Sub Regional RTEP Committee: Western
AEP Supplemental Projects

March 19, 2021

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

Need Number: AEP-2021-AP007

Process Stage: Need Meeting 3/19/2021

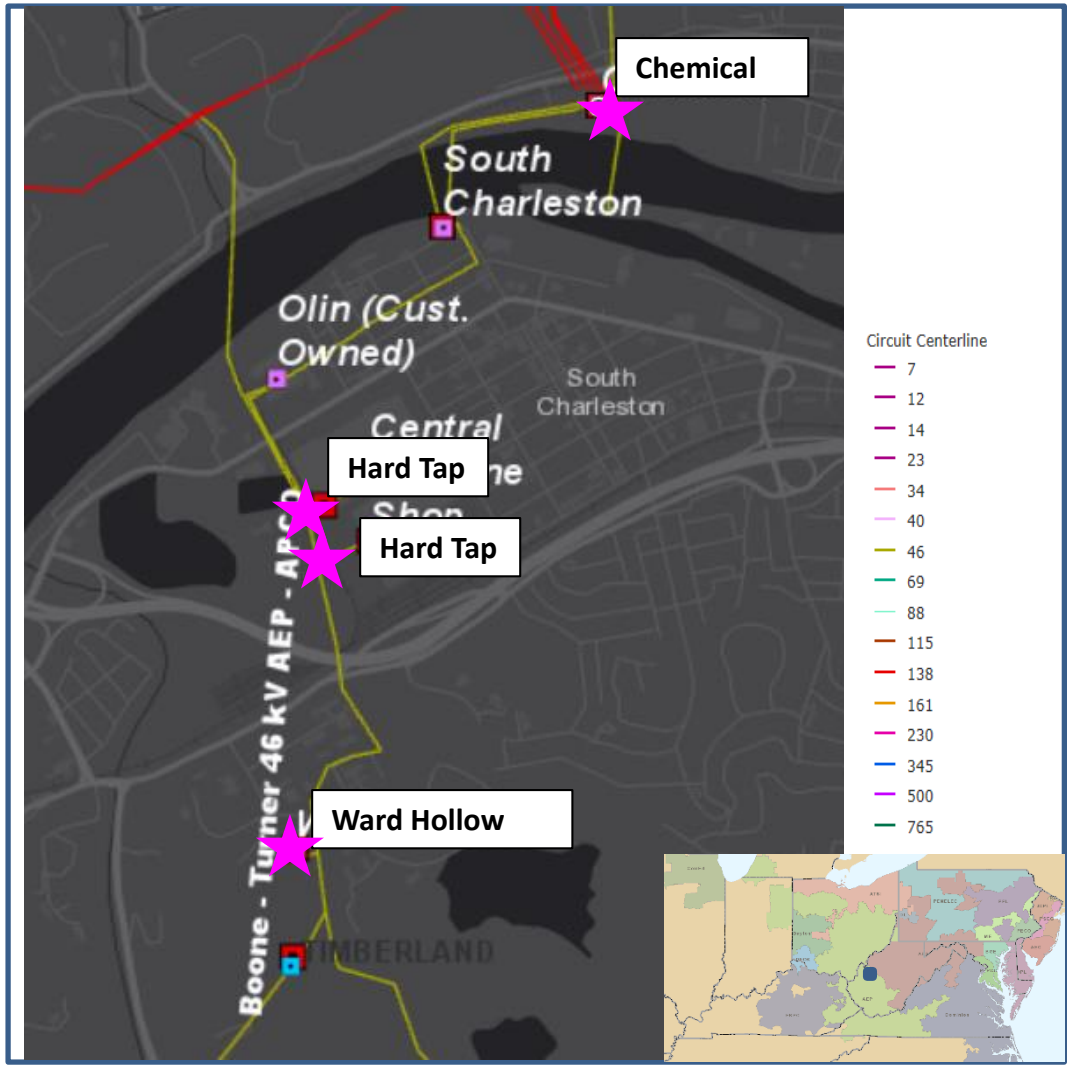
Project Driver: Operational Flexibility, Customer Service (AEP Assumptions slides 12, 14)

Specific Assumption Reference:

AEP Guidelines for Transmission Owner Identified Needs

Problem Statement:

- The 3 mile Chemical – Ward Hollow 46 kV line has two delivery points that are connected via hard taps. The hard taps complicate restoration activities and extend outages.
- Customers served at the hard taps have communicated concerns regarding continuation of service due to upcoming outages scheduled for ongoing projects at Chemical (B3100, S2348), South Charleston (S2348) and Turner (S2165)



AEP Transmission Zone M-3 Process
Christiansburg, VA

Need Number: AEP-2021-AP008

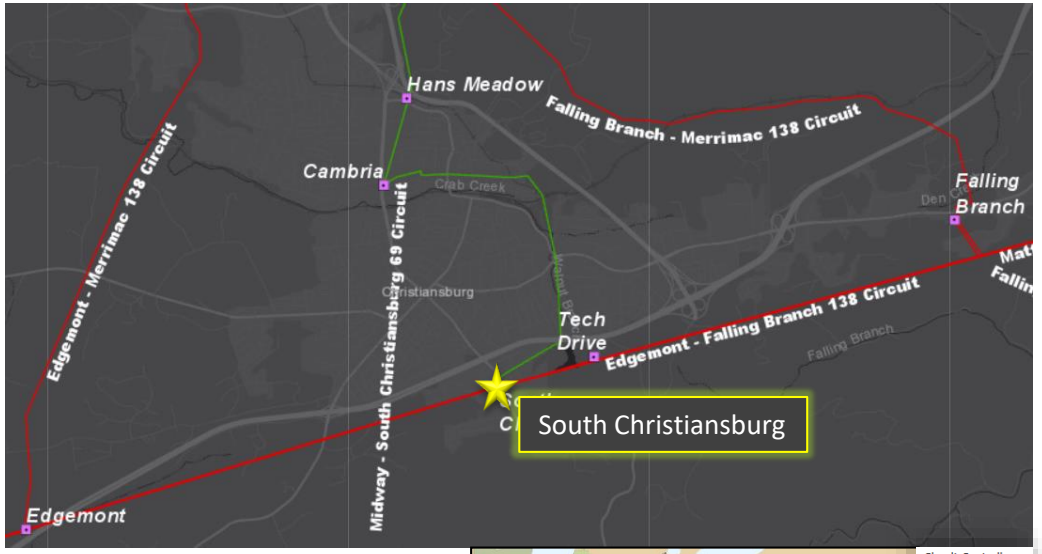
Process Stage: Needs Meeting 03/19/2021

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

Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 13)

Problem Statement:

- The 13.2 Mvar 69 kV capacitor bank at South Christiansburg station has failed.



AEP Transmission Zone M-3 Process
Carroll County, Virginia

Need Number: AEP-2021-AP009

Process Stage: Needs Meeting 3/19/2021

Supplemental Project Driver: Customer Service

Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 12)

Problem Statement:

- A customer has requested service for the establishment of a new distribution station in anticipation of a future industrial customer(s) located at the Wildwood Commerce Park site in Hillsville, VA.
- This station is the result of VA House Bill 1840 (HB1840) (Electric Utilities: Pilot Programs for Transmission Facilities Serving Business Parks).

AEP Transmission Zone M-3 Process
Boone County, WV

Need Number: AEP-2021-AP010

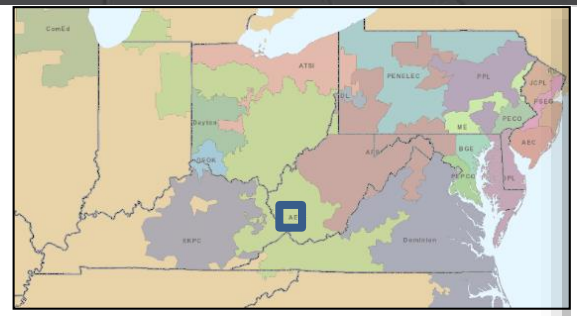
Process Stage: Needs Meeting 03/19/2021

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

Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 13)

Problem Statement:

- Both Spruce Laurel and Hampton stations are no longer feeding customers but have equipment connected to the transmission through path.



Circuit Centerline
- 7
- 12
- 14
- 23
- 34
- 40
- 46
- 69
- 88
- 115
- 138
- 161
- 230
- 345
- 500
- 765

AEP Transmission Zone M-3 Process
Wayne County, West Virginia

Need Number: AEP-2021-AP011

Process Stage: Needs Meeting 03/19/2021

Supplemental Project Driver: Equipment Condition/Performance/Risk

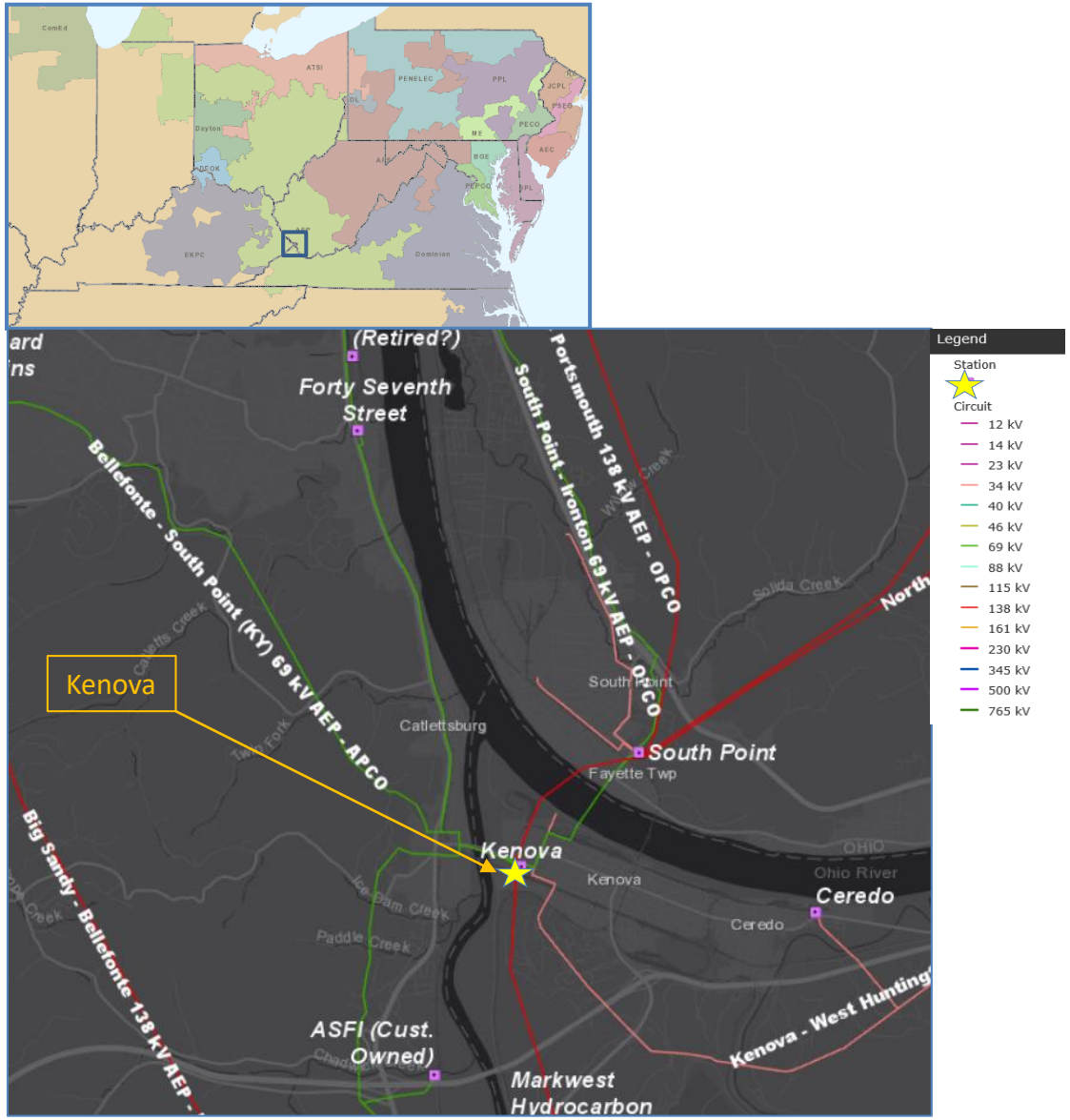
Specific Assumption Reference:

AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 13)

Problem Statement:

Kenova substation:

The 14.4 Mvar 69 kV capacitor bank at Kenova substation has failed.



AEP Transmission Zone M-3 Process
Fayette/Raleigh County, WV

Need Number: AEP-2021-AP012

Process Stage: Need Meeting 3/19/2021

Project Driver: Equipment Condition/Performance/Risk

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

Problem Statement:

Layland – Molly's Creek 69 kV, Molly's Creek – Brooklyn Switch (~8 miles)

- Circuit is comprised mostly of wood pole structures
  - 1913 vintage structures (98%)
  - Circuit fails to meet 2017 NESC Grade B loading criteria and AEP structural strength requirements
  - 4-bell porcelain insulators do not meet current AEP Standards
- 32 structures with at least one open condition (38% of the structures)
  - There are 58 structural open conditions affecting poles and crossarms including rot, woodpecker holes and insect damage
  - There are 2 shield wire open conditions related to broken strands, 5 hardware open conditions affecting guys and 2 forestry open conditions related to brush clearance
- Since 2014, there have been 6 momentary and 5 permanent outages on the Bradley - Layland No. 2A 69 kV circuit
  - Majority of the momentary outages were due to weather including lightning
  - Permanent outages due to vegetation from outside the ROW and lightning
  - Lack of shielding on 28% of the circuit likely contributed to poor lightning performance
  - Outages resulted in approximately 114k customer minutes of interruption

Thurmond SS – Claremont 69 kV (~2 miles)

- Circuit is comprised of wood pole structures
  - 1972 vintage structures (100%)
  - Circuit fails to meet 2017 NESC Grade B loading criteria and AEP structural strength requirements, and fails to meet ASCE structural strength requirements
  - 4-bell porcelain insulators do not meet current AEP Standards
- 5 structures with at least one open structural condition (17% of the structures)
  - There are 5 structural open conditions related to woodpecker damage and rot and 3 hardware conditions related to cracked insulator assembly and broken guys
  - Outage statistics included in the data above

AEP Transmission Zone M-3 Process
Buchanan County, Virginia

Need Number: AEP-2021-AP013

Process Stage: Needs Meeting 03/19/2021

Supplemental Project Driver: Equipment Condition/Performance/Risk

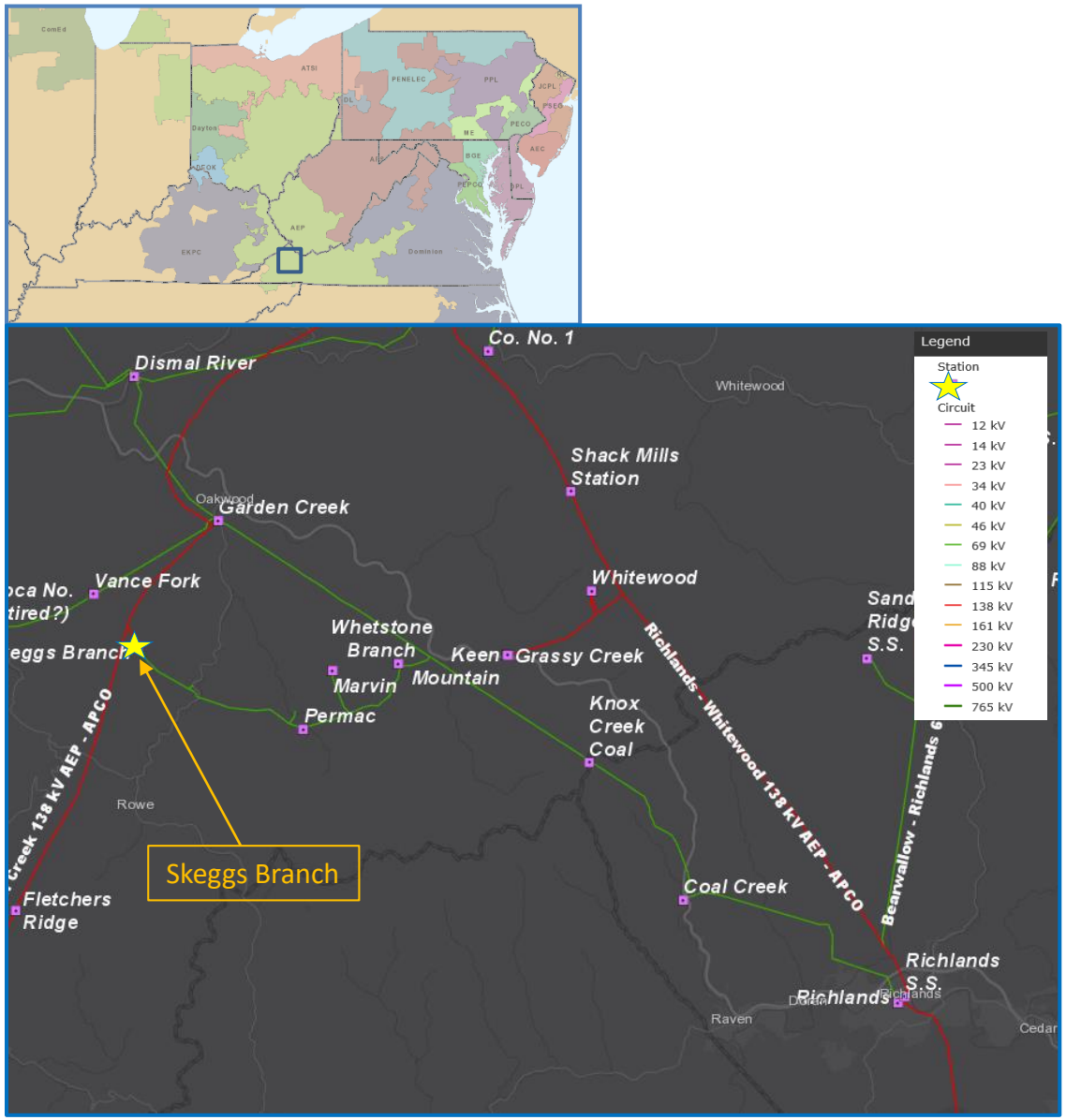
Specific Assumption Reference:

AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 13)

Problem Statement:

Skeggs Branch substation:

- 138/69/4 kV Transformer #1
  - 1950s Vintage Transformer , originally manufactured in 1952
  - The Transformer has elevated levels of Carbon Monoxide, Carbon Dioxide, Ethane, Methane, and Ethylene. There is an indication of overheating faults occurring in the main tank which have further degraded the insulating paper materials. One of the oil cooling pumps has developed a leak.
- 138kV Circuit Switcher A
  - Mark V type SF-6 filled (1970s vintage) manufactured by S&C.
  - This CS has experienced 37 Fault Ops
  - No gas monitor; sister units on the AEP system have a history of gas loss, interrupter failures, and operating mechanism failures.
- Relaying
  - Currently, 12 of the 14 relays (86% of all station relays) are in need of replacement. Of these, 11 are of the electromechanical type and 1 static type, which both have no spare part availability and limited fault data collection and retention. In addition, these relays lack of vendor support.
- Other:
  - The lack of a transformer low side/69kV line exit circuit breaker means that the 138kV circuit switcher operates for both 138kV and 69kV line faults.



