmission Zone: Supplemental Wytheville, Virginia

Need Number: AEP-2018-AP023
Process Stage: Needs Meeting
Needs Presented: 1/11/19
Supplemental Project Driver: Equipment Material/Condition/Performance/Risk
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

Problem Statement:

Wythe 138/69 kV transformer has experienced thermal through fault events, mostly in excess of 700°C, have led to numerous overheating events, steady increases in gasses including high levels of ethylene and ethane, and carbonization of the insulating paper. The oil's interfacial tension is showing signs of sludge beginning to form due to the carbonization created contaminants. In addition, the moisture content is beginning to climb which has not yet been reflected in a drop in dielectric strength. Wythe circuit breaker F is an FK type oil filled breaker. Oil filled breakers have much more maintenance required due to oil handling that their modern, SF6 counterparts do not require. The FK-439-115-3500-3 is no longer vendor supported and is 1 of 2 remaining on the AEP system, making spare parts difficult or impossible to acquire. Wythe circuit breaker M is a CF type oil filled breaker. Oil filled breakers have much more maintenance required due to oil handling that their modern, SF6 counterparts do not require. This particular unit has a recorded malfunction related to a broken S.S. line on the maintenance valve and pressure switches.

Continued on next slide



AEP Transmission Zone: Supplemental Ivanhoe & Galax, Virginia

Need Number: AEP-2018-AP023 continued
Process Stage: Needs Meeting
Needs Presented: 01/11/19
Supplemental Project Driver: Equipment Material/Condition/Performance/Risk
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

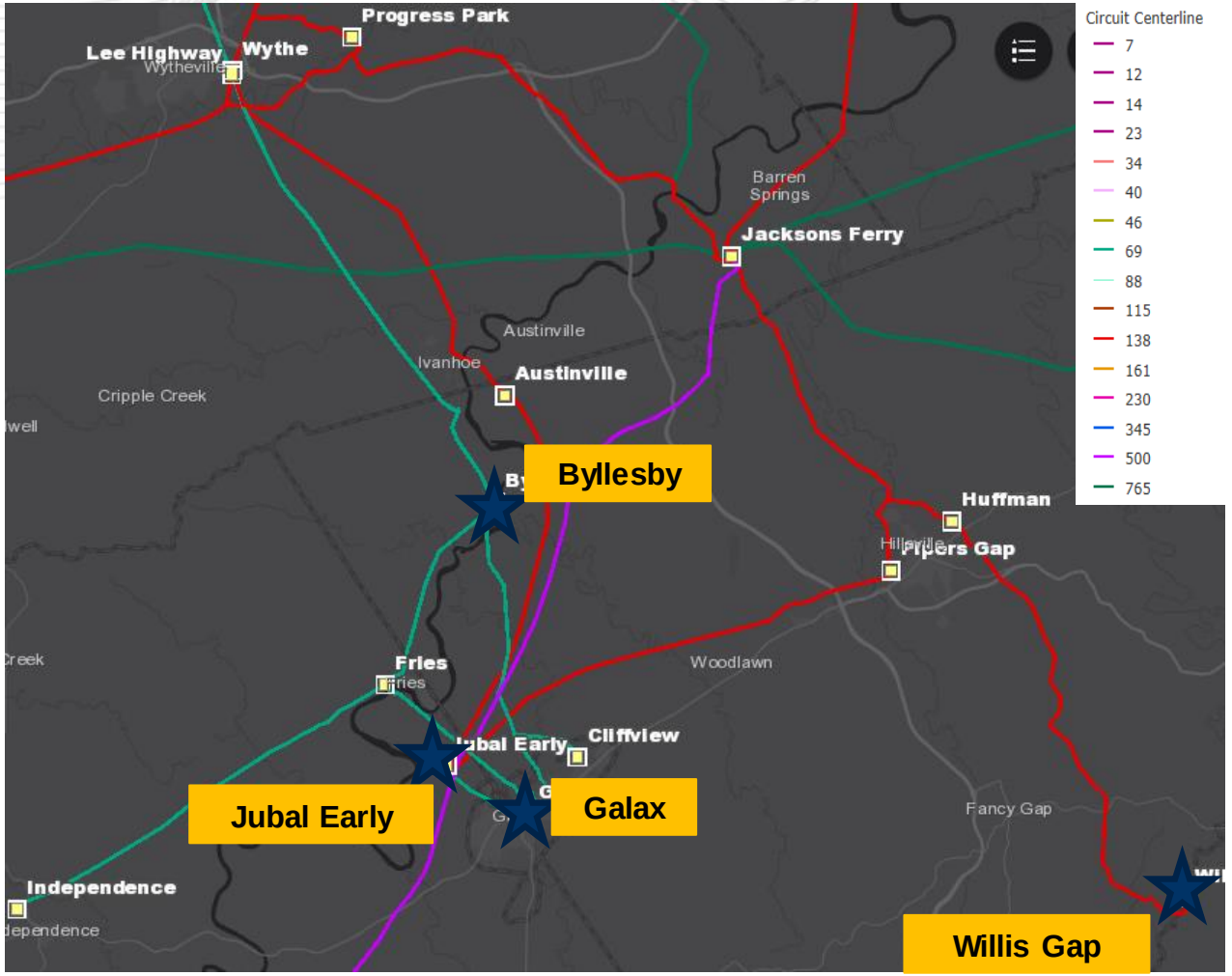
Problem Statement:

Byllesby circuit breakers B and D are oil filled breakers manufactured in 1952 and 1965 respectively. Both breakers have exceeded the designed number of fault operations (10). These breakers are GE FK type oil breakers with no oil containment. The GE FK type breakers are known to have an internal operating mechanism that are prone to high failure rates.

Galax circuit breakers G, F, and H are all GE FK type oil breakers with no oil containment. The GE FK type breakers are known to have an internal operating mechanism that are prone to high failure rates. Circuit Breakers G, F, and H are all approximately 50 years old and have exceeded the designed number of fault operations (10).

Jubal Early 138/69kV Transformer has reoccurring bushing damage, dielectric strength breakdown (insulation breakdown) and short circuit breakdown (due to fault events). Recent test reports show oil interfacial tension to be below the minimum acceptable level for a unit of this voltage class. Reduction in oil interfacial tension is related to oil contamination and presence of oxidation byproducts in the oil.

Huffman – Willis Gap 138 kV is a 15 mile long radial line that serves approximately 25 MVA of load at Willis Gap 138 kV station.



