Reliability Analysis Update
2023 RTEP Window 1

Sami Abdulsalam, Senior Manager
PJM Transmission Planning

Transmission Expansion Advisory Committee
December 5, 2023

2023 Window 1
First Read
Baseline Reliability Projects

APS Transmission Zone: Baseline
2023 RTEP Window 1 Cluster 1

Process Stage: First Read

Criteria: Summer Generator Deliverability

Assumption Reference: 2028 RTEP assumptions

Model Used for Analysis: 2028 RTEP Summer case

Proposal Window Exclusion: None

Problem Statement:

2023W1-GD-S499, 2023W1-GD-S500, 2023W1-GD-S501, 2023W1-GD-S87, 2023W1-GD-S80 & 2023W1-GD-S89

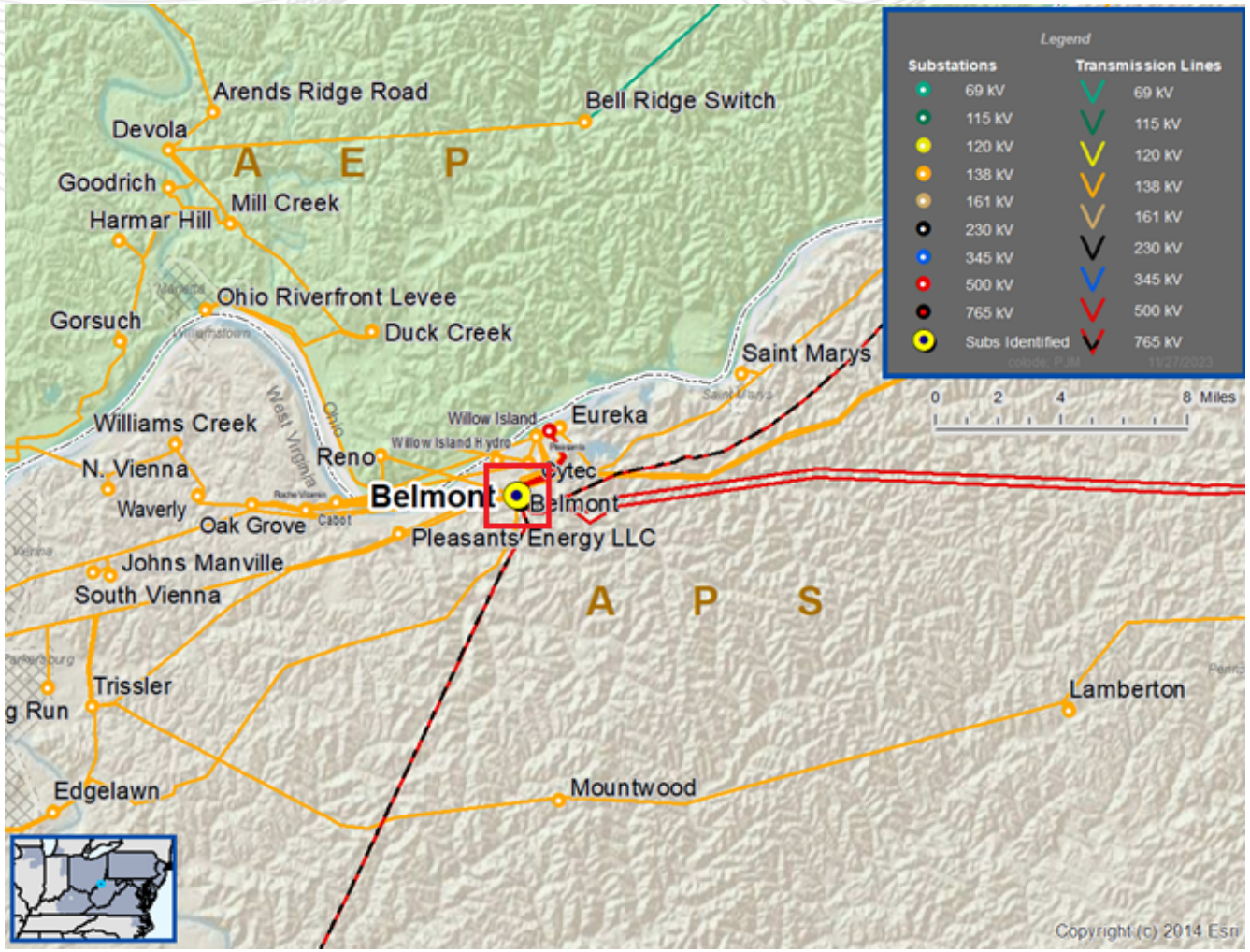
In the 2028 RTEP Summer case, Belmont 765/345 kV Transformer # 5 is overloaded for three common mode and single contingencies.

Existing Facility Rating:

Branch	SN/SE/WN/WE (MVA)
Belmont Transformer # 5	1986/2492/2611/2991

Preliminary Facility Rating:

Branch	SN/SE/WN/WE (MVA)
Belmont Transformer # 5	3125/4000/3500/4250



APS Transmission Zone: Baseline 2023 RTEP Window 1 Cluster 1

As part of the 2023 RTEP Window #1, project 2023-W1-903 listed in the table below is proposed to address the following violations: 2023W1-GD-S499, 2023W1-GD-S500, 2023W1-GD-S501, 2023W1-GD-S87, 2023W1-GD-S89 & 2023W1-GD-S80

Proposal ID	Proposing Entity	Upgrade Description	Upgrade Cost ($M)
2023-W1-903	FE (Selected)	Replace the Belmont 765/500 kV Transformer #5 with a new transformer bank consisting of three single-phase transformers and an additional single phase spare transformer.	42.05
2023-W1-851	TRANSOURCE (Not-Selected)	New Greenfield Cork 765kV substation will be roughly 0.55 miles from existing Belmont substation. The new substation will be a ring bus design with existing Kammer to Belmont and Mountaineer to Belmont line 765 kV lines terminating at the new Cork substation.	60.05
2023-W1-850	FE (Not-Selected)	Install second 765/500 kV transformer (#6) consisting of three single-phase transformers and a single phase spare unit, in parallel with the existing Transformer #5. Install 765 kV four-breaker ring bus and two 500 kV breakers. Replace 500 kV disconnect switches.	123.40
2023-W1-831	TRANSOURCE (Not-Selected)	New Greenfield Polecat Station will be roughly 3 miles from the existing Belmont Subation . The new 765/500kV Station that features a 765kV three-position ring bus and a 500kV three-position ring bus. The 765kV ring bus connects Belmont-Mountaineer 765kV, Kammer 765kV, and a new 765/500 transformer. The 500kV ring bus connects the new transformer, Belmont 500kV, and Flint Run 500kV transmission lines. 765kV circuit breaker upgrades will be completed at Mountaineer Station to meet the required 5000A rating.	145.70
2023-W1-605	TRANSOURCE (Not-Selected)	This project enhances 2023-W1-905 by using 954 KCMIL Rail ACSR which increases the throughPut of power by increasing the line conductor ampacity by 8%.Install reactor at New London and Oppossum Creek substation. Upgrade (3) wavetraps and (2) Circuit Breakers to 5000A equipment at Jacksons Ferry 765kV and Upgrade (2) Circuit Breakers to 5000A equipment at Cloverdale 765kV. Upgrade (1) Circuit Breaker to 5000A equipment at Broadford 765kV.	857.33

Proposal ID	Proposing Entity	Upgrade Description	Upgrade Cost ($M)
2023-W1-905	TRANSOURCE (Not-Selected)	New roughly 114 mi 765 kV line between Jousha Falls to new Transource Substation Yeat. Add (2) 765kV breakers at Joshua Falls to create a 2-breaker ring with the transformer still connected off the bus. New Yeat 765/500/230kV will be near existing Bristers 500/230kV substation. This substation will have (10) 500kV breakers, (2) 765/500kV transformers, (2) 500/230kV transformers, (2) 230kV CB's and (1) 765kV CB. Cut in Bristers–Ox 500kV and Meadowbrook–Vint Hill 500kV lines into Yeat's 500kV yard. AEP installs a new 12-mile dbl ckt BOLD (Breakthrough Overhead Line Design) 230kV line from Yeat–CloverHIll. Dominion installs a new 7.5-mile dbl ckt BOLD (Breakthrough Overhead Line Design) 230kV line from Warrenton–Wheeler. Dominion installs (2) 230kV breakers at Wheeler substation. Dominion installs new 0.1% reactor at Vinthill on Vinthill–Morrisville. Dominion Install new 0.1% reactor at Vinthill on Vinthill–Loudoun 1. Dominion Rebuilds 1.7 miles 230kV line from Marsh Run–RemingtonCt as double circuit. Dominion replaces remote end equipment to bring rating up on 230kV line from Wheeler–Linton Tap–Atlantic. Dominion rebuilds the 0.23-mile line between Bristers 500kV and Yeat 500kV.	1,300.86