AEP Transmission Zone M-3 Process
Buchanan County, Virginia

Need Number: AEP-2021-AP014

Process Stage: Needs Meeting 03/19/2021

Supplemental Project Driver: Equipment Condition/Performance/Risk

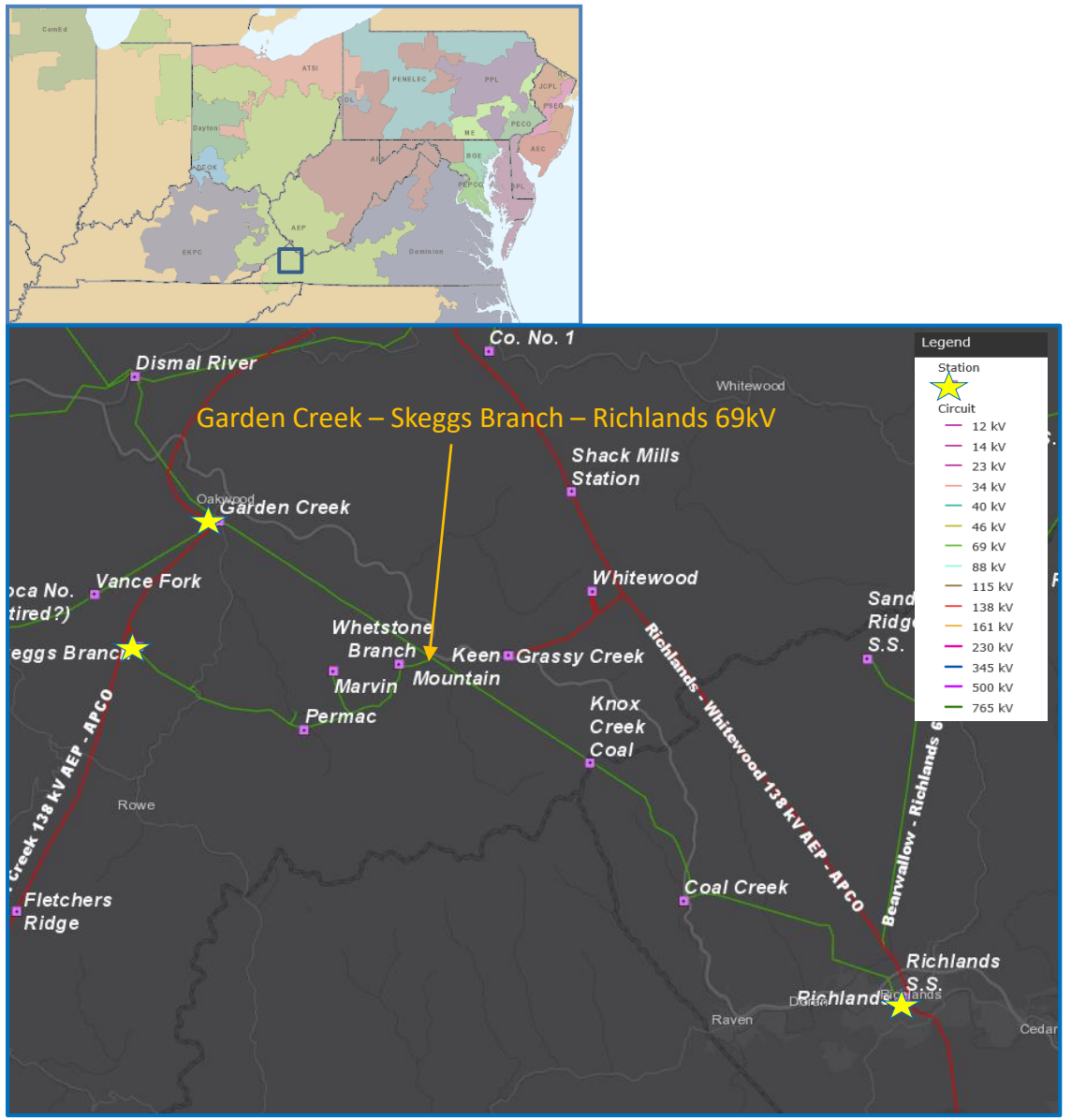
Specific Assumption Reference:
AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 13)

Problem Statement:
Line Name: Garden Creek – Skeggs Branch – Richlands 69kV
Original Install Date (Age): 1935,1962,1970
Length of Line: ~21 mi
Total structure count: 180
Original Line Construction Type: Wood and Lattice Steel
Conductor Type: 3/0 ACSR 6/1 (Pigeon), 556,500 CM ACSR 26/7 (Dove), and 336,400 CM ACSR 30/7 (Oriole)
Momentary/Permanent Outages: 26 Momentary and 6 permanent Outages
CMI (last 5 years only): 0
Line conditions:

- 42 structures with at least one open structural condition, 23% of the structures on this circuit.
- 73 structure related open conditions impacting wooden poles, lattice steel towers, crossarms, braces, and filler blocks including rot, bowing, woodpecker holes, insect damage, cracked, split, and heavy rust/corrosion.
- 1 open conditions related to broken strands
- 8 hardware related open conditions related to broken or chipped insulators and a buried guy.

Other:

- This circuit is operated normally open at Permac station
- Lack of sectionalizing capability due to multiple stations (Twin Valley SS, Marvin, Clell) being hard tapped to 69kV Line or operated radially
- Whetstone Branch is a 3 terminal switching station with no 69 kV line breakers.
- Only 11.6 miles of this line are currently shielded.



AEP Transmission Zone M-3 Process
Kanawha County, WV

Need Number: AEP-2021-AP015

Process Stage: Need Meeting 3/19/2021

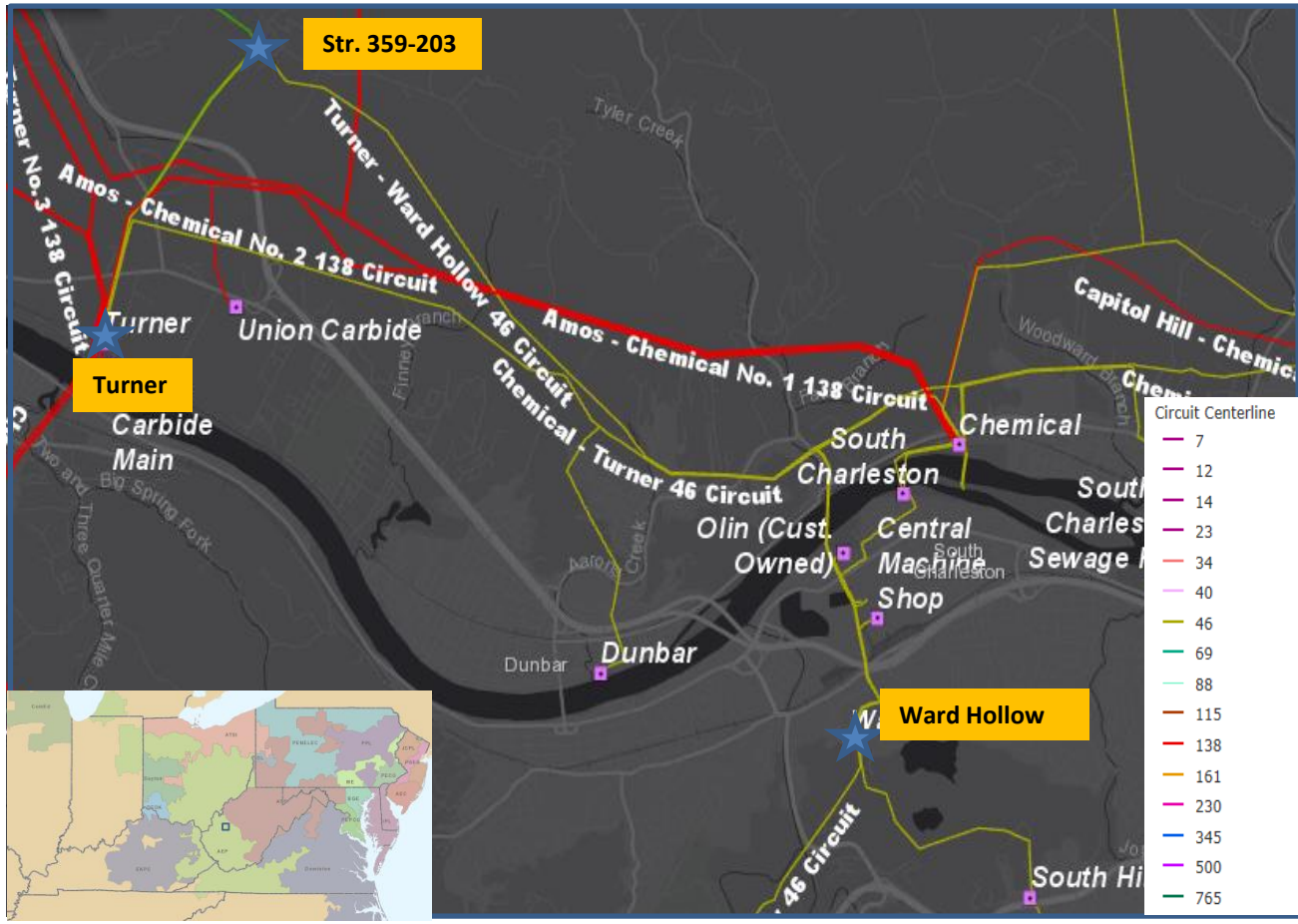
Project Driver: Equipment Condition/Performance/Risk

Specific Assumption Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 13); https://www.pjm.com/-/media/committees-groups/committees/srrtep-w/20191218/20191218-aep-system-pre-1930s-tower-lines.ashx

Problem Statement:

Turner (Starts at Str. 359-203) – Ward Hollow 46 kV Line (~5 miles)

- Circuit is comprised mostly of steel lattice structures, steel towers and wood poles
  - Originally installed in 1920
  - Wood pole structures mainly include pre 1970s vintage and 1980s vintage
  - Circuit fails to meet 2017 NESC Grade B loading criteria and AEP structural strength requirements and fails to meet the current ASCE structural strength requirements
- 8 structures with at least one open condition (30% of the structures)
  - 28 Structural conditions are related to poles and crossarms including rot top, woodpecker and rot heart.
  - 6 shielding/grounding open conditions related to broken/damaged strands
  - Additionally, refer to AEP presentation on pre-1930s steel lattice lines, linked above
- Since 2015, there have been 5 momentary and 11 permanent outages on the Turner – Ward Hollow 46 kV circuit
  - Momentary outages were due to wind, lightning and animal bus causes
  - Permanent outages due to lightning, vegetation from outside the ROW, wind, station relay, distribution, line conductor and station arrestor causes
  - Outages resulted in approximately 852 customer minutes of interruption for wholesale customers



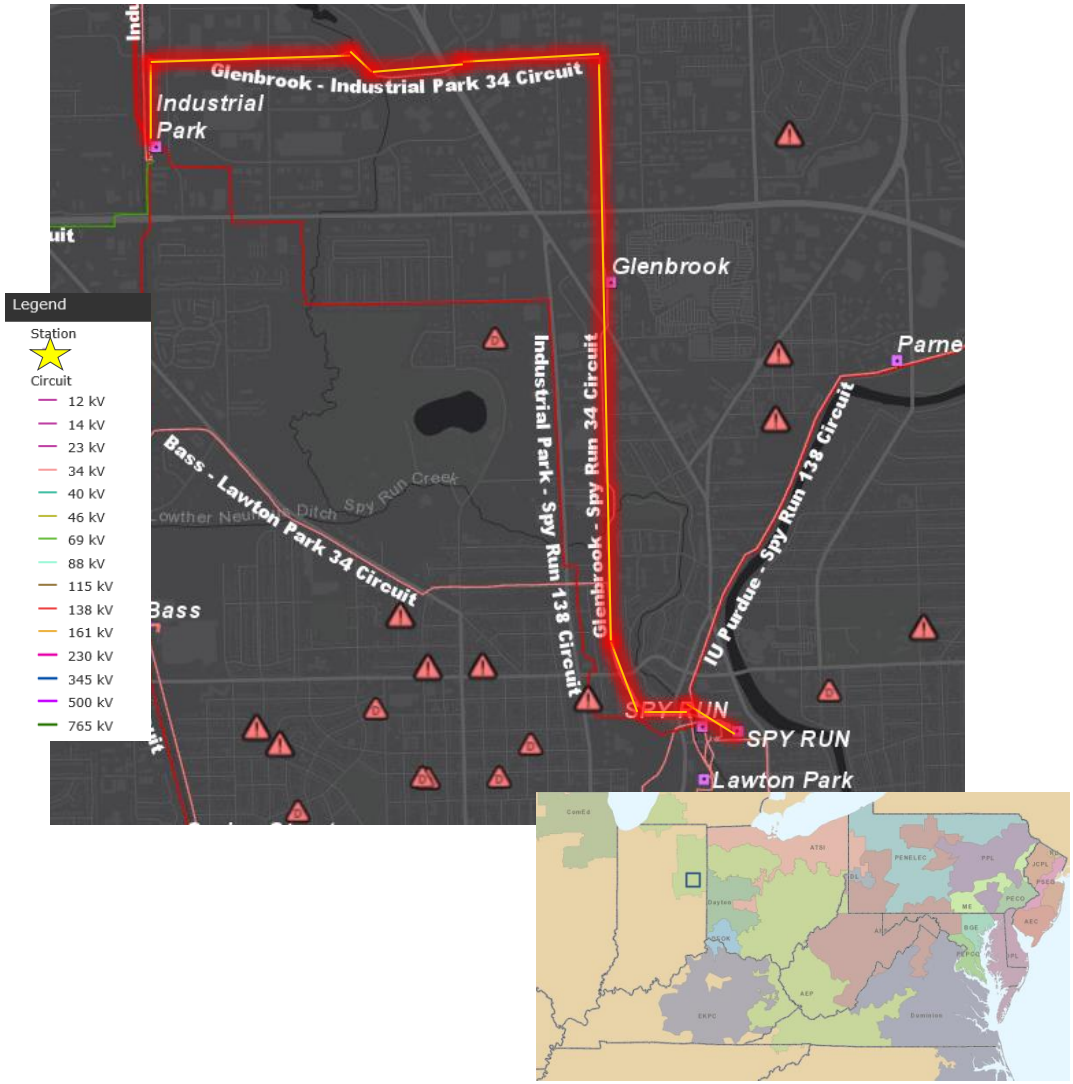
AEP Transmission Zone: Supplemental Industrial Park – Spy Run 34.5kV

Need Number: AEP-2021-IM005
Process Stage: Needs Meeting 3/19/2021
Supplemental Project Driver: Equipment Material/Condition/Performance/Risk
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

Problem Statement:

- **Industrial Park – Spy Run 34.5kV ~4.2 Miles**
  - Wood pole line originally constructed in 1965
  - 45 structures have at least one open condition (37% of line) including Rot Top, Insect Damage and Woodpecker holes
  - 18 structures were assessed by an aerial drone and 12 assessed by ground crew. 6 structures had heart rot, 12 structures had insect/woodpecker damage.
  - 121,563 CMI over the past 5 years with 2 outages
  - Structures do not meet 2017 NESC Grade B loading criteria, do not meet current AEP structural strength requirements, and do not meet the current ASCE structural strength requirements.

