PJM Western Sub-Regional RTEP Committee
ATSI Supplemental Upgrades

March 25, 2019

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

ATSI Transmission Zone

Need Number: ATSI-2019-053
Process Stage: Need Meeting
Need Presented: 3/25/2019

Project Driver(s):
Operational Flexibility and Efficiency
Infrastructure Resilience

Specific Assumption Reference(s)

Global Considerations

- System reliability and performance
- Substation / Line equipment limits
- Reliability of Non-Bulk Electric System (Non-BES) facilities
- Load and risk in planning and operational scenarios
- Load and/or customers at risk on single transmission lines

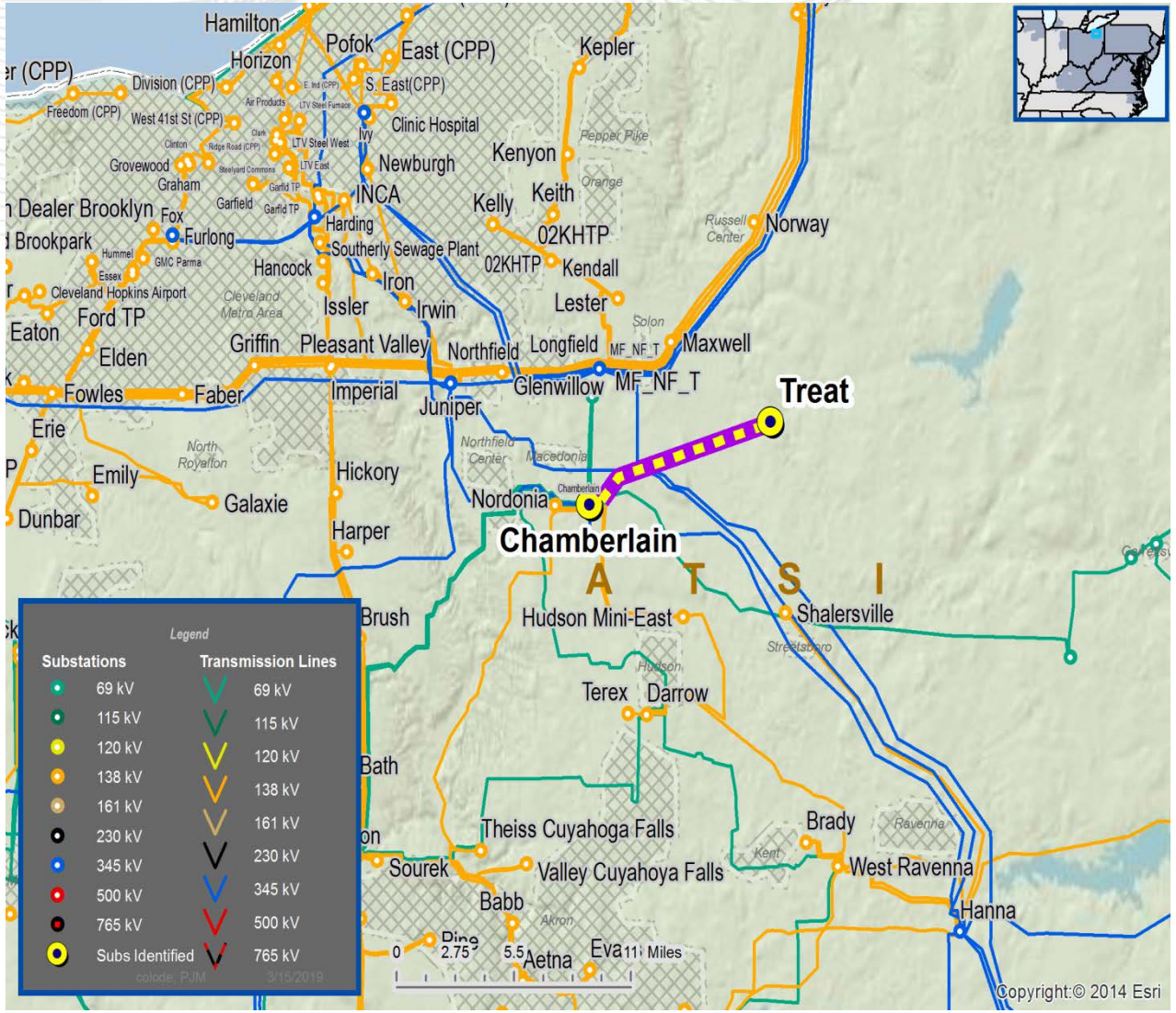
Network Radial Lines

- Load at risk and/or customers affected
- Proximity to other networked facilities

Problem Statement

Chamberlin-Treat 69 kV Line (Radial)

- The Chamberlin-Treat 69 kV line (approximately 13.4 miles) is a radial line.
- Customers and load at risk: Approximately 9,400 customers and 37 MWs of load.
- Limited operational flexibility to maintain service under transmission maintenance and restoration efforts.
- The Chamberlin-Treat 69 kV line has experienced four outages in the past five years.



ATSI Transmission Zone

Need Number: ATSI-2019-054
Process Stage: Need Meeting
Needs Meeting: 03/25/2019

Project Driver(s):
Equipment Material, Condition, Performance and Risk
Operational Flexibility and Efficiency
Infrastructure Resilience

Specific Assumption Reference(s)

Global Considerations

- System reliability and performance
- Substation / Line equipment limits

Problem Statement

Ottawa-West Fremont #2 138 kV Equipment and Tap Connection

- The existing KPF switches A-13135 and A-13136 are obsolete and no longer supported by the manufacturer. The existing customer tap connection (tapped between switch A-13135 and switch A-13136) on the Ottawa-West Fremont #2 138 kV line requires a 270 degree turn and crosses under both the Ottawa-West Fremont #1 and Ottawa-West Fremont #2 138 kV lines which creates operational maintenance constraints.

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

ATSI Transmission Zone

Need Number: ATSI-2019-001
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Project Driver(s):
Operational Flexibility and Efficiency
Infrastructure Resilience

Specific Assumption Reference(s)

Global Considerations

- System reliability and performance
- Substation / Line equipment limits
- Reliability of Non-Bulk Electric System (Non-BES) facilities
- Load and risk in planning and operational scenarios
- Load and/or customers at risk on single transmission lines

Problem Statement

Black River-Shinrock 69 kV Line

The Black River-Shinrock 69 kV line is approximately 24 miles long and serves five (5) transmission customers. The transmission line conductor is the limiting element.

- A Black River-Shinrock 69 kV line outage (N-1) results in approximately 47 MW and 14,200 customers being interrupted.
- Over the past five years, the Black River-Shinrock 69 kV line has experienced approximately 17 outages (9 sustained , 8 momentary).

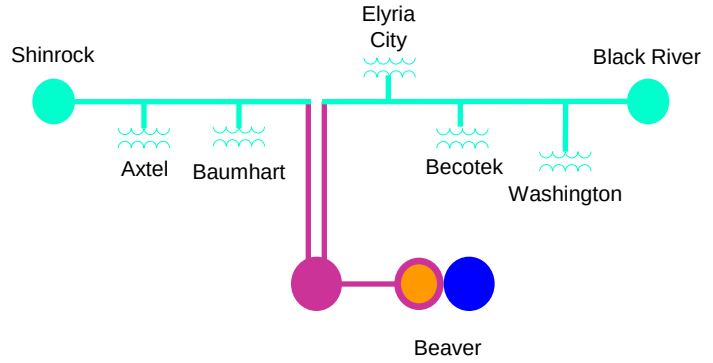
ATSI Transmission Zone

Need Number: ATSI-2019-001
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Proposed Solution:

Beaver Substation – New 138/69 kV Substation

- Build a new 138/69 kV substation near the existing Beaver 138 kV substation.
- Extend 138 kV line (Approximately 0.1 miles) from the Beaver 138 kV substation to the new site
- Install one (1) 138 / 69 kV 100/134 MVA transformer
- Build a three (3) breaker 69 kV ring bus and control house.
- Loop in/out the existing Black River-Shinrock 69 kV line with double circuit line extension (approximately 0.3 miles) to the new 69 kV ring bus.
- At Shinrock replace the existing Electromechanically Relays.
- ~~Add auto-sectionalizing scheme at Axtel substation.~~
- The project will add new 138/69 kV source to the area.
    - Provide operational flexibility and increased reliability
    - Provide additional capacity on the Beaver-Black River 138 kV line



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

Note: Auto-sectionalizing scheme to be installed at Axtel substation in 2019 as a separate project.

ATSI Transmission Zone

Need Number: ATSI-2019-001
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Transmission Line Ratings:

- Black River – Shinrock 69 kV Line
  - Before Proposed Solution: 80 MVA SN / 96 MVA SE
- Black River – Beaver 69 kV Line
  - After Proposed Solution: 80 MVA SN / 96 MVA SE
- Shinrock – Beaver 69 kV Line
  - After Proposed Solution: 80 MVA SN / 96 MVA SE

Alternatives Considered:

- Install 69 kV ring bus or auto-sectionalizing scheme at Axtel substation.

Estimated Project Cost: $7.4M
Projected IS Date: 12/31/2020
Status: Conceptual

ATSI Transmission Zone

Need Number: ATSI-2019-002
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Project Driver(s):
Operational Flexibility and Efficiency
Infrastructure Resilience

Specific Assumption Reference(s)

Global Considerations

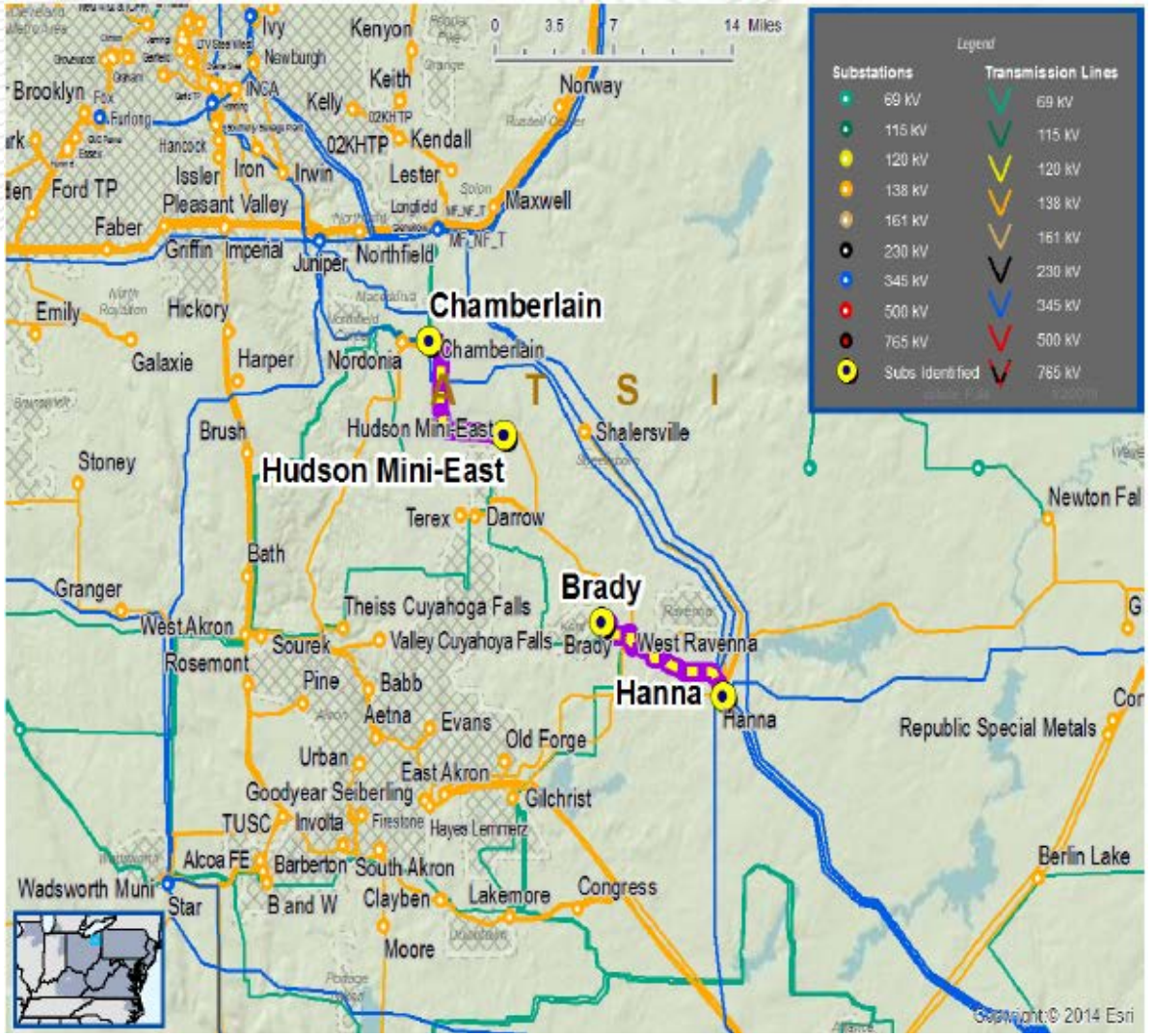
- System reliability and performance
- Substation / Line equipment limits
- Reliability of Non-Bulk Electric System (Non-BES) facilities
- Load and risk in planning and operational scenarios

Problem Statement

Brady 138 kV Area

PJM has issued PCLLRW to potentially drop 20 MW of load at Brady substation for the (N-1-1) outage of the Brady-Hanna 138 kV line and the Chamberlin-Hudson Muni 138kV line.

- Post-contingency voltage at Brady drops below 0.92 p.u. under this back-feed condition from Darrow 138 / 69 kV substation.
- The overall load at risk is approximately 61 MW, and the number of customers impacted is approximately 18,800.



ATSI Transmission Zone

Need Number: ATSI-2019-002
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Proposed Solution:

Brady 138 KV, 26.4 MVAR capacitor bank

- Install 138kV, 26.4 MVAR capacitor bank at Brady substation.
- Add one 138kV circuit breaker to convert Brady three (3) circuit breaker ring bus into four (4) circuit breaker ring bus.

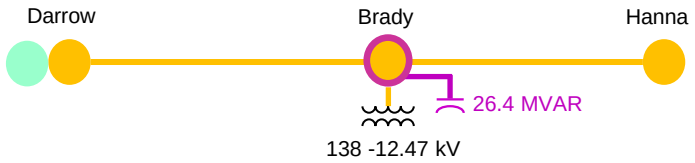
Transmission Line Ratings:

- No Impact

Alternatives Considered:

- Bring another 138 kV source into Brady substation.

