

Sub Regional RTEP Committee: Western AEP Supplemental Projects

October 16, 2020

Existing Project Changes

AEP Transmission Zone M-3 Process Parsons 138kV Conversion

Previously Presented: 11/2/2017 SR RTEP

Problem Statement:

Equipment Material/Condition/Performance/Risk:

The Marion-Parsons 40kV line is 1926 vintage and in poor condition and in need of a complete rebuild. It has 38 A conditions along the 5 mile length. Due to the fact that this is a double circuit line and the only source to Parsons station, a planned outage cannot be taken to rebuild the line. The 636 AAC & 636 ACSR conductors are rated for SN/SE=62/62 MVA.

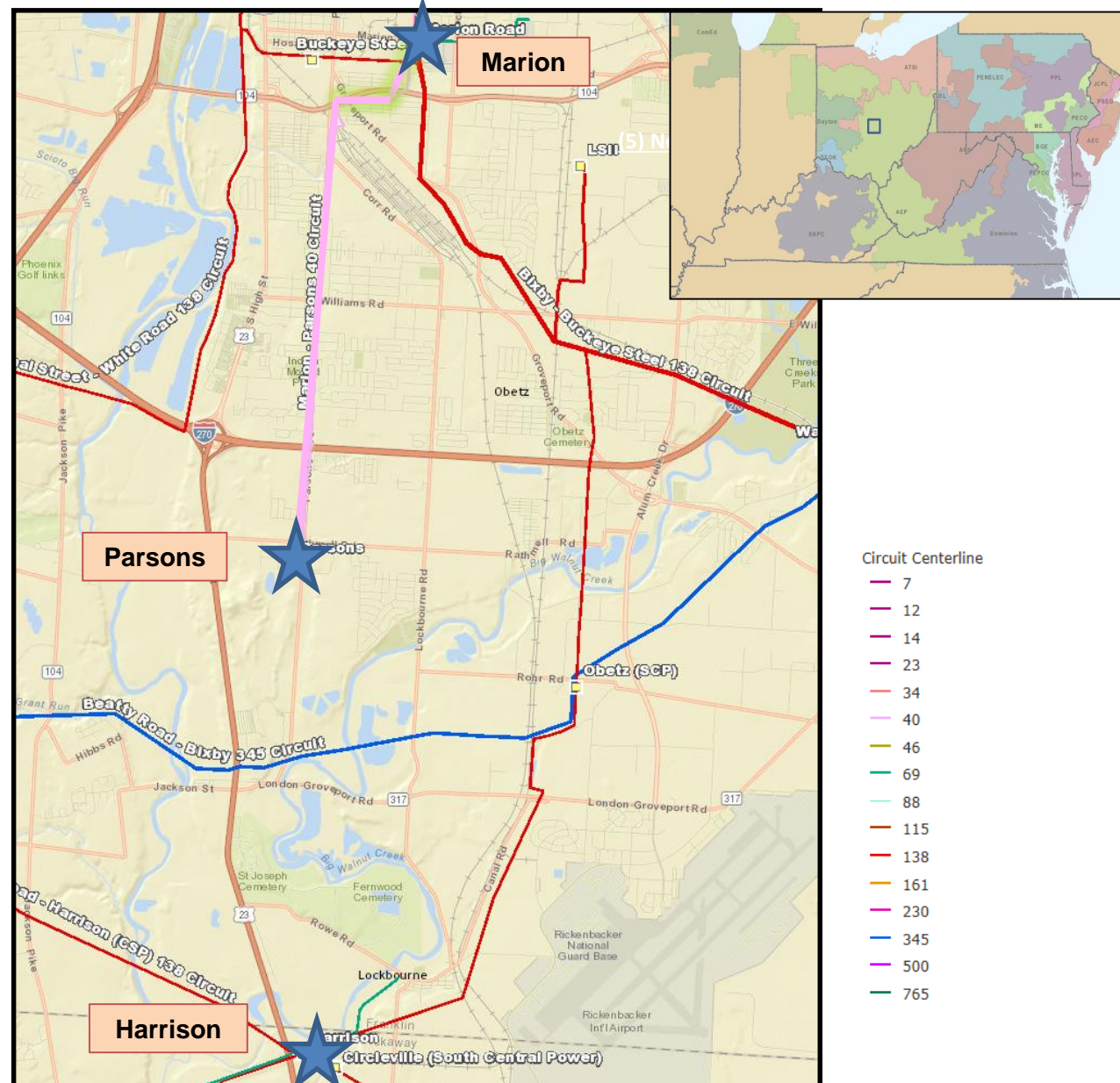
Parsons records show 25 fault operations on CB 42 and 11 fault operations on CB 44. The manufacturer recommends a limit of 10 fault operations.

Parsons circuit breakers #42 & #44 are showing signs of deterioration and use oil as the interrupting medium. Oil breaker maintenance has become more difficult due to the oil handling required to maintain them. Oil spills are frequent with breaker failures and routine maintenance can become an environmental hazard.

The drivers for replacement of these breakers are age, bushing damage, no repair part availability, amount of fault operations and PCB content. PCBs have been used as coolants and lubricants in transformers, breakers, and other electrical equipment because they don't burn easily and are good insulators. The manufacture of PCBs was stopped in the U.S. in 1977 because of evidence they build up in the environment and can cause harmful health effect.

Operational Flexibility and Efficiency:

Due to the fact that the Marion-Parsons 40kV line is the only source to Parsons station, it cannot be taken out of service for basic maintenance or to facilitate future conversion from the obsolete 40kV system to 69kV.



AEP Transmission Zone M-3 Process Parsons 138kV Conversion

Previous Selected Solution:

Construct a new Harrison-Parsons 69kV Line (energized @40kV), New 795 ACSR Drake in new ROW, SN/SE = 73 MVA **Estimated Transmission Cost: \$7.7M (s1429.1)**

Rebuild the Marion-Parson double circuit 40kV Line as single circuit 69kV (energized @40kV), SN/SE = 73 MVA, **Estimated Transmission Cost: \$14.0M (s1429.2)**

Harrison station, Relocate and install existing spare 138/40kV 46MVA transformer, 3,000A 138kV CB, & 2,000A 69kV CB **Estimated Transmission Cost: \$2.0M (s1429.3)**

Parsons station, Replace 2 40kV CB's with 2-2,000A 69KV CB's, install 9.4MVA capacitor bank **Estimated Transmission Cost: \$1.0M (s1429.4)**

Marion station, Install 9.4 MVA capacitor bank and retire unused equipment. **Estimated Transmission Cost: \$0.3M. (s1429.5)**

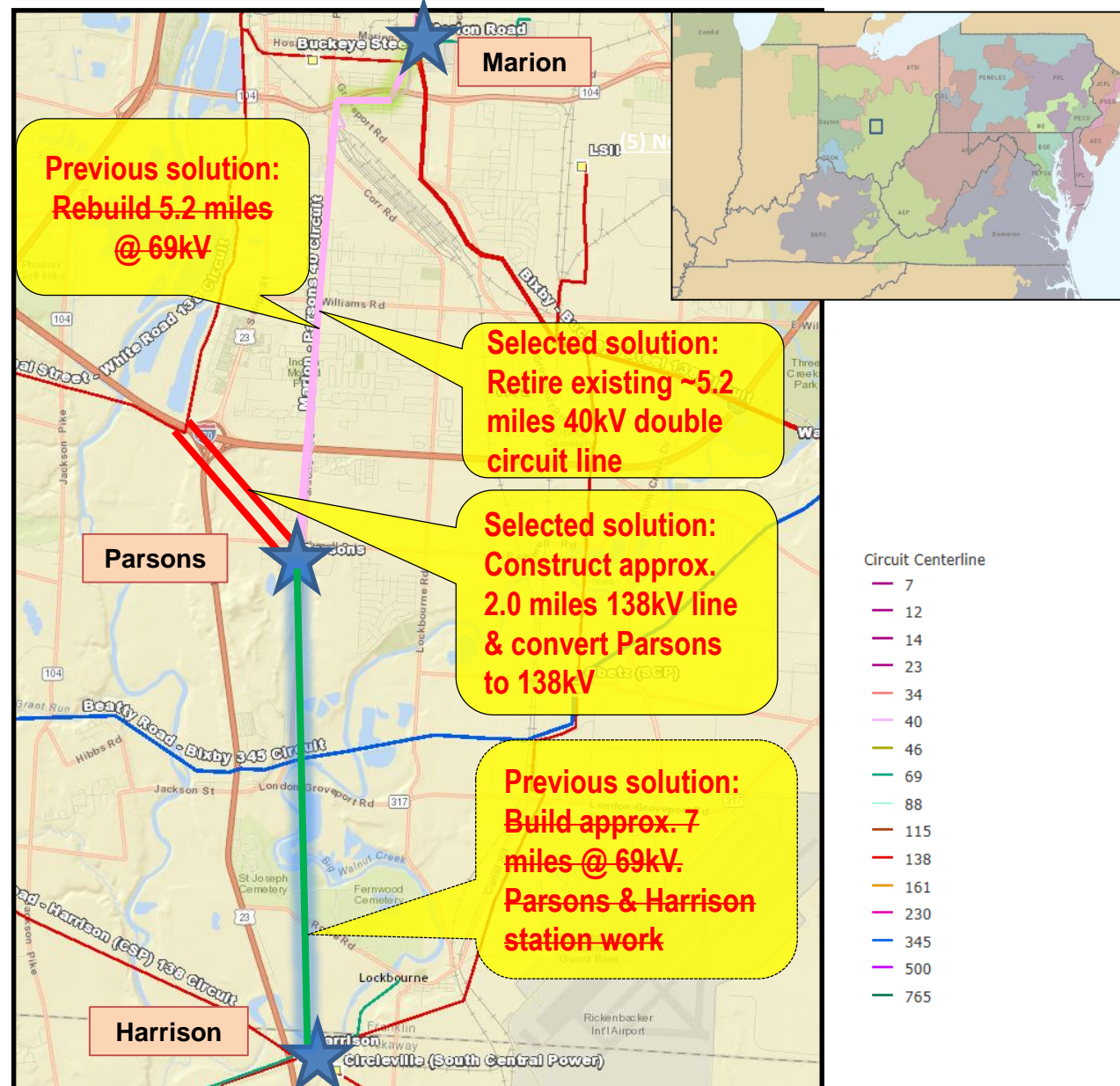
Total Estimated Transmission Cost: \$25.0M

Projected In-service: 12/01/2018

Project Status: Engineering

Selected Solution Update:

The solution has been updated to convert Parsons station from the non-standard 40kV to 138kV. Parsons substation shall be fed from an in & out design on the 138kV transmission line between Canal Street & White Road Stations. During detailed engineering it was determined that there would be extensive cost for ROW and constructability challenges on the Marion - Parsons and Parsons - Harrison circuits. The cost of this project went from \$25M to \$40M, which forced AEP to look into alternatives.



AEP Transmission Zone M-3 Process Parsons 138kV Conversion

Selected Solution:

- Marion – Parsons 40kV: Retire ~5.2 miles of double circuit 40kV line between Marion and Parsons. **(\$2342.1) Cost: \$2.97M**
- Parsons 138kV Extension: Extend the Canal Street – White Road 138kV circuit to Parsons ~2.0 miles of double circuit 138kV line (Greenfield) using 795 ACSS conductor. Extend fiber cable & install redundant fiber cable for relaying and communication to Parsons Station. **(\$2342.2) Cost: \$17.04M**
- Parsons 138kV Station: Replace existing 40kV yard with 138kV ring bus. Perform remote end work at Canal Street and White Road stations. **(\$2342.3) Cost: \$7.78M**
- Marion 138kV Station: Retire existing circuit breaker 21. **(\$2342.4) Cost: \$0.1M**

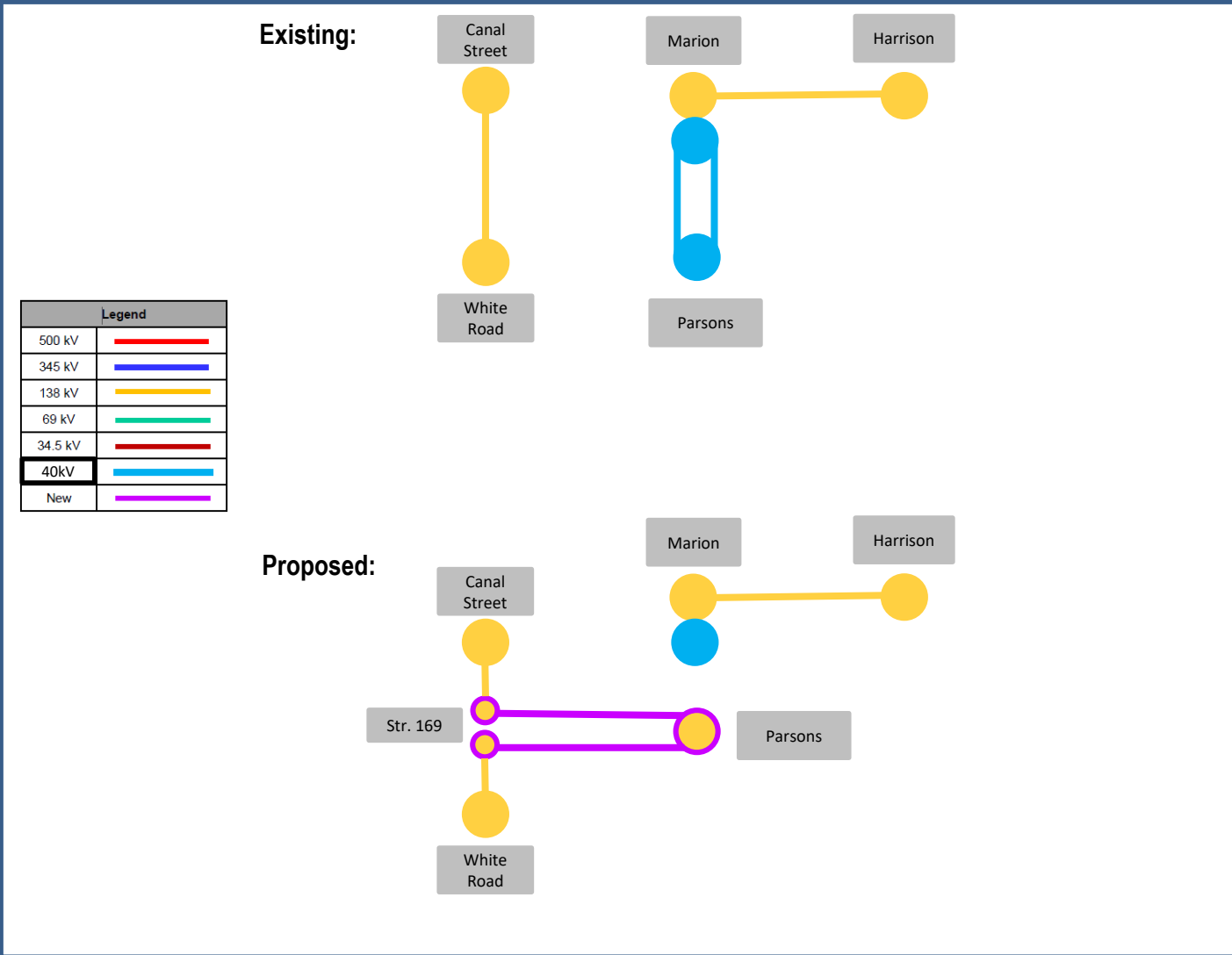
Total Estimated Transmission Cost: \$27.89M

Alternatives Considered:

Build new 69kV line from Harrison to Parsons, energized at 40kV. Rebuild existing double circuit Marion-Parsons 40kV line as single circuit 69kV, energized at 40kV. Harrison: Install spare 138/40kV transformer and associated protection / equipment at Harrison station. Design low side bus equipment and circuit exit as 69kV to facilitate future conversion to 69kV. Parsons: Upgrade/Install 40kV equipment as required. Install switched capacitor bank. All new equipment should be rated for 69kV wherever possible. Replace circuit breakers. Marion: Relaying changes. Install Capacitor Bank. **Cost: \$40.0M**

Projected In-Service: 08/01/2022

Project Status: Engineering



Needs

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

AEP Transmission Zone M-3 Process East Lima – Columbus Grove 69kV Line

Need Number: AEP-2020-OH037

Process Stage: Need Meeting 10/16/2020

Project Driver:

Equipment Material/Condition/Performance/Risk

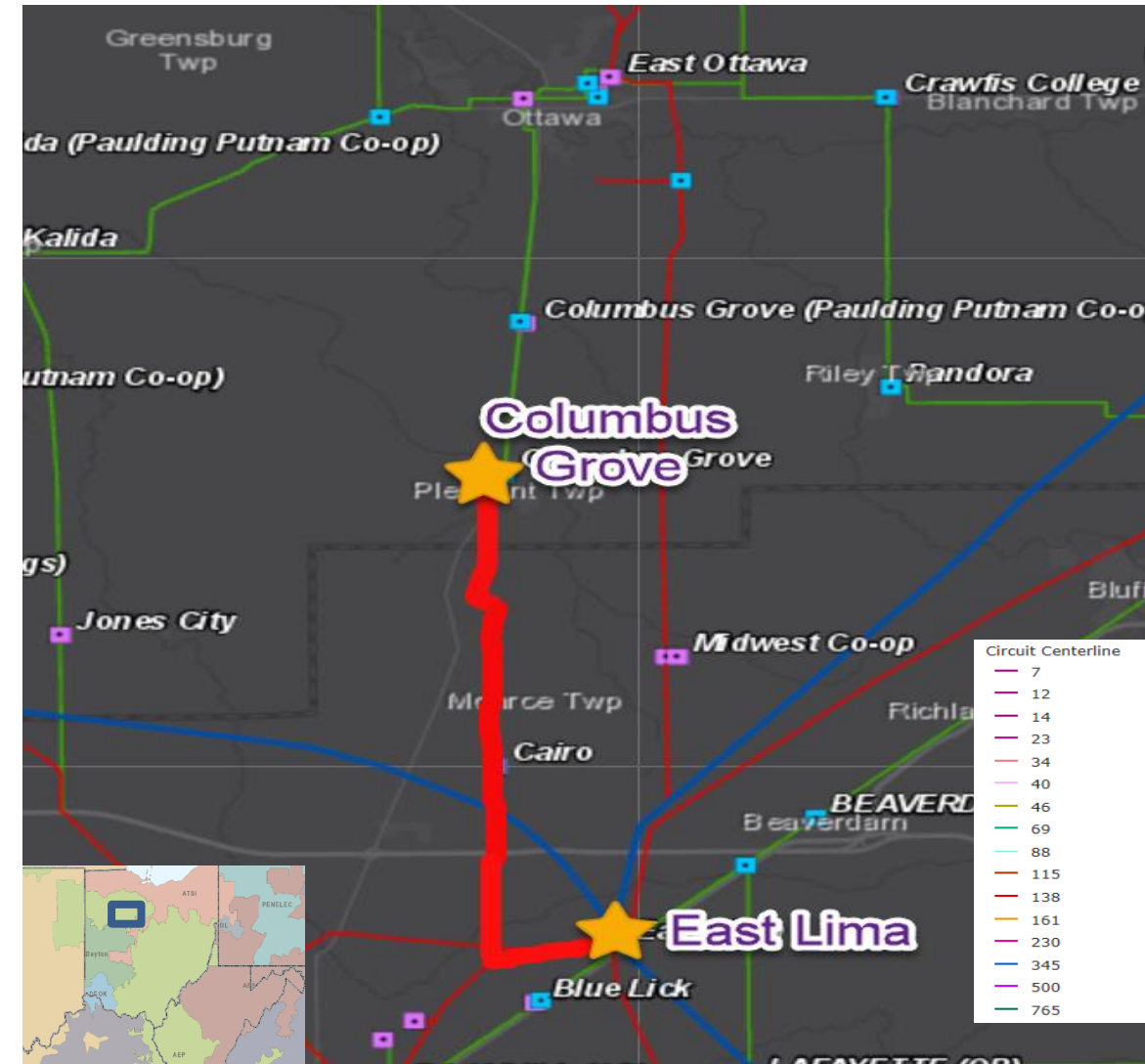
Specific Assumption Reference:

AEP Guidelines for Transmission Owner Identified Needs

Problem Statement:

East Lima – Columbus Grove 69kV (vintage 1953)

- Original install date: 1953
- Length of Line: 10.86 miles
- Total structure count: 255; 150 dating back to original installation.
- Original Line Construction Type: Wood monopoles
 - Cross Arm Material: Wood
 - The line has vertical and horizontal ceramic insulators and is butt wrap grounded
- Conductor: 4/0 ACSR 6/1 (Penguin) -72% and 556 kCM ACSR 26/7 (Dove) -28%
- Momentary/Permanent Outages and Duration: 20 total outages: 17 (Momentary), 3 (Permanent)
- 5 Year CMI: 911,294
- Number of open conditions: 112 Open conditions on 94 unique structures
 - Open conditions include: rotten heart, woodpecker holes, insect damage, split crossarms, burnt insulators, and broken ground lead wires
- Risk
 - Number of Customers at Risk: 3,272
 - Load at Risk: 22.71 MVA
 - The grounding/shielding and the insulation of the line is inadequate according to the current AEP standards.



AEP Transmission Zone M-3 Process Benwood 69kV

Need Number: AEP-2020-OH039

Process Stage: Need Meeting 10/16/2020

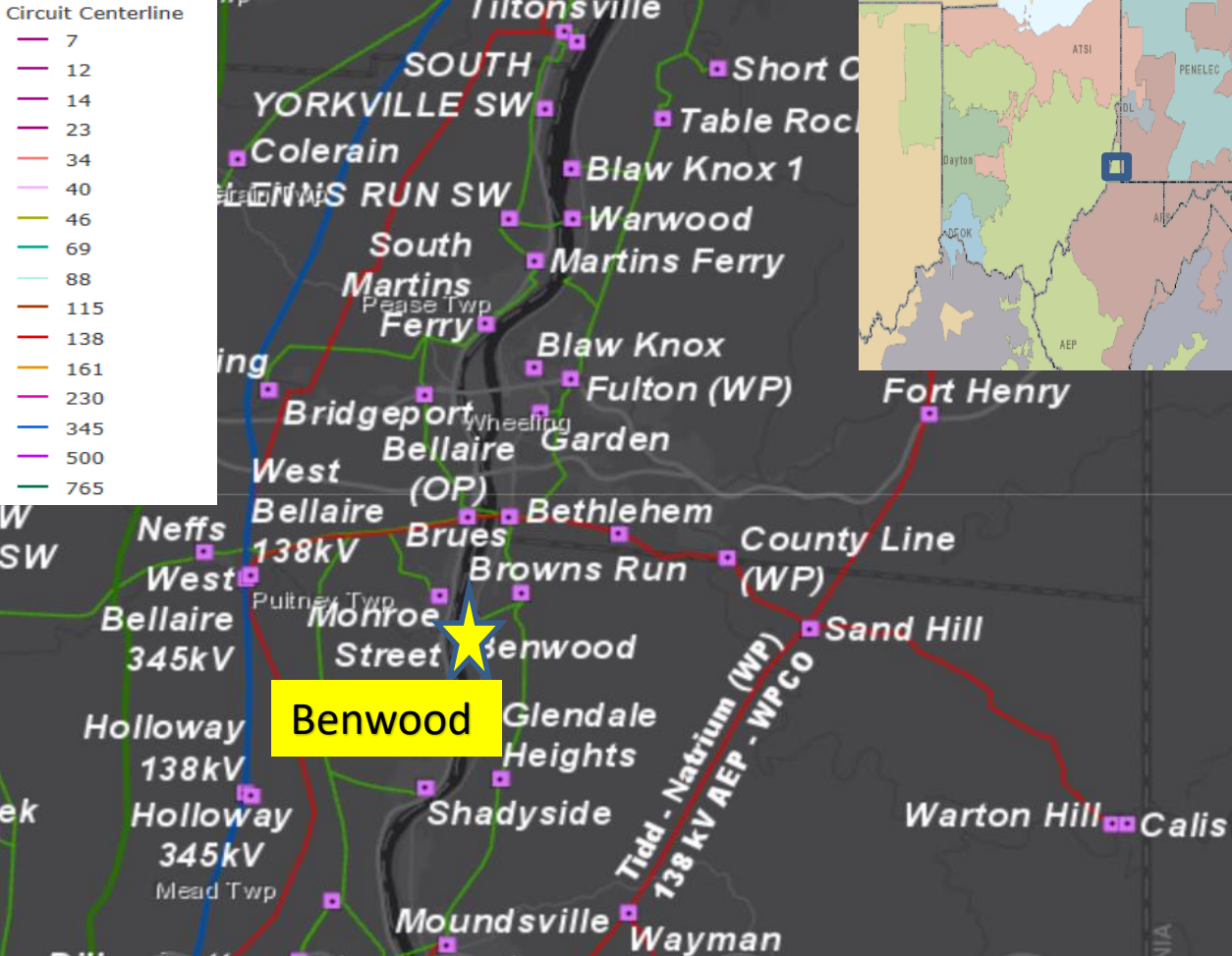
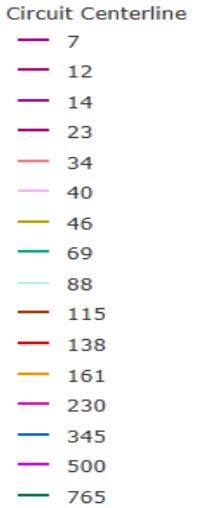
Project Driver:
Equipment Material/Condition/Performance/Risk

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

Problem Statement:

Benwood 69kV

- 69 kV oil filled circuit breakers “A” & “B” have 61 and 39 fault operations respectively (vintage 1965). They both have exceeded the recommended fault operations of 10. The breakers do not have oil containment.
 - ‘FK’ model breakers, which are prone to compressor failures, valve defects, and oil contamination
 - Control cables are direct-buried, not housed in conduit, which presents a greater risk of failure
 - Oil filled breakers require frequent maintenance. Oil spills are common and can result in significant environmental mitigation costs.
- 22 out of 23 relays in service at the station are electromechanical and 1 is a static relay. All of these relays have no vendor support, SCADA functionality, or spare parts available for repairs
 - The EMC relays lack fault recording and retention capabilities.
 - 69kV bus protection is a legacy design, with no redundancy
- The 69kV circuit protection systems to Brues & Moundsville stations use a legacy pilot wire system; the pilot wire to Moundsville is not functional (requiring backup system protection)
- The 300MCM bare Copper bus conductor is showing degradation
- 69kV bus PT’s are original to the station and of an obsolete design, along with the station service
- The fence perimeter is too close to the station equipment. Station fencing is not up to AEP standard and has animal concerns which can lead to outages at the station.
- The control house has past flooding damage, asbestos, and lead paint concerns. The control house has outdated and rusted AC/DC cabinets.



AEP Transmission Zone M-3 Process Van Wert County, Ohio

Need Number: AEP-2020-OH044

Process Stage: Need Meeting 10/16/2020

Project Driver:

Equipment Material/Condition/Performance/Risk, Operational Efficiency

Specific Assumption Reference:

AEP Guidelines for Transmission Owner Identified Needs

Problem Statement:

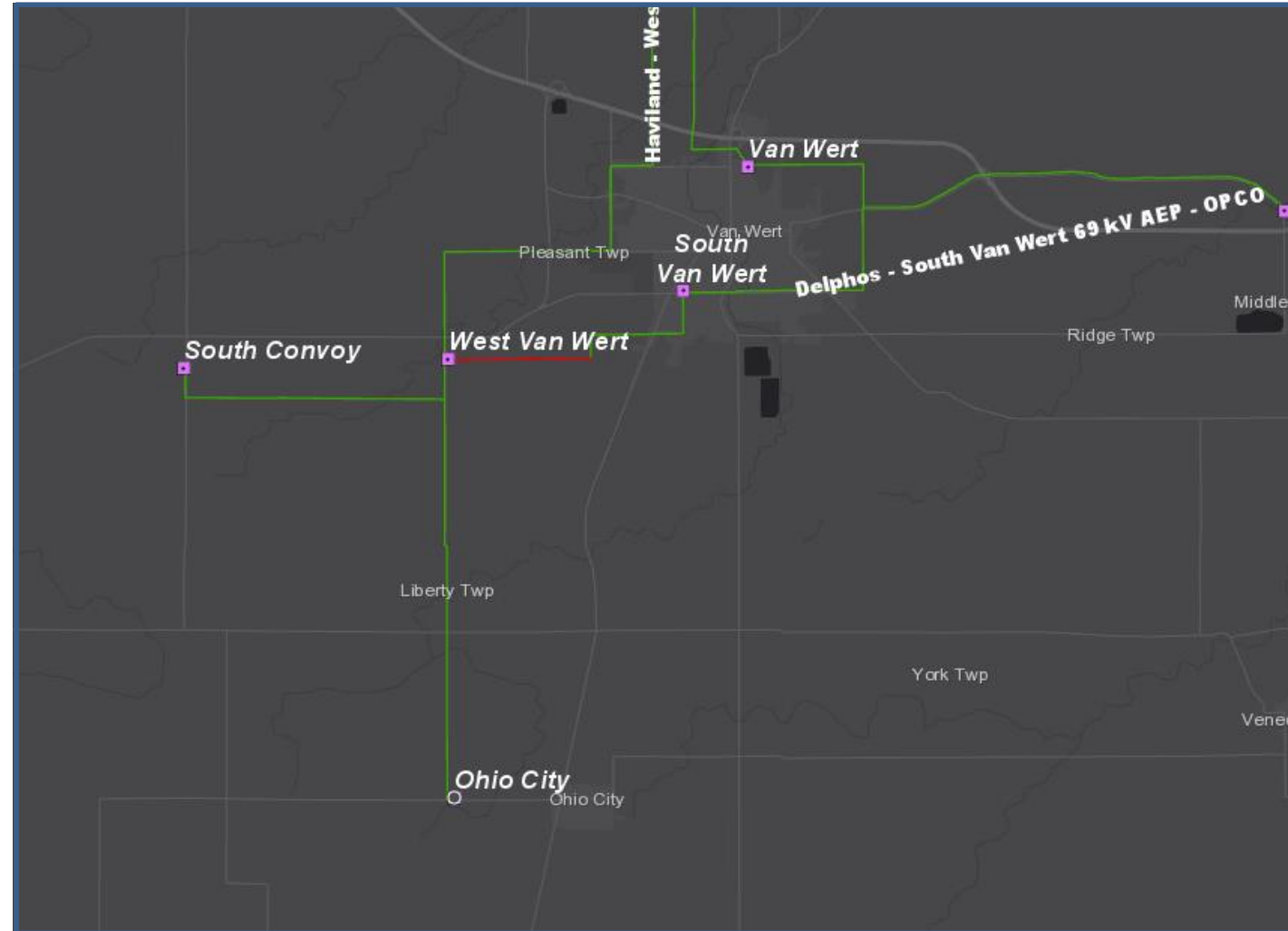
Line Name: Ohio City – West Van Wert 34.5kV Circuit

LINE CHARACTERISTICS

- **Original Install Date (Age):** 1963 (57 years)
- **Length of Line:** 8.90 miles
- **Total structure count:** 173
- **Original Line Construction Type:** Wood
 - 62% of structures replaced in 1994.
- **Conductor Type:** 1/0 Copper 7 (1939 Install), 4/0 ACSR 6/1 Penguin (1966 Install)

CONDITION / PERFORMANCE / RISK ASSESSMENT:

- **Condition Summary**
 - Open conditions / defects / inspection failures include: missing/broken ground wires, woodpecker damage, broken guy wires
 - Number of structures with defects/inspection failures: 24
- **Load at Risk:** 3.997 MVA
- **CMI:** 127,978 Customer Minutes of Interruption



AEP Transmission Zone M-3 Process Van Wert County, Ohio

Problem Statement (cont.):

CONDITION / PERFORMANCE / RISK ASSESSMENT:

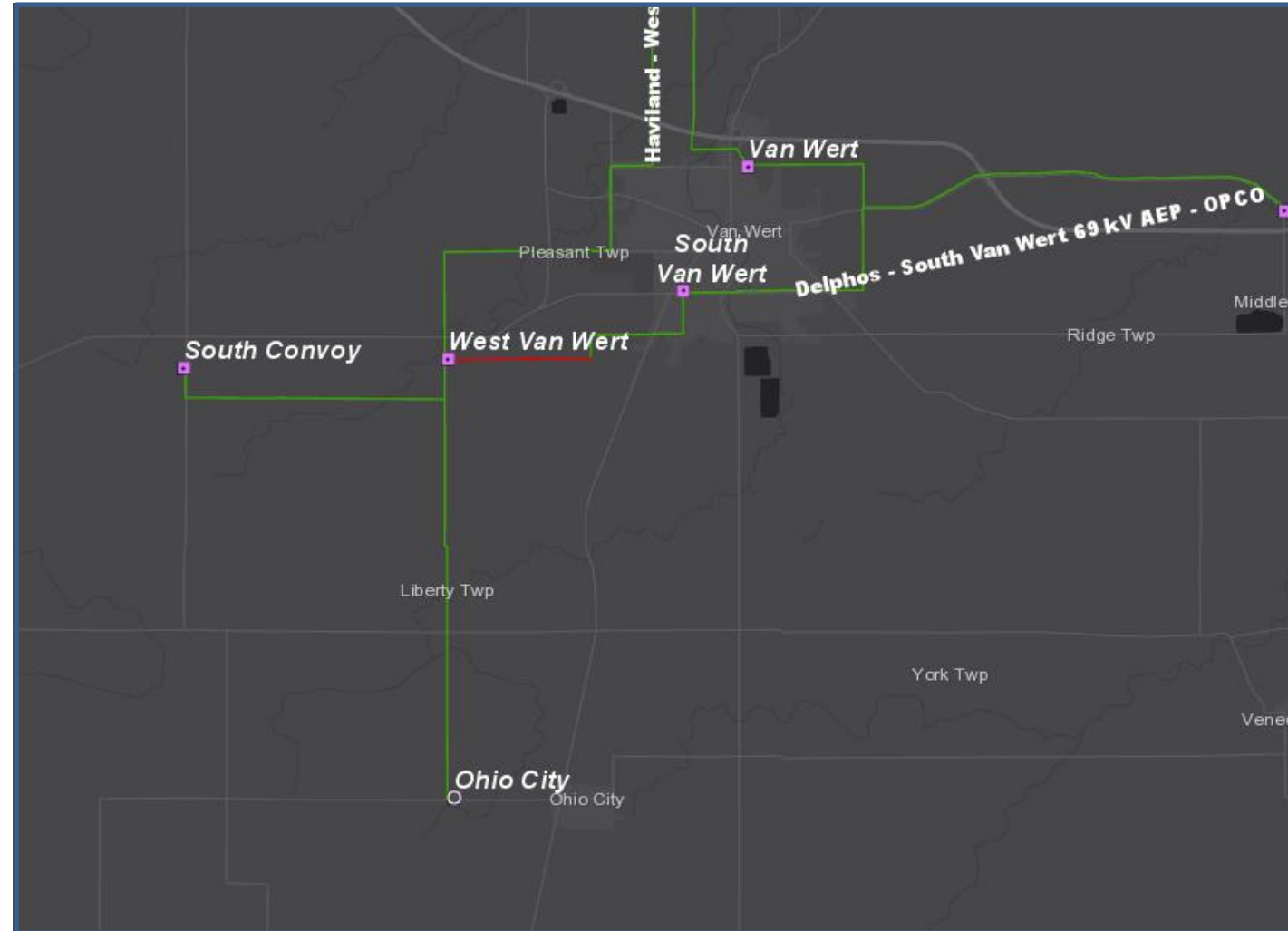
Station Name: Ohio City

Transformers Concerns:

- 1951 vintage and shows significant signs of dielectric breakdown (paper insulation), accessory damage (likely sludge in radiators, core, and coil), and short circuit breakdown.