Model: N/A



AEP Transmission Zone: Supplemental North Bluffton 69kV Load Addition

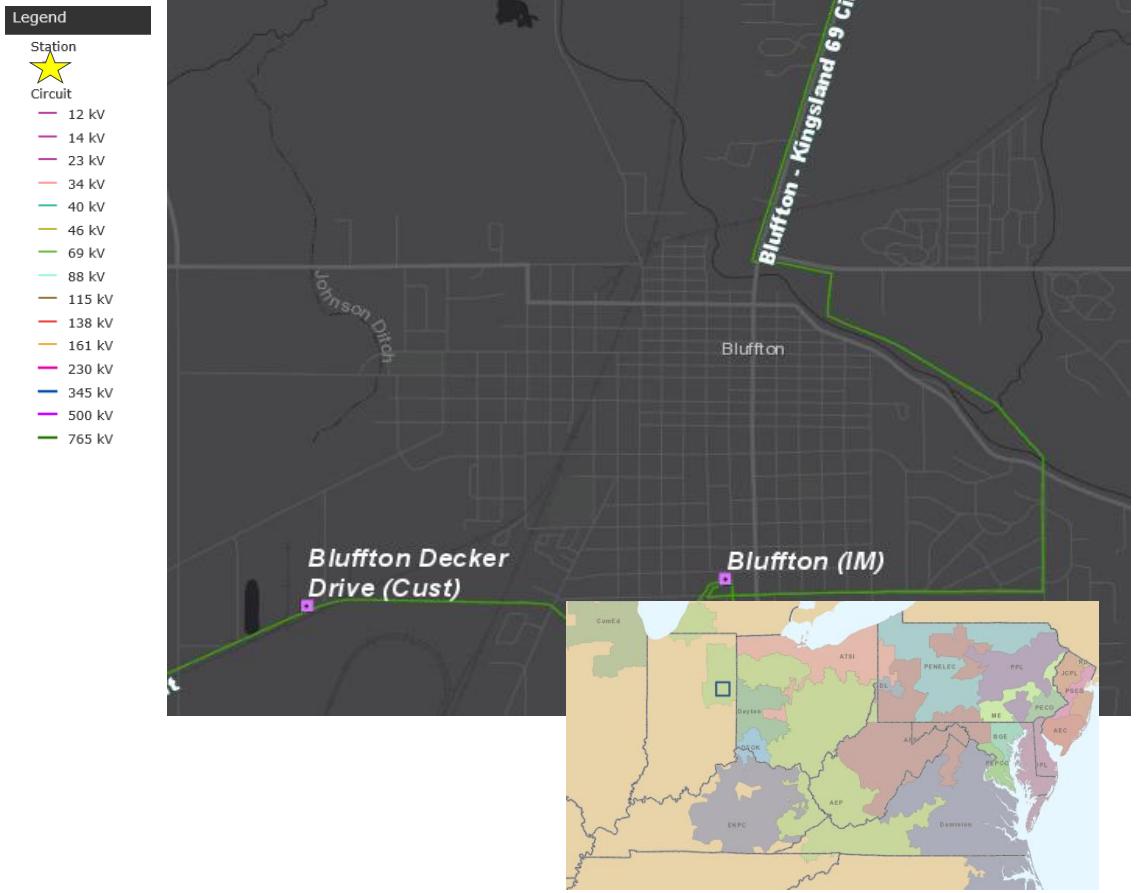
Need Number: AEP-2021-IM013
Process Stage: Needs Meeting 03/19/2021
Supplemental Project Driver: Customer Request
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 12)

Problem Statement:

North Bluffton 69kV

- City of Bluffton has requested an expansion to their delivery point to serve a new 5MW load increase by November 1, 2021

Model: 2025 RTEP



AEP Transmission Zone M-3 Process
Defiance, Ohio

Need Number: AEP-2021-OH009

Process Stage: Need Meeting 3/19/2021

Project Driver:

Equipment Material/Condition/Performance/Risk, Operational Flexibility and Efficiency and Customer Service

Specific Assumption Reference:

AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 12-14)

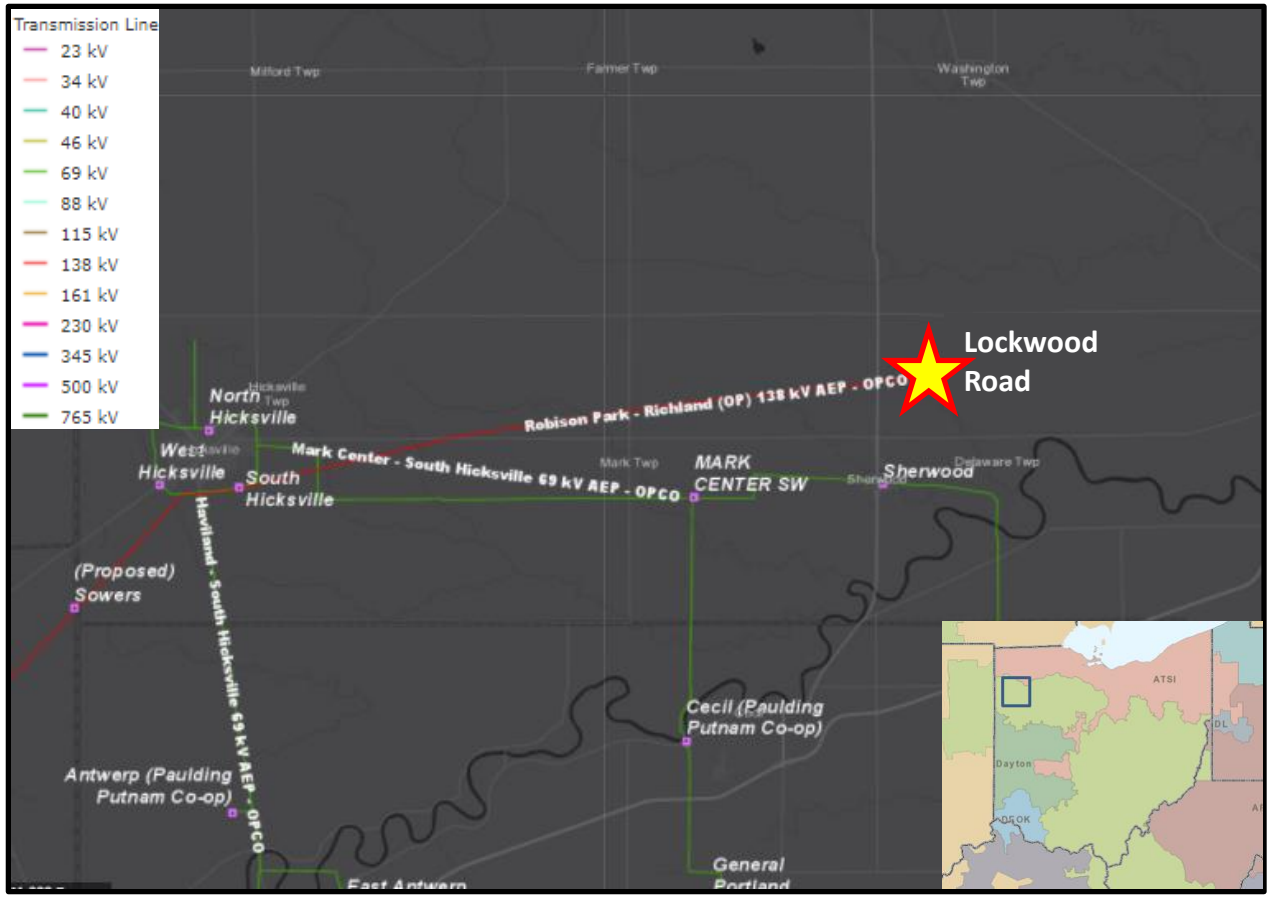
Problem Statement:

<u>Equipment Material/Condition/Performance/Risk</u>

<u>Lockwood Road 138 kV Station</u>

Circuit Breakers A:

- Manufactured Date: 1982
- Interrupting Medium: (SF6)
- Fault Operations:
  - Number of Fault Operations: 85
  - Manufacturer recommended Number of Operations: 10
- Additional Breaker Information: The expected life of the bushing gaskets and door inspection port seals is 25 years, this breaker has surpassed this age. Seals that are no longer adequate can cause SF6 leaks to become more frequent. The vendor provides no support or manufactures spare parts for this family of circuit breakers.
- Relays: Currently, 30 of the 31 relays (97% of all station relays) are in need of replacement. 25 of these are of the electromechanical type and 2 of the static type which have significant limitations with regards to spare part availability and fault data collection and retention. In addition, these relays lack of vendor support. There are also 3 microprocessor based relays commissioned in 2009 and have unsupported firmware.



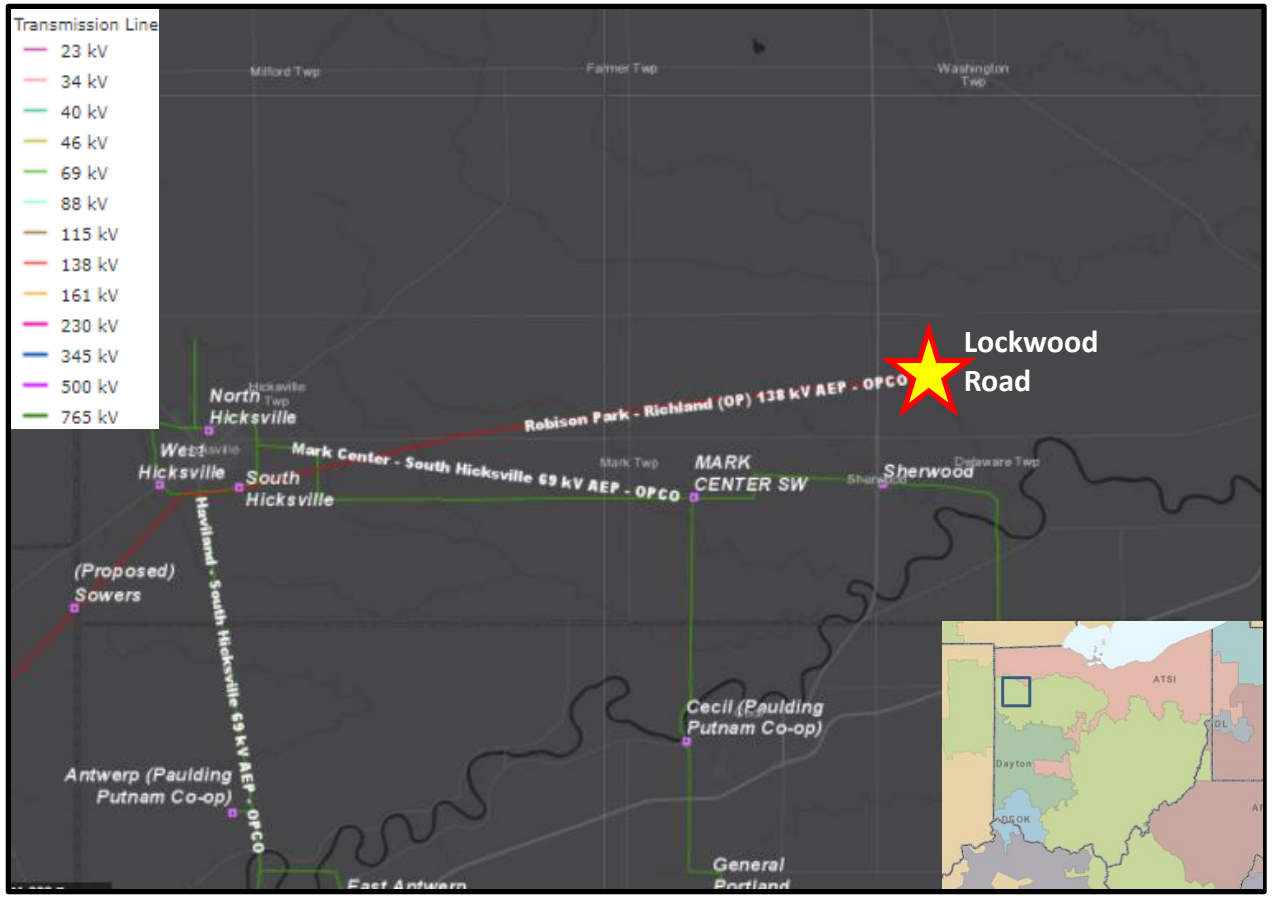
Problem Statement (Contd):

Operational Flexibility and Efficiency

- The Richland line terminal has a MOAB instead of a CB. This is a tie-line to First Energy.
- The bypass switch on CB-B complicates the bus protection. It is an operational challenge due to the City of Bryan having generation as well as a second source from the First Energy system (through Richland). Bypasses create protection reliability concerns.
- The capacitor at Lockwood Rd bank causes voltage quality issues for City of Bryan when either of the 138 kV sources into Lockwood Road are out of service due to the size of the bank.

Customer Service

- The existing Station is not expandable in its current configuration.
- There has been significant interest from large industrial load (future) to construct in this area, and specifically to connect to this station.



AEP Transmission Zone M-3 Process
Richland, Ohio

Need Number: AEP-2021-OH010

Process Stage: Need Meeting 03/19/2021

Project Driver:

Equipment Material/Condition/Performance/Risk

Specific Assumption Reference:

AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 11)

Problem Statement:

Howard Station:

Circuit Breaker: K

- Breaker Age:
  - 1959
- Interrupting Medium: (Oil)
- Fault Operations:
  - Number of Fault Operations: 27
  - Manufacturer recommended Number of Operations: 10

Additional Oil Filled Breaker Information: These breakers lack oil containment; oil filled breakers have much more maintenance required due to oil handling that their modern, SF6 counterparts do not require.

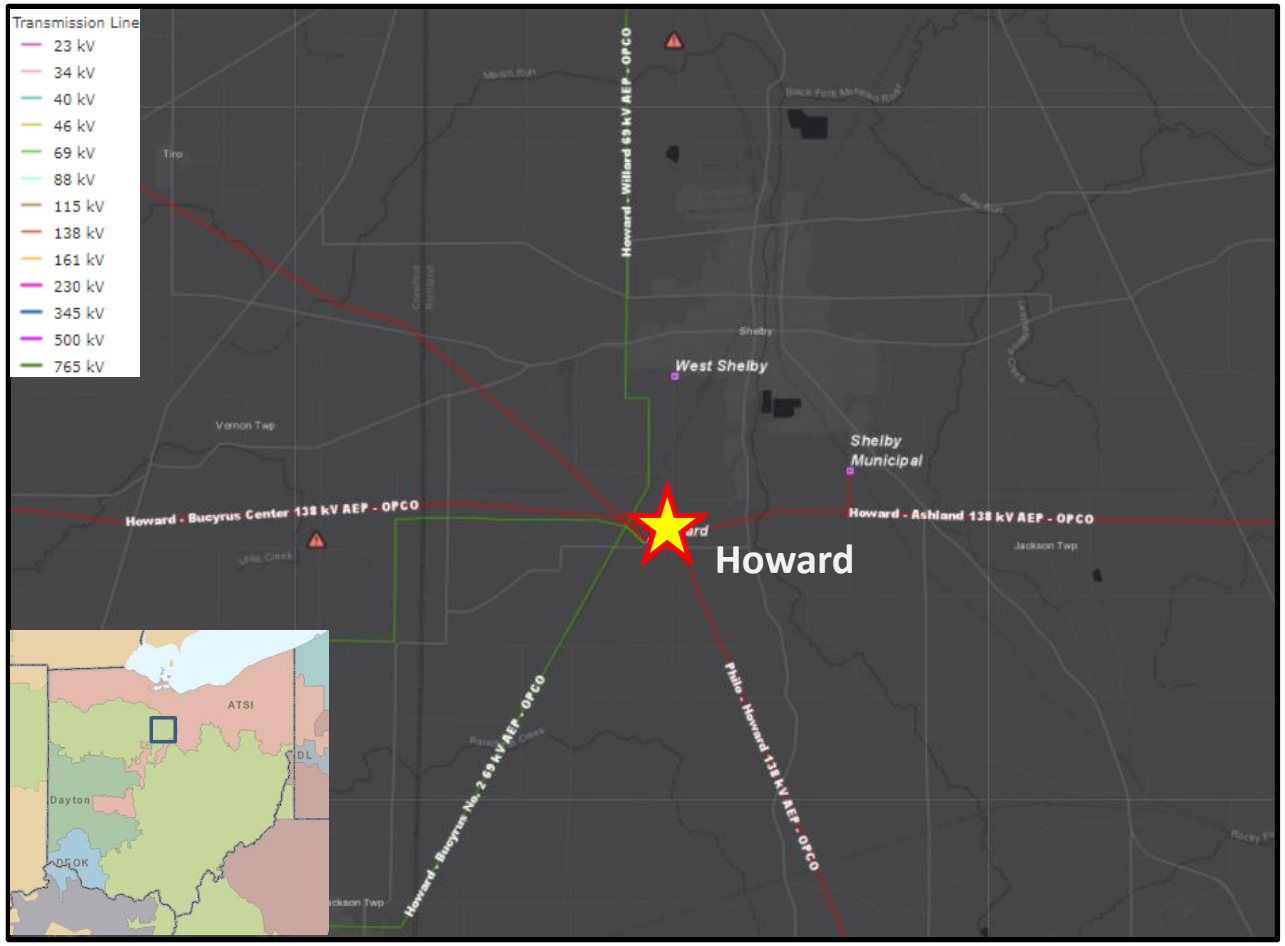
Circuit Breakers: A, B, & E

Breaker Age:

- 1990: A, B, & E

- Interrupting Medium: (SF6)
- Fault Operations:
  - Number of Fault Operations: A 13, B 30, & E 13
  - Manufacturer recommended Number of Operations: 10

Additional 145-PA model Breaker Info: As of May 11, 2020, there have been 437 recorded malfunctions of this 145-PA model family on the AEP System. The most common issues documented are related to loss of SF6 gas and mis-operations. The expected life of the bushing gaskets and door inspection port seals is 25 years; all four of these units have reached this age. Seals that are no longer adequate can cause SF6 leaks to become more frequent. The manufacturer provides no support for this family of circuit breakers, and no longer manufactures spare parts.



Problem Statement Continued:

Circuit Switcher: CS-CC

Switcher Age:

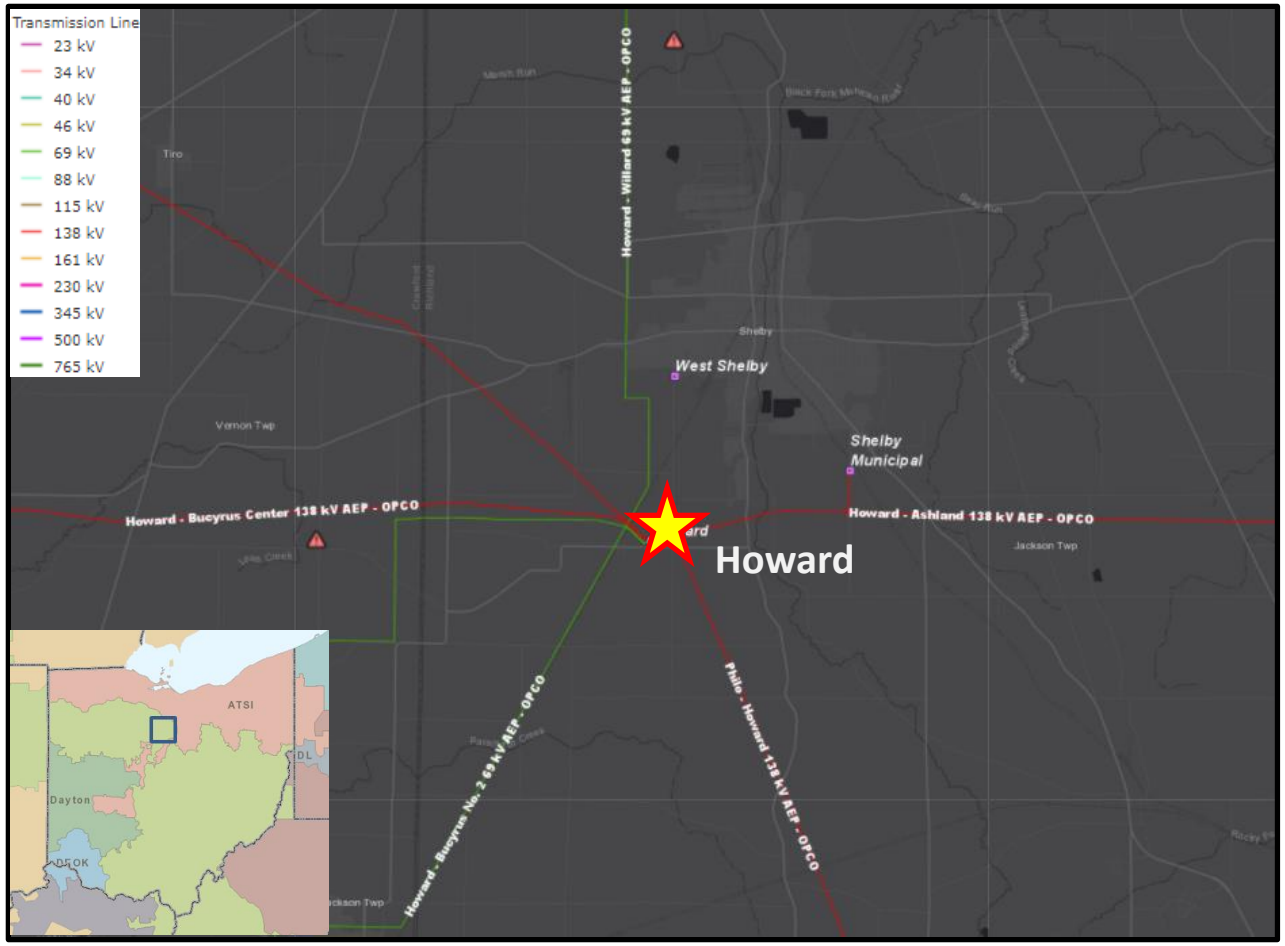
- 2000

- Interrupting Medium: (SF6)

Additional SF6 Mark V Type Information: The Mark V family of circuit switchers have no gas monitoring capability and have experienced 110 malfunctions from May 2000 to August 2019. Failed operational components including high contact resistance, gas loss, and interrupter failure represent half of these malfunctions.

