



# Sub Regional RTEP Committee PJM West

November 29, 2018

- The following definitions explain the basis for excluding flowgates and/or projects from the competitive planning process and designating projects to the incumbent Transmission Owner.
- Flowgates/projects excluded from competition will include the underlined language on the corresponding slide.
  - Immediate Need Exclusion: Due to the immediate need of the violation (3 years or less), the timing required for an RTEP proposal window is infeasible. As a result, the local Transmission Owner will be the Designated Entity - Operating Agreement, Schedule 6 § 1.5.8(m)
  - Below 200 kV: Due to the lower voltage level of the identified violation(s), the driver(s) for this project are excluded from the competitive proposal window process. As a result, the local Transmission Owner will be the Designated Entity - Operating Agreement, Schedule 6 § 1.5.8(n)
  - FERC 715 (TO Criteria): Due to the violation need of this project resulting solely from FERC 715 TO Reliability Criteria, the driver(s) for this project are excluded from the competitive proposal window process. As a result, the local Transmission Owner will be the Designated Entity - Operating Agreement, Schedule 6 § 1.5.8(o)
  - Substation Equipment: Due to identification of the limiting element(s) as substation equipment, the driver(s) for this project are excluded from the competitive proposal window process. As a result, the local Transmission Owner will be the Designated Entity - Operating Agreement, Schedule 6 § 1.5.8(p)

# Immediate Need



# AEP Transmission Zone: Baseline Enterprise Park Economic and Area Improvements

## AEP TO Criteria Violation (Immediate Need)

### Problem Statement:

### Planning Criteria Violations:

In 2023 RTEP winter case:

For the loss of the Cedar Creek – Fords Branch 46 kV line section or Cedar Creek 138/69/46 kV transformer:

-Voltage Magnitude issues are experienced at Fords Branch(.87pu) station.

For the loss of the Cedar Creek 138/69/46 kV transformer and Beaver Creek – Elwood 46 kV circuit:

-The Dorton 138/46 kV transformer will load to 103% of its winter emergency rating (65 MVA, capabilities study pending)

-The Breaks 69/46 kV transformer will load to 104% of its winter emergency rating (50 MVA, capabilities study pending)

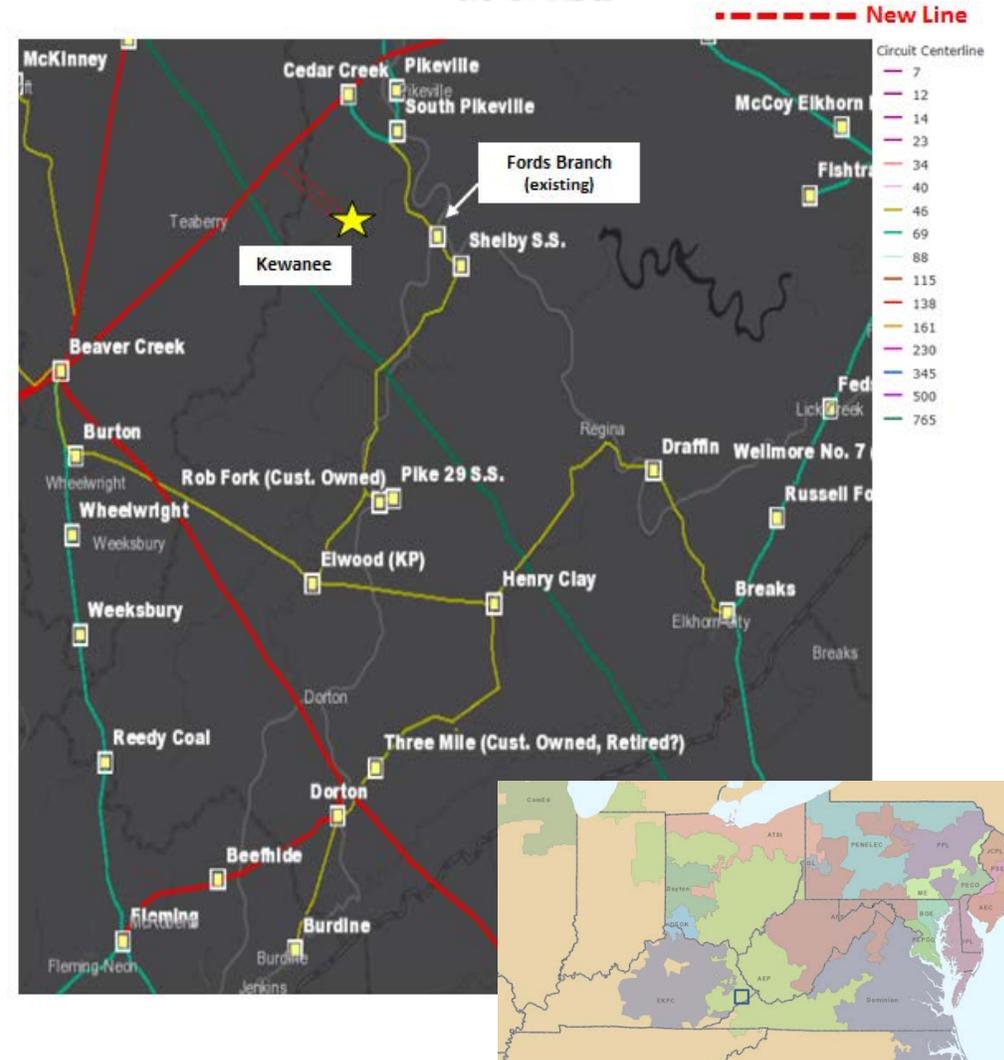
-The Henry Clay – Elwood 46 kV line section (~5.8 mi.) loads to 125% of its conductor's winter emergency rating (63 MVA).

-The Pike 29 S.S – Elwood 46 kV line section (~2.8 mi.) loads to 95% of its conductor's winter emergency rating (61 MVA).

-Voltage Magnitude issues are experienced at Fords Branch(.57pu),Pike29 (.66pu), Henry Clay (.80pu), Draffin (.89pu), Burdine (.91pu), and Elwood (.71pu) stations.

-Voltage Deviation issues are experienced at Fords Branch(33%), Pike29 (29%), Elwood (27%), Henry Clay (19%), Burdine (11%), and Draffin(12%) stations.

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## Planning Criteria Violations:

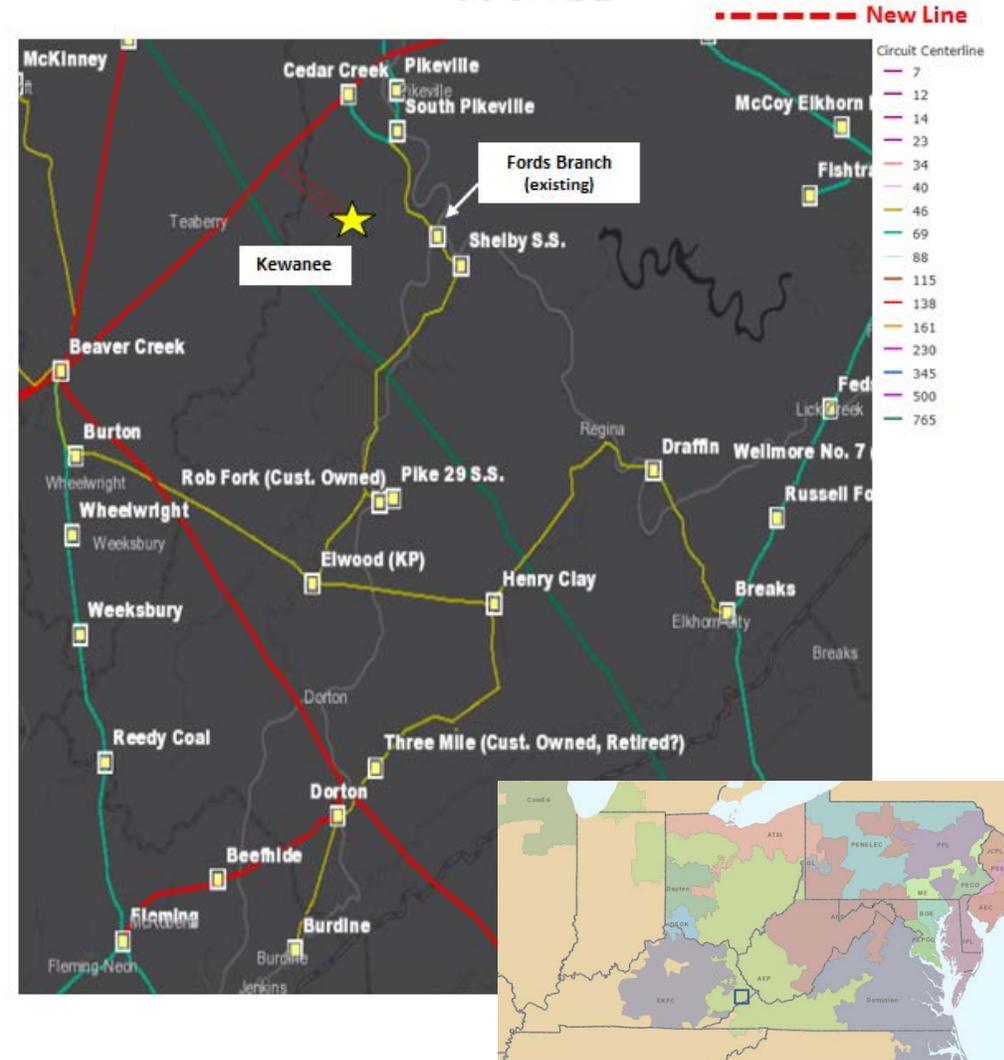
For the loss of the Cedar Creek 138/69/46 kV transformer and Dorton – 138/46 kV transformer:

- The Burton – Elwood 46 kV line section (~8.3 mi.) loads to 98 % of its winter emergency rating (55 MVA).
- Voltage Magnitude issues are experienced at Fords Branch(.80pu),Pike29 (.86pu), Henry Clay (.90pu), Burdine (.89pu), and Elwood (.89pu) stations.
- Voltage Deviation issues are experienced at Fords Branch(9%), Pike29 (8%), Elwood (8%), Henry Clay (9%), and Burdine (12%) stations.