OPERATIONAL EFFICIENCY:

- AEP has a normally open 34.5 kV tie with Dayton at Dayton's Rockford Substation that is built to 69kV standards. This is an out of phase interconnection point and can only be closed if the 12kV Dayton Rockford bus is de-energized first and the line is energized from AEP. AEP's Ohio City station is a radially served load out of West Van Wert. Since this is a normally open point, the Rockford load is radial under most operating conditions since a manual process must take place to switch the load to AEP's source if there is an issue with the Celina-Coldwater-Rockford 6688 69kV line. Dayton has limited switching options from Rockford substation so, the normally open point has needed to be used multiple times in recent years to transfer customers to the Ohio City source due to outages on the Dayton system.



AEP Transmission Zone M-3 Process Tiltonville, Ohio

Need Number: AEP-2020-OH042

Process Stage: Need Meeting 10/16/2020

Project Driver:

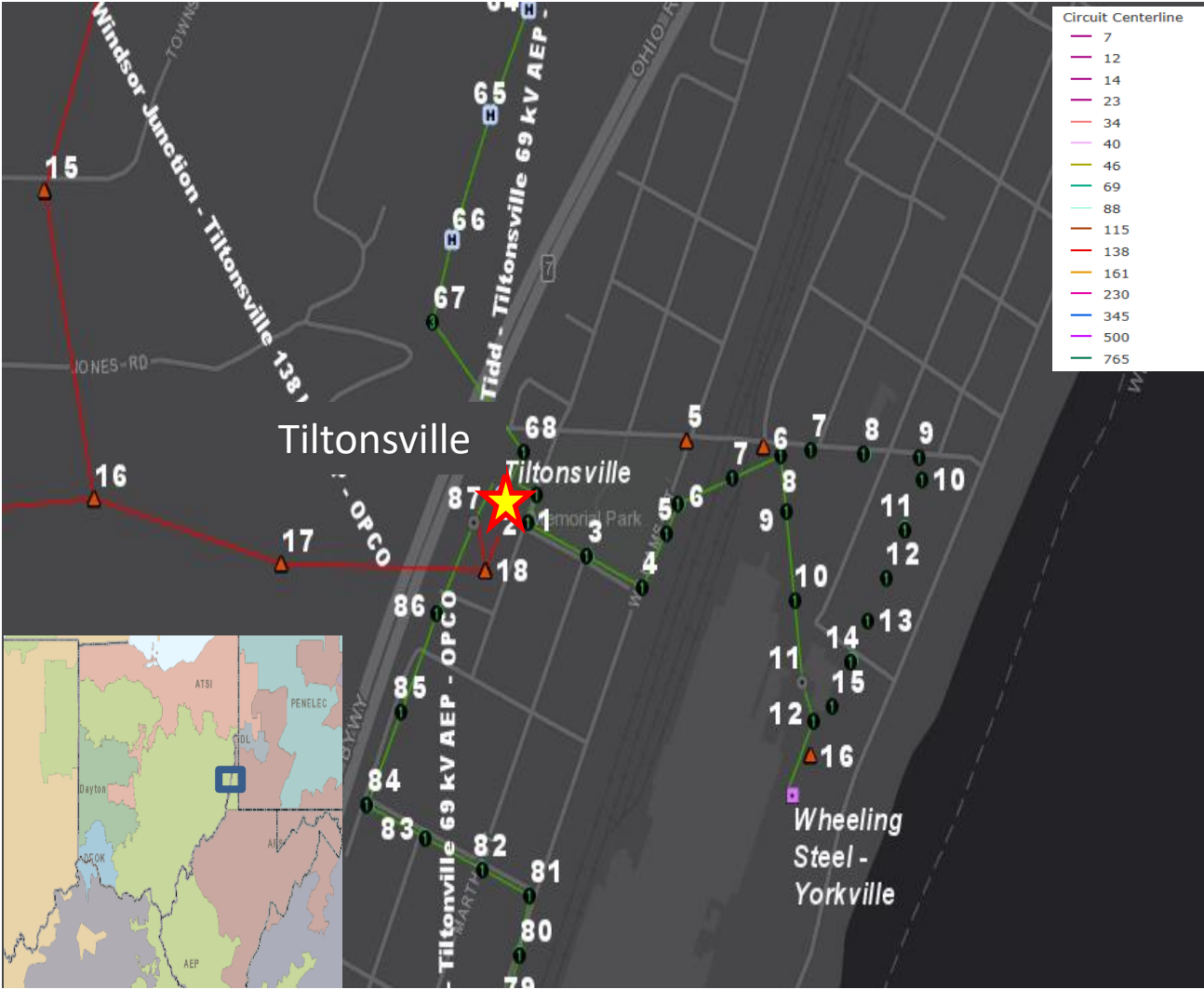
Equipment Material/Condition/Performance/Risk, Operational Flexibility and Efficiency

Specific Assumption Reference:

AEP Guidelines for Transmission Owner Identified Needs (slide 8).

Problem Statement:

- Three 69 kV circuit breakers CB-H, CB-E, & CB-F are GE 'FK' oil filled breakers of 1950s and 1970s vintage without oil containment and two of them have exceeded the recommended fault operations of 10. CB-H has 16 fault operations and CB-F 12 has fault operations. Additionally, oil filled breakers require frequent maintenance. Oil spills are common and can result in significant environmental mitigation costs.
- The 138/69kV, 90 MVA transformer is a 1978 vintage with decomposition of the paper insulating materials, signs of faults inside the tank, a dielectric breakdown. In addition, the transformer lacks oil containment system and sits on wood railroad ties.
- Currently, 57 of the 63 relays (90% of all station relays) are in need of replacement. 55 are of the electromechanical type and 2 of the static type, none of which have spare parts available for repairs or vendor support, lack fault data collection ability, and don't allow for SCADA functionality.
- Over the last 5 years there have been 1.8 million minutes of CMI at the station, which included 6 outage events due to equipment failure.
- The transformer protection includes an obsolete MOAB-ground-switch system, which relies on remote station fault clearing (at West Bellaire and FE's Windsor station).
- The lack of sectionalizing at the station creates dissimilar zones of protection (line, bus, and transformer), which can cause over tripping and miss-operations.
- This station (vintage 1935) has numerous other issues of concern: station service, lead paint, control house, numerous disconnect switches, cap-and-pin insulators prone to failure, battery system, bus PT's, crumbling foundations, inadequate grounding, presence of PCB's, and many direct-bury cables past their expected lifespan.



AEP Transmission Zone M-3 Process Ross County, Ohio

Need Number: AEP-2020-OH043

Process Stage: Need Meeting 10/16/2020

Project Driver:

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

Specific Assumption Reference:

AEP Guidelines for Transmission Owner Identified Needs (slide 8)

Problem Statement:

Slate Mills Station (vintage 1973)

- A recent inspection of Slate Mills Station (69/12 kV) has revealed significant deterioration of the wood poles that make up the majority of the station's structures. Concerns for the long term structural integrity of the station have led to the facility being classified as an imminent failure with short term and long term mitigation measures being actively investigated.
- Other equipment within the station is also showing signs of deterioration including the arrestors, bus work, and cross arms.
- AEP Ohio does not have the ability to transfer all of the customers served from Slate Mills elsewhere in the event of a failure at the station.



AEP Transmission Zone M-3 Process Astor – East Broad Street 138 kV

Need Number: AEP-2020-OH041

Process Stage: Need Meeting 10/16/2020

Project Driver:

Equipment Material/Condition/Performance/Risk

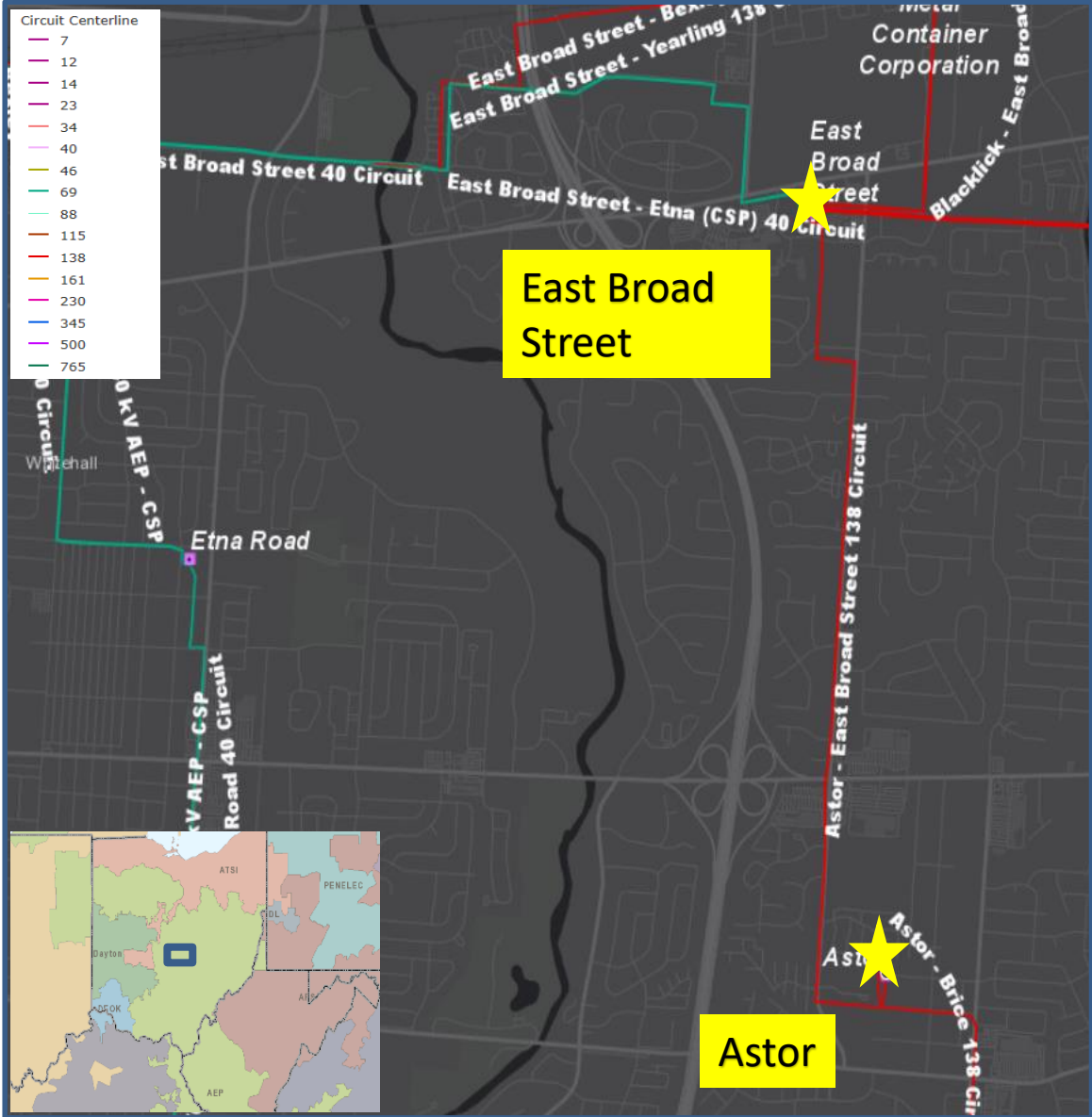
Specific Assumption Reference:

AEP Guidelines for Transmission Owner Identified Needs (slide 8).

Problem Statement:

Astor – East Broad Street 138 kV Single Circuit (2.75 miles)

- From 2015 – 2020 this circuit has experienced 2 momentary and 4 permanent outages resulting in 671K CMI.
- The circuit currently has 54 open conditions on 30 structures (out of 55 total structures) which includes pole damage, rot top, rotted/spit poles, and missing ground lead wires.
- 12 structures have been replaced at different times from 1970 to 2011; remaining are wood poles from 1955.
- The circuit conductor span was primarily installed in 1974 of 636,000 CM ALUM/1350 37 (Orchid 2.75 miles). There are also two spans of 795,000 CM ACSR/AW 26/7 (Drake)
- An Engineering and Field Assessment was conducted in 2019 and found the following issues:
 - The majority of structures do not meet 2017 NESC Grade B loading criteria
 - The majority of structures do not meet the current AEP structural strength
 - The majority of structures do not meet the current ASCE structural strength requirements
 - The phase to ground clearance of the typical structure supporting the average span length fails to meet current clearance requirements



Need Number: AEP-2020-AP041

Process Stage: Needs Meeting 10/16/2020

Supplemental Project Driver: Customer Service

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

Problem Statement:

AEP Distribution is requesting a new 138/12 kV transformer at Reusens station to transfer load from Peakland and Boonsboro stations due to the following concerns:

- Peakland station site inadequate for significant expansion (size & terrain) and is currently served by a radial tap from Reusens – Dearington 69 kV line.
- Both Peakland 12 kV circuits are loaded over 90% summer capacity
- Boonsboro 138/12 kV, 20 MVA transformer loaded over 90% in winter
- Boonesboro 12 kV circuit projected to overload by summer 2025



Solutions

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

AEP Transmission Zone M-3 Process Stockport, Ohio

Need Number: AEP-2020-OH006

Process Stage: Solution Meeting 10/16/2020

Previously Presented: Need Meeting 02/21/2020

Driver:

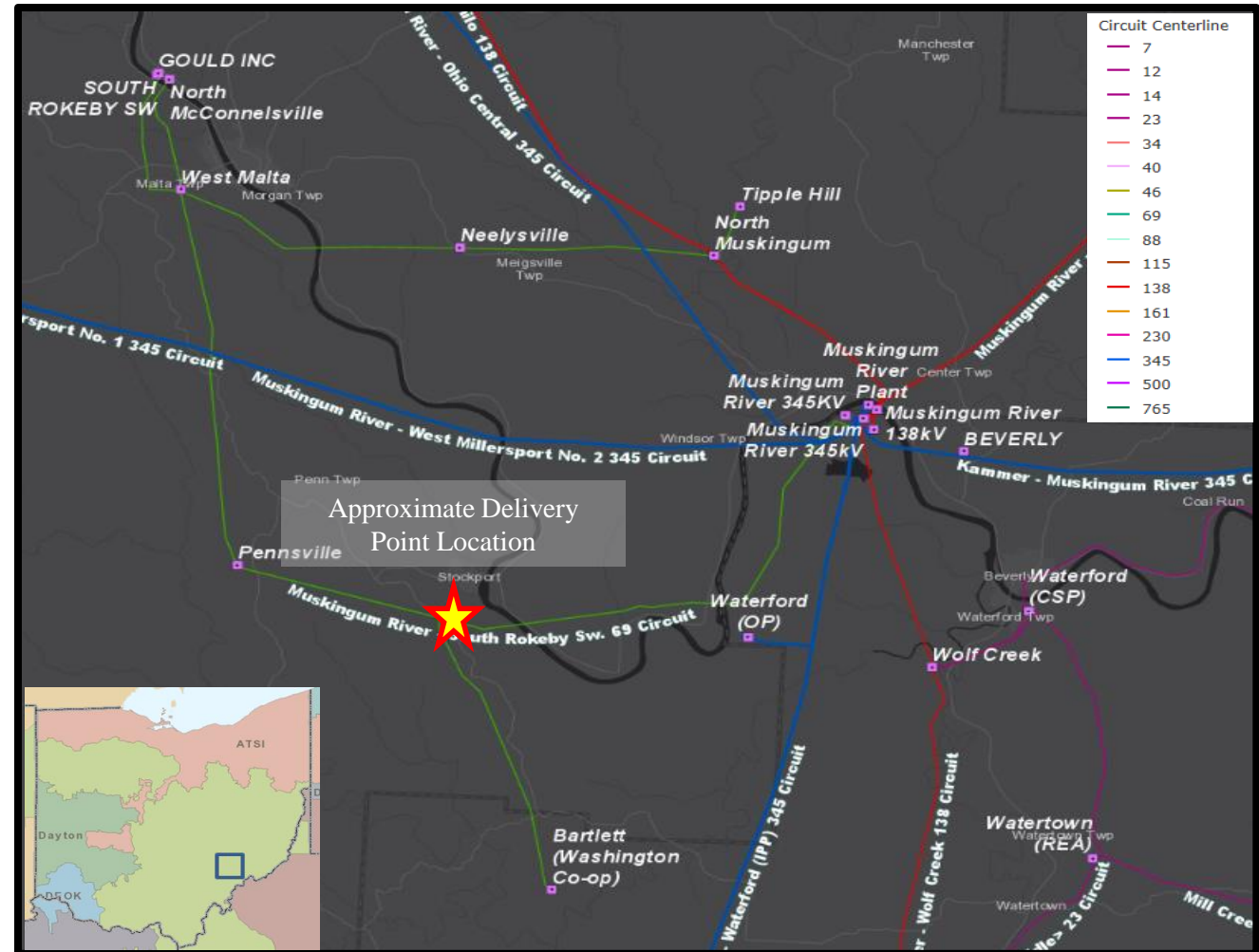
Customer Service

Specific Assumption Reference:

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

Problem Statement:

- AEP Ohio is Requesting a new 69kV delivery point on the Muskingum River – South Rokeby SW 69kV Circuit by 12/13/2021. Anticipated load is about 5 MVA.