Relays:

- Currently, 107 of the 122 relays (88% of all station relays) are in need of replacement. 83 of these are of the electromechanical type and 8 of the static type which have significant limitations with regards to spare part availability, fault data collection, and data retention. In addition, these relays lack of vendor support. There are also 16 microprocessor based relays commissioned between 2006 and 2011 that may have firmware that is unsupported. The existing RTU installed at Howard Substation is a legacy GE D200MEII/Ethernet unit that has no spare parts availability or vendor support.



AEP Transmission Zone M-3 Process
Washington & Morgan Counties, Ohio

Need Number: AEP-2021-OH011

Process Stage: Need Meeting 03/19/2021

Supplemental Project Driver: Equipment Condition/Performance/Risk

Specific Assumption Reference:

AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 13)

Problem Statement:

Line Name: Muskingum – South Rokeby 69kV

Original Install Date (Age): 1965

Length of Line: ~21.3 mi

Total structure count: 164

Original Line Construction Type: Wood

Conductor Type: 4/0 ACSR 6/1, 336,400 CM ACSR 18/1, and 336,400 CM ACSR 30/7 Momentary/Permanent Outages and Duration:10 Momentary and 2 Permanent Outages

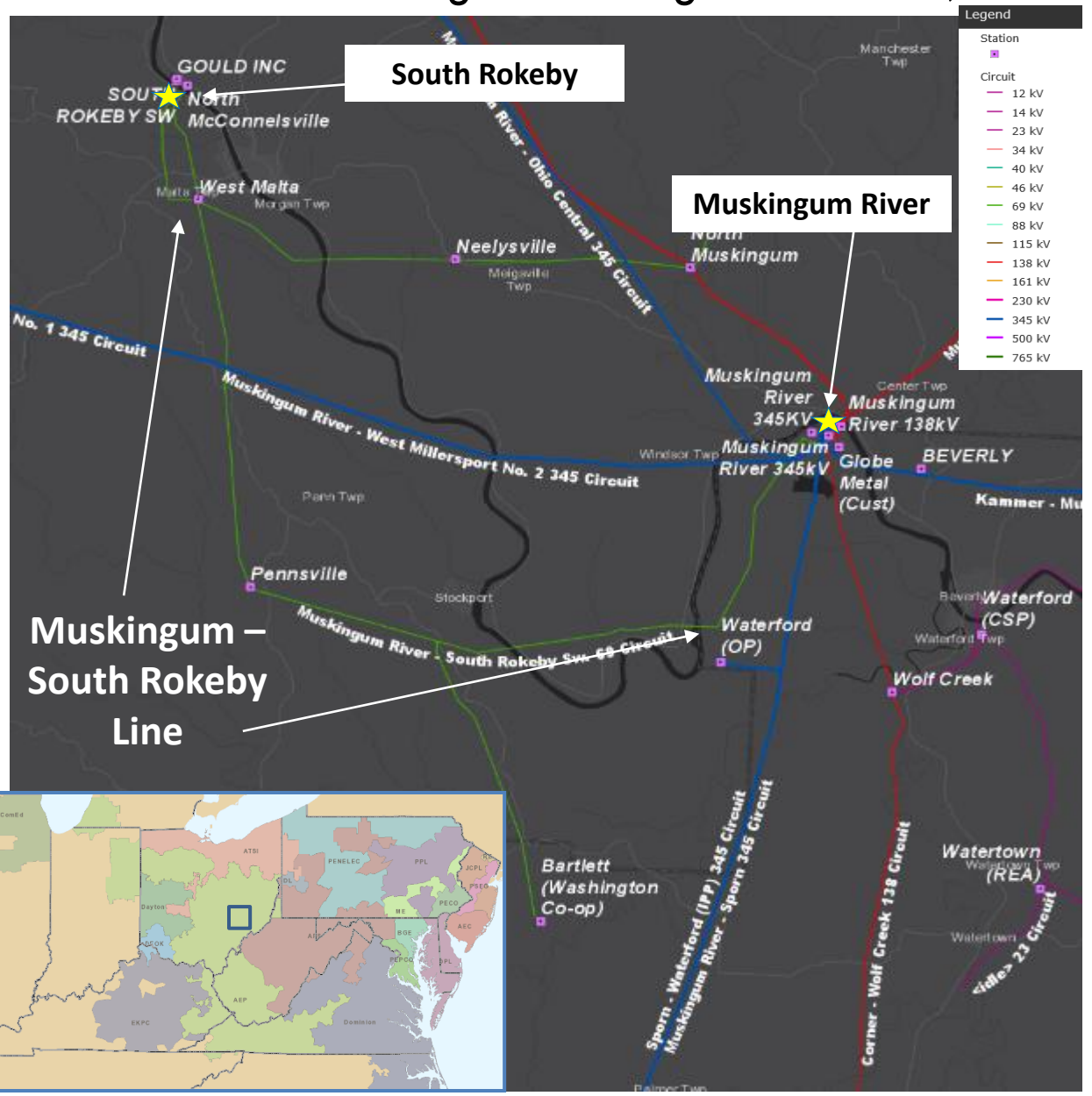
CMI: 315,751 (past five years)

Line conditions:

- 48 structures with at least one open condition, 29% of the structures on this circuit.
- 45 structure related open conditions impacting wooden poles, crossarms, braces, and filler blocks including rot, bowing, woodpecker holes, insect damage, cracked, split, and rot top
- 12 open conditions related to conductor issues including broken strands
- 12 hardware/shielding issues including open conditions related to burnt, broken, or chipped insulators.
- Structure Age: 72% 1960's, 15% 1970, 13% 1980's or newer

Other:

- The line shielding angle does not meet AEP's current shielding angle requirements
- Line does not meet current NESC Grade B loading criteria or AEP's current structural strength requirements.
- Washington Co-op's Bartlett Station is served radially from this line (~ 5.09 miles) with limited sectionalizing ability.



AEP Transmission Zone M-3 Process
Holmesville, Ohio

Need Number: AEP-2021-OH012

Process Stage: Need Meeting 3/19/2021

Supplemental Project Driver:

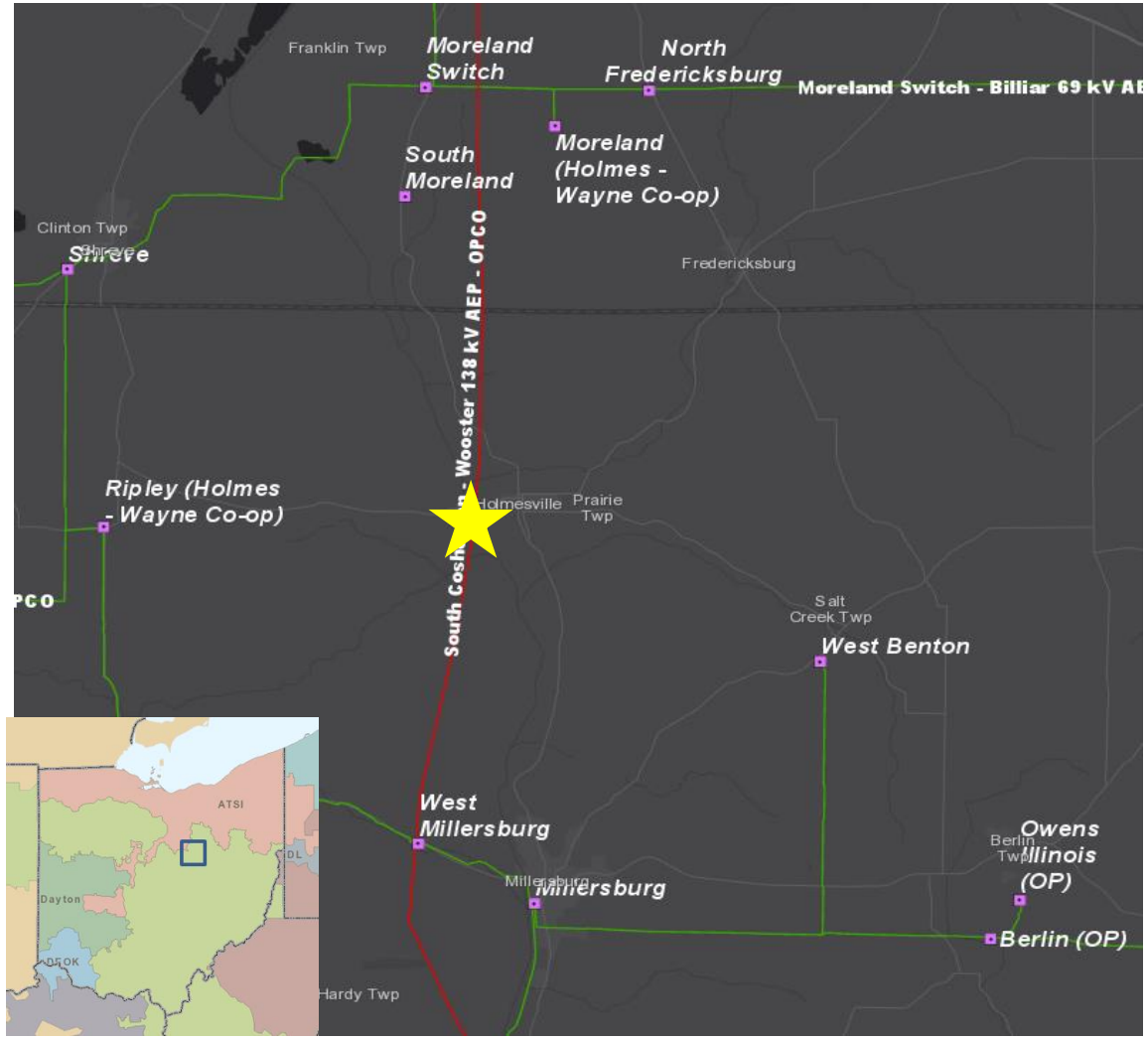
Customer Service

Specific Assumption Reference:

AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions slide 12)

Problem Statement:

- Buckeye is requesting, on behalf of Holmes- Wayne Electric co-op, a new 138kV delivery point on the West Millersburg- Wooster 138kV Circuit by August 2023. Anticipated load is 4.4 MW.



AEP Transmission Zone M-3 Process
George Washington-Kammer (Marshall County, WV)

Need Number: AEP-2021-OH013

Process Stage: Need Meeting 03/19/2021

Project Driver: Equipment Condition/Performance/Risk

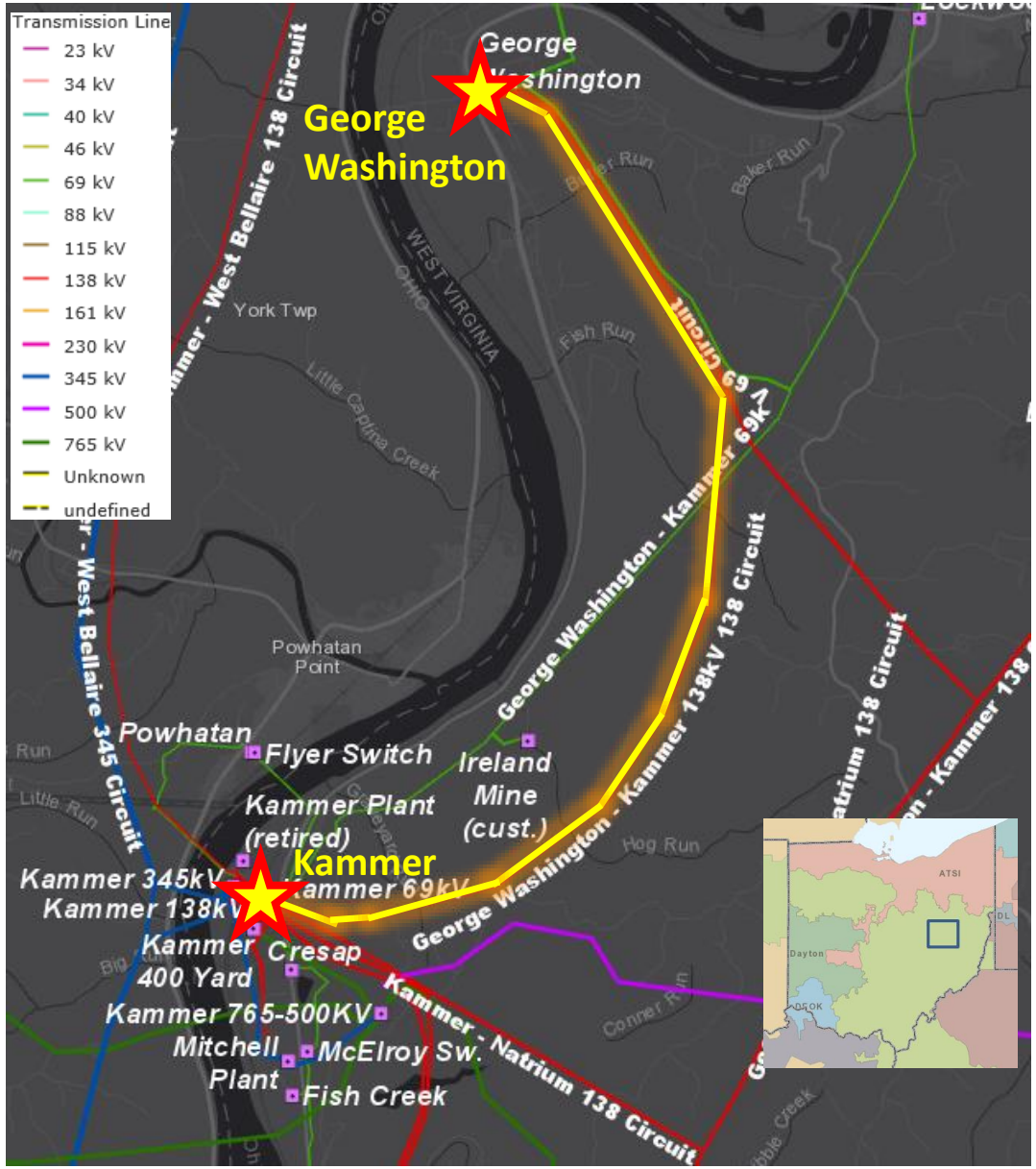
Specific Assumption Reference:

AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 13)

Problem Statement:

<u>George Washington-Kammer 138kV circuit (6.9 miles)</u>

- The line consist of 6.7 miles of original (1956) lattice towers and conductor (6-wired 636 ACSR). There is 0.2 miles of newer construction that is in adequate condition (outside the substation at each end).
- The shield wire design does not meet current shielding angle requirements.
- There are currently 14 hardware-based open conditions on the line (primarily insulator damage), 1 conductor condition (broken strands), and 1 structure condition.
- Some of the steel lattice towers show heavy rusting and corrosion. The original insulator strings show significant residue/contamination, leading to risk of flashovers and circuit outages.
    - Hook attachments freely move and wear through the hangers. This wear results in the loss of steel section over time. That section loss reduces the strength of the connection which can result in premature failure. There is evidence of hole elongation and the amount of steel left in the hanger holding up the suspension insulators is thin.