Estimated Project Cost: $1.4M
Projected IS Date: 12/31/2019
Status: Conceptual



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

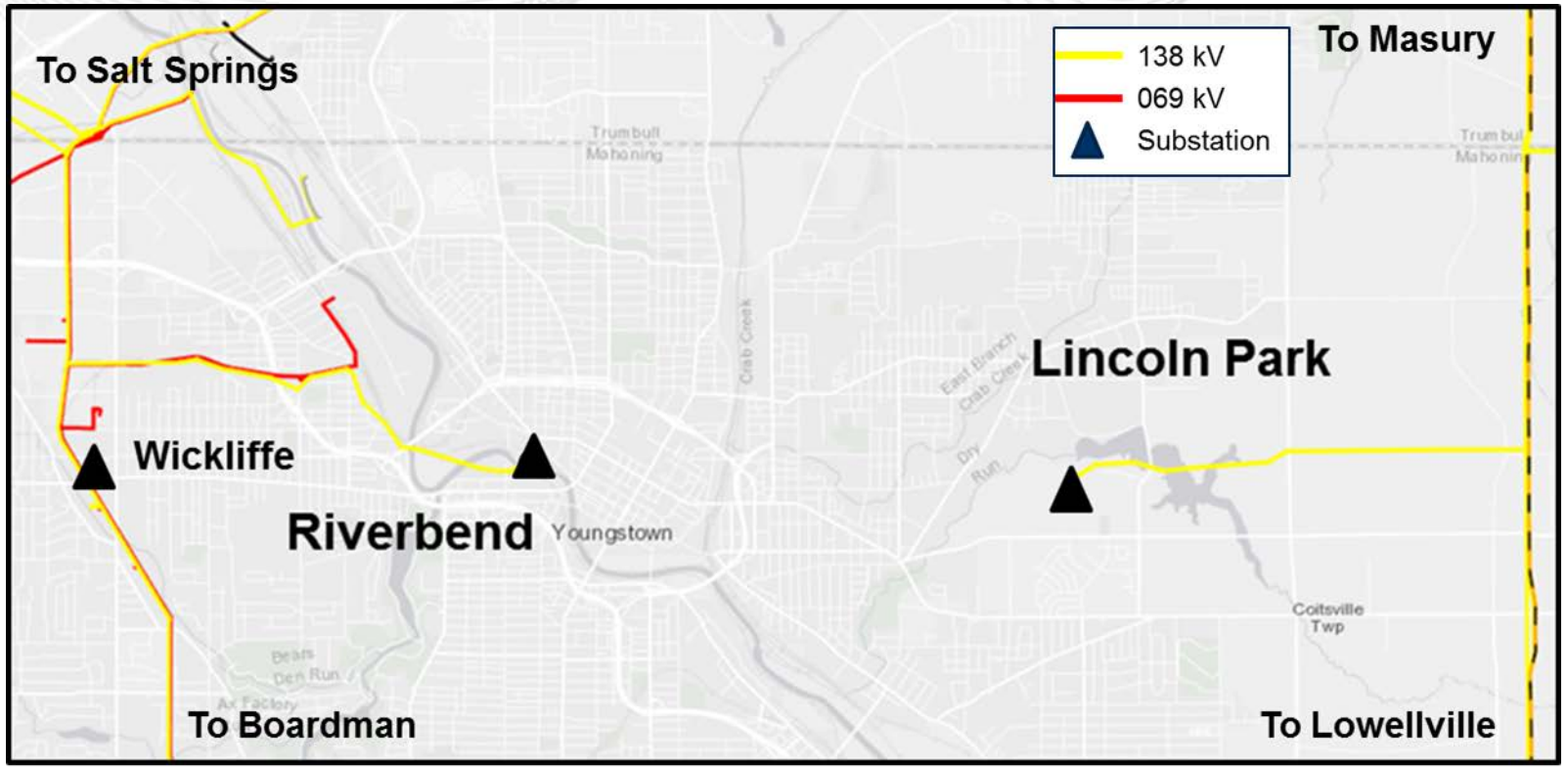
ATSI Transmission Zone

Need Number: ATSI-2019-003
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Project Driver(s):
Operational Flexibility and Efficiency
Infrastructure Resilience

Specific Assumption Reference(s)
Global Considerations

- System reliability and performance
- Substation / Line equipment limits
- Reliability of Non-Bulk Electric System (Non-BES) facilities
- Load and risk in planning and operational scenarios
- Load and/or customers at risk on single transmission lines



Problem Statement

Lincoln Park and Riverbend 138 kV Area

Lincoln Park 138 - 23 kV substation presently serves approximately 35 MW and 5,000 customers

- The loss of the Lincoln Park-Masury 138 kV line followed by the loss of the Lincoln Park-Lowellville 138 kV line (N-1-1) results in the loss of approximately 35 MW and 5,000 customers.

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Need Number: ATSI-2019-003
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Problem Statement - Continued

Riverbend 138 - 23 kV substation presently serves approximately 40 MW and 9,100 customers. Additionally the Wickliffe 138 kV substation serves approximately 22 MW and 10,000 customers.

- The loss of the Boardman-Wickliffe 138 kV line followed by the loss of the Riverbend-Salt Springs 138 kV line (N-1-1) results in the loss of roughly 62 MW and 19,100 customers.

System Performance

- Over the past 5 years, the Lincoln Park-Masury 138 kV line has experienced 1 outage
  (0 sustained , 1 momentary).
- Over the past 5 years, the Lincoln Park-Lowellville 138 kV line has experienced 4 outages
  (3 sustained , 1 momentary).
- Over the past 5 years, the Boardman-Wickliffe 138 kV line has experienced 2 outages
  (2 sustained , 0 momentary).
- Over the past 5 years, the Riverbend-Salt Springs 138 kV line has experienced 1 outage
  (1 sustained , 0 momentary).

ATSI Transmission Zone

Need Number: ATSI-2019-003
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Proposed Solution:

Lincoln Park – Riverbend 138 kV Line

- Build a new 138 kV line from Riverbend to Lincoln Park substation (roughly 5.7 miles)
- Convert the Riverbend substation into a 4-breaker ring bus configuration by installing two 138 kV breakers
- Expand the Lincoln Park 138 kV ring bus by installing one 138 kV breaker allowing for a new line terminal

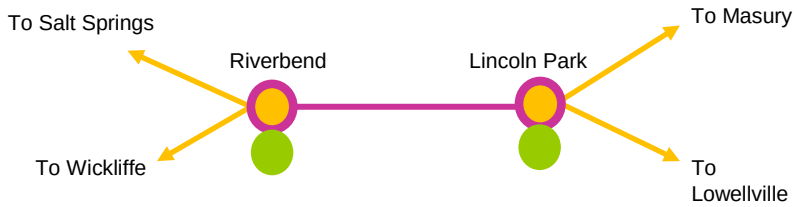
Transmission Line Ratings:

- Lincoln Park – Riverbend 138 kV Line
  - After Proposed Solution: 275 MVA SN / 333 MVA SE

Alternatives Considered:

- Build a new Salt Springs-Riverbend #2 138 kV Line and a new Lincoln Park-Shenango 138 kV Line.

Estimated Project Cost: $25.9M
Projected IS Date: 12/31/2022
Status: Conceptual



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

ATSI Transmission Zone

Need Number: ATSI-2019-004
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Project Driver(s):
Operational Flexibility and Efficiency
Infrastructure Resilience

Specific Assumption Reference(s)

Global Considerations

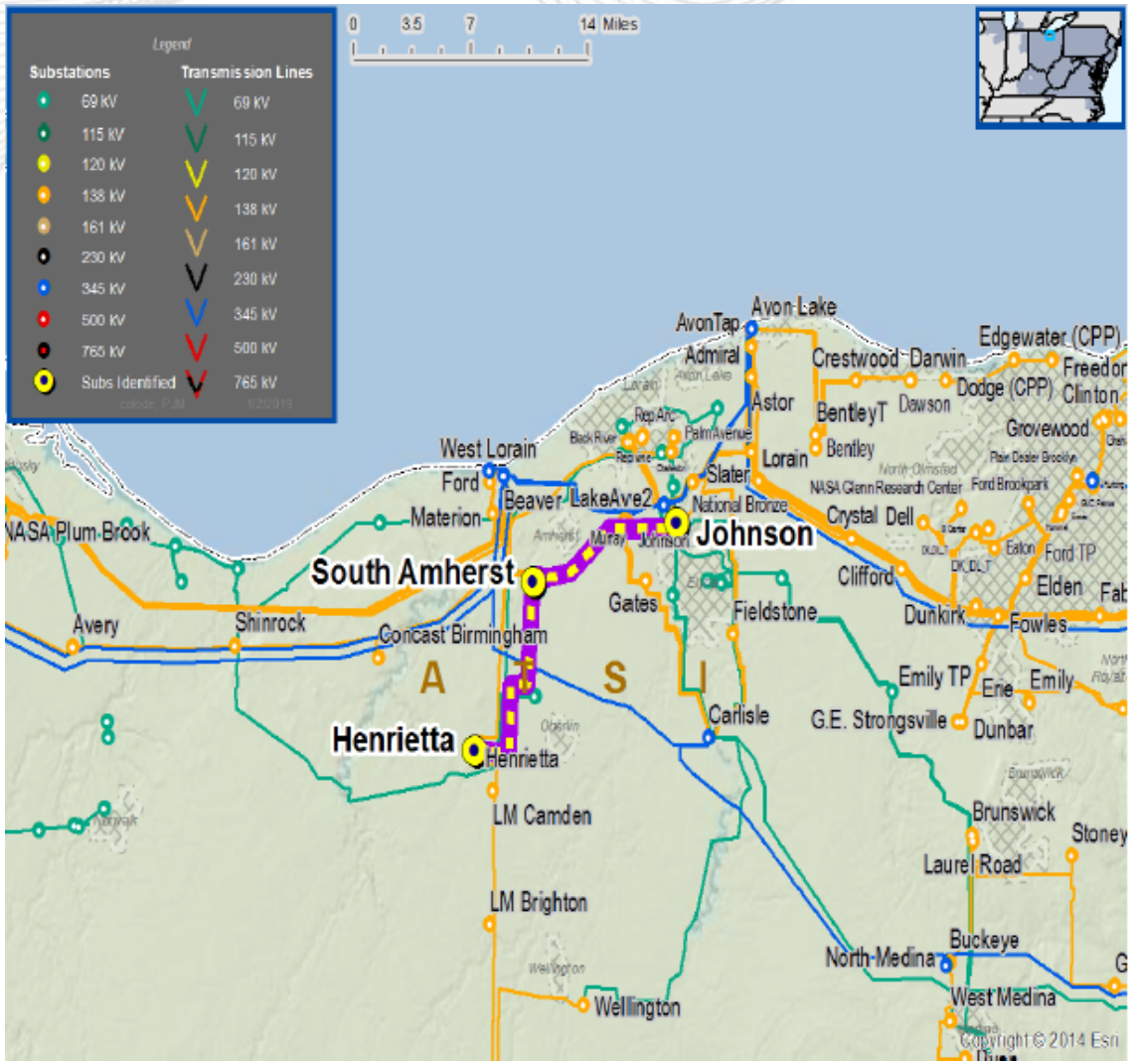
- System reliability and performance
- Substation / Line equipment limits
- Reliability of Non-Bulk Electric System (Non-BES) facilities
- Load and risk in planning and operational scenarios
- Load and/or customers at risk on single transmission lines

Problem Statement

Amherst 69 kV Area

The Amherst 69 kV substation is owned by Amherst Municipality with transmission service from a tapped 69 kV transmission line. The Henrietta-Johnson 69 kV line outage (N-1) results in approximately 39 MW & 9,195 customers at three transmission service points being interrupted.

- Over the past five years, the Henrietta-Johnson 69 kV line has experienced approximately 21 outages (13 sustained , 8 momentary).



ATSI Transmission Zone

Need Number: ATSI-2019-004
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Proposed Solution:

Amherst (New) 69 kV Ring Bus

- Build new 69 kV three (3) circuit breaker, future four(4), ring bus adjacent to Amherst Muni substation.
- Rebuild the Amherst Muni / Nordson tap (Approximately 1 mile) as double circuit 69 kV line, match the main line conductor, and loop the Henrietta-Johnson 69 kV line in/out of the new Amherst 69 kV ring bus.
- Terminate Amherst Muni into the new ring bus switch station.

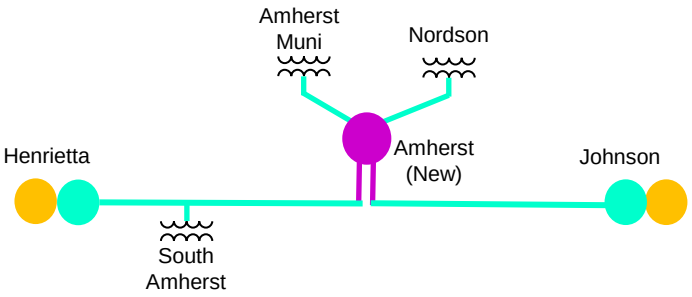
Transmission Line Ratings:

- Henrietta – Johnson (existing) 69 kV Line
  - Before Proposed Solution: 45 MVA SN / 54 MVA SE
- Henrietta – Amherst (New) 69 kV Line
  - After Proposed Solution:**45** MVA SN / **54** MVA SE
- Johnson – Amherst (New) 69 kV Line
  - After Proposed Solution: 80 MVA SN / 96 MVA SE

Alternatives Considered:

- Maintain existing configuration.

Estimated Project Cost: $4.0M
Projected IS Date: 12/31/2020
Status: Conceptual



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

ATSI Transmission Zone

Need Number: ATSI-2019-005
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Project Driver(s):
Equipment Material Condition
Performance and Risk

Specific Assumption Reference(s)

Global Considerations

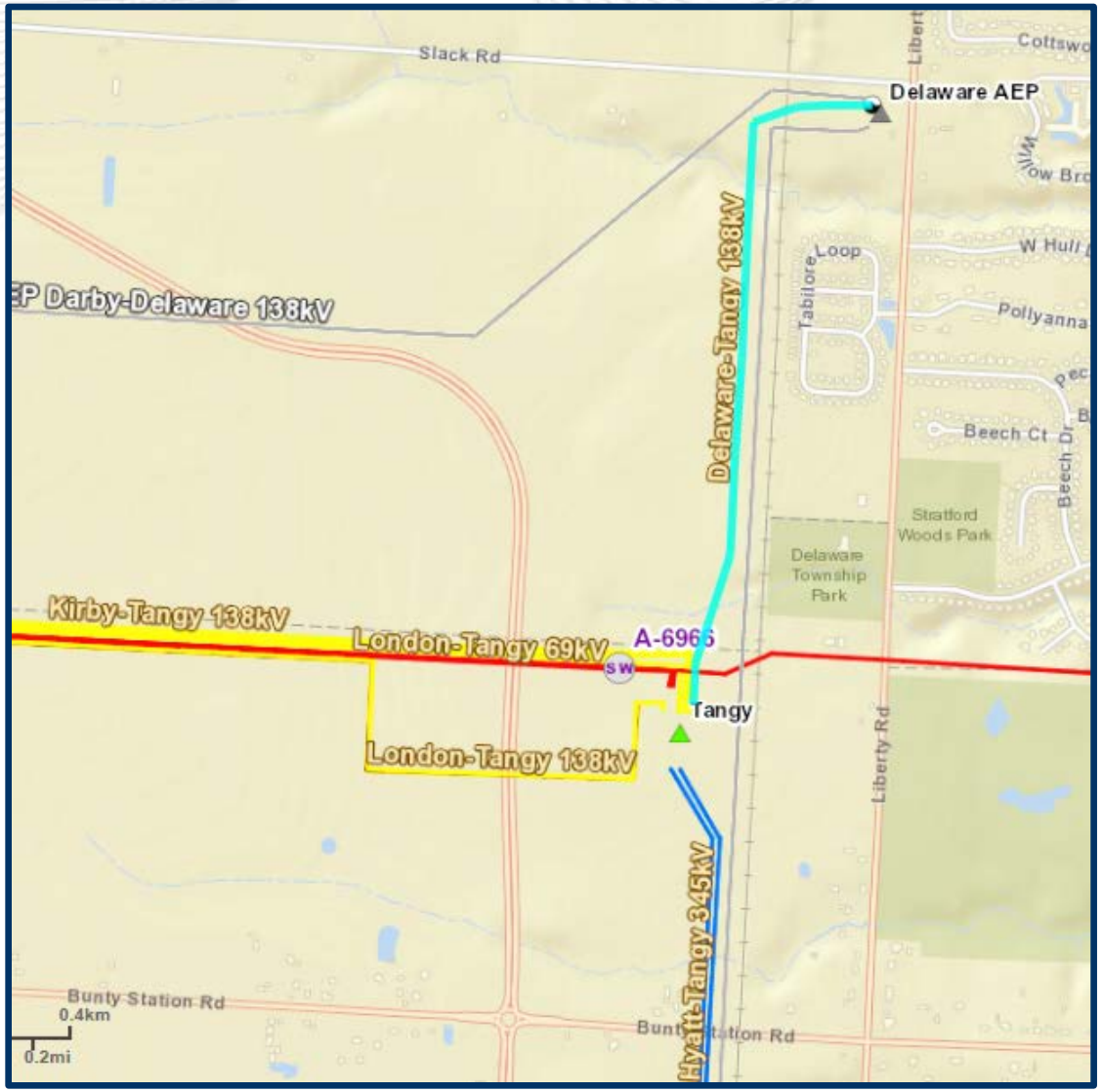
- Level of criticality to system performance and operations
- Expected service life (at or beyond) or obsolescence

Problem Statement

The Delaware – Tangy 138 kV Line is an ~1.0 mile tie line between FirstEnergy and AEP.

The line is operated normally open and has not been closed since 2014.

Failing pilot wire relays and phone line communications are near or beyond their expected service life or obsolete.



ATSI Transmission Zone

Need Number: ATSI-2019-005
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

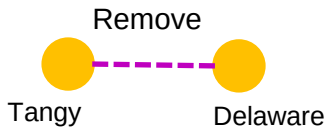
Proposed Solution:

- Remove the Tangy – Delaware 138 kV Line and poles.
- Remove Tangy's B50 relays associated with the Pilot wire scheme (CEY,NAA and CFPG).
- Keep all other relaying and equipment associated with Breaker B50.
- Breaker B50 will be used as the transfer breaker.

Alternatives Considered:

- Replace the obsolete relaying and phone line with fiber and 411L PR/L90 BU scheme with both using current differential over fiber.