AEP Transmission Zone M-3 Process Stockport, Ohio

Need Number: AEP-2020-OH006

Process Stage: Solution Meeting 10/16/2020

Proposed Solution:

- Install a 3 - 3000A Breaker 69kV ring bus called Grace station to serve the requested delivery point. **Estimated Cost: \$2.3M**
- Install approximately 0.2 miles of 69kV line to tie the greenfield Grace station in-and-out to the Muskingum River – South Rokeby 69kV circuit. **Estimated Cost: \$2.1M**
- Remove/Relocate approximately 0.05 miles of line on the Muskingum River – South Rokeby 69kV Line asset between structures 75 and 74A to accommodate the cut in to the new station. **Estimated Cost: \$0.1M**
- Remote end work at South Rokeby Switch. **Estimated Cost: \$0.9M**

Total Estimated Transmission Cost: \$5.4M

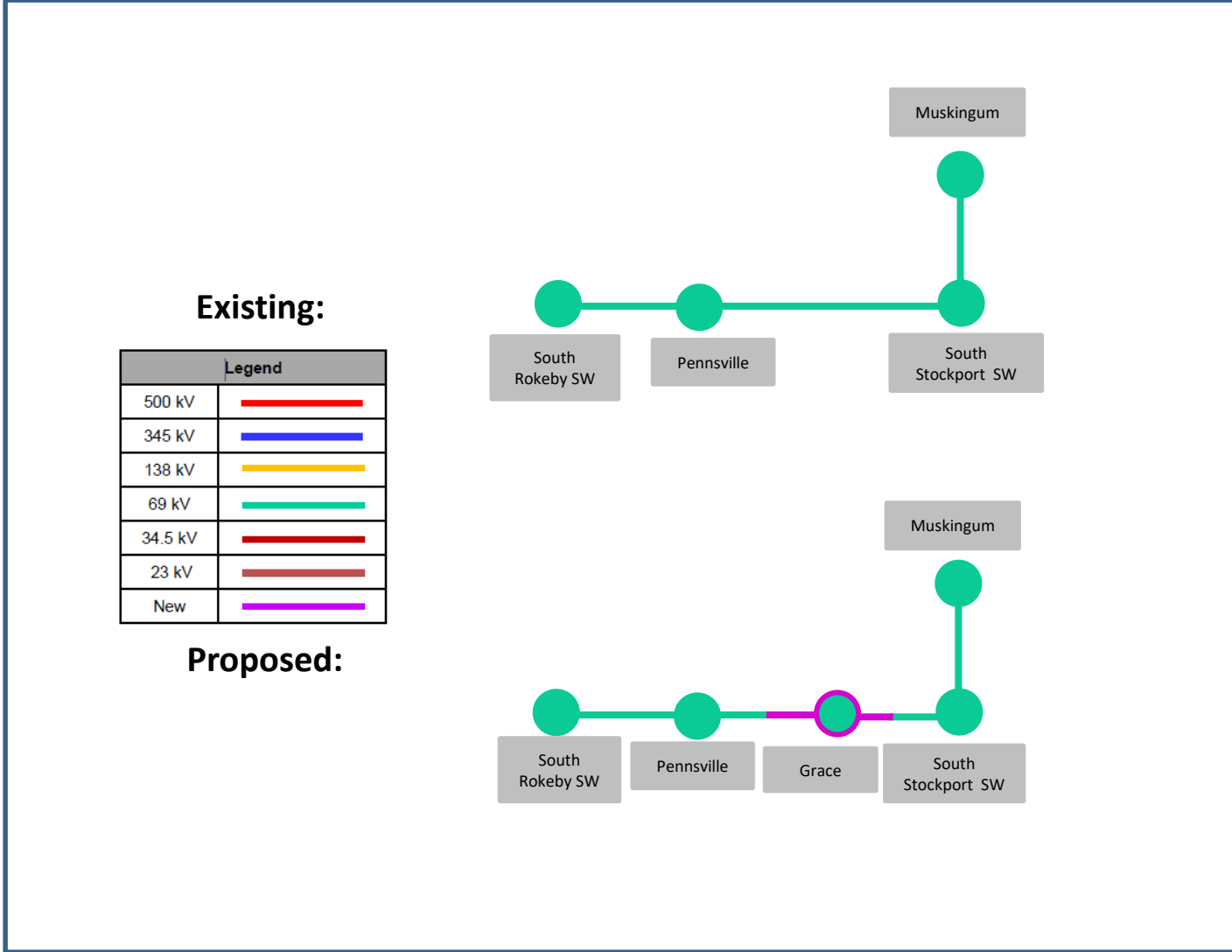
Alternatives Considered:

Install a 69 kV in and out station with switches only for the AEP Ohio Grace delivery point. This configuration would not sectionalize outages for an approximate 26 miles of line exposure. There have been 12 forced outages over the past 5 years, resulting in 652,450 CMI. Installing breakers allows for breaking up the circuit exposure for the Washington coop served from South Stockport Switch and the AEP customers served from Pennsville.

Projected In-Service: 5/1/2022

Project Status: Engineering

Model: 2024 RTEP



Need Number: AEP-2020-OH030

Process Stage: Solutions Meeting 10/16/2020

Previously Presented: Needs Meeting 5/22/2020

Supplemental Project Driver:

Customer Service and Operational Flexibility

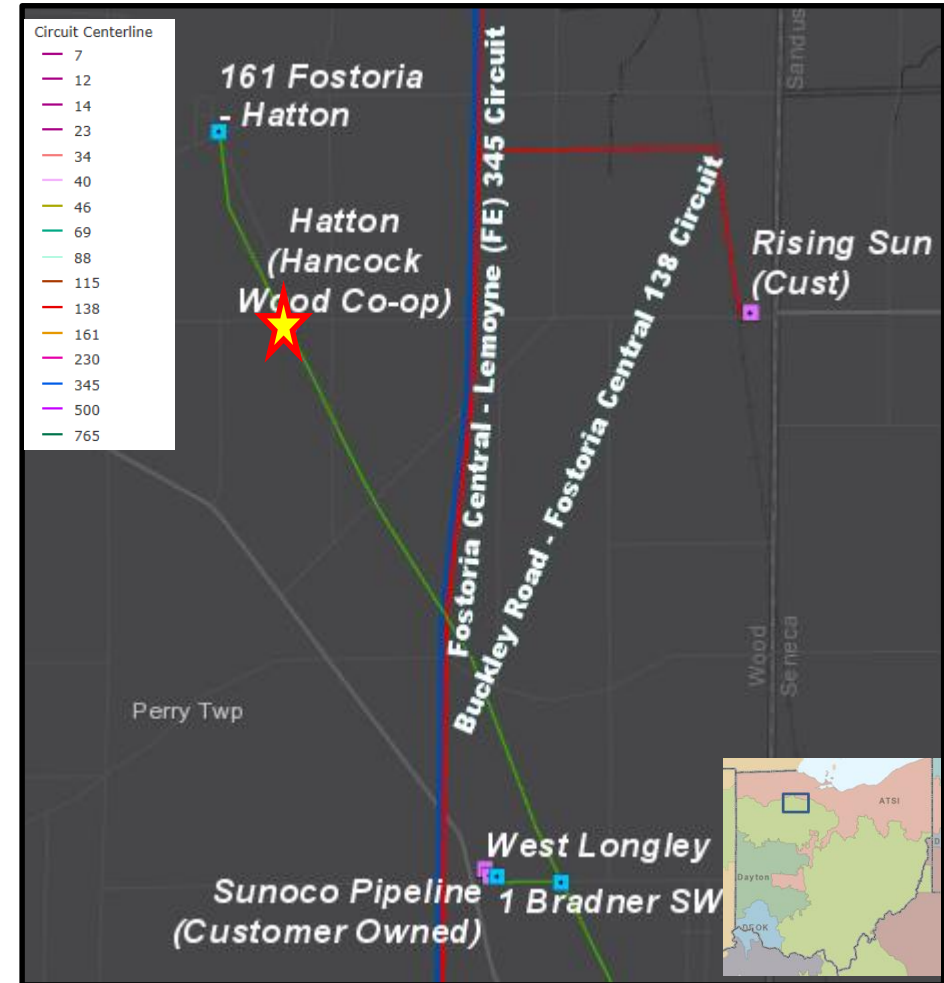
Specific Assumption Reference:

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

Problem Statement:

- Hancock-wood Co-op's has requested for new service to replace their existing Hatton Delivery Point. Hatton delivery point is currently served via a hard tap from the Pemberville (FE) – West End Fostoria 69kV circuit. The new customer station is being built adjacent to their existing substation. The hard tap limits operational capabilities for this circuit. It is difficult to coordinate maintenance efforts because any work on the section from Longley Switch to Pemberville (FE) involves outage to the Hatton Delivery Point.
- Load is approximately 2.26 MVA
- CMI: There were no unplanned outages, but there were six scheduled and one monetary outages that affected the customer, in the last 5 years.

Model: 2025 RTEP



AEP Transmission Zone M-3 Process Wood County, Ohio

Need Number: AEP-2020-OH030

Process Stage: Solutions Meeting 10/16/2020

Proposed Solution:

- Re-terminate the Fostoria – Hatton line to the new Hatton Switch.
Cost: \$0.52M
- Rebuild and re-terminate the Hancock Wood Co-op Extension - Hatton line into the new switch. **Cost: \$0.72M**
- Install a new three way phase-over-phase switch to serve the customer’s station. **Cost: \$0.51M**

Total Estimated Transmission Cost: \$1.75M

Alternatives Considered:

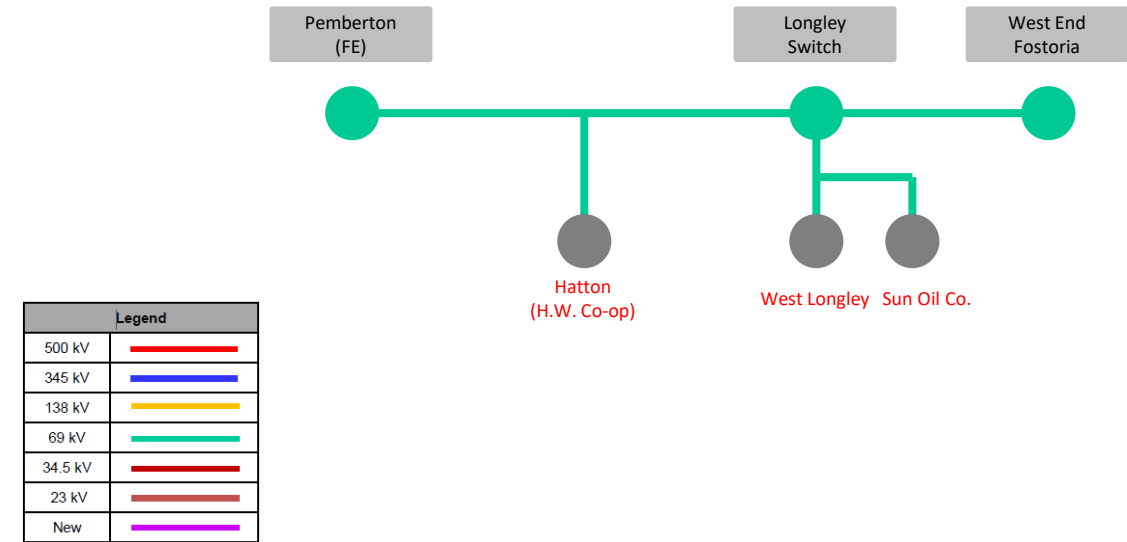
No viable cost-effective transmission alternative has been identified.

Projected In-Service: 5/15/2021

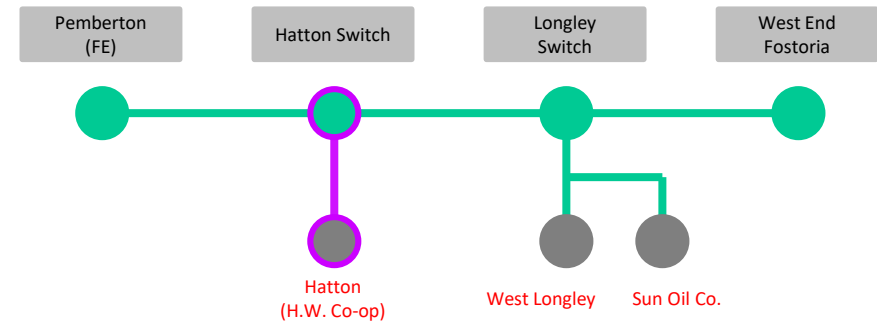
Project Status: Engineering

Model: 2025 RTEP

Existing Configuration:



Future Configuration:



Need Number: AEP-2020-OH031

Process Stage: Solution Meeting 10/16/2020

Previously Presented: Needs Meeting 5/22/2020

Supplemental Project Driver:

Customer Service and Operational Flexibility

Specific Assumption Reference:

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

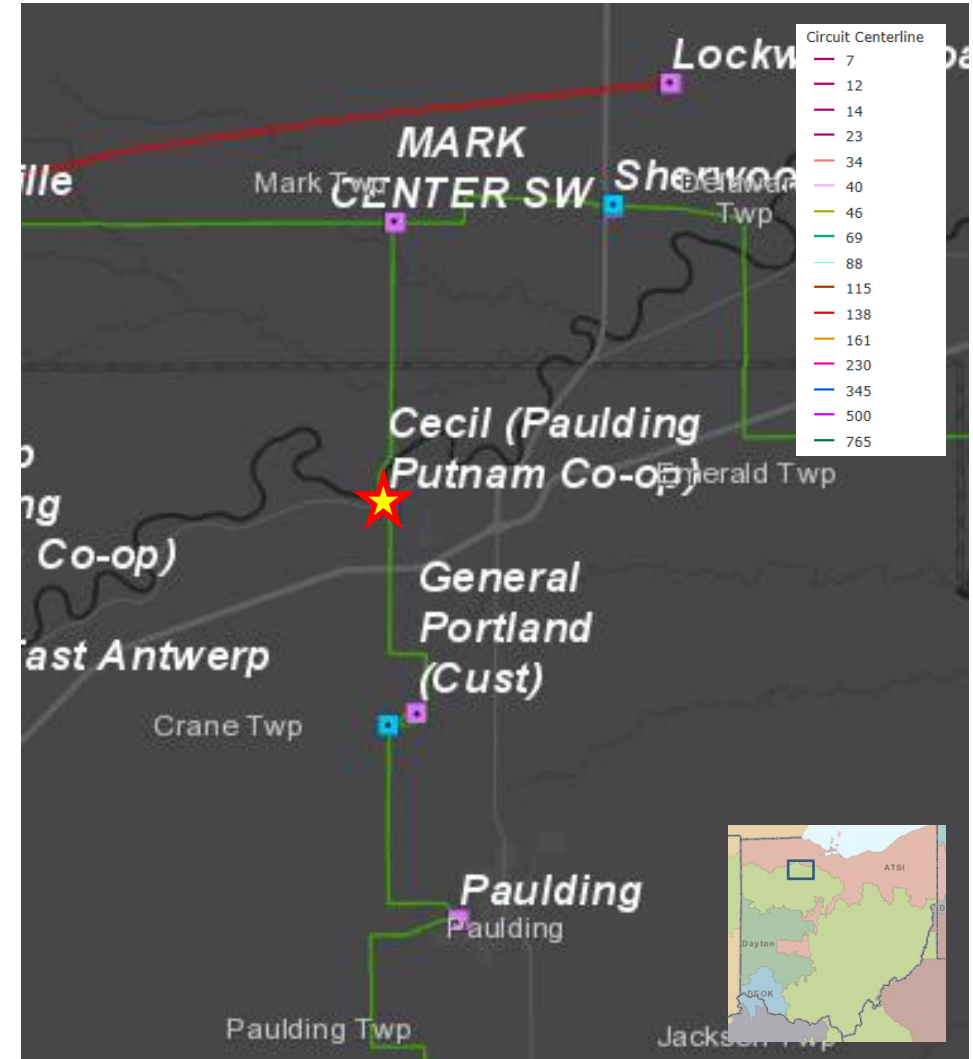
Problem Statement:

Paulding – Putnam Electric Co-op is replacing their 3.75 MVA transformer with a 12/16/20 MVA transformer, which requires some changes to their delivery point. This delivery point is served by the North Cecil switch on the Mark Center – Paulding 69 kV circuit. North Cecil has no auto-sectionalizing capability.

Load: The Co-op delivery point serves approximately 4.9 MW

CMI: In the last 5 years, there were 6 unscheduled outages affecting the customer, 3 of which were momentary and 3 were permanent outages. The 5-year CMI experienced by this customer is 170,520.