AEP Transmission Zone M-3 Process
Franklin County, OH

Need Number: AEP-2021-OH014

Process Stage: Needs Meeting 3/19/2021

Supplemental Project Driver:

Customer Service

Specific Assumption Reference:

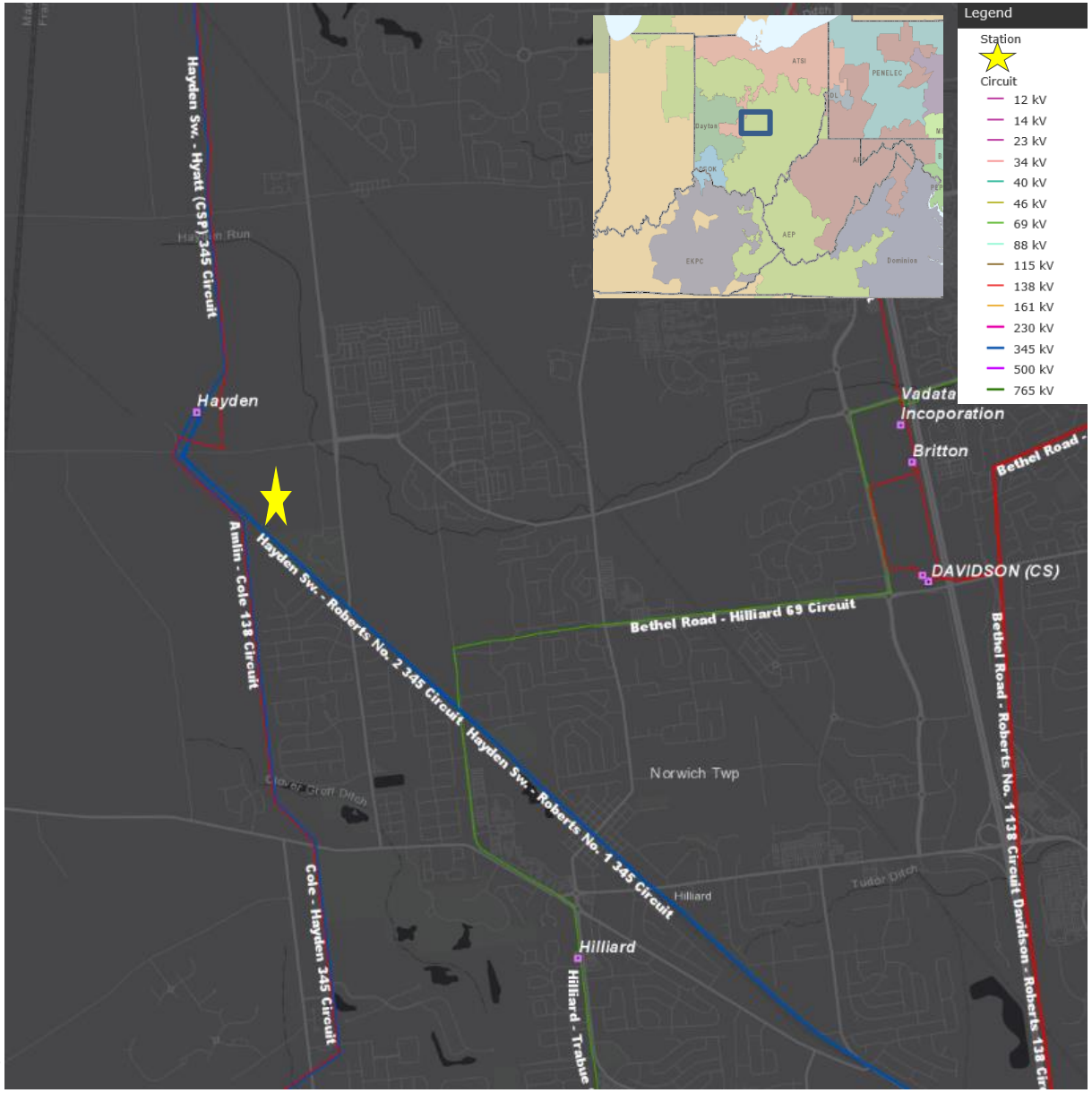
AEP Connection Requirements for the AEP Transmission System (AEP Assumptions Slide 12)

Problem Statement:

Customer Service:

- A customer has requested transmission service at a site just southeast of AEP's existing Hayden station in Hilliard, OH.
- The customer has indicated an initial peak demand of 64 MW with an ultimate capacity of up to 256 MW at the site.

Model: 2026 RTEP



AEP Transmission Zone M-3 Process
St. Clairsville, Ohio

Need Number: AEP-2021-OH015

Process Stage: Need Meeting 3/19/2021

Project Driver:

Equipment Material/Condition/Performance/Risk

Specific Assumption Reference:

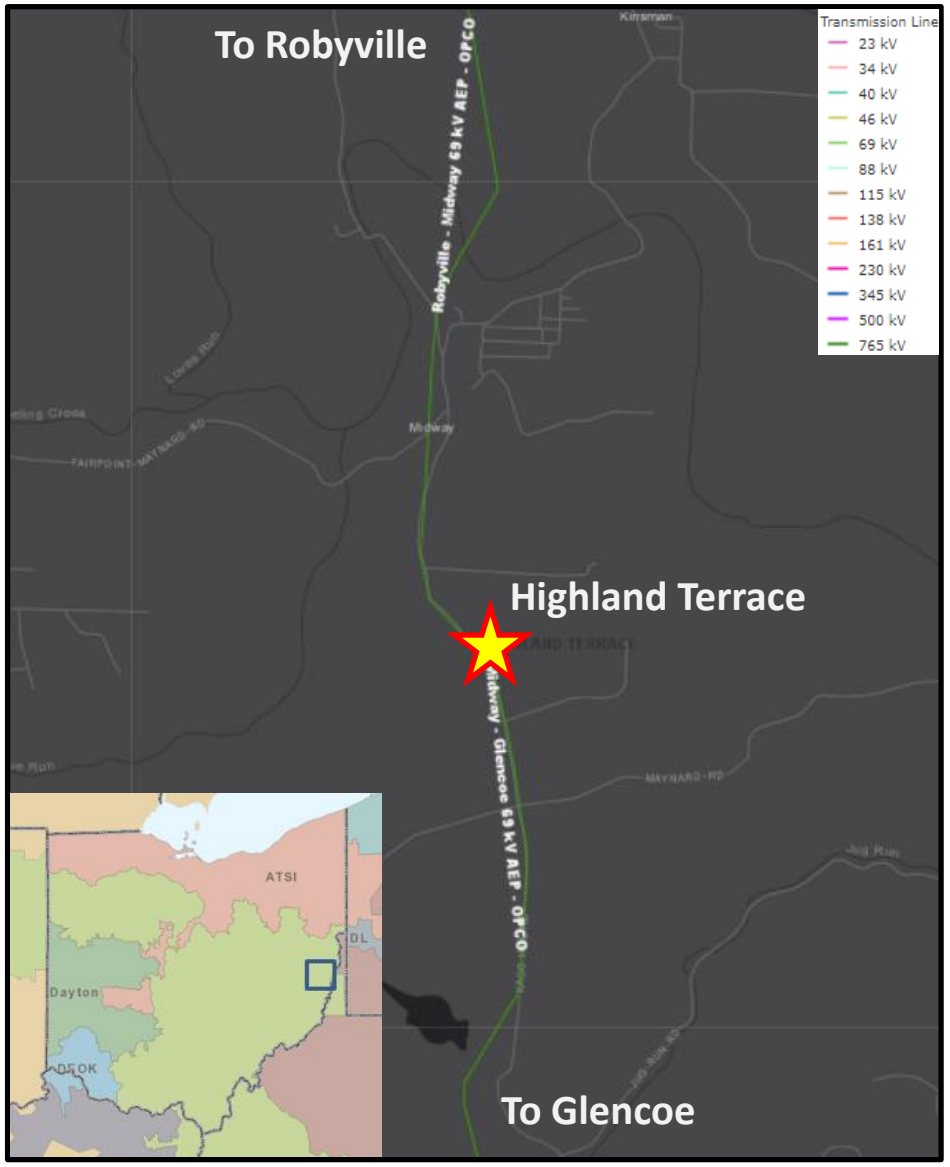
AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 13)

Problem Statement:

The Highland Terrace 69-12kV distribution substation north of St. Clairsville, Ohio is a unique 1975-vintage modular station ("station in a box"). The indoor station had a major failure in August 2019 and has been bypassed with a mobile since that time.

<u>Circuit Switcher CS-AA (69kV)</u>

- Breaker Age:
  - 1973
- Interrupting Medium: (Vacuum)
- Additional Information: This switcher has failed and is no longer in working condition. The vacuum bottles have failed and there are no replacement parts available for this unit. The vacuum interrupter bottles have suffered flashovers and the switch is currently inoperable.



AEP Transmission Zone M-3 Process
St. Clairsville, Ohio

Need Number: AEP-2021-OH015

Process Stage: Need Meeting 3/19/2021

Problem Statement Continued:

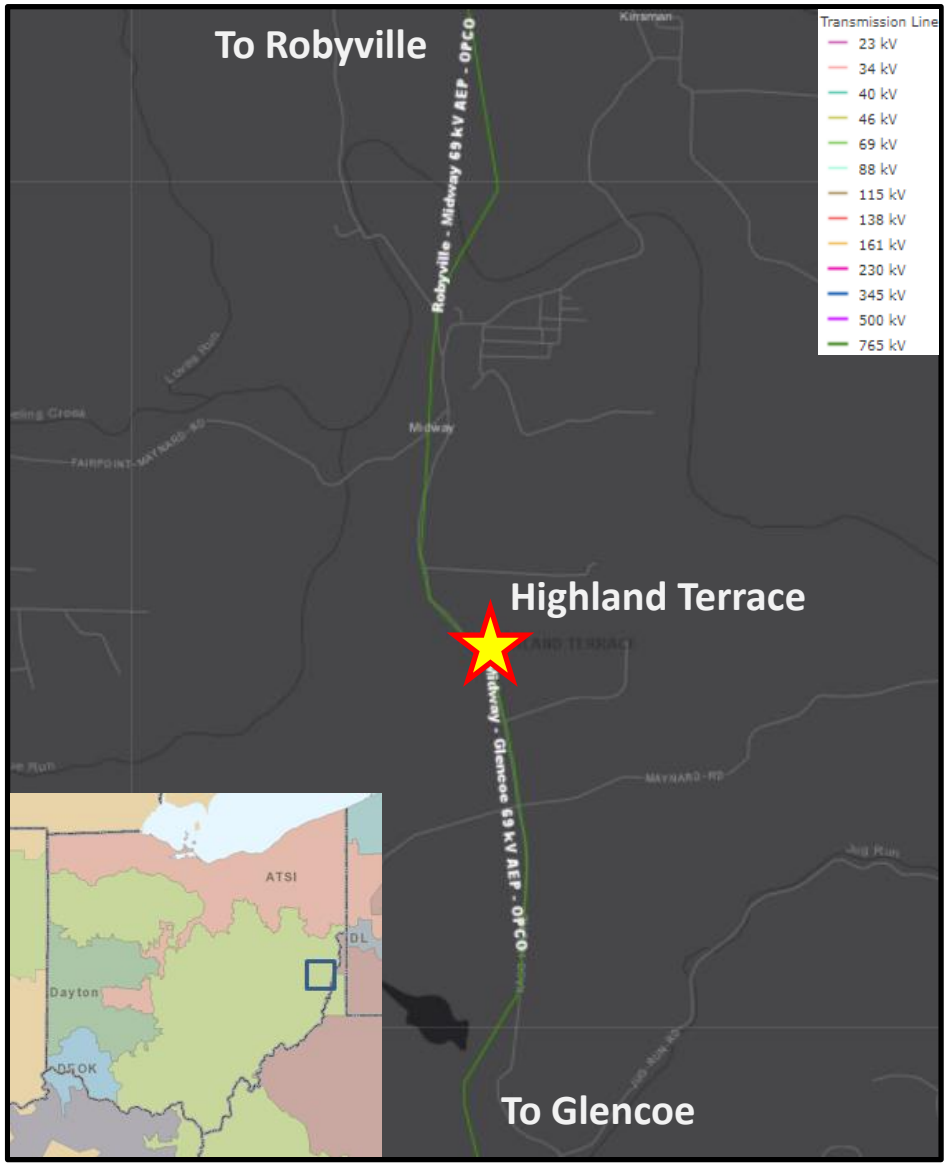
Transformer: 69/12 kV TR-1

- Age: 1975
- The dielectric strength and interfacial tension are trending downwards which can indicate an increase in particles within the oil, decreasing the dielectric strength of the oil to withstand fault events, which can damage the paper insulation. The values of dielectric strength, IFT and power factor indicate the dielectric strength of the insulation system (oil and paper) are in poor condition, which impairs the unit's ability to withstand electrical faults.
- No oil containment
- There are no surge arrestors installed, which does not meet AEP station standards

Relays:

- 22 relays, implemented to ensure the adequate protection and operation of the substation. Currently, 22 of the 22 relays (100% of all station relays) are in need of replacement. All 22 of these are of the electromechanical type which have significant limitations with regards to spare part availability and fault data collection and retention. In addition, these relays lack of vendor support.

Other: The metal building has various leaks and rust. The 69kV & 12kV underground cables are direct-bury and original to the station (1975). There is no perimeter fence for the modular station, leaving it vulnerable to vandalism or theft. There are identified needs on several 12 kV breakers (CB A & B). Over the past 5 years, equipment failures have caused 421,724 customer-minutes-of-interruption (CMI).



AEP Transmission Zone M-3 Process
Lawrence County, OH

Need Number: AEP-2021-OH017

Process Stage: Need Meeting 03/19/2021

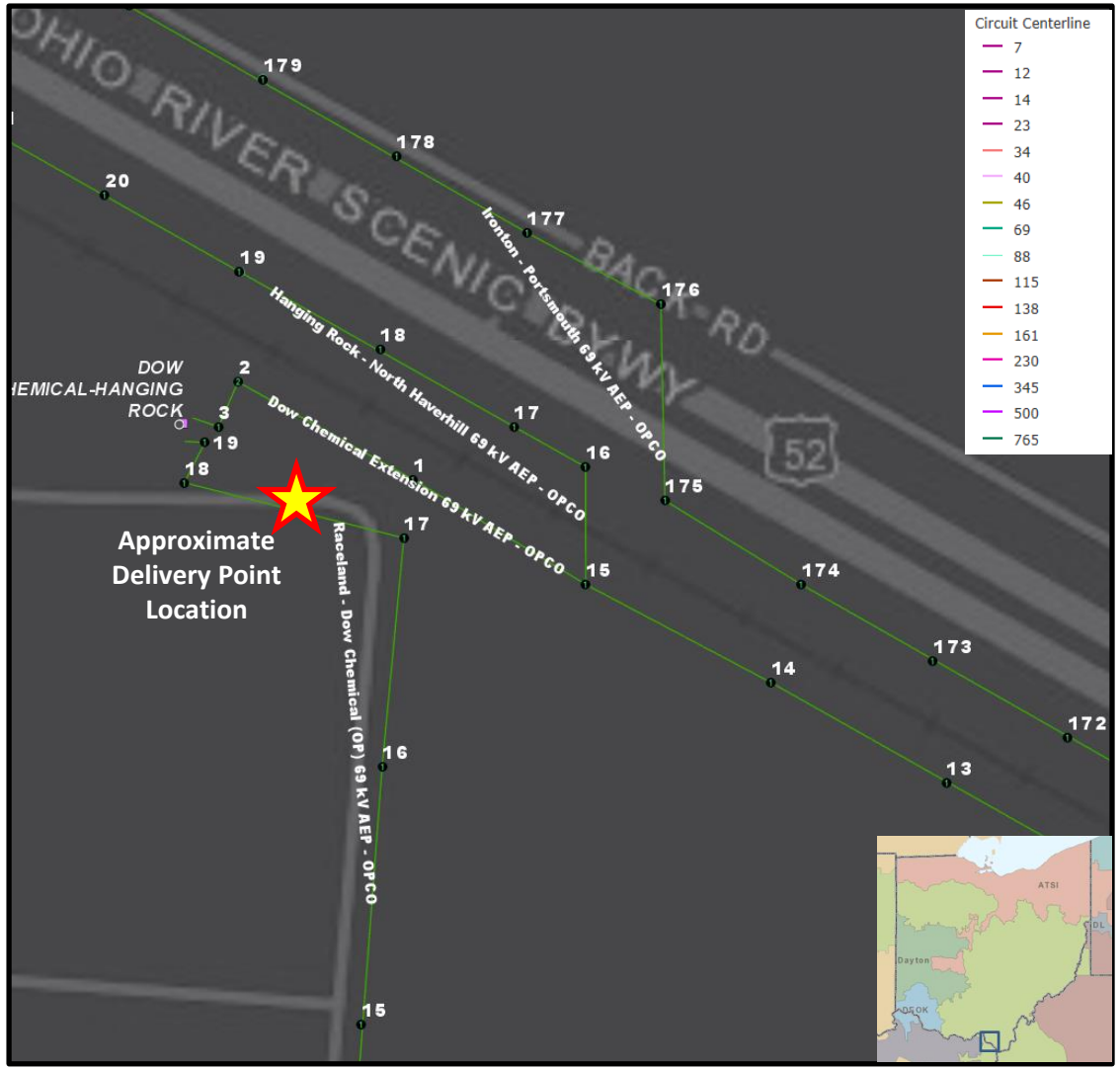
Project Driver: Customer Service

Specific Assumption Reference:

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

Problem Statement:

A customer has requested 69kV service in Lawrence County, Ohio. This request is on the Dow Chemical – Highland 69 kV line and the in-service date is February 2022. The anticipated peak load is approximately 22 MW.