Proposed Solution: 2023-W1-903 - Replace the Belmont 765/500 kV Transformer #5 with a new transformer bank with nameplate rating of 1500/2000/2500 MVA (ONAN/ONAF/ONAF), consisting of three single-phase transformers and a spare transformer. The loadability ratings of the new transformer are 3125/4000/4750 SN/SE/SLD and 3500/4250/4750 WN/WE/WLD. Replace 500 kV disconnect switches **(2023-W1-903)**

Total Estimated Cost: $42.05M

Required IS Date: 06/01/2028

Projected IS Date: 06/01/2028

ComEd Transmission Zone: Baseline Cherry Valley Circuit Breakers

Process Stage: First Read

Criteria: Summer Generator Deliverability

Assumption Reference: 2023 RTEP assumptions

Model Used for Analysis: 2028 RTEP cases

Proposal Window Exclusion: None

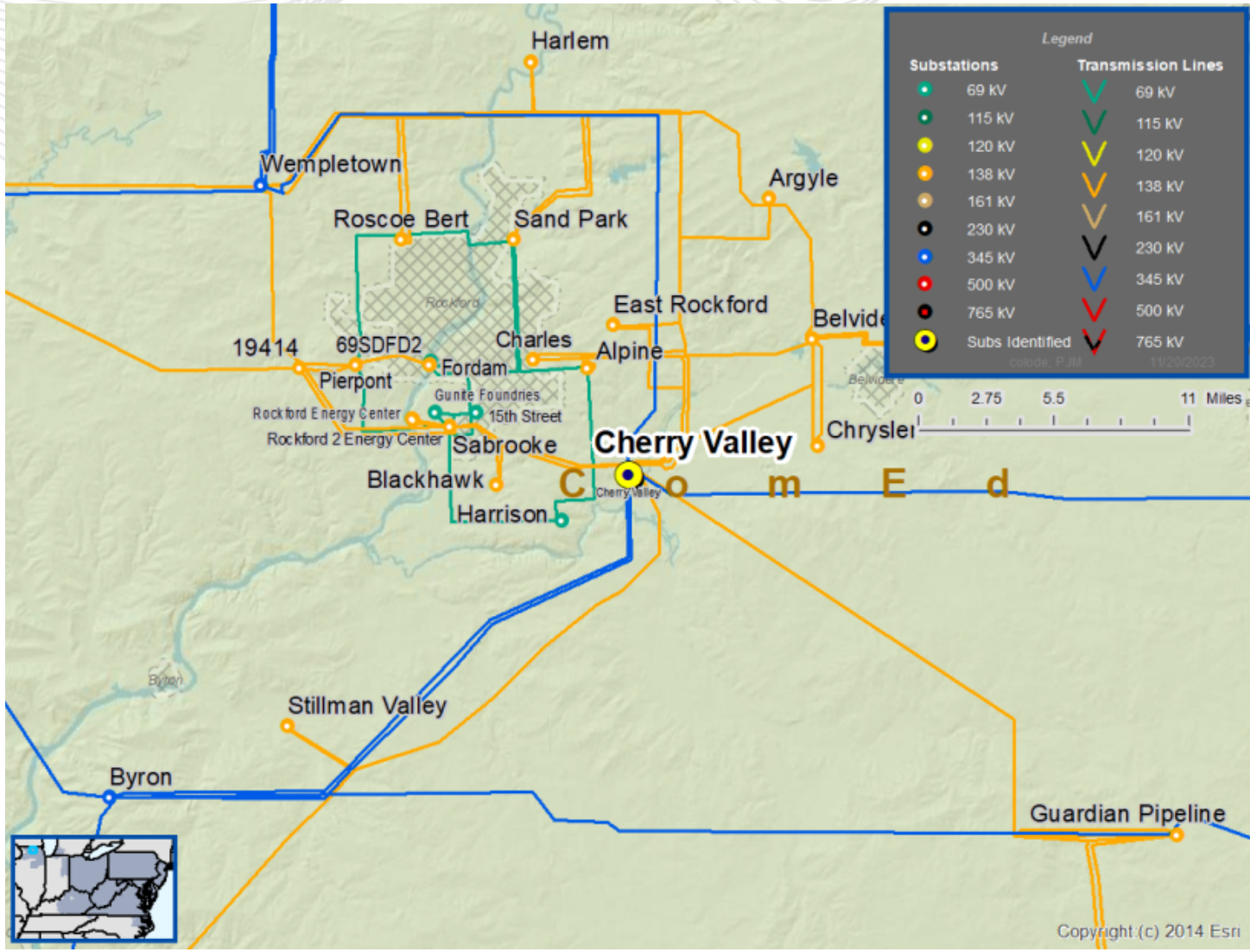
Problem Statement:

2023W1-GD-S641, 2023W1-GD-S642, 2023W1-GD-S662, 2023W1-GD-S663, 2023W1-GD-S1262, 2023W1-GD-S1263

In 2028 RTEP Summer case, the Cherry Valley R 345/138 kV transformer is overloaded for N-2 outages.

Existing Facility Rating:

Branch	SN/SE/SSTE/SLD WN/WE/WSTE/WLD (MVA)
Chery Valley R 345/138 kV Transformer	420/480/520/530 420/480/520/530



ComEd Transmission Zone: Baseline Cherry Valley Circuit Breakers

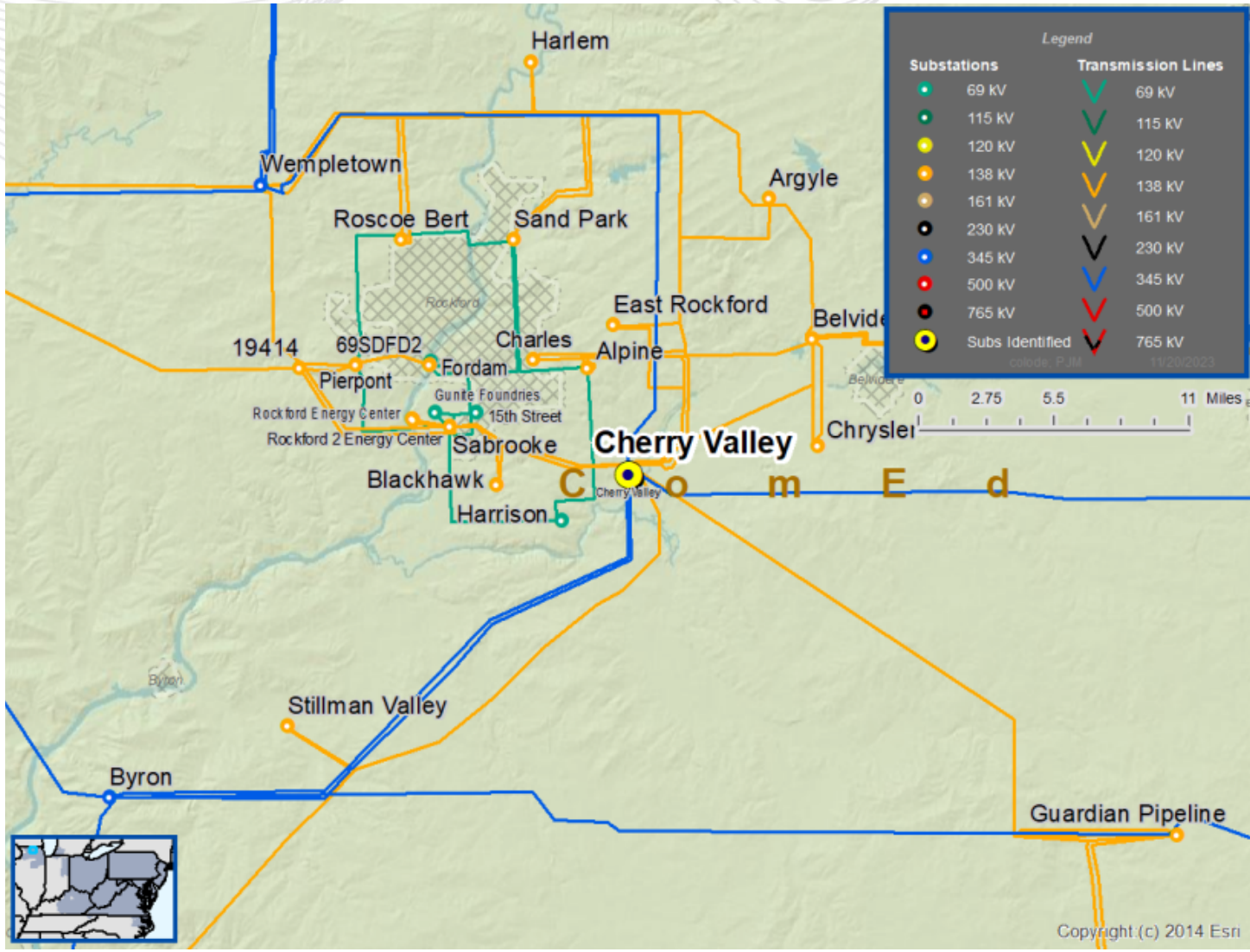
Proposed Solution: Proposal No. 2023-W1-771
Add three 345 kV circuit breakers to Cherry Valley substation.