Model: 2023 RTEP



Need Number: AEP-2020-OH031

Process Stage: Solution Meeting 10/16/2020

Proposed Solution:

Add auto-sectionalizing and SCADA control to the existing North Cecil Switch. This requires installing PT's, motors, a relay, and communication equipment. **Cost: \$360,023**

Alternatives Considered:

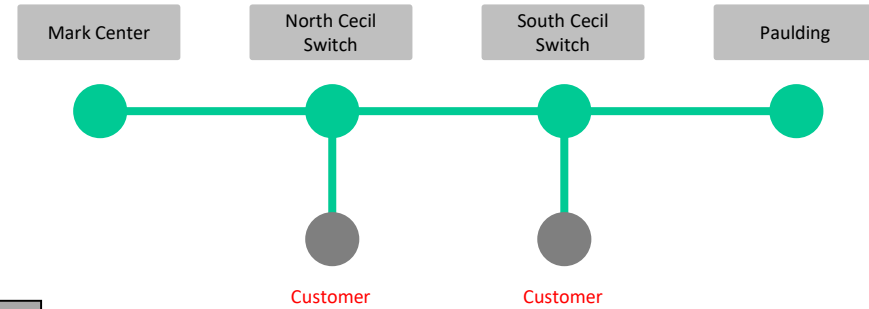
1. No viable cost-effective transmission alternative was identified.

Projected In-Service: 5/15/2021

Project Status: Engineering

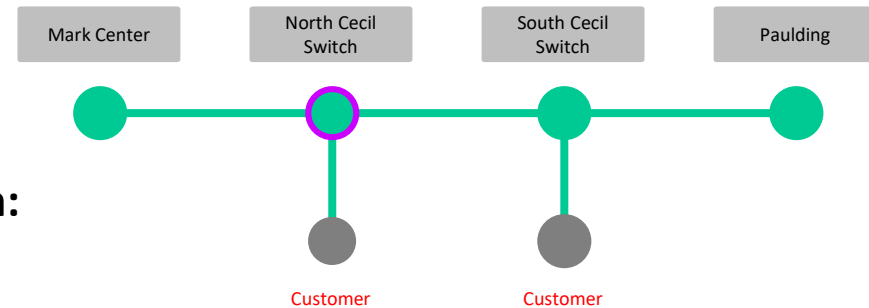
Model: 2023 RTEP

Existing Configuration:



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

Future Configuration:



AEP Transmission Zone M-3 Process Reedurban Transformer

Need Number: AEP-2020-OH036

Process Stage: Solution Meeting 10/16/2020

Previously Presented: Need Meeting 8/14/2020

Project Driver:

Equipment Material/Condition/Performance/Risk

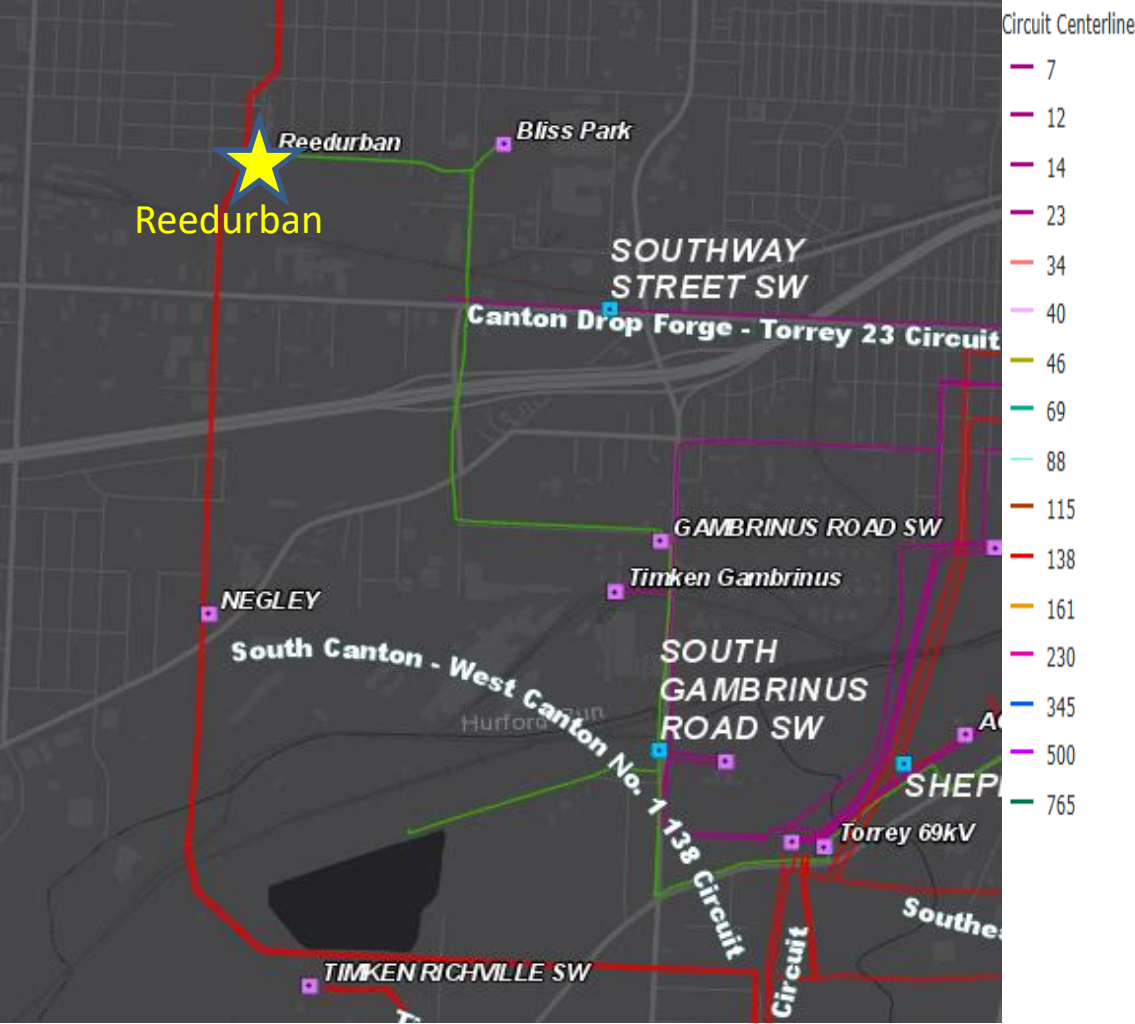
Specific Assumption Reference:

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

Problem Statement:

Station Name: Reedurban

- The 138-69kV transformer has failed and has been temporarily replaced with a mobile 138-69kV transformer.
- Manufactured and installed in 1988.
- 60 MVA nameplate, Westinghouse unit.
- Failure attributed to significant deterioration of transformer windings



AEP Transmission Zone M-3 Process Reedurban Transformer

Need Number: AEP-2020-OH036

Process Stage: Solutions Meeting 10/16/2020

Proposed Solution:

Replace the failed 138-69kV transformer with a spare 90 MVA transformer. Install a transformer oil containment system. Replace electromechanical transformer protection relays with microprocessor relays, along with 69kV PT's.

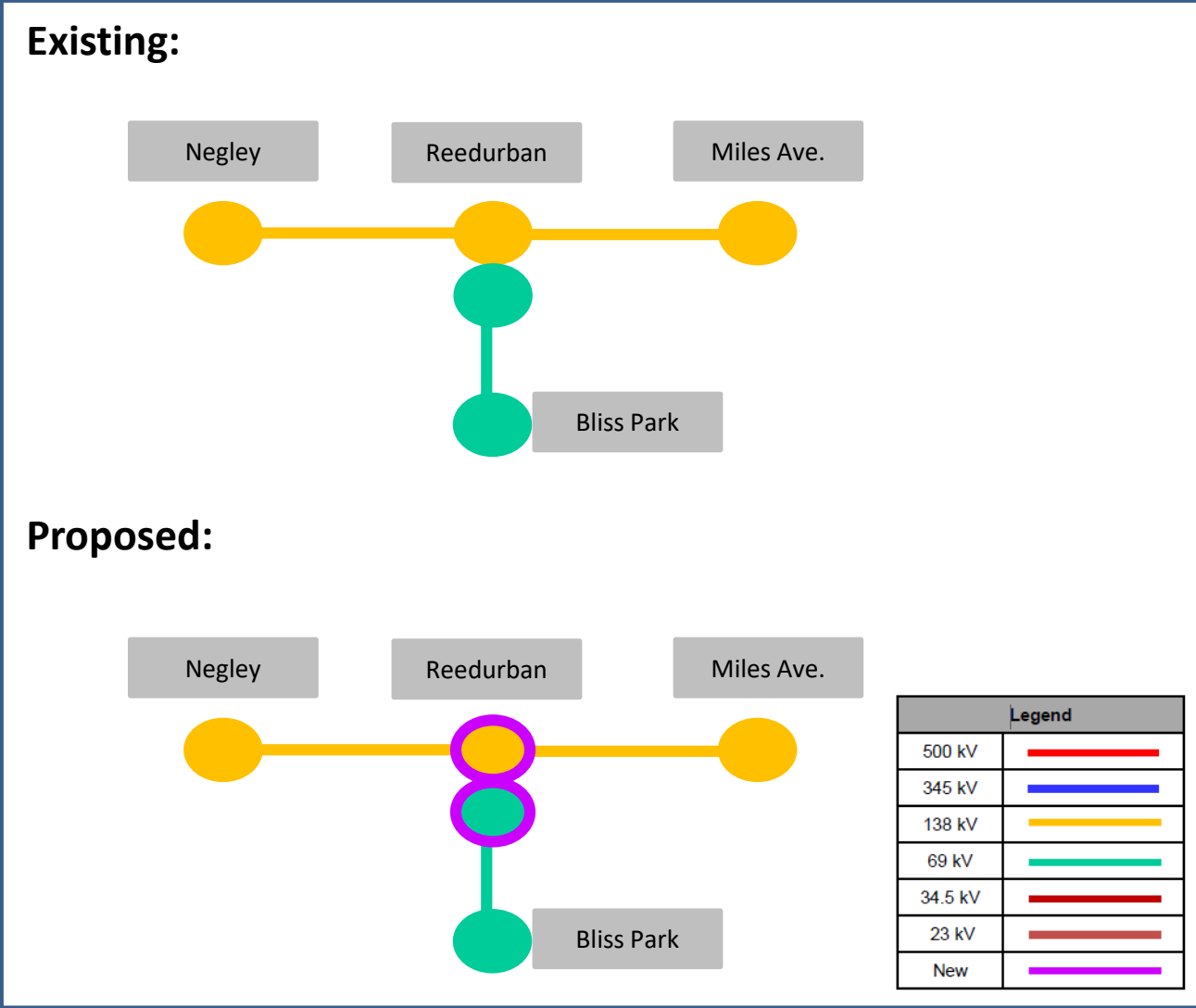
Estimated Cost: \$1.2M

Alternatives Considered:

1. Install a 60 MVA transformer to match the existing size. A spare 90 MVA unit is readily available; there is urgency to replace the failed equipment and restore the system to normal due to the industrial customers served from the 69 kV network.

Projected In-Service: 12/10/2020

Project Status: Engineering



AEP Transmission Zone: Supplemental Floyd County, Kentucky

Need Number: AEP-2019-AP025

Process Stage: Solutions Meeting 10/16/2020

Previously Presented : Needs Meeting 07/24/2019

Supplemental Project Driver:

Equipment Material/ Condition/Performance/Risk

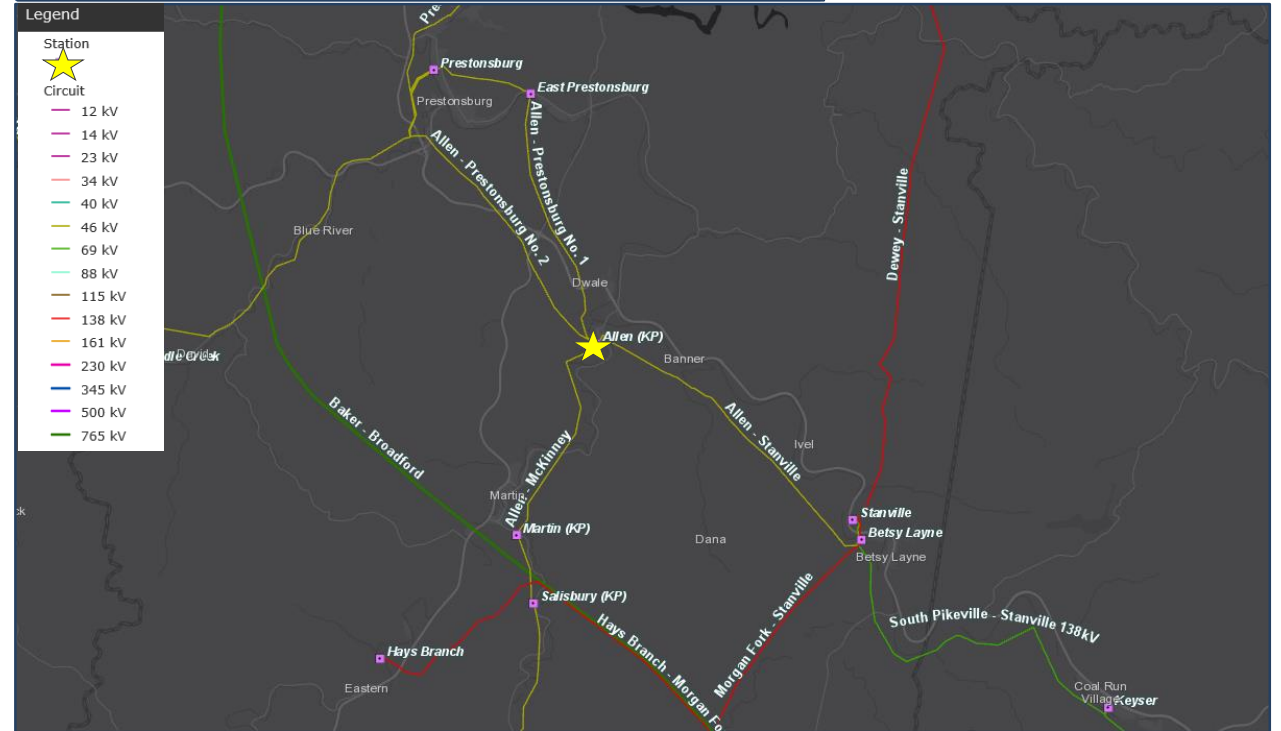
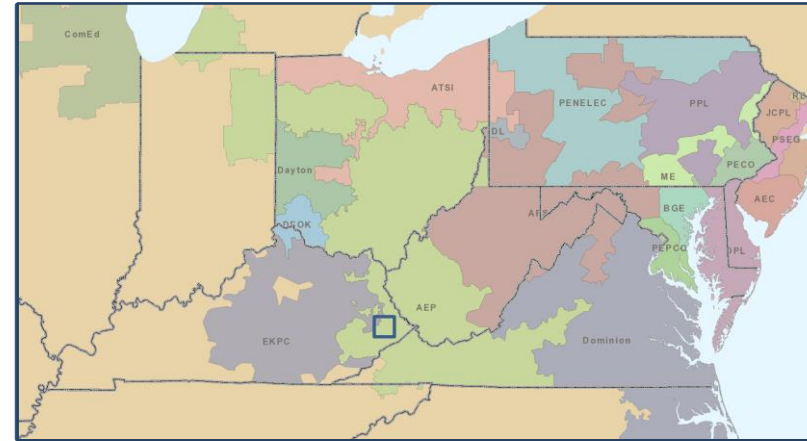
Specific Assumption References:

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

Model: N/A

Problem Statement:

- The existing Allen station has historically experienced severe flooding due to the stations current location in the flood plain. Historical flooding issues have lead to significant deterioration of the stations foundations and structures.
- The 46kV Circuit Breakers (CBs) A, B, C, & D are oil filled breakers without oil containment manufactured in 1960s. Oil filled breakers have much more maintenance required due to oil handling that their modern, SF6 counterparts do not require. These units comprise 4 of the remaining 12 of the FZO-69-1500P model family on the AEP System. Spare parts for these units are difficult to impossible to procure, and this model type is no longer vendor supported.
- The circuit breakers have experienced the following fault operations, CB A (27), C (20), and D (17). The manufacturer recommendation is 10 fault operations during it's in-service life. In addition, all CBs have documented malfunction records with A, C, and D having at least 1 documented since 2016. These include mainly air leaks, a broken trip latch component, and a trip test switch malfunction. The platform foundations that these are mounted on are crumbling in several locations.
- The 46kV CS AA is a VBM-69 model type, 1 of 15 remaining on the AEP System. Spare parts for these units are difficult to impossible to procure, and this model type is no longer vendor supported. These circuit switcher models are poor cold weather performers. This unit has 8 documented malfunction records including multiple failures to trip on poles 2 and 3 and one instance in 2011 in which the unit failed to close.



AEP Transmission Zone: Supplemental Floyd County, Kentucky

Need Number: AEP-2019-AP025

Process Stage: Solutions Meeting 10/16/2020

Previously Presented : Needs Meeting 07/24/2019

Proposed Solution:

Allen Substation:

Rebuild Allen Station to the northwest of its current footprint utilizing a standard air-insulated substation with equipment raised by 7' concrete platforms and control house raised by a 10' platform to mitigate flooding concerns. Install five 69 kV 3000A 40 kA circuit breakers in a ring bus (operated at 46kV) configuration with a 13.2 MVAR capacitor bank. Existing Allen station will be retired

Estimated Cost: \$10.55 M (Does not include the distribution cost)

Distribution Scope of Work: Install 69/46kV-12kV 20 MVA transformer along with 2-12kV breakers on 7' concrete platforms.