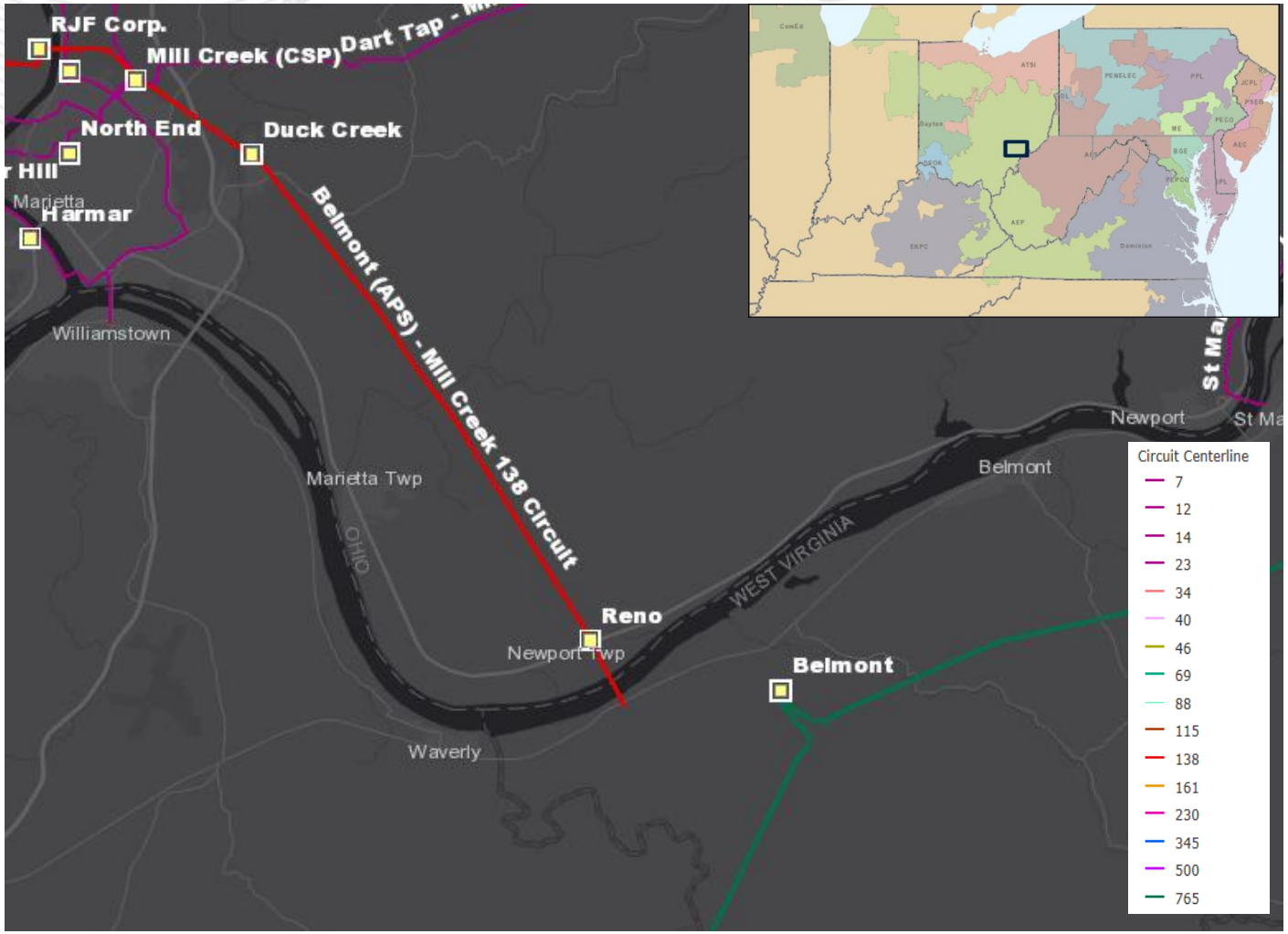
Solutions

AEP Transmission Zone: Supplemental Marietta, Ohio

Need Number: AEP-2018-OH014
Process Stage: Solutions Meeting 1/11/19
Needs Presented: 10/26/18
Supplemental Project Driver: Operational Flexibility and Efficiency, Customer Service.
Specific Assumption References:
AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 7 and 8)
Problem Statement:

Reno Substation is served off a 138kV hard tap. If there is an outage, planned or unplanned on the line sections between Belmont and Levee, the Reno load will be dropped. There is partial transfer capability for Reno during light load periods only. Levee Station cannot take all Reno's load because the distribution circuits are over five miles between the two stations dictated by geography.

The nearby Wade station is being retired as part of an area project to address an unreliable 23 kV system. Levee Station will will take a portion of Wade's load and the remaining load will be served from Reno Station.



AEP Transmission Zone: Supplemental
Marietta, Ohio

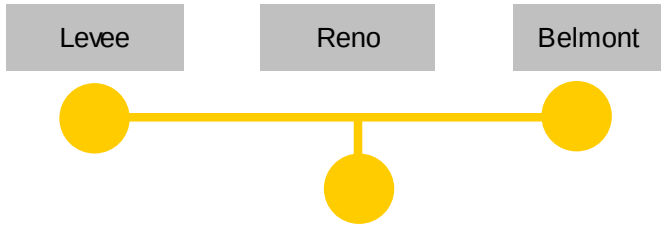
Need Number: AEP-2018-OH014

Proposed Solution:
At Reno, install a 3-way switch at the hard tap, and fiber and SCADA, and relocate a pole.

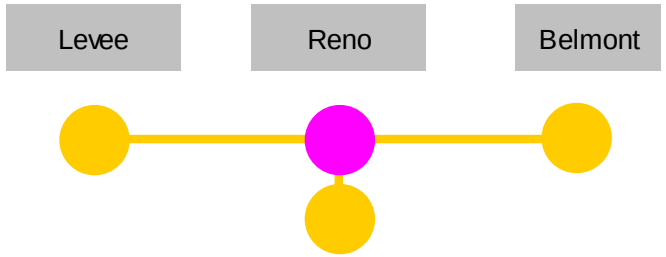
Alternatives:
Loop the transmission line through the station

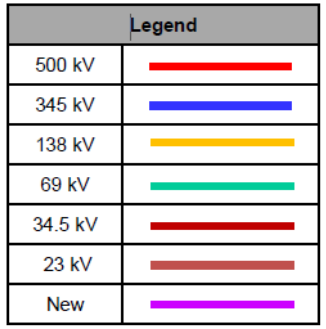
Estimated Transmission Cost: $2.56M
Projected In-Service: 6/1/2019
Project Status: Engineering

Existing



Proposed





AEP Transmission Zone: Supplemental Baltimore, Ohio

Need Number: AEP-2018-OH021
Process Stage: Solution Meeting 1/11/2019
Needs Presented: 11/29/2018
Supplemental Project Driver: Customer Request
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs
Problem Statement:

- Baltimore 69kV CBs E and F are oil type breakers (vintage 1951) and have been identified for replacement due to lack of spare part availability, historical reliability, and lack of vendor support. Oil breakers are difficult to maintain due to oil handling requirements. Oil spills can occur during maintenance and fixes. The breakers have experienced the following fault operations: CB E (5), CB F (5).
- Baltimore currently has 20 electro-mechanical relays employed. EM relays have limited spare part availability, a lack of vendor support, no SCADA functionality, and no fault data collection ability.
- Lancaster 69kV CBs B and D are oil type breakers (vintage 1989) and have been identified for replacement due to lack of spare part availability, historical reliability, and lack of vendor support. Oil breakers are difficult to maintain due to oil handling requirements. Oil spills can occur during maintenance and fixes. The breakers have experienced the following fault operations: CB B (4), CB D (18).
- Lancaster currently has 46 electro-mechanical relays employed. EM relays have limited vendor support, lack of SCADA functionality, and don't offer fault data collection

AEP Transmission Zone: Supplemental Lancaster, Ohio

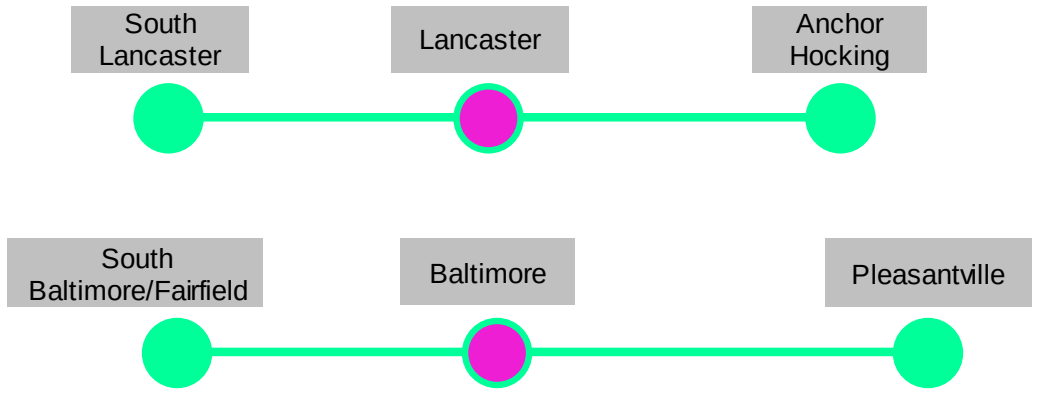
Need Number: AEP-2018-OH021

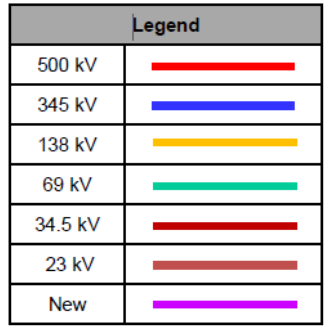
Proposed Solution:
At Lancaster station, replace existing 69 kV CB B and CB D with new non-oil breakers and upgrade relaying at the station. Estimated cost: $3.02M

At Baltimore station, replace existing CBs E and F with new non-oil breakers and upgrade relaying at station. Estimated cost: $2.21M

Alternatives:
No viable cost-effective alternative was identified.