Estimated Project Costs: $0.6M
Projected IS Date: 06/30/2020
Status: Conceptual



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

ATSI Transmission Zone

Need Number: ATSI-2019-006
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Project Driver(s):
Operational Flexibility and Efficiency
Infrastructure Resilience

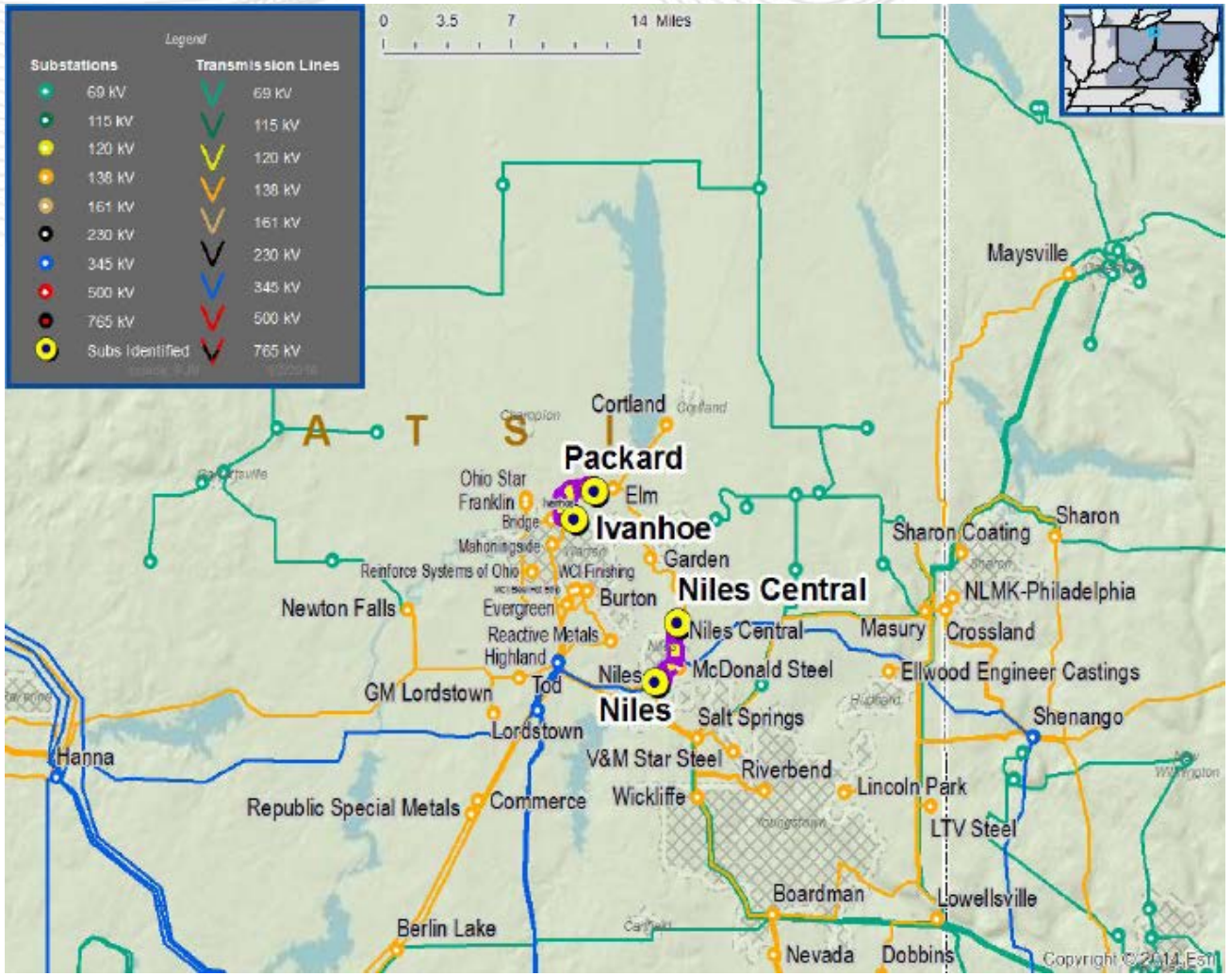
Specific Assumption Reference(s)
Global Considerations

- System reliability and performance
- Substation / Line equipment limits
- Reliability of Non-Bulk Electric System (Non-BES) facilities
- Load and risk in planning and operational scenarios
- Load and/or customers at risk on single transmission lines

Problem Statement
Elm 138 kV Area

The contingency loss of the Ivanhoe-Packard 138 kV line followed by the loss of the Niles-Niles Central Muni 138 kV line results in the loss of approximately 137 MW and 28,600 customers at six (6) transmission service points.

- Over the past five years, the Ivanhoe-Packard 138 kV line has experienced approximately 2 outages (1 sustained , 1 momentary).
- Over the past five years, the Niles-Niles Central Muni 138 kV line has experienced approximately 4 outages (1 sustained , 3 momentary).



ATSI Transmission Zone

Need Number: ATSI-2019-006
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Proposed Solution:

Elm 138 kV Ring Bus

- Convert Ivanhoe 138 kV substation to a six (6) breaker ring bus configuration by installing two (2) 138 kV breakers
- Convert Elm 138 kV substation to a five (5) breaker ring bus configuration (future 6) by installing four (4) 138 kV breakers
- Build approximately 3 miles of 138 kV line from Ivanhoe to Elm.

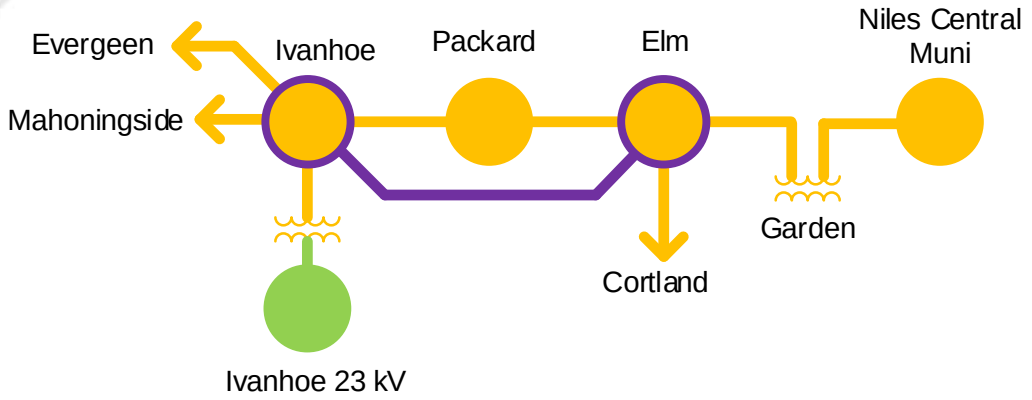
Transmission Line Ratings:

- Ivanhoe – Elm 138 kV Line
  - After Proposed Solution: 274 MVA SN / 333 MVA SE

Alternatives Considered:

- Build new transmission line (approximately 3 miles) from Niles to Niles Central Muni and convert Niles Central Muni to a four (4) breaker ring bus configuration (space constraints at Niles)

Estimated Project Cost: $12.1M
Projected IS Date: 6/1/2023
Status: Conceptual



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

ATSI Transmission Zone

Need Number: ATSI-2019-007
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Project Driver(s):
Operational Flexibility and Efficiency
Infrastructure Resilience

Specific Assumption Reference(s)

Global Considerations

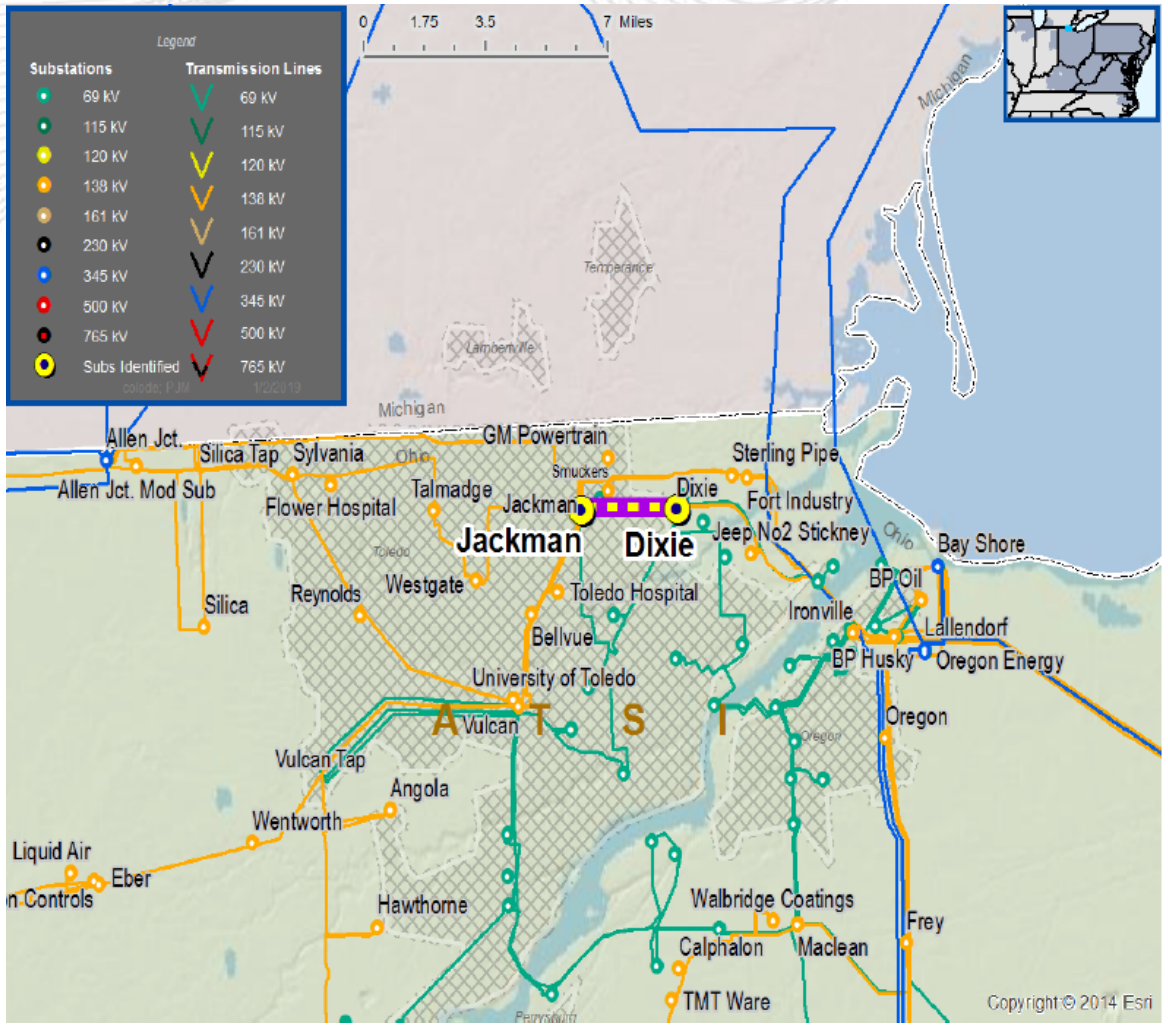
- System reliability and performance
- Substation / Line equipment limits
- Reliability of Non-Bulk Electric System (Non-BES) facilities
- Load and risk in planning and operational scenarios
- Load and/or customers at risk on single transmission lines

Problem Statement

Jackman 138 / 69 kV Area

The Jackman 69 kV substation is electrically isolated from the Jackman 138 kV substation; it is sourced from Dixie 69 kV substation. The contingency loss of the Dixie-Jackman 69 kV line or a stuck breaker at Dixie substation results in the loss of approximately 43 MW and 19,000 customers at three transmission service points.

- Over the past five years, the Dixie-Jackman 69 kV line has experienced approximately 1 outage (1 sustained , 0 momentary).



ATSI Transmission Zone

Need Number: ATSI-2019-007
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Proposed Solution:

Jackman 69 kV Ring Bus and Transformer

- Expand Jackman substation to a five (5) breaker 69 kV ring bus by adding 5 breakers.
  - Create positions for two transformers, a capacitor bank, and two line exits.

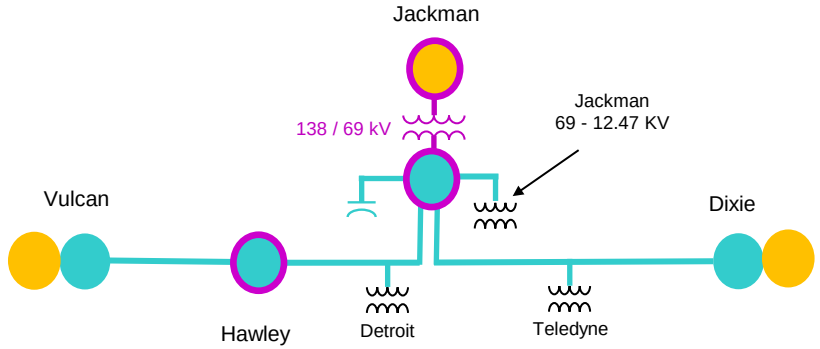
- Add a 138 kV high side breaker and install a 138 / 69 kV **100/**134 MVA transformer.
- Close the normally open circuit switcher at Hawley substation to network the Jackman 69 kV system with the Vulcan sourced 69 kV system by replacing both 69 kV circuit switchers at Hawley substation with 69 kV circuit breakers.

Transmission Line Ratings:

- Jackman-Vulcan 69 kV Line
  - Before Proposed Solution: 96 MVA SN / 96 MVA SE
  - After Proposed Solution: **108** MVA SN / 132 MVA SE
- Jackman-Dixie 69 kV Line
  - Before Proposed Solution: 107 MVA SN / 138 MVA SE
  - After Proposed Solution: 107 MVA SN / 138 MVA SE

Alternatives Considered:

- Maintain existing condition and elevated risk of failure



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

Estimated Project Cost: $8.1M
Projected IS Date: **12**/30/2023
Status: Conceptual

ATSI Transmission Zone

Need Number: ATSI-2019-008
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Project Driver(s):
Operational Flexibility and Efficiency
Infrastructure Resilience

Specific Assumption Reference(s)

Global Considerations

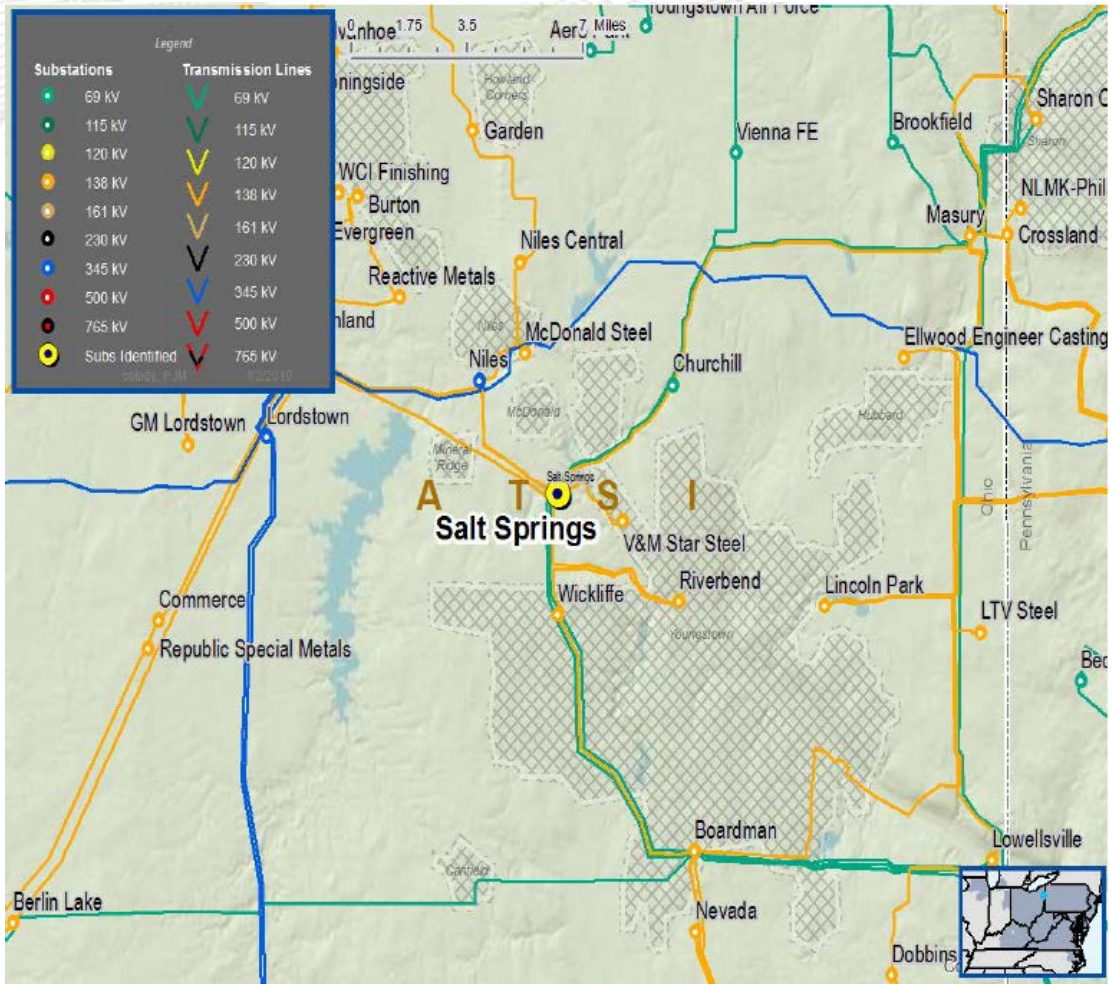
- System reliability and performance
- Substation / Line equipment limits
- Reliability of Non-Bulk Electric System (Non-BES) facilities
- Load and risk in planning and operational scenarios
- Load and/or customers at risk on single transmission lines

Problem Statement

Kimberly 69 kV Area

The Kimberly 69 kV substation is served from a 3.6 mile radial transmission line from Salt Springs 138 / 69 kV substation with 19 MW and 5,500 customers at risk.