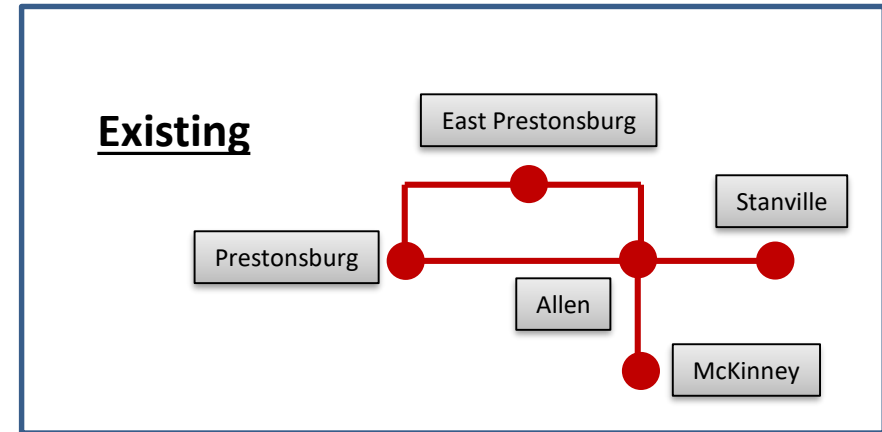
Transmission Line:

Allen – East Prestonsburg: A 0.20 mile segment of this 46 kV line will be relocated to the new station. (SN/SE/WN/WE: 53/61/67/73MVA). **Estimated Cost: \$0.33 M**

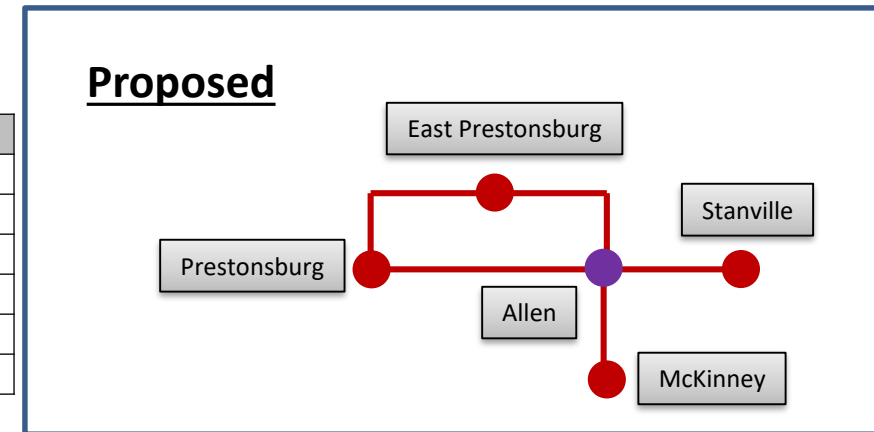
McKinney – Allen: The new line extension will walk around the south and east sides of the existing Allen Station to the new Allen Station being built in the clear. A short segment of new single circuit 69kV line and a short segment of new double circuit 69kV line (both operated at 46 kV) will be added to the line to tie into the new Allen Station bays. **Estimated Cost: \$1.95 M**

Stanville – Allen: A segment of this line will have to be relocated to the new station (SN/SE/WN/WE: 50/50/63/63MVA). **Estimated Cost: \$0.17 M**

Allen – Prestonsburg: 0.25 mile segment of this existing single circuit will be relocated. The relocated line segment will require construction of one custom self-supporting double circuit dead end structure and single circuit suspension structure. A short segment of new double circuit 69kV line (energized at 46 kV) will be added to tie into the new Allen Station bays which will carry Allen – Prestonsburg 46kV and Allen – East Prestonsburg 46kV lines. A temporary 0.15 mile section double circuit line will be constructed to keep Allen – Prestonsburg and Allen – East Prestonsburg 46kV lines energized during construction. **Estimated Cost: \$2.66 M**



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



AEP Transmission Zone: Supplemental Floyd County, Kentucky

Proposed Solution (Cont.):

Remote End

Remote end work will be required at Prestonsburg, Stanville, and McKinney stations. **Estimated Transmission Cost: \$0.34 M**

Total Estimated Transmission Cost: \$16 M

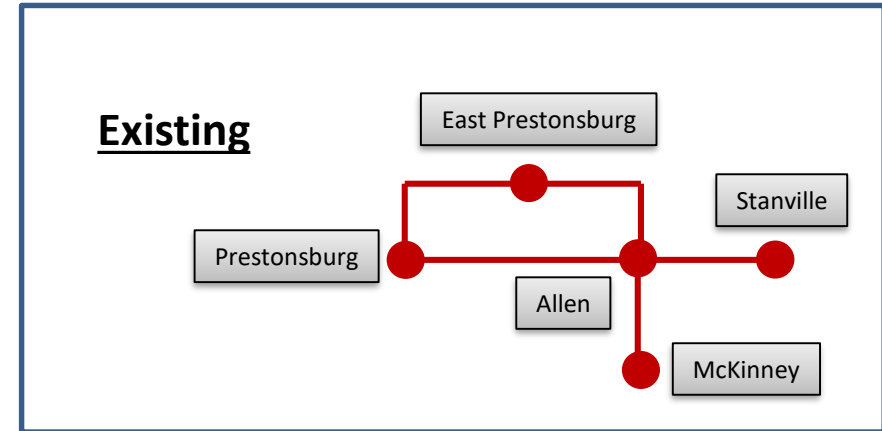
Alternatives Considered:

Construct a new greenfield substation at a station site identified appx. 1 mile from existing Allen station (A total of 13 sites were reviewed and this site was chosen as being the most prudent location). Install 69/12kV 30 MVA transformer (operated at 46kV) and 2-12kV breakers, Install five 69 kV 3000A 40 kA circuit breakers in a ring bus (operated at 46kV) configuration with a 13.2 MVAR capacitor bank. Construct approximately 1 mile of new 69 kV standard double circuit line between the existing Allen Station and a new station site utilizing the existing Allen – Prestonsburg #1 46 kV circuit ROW. This double circuit line would be used to get the existing Allen – McKinney and Allen - Stanville 46 kV circuits to the newly proposed station site. Construct approximately 0.7 miles of 69 kV single circuit line from about structure 9 on the Allen – Prestonsburg #2 circuit to the new station. Install a new structure (or two) on Allen – Prestonsburg #1 circuit south of structure 7 to bring the line into the new station.

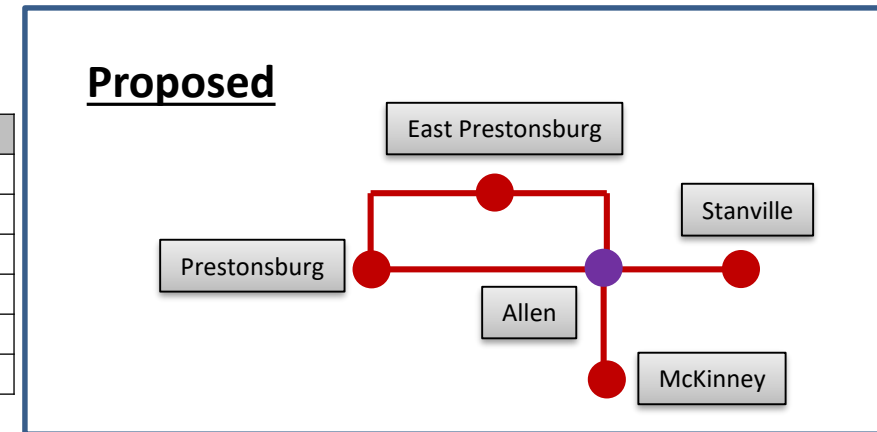
Estimated Cost: \$31 M (Transmission cost)

Project Status: Scoping

Projected In Service Date: 12/31/2023



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



AEP Transmission Zone M-3 Process

Bim Station

Need Number: AEP-2019-AP001

Process Stage: Solution Meeting 10/16/2020

Previously Presented: Needs Meeting 2/20/2019

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

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

Problem Statement:

Bim 69 kV

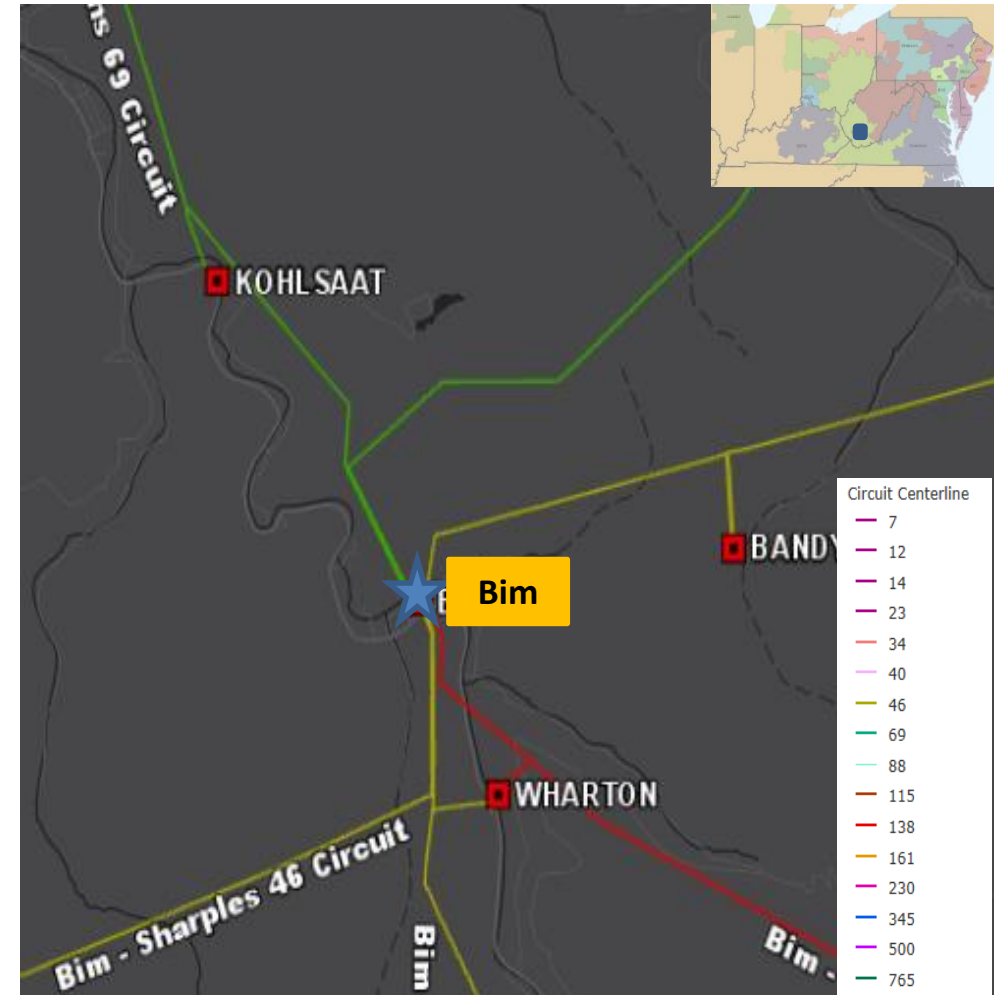
- Breaker “D”
 - 1967 FK oil type breaker without containment
 - Fault operations: 369, recommended 10 operations
- Cap Switchers “AA” and “BB”
 - SC-2030 type
 - No gas monitoring
 - Sister units have experienced numerous gas and interrupter failures

Bim 46 kV

- Breakers “A”, “B”, “C”, and “E”
 - 1967 FK oil type breakers without containment
 - Fault operations: CB A (85), CB B (14), CB C (131), CB E (63), recommended 10 operations

Bim Station

- Existing Gr. SW. MOAB configuration creates faults in the station; known safety hazard in legacy station designs
- Transformer Bank #1 138/69/46
 - Oil leaking at a steady rate
 - Deteriorating wooden crossties, obsolete arresters and bushings, LTC is not in adequate condition
 - Cooling system and controls need replaced
- GND Bank
 - Interfacial tension in all three units has been on the decline or at sustained low levels for around 15 years, indicating the development of sludge which can impede oil circulation/cooling
 - Rising/Sustained high moisture content has resulted in degrading/sustained low levels of dielectric strength
 - Obsolete arresters/bushings, deteriorating wooden crossties
 - Cooling system/controls need replaced



AEP Transmission Zone M-3 Process Bim Station

Need Number: AEP-2019-AP001

Process Stage: Solutions Meeting 10/16/2020

Proposed Solution:

Replace existing 138/69/46 kV 75 MVA with a new 138/69/46 kV 130 MVA XFR. Replace existing 138 kV ground switch MOAB with a new 138 kV circuit switcher. Replace existing 69 kV CB D with a new 69 kV 3000 A 40 kA breaker. Replace existing 69 kV shunt cap switcher BB with a new 69 kV 40 kA cap switcher. A 69 kV Ring bus was considered but not recommended considering circuit breaker F does not need to be replaced. In addition, a 69 kV ring bus would be difficult due to the lack of available high ground at the site, so a station expansion with major fill would be required. Replace existing 46 kV CBs A, B, C, and E with four new 46 kV 3000 A 40 kA breakers in a ring configuration. Retire existing 46 kV 14.4 MVAR cap bank. New DICM will be installed. The new equipment at Bim will result in a ratings increase on the Bim – Bandy Branch (Sundial) line section SN/SE/WE/WN: 84 MVA/84 MVA/106 MVA/ 106 MVA.

Remote end work required at Sharples, Skin Fork and Sundial.

Line work required on entrance spans due to the new station layout. Currently the 69 kV bus is located on top of the 46 kV bus. In order to perform the work necessary, the two buses will be separated and built in the clear.

Estimated Trans. Cost: 14.9M

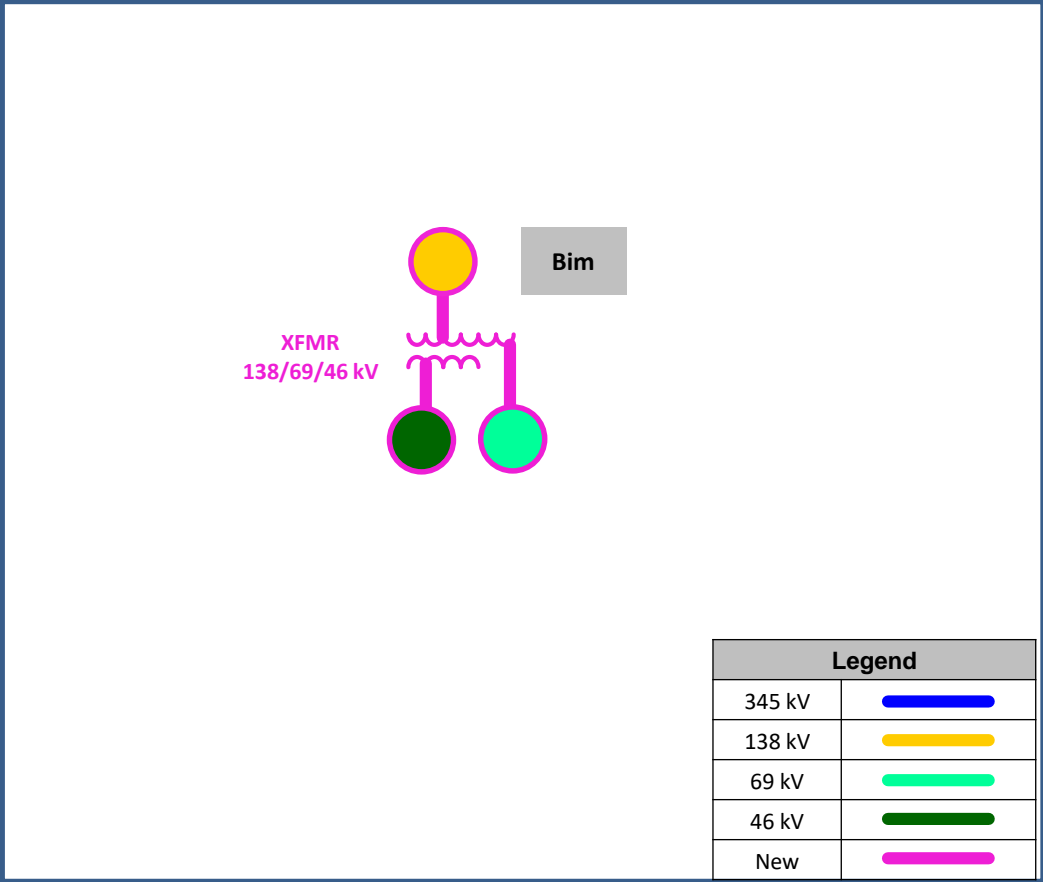
Ancillary Benefits: <Ancillary Benefits>

Alternatives Considered:

1. Relocating and rebuilding the station was considered, however this would require significant line work to go along with finding a suitable site that is large enough to accommodate the required equipment. The station currently has 6 circuits served out of it at 3 different voltage levels 138 kV, 69 kV and 46 kV.

Projected In-Service: 6/1/2022

Project Status: Scoping



Need Number: AEP-2020-AP040

Process Stage: Solutions Meeting: 10/16/2020

Previously Presented: Needs Meeting 9/11/2020

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

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

Problem Statement:

Station

Station Name: Lovedale

Circuit Breakers A, B & G (34.5 KV) Concerns:

- All of these breakers are 52 years old, oil filled without oil containment; oil filled breakers pose significant environmental risk associated with oil handling and leaks. Additionally, oil filled breakers require frequent maintenance. Oil spills are common and can result in significant environmental mitigation costs.
- Breakers A & B have experienced 41 & 11 fault operations, respectively, exceeding manufacturer's recommended number of 10.
- Breakers A, B & G are 3 of 31 of the FKA-34.5-1500-1 model remaining on the AEP system. Spare parts for these units are impossible to procure as this model type is no longer vendor supported.