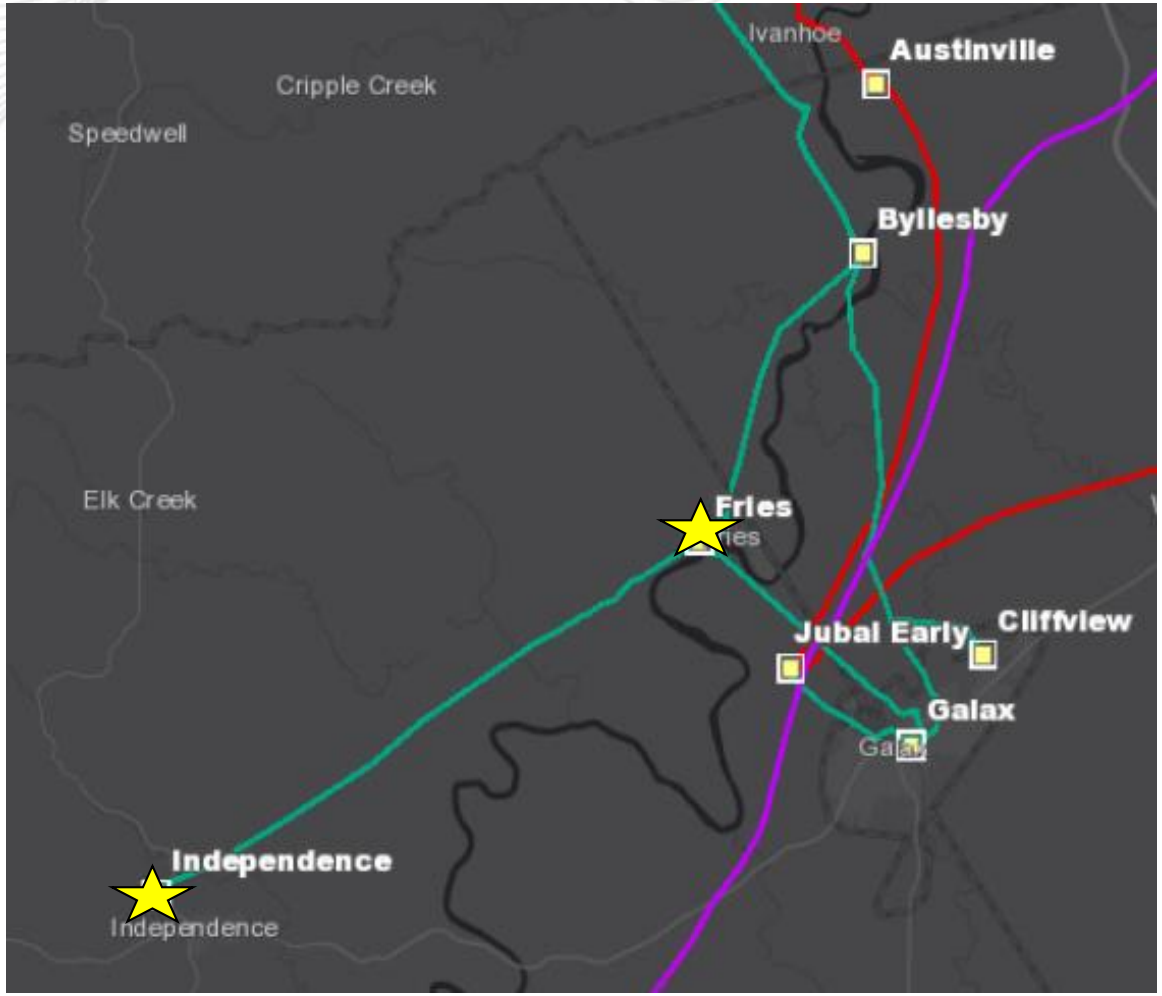
Total Estimated Transmission Cost: $5.23M
Projected IS Date: 12/15/2019
Project Status: Engineering





AEP Transmission Zone: Supplemental
Grayson County, VA

Need Number: AEP-2018-AP001
Process Stage: Solution Meeting 1/11/2019
Process Chronology: Needs Meeting 10/26/18
Supplemental Project Driver: Equipment Condition/Performance/Risk
Specific Assumption References: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)
Problem Statement:
The Fries – Independence 69kV line is an 11 mile long radial line and maintenance cannot be performed due to a lack of outages available on the line. Approximately 20 MVA is served out of Independence during winter peak conditions and is dropped for outages on this circuit. From 2013-2018, the Fries – Independence 69 kV circuit has experienced 5 permanent outages and 4 momentary outages, resulting in approximately 5.7M customer minutes interrupted. Fries–Independence 69 kV line has 23 open conditions associated with the structures that make up the line. Conditions include woodpecker damage and rot top. Majority of the circuit utilizes 1950s wood structures



Need Number: AEP-2018-AP001

Proposed Solution:
Construct a new 69 kV line (approximately 15 miles) from Jubal Early Station to Independence Station. Install a 69 kV circuit breaker at Jubal Early Station and two 69 kV circuit breakers at Independence Station.

Alternatives:
Construct a second 69 kV line (approximately 12 miles) from Fries Station to Independence Station. Install two 69 kV circuit breakers at Independence Station. Expand Fries Station. Install three new 69 kV circuit breakers at Fries Station.

Total Estimated Transmission Cost: $32.5M
Projected IS Date: 6/1/2022
Project Status: Scoping

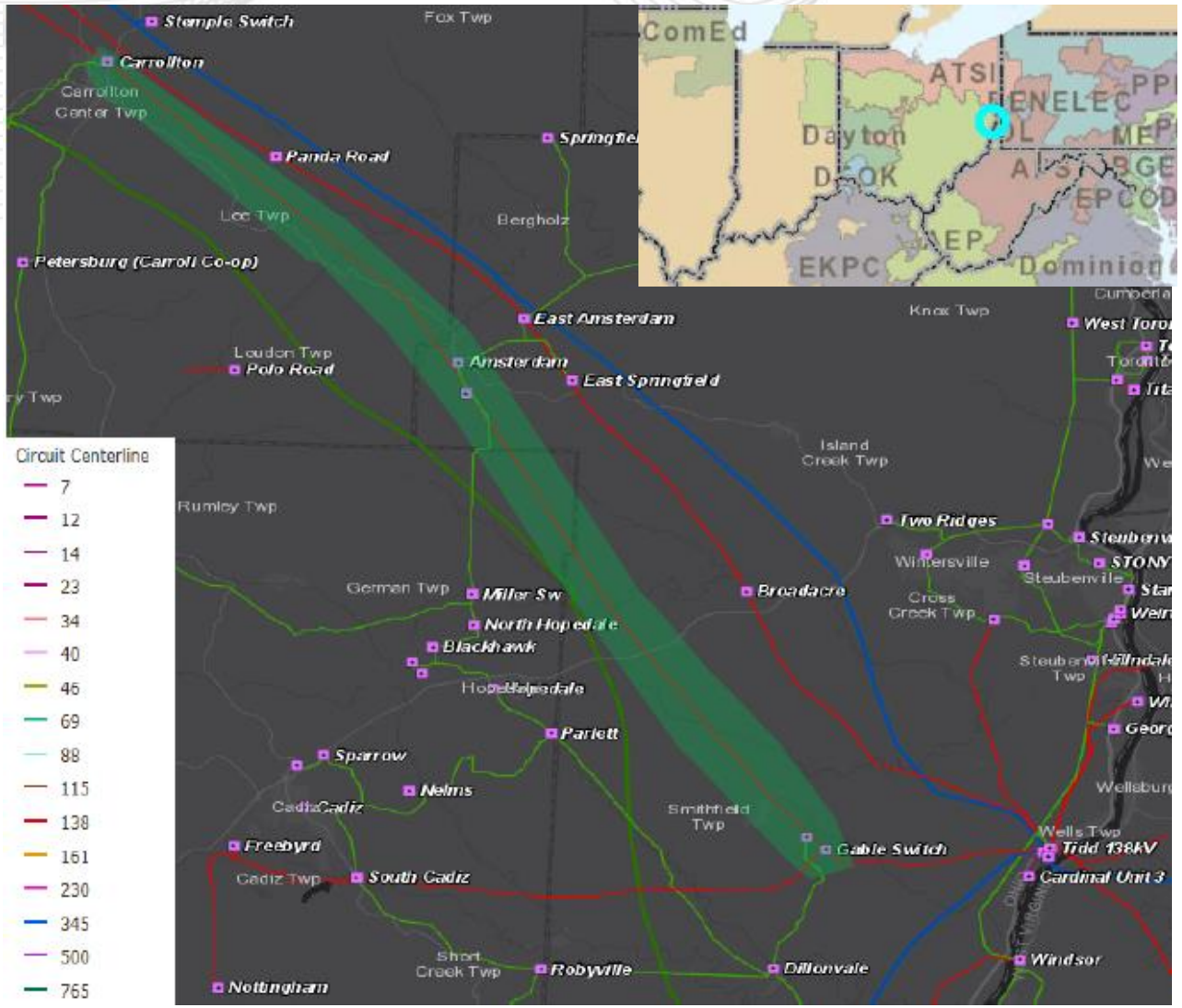
Legend	
345 kV	
138 kV	
69 kV	
46 kV	
New	

AEP Transmission Zone: Supplemental Carrollton, Ohio

Need Number: AEP-2018-OH011
Process Stage: Solution Meeting 1/11/19
Needs Presented: 10/26/18
Supplemental Project Driver: Equipment Material/Condition/ Performance/Risk
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)
Problem Statement:
The 29-mile Gable-Carrollton 138kV circuit (vintage 1917) is in poor condition and is a reliability risk to the transmission system. The circuit consists of lattice towers and 6-wired 200 kcmil copper conductor. After a century in the field, the lattice towers have degraded significantly, with heavy rusting and broken tower legs. The copper conductor has become very brittle and is difficult for crews to repair. Some towers are sitting in water. The suspension insulators and hardware are also heavily worn.