Estimated Cost: $7.75 M

Preliminary Facility Rating: No change to transformer rating, 63 kA circuit breakers

Alternatives: None

Required IS Date: 6/1/2028
Projected IS Date: 6/1/2028



ComEd Transmission Zone: Baseline
2023 RTEP Window 1 Cluster 3

Process Stage: First Read

Criteria: Winter Generator Deliverability

Assumption Reference: 2023 RTEP assumptions

Model Used for Analysis: 2028 RTEP cases

Proposal Window Exclusion: None

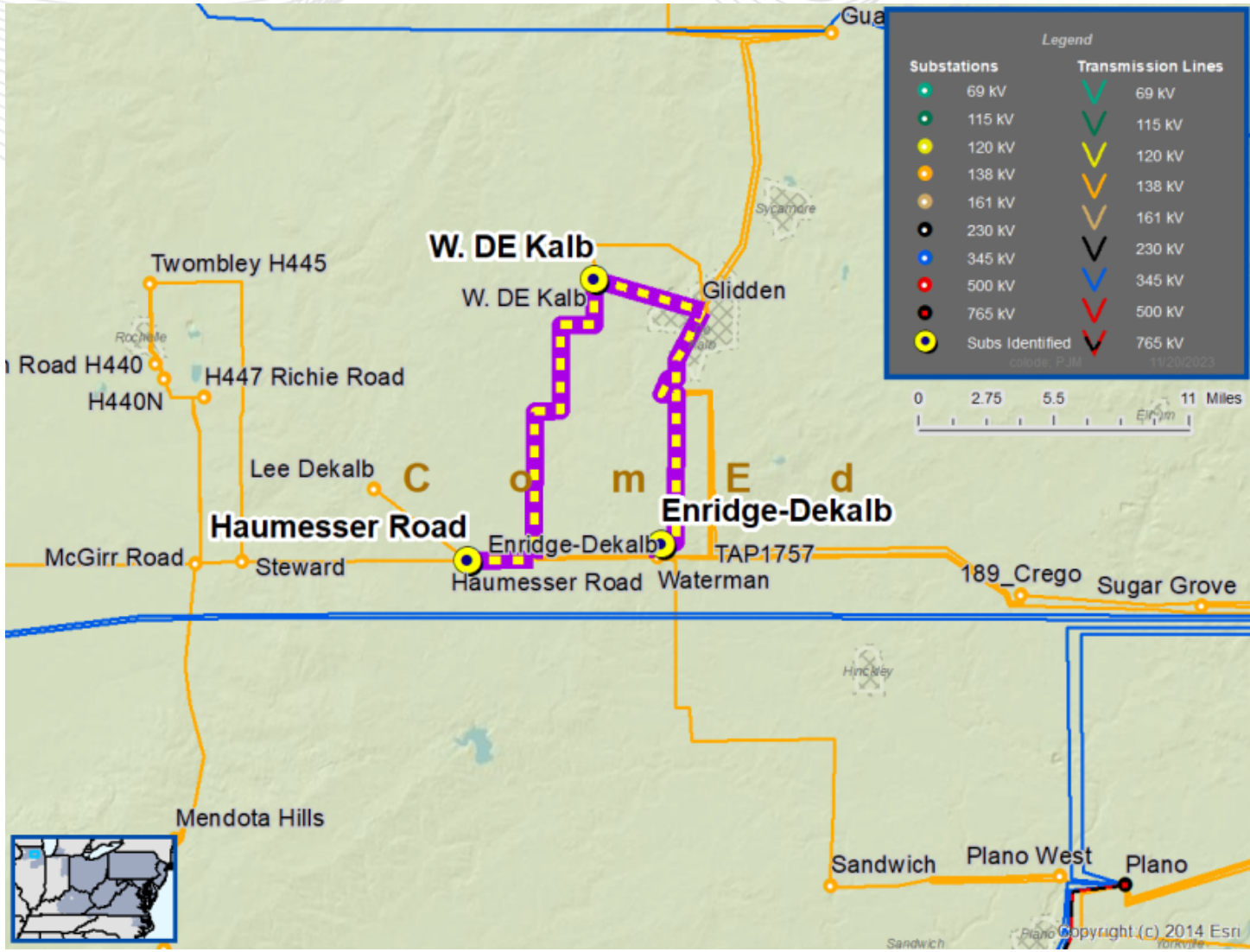
Problem Statement:

2023W1-GD-W229, 2023W1-GD-W955, 2023W1-GD-W988, 2023W1-GD-W945, 2023W1-GD-W993, 2023W1-GD-W268, 2023W1-GD-W972, 2023W1-GD-W1397, 2023W1-GD-W1387, 2023W1-GD-W946

In 2028 RTEP Winter case, the Haumesser Road-West DeKalb Tap-ESS H452 (Enridge-DeKalb) Tap 138 kV line is overloaded for N-1 and N-2 outages.

Existing Facility Rating:

Branch	SN/SE/SSTE/SLD WN/WE/WSTE/WLD (MVA)
HAUMESSER; B-W DEKALB ;3T 138 kV	452/452/455/471 472/472/476/495
W DEKALB ;3T-ESS H452 ;RT 138 kV	376/452/455/471 452/472/476/495



ComEd Transmission Zone: Baseline
2023 RTEP Window 1 Cluster 3

As part of the 2023 RTEP Window #1, project 2023-W1-712 listed in the table below is proposed to address the following violations: 2023W1-GD-W229, 2023W1-GD-W955, 2023W1-GD-W988, 2023W1-GD-W945, 2023W1-GD-W993, 2023W1-GD-W268, 2023W1-GD-W972, 2023W1-GD-W1397, 2023W1-GD-W1387, 2023W1-GD-W946

Proposal ID	Proposing Entity	Project Type	Upgrade Description	Upgrade Cost ($M)
500 (Not Selected)	ComEd	Greenfield	Expand Haumesser Road substation. Extend the line 11323 West Dekalb tap 1.6 miles into Haumesser Road to create new line 9411 from Haumesser to West Dekalb. Expand West Dekalb to tie line 9411 from Haumesser Road to the existing line 8315 from Glidden. Reconductor/rebuild 10 miles of line 9411 and 6 miles of line 8315.	113.94
712 (Selected)	ComEd	Upgrade	Rebuild/reconductor 138 kV line 11323 from Haumesser Road to the H-452 tap.	10.22
972 (Not Selected)	ComEd	Upgrade	Rebuild 138 kV line 11323 as double circuit from Haumesser Road to the H-452 tap and string a second circuit. Expand Haumesser Road to a 4 circuit breaker ring bus. Add a circuit breaker at H-452 to create a second path between Haumesser Road and Waterman.	28.11

ComEd Transmission Zone: Baseline 2023 RTEP Window 1 Cluster 3

Proposed Solution: Proposal No. 2023-W1-712
Rebuild/reconductor 138 kV line 11323 from Haumesser Road to the H-452 tap.