Solutions

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

Need Number: AEP-2020-AP027

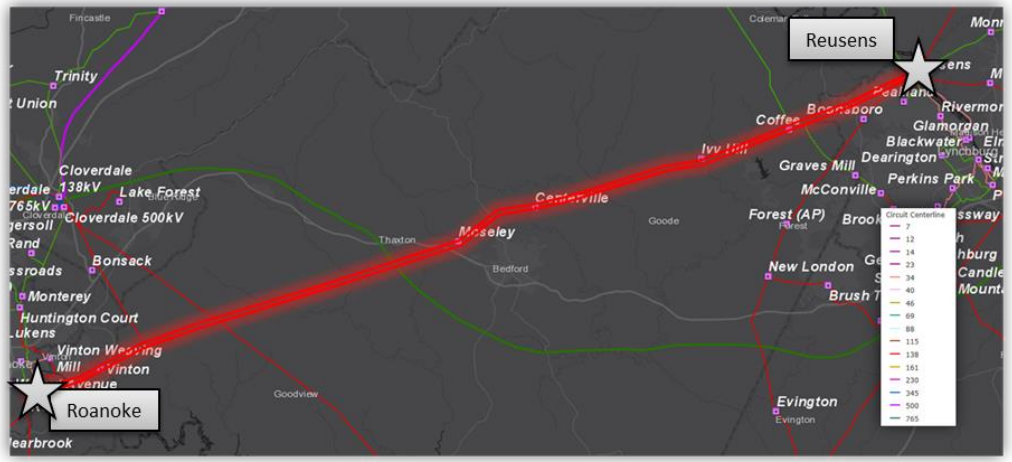
Process Stage: Needs Meeting 04/20/2020

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

Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8); AEP Eastern System Pre-1930s Era Lattice Tower and Transmission Line System

Problem Statement:

- **Reusens-Roanoke 138 kV Double Circuit Line Asset (43 mi.)**
  - Installed between 1926 and 1933 using double circuit steel lattice towers
  - Recent field assessments have identified severe ovalization of holes at hanger bar connections and severe cross arm and hanger rusting as well as uniform corrosion, pitting, and deformation of steel members below grade. Evidence of steel corrosion at joints and on upper steel members was also documented.
  - Ferrous clamps are present on this line asset; these types of clamps can cause accelerated degradation of conductor at connection points due to excess heat generated even when operated at acceptable, rated levels.
  - From 2014-2018, there have been 55 momentary and 12 permanent outages on the four circuits that comprise the Reusens-Roanoke line
    - **Cloverdale-Roanoke 138 kV Circuit***
      - From 2014-2018, 8 momentary and 1 permanent outage occurred resulting in 276,350 customer minutes of interruption impacting 69 MVA of peak load
      - Permanent outage(s) were caused by: Vegetation Fall-In (1)
    - **Cloverdale-Reusens 138 kV Circuit***
      - From 2014-2018, 28 momentary and 6 permanent outages occurred resulting in 1,467,704 customer minutes of interruption impacting 39 MVA of peak load
      - Permanent outage(s) were caused by: Lightning (4), Tree Removal (1), Vegetation Fall-In (1)
    - **Moseley-Roanoke 138 kV Circuit**
      - From 2014-2018, 9 momentary and 1 permanent outage occurred
      - Permanent outage(s) were caused by: Lightning (1)
    - **Moseley-Reusens 138 kV Circuit**
      - From 2014-2018, 10 momentary and 4 permanent outages occurred impacting 44 MVA of load (Town of Bedford)
      - Permanent outage(s) were caused by: Lightning (2), Vegetation Fall-In (1), Field Error (1)



*Note: Circuit is associated with both the Roanoke-Cloverdale and Reusens-Roanoke line assets

26

Need Number: AEP-2020-AP033

Process Stage: Needs Meeting 05/22/2020

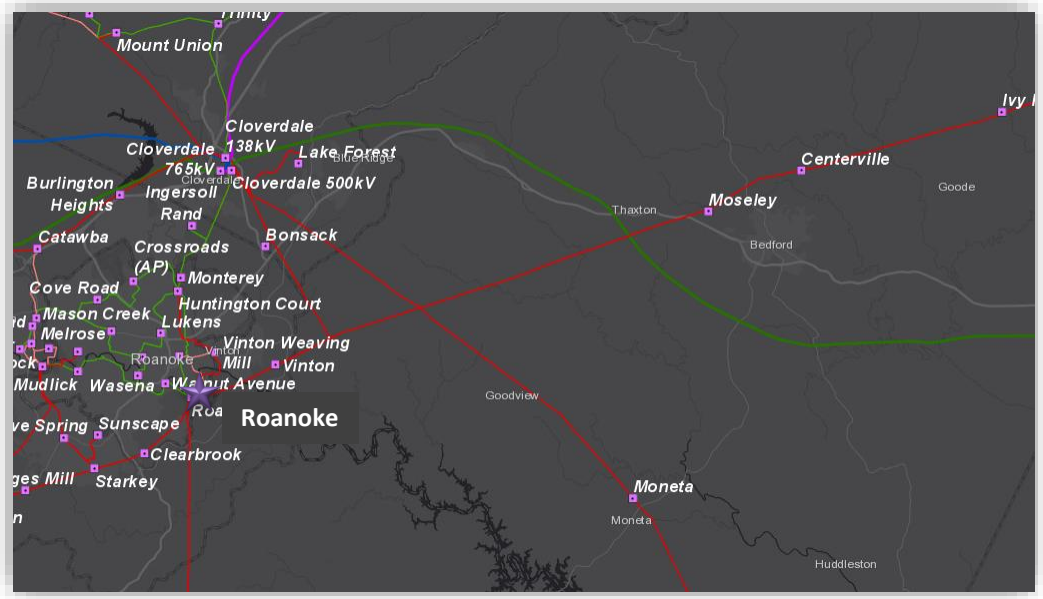
Supplemental Project Driver: Equipment Condition/Performance/Risk

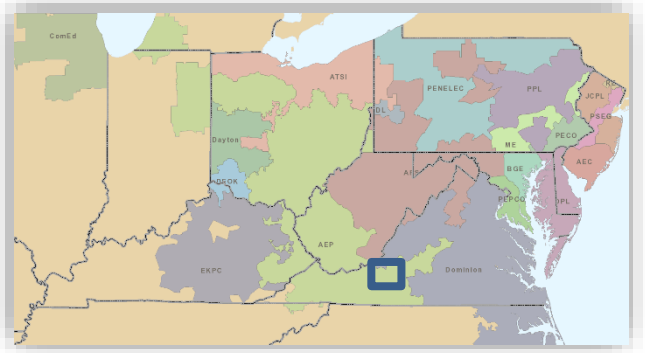
Specific Assumption Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

Problem Statement:

Roanoke Station:

- 138/69/12 kV Transformer #5
  - 1981 Vintage Transformer
  - Elevated levels of carbon monoxide, carbon dioxide and hydrogen indicate excessive levels of decomposition of the paper insulating materials.
- 138 kV Circuit Switchers BB and CC
  - Both are 1990's vintage
  - The Mark V family of circuit switchers have no gas monitor and currently in-service units on the AEP system have experienced 110 malfunctions from May 2000 to August 2019. Failed operational components including high contact resistance, gas loss, and interrupter failure represent half of these malfunctions. Two malfunctions of note were catastrophic equipment failures involving failures to trip.
- 138 kV Capacitor Bank CC and 34.5 kV Capacitor Bank AA
  - Leaking around bushings on both banks
  - 6 cans are failed on bank CC
- 69 kV Circuit Breakers U and V
  - 1970's Vintage Circuit Breakers
  - These breakers are oil filled without oil containment; oil filled breakers have much more maintenance required due to oil handling that their modern, SF6 counterparts do not require
  - Circuit breaker U has each exceeded the manufacturer's designed number of full fault operations (12)





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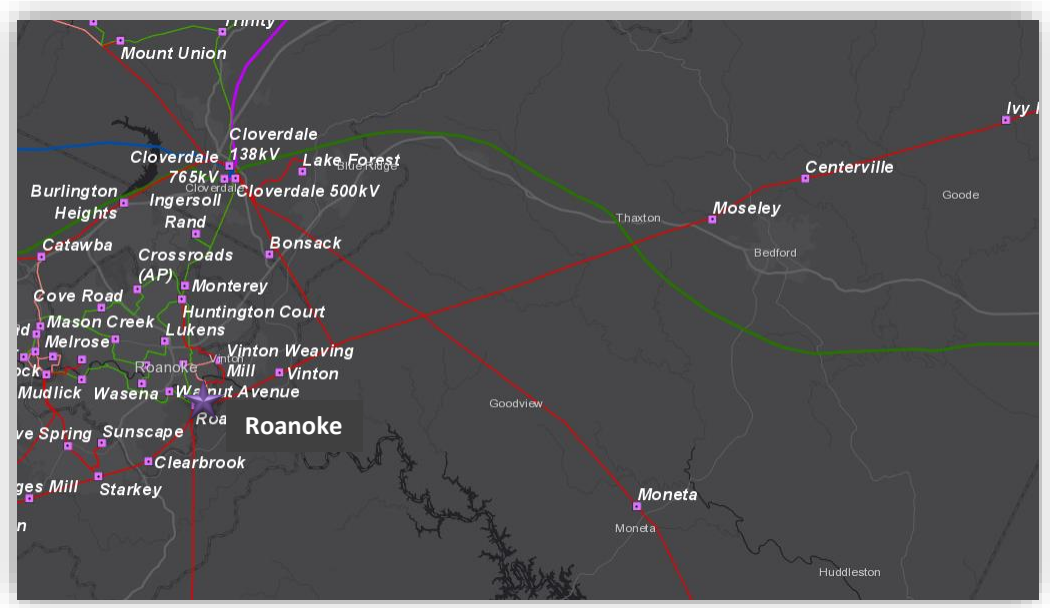
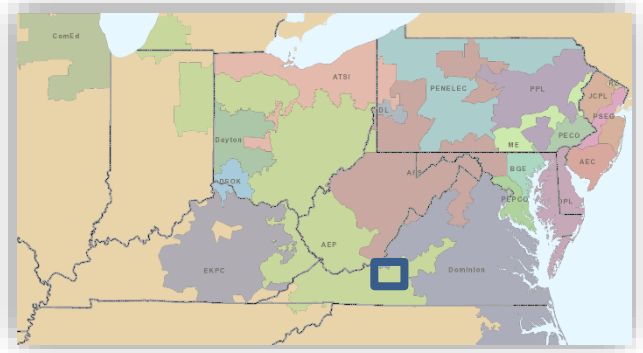
Roanoke Station:

- Relaying
  - Roanoke Substation currently deploys 103 relays, implemented to ensure the adequate protection and operation of the substation. Currently, 79 of the 103 relays (77% of all station relays) are in need of replacement.
    - There are 50 electromechanical and 8 static which have significant limitations with regards to fault data collection and retention. These relays lack vendor support and have little to no access to spare parts.
    - There are 3 DPU microprocessor type relays on the three distribution breakers. The DPU relays pose a potential 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.
    - There are 18 microprocessor relays that utilize legacy firmware.
- Pilot Wire
  - Pilot wire relaying exists on the Campbell Ave. 69 kV, Roanoke 69 kV and Campbell Ave 34.5 kV circuits
  - TFS lacks adequate crew training and experience on handling pilot wire; only a small number of crews are available with necessary experience to perform corrective maintenance
  - High corrective maintenance costs are incurred (P&C, line, forestry, build roads, etc.)
- High-Side Transformer Protection
  - No automatic high-side protection exists on transformer #5 or #2
  - Both are directly connected to 138 kV bus #2, which would operate five 138 kV circuit breakers for a transformer fault





Need Number: AEP-2020-AP034

Process Stage: Needs Meeting 05/22/2020

Supplemental Project Driver: Equipment Condition/Performance/Risk

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

Problem Statement:

Centerville Station:

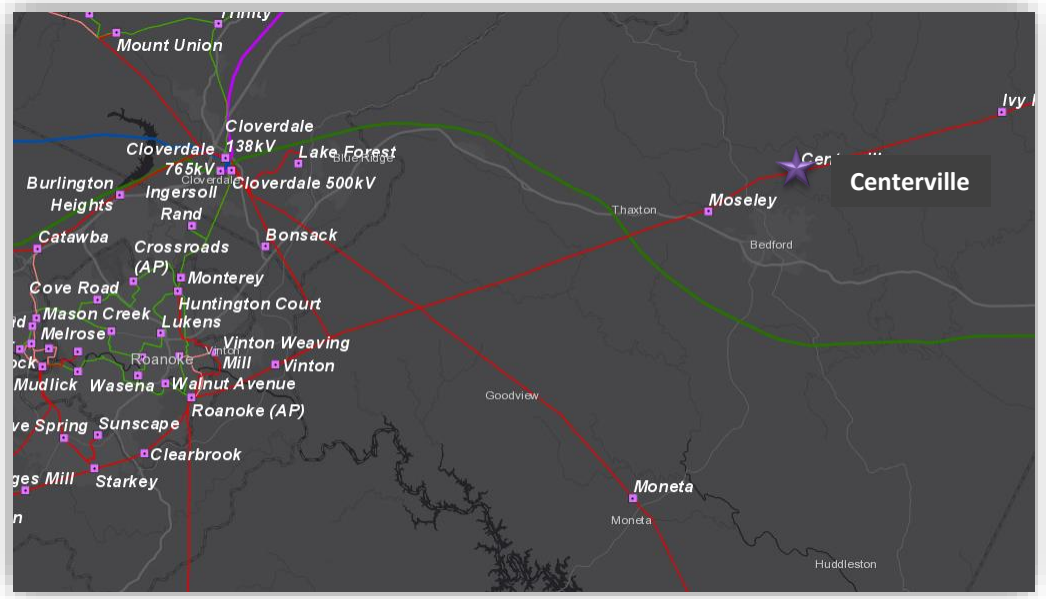
- 69 kV Circuit Breaker B
  - 1970's Vintage Circuit Breaker
  - Oil filled breaker without oil containment. Oil filled breakers have much more maintenance required due to oil handling that their modern, SF6 counterparts do not require.
  - This circuit breaker, has exceeded the manufacturer's designed number of full fault operations (108)

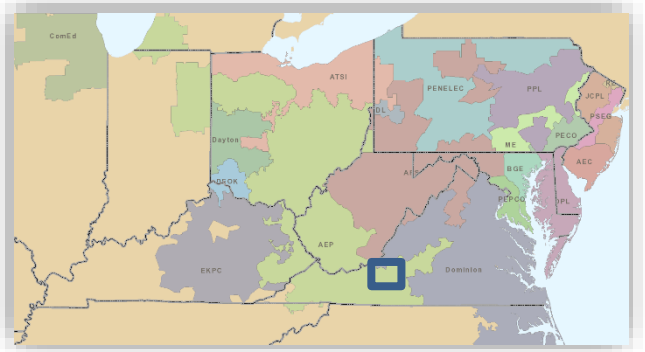
- High-side Transformer MOAB Ground Switch (138/69/12 kV T1) is used for high-side transformer protection

- There is a three terminal line configuration through the Town of Bedford 69 kV loop.

- The flip-flop configuration connection to the double circuit 138 kV line that runs adjacent to the station is a source of operational and protection challenges when faults occur.

- Relaying
  - Centerville Substation currently deploys 26 relays, implemented to ensure the adequate protection and operation of the substation. Currently, all 26 of the relays (100% of all station relays) are in need of replacement. There are 21 of the electromechanical which have significant limitations with regards to fault data collection and retention. These relays lack vendor support and have little to no access to spare parts. Also, the remaining 5 relays that are microprocessor based from utilize legacy firmware.





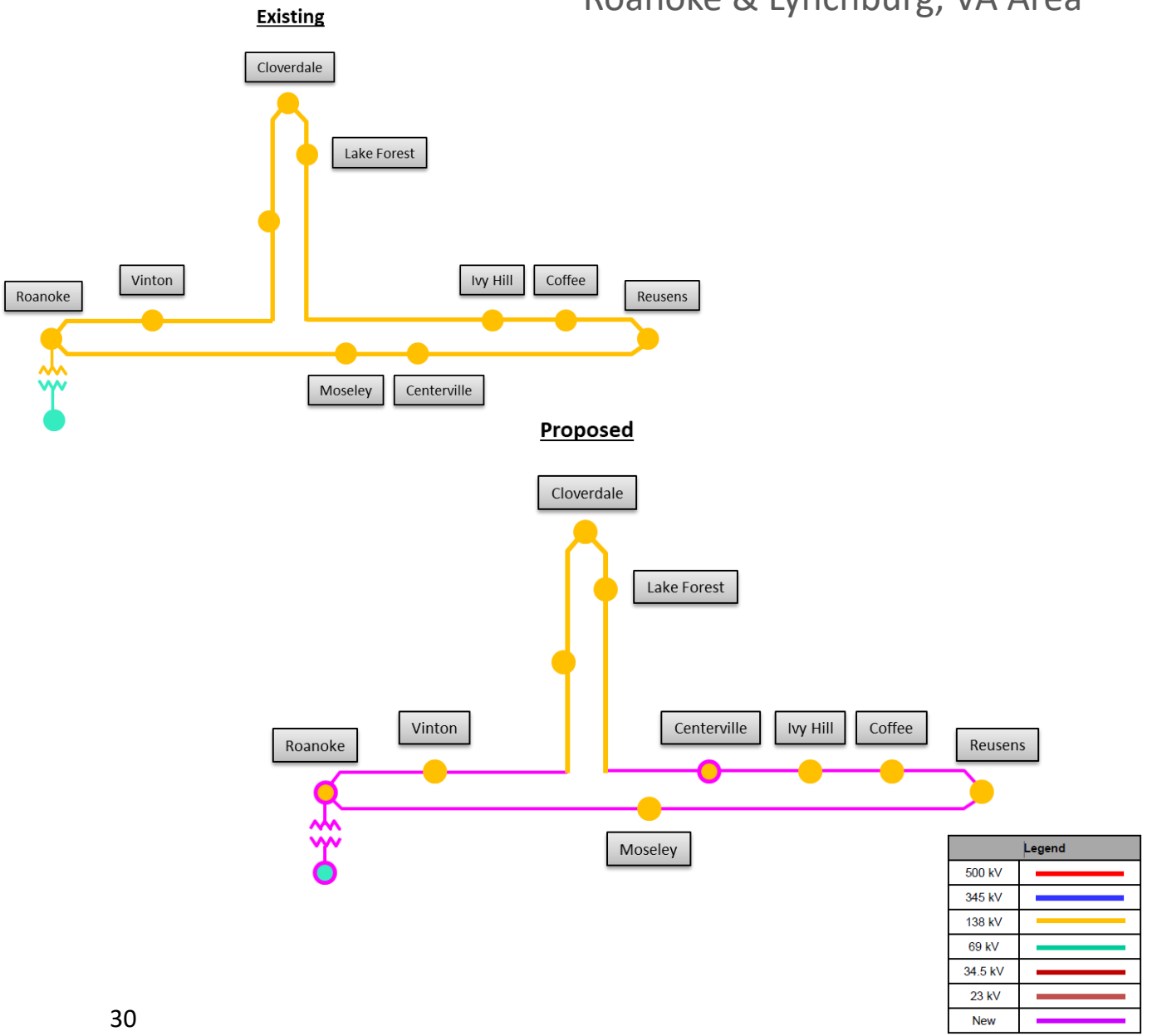
AEP Transmission Zone M-3 Process
Roanoke & Lynchburg, VA Area

Need Number(s): AEP-2020-AP027, AEP-2020-AP033, AEP-2020-AP034

Process Stage: Solutions Meeting 3/19/2021

Proposed Solution:

- Rebuild ~43 miles of double circuit 138 kV line between Reusens and Roanoke substations **Estimated Cost: $142.0 M**
- Acquire additional Reusens-Roanoke 138 kV ROW as needed for the rebuild. **Estimated Cost: $13.7 M**
- Reconductor ~0.1 mile span into Ivy Hill Station. **Estimated Cost: $0.2M**
- Tie into the existing Roanoke-Cloverdale 138 kV Line via a new ~0.3 mile extension. **Estimated Cost: $0.7M**
- Install new wire as underbuild on the Reusens-Roanoke 138kV line and re-route the existing Campbell Avenue-Roanoke 34.5 kV line due to Roanoke substation reconfiguration. **Estimated Cost: $0.5M**
- Re-route the existing Roanoke-Walnut 69kV line due to Roanoke substation reconfiguration. Three (3) replacement structures are expected to shift the alignment and follow the western part of the substation fence to terminate into the new box bay at Reusens Substation. **Estimated Cost: $1.1M**
- At Roanoke station, replace 138 kV capacitor bank switcher "BB" with a 3000 A, 40 kA circuit breaker. Replace 138 kV capacitor bank switcher "CC" with a 3000 A, 40 kA circuit breaker. Replace 138 kV capacitor bank "CC" with a new 57.6 MVAr capacitor bank. Install high-side circuit switchers on Transformers #2 (138/34.5 kV) and #5 (138/69 kV). Replace transformer #5 (138/69/12 kV) with a 130 MVA, 138/69/12 kV transformer. Replace 69 kV circuit breakers "U" and "V" with 2000 A, 40 kA circuit breakers. Replace pilot wire relaying with fiber relaying associated with 69 kV CBs "U" and "V", and 34.5 kV CB "L". **Estimated Cost: $10.1M**