The circuit has 39 open conditions, with the majority being structural issues (e.g., degraded tower parts & broken insulators). The circuit has experienced 5 outages in the last 3 years (2016-2018 YTD), including a 50-hour outage due to broken conductor.

This circuit spans the center of the Ohio Utica shale gas region in Carroll/ Harrison Counties, with major activity from existing industrial customers and frequent economic development inquiries for future loads (e.g., pipeline compressor stations & midstream processing plants).



AEP Transmission Zone: Supplemental Carrollton, Ohio

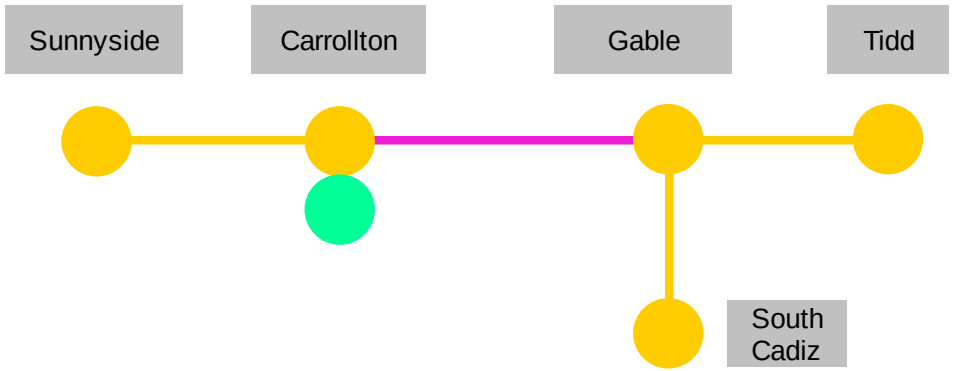
Need Number: AEP-2018-OH011
Proposed Solution:
Rebuild the 29-mile Gable-Carrollton 138kV circuit. Remove double-circuit lattice towers with 6-wired 200 kcmil CU. Install double-circuit steel poles with 6-wired 1234 ACSS/TW Yukon conductor.

Note that the other 2 segments of this 138kV pathway are already being rebuilt similarly: Tidd-Gable 138kV (in-service, S1067) and Carrollton-Sunnyside 138kV (in-construction, S1425).

Rebuilding the circuit as 6-wired permits AEP to maximize the use of its right-of-way in this region, which has major activity from oil & gas pipeline expansion competing for right-of-way. Installing a larger conductor permits future customer expansion in this area in the heart of the Utica shale gas play. In addition, this option permits the circuit to be split into two 138kV circuits when the need arises.

Alternatives:
No viable cost-effective transmission alternative was identified. The problematic transmission line could not be retired in place, due to serving as an important power pathway on the AEP transmission grid. Retiring it would have left the Carrollton 138-69-12kV station radial from Sunnyside station, and removed a strong 138kV power source to the Canton area. Carrollton serves as a source to the local 69kV sub-transmission system and also serves AEP Ohio distribution customers at 12kV.
Retiring the circuit would have resulted in a less reliable transmission system and could have an adverse impact on customers. In addition, removing the circuit would have left the load pocket between Gable and Freebyrd served by only two sources (from Tidd & Nottingham), which places it at risk for load shed under N-1-1 contingency scenarios. This 3rd source into Gable mitigates the situation.

Total Estimated Transmission Cost: $42.1M
Projected IS Date: 11/01/2021
Project Status: Engineering

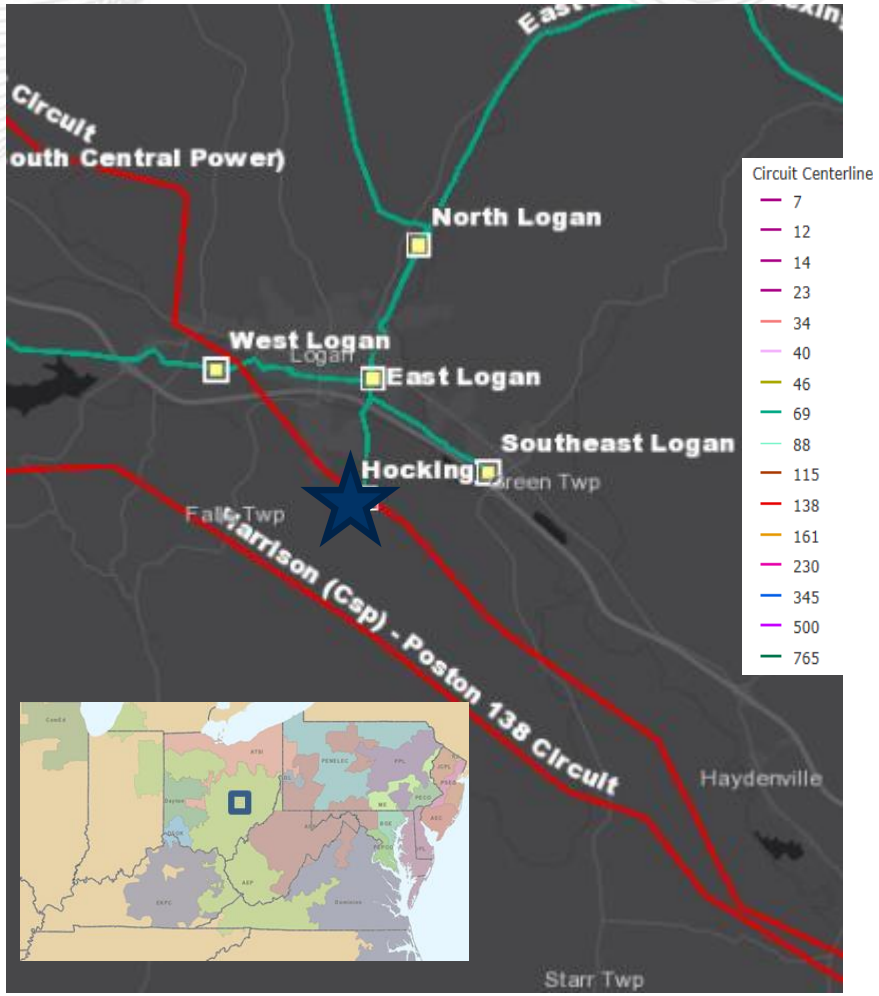


Legend	
500 kV	
345 kV	
138 kV	
69 kV	
34.5 kV	
23 kV	
New	

AEP Transmission Zone: Supplemental Logan, Ohio

Need Number: AEP-2018-OH025
Process Stage: Solution Meeting 1/11/2019
Needs Presented: 11/29/2018
Supplemental Project Driver: Equipment Material/Condition/Performance/Risk
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)
Problem Statement:

- Hocking 138kV MOAB "W" is in a failed state. When operating, arcing occurs, resulting in the tripping of remote breakers/circuit switchers.
- The structures supporting this MOAB will not allow for a like for like replacement due to the extra weight.

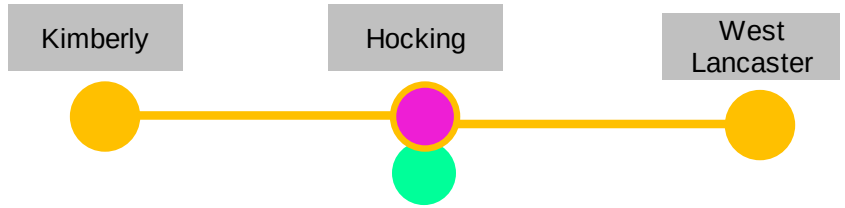


Need Number: AEP-2018-OH025
Process Stage: Solution Meeting 1/11/2019
Needs Presented: 11/29/2018

Proposed Solution:
Replace the existing 138 kV MOAB "W" with a 3000 A/63 kA breaker. Historically, operating this MOAB has resulted in the tripping of the 138 kV circuit breaker "A" and 69 kV circuit breaker "C" at Hocking due to a phase-to-phase fault. The structure supporting this MOAB doesn't allow for it to be replaced by a vertical-break switch due to the extra weight on the structure. Hocking Station was designed to allow the installation of a circuit breaker in the future. In addition, this circuit breaker eliminates three dissimilar protection zones (bus, transformer and line).

Alternatives:
- Install three 138 kV breakers in a ring bus configuration.