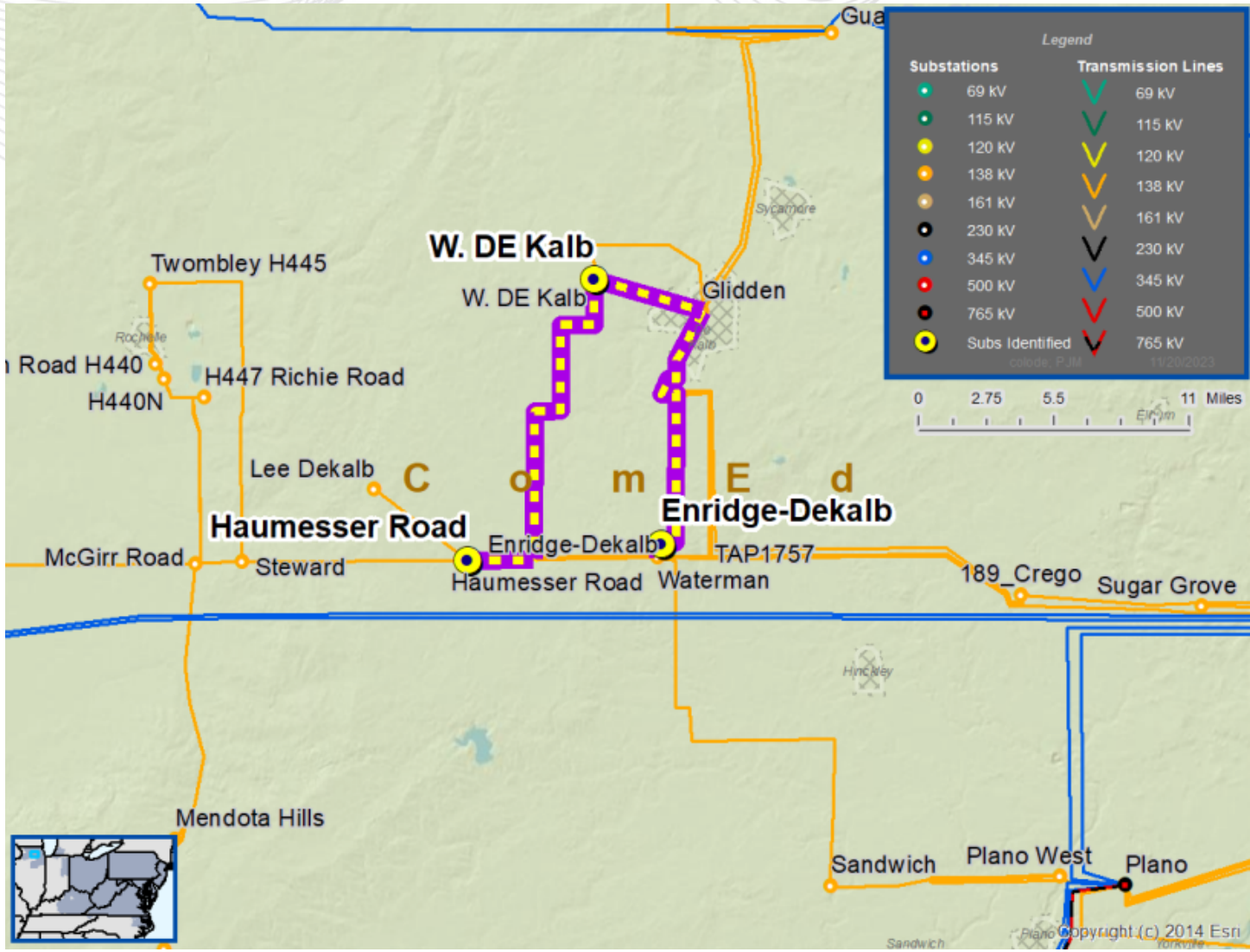
Estimated Cost: $10.22 M

Preliminary Facility Rating:

Branch	SN/SE/SSTE/SLD WN/WE/WSTE/WLD (MVA)
HAUMESSER; B-W DEKALB ;3T-ESS H452 ;RT 138 kV	405/511/522/563 479/565/578/625

Additional Benefits: The line will be rebuilt as double circuit to accommodate a future circuit from Haumesser Road to H-452, but only a single circuit will be installed for this project.

Required IS Date: 6/1/2028
Projected IS Date: 12/1/2026



Recommended Solutions – 2023 Window 1
Second Read
Baseline Reliability Projects

AEP Transmission Zone: Baseline
Olive 345kV Breaker "D" Replacement

Process Stage: Recommended Solution – Second Read

Criteria: Over Duty Breaker

Assumption Reference: 2028 RTEP assumption

Model Used for Analysis: 2028 RTEP Short Circuit base case

Proposal Window Exclusion: None

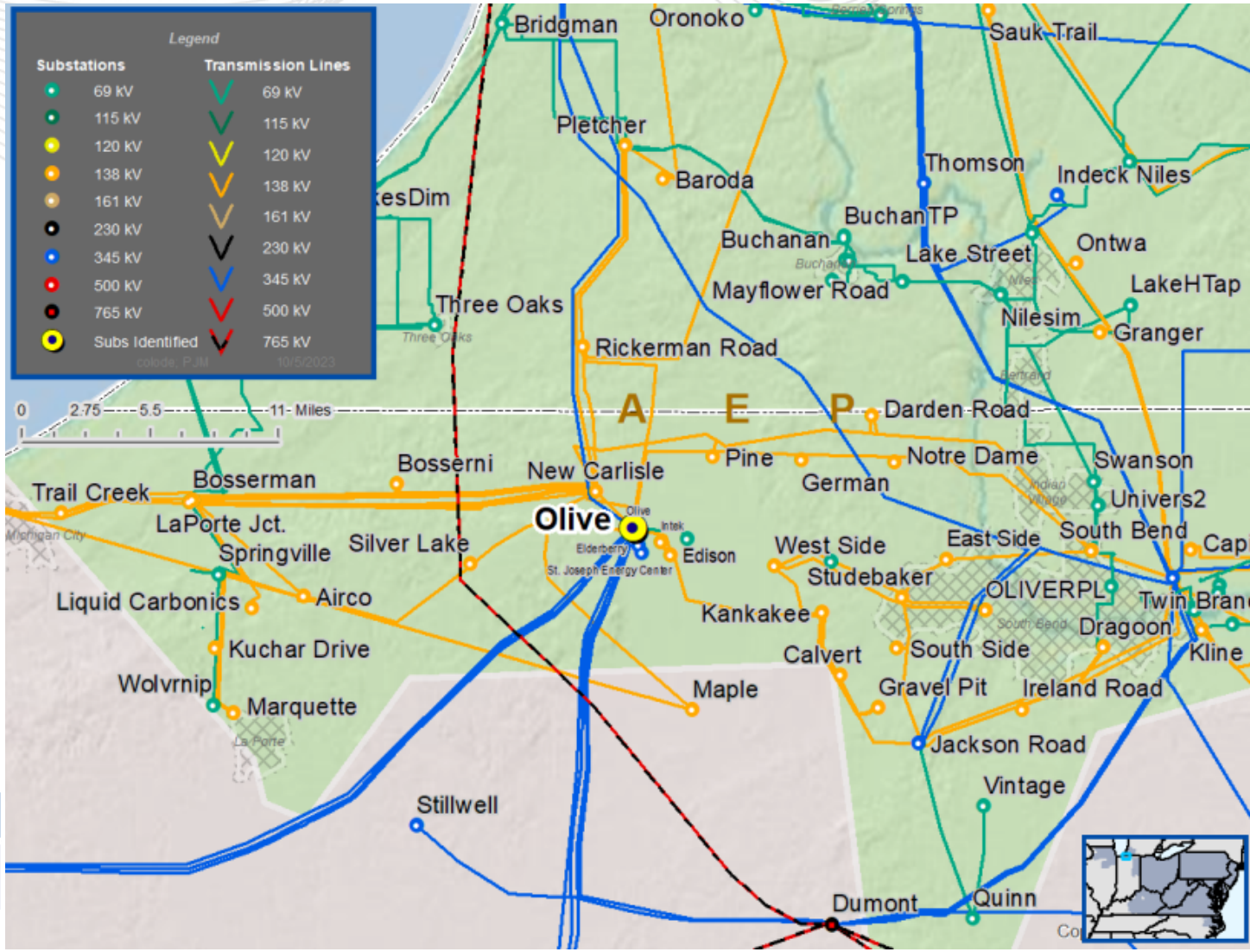
Problem Statement:

2023W1-SC-4

In th2028 RTEP Short Circuit base case, the Olive 345 kV breaker "D" is identified as over duty.

Existing Facility Rating:

Circuit Breaker	Interrupting Rating (kA)
Olive 345kV breaker "D"	50



AEP Transmission Zone: Baseline Olive 345kV Breaker “D” Replacement

As part of the 2023 RTEP Window #1, the project listed in the table below is proposed to address the following violations: 2023W1-SC-4

Proposal ID	Proposing Entity	Upgrade Description	Upgrade Cost ($M)
384	AEP	Replace the overdutied Olive 345kV circuit breaker "D" with a 5000A 63 kA circuit breaker.	1.083

AEP Transmission Zone: Baseline
Olive 345kV Breaker "D" Replacement

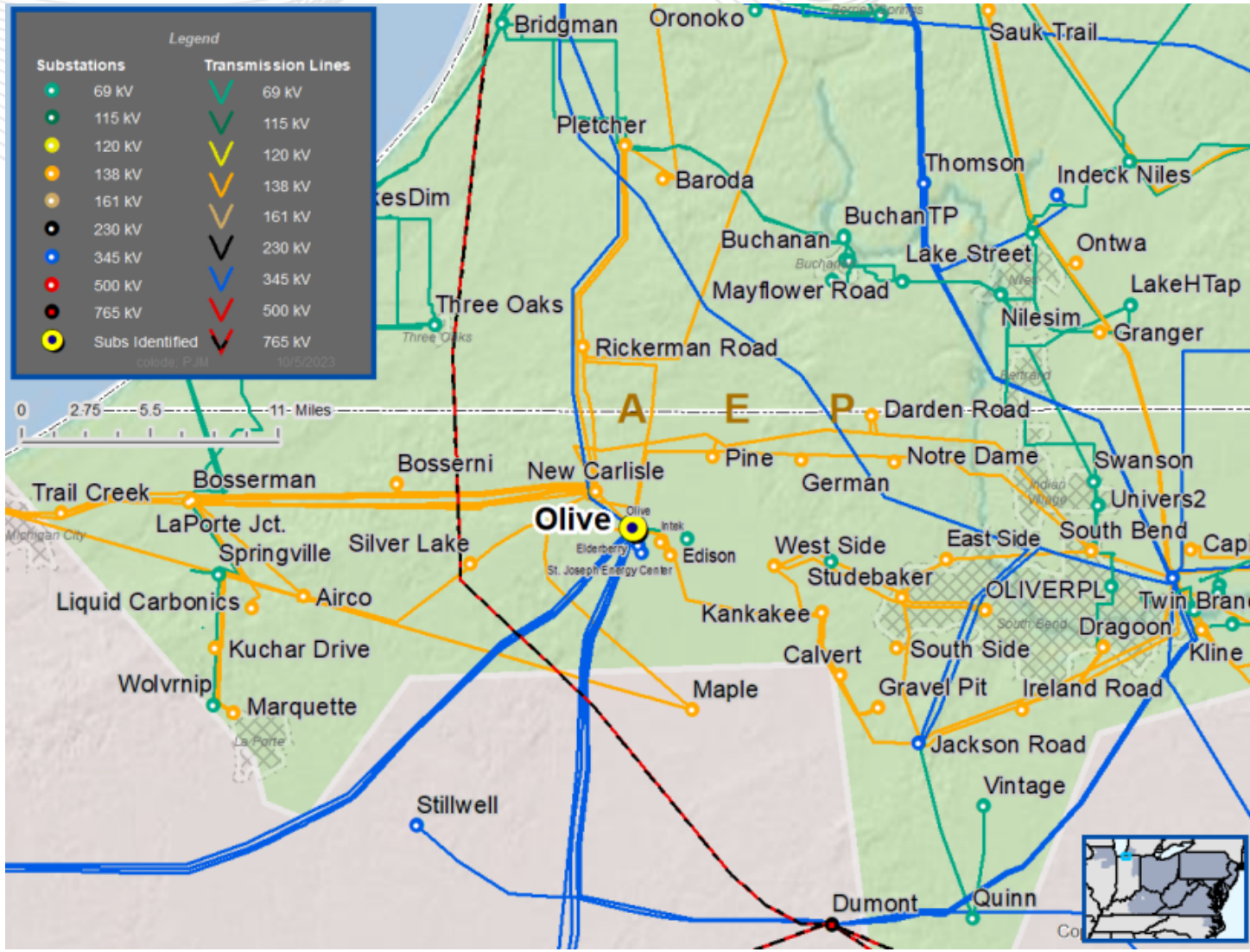
Proposed Solution: Proposal #2023_W1-384

