SRRTEP – PJM West
Reliability Analysis and Supplemental Project Update

Subregional RTEP Committee

PJM West

September 11, 2017

Baseline Reliability and Supplemental Projects
First Review

Baseline Reliability –Project Additional Scope

Problem Statement:

The Hazard – Wooton 161 kV line overloads under summer and winter peak conditions during generation deliverability analysis performed as part of the 2016 PJM RTEP Window 2. During the 2016 PJM RTEP Window 2, the recommended solution is "Perform a Sag Study of the Hazard – Wooten 161 kV line to increase the thermal rating of the line" (B2761.2, presented on 10/6/2016 TEAC). The results of the sag study determined that 40 of the 45 structures which comprise the line would need to be replaced due to sag clearance issues. Additionally, approximately 6.3 of the 6.5 mile Hazard – Wooten 161 kV line utilizes wood structures from 1943. There are currently a total of 52 category A open conditions along the 6.5 mile long line which is comprised of 45 structures. These open conditions include damaged/rotted poles and damaged guy wires, shield wire, conductor, insulators, and cross arms. Therefore, the conclusion of the sag study is to rebuild the line.

Potential Solution:

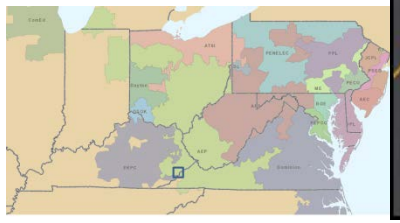
Rebuild the Hazard – Wooten 161 kV line utilizing 795 26/7 ACSR conductor (300 MVA rating).

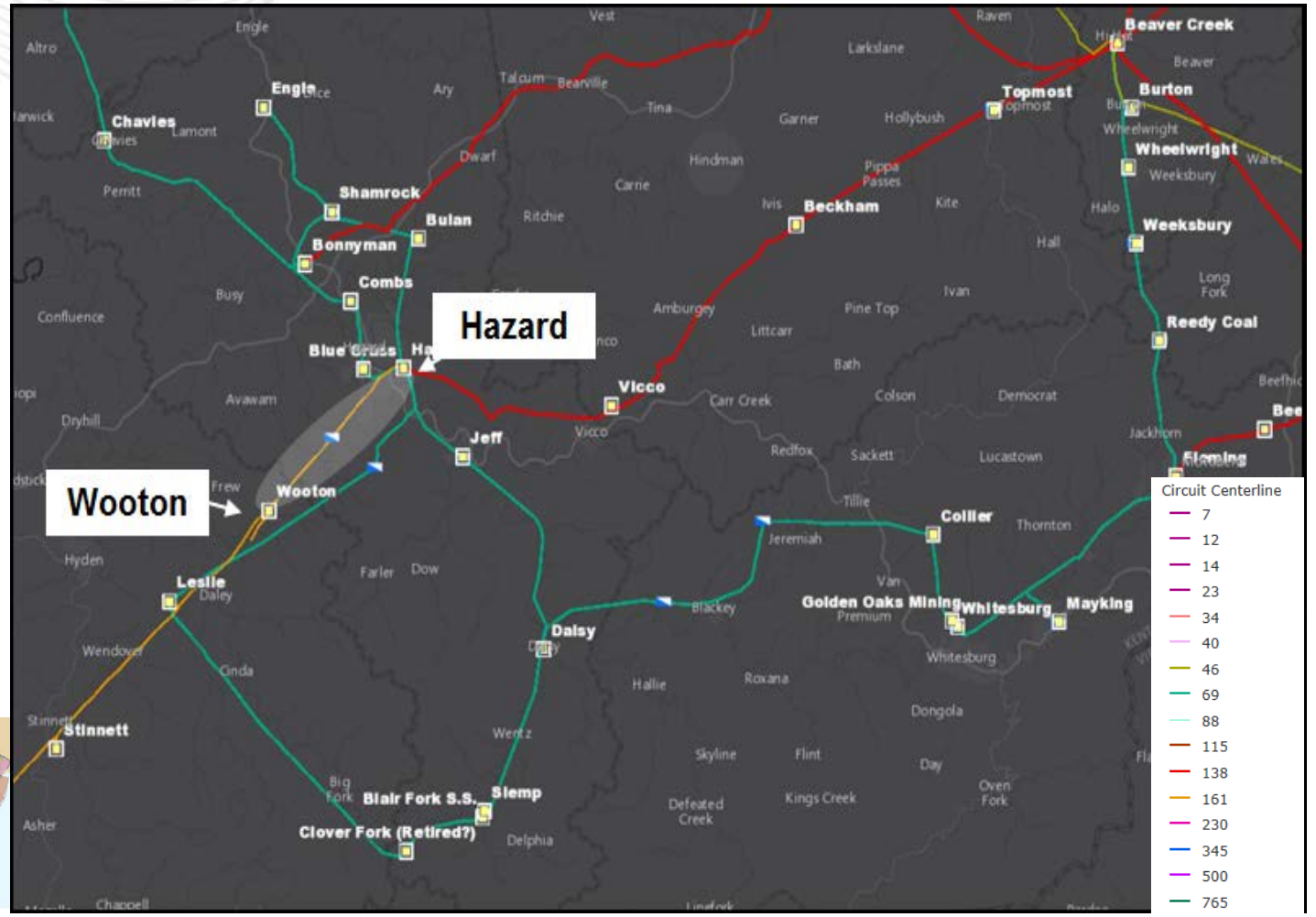
Alternatives:

No feasible alternatives.

Estimated Project Cost: $16.48M

Required IS Date: 6/1/2021





ComEd Transmission Zone

Baseline Reliability – Light Load Deliverability Violation

Problem Statement:

Queue O-09 and O-29 are back to active from suspension. Rock Falls – Nelson 138KV Red line, Schauff Road (O09&O29) – Nelson Tap 138kV Red line and Schauff Road(O9&O29) – Rock Falls 138kV Red line are overload in base case and multiple single contingencies.

Immediate Need: Due to the immediate need, the timing required for an RTEP proposal window is infeasible. As a result, the local Transmission Owner will be the Designated Entity.

Potential Solution:

Install a new 138 kV circuit 18702 from Schauff Road to Rock Falls and install a fourth breaker and a half run at Schauff Road.

Alternatives:

Replace station equipment at Rock Falls on 138 kV line 15509 Rock Falls – Nelson

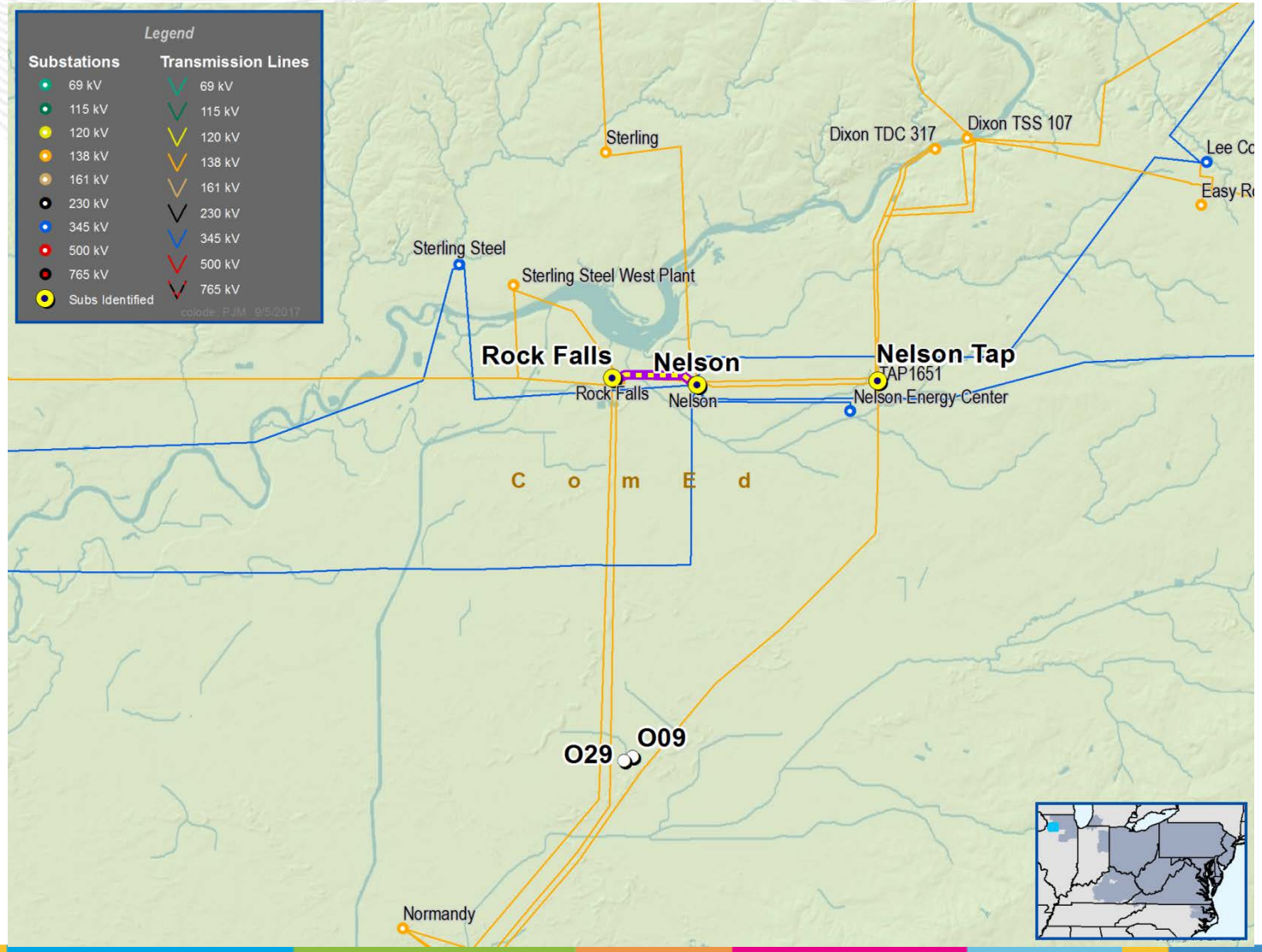
And re-conductor 138 kV line 15508 from O29 (Schauff Road) to Nelson tap

And re-conductor 138 kV line 13311 from O9 (Schauff Road) to Rock Falls

Total: $ 25M --higher cost and smaller network benefit

Estimated Project Cost: $20M

Required IS Date: 11/1/2019



Previously Presented Baseline and Supplemental Projects Second Review

AEP Transmission Zone Baseline Reliability

Baseline Reliability - TO Criteria Violation

Previously Presented: 8/30/2017 SRTEAC

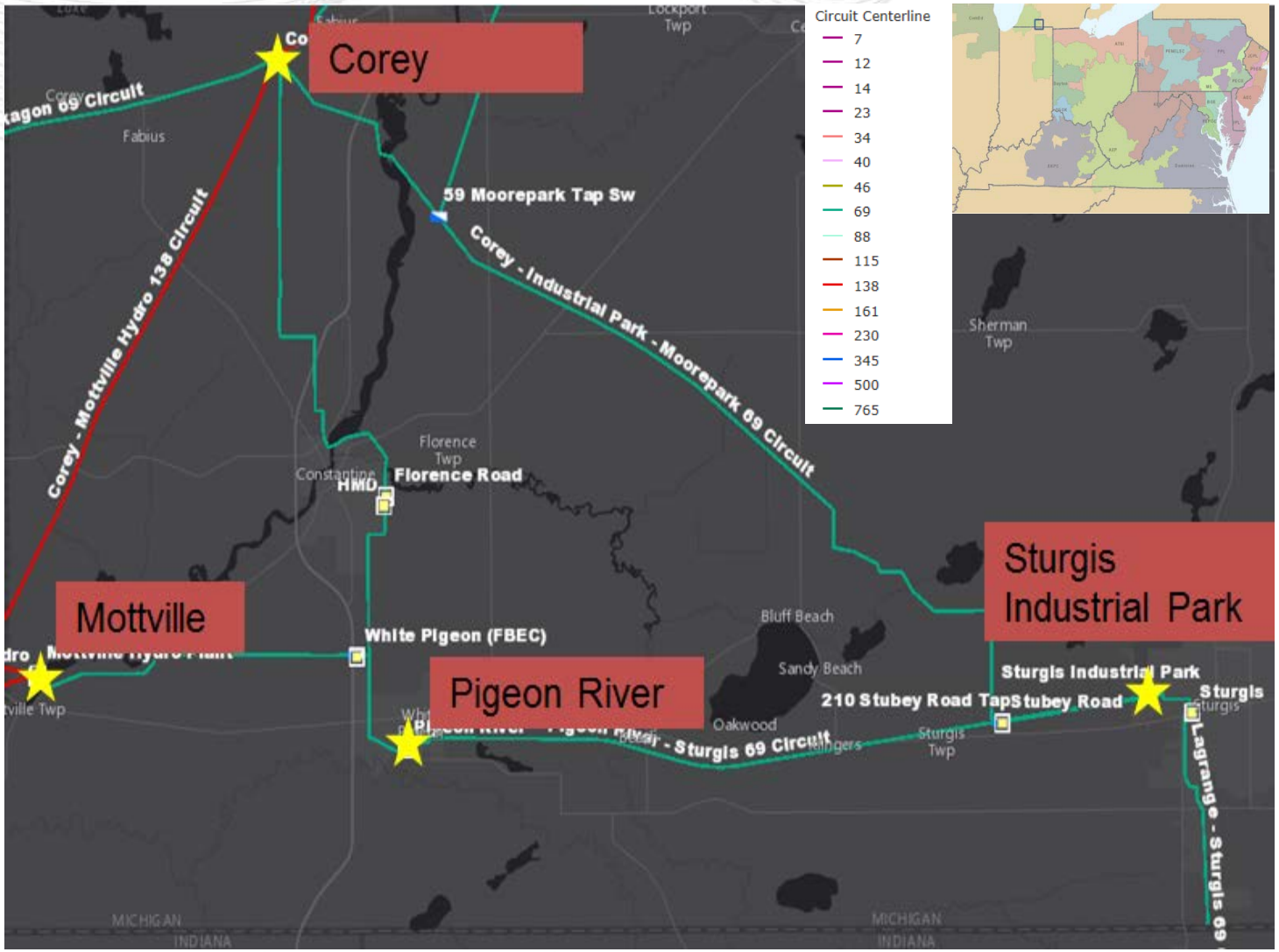
Problem Statement:

Planning Criteria Violations: The 6.7 miles Mottville – Pigeon River 69kV line is one of the strongest sources at the eastern edge of the Michigan footprint. The total load served from the Mottville – Pigeon River and the Corey – Pigeon River 69kV lines is approximately 74 MVA. AEP Transmission planning has identified multiple N-1-1 contingency scenarios that result in thermal violations on the Mottville – Pigeon River (3/0 ACSR, 44MVA, 115% worst loading) and Corey – Pigeon River (3/0 ACSR, 44MVA, 101% worst loading) 69kV lines for loss of any sources out of Corey station.

Equipment Material/Condition/Performance/Risk: The 6.7 miles Mottville – Pigeon River 69kV line was installed in 1978 and has 23 structures without ground wire and/or with broken ground wire. Transmission line engineering and Transmission Field Services agree that the existing structures will not have the capacity to keep standard clearances if a bigger conductor is installed. There are 10 open A conditions along the line. The existing 69kV CB H at Pigeon River station is a 1200 A 19 kA oil filled breaker that was manufactured in 1969. This breaker has had 89 fault operations, exceeding the manufacturer limit of 10. Oil samples on this breaker indicate a large concentration of PCB. Oil spills are frequent with breaker failures and routine maintenance can become an environmental hazard.

Operational Flexibility and Efficiency: Multiple Post Contingency Local Loading Relief Warnings (PCLLRW's) have been issued in this area as a result of the current 44MVA rating of the line. In order to identify a potential temporary solution to the PCLLRW's, transmission planning performed a LIDAR study on this line to determine the feasibility of operating it at a higher operating temperature. LIDAR study identified clearance constraints across several sections of the line that will prohibit increasing the operating temperature.