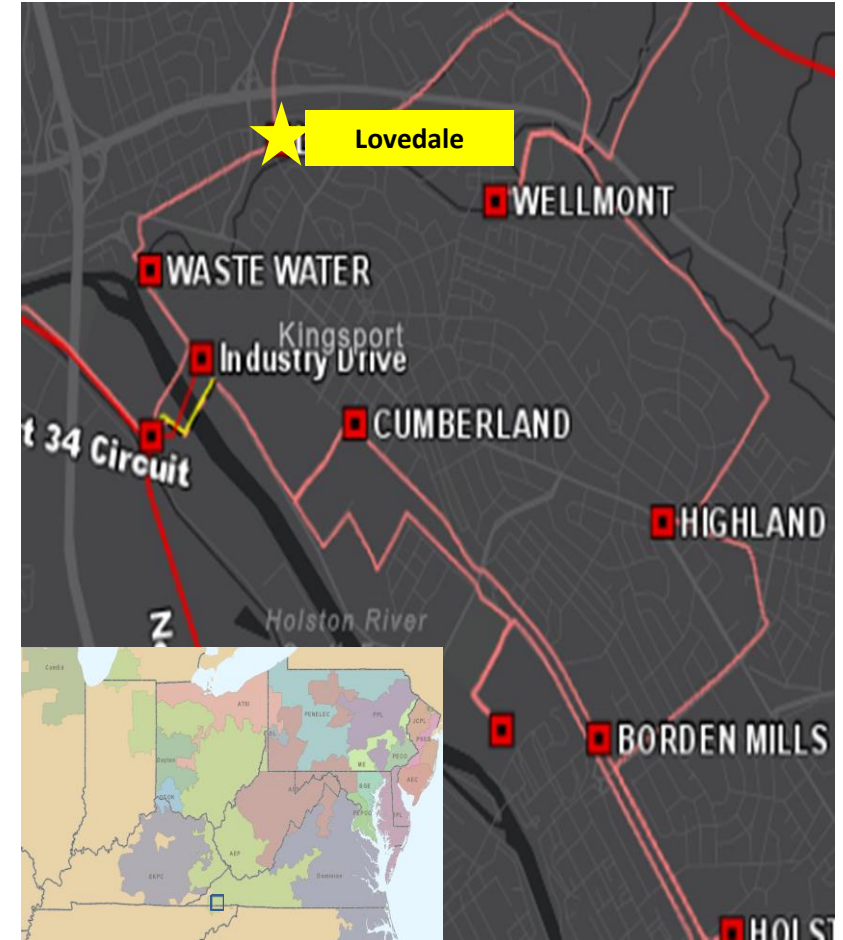
Other station concerns:

- The station yard is very cramped and tight. There is limited ability for crews to perform necessary maintenance due to a lack of space for vehicles and equipment.
- The bus arrangement is tight and congested with tubing comprised mainly of copper
- Cap and pin insulators are used throughout the station
- There are additional needs on the Distribution voltage class equipment within the station

Relay concerns:

- Currently, 33 of the 40 deployed relays are electromechanical type which have significant limitations with regards to fault data collection and retention. In addition, these relays lack vendor support with no spare part availability for repairs.

AEP Transmission Zone: Supplemental Sullivan, TN



AEP Transmission Zone: Supplemental Sullivan, TN

Need Number: AEP-2020-AP040

Process Stage: Solutions Meeting: 10/16/2020

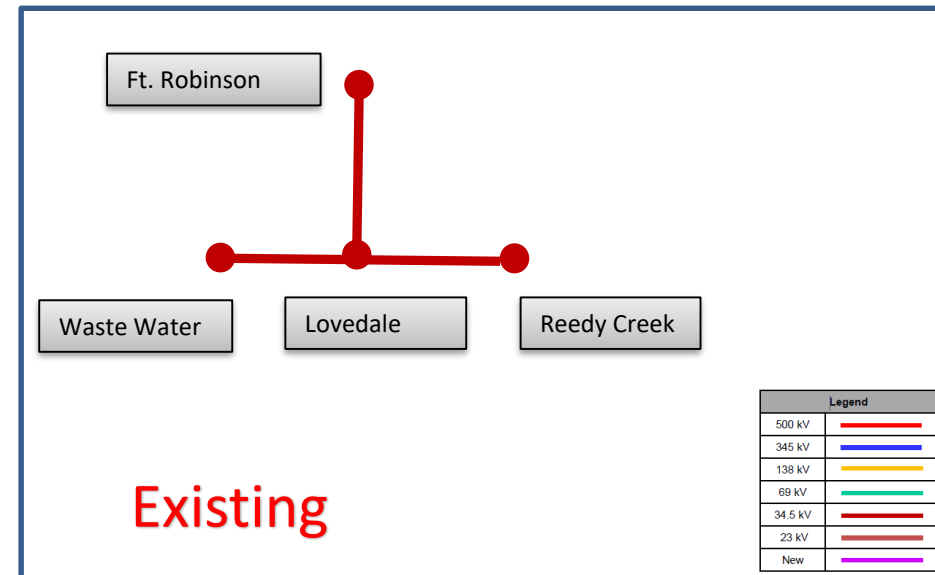
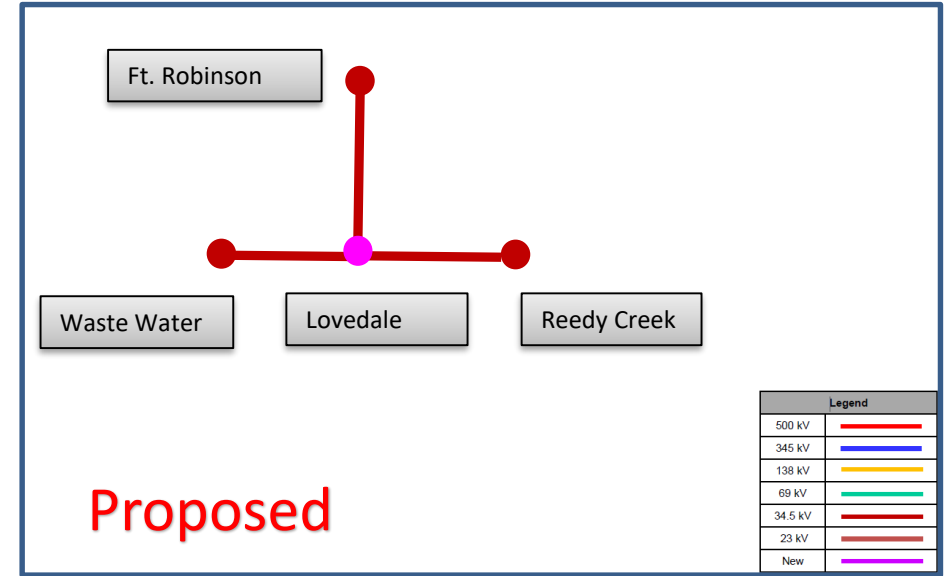
Proposed Solution:

- Rebuild Lovedale Substation to 69 kV standards (energized at 34.5 kV)
 - Station highside at Lovedale: Replace existing 34.5 kV circuit breakers A, B & G with new 69 kV rated 3000A 40 KA circuit breakers. **Estimated Cost: \$2.3M (Distribution cost is not included)**
 - Required T-line Entrance Work necessary to relocate to the new station site (Highland-Lovedale, Fort Rob-Lovedale, Lovedale-Waste Water) **Estimated Cost: \$1.1M**
 - Required ROW (Lovedale-Waste Water) **Estimated Cost: \$0.1**
 - Remote End Work (Highland, Reedy Creek, Fort Robinson) **Estimated Cost:\$0.7M**
 - **Distribution Scope of Work:** Install (2) 69-34.5/12 kV distribution Transformers, (4) feeder exits with breakers and a bus-tie.

Total Estimated Transmission Cost: ~\$4.2M

Project Status: Scoping

Projected In-Service: 11/15/2023



Need Number: AEP-2020-AP013

Process Stage: Solutions Meeting: 10/16/2020

Previously Presented: Needs Meeting 02/21/2020

Supplemental Project Driver: Equipment Condition/Performance/Risk

Specific Assumption Reference:

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

Problem Statement:

Fort Robinson Station

Circuit Breaker E (69 KV):

- Circuit breaker E is 52 years old, CG/CF, oil filled type breaker without oil containment; oil filled breakers have much more maintenance required due to oil handling and spills can result in significant mitigation cost.
- It has experienced 113 fault operations — exceeding manufacturer’s recommended number of 10.

Circuit Breaker D (34.5 KV) Concerns:

- Circuit breaker D is 36 years old, CG, oil filled without oil containment; oil filled breakers have much more maintenance required due to oil handling and spills can result in significant mitigation cost.
- It has experienced 33 fault operations — exceeding manufacturer’s recommended number of 10.
- CB D is 1 of only 27 remaining of the CG-48-72.5-31.5-1200 models on the AEP system. The manufacturer provides no support for the CF/CG/CGH/CH family of circuit breakers and spare parts are increasingly more difficult to obtain. This model has experienced major malfunctions associated with their OA-3 hydraulic mechanism, which includes low-pressure readings, hydraulic leaks, pump lockouts, and failure to shut off.

Transformer 1 (138/69-34.5 KV) :

- The current low side GOAB switch on the tertiary side of 1 Bank is incapable of load breaking.
- MOAB/Ground SW configuration on the high side of the transformer.
- Grounding bank is 48 years old with elevated levels of acetylene. This concentration of acetylene indicates excessive internal component decomposition due to arcing within the tank.

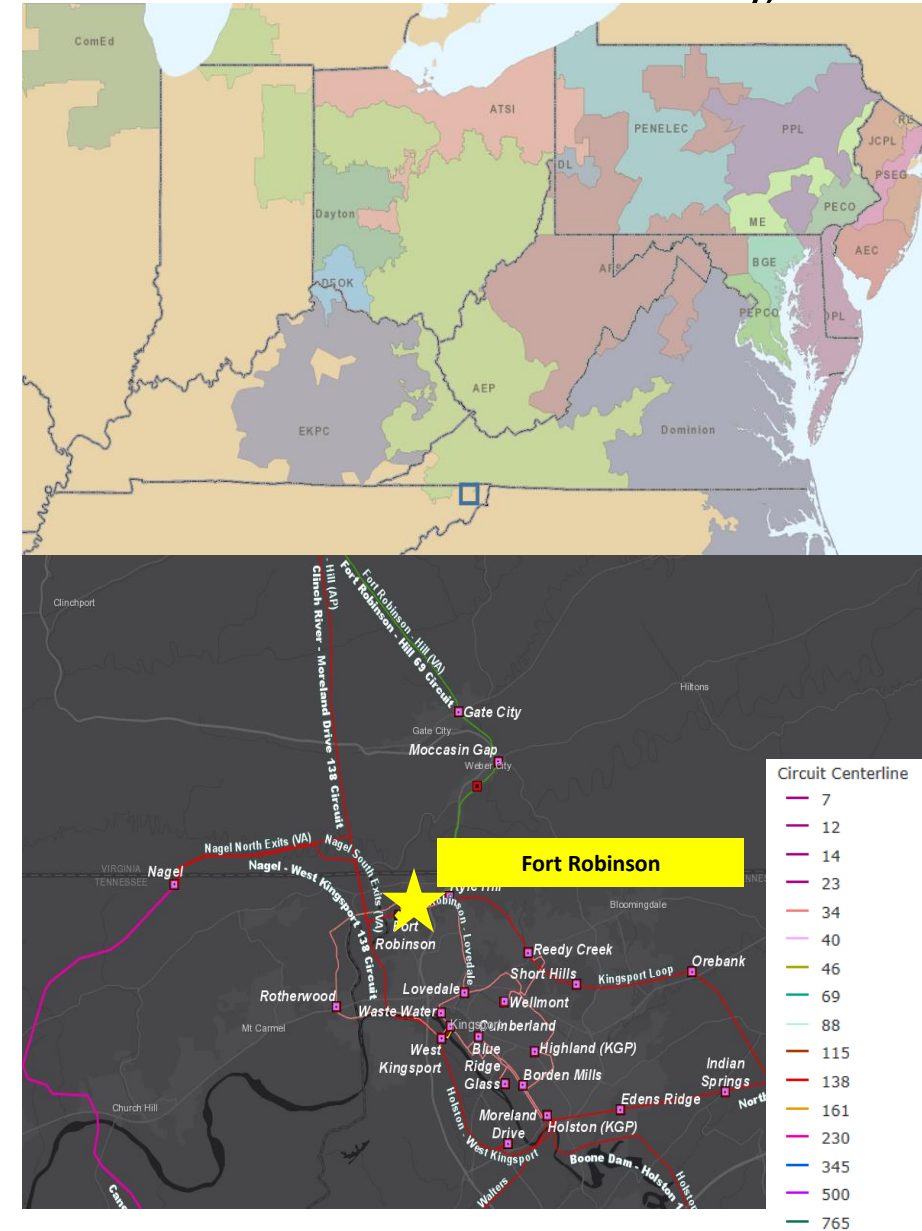
Relay Concerns:

- There are 33 electromechanical type relays (82% of all relays at the station) which have significant limitations with regards to fault data collection and retention.
- There are 4 microprocessor based relays with unsupported firmware and lack of vendor support.

Operations Concerns:

- Fort Robinson Station is served off of the Nagel – Wolf Hills 138 kV circuit moreland which is 39.11 miles long without CB sectionalizing.

AEP Transmission Zone: Supplemental Sullivan County, TN



Need Number: AEP-2020-AP014

Process Stage: Solutions Meeting: 10/16/2020

Previously Presented: Needs Meeting 02/21/2020

Supplemental Project Driver: Equipment Condition/Performance/Risk

Specific Assumption Reference:

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

Problem Statement:

Hill Station

Circuit Breaker H (69 KV):

- Circuit breaker H is 52 years old, CF model type, oil filled type breaker filled without oil containment; oil filled breakers have much more maintenance required due to oil handling and oil spills can result in significant mitigation cost. Spare parts for these units are difficult to impossible to procure.
- 91 fault operations — exceeding manufacturer’s recommended number of 10.

Circuit Switcher AA (69 KV):

- Circuit switcher AA is 25 years old, 2030-69, SF6 type breaker. This type of circuit switcher has no gas monitor and sister units have a history of malfunctions, including gas loss, interrupter failures, and operating mechanism failures.

Transformer 1 (138/69-34.5 KV) Concerns:

- Transformer bank 1 is 63 years old with elevated levels of carbon dioxide and moisture and a decrease in dielectric strength.
- The current MOAB/Ground SW configuration on the high side of the transformer

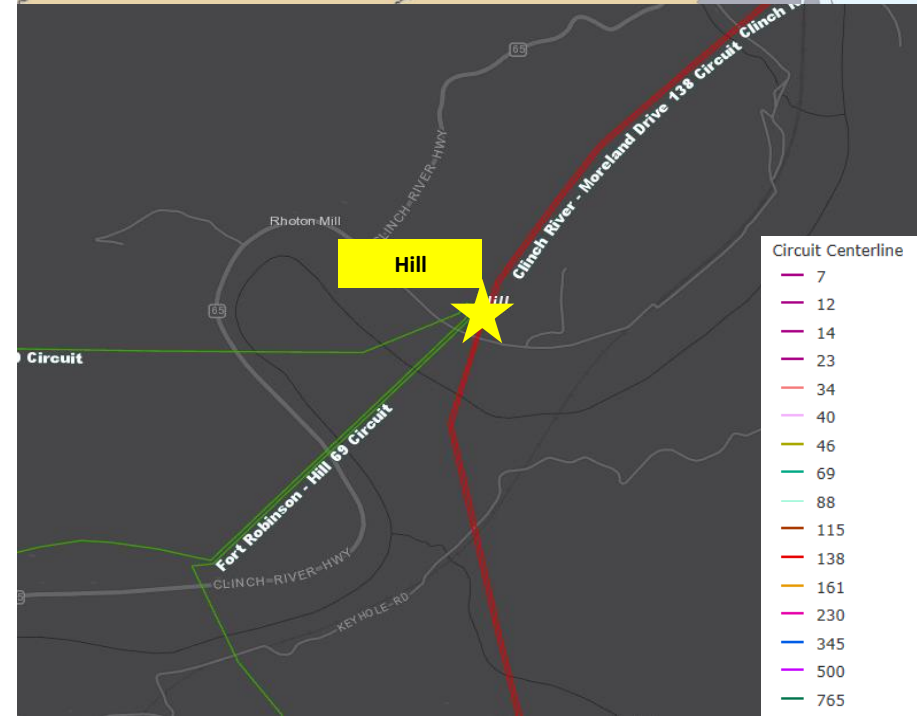
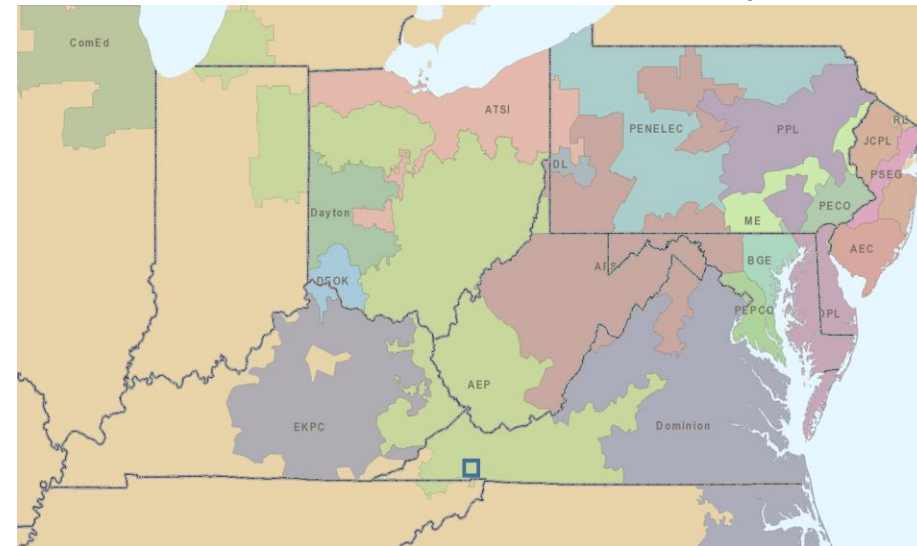
Relays

- 20 relays (53%) are of the electromechanical type which have limitations with regards to fault data collection and retention.
- These relays lack vendor support and have no access to spare parts.