Total Estimated Transmission Cost: $753K
Projected IS Date: 3/11/2019
Project Status: Engineering



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

AEP Transmission Zone: Supplemental Muncie, Indiana

Need Number: AEP-2018-IM007
Process Stage: Solution Meeting 1/11/19
Needs Presented: 10/26/2018
Supplemental Project Driver: Equipment Condition/Performance/Risk
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)
Problem Statement:

Medford Station

- Transformer 1 – 1959 Vintage
  - Extremely high values of combustible gasses
  - Overheating faults have occurred within the unit.
  - Interfacial tension and the power factor values are at concerning levels proving the oil quality degradation
- Breakers "A" "B" and "C"
  - 1943-53 vintage FK oil breakers without containment
  - Fault Operations: CB A(53) CB B(27) CB C(21) – Recommended(10)

23rd Street Station

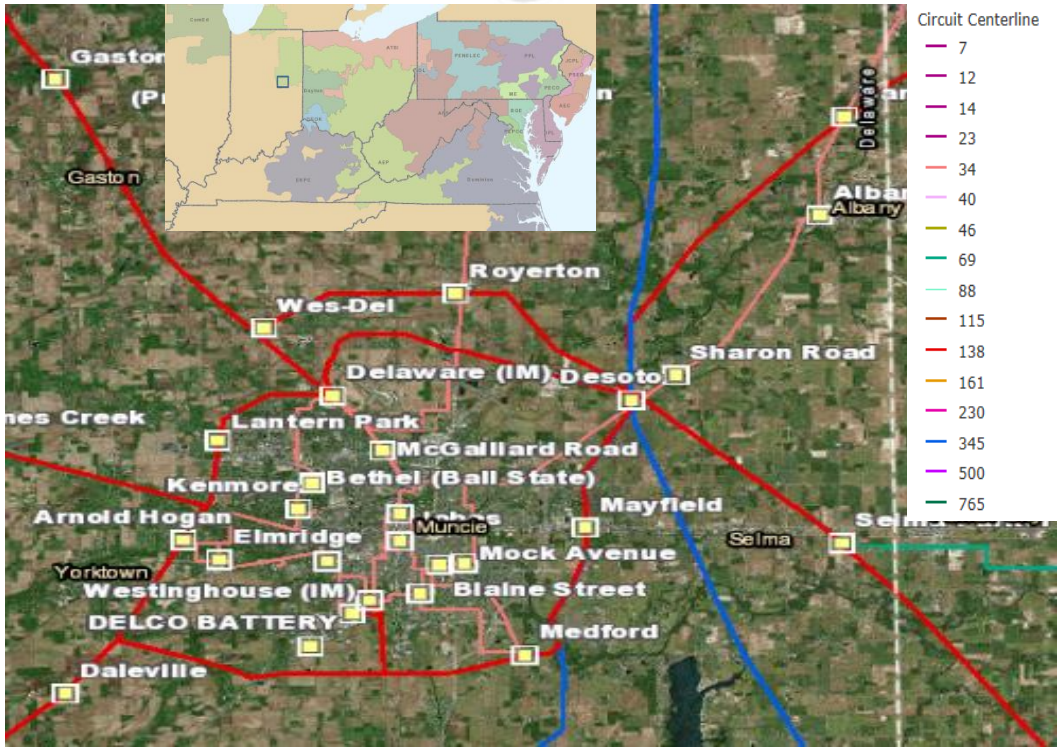
- Breakers "B", "C", "D", "E", "G", "J" and "K"
  - 1971 vintage FK oil breakers without containment
  - Fault Operations: CB B(30) CB C(44) CB D(16) CB E(0) CB G(25) CB J(18) CB K(28) – Recommended(10)

Arnold Hogan

- Distribution XF 2 – 1970 Vintage
  - Experienced a failure in 1999

Blaine Street Station

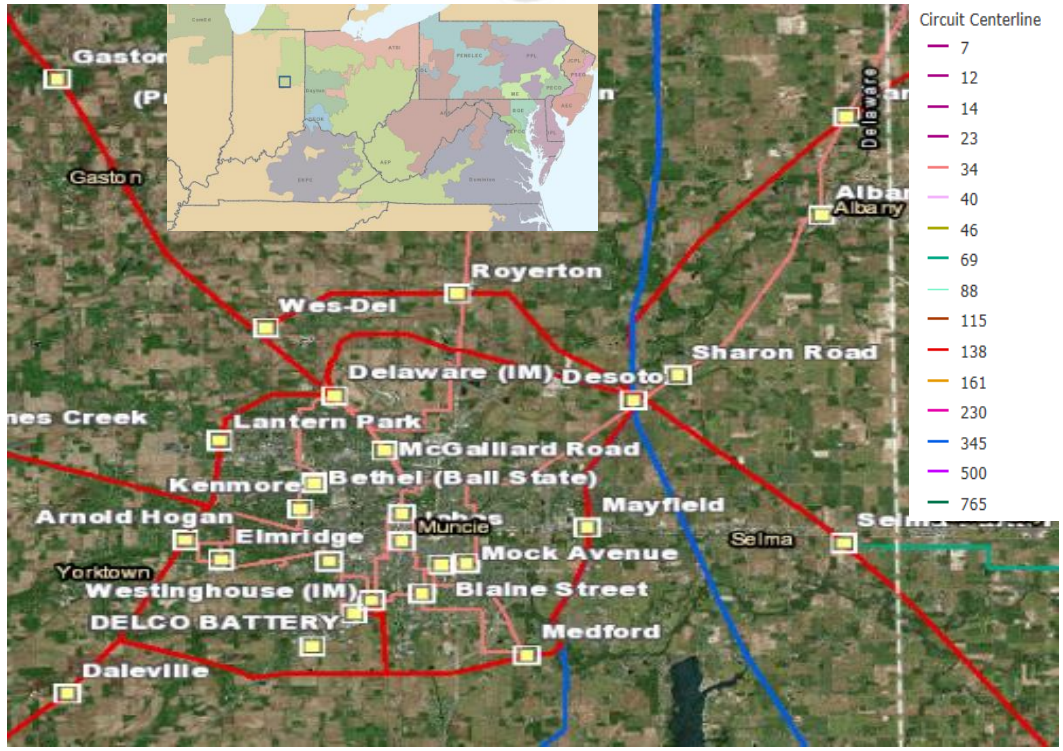
- Breaker "E"
  - 1970 vintage oil filled FK-breakers without oil containment
  - Fault Operations: CB E(29) – Recommended(10)



AEP Transmission Zone: Supplemental
Muncie, Indiana

Need Number: AEP-2018-IM007
Process Stage: Solution Meeting 1/11/19
Needs Presented: 10/26/2018
Supplemental Project Driver: Equipment Condition/Performance/Risk
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)
Problem Statement:
Arnold Hogan – 23rd Street

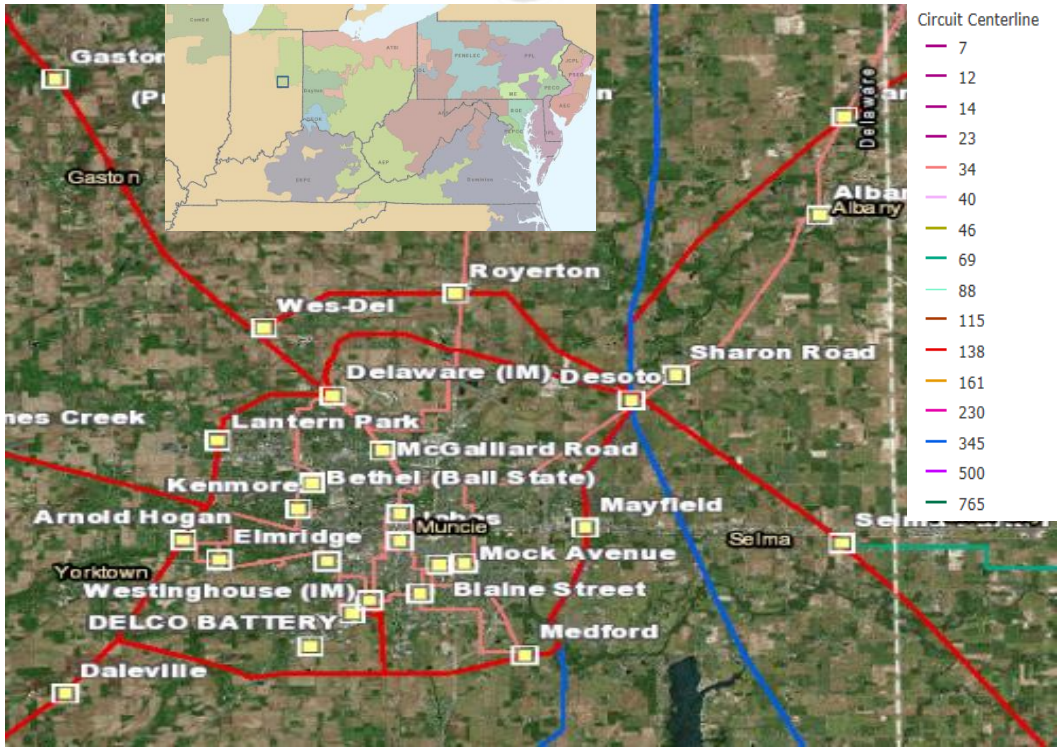
- 1963 wood crossarm construction
- 3/0 copper and 4/0 ACSR
- Subject to 20 open A conditions
- Subject to 26 open B conditions
- In the past 10 years, 47 structures have had active maintenance performed. This is expected to increase as line ages.