For the loss of the Cedar Creek 138/69/46 kV transformer and Dorton – Elwood – Breaks 46 kV circuit:

- The Burton – Elwood 46 kV line section (~8.3 mi.) loads to 113 % of its conductor's winter emergency rating (63 MVA).
- The Burton – Beaver Creek 46 kV line section (~2.2 mi.) loads to 119 % of its conductor's winter emergency rating (63 MVA).
- The Beaver Creek 138/69/46 kV transformer #1 will load to 103% of its winter emergency rating (58 MVA) .
- Voltage Magnitude issues are experienced at Fords Branch(.67pu),Pike29 (.75pu), and Elwood (.79pu) stations.
- Voltage Deviation issues are experienced at Fords Branch(25%), Pike29 (21%), Elwood (19%), and Burton (9%) stations.

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**Customer Service:**

Kentucky Power Distribution has requested an additional 40 MW of capacity to serve distribution customers at the Kentucky Enterprise Industrial Park, Projected IS date: 12/1/2019

**Planning Criteria Violations with the additional 40MW load:**

Base Case voltage violation (.89pu) at Fords Branch

For the loss of the Cedar Creek – Fords Branch 46 kV line section or Cedar Creek 138/69/46 kV transformer:

- The Elwood 46 kV network becomes non convergent due to a voltage collapse.

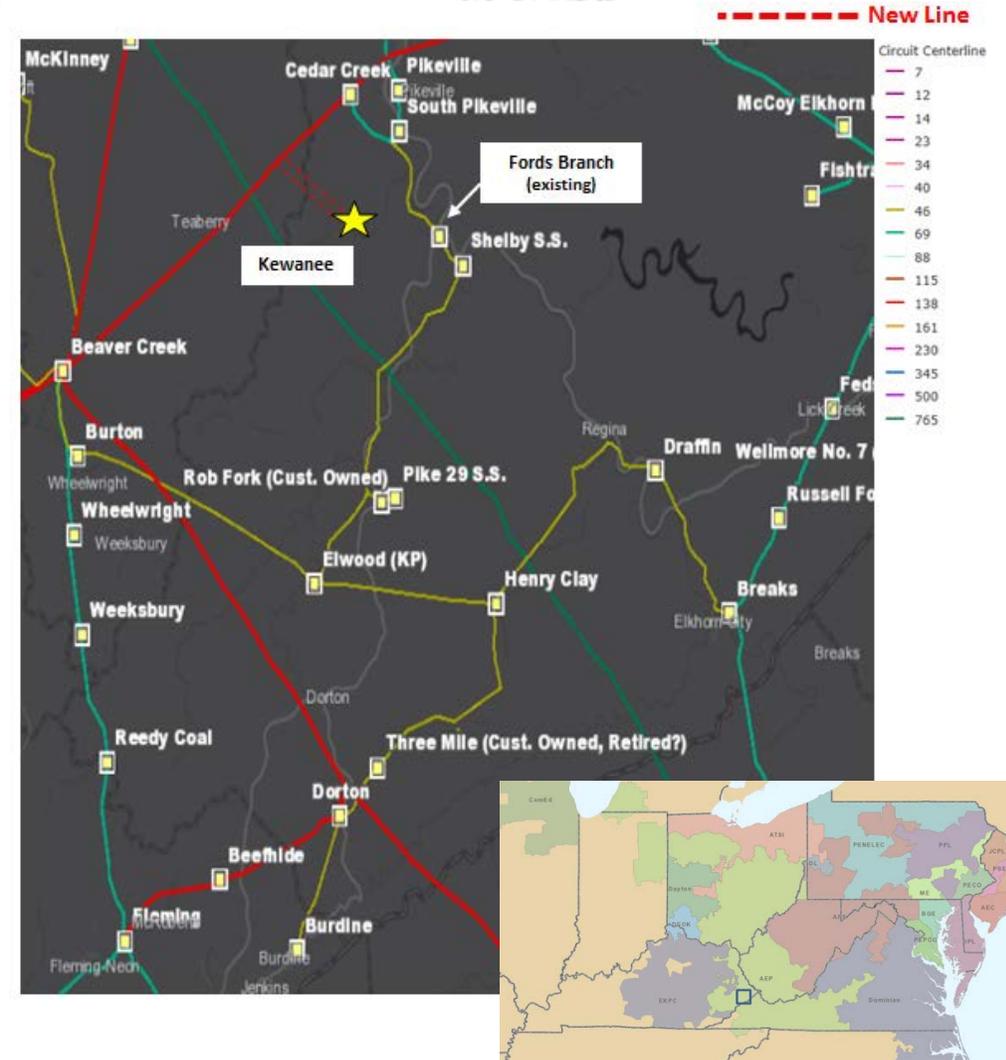
For the loss of the Henry Clay – Elwood 46 kV line section:

- A portion of the Cedar Creek - Fords Branch 46 kV line section (~3 mi.) will load to 103% of its conductor's winter emergency rating (61 MVA)
- Voltage Magnitude issues are experienced at Fords Branch(.87pu),Pike29 (.90pu), and Elwood (.91pu) stations.

A bus outage at Elwood Station results in:

- The Cedar Creek - Fords Branch 46 kV line section (~4.9 mi.) will load to 139% of its largest conductor's winter emergency rating (84 MVA).
- The Cedar Creek 138/69/46 kV transformer will load to 146% of its 46 windings winter emergency rating (80 MVA)
- Voltage Magnitude issues are experienced at Fords Branch(.66pu) and Pike29 (.63pu) stations.
- Voltage Magnitude issues are experienced at Fords Branch(.30%) and Pike29 (37%) stations.

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### Planning Criteria Violations with the additional 40MW load:

For the loss of the Beaver Creek – Burton 46 kV line section:

- A portion of the Cedar Creek - Fords Branch 46 kV line section (~3 mi.) will load to 109% of its conductor's winter emergency rating (61 MVA)
- Voltage Magnitude issues are experienced at Fords Branch(.88pu) and Pike29 (.91pu) stations.

For the loss of the Beaver Creek – Elwood 46 kV line circuit:

- A portion of the Cedar Creek - Fords Branch 46 kV line section (~3 mi.) will load to 105% of its conductor's winter emergency rating (61 MVA)
- Voltage Magnitude issues are experienced at Fords Branch(.89pu) station