Customer Service: The City of Sturgis has requested a study to analyze the impacts of 20 MW demand increase. Planning analysis shows that a 138 kV conversion will be required to mitigate low voltage constraints as result of a 20 MW demand increase in the Sturgis area. Presently, City of Sturgis operates its 69 kV network in radial configuration due to operational constraints on the AEP network. In addition to the 20 MW demand, City of Sturgis is also planning to close the network to improve reliability. By designing the proposed line to 138 kV standards for a future conversion the network is able to meet the 20 MW incremental demand and City's desire to close the network. The incremental cost of 138 kV design is $0.2M per mile.



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Baseline Reliability - TO Criteria Violation

Recommended Solution:

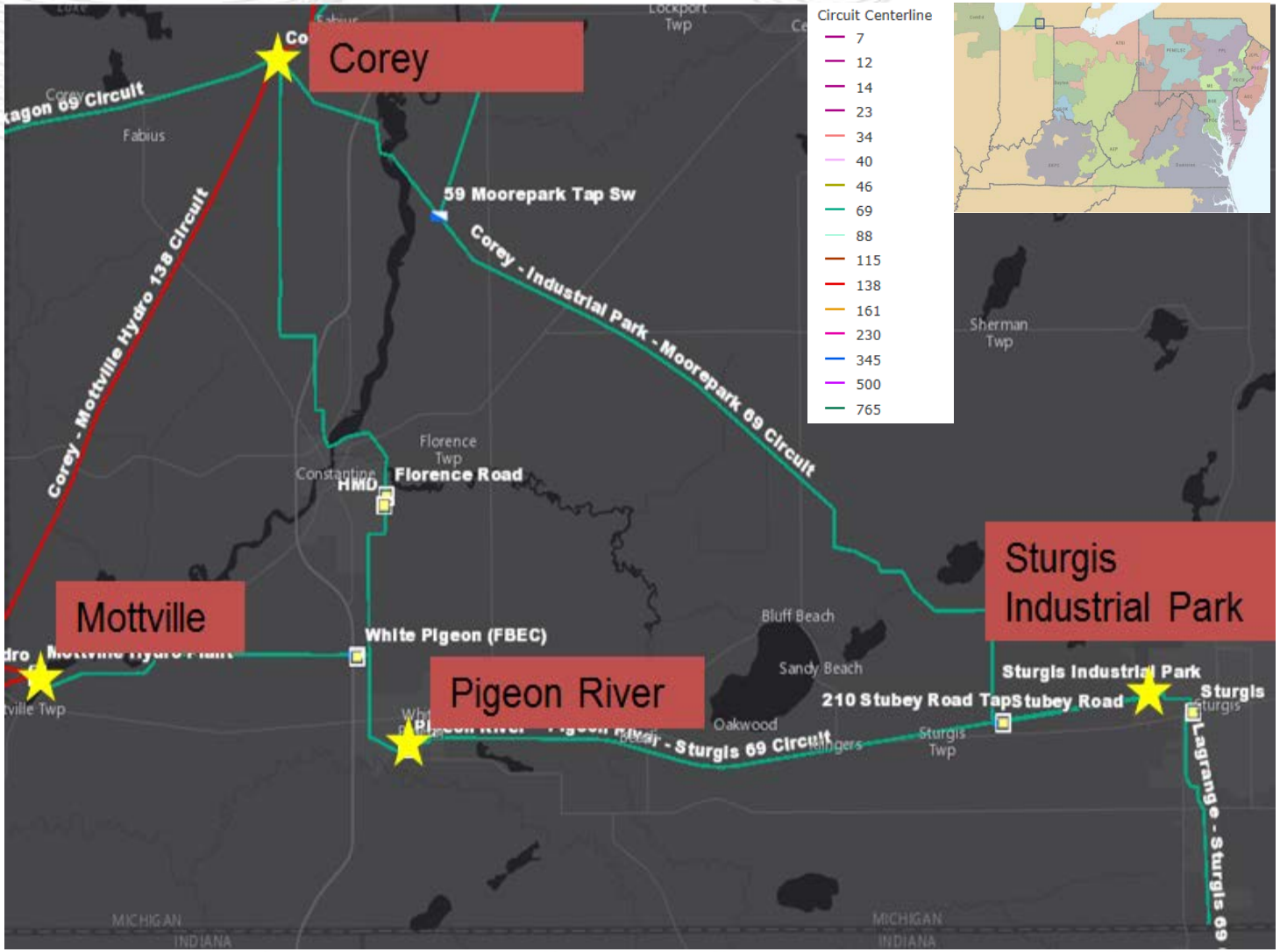
Rebuild approximately 6.7 miles of 69kV line between Mottville and Pigeon River using 795 ACSR conductor (129 MVA rating). New construction will be designed to 138kV standards but operated at 69kV. (B2936.1)

Pigeon River Station: Replace existing MOAB Sw. 'W' with a new 69kV 3000 A 40 kA breaker, and upgrade existing relays towards HMD station. Replace CB H with a 3000 A 40 kA breaker. (B2936.2)

Estimated Project Cost: $12M for rebuilding and $1.5M for pigeon river station upgrades (Total $13.5M)

Required ISD: 6/1/2020

Status: Scoping



Baseline Reliability – Common Mode Violation

Previously Presented: 8/30/2017 SRTEAC

Problem Statement:

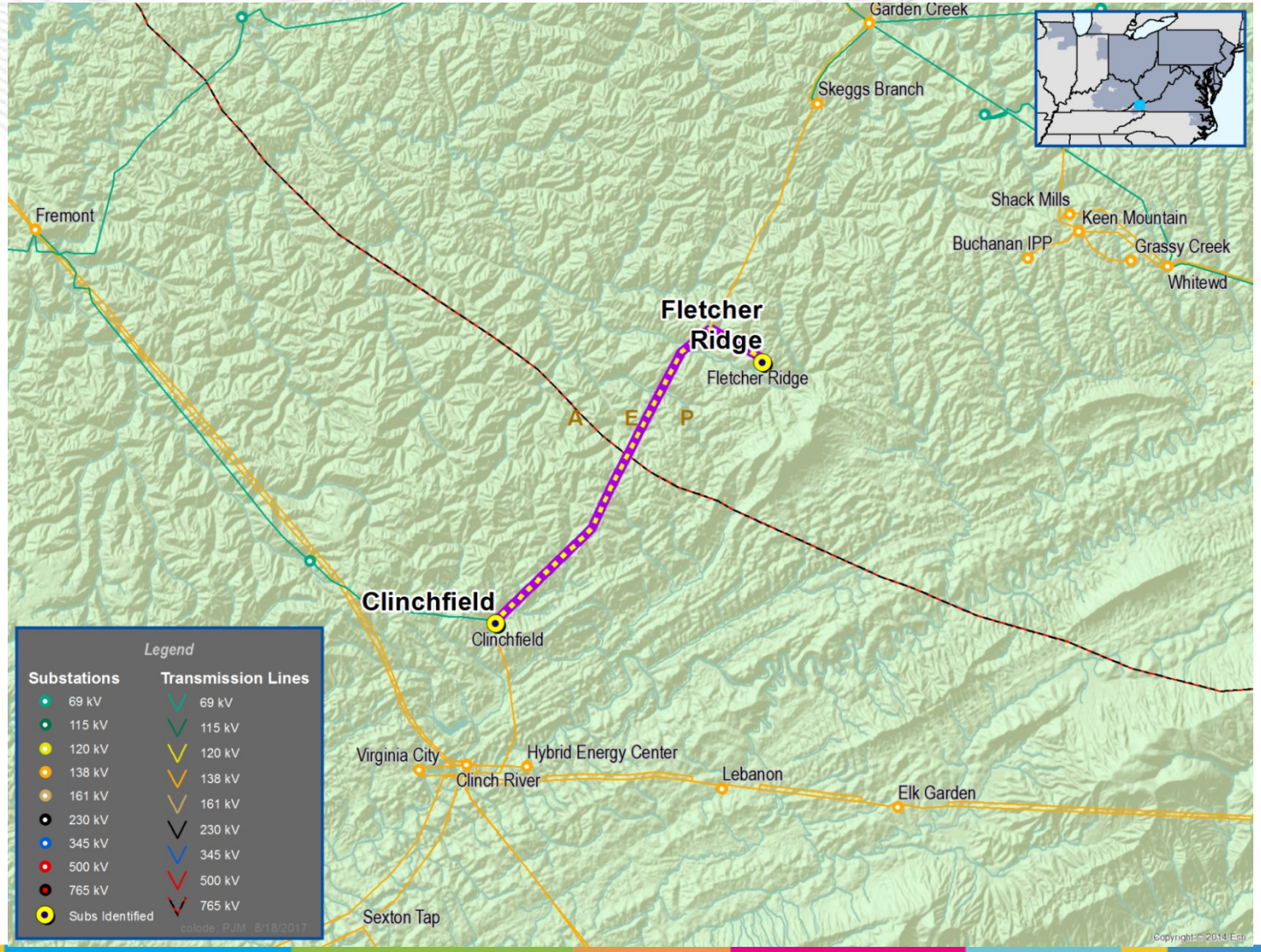
Clinchfield – Fletcher Ridge 138kV line is overloaded for the loss of Broadford – Saltville 138kV line with the stuck breaker at Saltville 138kV (GD-S862)