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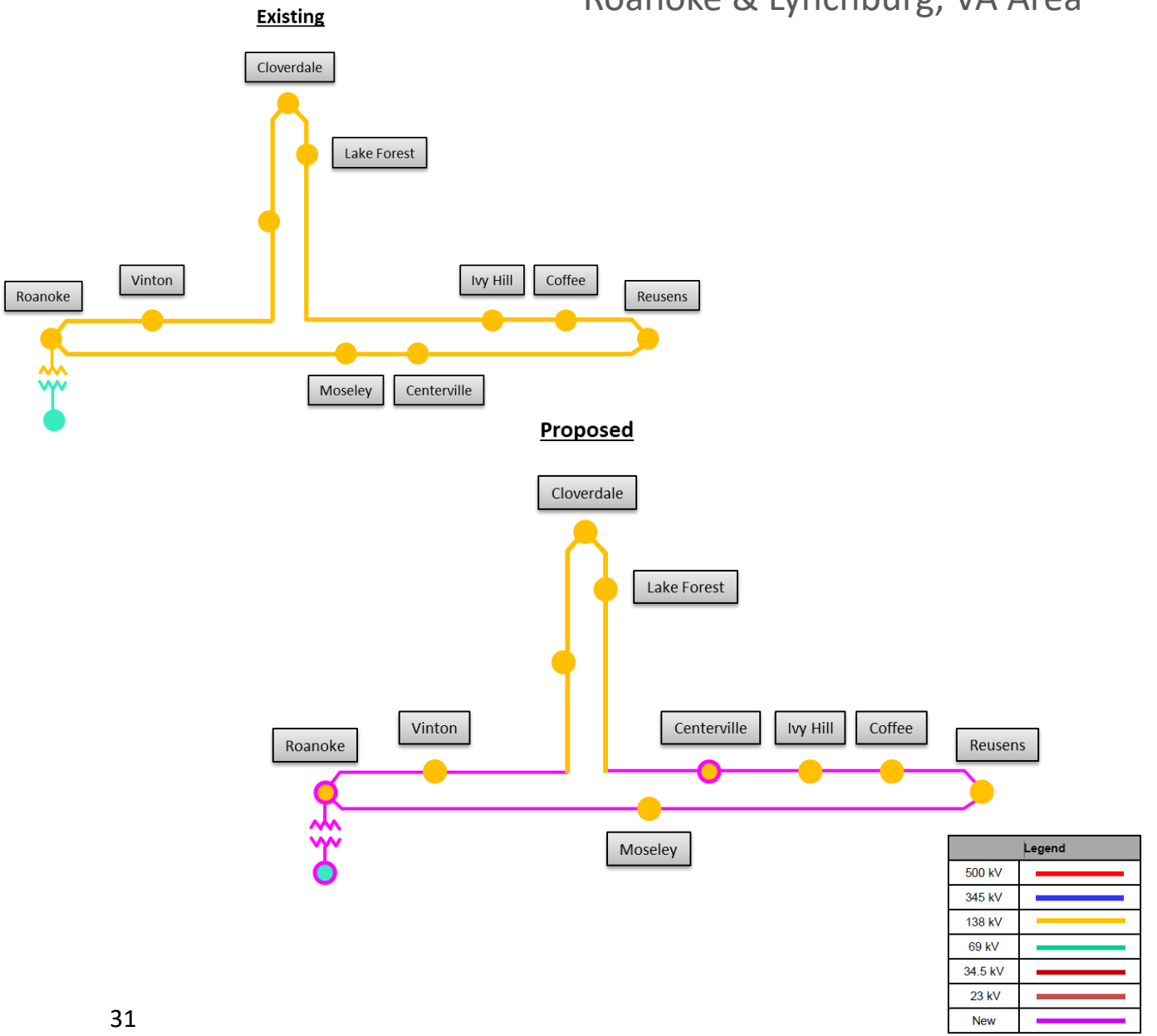
- At Centerville station, reconfigure existing 138 kV with two (2) new 138 kV circuit breakers on each line exit towards Cloverdale and Reusens substations rated at 3000 A, 40 kA to eliminate the three terminal line. Replace MOAB ground switch with circuit switcher on high-side of the Transformer #1 (138/69/34.5 kV). Replace 69 kV circuit breaker "B", associated disconnect switches and foundations with 3000 A, 40 kA circuit breaker. **Estimated Cost: $6.7M**
- At Campbell Avenue station, replace pilot wire relaying with fiber relaying associated with 34.5 kV CB-B and 69 kV CB-C. **Estimated Cost: $0.9M**
- At Walnut Avenue station, replace pilot wire relaying with fiber relaying associated with 69 kV CB-C. **Estimated Cost: $0.5M**
- Install fiber extensions and telecom to support SCADA connectivity along the line and at Vinton, Ivy Hill, Coffee, and Moseley stations. **Estimated Cost: $1.2M**
- **Total Estimated Transmission Cost: $177.6 M**



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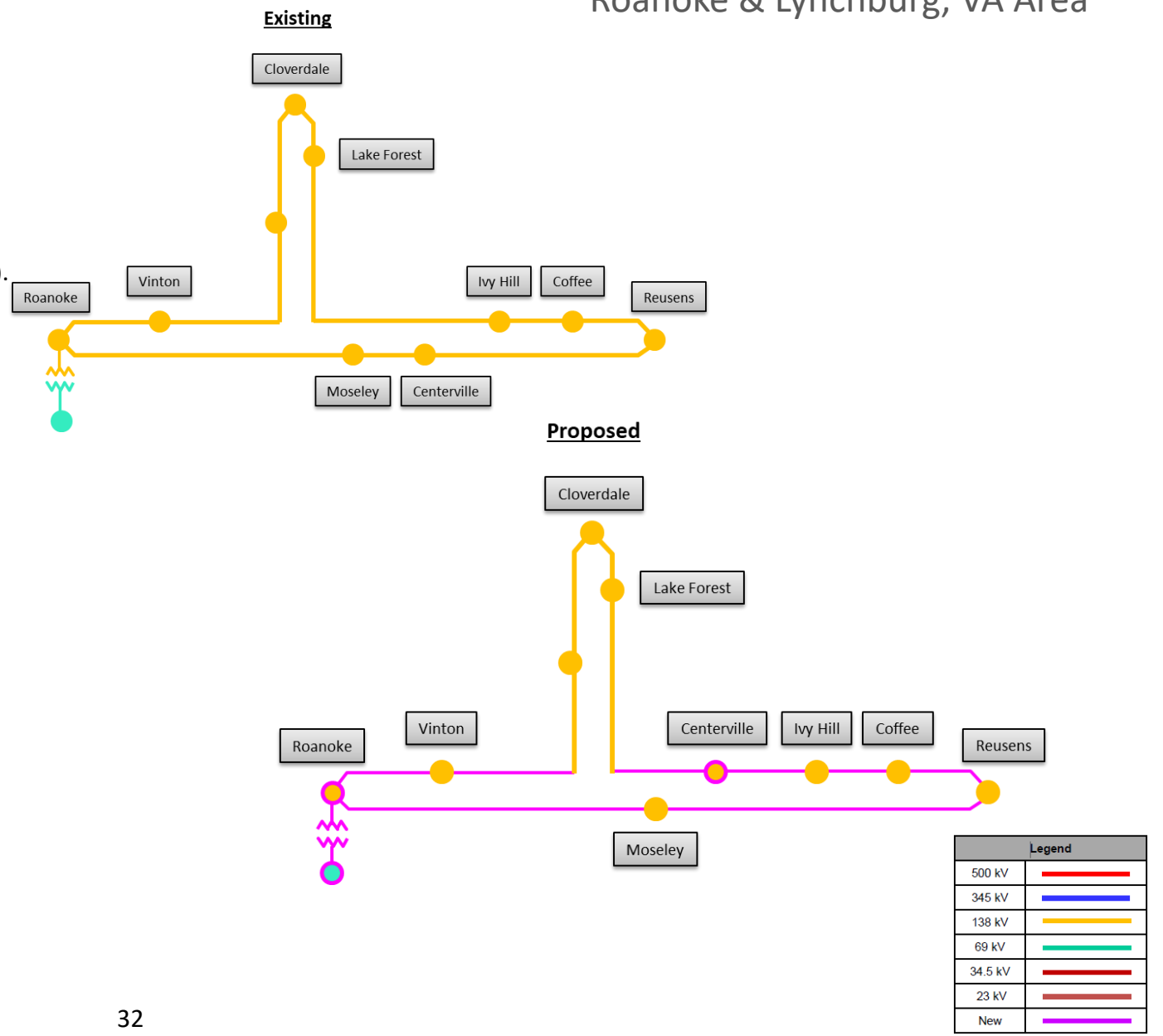
Ancillary Benefits:
The reconfiguration of Centerville Station from a N.O. "flip-flop" scheme connected to the double circuit 138 kV line via Motor Operated Air-Breaker switches to 138 kV circuit breakers on each line exit of the Cloverdale-Reusens 138 kV circuit will improve the operational flexibility and reliability performance to the customers served from Centerville (Town of Bedford and AEP Distribution).

Alternatives Considered:
Due to the sensitivity of construction outages in the area, a build in the clear option was considered. However, due to the potential impact to several land owners, rebuilding the line in the existing ROW is the preferred solution.
Estimated Cost of Alternative: $225 M

Projected In-Service: 10/31/2028

Project Status: Scoping



AEP Transmission Zone M-3 Process
Johnson County, KY

Need Number: AEP-2020-AP029

Process Stage: Solutions Meeting 03/19/2021

Previously Presented: Needs Meeting 04/20/2020

Supplemental Project Driver: Equipment Condition/Performance/Risk

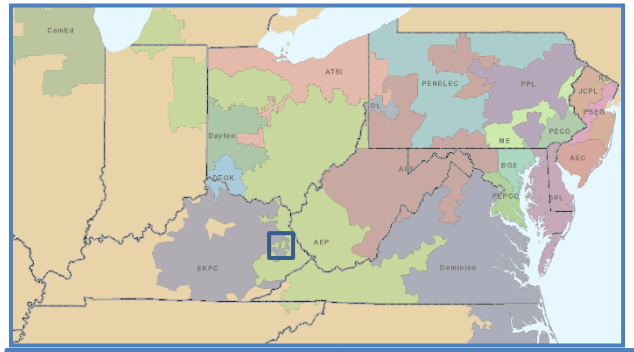
Specific Assumption Reference:
AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

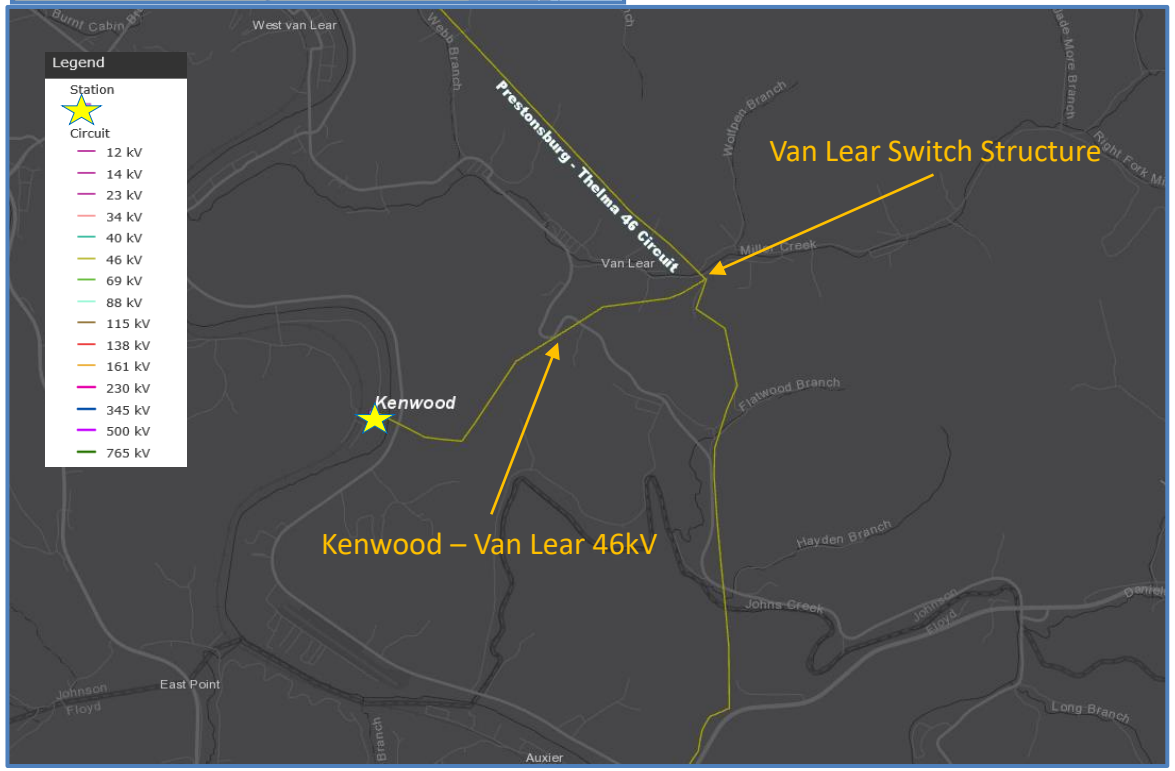
Problem Statement:
Line Name: Kenwood – Van Lear 46kV
Original Install Date (Age): 1969
Length of Line: 1.77 mi
Total structure count: 11
Original Line Construction Type: Wood
Conductor Type: 336,400 ACSR 26/7
Line conditions:

- 3 of the 11 structures have conditions that comprise 27% of the line section.
- Open conditions include: rot and woodpecker damage.
- Kenwood Station is currently radially fed with a peak load near 22 MVA.

Van Lear Switch:

- The switches at Van Lear have been tagged as inoperable and unsafe to operate. The old hydraulic type mechanism on these switches does not operate properly, arcing horns are burnt off, and operating rod supports are damaged.





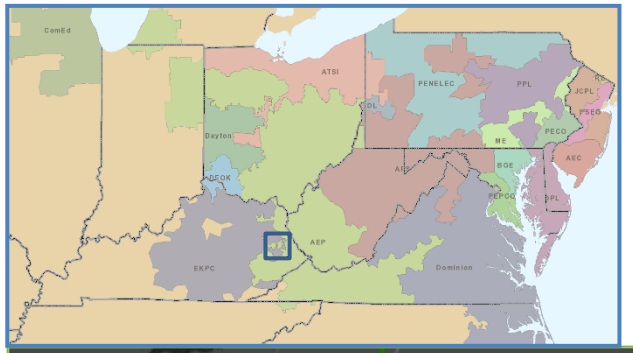
AEP Transmission Zone M-3 Process
Johnson County, Kentucky

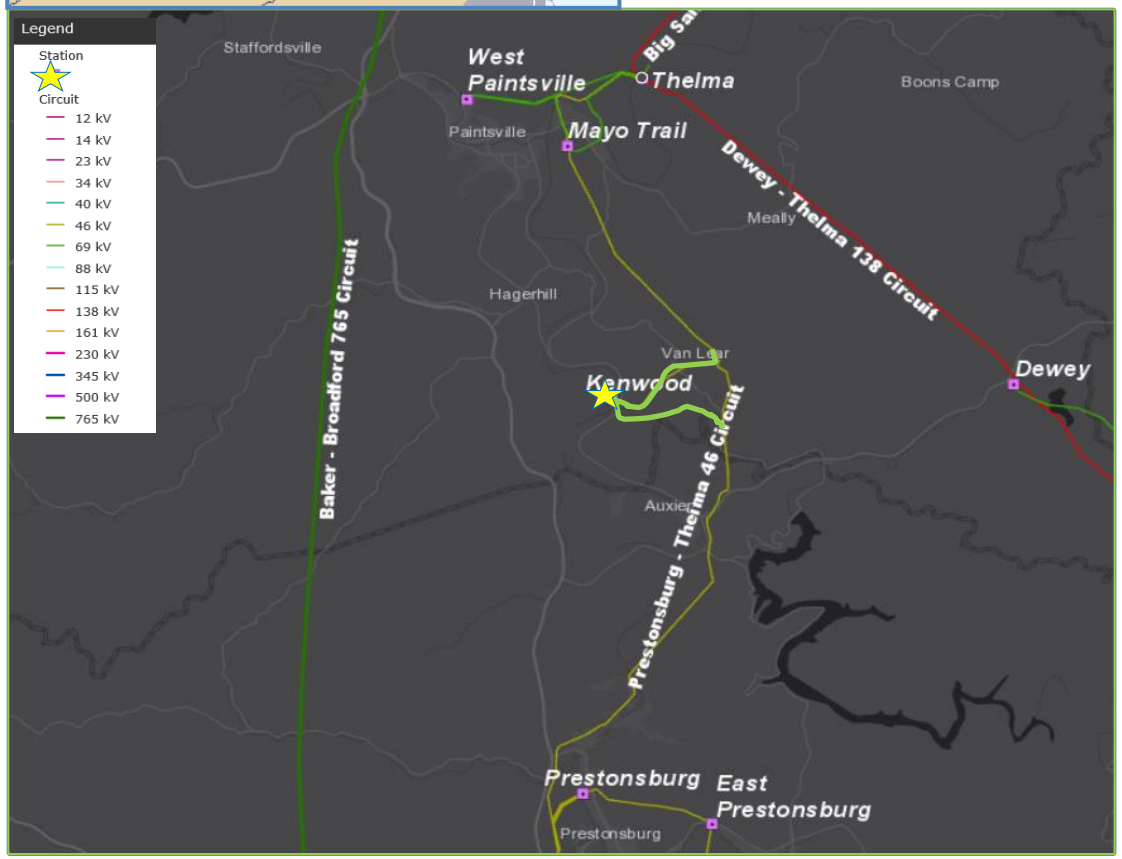
Need Number: AEP-2020-AP029

Process Stage: Solutions Meeting 03/19/2021

Proposed Solution:

- A green field line is to be constructed (Kenwood 69kV Extension) and to be operated at 46kV. The new extension will provide looped service into Kenwood substation. It will be approximately 2.25 miles of single circuit construction through mountainous terrain in Floyd and Johnson Counties in Kentucky. The extension will tap the existing Prestonsburg-Thelma 46kV Line around structure K346-50. (SN:53 MVA , SE:61 MVA, WN:67 MVA, WE:73 MVA) **Estimated Cost: $5.8 M**
- Rebuild the existing ~1.77 mi Kenwood Tap line from Kenwood to Van Lear Tap Structure on the existing center line. (SN:53 MVA , SE:61 MVA, WN:67 MVA, WE:73 MVA)
  Estimated Cost: $4.9 M
- Provide splicing for 2.25 miles of 96ct OPGW on the Kenwood 69kV Extension Line and 1.77 mi Kenwood TAP line. This extension spans from Kenwood Station to the Prestonsburg-Thelma 46kV line. **Estimated Cost: $0.1 M**
- At Kenwood substation, Extend the walk bus and add second 46KV line to set up Kenwood station as a looped station with MOABS protecting each exit. Add new H-Frame dead end with MOAB and single phase CCVT. Add MOAB and single phase CCVT to existing line. Relocate 3 phase CCVT's from cap bank AA to 46KV Bus. Add 3-bay transclosure, and separate battery enclosure. Replace Battery and Charger. **Estimated Cost: $0 M (Distribution costs only)**
- Retire Van Lear SS. **Estimated Cost: $0.1 M**
- Remote end work at Prestonsburg substation. **Estimated Cost: $0 M (Distribution costs only)**
- Retire the ~1.5 mi 46kV line section from str. 52 to Van Lear SS. This line section is part of the Prestonsburg – Thelma 46kV line need (AEP-2018-022). **Estimated Cost: $1.2 M**





AEP Transmission Zone M-3 Process
Floyd/Johnson County, Kentucky

Proposed Solution (Cont.):

Ancillary benefits:

- Removal of ~1.5 mi 46kV line section on Prestonsburg – Thelma 46kV line mitigates issues identified on this line section, solutions are currently being evaluated to address the remainder of the needs on the entire Prestonsburg – Thelma line (AEP-2018-022).
- Proposed work would also improve reliability for customers served from Kenwood substation. Kenwood substation serves 22 MVA of load at peak and only half of that load is transferrable.