Additionally, the contingency loss of the nearby Berlin Lake-Boardman 69 kV line results in the loss of approximately 46 MW and 12,500 customers at four (4) transmission service points.



ATSI Transmission Zone

Need Number: ATSI-2019-008
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Proposed Solution:

Weldon 69 kV Ring Bus and Line Build

- Construct a new four (4) breaker ring bus (Weldon Substation) outside the existing Canfield Steel substation.
- Network the new four (4) breaker ring bus by completing the following:
  - Loop the existing Canfield Steel radial 69 kV circuit into the new Weldon substation
  - Loop the existing Berlin Lake-Boardman 69 kV line into new Weldon substation by constructing roughly 0.6 miles 69 kV line adjacent to existing Canfield Steel 69 kV radial circuit
  - Build new Weldon-Kimberly 69 kV line (approximately 6.4 miles).
- Install new line exit switch and SCADA to the line exits at Kimberly.
- Install auto-sectionalizing scheme at Canfield substation.

Transmission Line Ratings:

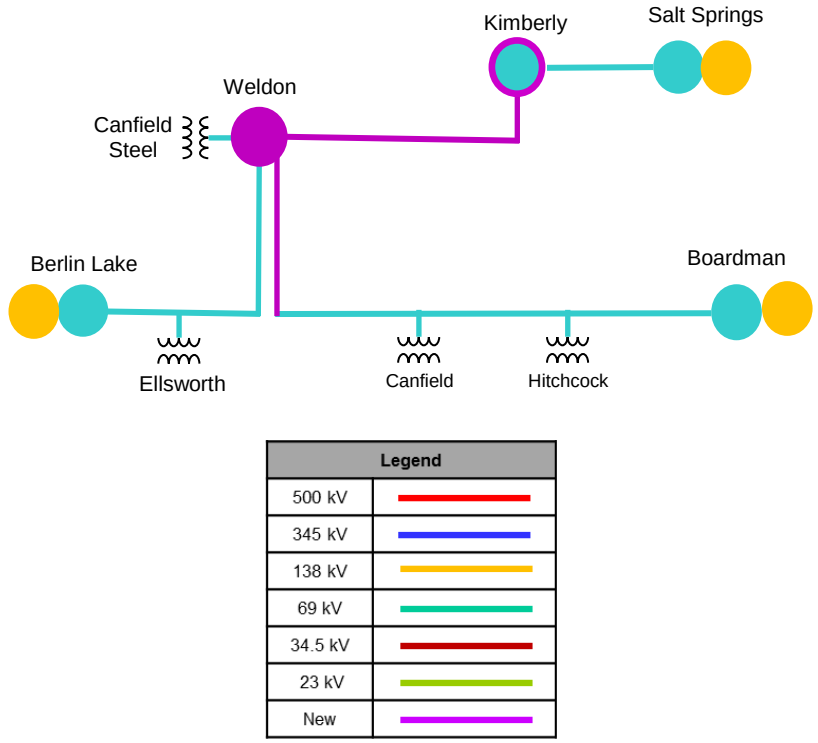
Berlin Lake-Weldon 69 kV Line
- After Proposed Solution: 80 MVA SN / 96 MVA SE

Weldon-Boardman 69 kV Line
- After Proposed Solution: 80 MVA SN / 96 MVA SE

Weldon-Kimberly 69 kV Line
- After Proposed Solution: 111 MVA SN / 135 MVA SE

Alternatives Considered:

- Install ring bus at Canfield substation (Space constrained)
- Network Kimberly substation by building a new 69 kV line from Kimberly to Salt Springs substation



Estimated Project Cost: $17.4M
Projected IS Date: 6/1/2023
Status: Conceptual

ATSI Transmission Zone

Need Number: ATSI-2019-009
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Project Driver(s):
Operational Flexibility and Efficiency
Infrastructure Resilience

Specific Assumption Reference(s)
Global Considerations

- System reliability and performance
- Substation / Line equipment limits
- Reliability of Non-Bulk Electric System (Non-BES) facilities
- Load and risk in planning and operational scenarios
- Load and/or customers at risk on single transmission lines

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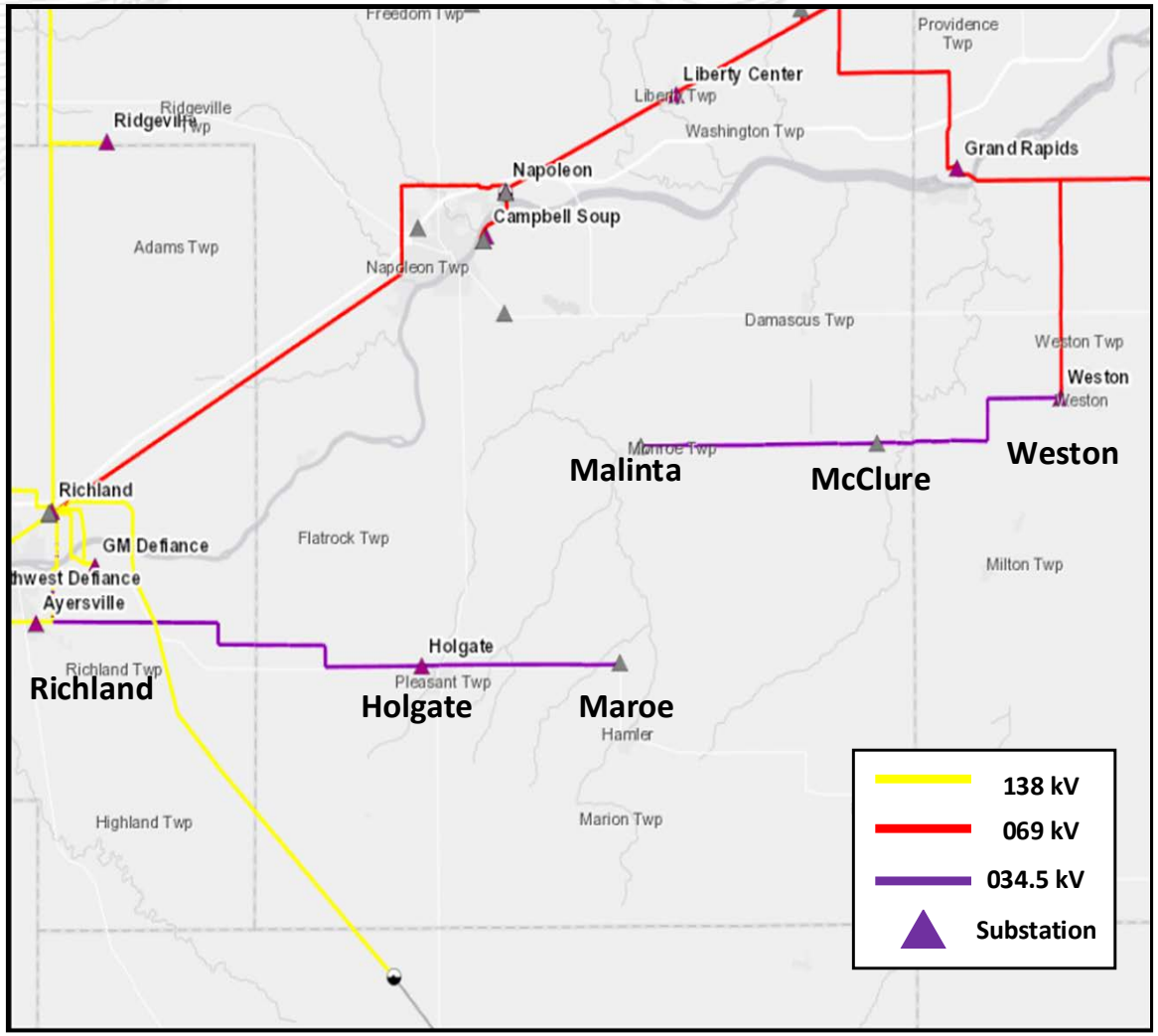
ATSI Transmission Zone

Need Number: ATSI-2019-009
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Problem Statement

Maroe-Malinta 34.5 kV Area

- *The existing Richland-Maroe 34.5 kV line is a radial line with limited capability of transferring load onto different circuits for emergency restoration and scheduling of routine maintenance.*
- *The loss of the Richland-Maroe 34.5 kV radial line results in the loss of approximately 8 MW and 2,550 customers at two (2) sub-transmission service points.*
- *The existing Weston-Malinta 34.5 kV line is a radial line with limited capability of transferring load onto a different circuits for emergency restoration and scheduling of routine maintenance.*
- *The loss of the Weston-Malinta 34.5 kV radial line results in the of approximately 6 MW and 1,000 customers at two (2) sub-transmission service points.*
- *The 138 / 34.5 kV transformer #1 at Richland substation is greater than 70 years old and is showing signs of end of life; including oil leaks, failing components, and increasing maintenance.*
- *The 69 / 34.5 kV transformer #3 at Westin substation is greater than 74 years old and is showing signs of end of life; including oil leaks and deteriorating components.*
- *Customers taking sub-transmission service on these two radial lines have requested additional reliability and operational flexibility.*
  - *The 34.5 kV radial lines cannot be networked due to insufficient short circuit current.*
  - *The Westin 69 / 34.5 kV transformer #3 (end of life) does not have the capacity to carry the entire load on a networked 34.5 kV system for a path end outage at Richland substation.*



ATSI Transmission Zone

Need Number: ATSI-2019-009
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Proposed Solution:

Richland-Weston 69 kV Line - Conversion from 34.5 kV

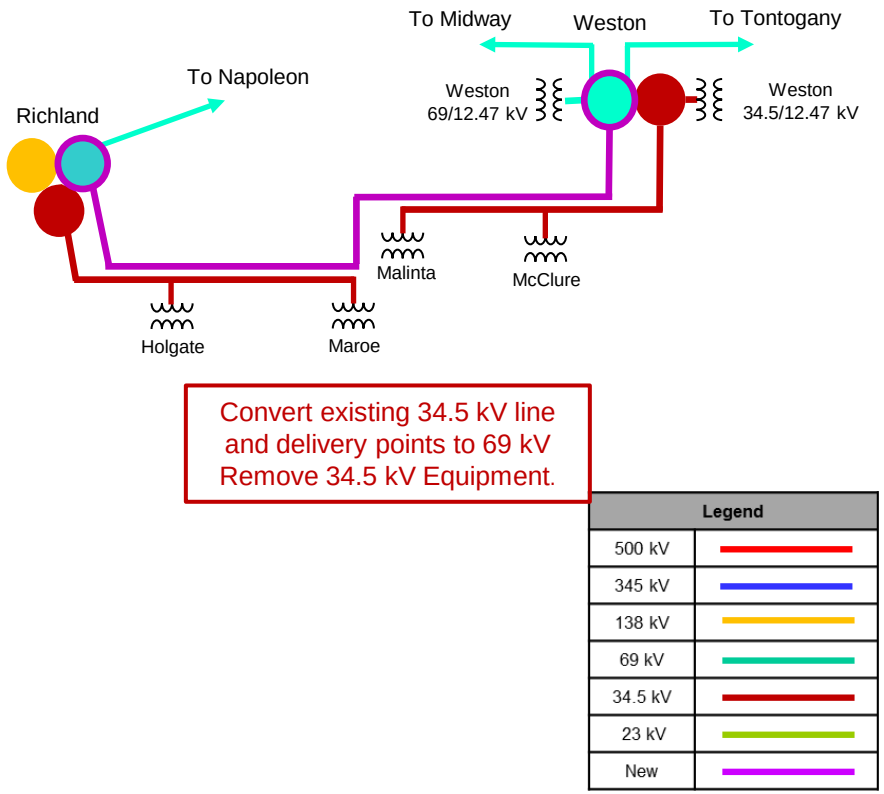
- **Richland Substation:** Install one (1) new 69 kV breaker and reconfigure the 69 kV yard to a three (3) breaker ring bus with a new 69 kV line exit to Weston substation. Remove all 34.5 kV equipment post conversion (ex: Richland 138 - 34.5 kV transformer #1 and circuit breakers).
- **Weston Substation:** Expand Weston substation to a four (4) breaker, future six (6) breaker ring bus with 69 kV line exits for the new Richland line, and the Midway and Tontogany 69 kV lines. Remove all 34.5 kV equipment post conversion (ex: Weston 69 - 34.5 kV transformer #3 and circuit breakers).
- **New Richland-Weston 69 kV Line:**
  - Build new 5.6 mile 69 kV line to network Richland-Maroe and Weston-Malinta radial lines.
  - Convert the existing Richland-Maroe 34.5 kV line to 69 kV (Approximately 19 miles); customers to upgrade existing substation equipment at Holgate and Maroe to 69 kV.
  - Convert the existing Weston-Malinta 34.5 kV line to 69 kV (Approximately 13 miles) ; customers to upgrade existing substation equipment at Weston, McClure, and Malinta substations.
  - Remove all 34.5 kV equipment post conversion.

Transmission Line Ratings:

- Richland-Weston 69 kV Line
  - After Proposed Solution: 80 MVA SN / 96 MVA SE

Alternatives Considered:

- Replace existing 138 - 34.5 kV and 69 - 34.5 kV transformers; rehab the existing 34.5 kV lines and maintain radial configuration; limits restoration, maintenance, and future economic growth.