AEP Transmission Zone: Supplemental
Muncie, Indiana

Need Number: AEP-2018-IM007
Process Stage: Solution Meeting 1/11/19
Needs Presented: 10/26/2018
Supplemental Project Driver: Operational Flexibility and Efficiency
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)
Problem Statement:
Elmridge Tap

- 3 terminal line outside of Elmridge Station.

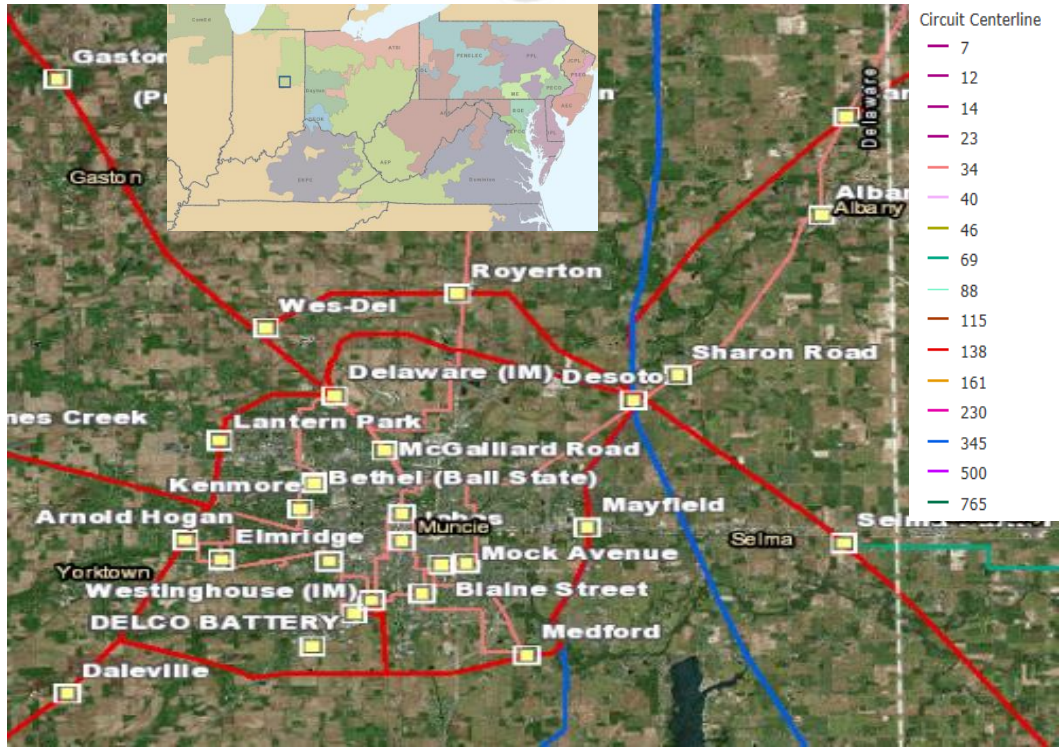


AEP Transmission Zone: Supplemental
Muncie, Indiana

Need Number: AEP-2018-IM007
Process Stage: Solution Meeting 1/11/19
Needs Presented: 10/26/2018
Supplemental Project Driver: Customer Service
Specific Assumptions Reference: Obligation to serve
Problem Statement:

Arnold Hogan Station
- AEP Distribution has requested a new delivery point at Arnold Hogan Station

Delco Battery Site
- AEP Distribution has requested a new delivery point at the old Delco site to facilitate the industrial load pocket
- Transmission has received multiple customer requests at the industrial park near Delco Battery Site



AEP Transmission Zone: Supplemental/Baseline
Muncie, Indiana

Need Number: AEP-2018-IM007
Process Stage: Solution Meeting 1/11/19
Needs Presented: 10/26/2018
Proposed Solution:

Arnold Hogan
Install a new Distribution transformer and bay. Replace existing transformer and Install a switcher on both transformers. Rebuild the 138kV side as a breaker and a half with 3 new 138kV breakers. Rebuild the 34.5kV voltage class as a ring bus with a new 28.8Mvar cap bank.

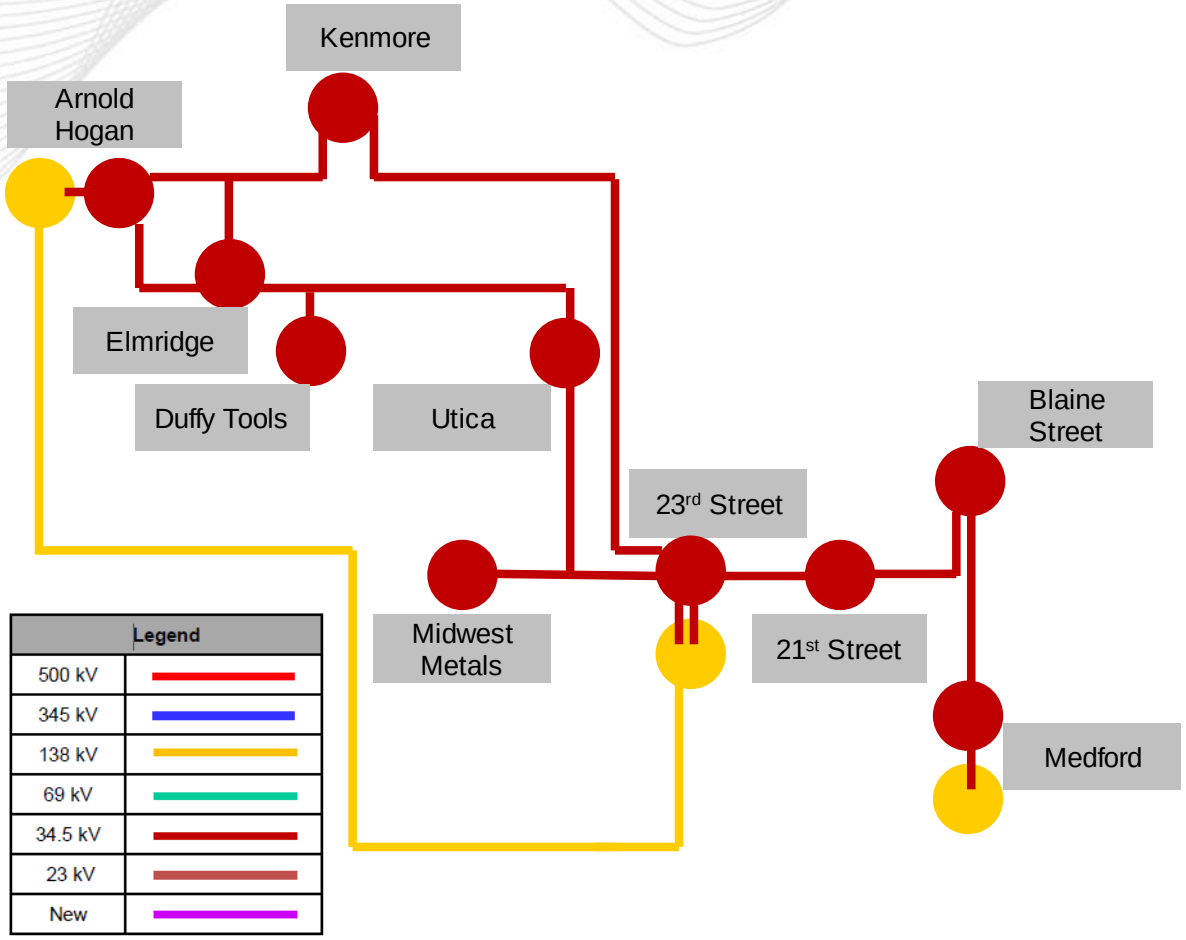
Elmridge
Retire Elmridge Station

23rd Street
Rebuild the 34.5kV voltage class as a 6 breaker ring bus with 5 new 69kV rated breakers. Install 3 138kV breakers to form a ring bus on the high side. Retire the cap banks. Rebuild the underground line exits as overhead

Medford
Rebuild station with a 3 breaker 69kV rated ring bus on the 34.5 side. Rebuild the high side as a 3 breaker 138kV ring bus. Replace the transformer with a 138/69/34.5kV bank. Retire the cap bank.

Blaine Street
Retire breaker E and construct a new 69kV rated bus with a new 69kV rated breaker and distribution bank.

Fuson
Build a new 138kV station with a 138kV bus tie breaker and 2 distribution banks to serve the Delco Battery site.