Recommended Solutions:

Replace the existing 636 ACSR 138 kV Bus at Fletchers Ridge with a larger 954 ACSR conductor (B2937)

Estimated Project Cost: $0.63M

Required ISD: 6/1/2022



Baseline Reliability – Generator Deliverability and Common Mode Violation

Previously Presented: 8/30/2017 SRTEAC

Problem Statement:

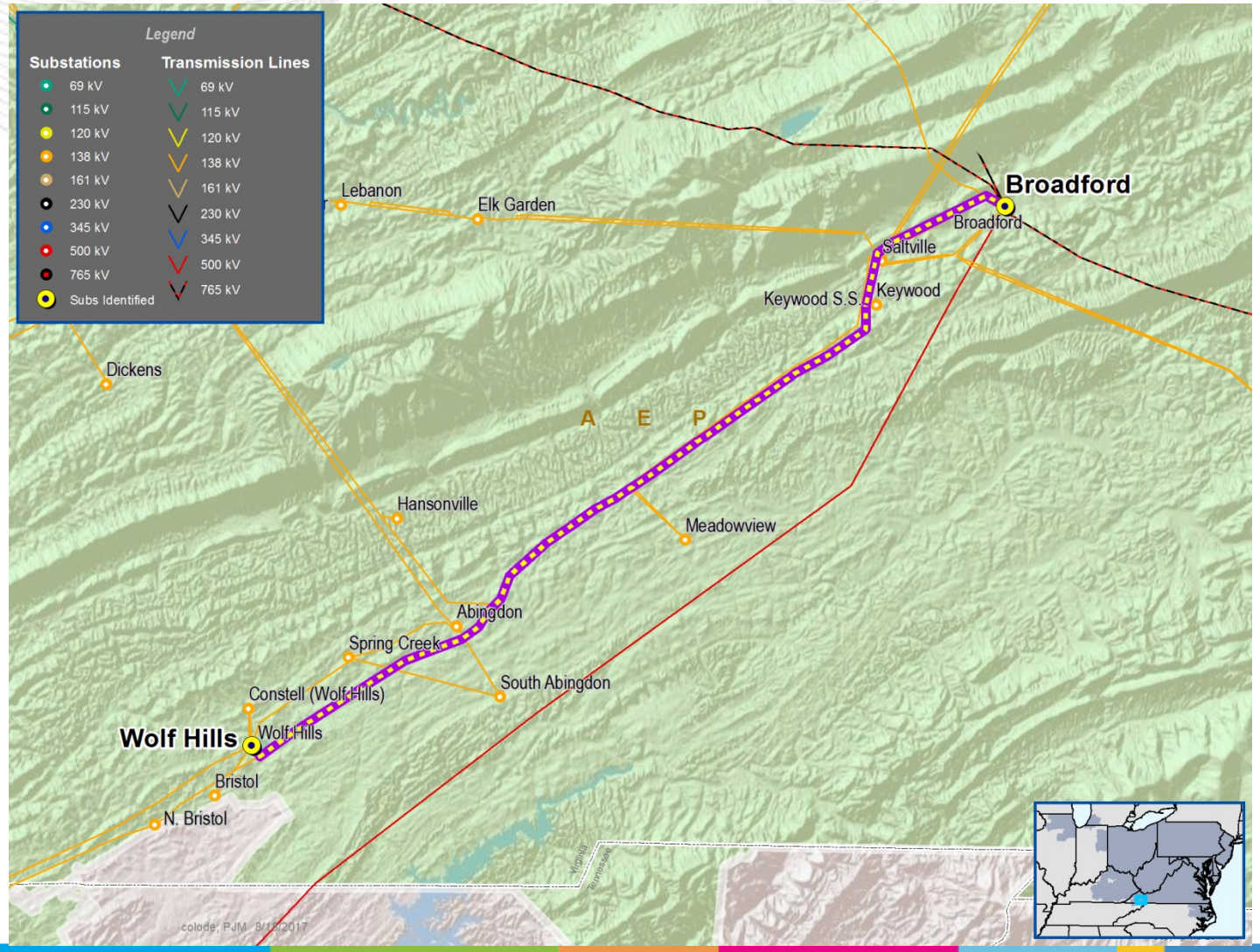
Broadford – Wolf Hills 138kV line is overloaded for the loss of the Boardford – Sullivan 500KV line and the Broadford 765/500kV transformer or the loss of the Broadford – Sulllivan 500kV line with the breaker stuck at Broadford 765kV. (GD-S70, GD-S114, GD-S755, GD-S802)

Recommended Solutions:

Perform a sag mitigations on the Broadford – Wolf Hills 138kV circuit to allow the line to operate to a higher maximum temperature. (B2938)

Estimated Project Cost: $2.6M

Required ISD: 6/1/2022



Baseline Reliability – Summer Generator Deliverability

Previously Presented: 8/30/2017 SRTEAC

Problem Statement:

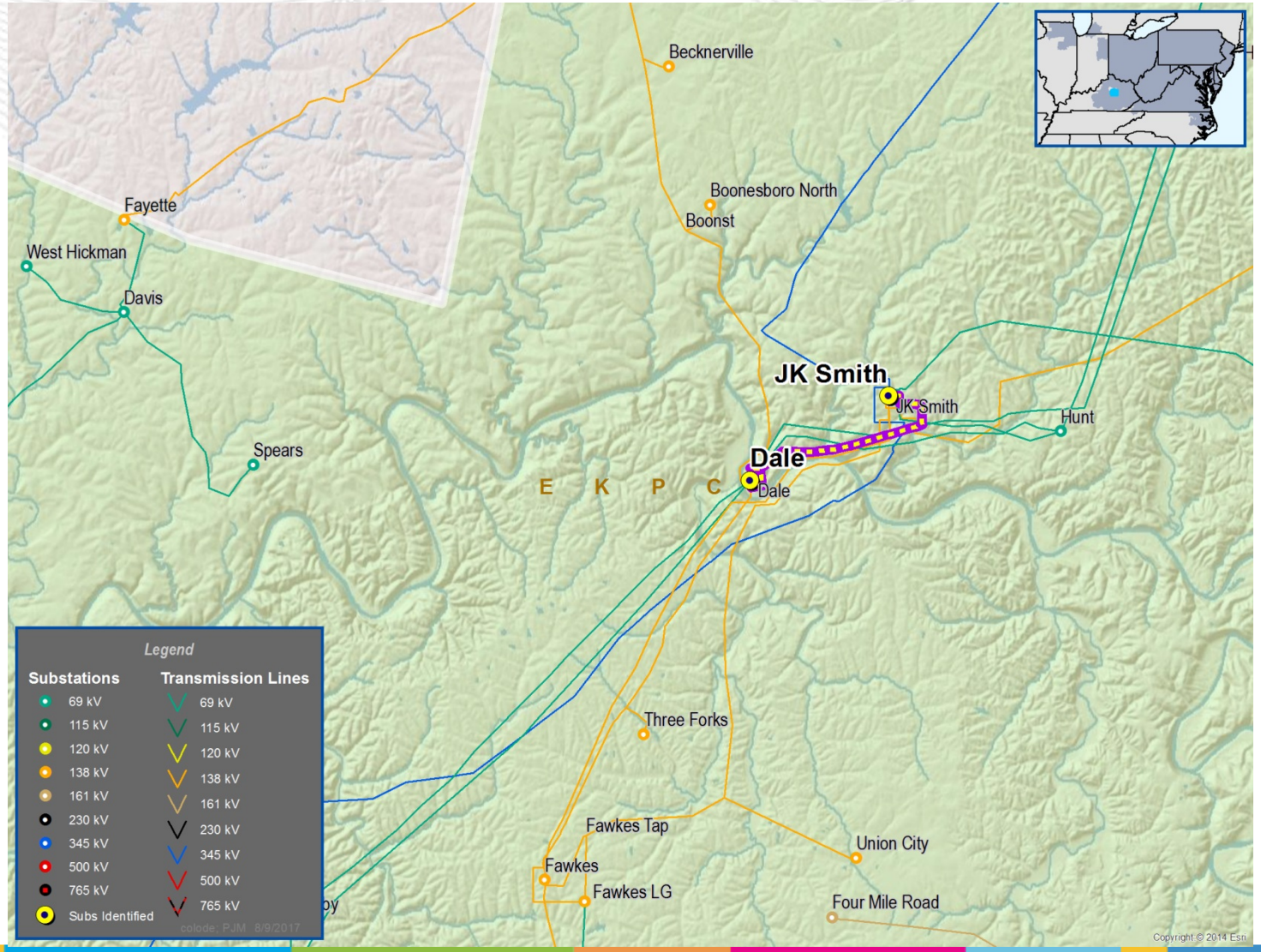
JK Smith – Dale 138kV line is overloaded for the loss of the JK Smith – N Clark 345kV line (GD-S174)

Recommended Solutions:

Increase the conductor MOT for the Dale – JK Smith 138kV line to 275˚F. The new summer ratings would be 229/296 (B2939)

Estimated Project Cost: $0.4M

Required ISD: 6/1/2022



Baseline Reliability – Winter Generator Deliverability

Previously Presented: 8/30/2017 SRTEAC

Problem Statement:

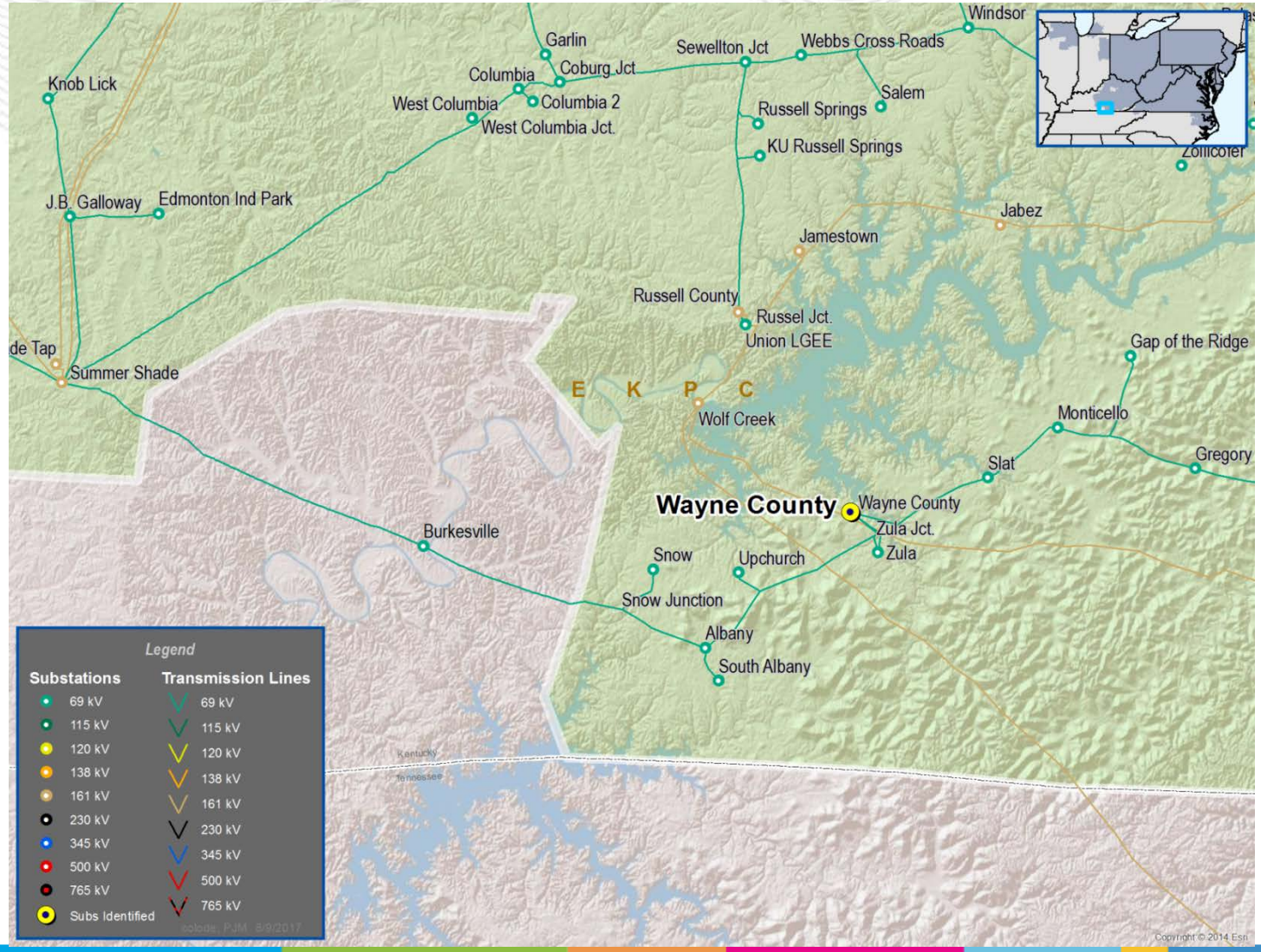
The Wayne Co – Wayne Co KY 161kV line is overloaded for the loss of the Summer Shade 161kV bus section S11-1039. (GD-W314, GD-W483)

Recommended Solutions:

Upgrade the distance relay on the Wayne Co – Wayne Co KY 161kV line to increase the line winter rating would be 167/167. (B2940)

Estimated Project Cost: $0M

Required ISD: 12/1/2022



ComEd Transmission Zone Baseline Reliability

Baseline Reliability – > 300MW Load Loss

Previously Presented: 8/30/2017 SRTEAC

Problem Statement:

>300MW load loss for the loss of the 138kV tower lines L4605 (Des Plaines – Busse – Schaumburg – Landmeier – Tonne 138kV "Red" line) and L4606 (Des Plaines – Busse – Schaumburg – Landmeier –Tonne 138kV "Blue" line) (N1-SLD1)

Immediate Need: Due to the immediate need, the timing required for an RTEP proposal window is infeasible. As a result, the local Transmission Owner will be the Designated Entity.