1) Replace the overdutied Olive 345kV circuit breaker "D" with a 5000A 63 kA circuit breaker.
2) Re-use existing cables and a splice box to support the CB install. **(B3790)**

Preliminary Facility Rating:

Circuit Breaker	Interrupting Rating (kA)
Olive 345kV breaker "D"	63

Estimated Cost: $1.083M
Required IS Date: 6/1/2028
Projected IS Date: 9/1/2027
Previously Presented: 10/31/2023



AEP Transmission Zone: Baseline Mountaineer 765 kV Wavetrap Replacement

Process Stage: Recommended Solution – Second Read

Criteria: Summer Gen Deliv

Assumption Reference: 2023 RTEP assumption

Model Used for Analysis: 2028 RTEP cases

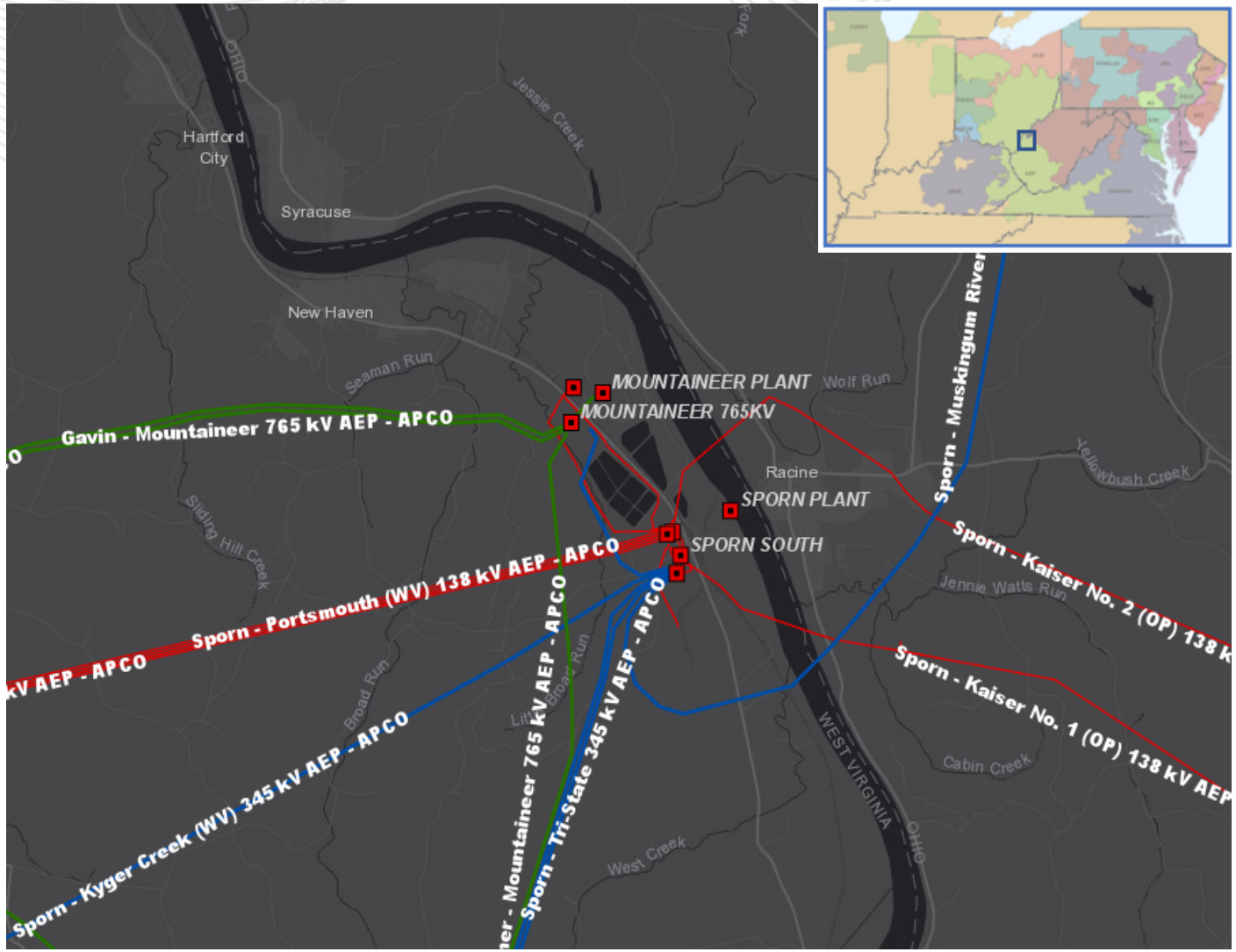
Proposal Window Exclusion: Substation Equipment Exclusion

Problem Statement: FG: 2023-W1-GD-S1286, 2023-W1-GD-S595, 2023-W1-GD-S671, 2023-W1-GD-S726, 2023-W1-GD-S820, 2023-W1-GD-S834

In 2028 RTEP Summer case, the Belmont - Mountaineer-765 kV is overloaded in generator deliverability test for multiple common mode contingencies.

Existing Facility Rating:

Branch	SN/SE/WN/WE (MVA)
Mountaineer - Belmont 765kV line	4047/4571/4484/4961



AEP Transmission Zone: Baseline
Mountaineer 765 kV Wavetrap Replacement

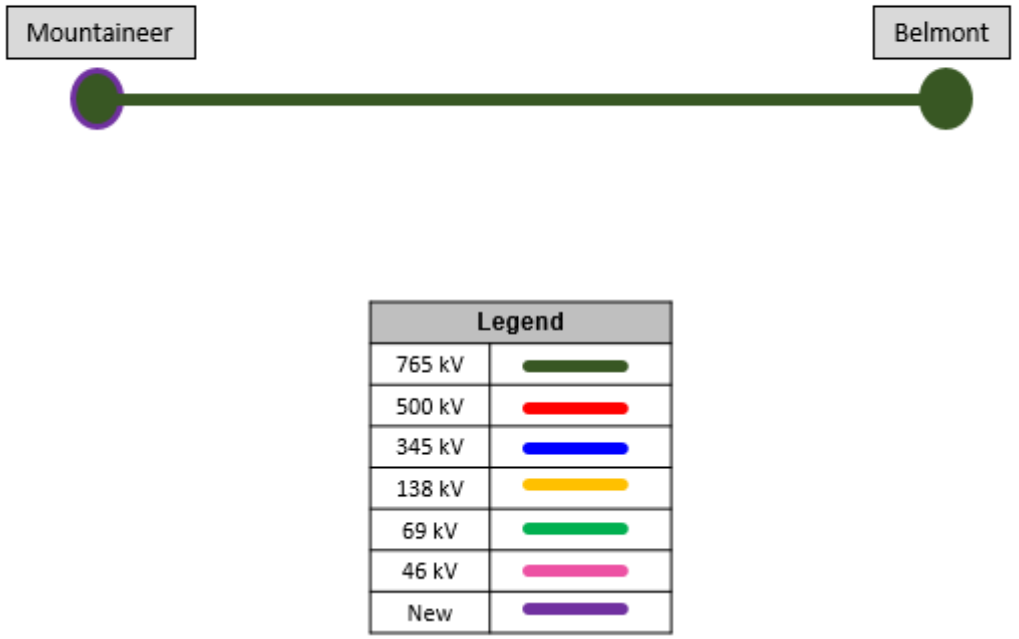
Proposed Solution: Replace existing 3000 A wavetrap at Mountaineer 765 kV, on the Belmont - Mountaineer 765 kV line, with a new 5000 A wavetrap.
(B3785)
Estimated Cost: $0.46M