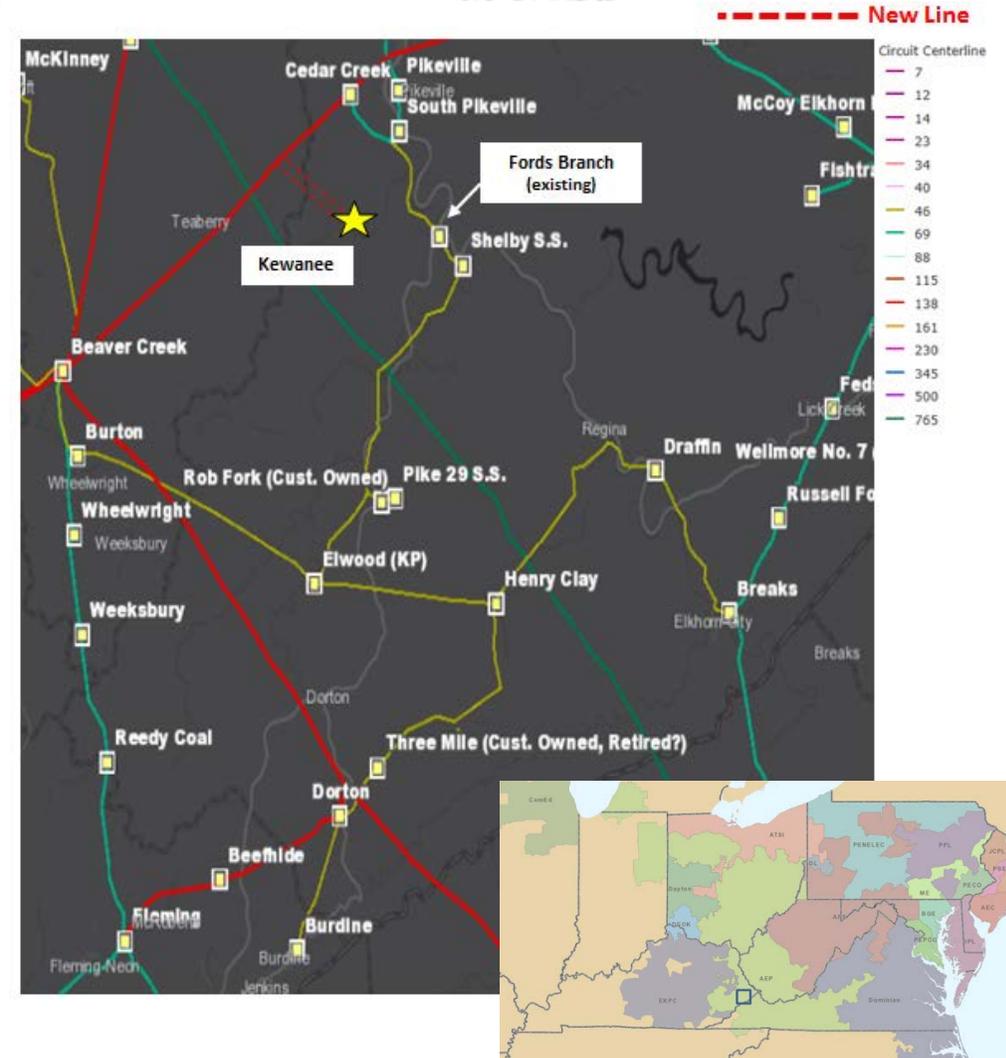
For the loss of the Dorton 138/46 kV transformer:

- A portion of the Cedar Creek - Fords Branch 46 kV line section (~3 mi.) will load to 100% of its conductor's winter emergency rating (61 MVA)
- Voltage Magnitude issues are experienced at Fords Branch(.88pu) and Pike29 (.91pu) stations.

For the loss of the Breaks 69/46 kV transformer:

- Voltage Magnitude issues are experienced at Fords Branch(.89pu) station.

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## Planning Criteria Violations with the additional 40MW load:

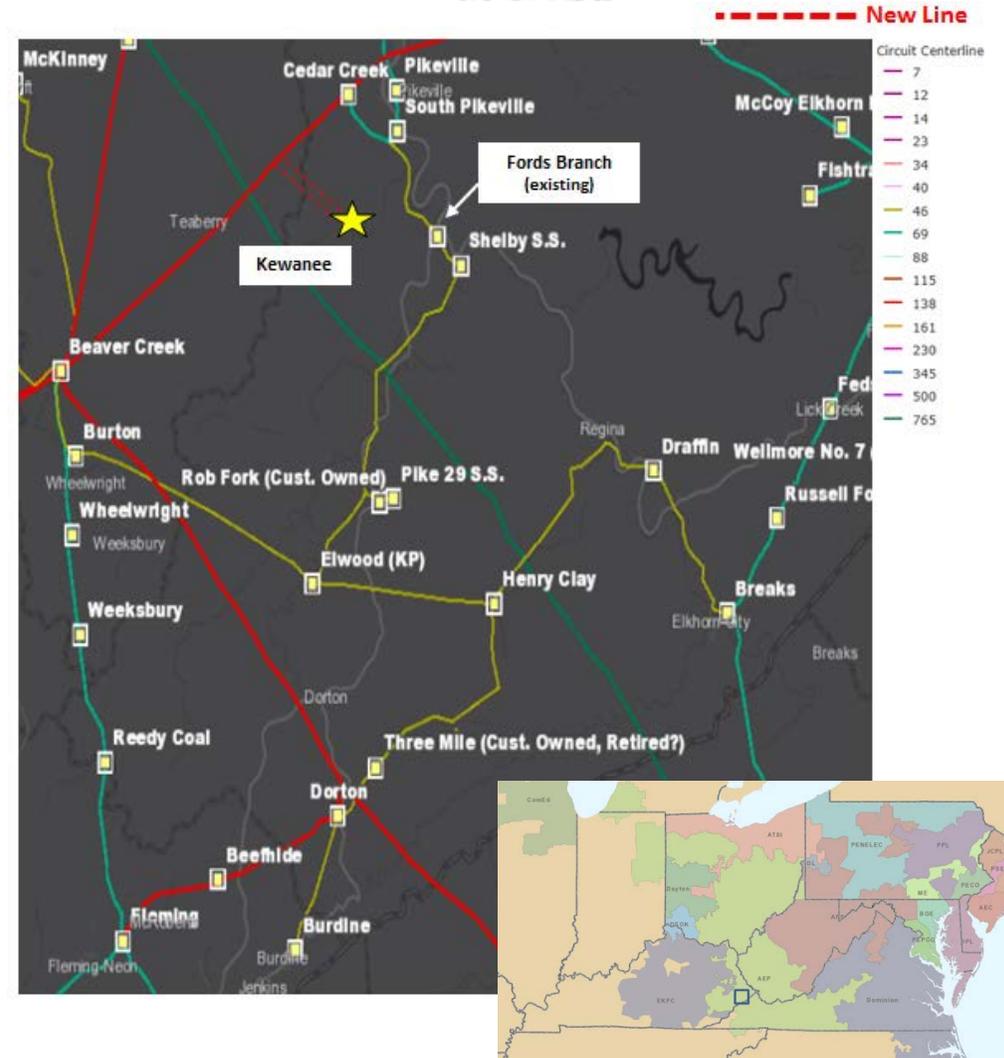
For loss of the Beaver Creek – Elwood 46 kV circuit and Dorton 138/46 kV transformer:

- The Cedar Creek - Fords Branch 46 kV line section (~4.9 mi.) will load to 115% of its largest conductor's winter emergency rating (84 MVA).
- The Cedar Creek 138/69/46 kV transformer will load to 121% of the transformer's 46 kV windings winter emergency rating (80 MVA).
- The Breaks 69/46 kV transformer will load to 134% of the transformers winter emergency rating (50 MVA).
- The Breaks – Draffin 46 kV line section (~4.5 mi.) will load to 102% of its conductor's winter emergency rating (63 MVA).
- The Draffin – Henry Clay 46 kV line section (~7.33 mi.) will load to 105% (92% of its conductor's winter emergency rating (63 MVA)) (55 MVA).
- Voltage magnitude issues are experienced at Fords Branch(.77pu), Pike29 (.77pu), Elwood (.78pu), Henry Clay (.80pu), Draffin (.88pu), and Burdine (.78pu) stations.
- Voltage Deviation issues are experienced at Fords Branch (15%), Pike29 (17%), Elwood (18%), Henry Clay (20%), Draffin (14%), and Burdine (25%) stations.

For loss of the Beaver Creek – Elwood 46 kV circuit and Breaks 69/46 kV transformer:

- A portion of the Cedar Creek - Fords Branch 46 kV line section (~3 mi.) will load to 141% of its conductor's winter emergency rating (61MVA) and 102% of the line's largest conductor winter emergency rating (84 MVA).
- The Cedar Creek 138/69/46 kV transformer will load to 107% of the transformer's 46 kV windings winter emergency rating (80 MVA).
- A portion of the Dorton – Henry Clay 46 kV circuit (~6 mi.) will load to 98% of its conductor's winter emergency rating (63 MVA).
- The Dorton 138/46 kV transformer will load to 110% of its winter emergency rating (65 MVA, capabilities study pending).
- Voltage magnitude issues are experienced at Fords Branch(.79pu), Pike29 (.80pu), Elwood (.82pu), Henry Clay (.84pu), and Draffin (.83pu) stations.
- Voltage Deviation issues are experienced at Fords Branch (8%), Pike29 (11%), Elwood (11%), Henry Clay (11%),and Draffin (15%) stations.