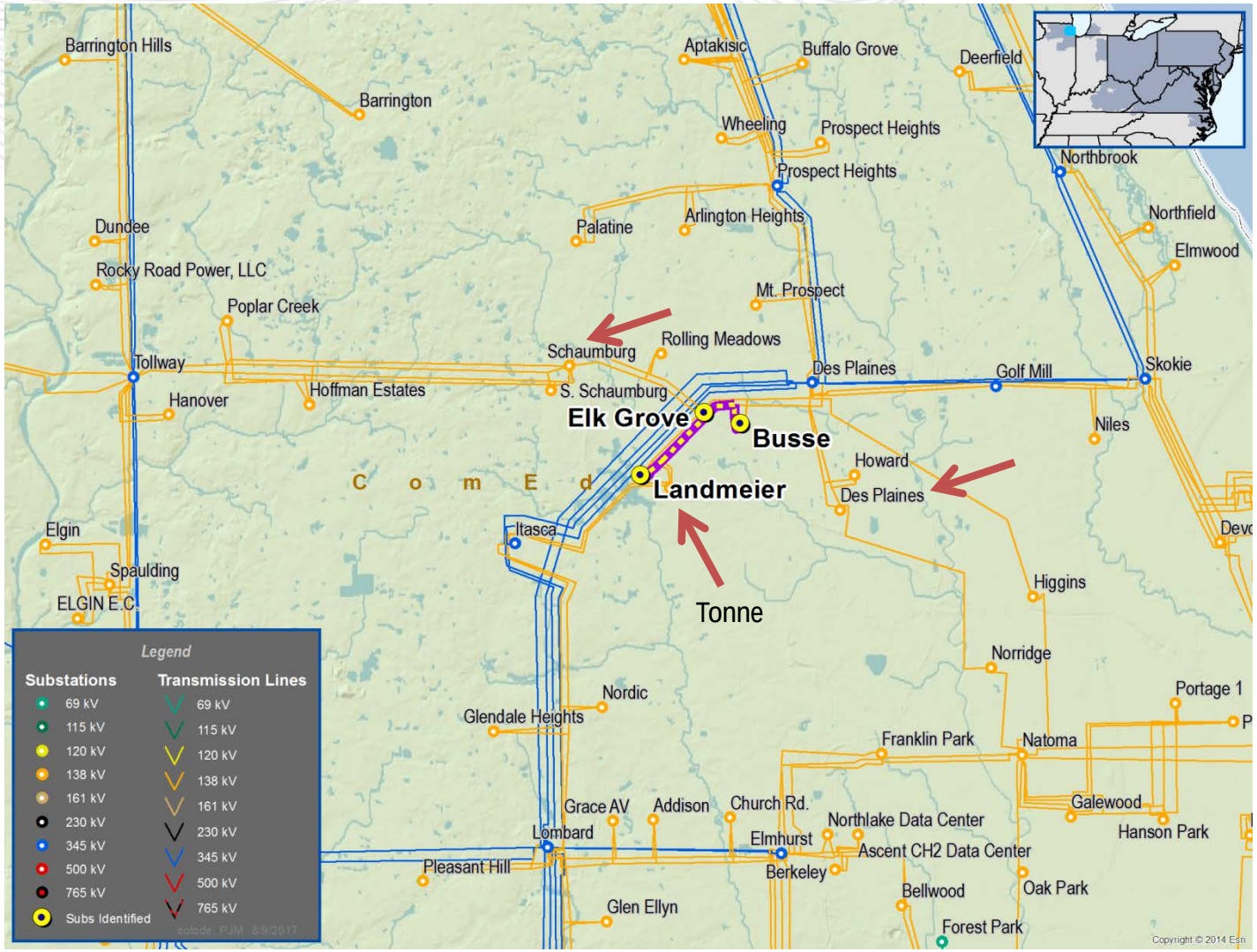
Recommended Solution:

Build an indoor new Elk Grove 138kV GIS substation at the point where Rolling Meadows & Schaumburg tap off from the main lines, between Landmeier and Busse. The four 345 kV circuits in the ROW will be diverted into Gas Insulated Bus (GIB) and go through the basement of the building to provide clearance for the above ground portion of the building. (B2941)

Estimated Project Cost: $90M

Required ISD: Immediate need

Projected ISD: 6/1/2021



DEOK Transmission Zone
Baseline Reliability

Baseline Reliability – Project Scope Change Of B2828

Previously Presented: 8/30/2017 SRTEAC

Original Scope: Install 5% reactors at Miami Fort 138 kV to limit current
New Scope: Install 10% reactors at Miami Fort 138 kV to limit current

Immediate Need:
Due to the immediate need, the timing required for an RTEP proposal window is infeasible. As a result, the local Transmission Owner will be the Designated Entity.

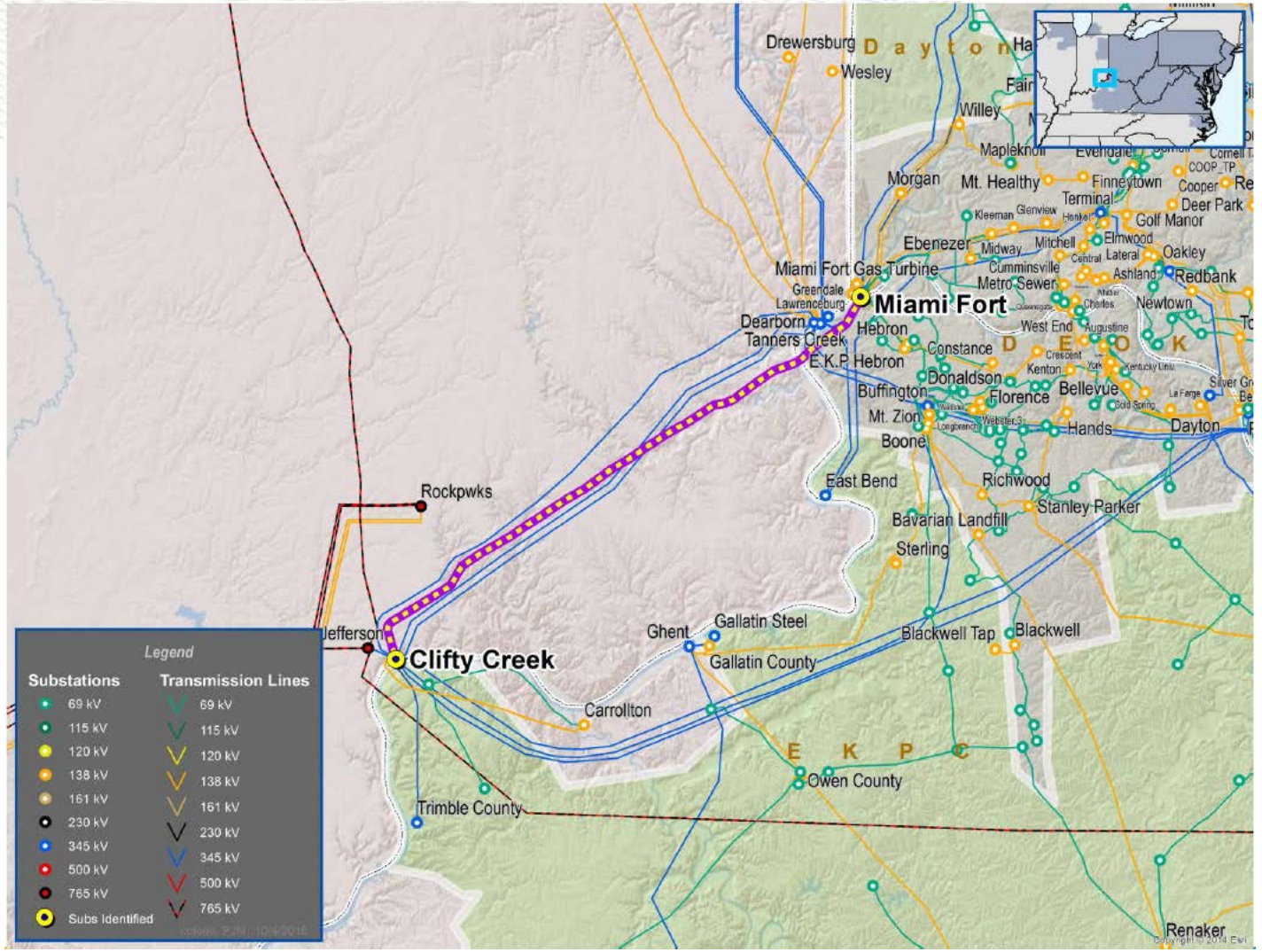
Problem Statement:
Miami Fort –Clifty Creek 138KV line is overloaded for the loss of the Clifty- Dearborn 345kV tower lines due to the retirement of the Stuart and Killen units (GD-S598)

Original Estimated Project Cost: $1M

New Estimated Project Cost: $1M

Original Required ISD: 6/1/2018

New Required ISD: 6/1/2018



Supplemental Project

Previously Presented: 8/30/2017 SRTEAC

Problem Statement:

Equipment Material/Condition/Performance/Risk: Forming the Blaine Street – Haymond circuit allows 4.5 miles of the Bellaire – Delaware circuit to be retired. This circuit has 16 current open conditions including split and broken crossarms; broken ground lead wires; broken guy wires; broken and loose insulators; cracked and burnt poles; broken shield wire; and disconnected or broken X-braces.