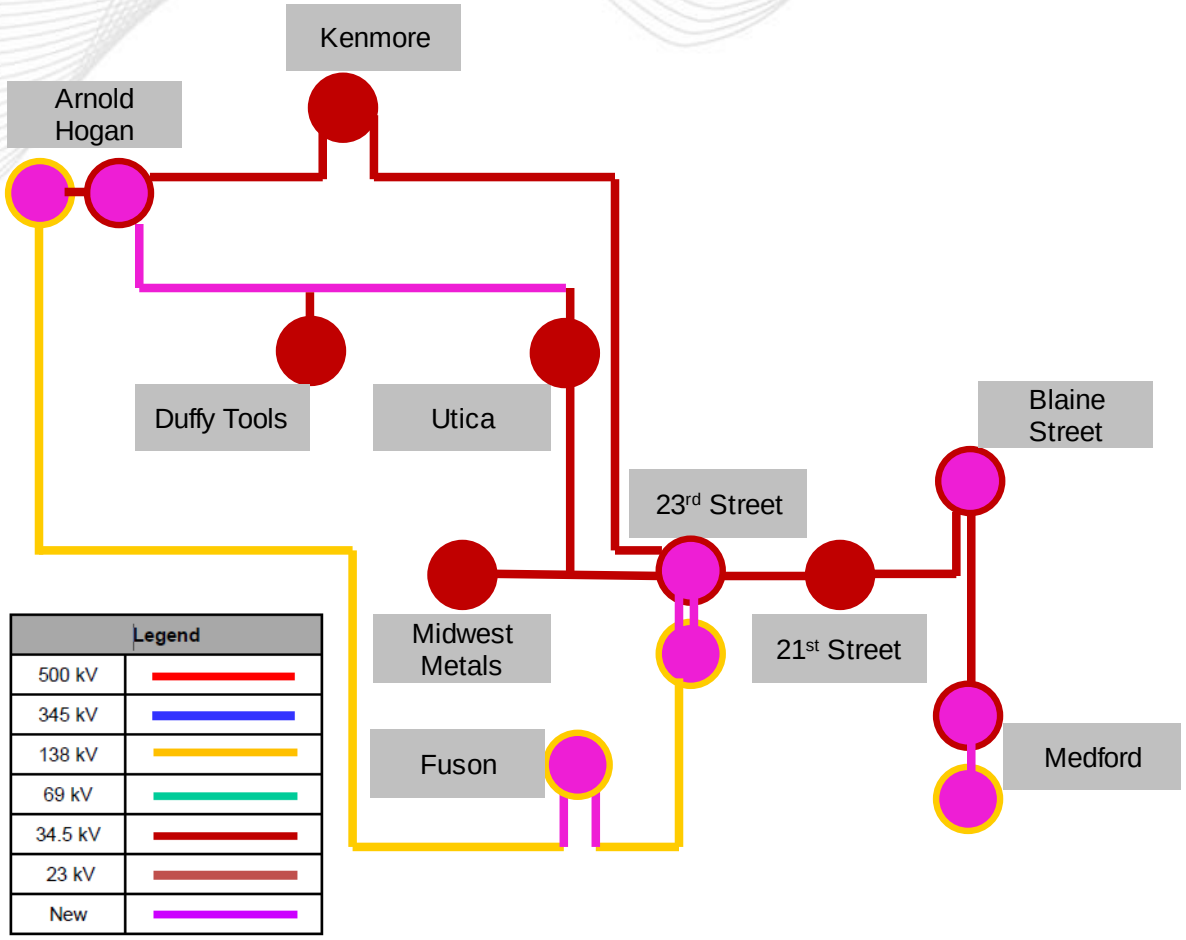
Need Number: AEP-2018-IM007

Proposed Solution:

Arnold Hogan – 23rd Street
Rebuild from Arnold Hogan – STR 56 north of Utica using 556 ACSR.
Fuson Tap
Build a new 138kV line toward the Fuson station site using 1033.5 ACSR.
Elmridge Tap
Retire the Elmridge tap line.

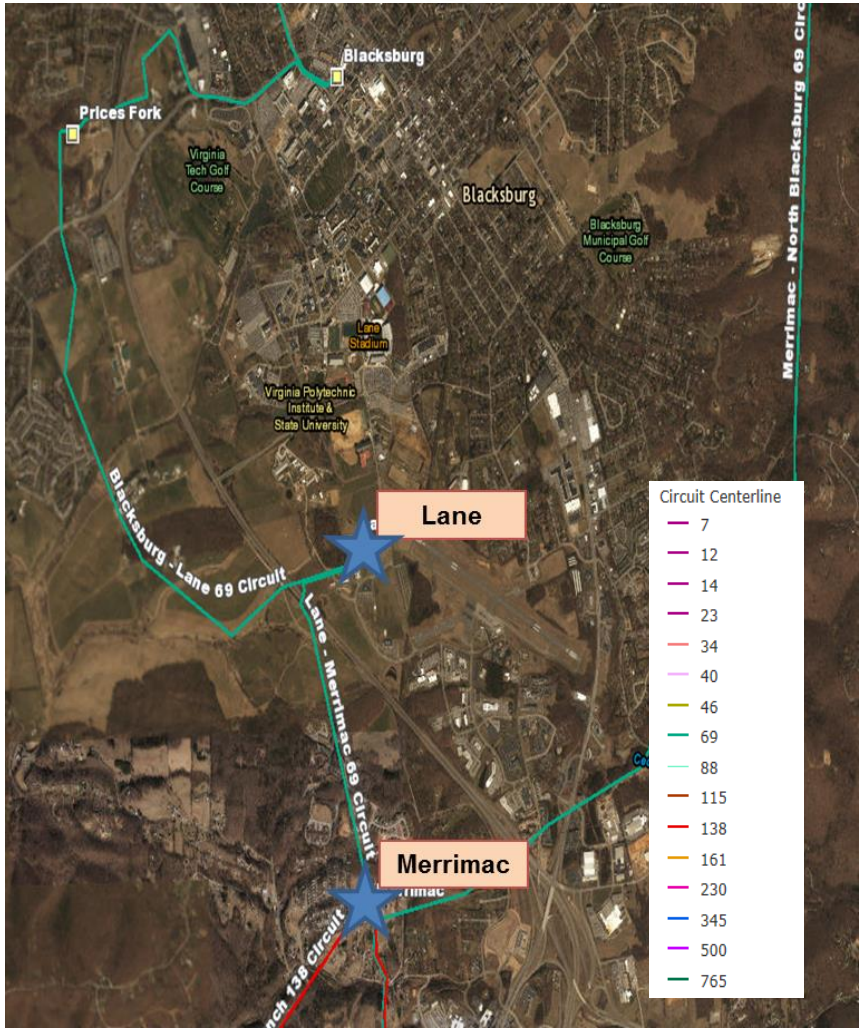
Alternatives:
Instead of rebuilding Hogan-Elmridge and Elmridge Extension 34.5 kV line assets as proposed under the proposed solution (with a few reroutes) construction of a greenfield Arnold Hogan-Elmridge-Utica transmission line can be considered as an alternate. This alternate would be extremely challenging to site and secure ROW for the greenfield route. And for that reason, this alternate solution is not preferred. No viable alternate solutions exist for Arnold Hogan, 23rd Street, Medford and Blaine Street stations.

Total Estimated Transmission Cost: $68.88M
Projected IS Date: 6/1/2022
Project Status: Scoping



AEP Transmission Zone: Supplemental Blacksburg, VA

Need Number: AEP-2018-AP008
Process Stage: Solution Meeting 1/11/19
Needs Presented: 10/26/18
Supplemental Project Driver: Customer Service
Specific Assumptions Reference: AEP Connection Requirements for the AEP Transmission System (AEP Assumptions Slide 7)
Problem Statement:
Virginia Tech Electric Service (VTES) requested a new 69 kV delivery point from AEP's Lane substation located in Blacksburg, VA to serve 5 MW of new load.