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## Planning Criteria Violations with the additional 40MW load:

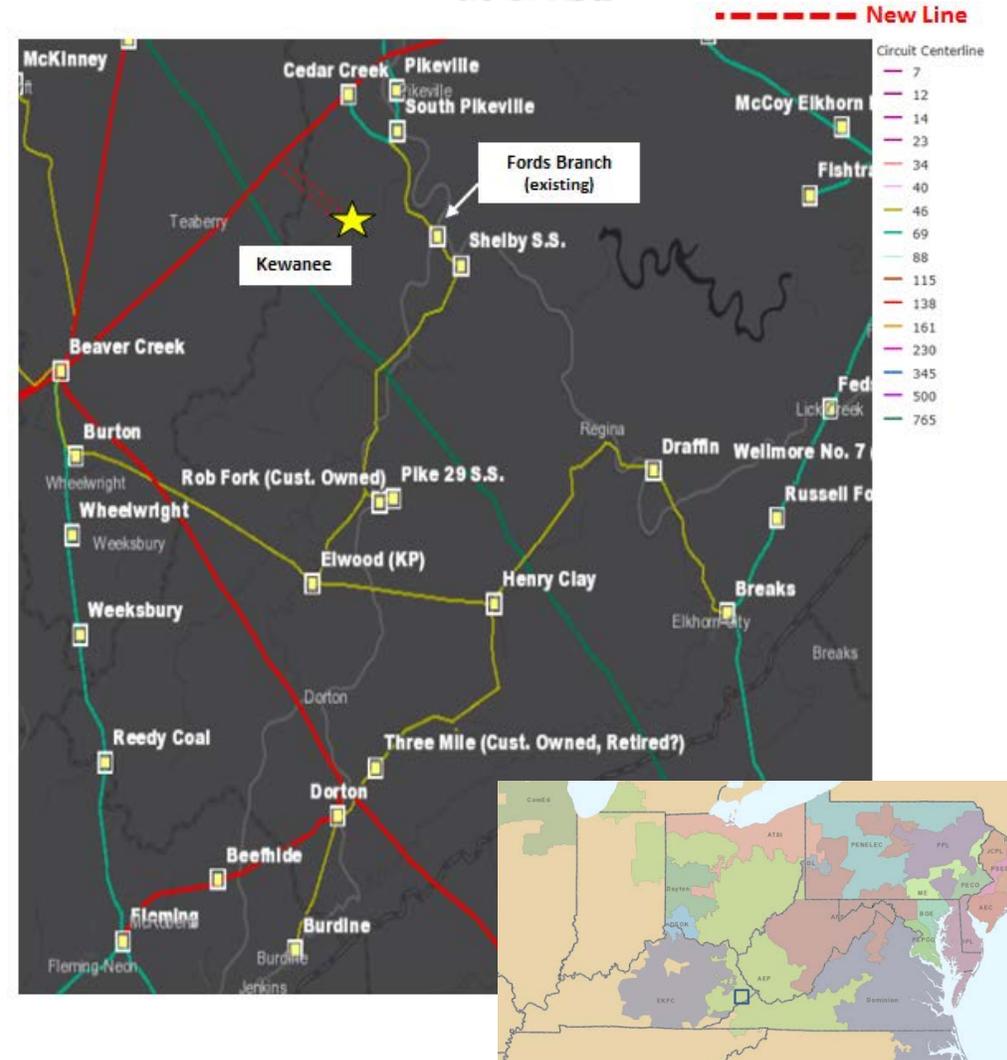
For loss of the Dorton 138/46 kV and Breaks 69/46 kV transformers:

- The Cedar Creek - Fords Branch 46 kV line section (~4.9 mi.) will load to 100% of its largest conductor's winter emergency rating (84 MVA).
- The Cedar Creek 138/69/46 kV transformer will load to 105% of the transformer's 46 kV windings winter emergency rating (80 MVA).
- The Beaver Creek – Burton 46 kV line section (~2.2 mi.) will load to 125% of its conductor's winter emergency rating (63 MVA).
- The Burton – Elwood 46 kV line section (~8.25 mi.) will load to 120% of its conductor's winter emergency rating (63 MVA).
- The Beaver Creek 138/69/46 kV transformer #1 will load to 105% of its winter emergency rating (58 MVA) .
- Voltage magnitude issues are experienced at Fords Branch(.79pu), Pike29 (.80pu), Elwood (.81pu), Henry Clay (.77pu), Draffin (.76pu), and Burdine (.75pu) stations.
- Voltage Deviation issues are experienced at Fords Branch (13%), Pike29 (16%), Elwood (17%), Henry Clay (22%), Burdine (23%), Burton (9%), and Draffin (27%) stations.

For loss of the Beaver 138/69/46 kV transformer #2 and Dorton 138/46 kV transformer:

- The Beaver Creek 138/69/46 kV transformer #1 will load to 104% of its winter emergency rating (58 MVA) .
- A portion of the Cedar Creek - Fords Branch 46 kV line section (~3 mi.) will load to 104% of its conductor's winter emergency rating (61MVA)
- Voltage magnitude issues are experienced at Fords Branch(.87pu), Pike29 (.90pu), and Burdine (.91pu) stations.
- Voltage Deviation issues are experienced at Burdine (9%) station.

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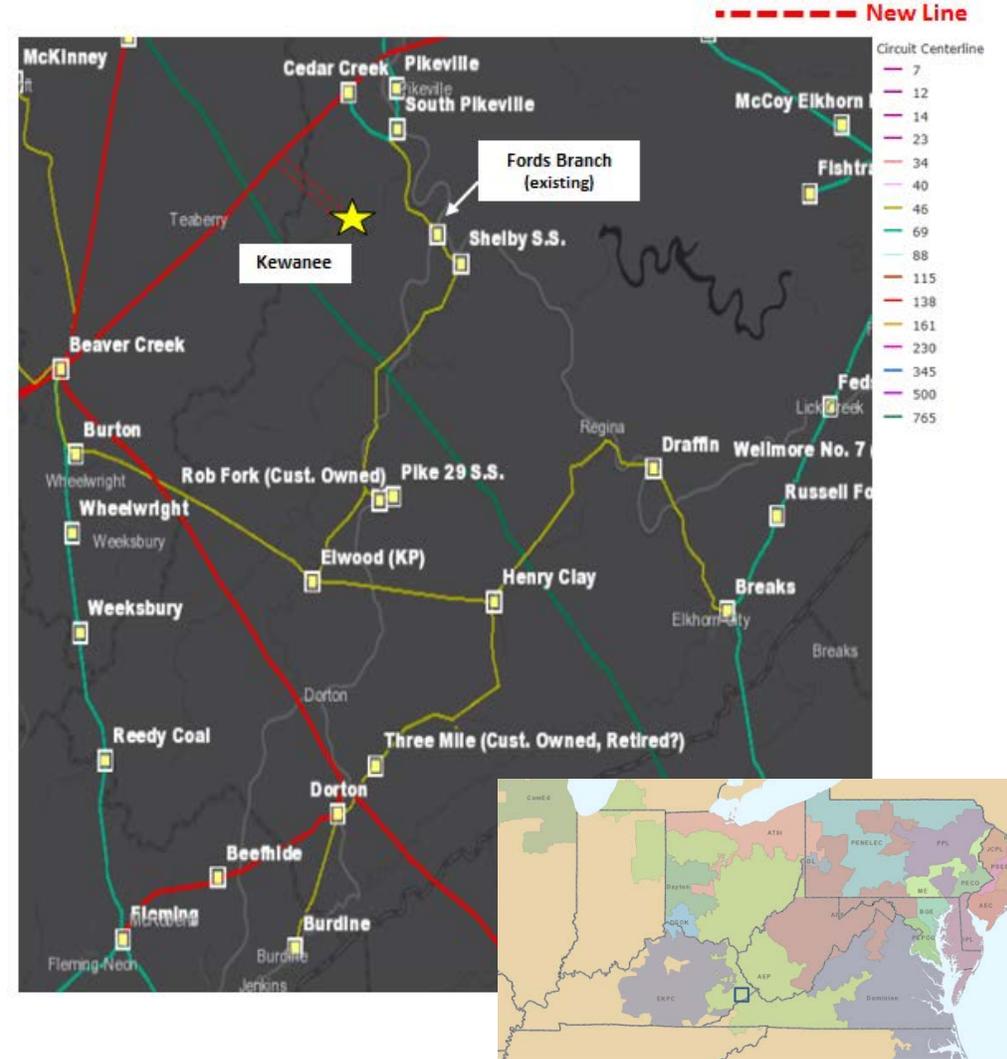
**Equipment Material/Condition/Performance/Risk:**

The 46/34.5 kV transformer (vintage 1992) at Fords Branch Station is showing signs of dielectric breakdown (insulation), accessory damage (bushings/windings) and short circuit breakdown (due to amount of through faults). The wood pole Phase over Phase switch that currently serves Fords is inoperable and in need of replacement. The 34.5 kV circuit breakers "A" & "B" at Fords Branch are ESV type breakers manufactured in 1992, which are an oil type breaker that are being replaced across the AEP footprint due to their history of violent failures. In addition, breakers "A" & "B" have experienced 262 and 333 fault operations, exceeding the manufacture recommendation of 10.

**Operational Flexibility and Efficiency**

The 46/34.5 kV transformer at Fords Branch Station utilizes a ground switch MOAB scheme as part of the high side transformer protection. The proposed 138/12 kV transformer at Kewanee station will allow for load to be transferred away from the existing Betsy Layne – Cedar Creek 69 kV circuit which has historical seen flows close to its 91 MVA conductor winter emergency rating.