Estimated Project Cost: $50M
Projected IS Date: 12/31/2023
Status: Conceptual

ATSI Transmission Zone

Need Number: ATSI-2019-011
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Project Driver(s):
Equipment Material, Condition, Performance and Risk
Operational Flexibility and Efficiency
Infrastructure Resilience

Specific Assumption Reference(s)

Global Considerations

- System reliability and performance
- Substation / Line equipment limits

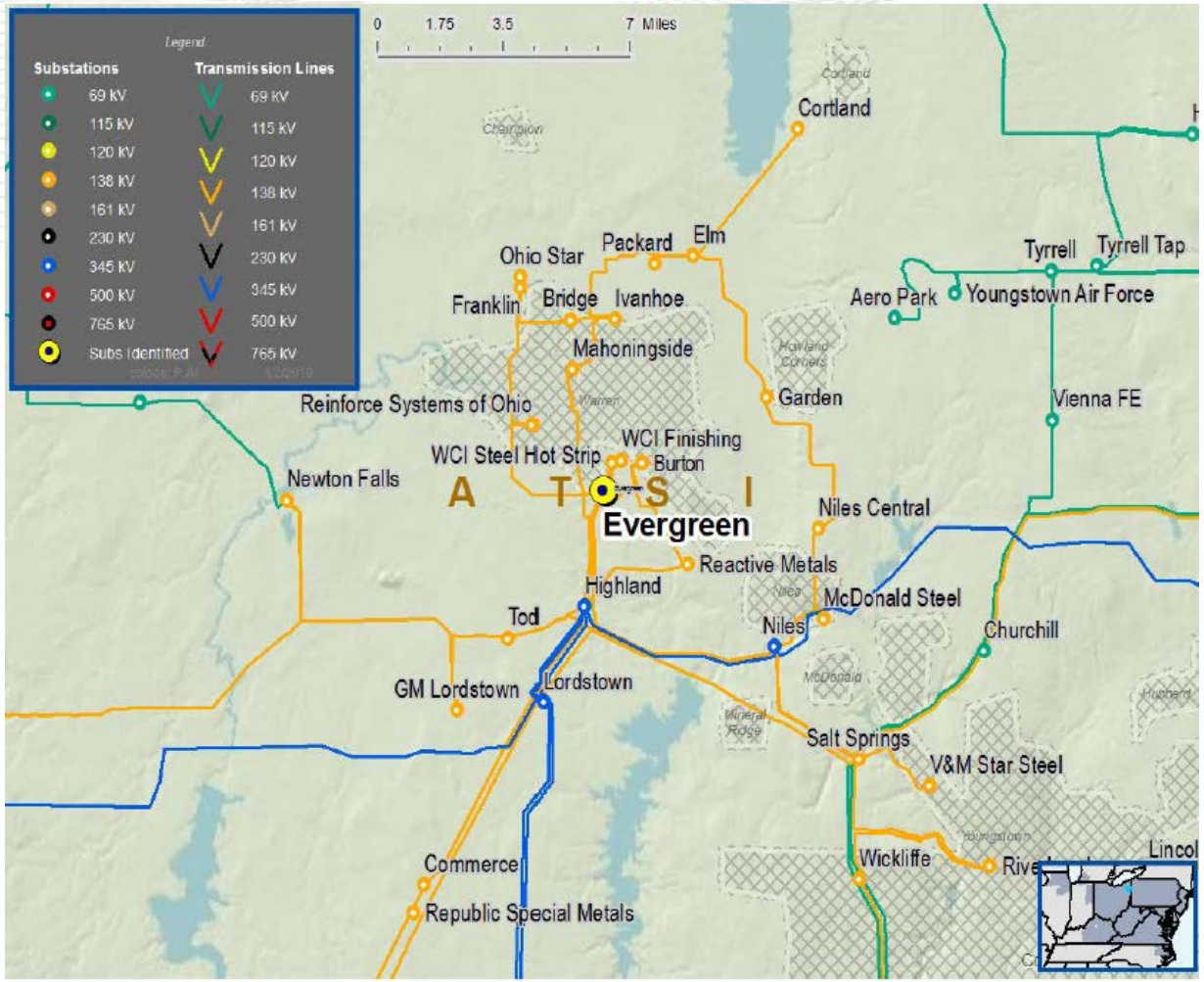
Upgrade Relay Schemes

- Bus protection schemes
- Relay schemes that have a history of mis-operation

Problem Statement

Evergreen Substation 138 kV Equipment and Protection

- BES bus protection is presently performed by a complex scheme that has a history of causing mis-operations at other substations. The scheme uses distributed electromechanical relays to exclude a bus fault rather than detecting the bus fault directly.



ATSI Transmission Zone

Need Number: ATSI-2019-011
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Proposed Solution:

Evergreen 138 kV Relay Upgrades

- Replace bus protection scheme with dual differential protection.
- Replace bus PTs due to condition
- Replace 3 breakers (B23, B24, and B27 bus transfer) due to condition and insufficient lack of sufficient CTs for proper system to support standard, redundant bus protection.

Transmission Line Ratings:

- Evergreen-Ivanhoe 138 kV Line
  - Before Proposed Solution: 226 MVA WN / 249 MVA WE
  - After Proposed Solution: 226 MVA WN / 286 MVA WE
- Evergreen-Niles 138 kV Line
  - Before Proposed Solution: 224 MVA SN / 293 MVA SE
  - After Proposed Solution: 278 MVA SN / 339 MVA SE

Alternatives Considered:

- Maintain existing protection scheme with high risk for mis-operation.

Estimated Project Cost: $1.3M
Projected IS Date: 3/1/2021
Status: Conceptual

No diagram required.
All work is within the substation

ATSI Transmission Zone

Need Number: ATSI-2019-012
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Project Driver(s):
Equipment Material, Condition, Performance and Risk
Operational Flexibility and Efficiency
Infrastructure Resilience

Specific Assumption Reference(s)

Global Considerations

- System reliability and performance
- Substation / Line equipment limits

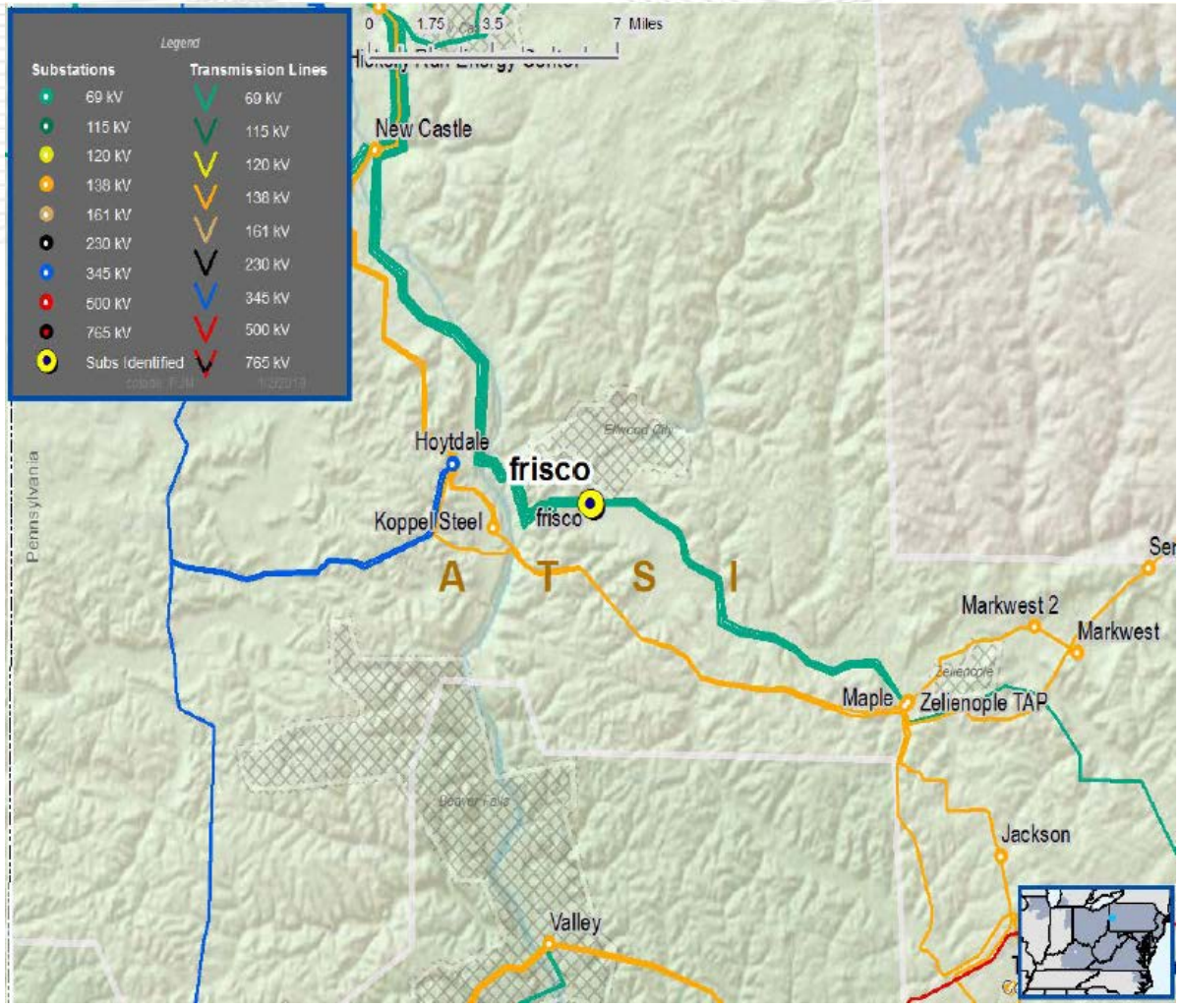
Upgrade Relay Schemes

- Protection system with single point of failure

Problem Statement

Frisco Substation 69 kV Protection

- Line protection at Frisco substation consists of a single relay protection scheme. A recent relay failure during a fault at a nearby substation led to delayed fault clearing and a larger number of customers affected than necessary. There is not backup relay schemes to reduce customer exposure to a similar single point of failure.



ATSI Transmission Zone

Need Number: ATSI-2019-012
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Proposed Solution:

Frisco 69 V Relay Upgrades

- Replace bus protection with dual differential scheme.
- Upgrade relays and substation conductors on the Frisco-Maple 69 kV line exit.

Transmission Line Ratings:

- Frisco-Maple #1 69 kV Line (Frisco-Knox T)
  - Before Proposed Solution: 72 MVA SN / 72 MVA SE
  - After Proposed Solution: 80 MVA SN / 96 MVA SE

Alternatives Considered:

- Maintain existing protection scheme with high risk for mis-operation and single point of failure.

Estimated Project Cost: $0.3M
Projected IS Date: 12/31/2020
Status: Conceptual

No diagram required.
All work is within the substation

ATSI Transmission Zone

Need Number: ATSI-2019-013
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Project Driver(s):
Equipment Material, Condition, Performance and Risk
Operational Flexibility and Efficiency
Infrastructure Resilience

Specific Assumption Reference(s)

Global Considerations

- System reliability and performance
- Substation / Line equipment limits

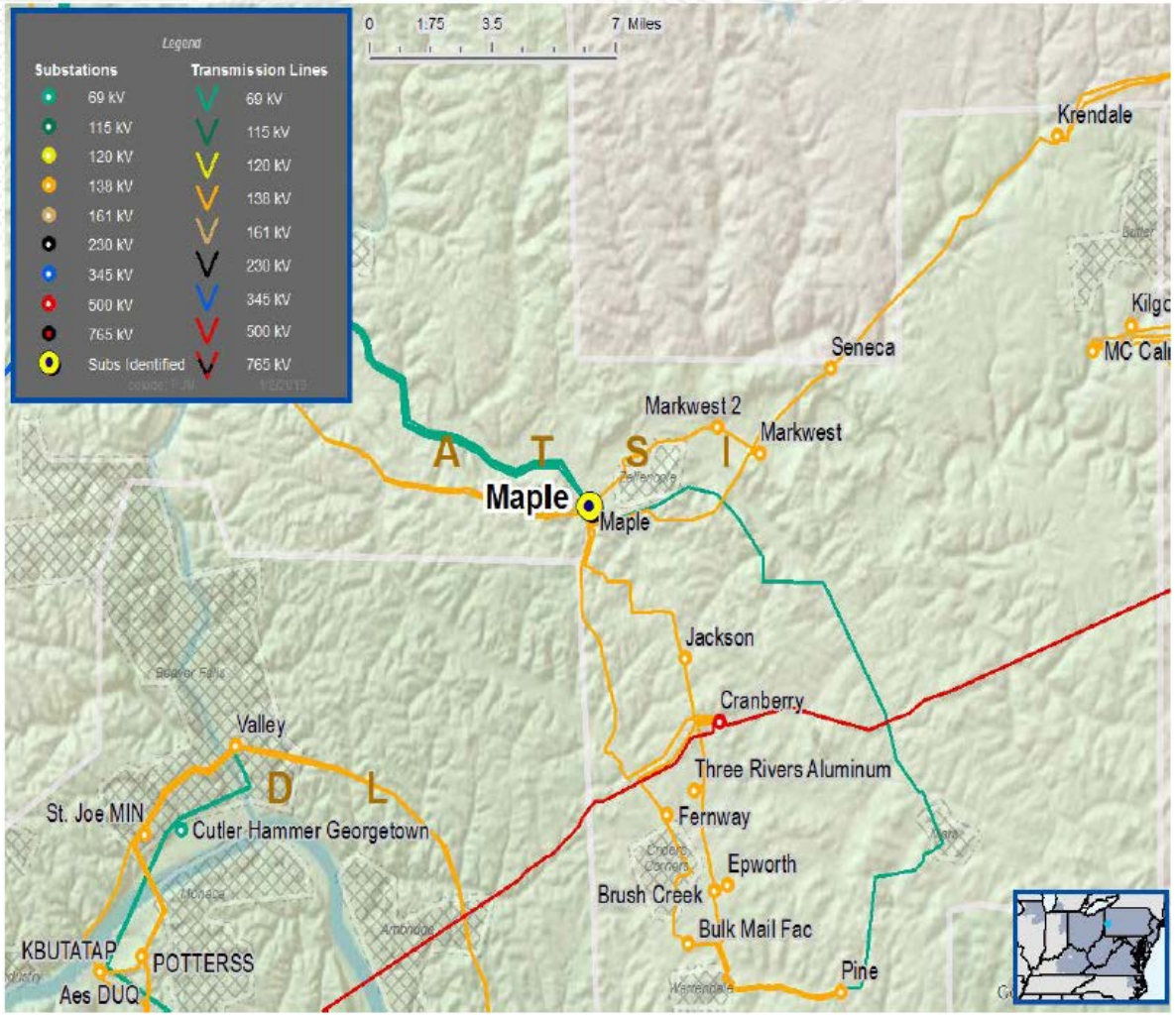
Upgrade Relay Schemes

- Protection system with single point of failure

Problem Statement

Maple Substation 69 kV Protection

- Line protection at Maple substation consists of a single relay protection scheme. A recent relay failure during a fault at a nearby substation led to delayed fault clearing and a larger number of customers affected than necessary. There is not backup relay schemes to reduce customer exposure to a similar single point of failure.



ATSI Transmission Zone

Need Number: ATSI-2019-013
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Proposed Solution:

Maple 69 kV Relay Upgrades

- Replace bus protection scheme with dual differential protection.
- Replace two breakers (B118, and B134) due to condition and lack of sufficient CTs to support standard redundant bus protection.
- Upgrade the relays on the Maple-Frisco #2 69 kV line exit.

Transmission Line Ratings:

- Maple-Frisco #2 69 kV Line (Maple-Thompson T)
  - Before Proposed Solution: 62 MVA SN / 62 MVA SE
  - After Proposed Solution: 80 MVA SN / 96 MVA SE

Alternatives Considered:

- Maintain existing protection scheme with high risk for mis-operation and single point of failure.

Estimated Project Cost: $0.95M
Projected IS Date: 12/31/2021
Status: Conceptual

No diagram required.
All work is within the substation

ATSI Transmission Zone

Need Number: ATSI-2019-015
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Project Driver(s):
Equipment Material, Condition, Performance and Risk

Specific Assumption Reference(s)

Global Factors

- At or beyond expected service life or obsolete
- Failure risk, to the extent caused by asset design characteristics, or historical industry/company performance data, or application design error
- Show a high level of criticality to system performance and operations

Substation Condition Rebuild / Replacement

- Circuit breakers and other fault interrupting devices
- Switches
- Station system protection and controls

Problem Statement

Ashtabula 138 kV Substation Equipment and Protection

- *Two (2) 138 kV breakers (B143 & B149), lightning arresters and associated switches, and control wiring are showing degrading performance, increasing maintenance, age (46-63 years), and obsolescence of equipment and spare parts.*

ATSI Transmission Zone

Need Number: ATSI-2019-015
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Proposed Solution:

Ashtabula 138 kV Breakers and Relay Upgrades

- Replace two (2) 138 kV breakers (B143 & B149), associated switches, and substation conductor.

Transmission Line Ratings:

- Ashtabula-Pitts Conn Dock Q15 138 kV Line
  - Before Proposed Solution: 329 MVA SN / 399 MVA SE
  - After Proposed Solution: 347 MVA SN / 423 MVA SE

Alternatives Considered:

- Maintain existing condition and risk of failure.