Preliminary Facility Rating:

Branch	SN/SE/WN/WE (MVA)
Mountaineer - Belmont 765kV line (Existing)	4047/4571/4484/4961
Mountaineer - Belmont (765) (Post Upgrade)	4558/5523/5992/6845

Required IS Date: 6/1/2028
Projected IS Date: 6/1/2028
Previously Presented: 10/31/2023

Proposed:



AEP & OVEC Transmission Zone: Baseline Kyger Creek Station Equipment Replacement

Process Stage: Recommended Solution – Second Read

Criteria: Summer Gen Deliv

Assumption Reference: 2023 RTEP assumption

Model Used for Analysis: 2028 RTEP cases

Proposal Window Exclusion: Substation Equipment Exclusion

Problem Statement: FG: 2023-W1-GD-S582, 2023-W1-GD-S584, 2023-W1-GD-S590, 2023-W1-GD-S646, 2023-W1-GD-S650

In 2028 RTEP Summer case, the Kyger Creek-Sporn 345 kV line is overloaded under gen deliv analysis for multiple common mode contingencies.

Existing Facility Rating:

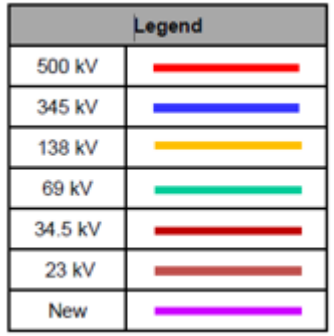
Branch	SN/SE/WN/WE (MVA)
Kyger Creek - Sporn (345)	1025/1204/1298/1512

AEP & OVEC Transmission Zone: Baseline
Kyger Creek Station Equipment Replacement

Proposed Solution:
Replace AEP owned station takeoff riser and breaker BB risers at OVEC owned Kyger Creek station.(B3788.1) **Estimated Cost: 0.41M**
Replace OVEC owned breaker AA risers, bus work, and breaker AA disconnect switches at OVEC owned Kyger Creek station. (B3788.2) **Estimated Cost: 0.75M**
Total Estimated Cost: $1.16 M

Branch	SN/SE/WN/WE (MVA)
Kyger Creek - Sporn 345kV line	1189/1540/1507/1778

Existing:



Proposed:

Required IS Date: 6/1/2028
Projected IS Date: 6/1/2028
Previously Presented: 10/31/2023

DPL Transmission Zone: Baseline

Process Stage: Recommended Solution – Second Read

Criteria: Summer Generation Deliverability

Assumption Reference: 2028 RTEP assumption

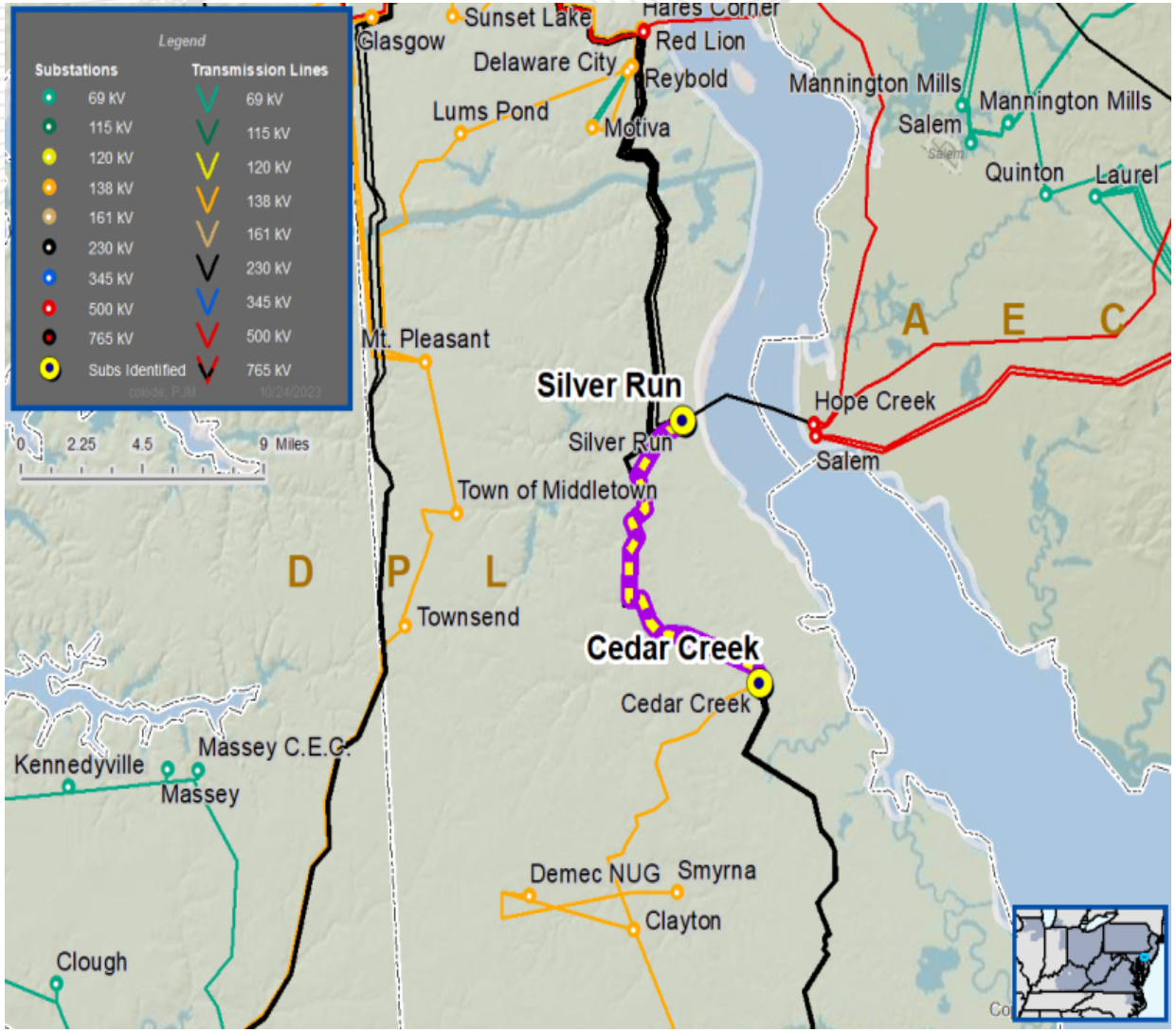
Model Used for Analysis: 2028 RTEP Summer case

Proposal Window Exclusion: No

Problem Statement: The Silver Run – Cedar Creek 230 kV circuit overloaded for several contingencies

Violations were posted as part of the 2023 Window 1: FG#s

2023W1-IPD-S1	2023W1-IPD-S5	2023W1-IPD-S9	2023W1-IPD-S13	2023W1-IPD-S17	2023W1-IPD-S27
2023W1-IPD-S2	2023W1-IPD-S6	2023W1-IPD-S10	2023W1-IPD-S14	2023W1-IPD-S18	2023W1-IPD-S28
2023W1-IPD-S3	2023W1-IPD-S7	2023W1-IPD-S11	2023W1-IPD-S15	2023W1-IPD-S19	2023W1-IPD-S29
2023W1-IPD-S4	2023W1-IPD-S8	2023W1-IPD-S12	2023W1-IPD-S16	2023W1-IPD-S26	



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DPL Transmission Zone: Baseline