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### Selected Solution

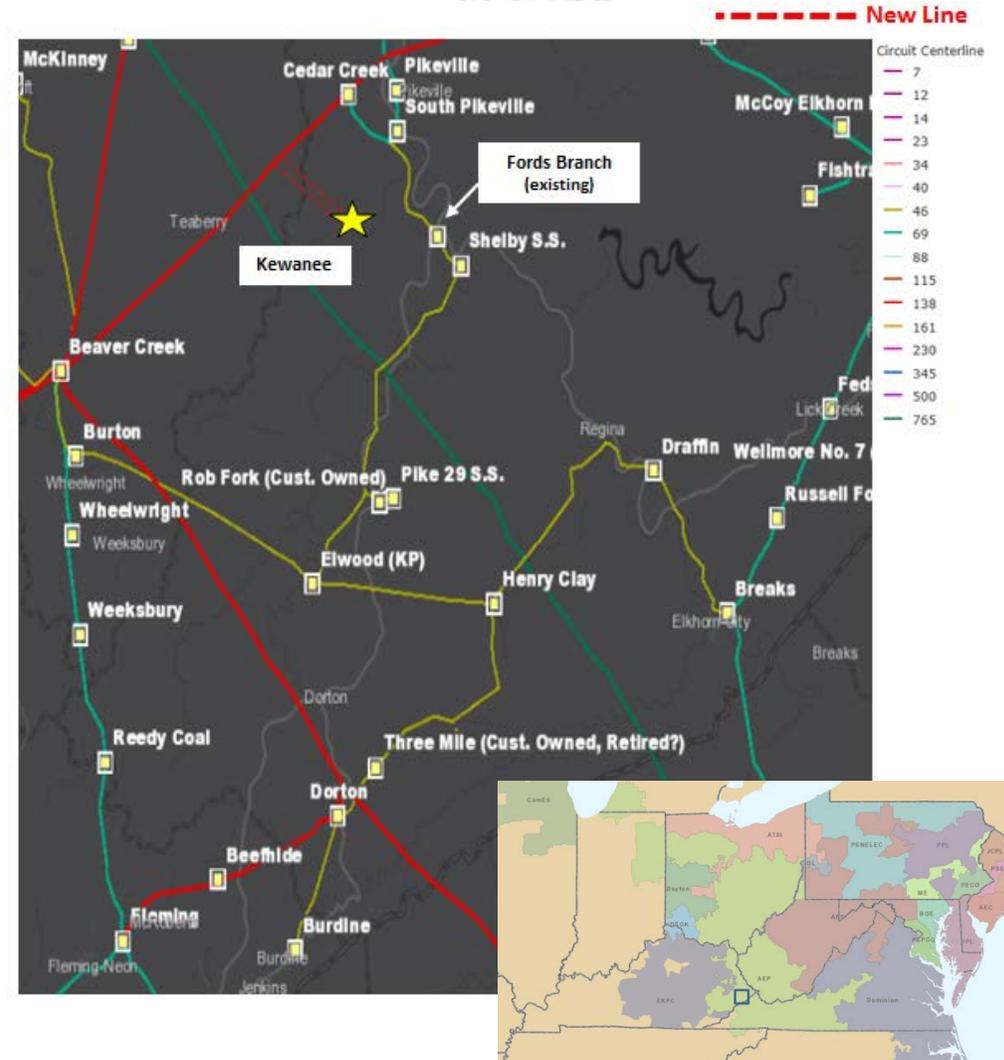
Construct a new greenfield station to the west (~1.5 mi.) of the existing Fords Branch Station in the new Kentucky Enterprise Industrial Park. This station will consist of six 3000A 40kA 138 kV breakers laid out in a ring arrangement, two 30 MVA 138/34.5 kV transformers, and two 30 MVA 138/12 kV transformers. The existing Fords Branch Station will be retired. (B3087.1) Estimated Cost: \$ 3.4 M

Construct approximately 5 miles of new double circuit 138 kV line in order to loop the new Kewanee station into the existing Beaver Creek – Cedar Creek 138 kV circuit. (B3087.2) Estimated Cost: \$ 19.9 M

Remote end work will be required at Cedar Creek Station. (B3087.3) Estimated Cost: \$ 0.5 M

**Total Estimated Transmission Cost: \$23.8M**

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## Alternate #1

Rebuild the overloaded 46 kV circuit sections (~45 miles). Replace the overloaded Beaver Creek 138/69/46 kV and Breaks 69/46 kV transformers. While this may resolve the identified thermal overloads. This alternative may not solve the identified voltage violations. This alternative would also not address the additional system needs specified in the Project Justification.

**This alternative was deemed to not be cost effective.**

## Alternate #2

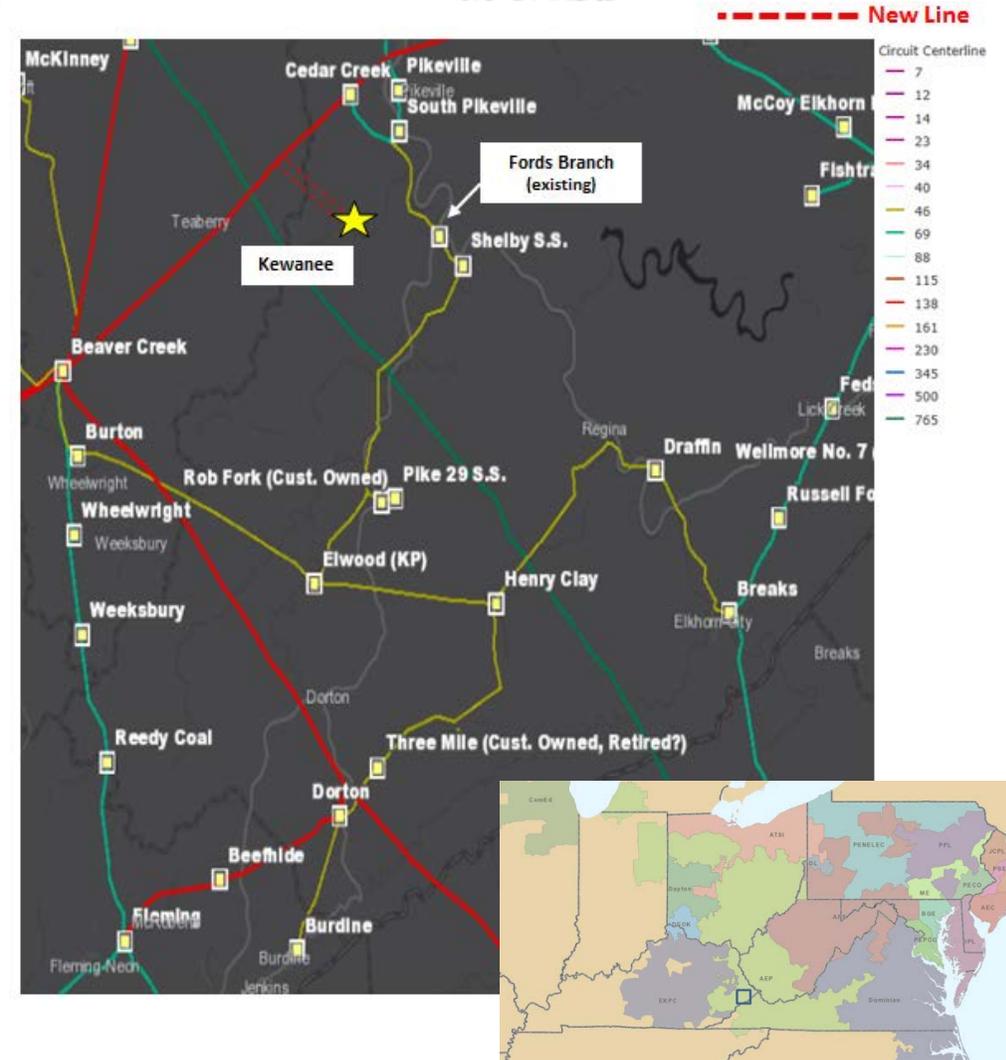
Install two additional transformers at Cedar Creek station. This would require an expansion at Cedar Creek station. Construct approximately 5 miles of new double circuit 46 kV line from Cedar Creek to Fords Branch Stations. This would require a significant expansion of Fords Branch station which is not feasible due to the land locked nature of that station being surrounded by residences, mountains, and the flood plain. Because of this, Fords Branch would need to be relocated and constructed as a greenfield station, likely at the Enterprise Industrial Park due to lack of suitable sites nearby. The relocation would require an additional 2 miles of double circuit and single circuit 46 kV line to be constructed to connect the station to the existing 46 kV circuits that currently terminate at Fords Branch. 46 kV circuit breakers would be required at the new Fords Branch station.

Estimated Cost: ~\$35M

Required In-service: 12/1/2019

Projected In-service: 11/30/2019

Project Status: Scoping



# Baseline Reliability Projects

## AEP TO Criteria Violation

### Problem Statement:

#### Planning Criteria Violations:

In the 2022 RTEP Winter Case, thermal violation on the Lakine – Racine 69 kV circuit (146% of 56 MVA emergency rating) under N-1-1 conditions including the loss of the Gavin – Meigs 69 kV circuit plus the loss of the future Leon – Ripley 138 kV circuit (previously Leon – Ravenswood 69 kV circuit).