Operational Flexibility and Efficiency: Bellaire Station no longer serves load. O&M expenditures are being made to maintain the station in safe working order. Retiring and removing Bellaire Station will eliminate ongoing O&M costs and simplify system configuration.

Consolidation of certain elements of the Muncie area 34 kV sub-transmission system will allow obsolete and deteriorated line sections and station facilities to be retired and removed rather than maintained and/or replaced. Simplification of the Muncie area sub-transmission system will reduce cost and complexities associated with planning, inspecting, maintaining, replacing, and operating the system.

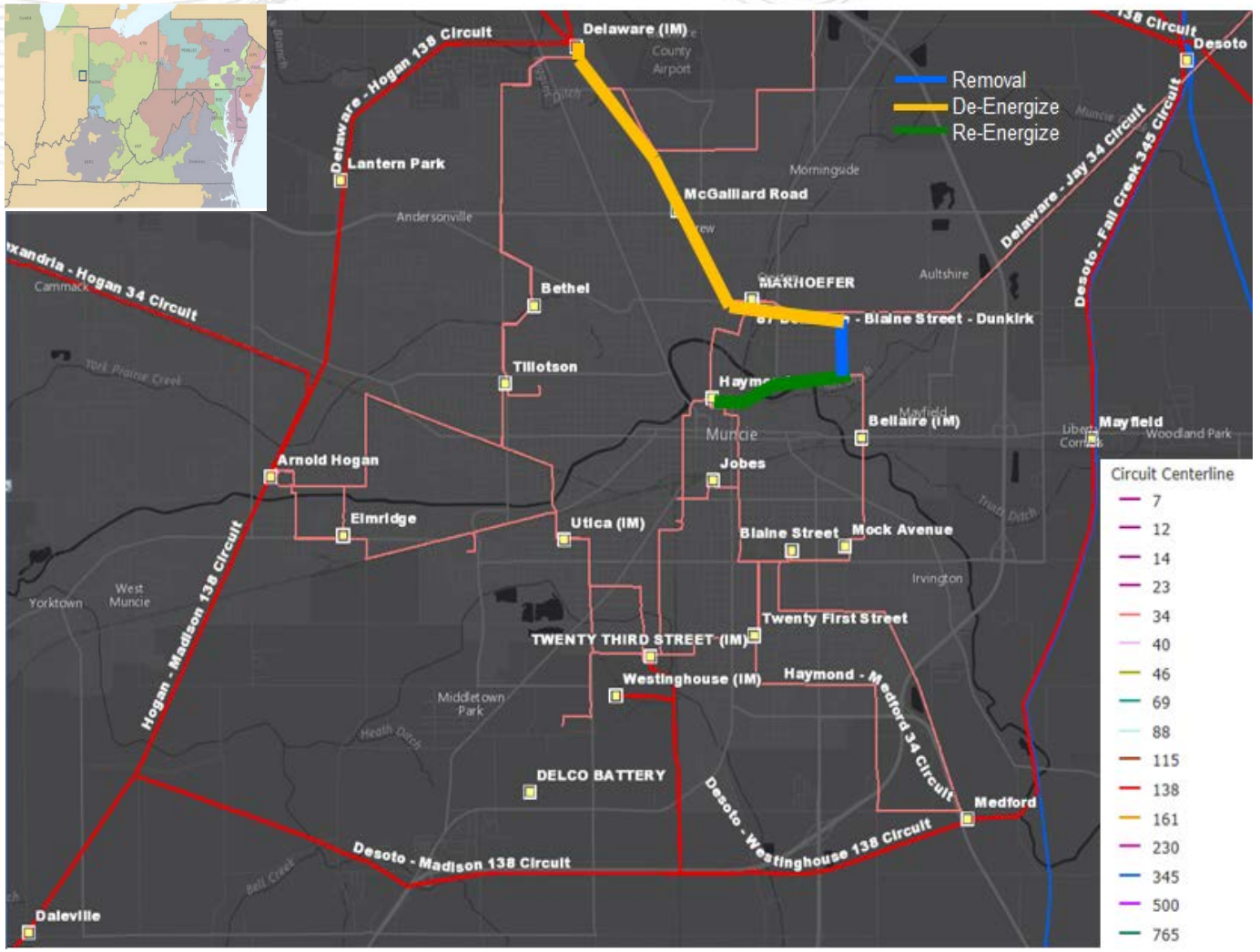
Selected Solution:

Retire and bypass Bellaire 34.5kV station. Retire and de-energize a portion of the Bellaire-Delaware 34.5 kV line. Re-energize and re-terminate the Haymond-Modoc 34.5kV line to create a new Haymond-Mock Avenue-Blaine Street 34.5kV circuit. (S1371)

Estimated Project Cost: $1.37M

Project ISD: 9/21/2017

Status: Construction



AEP Transmission Zone

Supplemental Project

Previously Presented: 8/30/2017 SRTEAC

Problem Statement:

Equipment Material/Condition/Performance/Risk: The Liberty Center – Bluffton line was built with wood poles in 1951 and 1964 with a mix of 1/0 and 4/0 ACSR conductor (50 MVA rating). There are 72 open conditions along the 6.4 mile long line, including split bayonets; broken and inadequate clearance conductors; split and twisted cross-arms; tree, vine and brush hazards; broken and missing ground lead wires; broken and loose insulator; broken and insect damaged knee/vee braces; disconnected OPGW and pilot wire; cracked, damaged, rotted, split and damaged poles; and improperly installed and broken shield wire..

The existing Liberty Center REMC switch difficult to maintain due to its location and lack of access road to the switch. By relocating the switch, maintenance and outages are easier to coordinate.

Selected Solution:

Retire the old Liberty Center REMC switch and install a new 69kV 1200A 3 way PoP switch at structure at Meridian Road. (S1372.1) --$0.299M

Replace Bluffton and Liberty Center line switches with 1200A 61kA 1-way GOAB's -- $0.502M