Need Number: AEP-2018-AP008

Proposed Solution:

- Expand Lane Station to establish a new VTES 69 kV delivery point
- Install one 69 kV circuit breaker and associated equipment
- Motorize an existing 69 kV line switch
- Add 12 kV metering to two new customer owned 69/12 kV transformers
- Relocate Lane-Merrimac 69 kV line to accommodate the station expansion/new line termination location

Alternatives:

- No viable cost-effective transmission alternative was identified

Total Estimated Transmission Cost: $0.2M
Projected IS Date: 8/1/2019
Project Status: Engineering

Bubble Diagram Not Applicable
Station Upgrades Only

AEP Transmission Zone: Supplemental Wapakoneta, Ohio

Need Number: AEP-2018-OH001

Process Stage: Solution Meeting 1/11/19

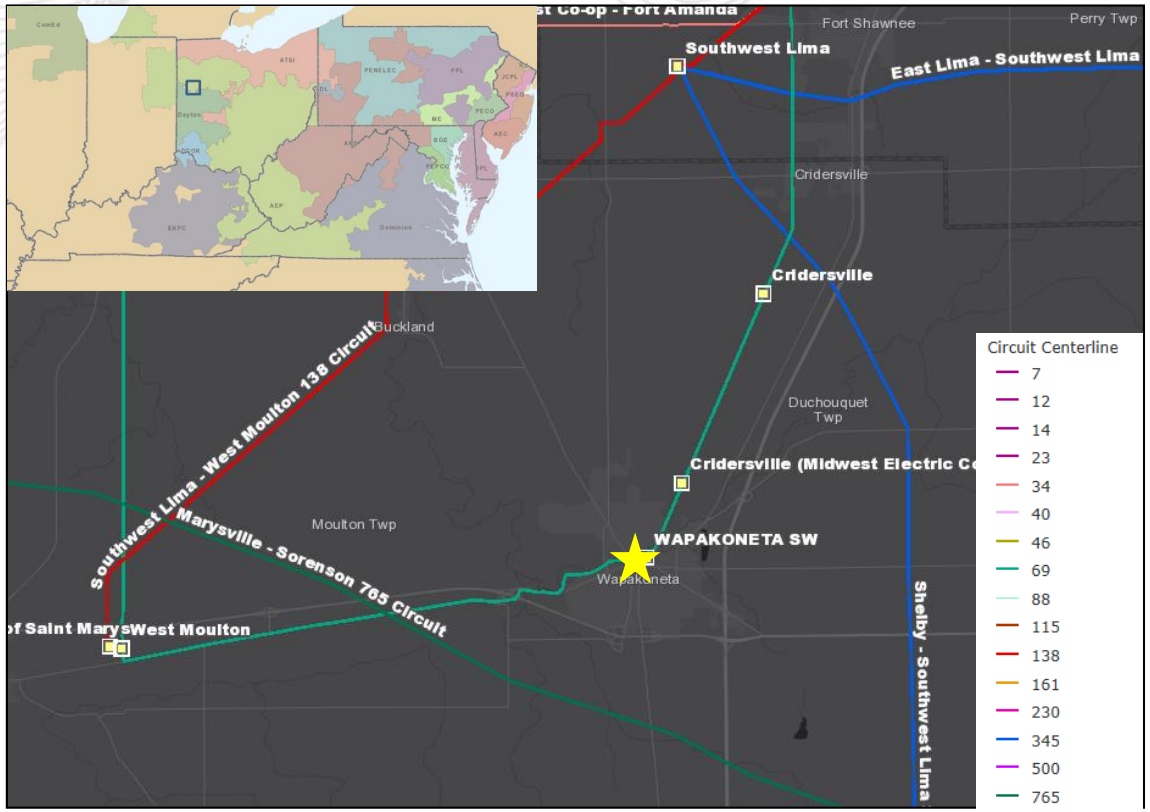
Needs Presented: 10/26/18

Supplemental Project Driver: Customer Service

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

Problem Statement:
Obligation to serve new customer load for the City of Wapakoneta. Total future load expected to be served from Gemini station is approx. 127MW.

The total 127 MW future load includes an additional estimated 40MW of new load from other new potential customers at the same location.



AEP Transmission Zone: Supplemental Wapakoneta, Ohio

Need Number: AEP-2018-OH001
Process Stage: Solution Meeting 11/1/2019

Proposed Solution:

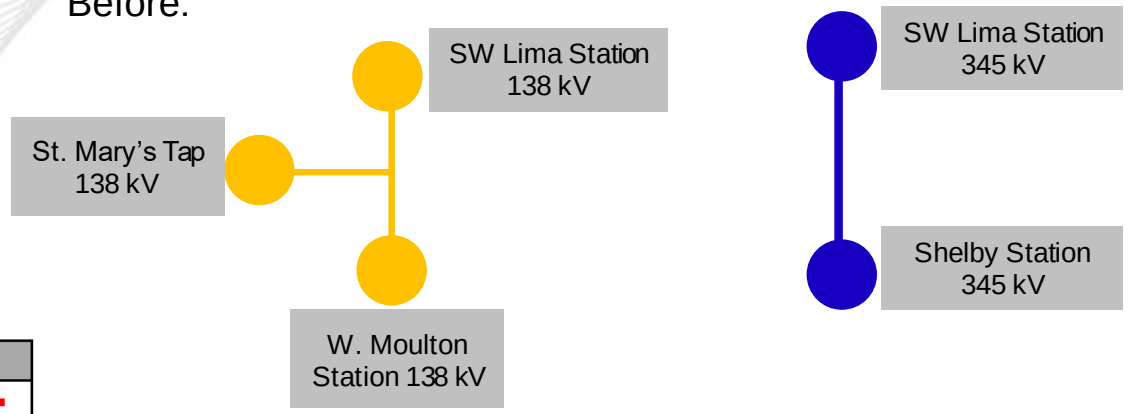
Build a new 345/138 kV Gristmill Station cutting into the Southwest Lima – Shelby 345 kV line. Build a new 138 kV Gemini Station southeast of the City of Wapakoneta to serve the load request. Build a new 138 kV line connecting Gristmill to Gemini Stations. Build a new 138 kV line from the new 138 kV Gemini Station to existing West Moulton 138 kV Station. Rebuild the West Moulton 138 kV Station as a 4 breaker ring bus. Remove the existing City of St Marys hard tap off the Southwest Lima – West Moulton 138 kV line and bring it into West Moulton 138 kV station (~0.2 mi away).

Alternative:

Build a new 138 kV Gemini Station southeast of the City of Wapakoneta. Build a new 138 kV line from the new Gemini 138 kV Station to West Moulton 138 kV Station. Build a new 138 kV line from Gemini 138 kV station to existing SW Lima 138 kV Station. This alternative was not chosen due to higher costs due to the additional line mileage.

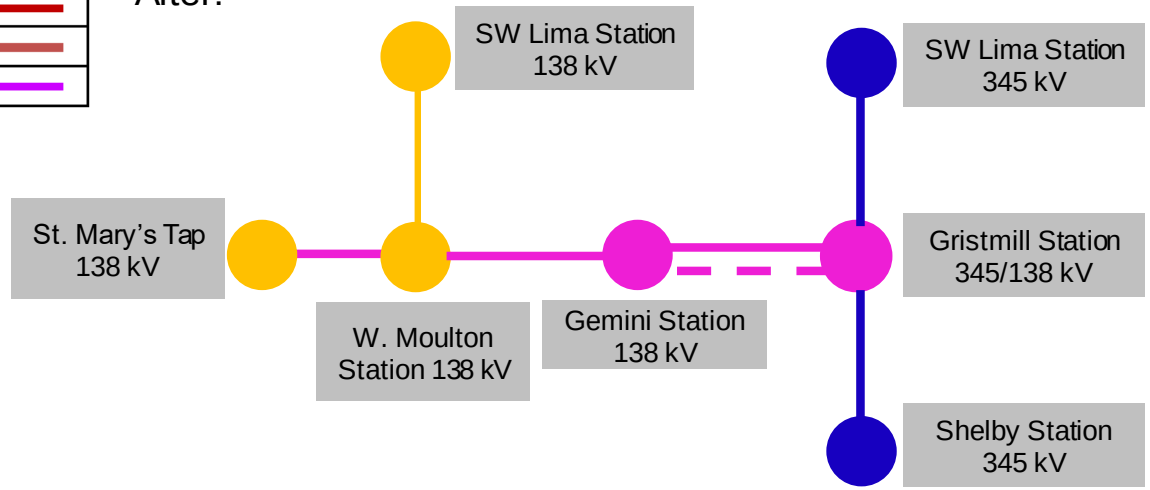
Total Estimated Transmission Cost: $66.2M
Projected IS Date: 12/31/2020
Project Status: Engineering

Before:



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

After:



Revision History

12/26/2018 – V1 – Original version posted to pjm.com

3/19/2019 – V2 – Slide #25, Change AEP-2018-OH0020 to –AEP-2018-OH020

– Slide #27, Change AEP-2018-OH0028 to –AEP-2018-OH028

– Slide #28, Change AEP-2018-OH0029 to –AEP-2018-OH029

– Slide #29, Change AEP-2018-OH0030 to –AEP-2018-OH030

– Slide #30, Change AEP-2018-OH0031 to –AEP-2018-OH031

– Slide #31, Change AEP-2018-OH0032 to –AEP-2018-OH032

– Slide #32, Change AEP-2018-OH0033 to –AEP-2018-OH033

– Slide #34, 35, Change AEP-2018-OH0014 to –AEP-2018-OH014

– Slide #36, 37, Change AEP-2018-OH0021 to –AEP-2018-OH021

– Slide #42, 43, Change AEP-2018-OH0025 to –AEP-2018-OH025

5/16/2019 – V3 – Slide #19-21, Changes are marked in the slides

– Slide #33-37, new slides added

11/11/2019 – V4 – Slide #32, Changes are marked in the slides

3/30/2020 – V5 – Slide #8 and #9, Changes are marked in the slides

– Slide #38-39, new slides added (AEP-2018-AP023)