### Potential Solution:

Rebuild Lakine – Racine Tap 69 kV line section (9.2 miles) to 69 kV standards, utilizing 795 26/7 ACSR conductor (W.N. 162 MVA, W.E. 202 MVA). **Estimated Cost: \$23.9M**

### Alternatives:

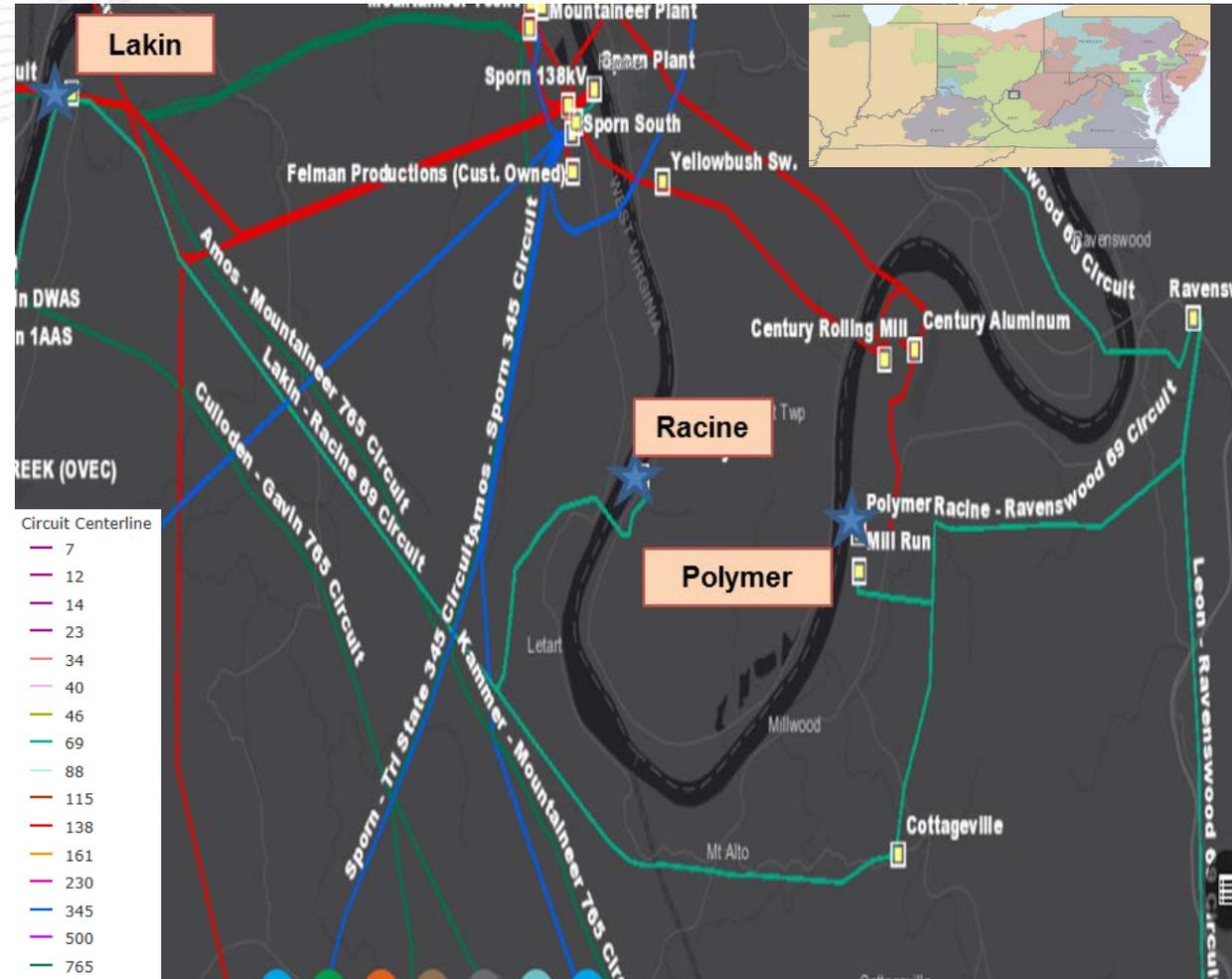
Retire the Lakine – Racine 69kV circuit (~13.27 miles). Replace the two 138kV MOABS at Polymer with two 138kV circuit breakers. Establish a 69kV bus at Polymer. Install a 90MVA 138/69kV transformer with a high side circuit switcher at Polymer. Install a 69kV breaker at Polymer. Build approximately 4.5 miles from Polymer 69kV to Racine 69kV utilizing 795 26/7 ACSR conductor. Build approximately 2 miles of 69kV line utilizing 795 26/7 ACSR conductor from Polymer to connect to the Ravenswood – Racine 69kV circuit. This solution was not pursued due to the increased cost.

**Conceptual Cost Estimate: \$31.5M**

**Required In-service:** 12/1/2022

**Projected In-service:** 6/1/2022

**Project Status:** Scoping



Previously Presented : 10/26/2018 Western SRTEAC

**Problem Statement:**

FERC 715 (TO Criteria)

Sub-transmission facilities in the Findlay and North Baltimore areas have been identified in the 2022 RTEP model.

N-1 Thermal:

**Monitored Facility, Contingency, 2022RTEP % Loading, Evaluated MVA Rating**

New Liberty – West Melrose 34kV Circuit, North Findlay CB B, 127%, 27 MVA

N-1 Voltage Magnitude:

**Monitored Bus, Contingency, 2022RTEP pu Voltage**

Cygnets-Buckeye 34.5kV, North Findlay CB B, 0.89pu

Hamman Sw 34.5kV, North Findlay CB B, 0.89pu

Mungen 34.5kV, North Findlay CB B, 0.88pu

Portage 34.5kV, North Findlay CB B, 0.88pu

N-1 Voltage Deviation:

**Monitored Bus, Contingency, 2022RTEP % Worst Deviation**

BP Pumping 34.5kV, North Findlay CB B, 10.8%

Cory 34.5kV, Multiple Contingencies, 12.3%

DTR 34.5kV, Multiple Contingencies, 12.5%

East Mt Cory 34.5kV, Multiple Contingencies, 11.2%

McIntosh 34.5kV, Multiple Contingencies, 12.3%

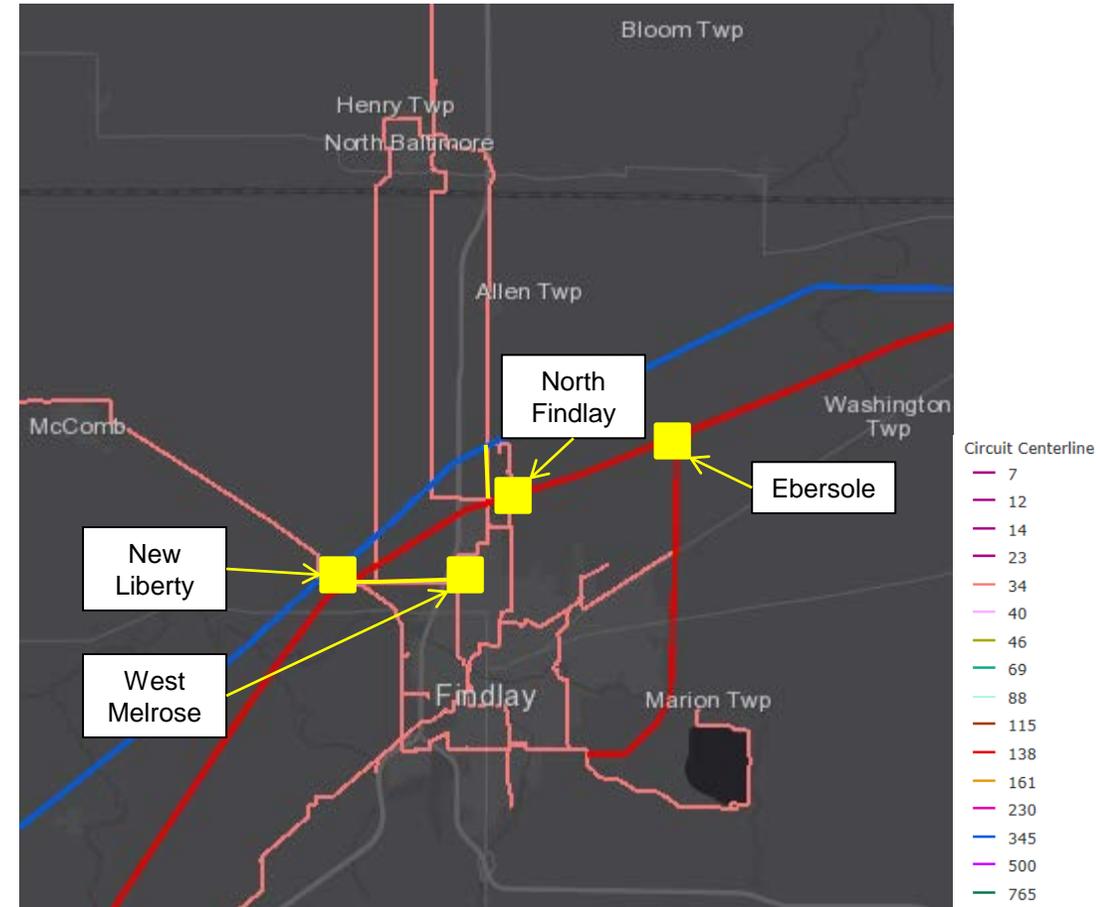
North Woodcock 34.5kV, Multiple Contingencies, 9.7%