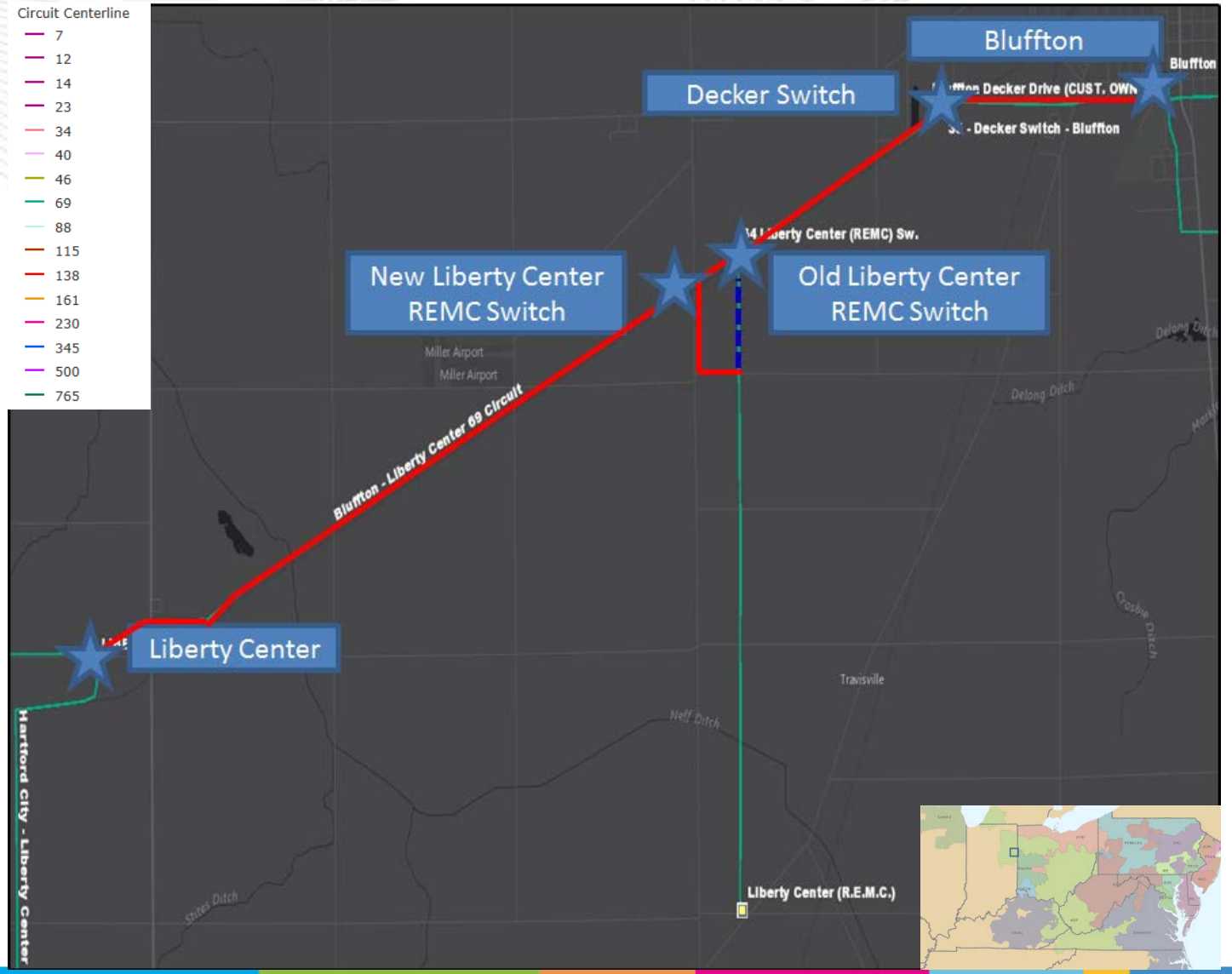
Rebuild the full 6.43 miles of the Liberty Center – Bluffton 69kV circuit utilizing 795 26/7 ACSR (129 MVA rating) (S1372.2) -- $8.698M

Retire line from the old Liberty Center Switch to structure 5 and build 0.58 miles using 4/0 ACSR from the new Liberty Center Switch to structure 5. (S1372.3) -- $1.064M

Estimated Project Cost: $10.56M

Project ISD: 3/1/2018

Status: Engineering



Supplemental Project

Previously Presented: 8/30/2017 SRTEAC

Problem Statement:

Customer Service: Establish new 138kV service to a 180 MW (peak) customer facility in New Albany, OH, directly adjacent to the Jug Street – Kirk 138kV circuit.

Selected Solution:

Establish a new 138kV, breaker and a half station with 12-CBs (Babbitt Station). Cut existing Jug Street – Kirk 138kV circuit and run two single pole line extensions to the new Babbitt Station. (S1373)

Estimated Project Cost: $22.647M

Project ISD: 8/31/2018

Status: Engineering

DEOK Transmission Zone

Supplemental Project

Previously Presented: 7/21/2017, 8/30/2017 SRTEAC

Problem Statement:

At Beckford, previous retired units fed six 138 kV buses. Now the primary sources for those buses are the two 345/138 kV transformers at Pierce. This project will eliminate having both sources from Pierce being connected to the same termination structure at Beckjord with each source connected in a single-bus single-breaker configuration. The feeder will be moved to a different structure and connected to the former Unit 4 position. Each feeder will then be connected in a double-bus double-breaker configuration. This will eliminate the operational restrictions of having each feeder being capable of only feeding one bus and the common mode outage of losing both sources from Pierce. Drivers: operational flexibility, reliability.

Selected Solution:

Relocate one feeder to a different structure feeding a different set of buses. Connect both feeders in a double-bus double-breaker arrangement. (S1364)

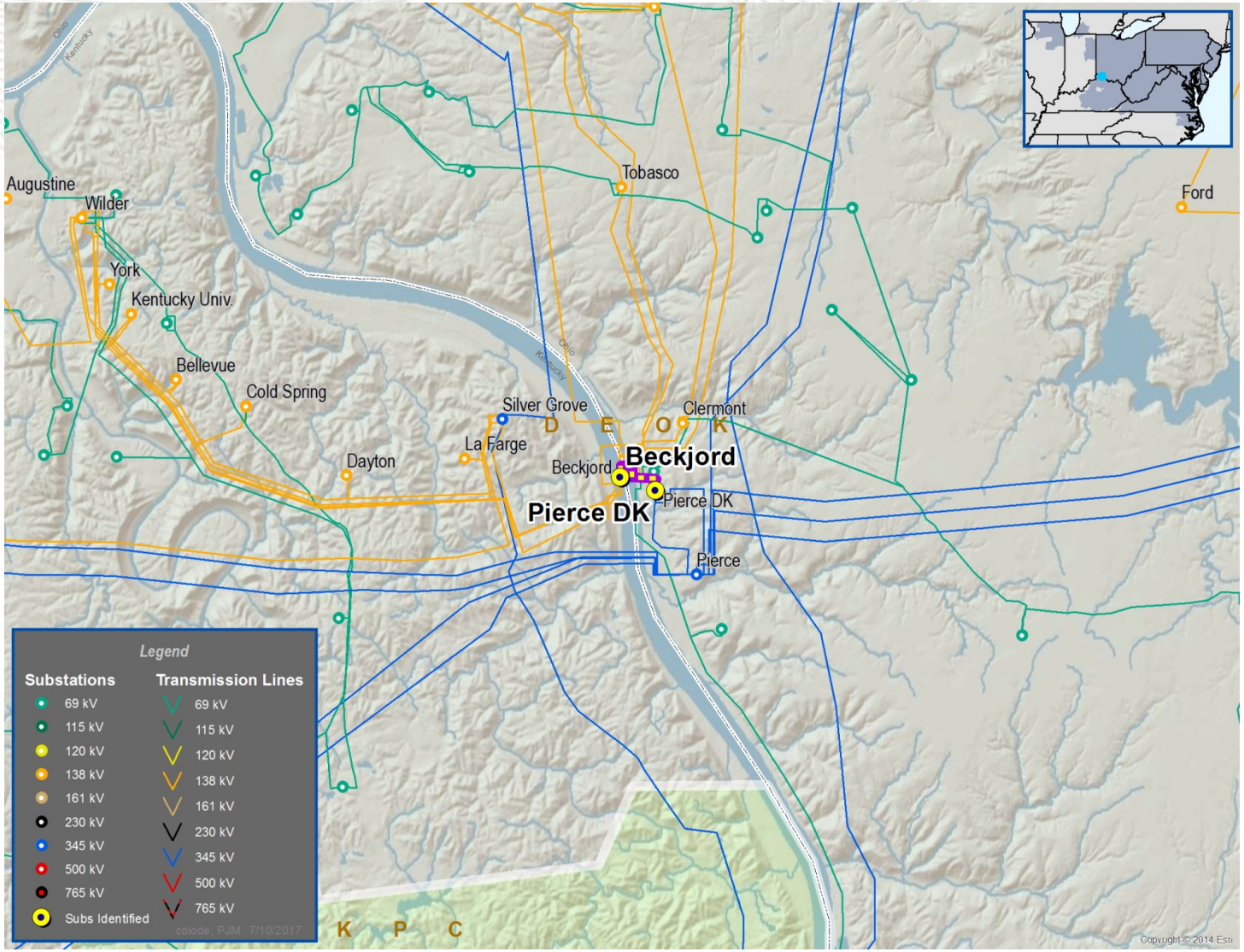
Alternatives:

No alternatives were reviewed.

Estimated Project Cost: 0.18M

Project ISD: 12/31/2020

Status: Engineering



Questions?

Email: RTEP@pjm.com

Revision History

9/5/2017 – Original version posted to PJM.com

9/7/2017 – Slides #4, Added missing information

1/9 2019 – Slides #11, Change Required IS Date from 6/1/2022 to 12/1/2022