Total Estimated Transmission Cost: $12.1 M

Alternative considered:

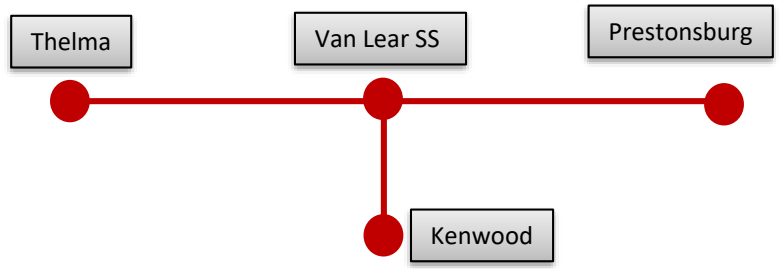
Alternative:

- Relocate and replace the Van Lear switch. It would need to be relocated from its current position in order to be replaced and facilitate accessibility. Install new ~2.25 mi 69kV Kenwood Tap line (energized at 46kV) section from Prestonsburg – Thelma 46kV line. Rebuild 1.5 miles of line on Prestonsburg-Thelma to address portion of need identified under AEP-2018-AP022 instead of retiring this section as proposed. Retire ~1.77 mi existing 46kV line from Kenwood to the existing Van Lear switch. After this work is complete, Kenwood would still be radially fed and in an area where outages could potentially be extensive due to the nature of local terrain.
- **Estimated Alternative Cost: $14.5 M**

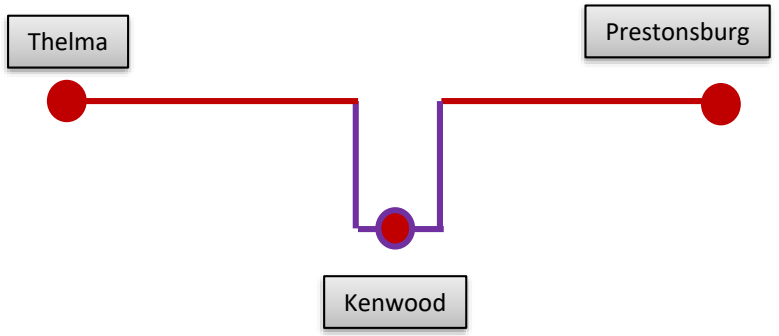
Projected In-Service: 11/30/2023

Project Status: Scoping

Existing:



Proposed:



Legend	
500 kV	
345 kV	
138 kV	
69 kV	
46 kV	
New	
Retire	

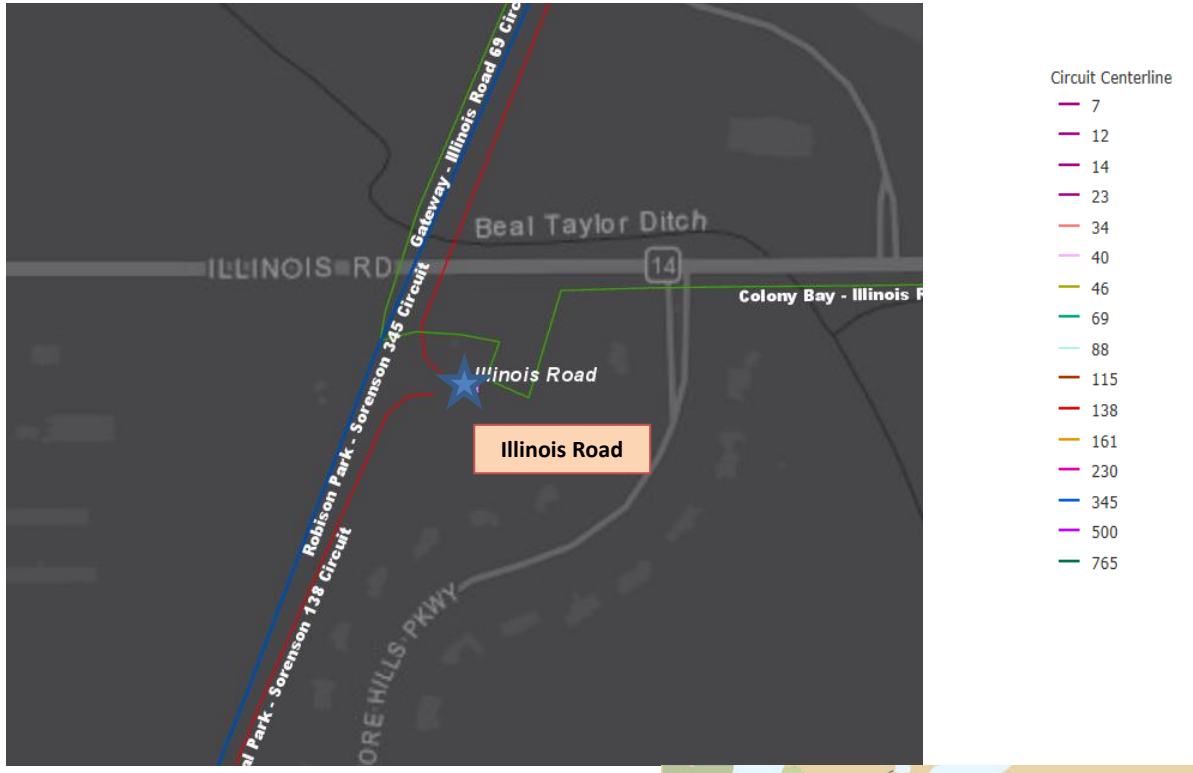
AEP Transmission Zone: Supplemental
Illinois Road Transformer

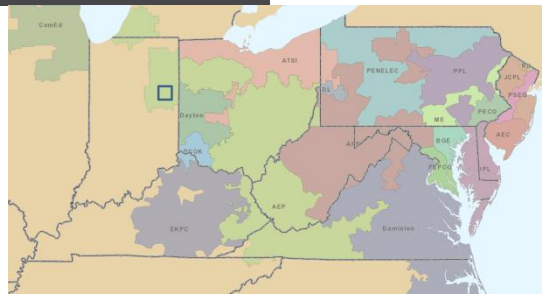
Need Number: AEP-2020-IM024
Process Stage: Solution Meeting 3/19/2021
Previously Presented: Needs Meeting 11/20/2020
Supplemental Project Driver: Equipment Material/Condition/Performance/Risk
Specific Assumptions Reference: AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)
Problem Statement:

Illinois Road 138/69kV Station:

138/69/12kV Transformer 1

- Manufactured in 1980
- Transformer is showing elevated moisture levels, low levels of Interfacial Tension and an increasing trend in Power Factor.
- This level of moisture is an indication of gasket leaks and breakdown in oil or paper insulation.
- The low level of Interfacial Tension is an indication acid has coated the insulation and sludge is ready to deposit within the main tank.
- The upward trend in PF indicates that there is an increase in particles in the oil.





AEP Transmission Zone M-3 Process
Illinois Road Transformer

Need Number: AEP-2020-IM024

Process Stage: Solution Meeting 3/19/2021

Proposed Solution:

Replace the 138/69kV Transformer with a 90MVA 138/69kV Transformer.

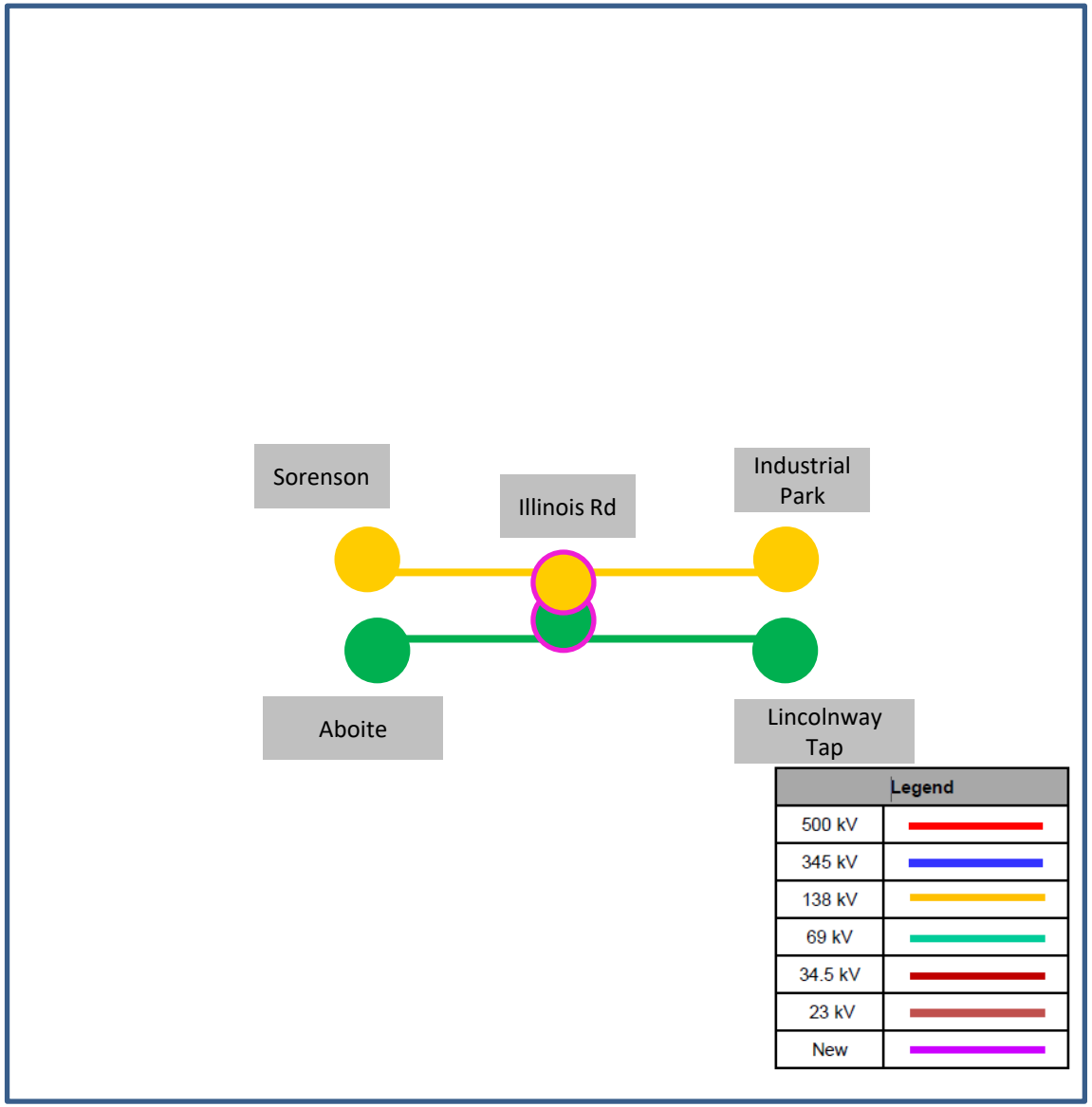
Cost estimate: $1.7 Million

Alternatives:

Considering the availability of outages and space in the station, no other alternatives were considered. NOTE: s2193, which replaces breakers at Illinois Rd, will be aligned with this work so that outages can taken together.

Projected In-Service: 5/16/2022

Project Status: Scoping



AEP Transmission Zone M-3 Process
Columbus, Ohio

Need Number: AEP-2020-OH045

Previously Presented: Need Meeting 11/20/2020

Process Stage: Solutions Meeting 03/19/2021

Supplemental Project Driver:

Customer Service

Specific Assumption Reference:

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

Problem Statement:

- AEP Ohio has requested installation of a second 138/13.8 kV transformer at Fifth Ave Station to address increased loading on the existing distribution feeders at the station due to load growth in the area. Fifth Avenue station has limited transferability and serves approximately 7,000 customers via a single transformer in an urban environment.
- AEP Ohio has also expressed concerns over the amount of exposure that existing feeders out of Hess station are subject to in the area.

Model: 2025 RTEP

AEP Transmission Zone M-3 Process
Fifth Avenue Distribution Transformer 2

Need Number: AEP-2020-OH045

Process Stage: Solutions Meeting 3/19/2021

Selected Solution:

- Fifth Avenue 138kV: Upgrade the existing 138kV partial ring bus to a complete 138kV ring bus and provide a high side connection for a new Distribution transformer. Complete the 138kV ring bus by adding 2-138KV circuit breakers along with associated bus work and relaying equipment.

Cost: $1.0M

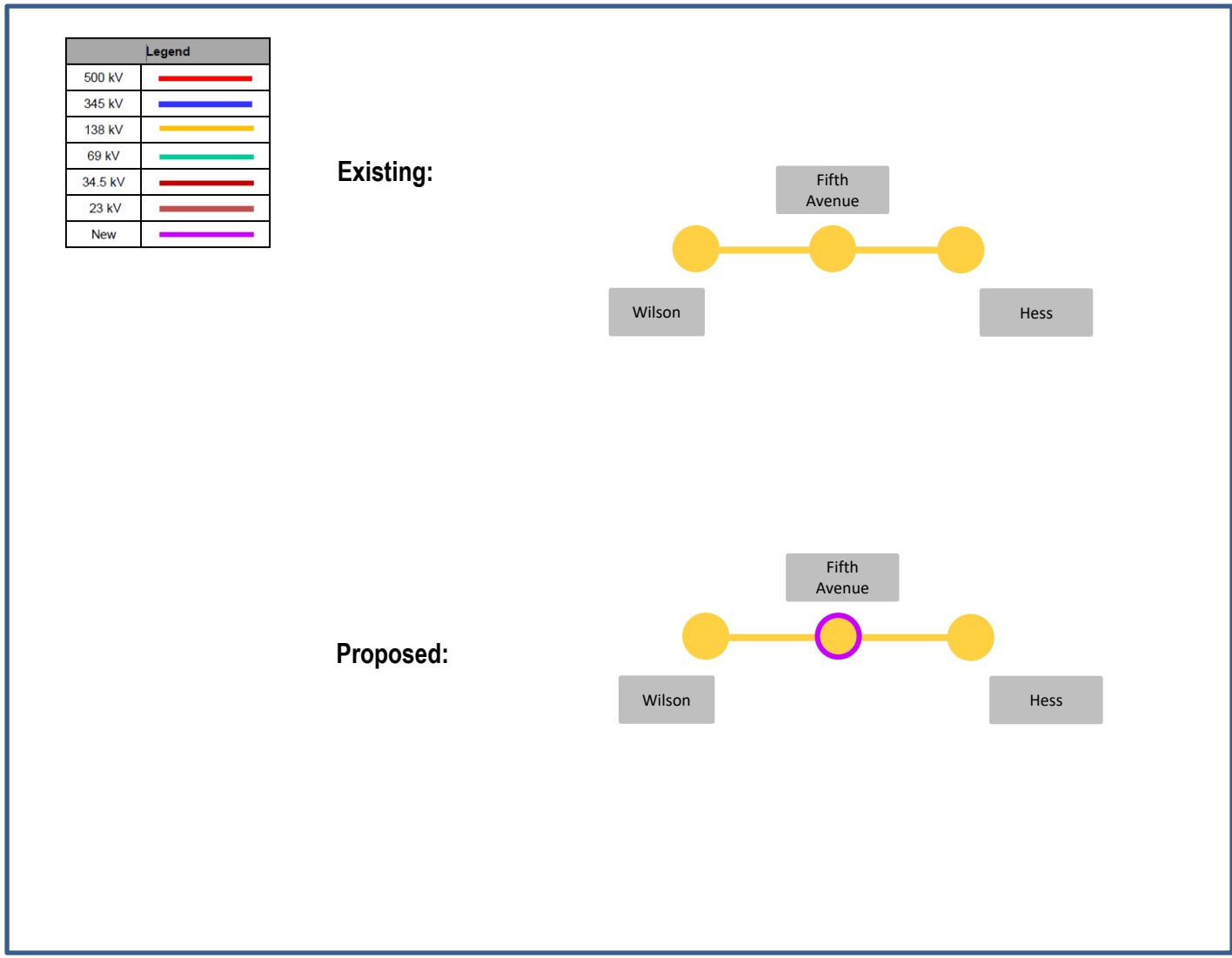
Total Estimated Cost: $1.0M

Alternatives Considered:

Considering the location of the requested station site (rebuilt under s2062), no other alternatives were identified.

Projected In-Service: 05/16/2022

Project Status: Engineering



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

3/9/2021 – V1 – Original version posted to pjm.com

5/24/2021 – V2 – Slide #35, corrected the typo in the date 11/31 to 11/30