Rawson 34.5kV, Multiple Contingencies, 10.8%

South Mt Cory Sw 34.5kV, Multiple Contingencies, 12.3%

West Melrose 34.5kV, North Findlay CB B, 14.2%

Woodcock Sw 34.5kV, Multiple Contingencies, 12.4%



**N-1-1 Thermal:**

**Monitored Facility, Contingency, 2022RTEP % Loading, Evaluated MVA Rating**

New Liberty – West Melrose 34.5kV Circuit, Ebersole – North Findlay 138kV and (North Woodcock T1 or East Lima – North Findlay 138kV circuit), 131%, 27 MVA

Centrex – Findlay 34.5kV Circuit, New Liberty T1 and Findlay Center – South Findlay 34.5kV, 103%, 27 MVA

Centrex – Findlay Refinery 34.5kV Circuit, New Liberty T1 and Findlay Center – South Findlay 34.5kV, 103%, 27 MVA

**N-1-1 Voltage Magnitude:**

**Monitored Bus, Contingency, 2022RTEP pu Voltage**

BP Pumping 34.5kV, East Lima – North Findlay 138kV and (New Liberty T1 or T2), 0.90pu

Cory 34.5kV, East Lima – North Findlay 138kV and (New Liberty T1 or T2), 0.89pu

Cygnets-Buckeye 34.5kV, Multiple Contingencies, 0.88pu

DTR 34.5kV, East Lima – North Findlay 138kV and (New Liberty T1 or T2), 0.89pu

East Mt Cory 34.5kV, East Lima – North Findlay 138kV and (New Liberty T1 or T2), 0.89pu

Hamman Sw 34.5kV, Multiple Contingencies, 0.88pu

Henry 34.5kV, Multiple Contingencies, 0.89pu

McIntosh 34.5kV, East Lima – North Findlay 138kV and (New Liberty T1 or T2), 0.89pu

Mungen 34.5kV, Multiple Contingencies, 0.87pu

Portage 34.5kV, Multiple Contingencies, 0.87pu

Rawson 34.5kV, East Lima – North Findlay 138kV and (New Liberty T1 or T2), 0.90pu

South Mt Cory Sw 34.5kV, East Lima – North Findlay 138kV and (New Liberty T1 or T2), 0.89pu

Woodcock Sw 34.5kV, East Lima – North Findlay 138kV and (New Liberty T1 or T2), 0.89pu

Landmark 34.5kV, Findlay Center – Plaza St 34.5kV and Ebersole T1, 0.88pu

Ebersole 34.5kV, Findlay Center – Plaza St 34.5kV and Ebersole T1, 0.88pu

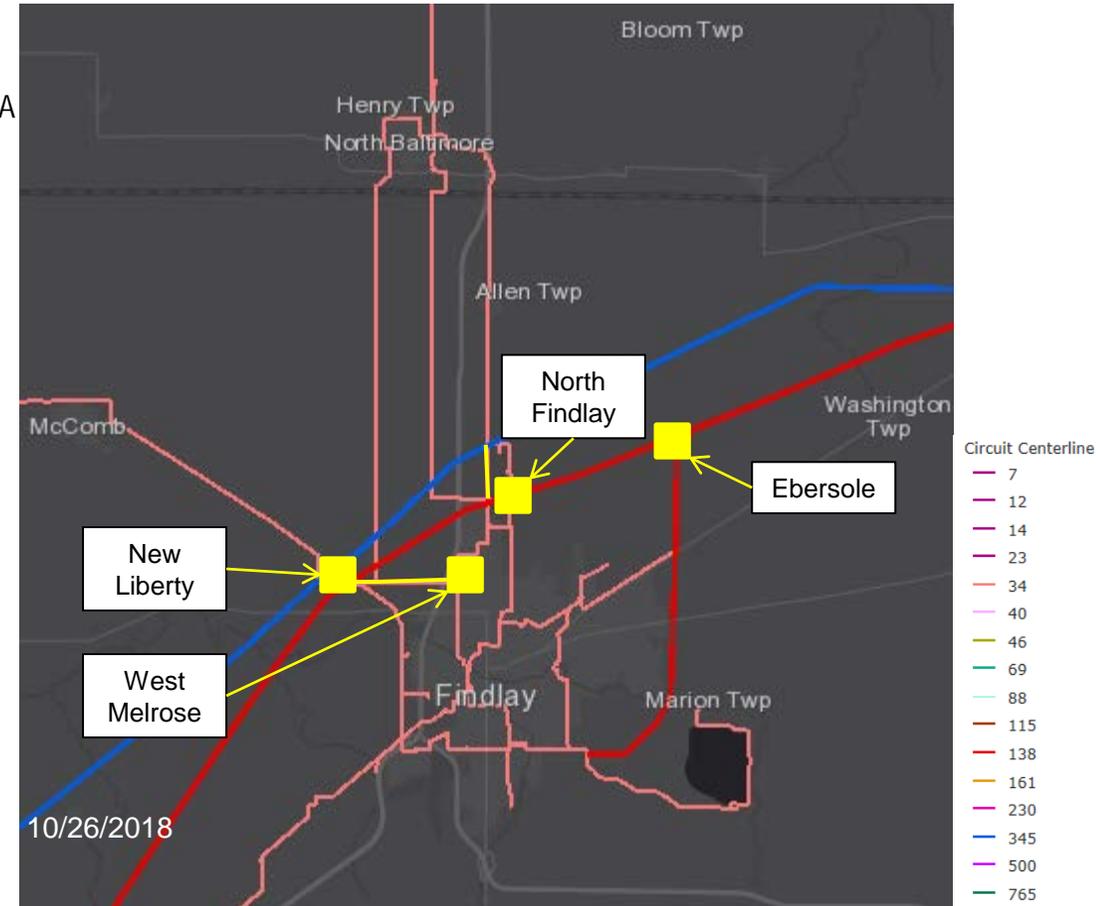
Crestwood 34.5kV, Findlay Center – Plaza St 34.5kV and Ebersole T1, 0.88pu

North Crestwood Sw 34.5kV, Findlay Center – Plaza St 34.5kV and Ebersole T1, 0.88pu

Plaza St 34.5kV, Findlay Center – Plaza St 34.5kV and Ebersole T1, 0.88pu

Harris 34.5kV, Findlay Center – Plaza St 34.5kV and Ebersole T1, 0.88pu

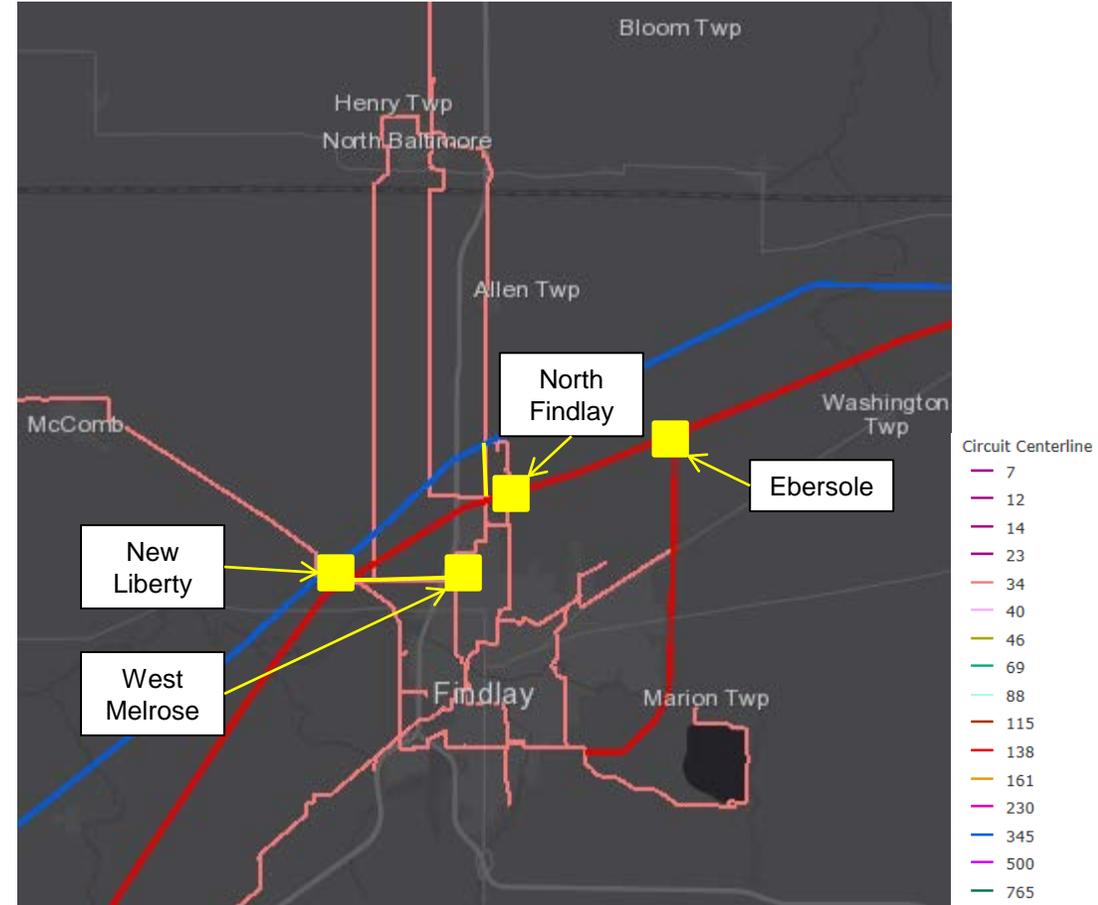
Bernard Sw 34.5kV, Findlay Center – Plaza St 34.5kV and Ebersole T1, 0.89pu