Recommended Solution: Proposal #2023-W1-573

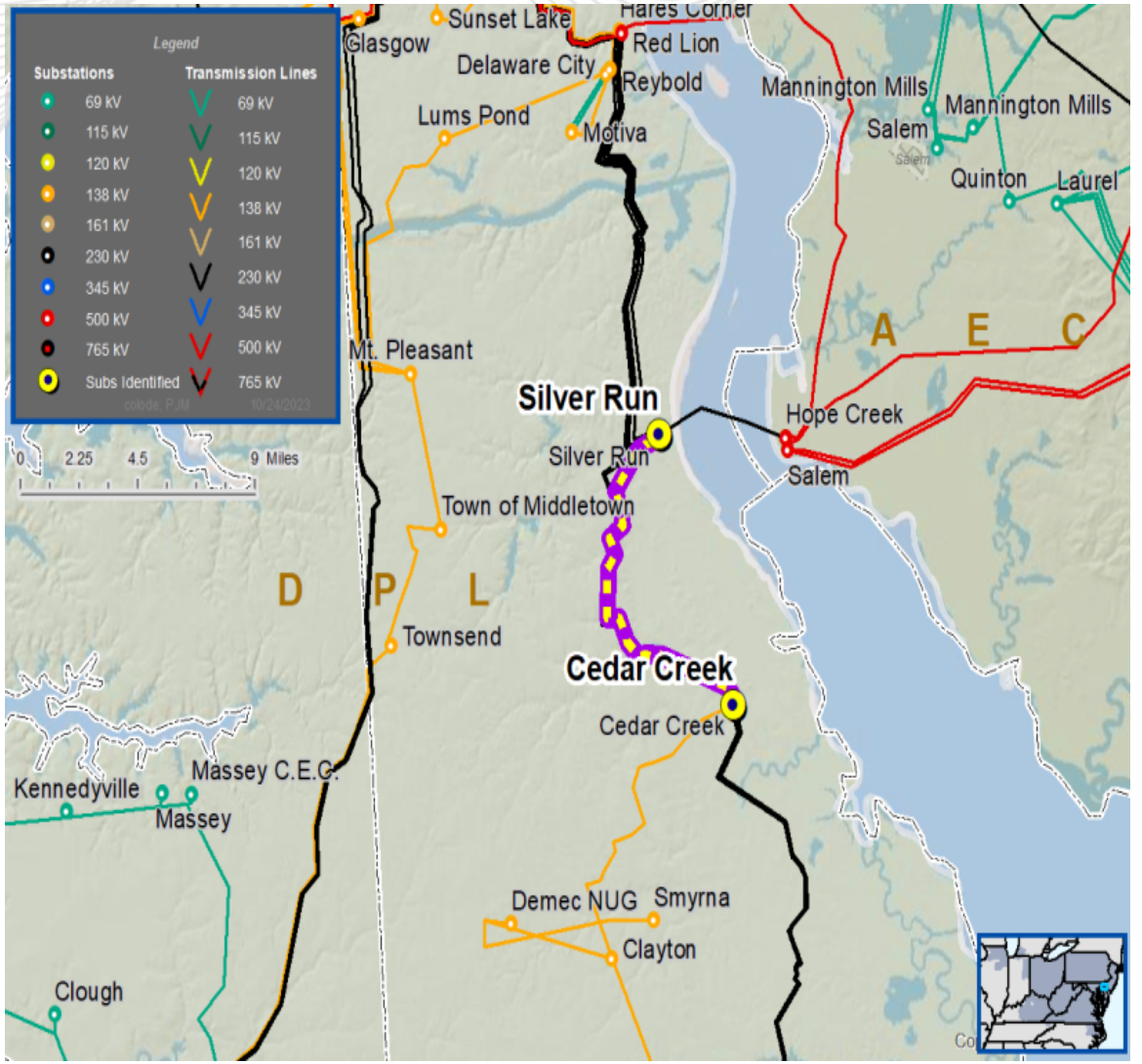
- Reconductor Silver Run - Cedar Creek 230kV line. Reconductor 8.8 miles of 230 kV Circuit with 1594-T11/ACCR “Lapwing” conductor and replace all insulators with high temp hardware. **(B3793.1)**
- **Cedar Creek**– Replace three (3) standalone CTs, disconnect switch, stranded bus, and rigid bus to achieve higher rating. **B3793.2)**
- **Silver Run -** Replace three(3) 1-1590 ACSR Jumpers and one(1) air disconnect switch. **B3793.3)**

Existing Facility Rating: 653SN/808SE, 753WN/911WE MVA

Proposed Facility Rating: 996SN/1146SE , 1060WN/1209WE MVA
Estimated Cost: $8.7 M
Alternatives

- None

Required In-Service: 6/1/2028
Projected In-Service: 6/1/2028



PECO Transmission Zone: Baseline

Process Stage: Recommended Solution – Second Read

Criteria: Summer Generation Deliverability

Assumption Reference: 2028 RTEP assumption

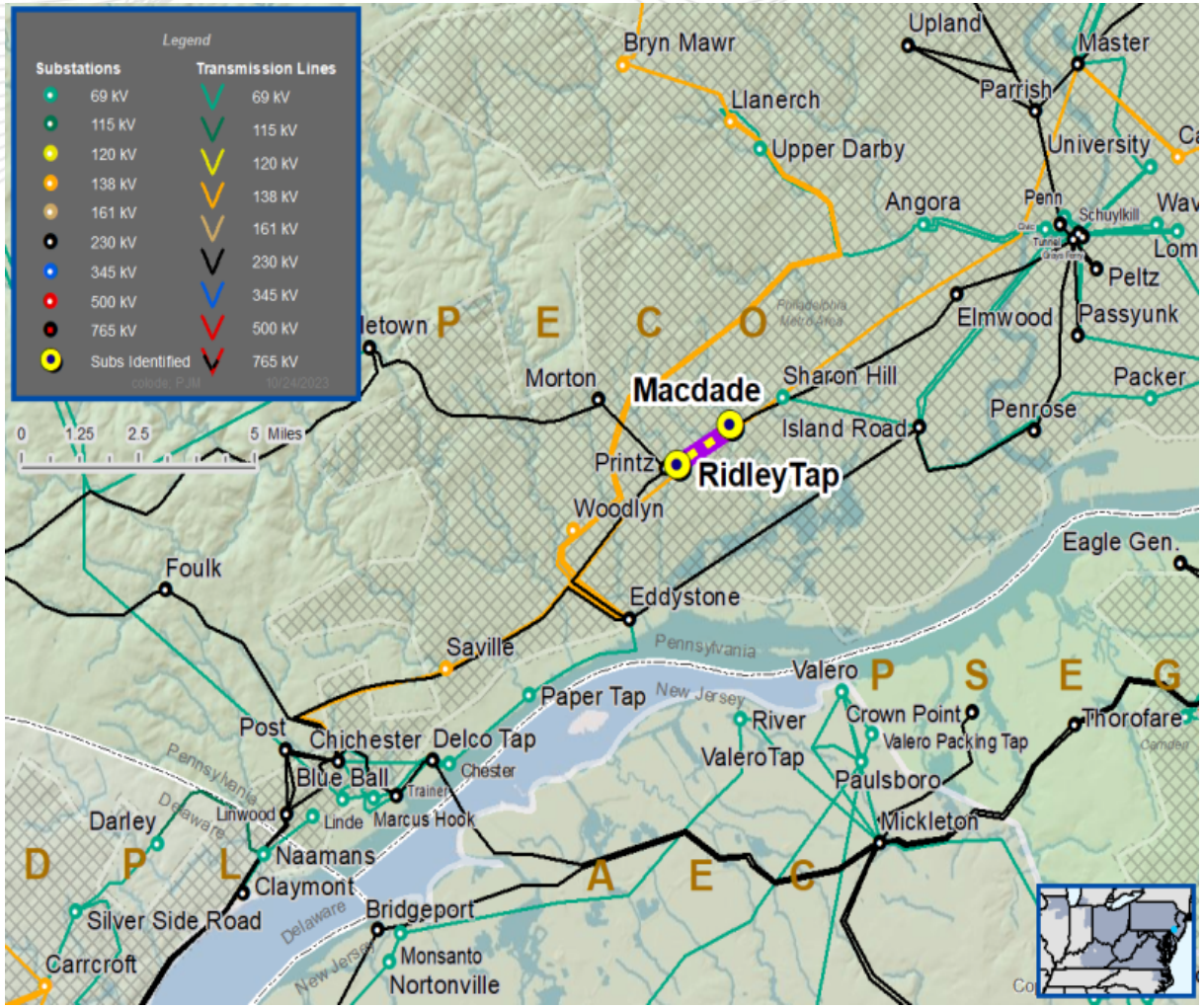
Model Used for Analysis: 2028 RTEP Summer case

Proposal Window Exclusion: Substation equipment Exclusion

Problem Statement: The Ridley – Macdade 230 kV circuit overloaded for several contingencies

Violations were posted as part of the 2023 Window 1: FG#s

2023W1-GD-S108	2023W1-GD-S1267	2023W1-GD-S1276
2023W1-GD-S693	2023W1-GD-S1397	2023W1-GD-S833
2023W1-GD-S704	2023W1-GD-S134	2023W1-GD-S845
2023W1-GD-S705		



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PECO Transmission Zone: Baseline

Recommended Solution:

- Replace relays at Macdade, Printz, and Morton 230 kV station to increase rating limits of transmission. Line protection relays will be upgraded with latest standard relays used across the PECO system. **(B3844)**