Operations Concerns:

- Hill Station is served off of the Clinch River – Nagle 138 kV circuit which is 41.61 miles long without CB sectionalizing.

AEP Transmission Zone: Supplemental Scott County, VA



AEP Transmission Zone: Supplemental Sullivan County, Tennessee/ Scott County, Virginia

Need Number: AEP-2020-AP015

Process Stage: Solutions Meeting: 10/16/2020

Previously Presented: Needs Meeting 02/21/2020

Supplemental Project Driver: Equipment Condition/Performance/Risk

Specific Assumption Reference:

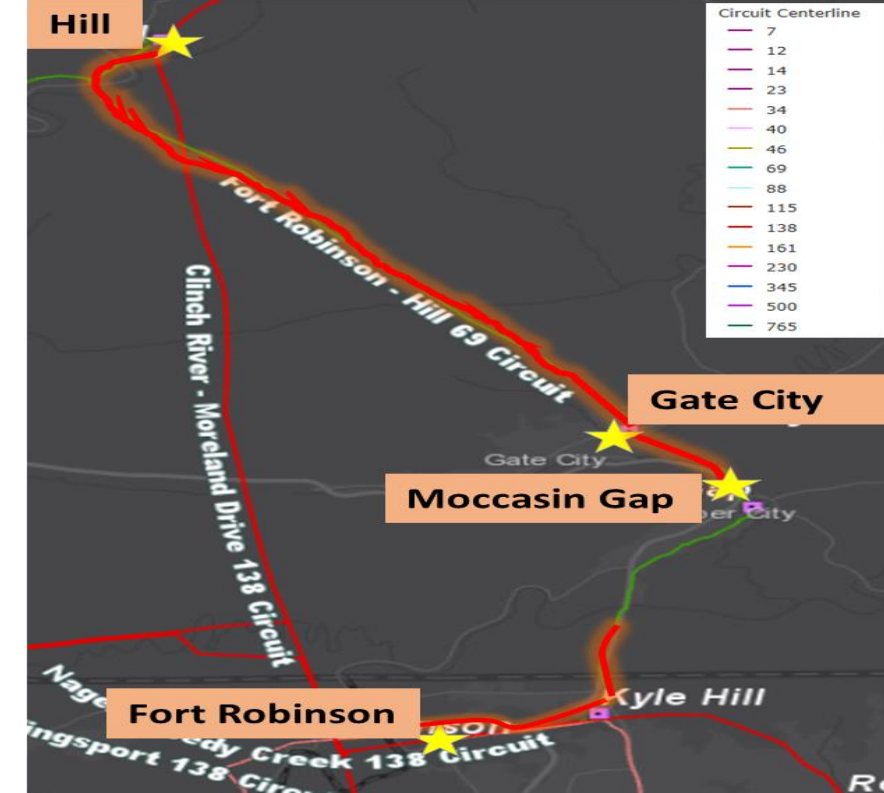
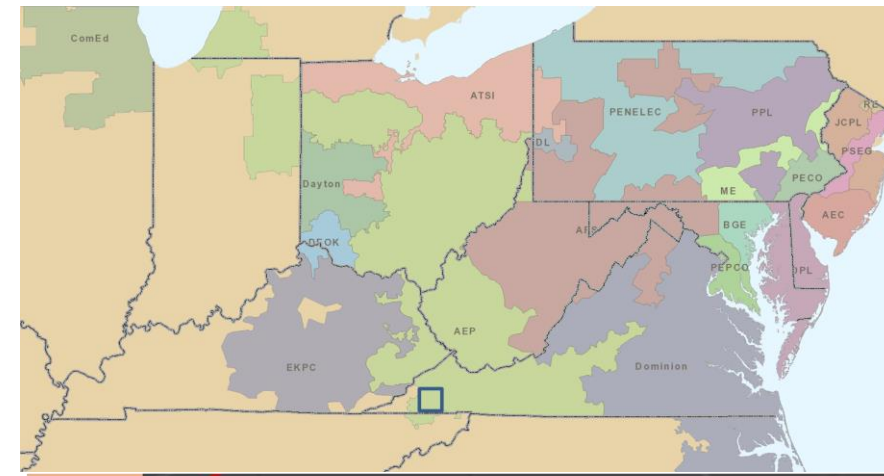
AEP Guidelines for Transmission Owner Identified Needs (AEP Assumptions Slide 8)

Problem Statement:

Fort Robinson —Hill 69 KV (installed in 1970)

- Length: ~~12.7~~ ~14.2 Miles
- Original Construction Type: Wood (86% original)
- Original Conductor Type (91% original): 219.9 ACSR, 1/0 CU, 336 ACSR, 4/0 ACSR, and 556 ACSR
- Momentary/Permanent Outages: 7 momentary, 8 permanent (5 years)
- CMI: 5,721,762
- Total structure count: ~~127~~ 213
- Number of open conditions: 120
 - Open conditions include: broken conductor strands, broken/burnt insulators, split Bayonet, cracked X-Brace.
- Unique structure count with open conditions: 95 (44%)
- Additional Info:
 - There have been 5 weather related momentary outages, with 4 of those being attributed to lightning as well as 1 permanent outage. These lightning caused outages are indicative of insufficient shielding and/or insufficient grounding

Note: ~1.5 mile 1/0 Cu conductor section of the ~ 5 miles Fort Robinson – Moccasin Gap 69 KV line section will be addressed as part of b3101



AEP Transmission Zone: Supplemental Sullivan County, Tennessee/ Scott County, Virginia

Need Number: AEP-2020-AP013, AEP-2020-AP014, AEP-2020-AP015

Process Stage: Solutions Meeting: 10/16/2020

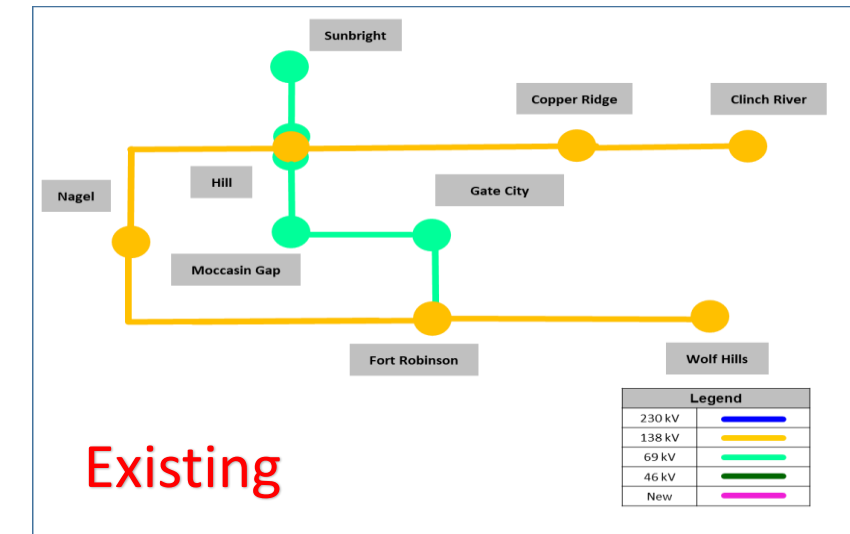
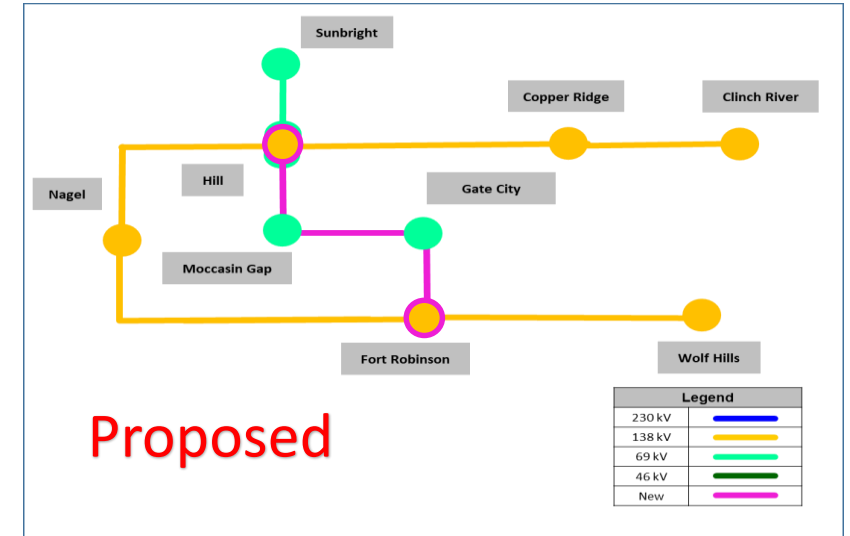
Proposed Solution:

- Rebuild ~12.7 miles of the existing Fort Robinson – Hill 69 kV line between Fort Robinson and Hill stations.
 Fort Robinson – Moccasin Gap: (SN/SE/WN/WE: 102/142/120/160MVA) Limited by Line Conductor
 Moccasin Gap - Gate City - Hill: (SN/SE/WN/WE: 79/92/100/109MVA)) Limited by Risers at Gate City
Estimated Cost: \$30.9M
- At Fort Robinson station, replace existing 69 KV circuit breaker E with a new 3000A 40 KA circuit breaker. Replace existing 34.5 KV circuit breaker D with a new 69 KV rated 3000A 40 KA circuit breaker. Replace existing ground bank at transformer # 1 with new ground bank. Replace existing ground MOAB for transformer #1 with H.S. circuit switcher. Replace existing line MOABs Y & W with 138 kV circuit breakers. Replace 34.5 kV disconnects on breaker J. Install new low side 34.5 KV Circuit breaker at Transformer #1. **Estimated Cost: \$7.2M**
- At Hill station, replace existing 69 KV circuit breaker H with new 40 KA 3000A circuit breaker. Replace existing 69 KV circuit breaker E with new 40 KA 3000A circuit breaker for constructability flexibility, existing breaker E can be used as a capital spare. Replace existing 69 KV cap bank circuit switcher AA with new circuit breaker. Replace existing 138/69 KV 40 MVA transformer # 1 with new 138/69 KV 40 MVA transformer #1, add H.S. circuit switcher to the new transformer. Replace existing 138KV line MOABs W & Y with new 138 kV circuit breakers. Replace ground MOAB switches on 138/12 KV T2 with circuit switcher. **Estimated Cost: \$6.7M**
- Remote end relaying work at Clinch River, Wolf Hills, Lovedale, Holston, West Kingsport. **Estimated Cost: \$2M**

Total Estimated Transmission Cost: \$46.8M

Project Status: Scoping

Projected In-Service: 7/01/2023



AEP Transmission Zone: Supplemental Washington County, Virginia

Need Number: AEP-2020-AP013, AEP-2020-AP014, AEP-2020-AP015

Process Stage: Solutions Meeting: 10/16/2020

Alternatives Considered:

Construct a new 138 kV line by tapping the Clinch River – Moreland Drive 138 kV circuit; building approximately 5 miles of new 138 kV line to Moccasin Gap. Build a new ~1.5 mile 138 kV line from Moccasin Gap to Gate City. Build a new ~4 mile 138 kV line from Gate City to Clinch River – Moreland Drive 138KV — creating a loop in/out from the Clinch River – Moreland Drive 138 kV circuit. **Estimated Cost: \$31.5M**

Moccasin Gap: Establish 138 kV bus, install two new 138 kV circuit breakers, replace existing 69/12 transformers #1 and #2 with two new 138/12 kV transformers. Install a new 138 kV high side circuit switcher on each transformer. **Estimated Cost: \$7M**

Gate City: Establish 138 kV bus, install two 138 kV circuit breakers, install a new 138/12 kV transformer, install a new 138 kV high side circuit switcher. **Estimated Cost: \$5M**

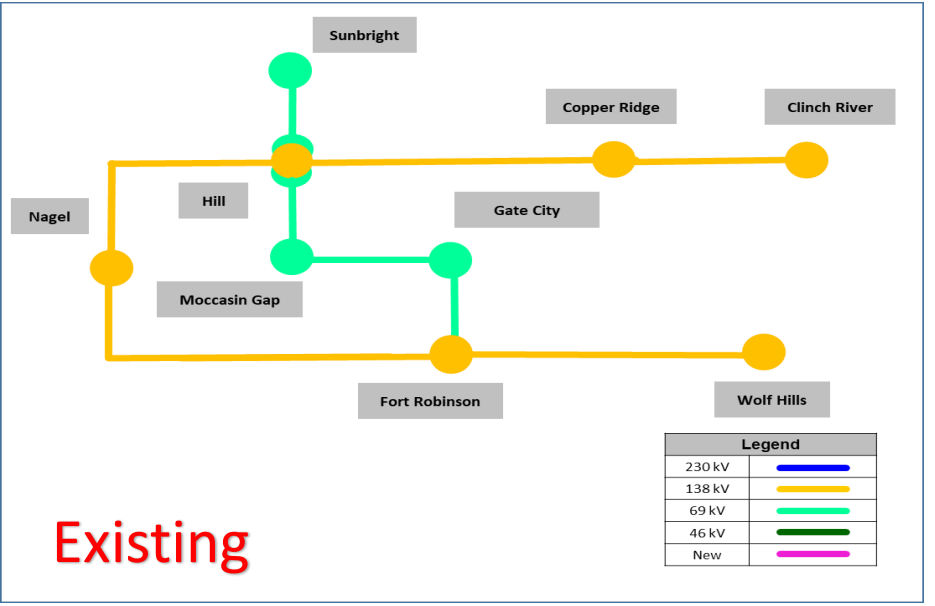
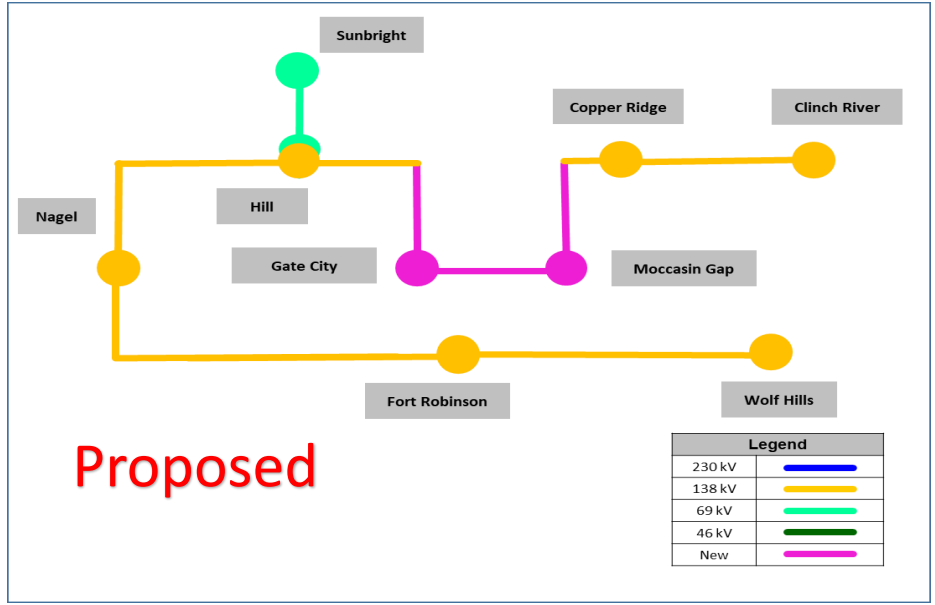
Fort Robinson: Replace existing 34.5 kV circuit breaker D with a new 3000A 40 KA circuit breaker. Replace existing ground MOAB for transformer #1 with H.S. circuit switcher. Replace existing line MOABs Y & W with new circuit breakers, replace existing ground bank at transformer # 1 with new ground bank. **Estimated Cost: \$6.2M**

Hill: Replace existing 69 kV circuit breaker E with new 69KV circuit breaker. Replace existing high side ground switches at transformers #1 and #2. Replace Cap bank circuit switcher AA with new 69 kV circuit switcher. **Estimated Cost: \$5.7M**

Fort Robinson — Hill 69 KV: Retire/Remove Fort Robinson – Hill 69 kV. **Estimated Cost: \$4.2M**

Clinch River – Moreland Drive 138 KV: Retire ~ 1.5 miles. **Estimated Cost: \$0.45M**

Concerns with this alternative: Retiring Fort Robinson — Hill 69 kV line will take a source from Hill 69 kV bus, rendering Sunbright Station’s load vulnerable to planned or unplanned outages at 138/69 kV transformer #1 at Hill station. **Total Estimated Cost: ~60M**



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

10/6/2020 – V1 – Original version posted to pjm.com

10/12/2020 – V2 – Slide #5, Changed Total Estimated Transmission Cost from \$27.8M to \$27.89M

– Slide #9, Changed Need Number from AEP-2020-OH041 to AEP-2020-OH044

10/12/2020 – V3 – Slide #7, Updated slide title

8/22/2021 – V4 – Slide #5, Corrected the conductor type from 795 ACSR to ACSS