N-1-1 Voltage Deviation:

**Monitored Bus, Contingency, 2022RTEP % Worst Deviation**

- Ash Ave, Findlay – Findlay Center 34kV and (East Lima – North Findlay 138kV or North Woodcock T1), 10.6%
- BP Pumping 34.5kV, Multiple Contingencies, 11.5%
- Cory 34.5kV, Multiple Contingencies, 13%
- Cygnets-Buckeye 34.5kV, Multiple Contingencies, 14%
- East Mt Cory 34.5kV, Multiple Contingencies, 11.9%
- Hamman Sw 34.5kV, Multiple Contingencies, 14.2%
- Henry 34.5kV, Multiple Contingencies, 14%
- McIntosh 34.5kV, Multiple Contingencies, 14%
- Midland Switch 34.5kV, Combinations involving loss of both North Findlay T1 and T2, 12.8%
- Mungen 34.5kV, Multiple Contingencies, 14.4%
- Portage 34.5kV, Multiple Contingencies, 14.4%
- Rawson 34.5kV, Multiple Contingencies, 11.5%
- South Mt Cory Sw 34.5kV, Multiple Contingencies, 13%
- West Melrose 34.5kV, Multiple Contingencies, 11.3%
- West Findlay, New Liberty T1/T2 and (East Lima – North Findlay 138kV or North Woodcock T1), 8.7%
- Woodcock Sw 34.5kV, Multiple Contingencies, 13.1%
- Landmark 34.5kV, Findlay Center – Plaza St 34.5kV and Ebersole T1, 11.1%
- Ebersole 34.5kV, Findlay Center – Plaza St 34.5kV and Ebersole T1, 12.6%
- Crestwood 34.5kV, Findlay Center – Plaza St 34.5kV and Ebersole T1, 10.1%
- North Crestwood Sw 34.5kV, Findlay Center – Plaza St 34.5kV and Ebersole T1, 10.1%
- Plaza St 34.5kV, Findlay Center – Plaza St 34.5kV and Ebersole T1, 10%
- Harris 34.5kV, Findlay Center – Plaza St 34.5kV and Ebersole T1, 10%
- Bernard Sw 34.5kV, Findlay Center – Plaza St 34.5kV and Ebersole T1, 9.6%



In addition to being identified for planning criteria thermal violations the following two line assets have the following age/condition characteristics.

- New Liberty – Findlay 34.5kV: The 1.5 miles section of line identified is 4/0 Copper conductor (circa 1937) and wood structures (ranging from 1940's – 1980's). The line section currently has 0 open A conditions.
- New Liberty – North Baltimore 34.5kV: The 0.5 miles of rebuild identified is 336 ACSR conductor (circa 1940) with wood structures (circa 1950's). The line section has 1 open A condition (structure).
- West Melrose – Whirlpool 34.5kV: The 1 mile section of line identified is 4/0 ACSR conductor (circa 1926) and wood structures (ranging from 1920's – 1980's). The line section currently has 8 open A conditions (structure and conductor).

### Recommended Solution:

Rebuild New Liberty – Findlay 34kV Line Str's 1 – 37 (1.5 miles), utilizing 795 26/7 ACSR conductor (S.N. 64 MVA, S.E. 90 MVA). (B3086.1) Estimated Trans Cost: \$3.4M

Rebuild New Liberty – North Baltimore 34kV Line Str's 1-11 (0.5 miles), utilizing 795 26/7 ACSR conductor (S.N. 64 MVA, S.E. 90 MVA). (B3086.2) Estimated Trans Cost: \$1.8M

Rebuild West Melrose – Whirlpool 34kV Line Str's 55- 80 (1 mile), utilizing 795 26/7 ACSR conductor (S.N. 64 MVA, S.E. 90 MVA). (B3086.3) Estimated Trans Cost: \$2.37M

North Findlay Station: Install (1) Line 138kV CB 3000A 63kA, Low Side T1 34.5kV CB 2000A 40kA, High Side T1 138kV circuit switcher. (B3086.4) Estimated Cost: \$1.7M

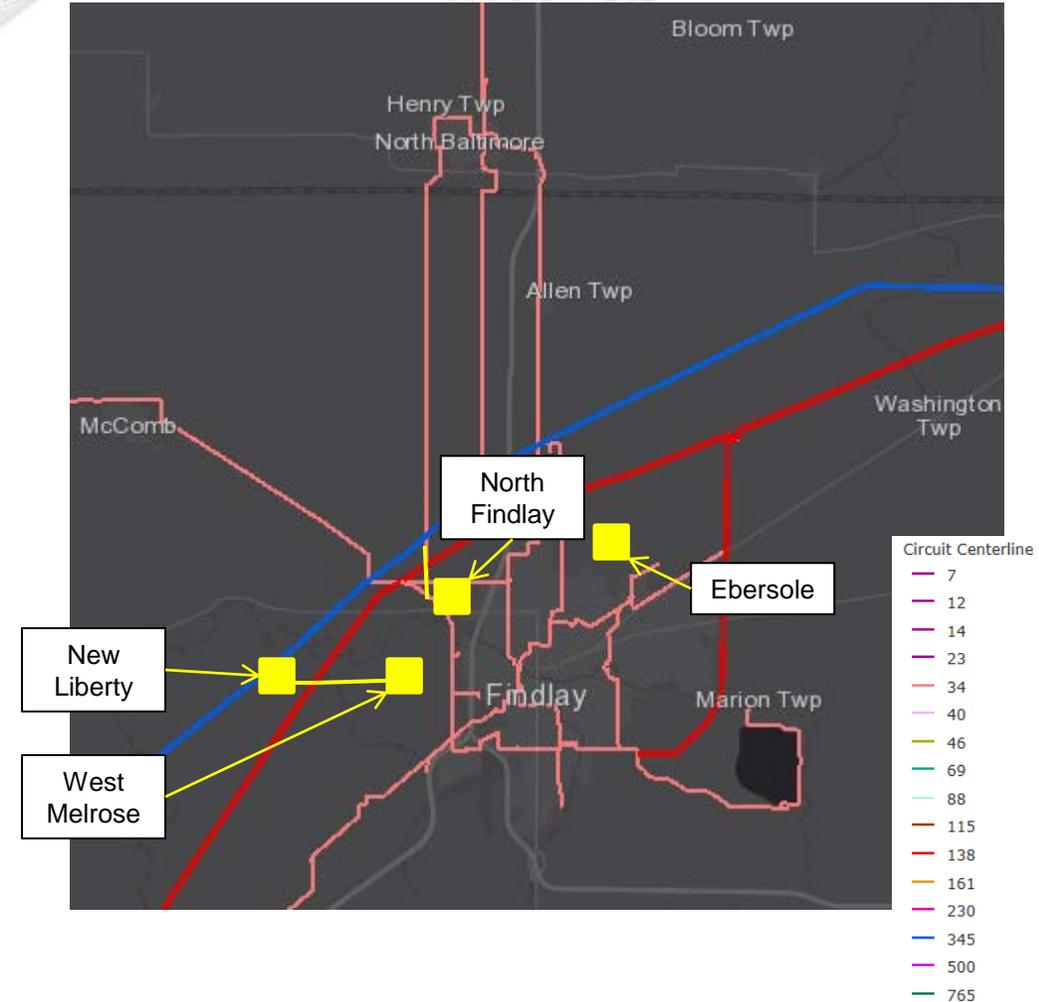
Ebersole Station: Install second 90 MVA 138/69/34kV Trf. Install two low side CBs for T1 and T2. 69kV 2000A 40kA. (B3086.5) Estimated Trans Cost: \$3.75M

**Total Estimated Transmission Cost: \$13.02M**

Required IS Date: 6/1/2022

Projected IS Date: 12/31/2021

Project Status: Scoping/ Engineering



# Next Steps



## Upcoming Western SRRTEP Dates

West	Start	End
12/5/2018	12:00	4:00

# Questions?





# Revision History

11/20/2018 – V1 – Original version posted to [pjm.com](http://pjm.com)