Estimated Project Cost: $5.2M
Projected IS Date: 12/31/2019
Status: Conceptual

No diagram required.
All work is within the substation

ATSI Transmission Zone

Need Number: ATSI-2019-017
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Project Driver(s):
Equipment Material, Condition, Performance and Risk

Specific Assumption Reference(s)

Global Factors

- At or beyond expected service life or obsolete
- Failure risk, to the extent caused by asset design characteristics, or historical industry/company performance data, or application design error
- Show a high level of criticality to system performance and operations

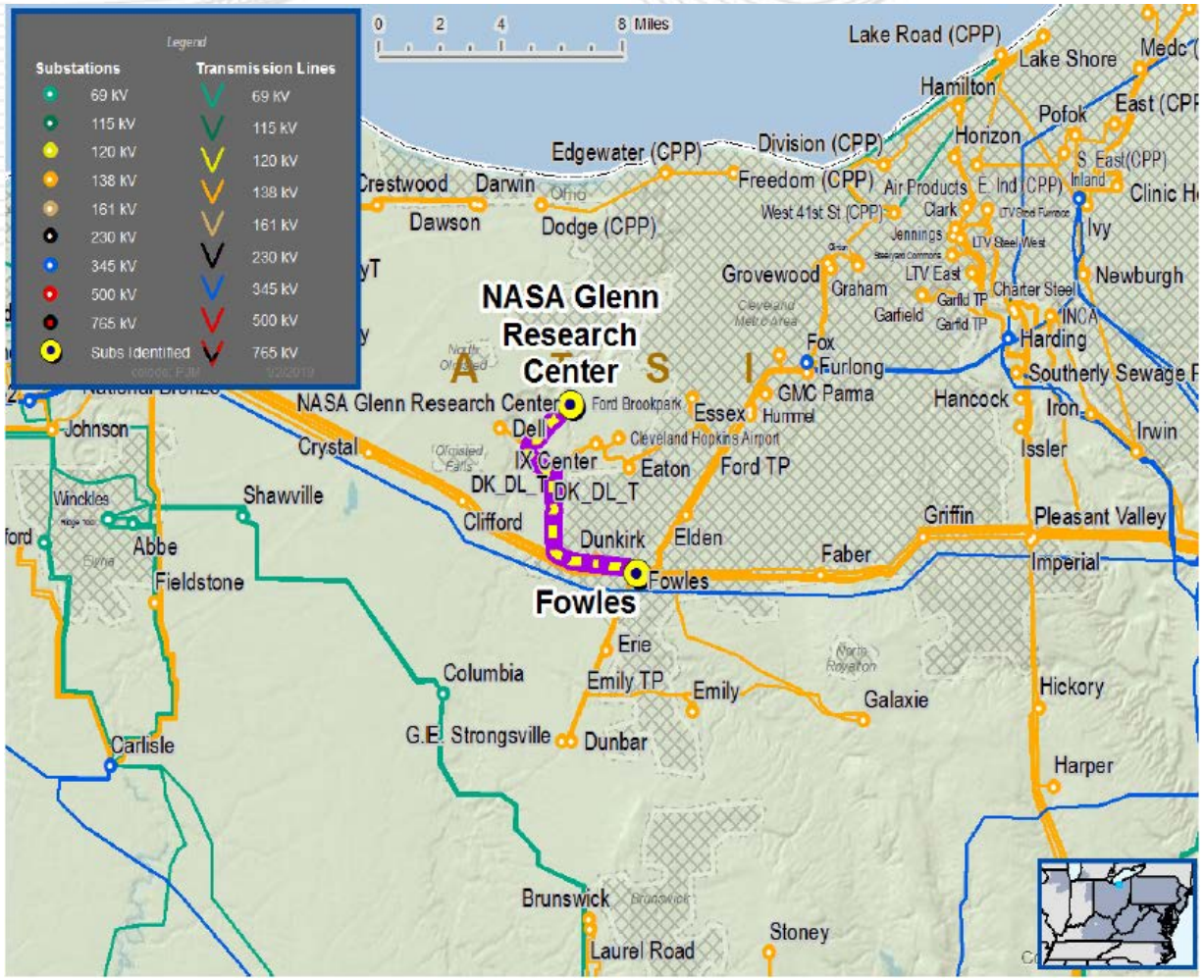
Substation Condition Rebuild / Replacement

- Circuit breakers and other fault interrupting devices
- Switches
- Relays
- CCVTs

Problem Statement

Fowles – NASA Q16 138 kV Terminal Equipment

- *One (1) 138 kV breaker at Fowles (Q16), associated switches, relays, and CCVTs are showing degrading performance, increasing maintenance, age (60 years), and obsolescence of equipment and spare parts.*



ATSI Transmission Zone

Need Number: ATSI-2019-017
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Proposed Solution:

Fowles138 kV Breaker and Substation Upgrades

- *Replace the 138 kV Q16 breaker at Fowles, associated switches, substation conductor, EM relays, and CCVTs.*

Transmission Line Ratings:

- Fowles-NASA Q16 138 kV Line (Fowles-Dunkirk Tap)
  - Before Proposed Solution: 153 MVA SN / 199 MVA SE
  - After Proposed Solution: 237 MVA SN / 287 MVA SE

Alternatives Considered:

- Maintain existing condition and risk of failure.

Estimated Project Cost: $0.7M
Projected IS Date: 12/31/2019
Status: Conceptual

No diagram required.
All work is within the substation

ATSI Transmission Zone

Need Number: ATSI-2019-019
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Project Driver(s):
Equipment Material, Condition, Performance and Risk

Specific Assumption Reference(s)

Global Factors

- At or beyond expected service life or obsolete
- Failure risk, to the extent caused by asset design characteristics, or historical industry/company performance data, or application design error
- Show a high level of criticality to system performance and operations

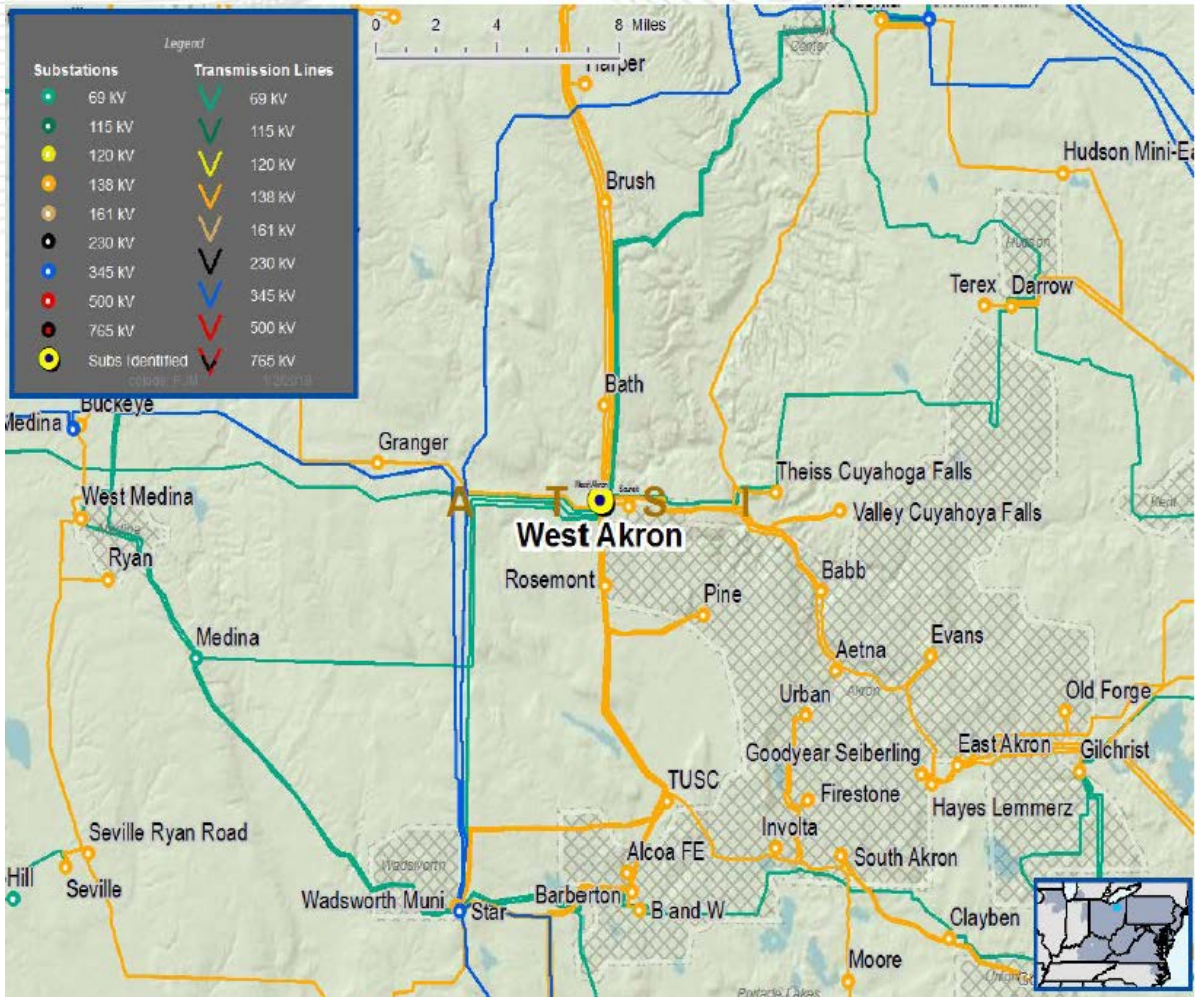
Substation Condition Rebuild / Replacement

- Circuit breakers and other fault interrupting devices
- Switches
- Current transformers (CTs), control cables, and cable trays
- Carrier sets and associated wave-traps
- Line Arresters, Risers and connections

Problem Statement

West Akron 138 kV Substation

One (1) 138 kV Oil Circuit Breaker (OCB) breaker (B1) at West Akron, lightning arresters and associated switches, and CCVTs are showing degrading performance, increasing maintenance, age (30 years), and obsolescence of equipment and spare parts.



ATSI Transmission Zone

Need Number: ATSI-2019-019
Process Stage: Solution Meeting
Solutions Meeting: 03/28/2019
Needs Meeting: 01/14/2019

Proposed Solution:

West Akron 138 kV Breaker and Substation Upgrades

- Replace the 138 kV B1 Oil Circuit Breaker (OCB) breaker at West Akron, wave-trap, substation conductor, and associated switches, and CCVTs

Transmission Line Ratings:

- West Akron-Pleasant Valley 138 kV Line (West Akron-Bath Tap)
  - Before Proposed Solution: 196 MVA SN / 228 MVA SE
  - After Proposed Solution: 196 MVA SN / 242 MVA SE

Alternatives Considered:

- Maintain existing condition and risk of failure.

Estimated Project Cost: $0.6M
Projected IS Date: 12/01/2019
Status: Conceptual

No diagram required.
All work is within the substation

ATSI Transmission Zone

Need Number: ATSI-2019-020
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Project Driver(s):
Equipment Material, Condition, Performance and Risk

Specific Assumption Reference(s)

Global Factors

- At or beyond expected service life or obsolete
- Show a high level of criticality to system performance and operations
- Impact customer outage frequency and/or duration

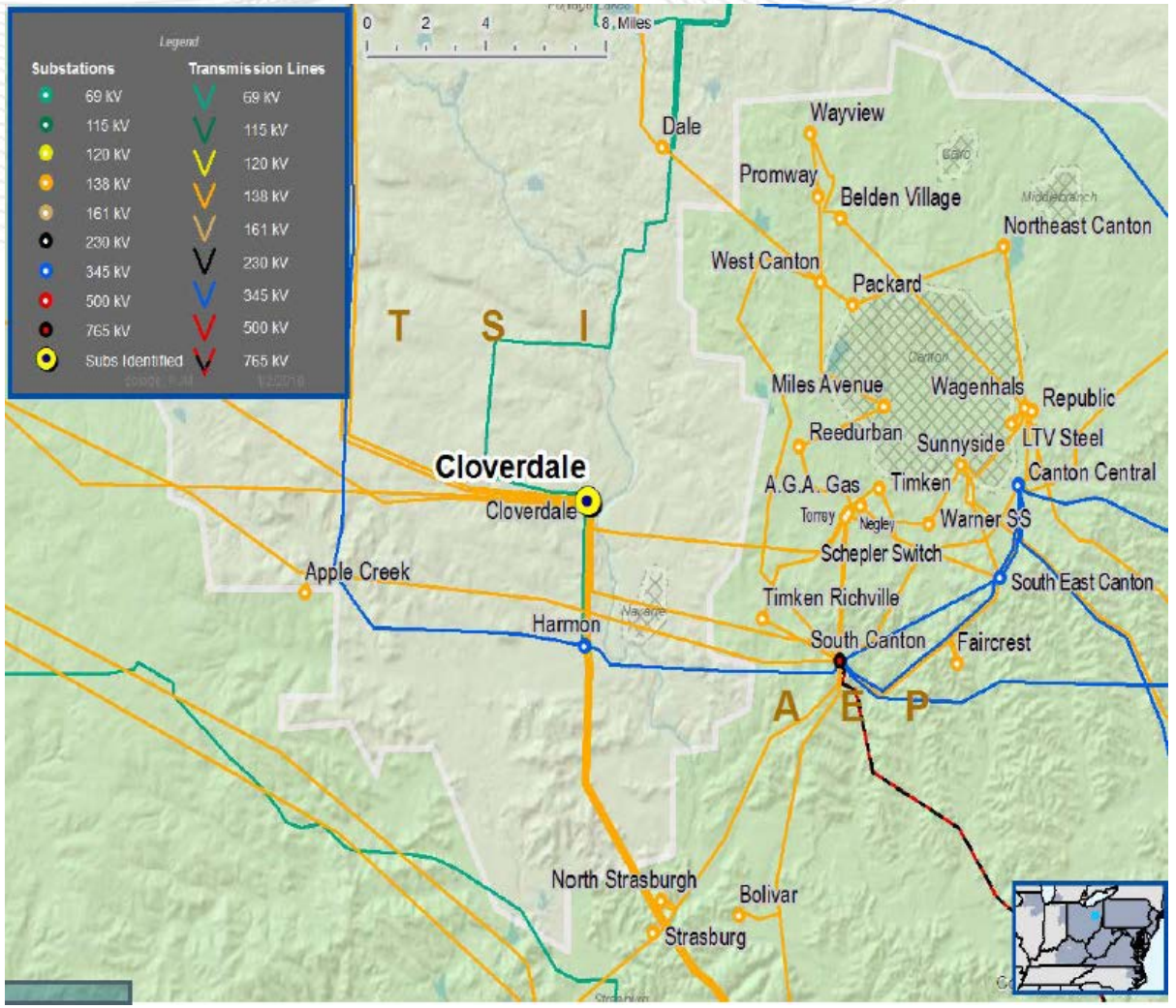
Upgrade Relay Schemes

- Relay schemes that have a history of mis-operation
- Obsolete and difficult to repair communication equipment (DTT, Blocking, etc.)
- Communication technology upgrades
- Bus protection schemes

Problem Statement

Cloverdale 69 kV Substation Assessment

The electromechanical relays and communication equipment at the 69 kV Cloverdale substation have been identified to be prone to mis-operation. The disconnect switches have operation difficulty and are greater than 40 years of age. The 69 kV Bus PTs are nearing end of life with increased risk of failure.



ATSI Transmission Zone

Need Number: ATSI-2019-020
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Proposed Solution:

Cloverdale 69 kV Relay and Equipment Upgrades

- Replace the 69 kV line relays related to breakers B269 and B233, relays related to transfer bus breaker relays B275, 69 kV bus PTs, and associated CTs, disconnection switches, and communication equipment at the 69 kV Cloverdale substation.

Transmission Line Ratings:

- Cloverdale-Dale #2 69 kV Line (Cloverdale-Carmont Tap)
  - Before Proposed Solution: 139 MVA SN / 153 MVA SE
  - After Proposed Solution: 139 MVA SN / 169 MVA SE

Alternatives Considered:

- Maintain existing condition and risk of failure.