Existing Facility Rating: 927SN/927SE, 927WN/927WE MVA

Proposed Facility Rating: 1079SN/1260SE, 1301WN/1455WE MVA

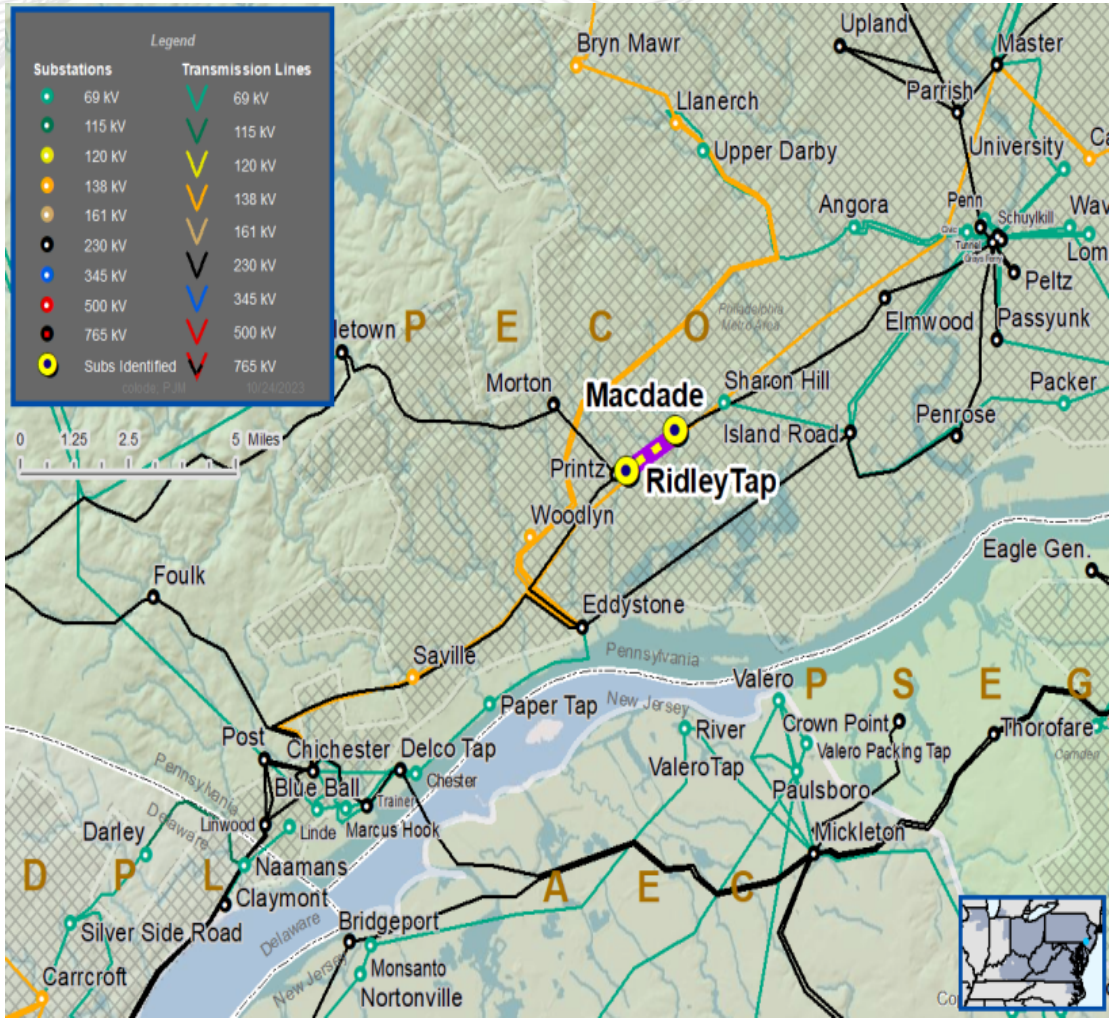
Estimated Cost: $1.4 M

Alternatives

- None

Required In-Service: 6/1/2028

Projected In-Service: 6/1/2028



PSEG Transmission Zone: Baseline

Process Stage: Recommended Solution – Second Read

Criteria: Light Load Baseline Voltage

Assumption Reference: 2028 RTEP assumption

Model Used for Analysis: 2028 RTEP Summer case

Proposal Window Exclusion: No

Problem Statement: High voltage issue on multiple stations around Waldwick vicinity for several contingencies.

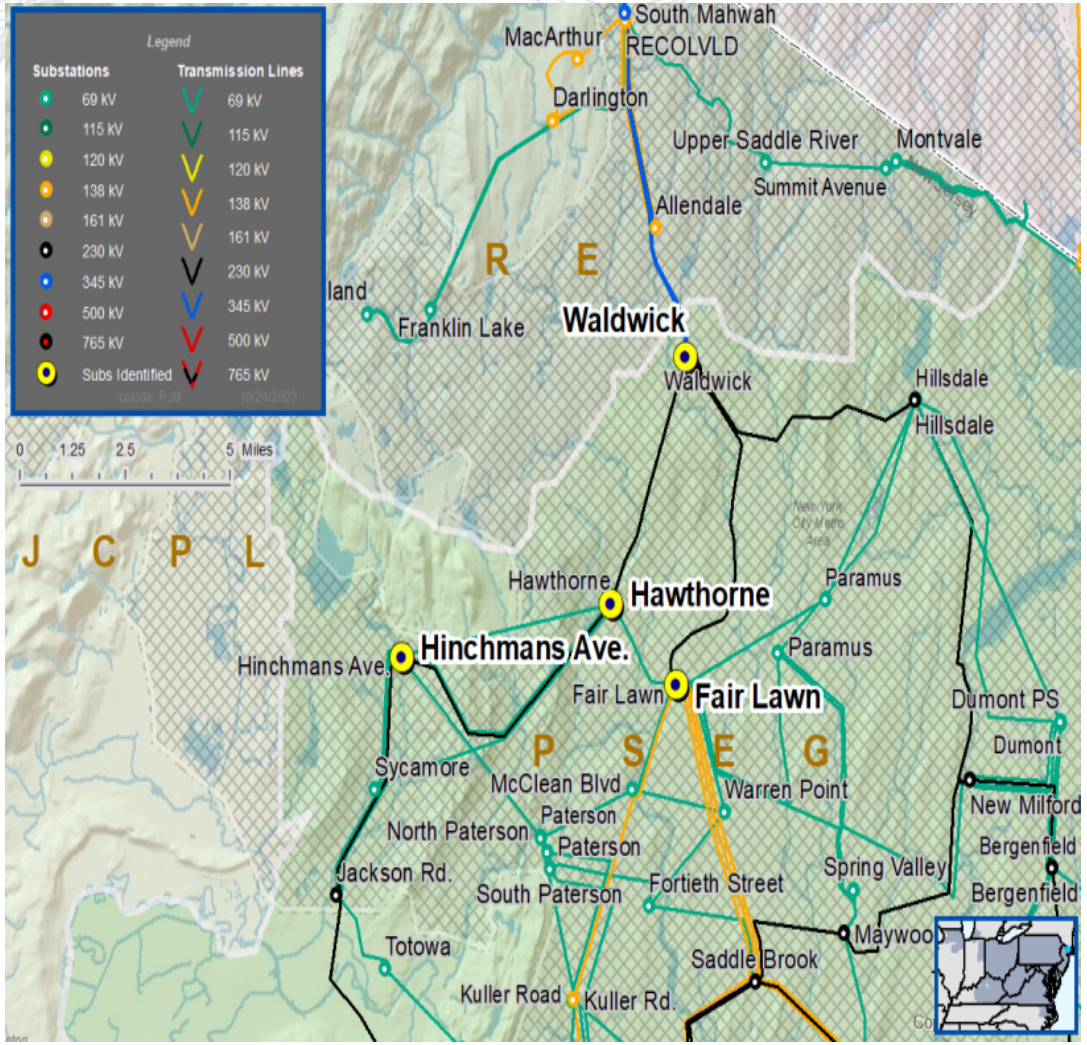
Violations were posted as part of the 2023 Window 1: FG#s

2023W1-N1-LLVM13	2023W1-N1-LLVM17	2023W1-N1-LLVM21	2023W1-N1-LLVM25	2023W1-N1-LLVM29	2023W1-N1-LLVM33
2023W1-N1-LLVM14	2023W1-N1-LLVM18	2023W1-N1-LLVM22	2023W1-N1-LLVM26	2023W1-N1-LLVM30	2023W1-N1-LLVM34
2023W1-N1-LLVM15	2023W1-N1-LLVM19	2023W1-N1-LLVM23	2023W1-N1-LLVM27	2023W1-N1-LLVM31	2023W1-N1-LLVM35
2023W1-N1-LLVM16	2023W1-N1-LLVM20	2023W1-N1-LLVM24	2023W1-N1-LLVM28	2023W1-N1-LLVM32	2023W1-N1-LLVM36
2023W1-N1-LLVM37	2023W1-N1-LLVM38				

Recommended Solution:
Replace existing 230kV 50MVAR fixed shunt reactor with a 230kV 150MVAR variable shunt reactor. **(B3794.1)**
Replace existing 345kV 100MVAR fixed shunt reactor with a 345kV 150MVAR variable shunt reactor . **(B3794.2)**
Estimated Cost: $29.6 M

Alternatives
- None

Required In-Service: 6/1/2028
Projected In-service: 6/1/2028



Contact

Facilitator:
Dave Souder,
Dave.Souder@pjm.com

Secretary:
Tarik Bensala,
Tarik Bensala@pjm.com

SME/Presenter:
Sami Abdulsalam,
Sami.Abdulsalam@pjm.com

Reliability Analysis Update

Member Hotline

(610) 666 – 8980

(866) 400 – 8980

custsvc@pjm.com

Revision History

Version No.	Date	Description
1	Nov 30th 2023	• Original slides posted

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