Estimated Project Cost: $0.5M
Projected IS Date: 6/1/2020
Status: Conceptual

No diagram required.
All work is within the substation

ATSI Transmission Zone

Need Number: ATSI-2019-021
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Project Driver(s):
Equipment Material, Condition, Performance and Risk

Specific Assumption Reference(s)

Global Factors

- Level of criticality to system performance and operations
- Negative impact on equipment health and/or system reliability
- Customer outage frequency and/or durations
- Expected service life (at or beyond) or obsolescence

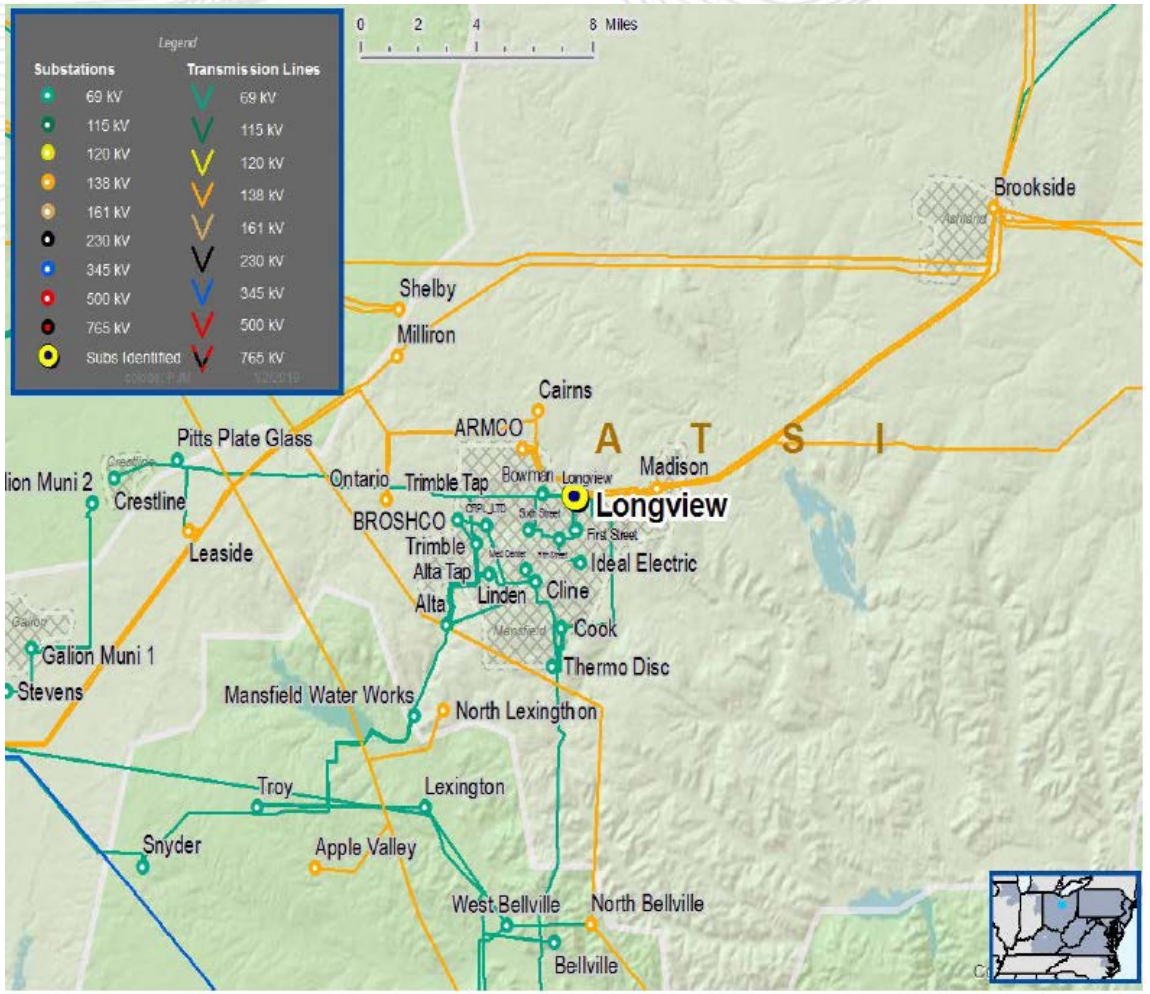
Upgrade Relay Schemes

- Relay schemes that have a history of mis-operation
- Obsolete and difficult to repair communication equipment (DTT, Blocking, etc.)
- Communication technology upgrades
- Bus protection schemes

Problem Statement

Longview 69 kV Substation Assessment

- *The electromechanical relays and communication equipment at the 69 kV Longview substation have been identified to be prone to mis-operation. The disconnect switches have operation difficulty and the 69 kV Bus PTs are nearing end of life with increased risk of failure.*



ATSI Transmission Zone

Need Number: ATSI-2019-021
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Proposed Solution:

Longview 69 kV Relay Upgrades

- Replace line relays and bus transfer switches associated with breakers B228, B232, B215, B70, B4 and bus tie breaker B94. Replace 69 kV bus PTs.
- Longview-Mohican 69 kV line being rebuilt under ATSI-2019-024

Transmission Line Ratings:

- Longview-Mohican 69 kV Line (Longview-Mifflin Muni Tap)
  - Before Proposed Solution: 36 MVA SN / 36 MVA SE
  - After Proposed Solution: 80 MVA SN / 96 MVA SE
    - *Final rating with ATSI-2019-021 and ATSI-2019-024 complete.*

Alternatives Considered:

- Maintain existing condition and risk of failure.

Estimated Project Cost: $1.3M
Projected IS Date: 09/23/2019
Status: Conceptual

No diagram required.
All work is within the substation

ATSI Transmission Zone

Need Number: ATSI-2019-022
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Project Driver(s):
Equipment Material, Condition, Performance and Risk

Specific Assumption Reference(s)
Global Factors

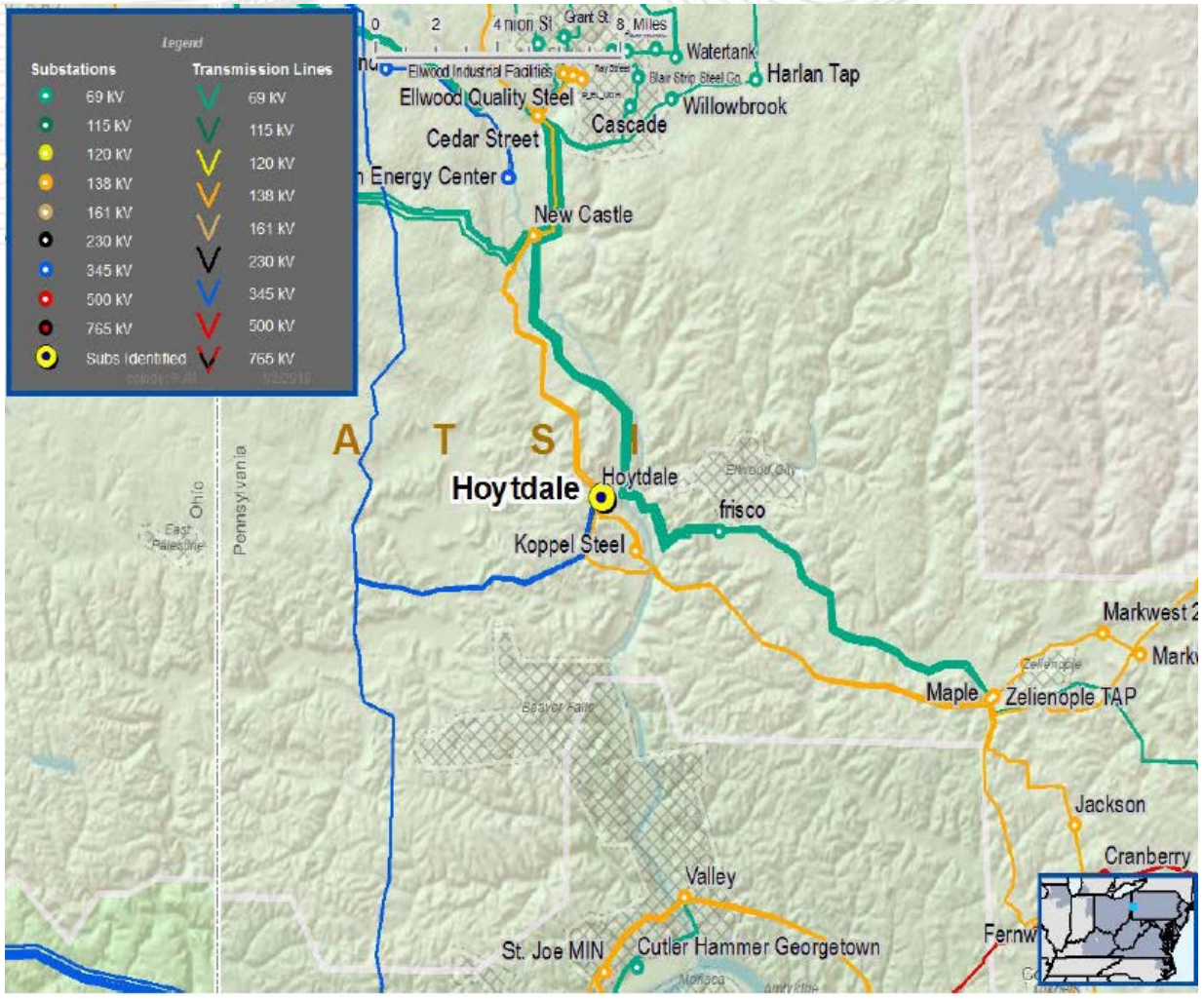
- Level of criticality to system performance and operations
- Equipment installation times (long lead and/or extended)
- Environmental considerations
- Expected service life (at or beyond) or obsolescence

Substation Condition Rebuild / Replacement

- Power transformers and load tap changers (LTCs)

Problem Statement
Hoytdale Substation Transformer Assessment

- *The existing 345 / 138 kV Hoytdale transformer #1 is showing end of service life issues; including oil leaks, moisture ingress, problematic cooling controls, unreliable gauges / annunciators, failing pumps and relays that are prone to mis-operations.*



ATSI Transmission Zone

Need Number: ATSI-2019-022
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Proposed Solution:

Hoytdale 345 / 138 kV Transformer #1

- Replace the *345 / 138 kV Transformer #1 400 MVA transformer with a standard 448 MVA transformer.*
- *Replace existing relays, MOABs A-108 and A-36, and CCVTs*

Transmission Line Ratings:

- Hoytdale 345 / 138 kV Transformer #1
  - Before Proposed Solution: 514 MVA SN / 533 MVA SE
  - After Proposed Solution: 533 MVA SN / 601 MVA SE

Alternatives Considered:

- Rebuild and reseal transformer, replacing pumps, bushings, gauges and cooling controls. Replace identified relays, CCVTs, and MOABs. Add on-line monitoring to transformer.
- Maintain existing condition and risk of failure.

Estimated Project Cost: $4.8M
Projected IS Date: 6/1/2021
Status: Conceptual

No diagram required.
All work is within the substation

ATSI Transmission Zone

Need Number: ATSI-2019-023
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Project Driver(s):
Equipment Material, Condition, Performance and Risk

Specific Assumption Reference(s)

Global Factors

- Increasing negative trend in maintenance findings and/or costs
- Limited availability of spare parts, software obsolescence and/or compatibility, or vendor technical support
- Expected service life (at or beyond) or obsolescence

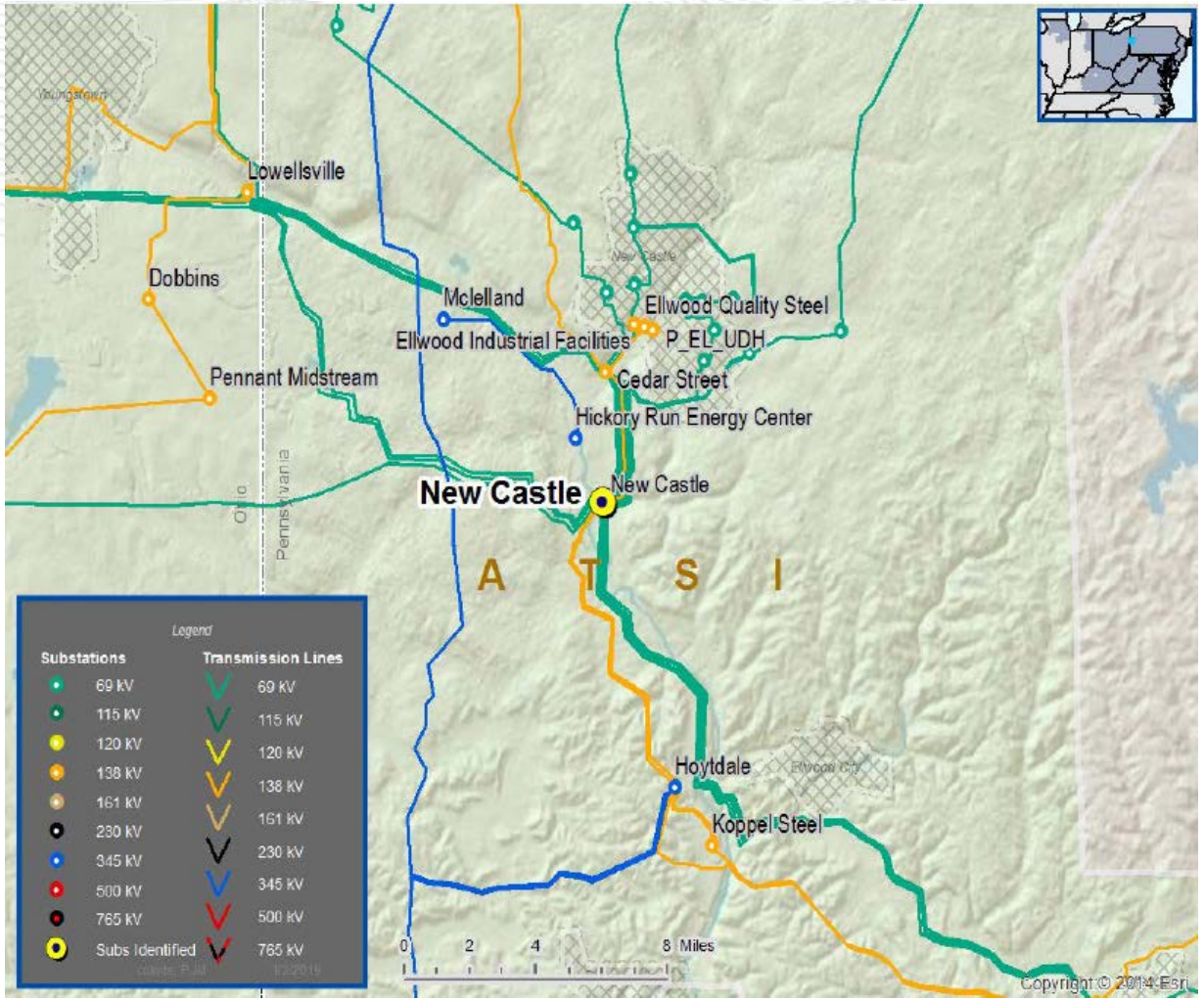
Substation Condition Rebuild / Replacement

- Circuit breakers and other fault interrupting devices
- Switches
- Risers and connections

Problem Statement

New Castle 138 kV and 69 kV Substation Assessment

- *One (1) 138 kV OCB breaker (B166) and five (5) 69 kV OCB breakers (B32, B86, B90, B96 and B106) at New Castle are showing end of life characteristics; including deteriorated bushings, mechanism, oil leaks, and age (> 30 years) with increasing maintenance and obsolescence of equipment and spare parts. Associated disconnect switches are also deteriorating with failures and operating difficulties.*



ATSI Transmission Zone

Need Number: ATSI-2019-023
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Proposed Solution:

New Castle 138 kV and 69 kV Breakers

- Replace existing 138 kV oil circuit breaker B166, five (5) 69 kV oil circuit breakers (B32, B86, B90, B96, and B106), substation conductor, and associated disconnect switches at New Castle substation.
- Upgrade substation conductor at Lowellville substation on the New Castle-Lowellville 69 kV line.
- Upgrade disconnect switches at Frisco substation on the New Castle-Frisco 69 kV line.

Transmission Line Ratings:

- New Castle-Lowellville 69 kV Line (Lowellville-Bessemer Tap)
  - Before Proposed Solution: 88 MVA SN / 115 MVA SE
  - After Proposed Solution: 100 MVA SN / 121 MVA SE
- New Castle-Frisco 69 kV Line (Firsco-KoppleTap)
  - Before Proposed Solution: 82 MVA SN / 103 MVA SE
  - After Proposed Solution: 100 MVA SN / 121 MVA SE

Alternatives Considered:

- Maintain existing condition and risk of failure.

Estimated Project Cost: $3.4M
Projected IS Date: 12/31/2020
Status: Conceptual

No diagram required.
All work is within the substation

ATSI Transmission Zone

Need Number: ATSI-2019-024
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Project Driver(s):
Equipment Material, Condition, Performance and Risk

Specific Assumption Reference(s)
Global Factors supporting Line Rebuild

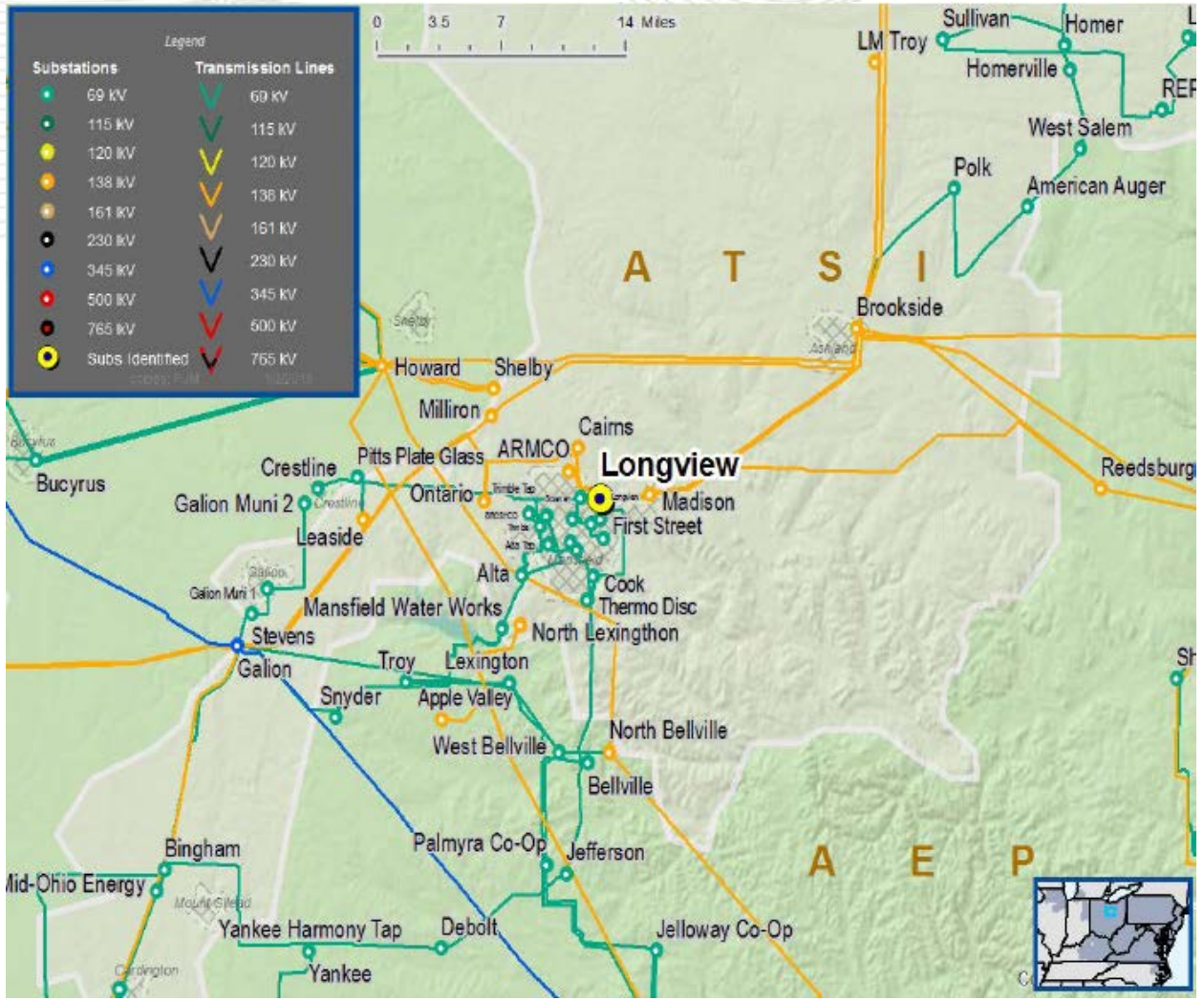
- Negative impact on equipment health and/or system reliability
- Age/condition of wood pole structures and line hardware
- Increasing negative trend in maintenance findings and/or costs
- Limited availability of spare parts and/or vendor technical support
- Current design criteria, applicable codes, and industry best practices

Problem Statement
Coulter-Longview 69 kV Line Assessment

- *The poles and associated hardware on this line have reached end of life with 90% of the poles greater than 60 years.*
- *Maintenance and repairs are trending upward in frequency and severity.*
- *Four Air Break switches are obsolete and no longer supported for parts.*
- *Conductor (1/0 and 2/0 Copper) dates to original construction*

System Performance

- Over the past 5 years, the Coulter-Longview 69 kV line has experienced 10 outages (6 sustained , 4 momentary).



ATSI Transmission Zone

Need Number: ATSI-2019-024
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Proposed Solution:

Longview-Mohican 69 kV Line (Longview-Coulter 69 kV Line Segment)

- Rebuild the Longview-Coulter 69 kV line segment (approximately 15.8 miles of the 22.1 line miles), replace four (4) line switches (A-10, A-19, A-23 and A-27) and add SCADA control.
- Terminal equipment at Longview substation to be upgraded under ATSI-2019-021; including:
  - Line relaying, substation conductor, and disconnect switches

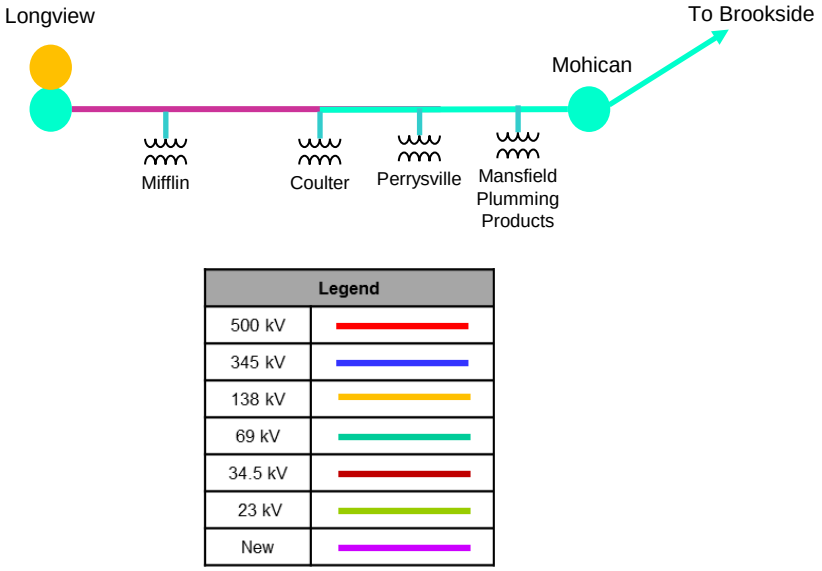
Transmission Line Ratings:

- Longview-Mohican 69 kV Line
  - Before Proposed Solution: 36 MVA SN / 36 MVA SE
  - After Proposed Solution: 80 MVA SN / 96 MVA SE
    - *Final rating with ATSI-2019-021 and ATSI-2019-024 complete.*

Alternatives Considered:

- Selective pole replacements and line rehab. This alternative was not selected due to 99% of the poles not meeting reliability evaluation for age and condition: Greater than 70 years old, top rot, woodpecker, failed hammer and sound tests, worn attachment hardware, rising maintenance costs.

Estimated Project Cost: $22.2M
Projected IS Date: 12/31/2022
Status: Conceptual



ATSI Transmission Zone

Need Number: ATSI-2019-025
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Project Driver(s):
Equipment Material, Condition, Performance and Risk

Specific Assumption Reference(s)
Global Factors supporting Line Rebuild

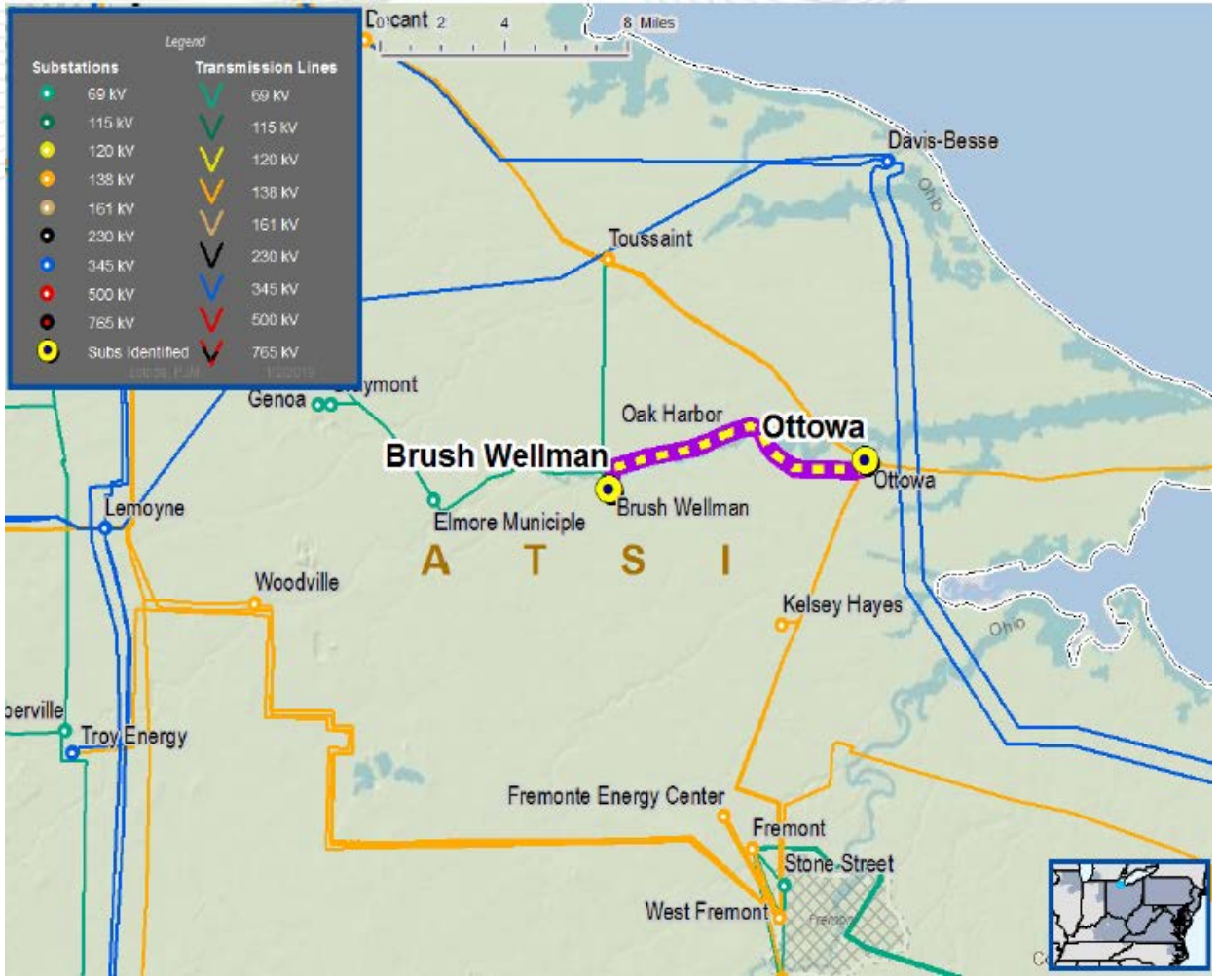
- Negative impact on equipment health and/or system reliability
- Age/condition of wood pole structures and line hardware
- Increasing negative trend in maintenance findings and/or costs
- Limited availability of spare parts and/or vendor technical support
- Current design criteria, applicable codes, and industry best practices

Problem Statement
Brush Wellman-Ottawa 69 kV Line Assessment

- *The poles and associated hardware on this line have reached end of life with 92% of the poles greater than 60 years.*
- *Maintenance and repairs are trending upward in frequency and severity.*
- *Four Air Break switches are obsolete and no longer supported for parts.*

System Performance

- Over the past 5 years, the Brush Wellman-Ottawa 69 line has experienced 4 outages (3 sustained , 1 momentary).



ATSI Transmission Zone

Need Number: ATSI-2019-025
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Proposed Solution:

Brush Wellman-Ottawa 69 kV Line

- Rebuild the Brush Wellman-Ottawa 69 kV line (approximately 7.3 miles)
- Replace four line switches; A-7240, A-7228, A-7235 and **7235** N.O
- Upgrade the terminal equipment at Brush Wellman substation including:
  - Substation conductors and relay communication equipment

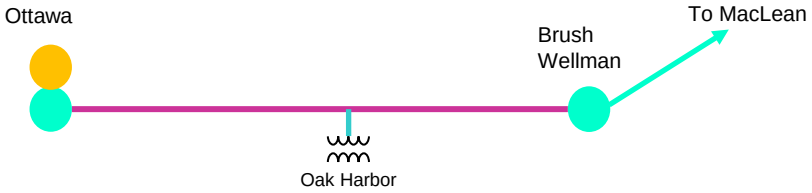
Transmission Line Ratings:

- Brush Wellman-Ottawa 69 kV Line
  - Before Proposed Solution: 72 MVA SN / 72 MVA SE
  - After Proposed Solution: 80 MVA SN / 96 MVA SE

Alternatives Considered:

- Selective pole replacements (REHAB) and continue to maintain from present condition with risk of failure.

Estimated Project Cost: $10.0M
Projected IS Date: 12/31/2022
Status: Conceptual



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

ATSI Transmission Zone

Need Number: ATSI-2019-026 through ATSI-2019-049
Process Stage: Solution Meeting
Solutions Meeting: 03/25/2019
Needs Meeting: 01/14/2019

Project Driver(s):
Operational Flexibility and Efficiency
Infrastructure Resilience

Specific Assumption Reference(s)

Global Factors

- System reliability and performance
- Substation / line equipment limits

Upgrade Relay Schemes

- Relay schemes that have a history of mis-operation
- Obsolete and difficult to repair communication equipment (DTT, Blocking, etc.)
- Communication technology upgrades
- Bus protection schemes

Continued on next slide…

Map Not Shown
Multiple Locations

ATSI Transmission Zone

Problem Statement

PJM Zone - ATSI

- FirstEnergy has identified protection schemes using a certain vintage of relays and communication equipment that have a history of misoperation.
- Proper operation of the protection scheme requires all the separate components perform adequately during a fault
- In many cases the protection equipment cannot be repaired due to a lack of replacement parts and available expertise in the outdated technology.
- Transmission line ratings are limited by terminal equipment.

ATSI-2019-	Transmission Line / Substation Locations	Existing Line Rating (SN / SE)	Existing Conductor Rating (SN / SE)	Limiting Terminal Equipment
026	Allen Junction-Vulcan 138 kV Line	290 / 325	290 / 346	Line Relay, Substation Conductor / Drops
027	Avery 138 / 69 kV Substation	153 / 153	177 / 177	Relay, Substation Conductor / Drops, Disconnect Switches
028	Bayshore-GM Powertrain 138 kV Line	278 / 342	278 / 343	Line Relay
029	Bayshore-Jeep 138 kV Line	297 / 326	297 / 365	Line Relay, Substation Conductor / Drops
030	Blue Jacket-Kirby 138 kV Line	218 / 269	278 / 339	External Company Equipment
031	Carlisle-Gates 138 kV Line	196 / 210	233 / 282	Line Relay, Wave-trap, Substation Conductor / Drops
032	Cedar Street-New Castle 138 kV Line	294 / 350	370 / 452	Line Relay, CT, Circuit Breaker, Substation Conductor / Drops, Disconnect Switches
033	East Akron-West Ravenna 138 kV Line	176 / 229	200 / 242	Substation Conductor / Drops
034	GM Defiance-Richland #1 138 kV Line	216 / 229	216 / 264	Line Relay
035	GM Defiance-Richland #2 138 kV Line	216 / 229	216 / 264	Line Relay

Continued on next slide…

ATSI Transmission Zone

Problem Statement – Continued from previous slide

ATSI-2019-	Transmission Line / Substation Locations	Existing MVA Line Rating (SN / SE)	Existing MVA Conductor Rating (SN / SE)	Limiting Terminal Equipment
036	Greenfield-New Departure 138 kV Line	153 / 199	200 / 242	Substation Conductor / Drops
037	Hanna-West Ravenna #1 138 kV Line	295 / 369	324 / 395	Substation Conductor / Drops
038	Hoytdale-Maple 138 kV Line	278 / 332	278 / 339	Wave-trap
039	Hyatt-Tangy 345 kV Line	971 / 971	1560 / 1900	External Company Equipment
040	Ivanhoe-Mahoningside 138 kV Line	196 / 222	200 / 242	Wave-trap
041	Ivanhoe-Packard 138 kV Line	196 / 210	200 / 242	Line Relay, Wave-trap
042	Jennings-LTV West Q-12 138 kV Line	43 / 43	256 / 262	Line Relay, CT, Circuit Breaker
043	Jennings-LTV West Q-14 138 kV Line	43 / 43	256 / 262	Line Relay, CT, Circuit Breaker
044	Kirby-Tangy 138 kV Line	265 / 273	278 / 339	Line Relay, Substation Conductor / Drops
045	Midway-Levis Park 138 kV Line	278 / 286	308 / 376	Line Relay, Substation Conductor / Drops
046	Midway-Napoleon 138 kV Line	161 / 179	161 / 194	Meter
047	Salt Springs-Riverbend 138 kV Line	223 / 223	278 / 339	Line Relay, CT, Substation Conductor / Drops
048	Star-Wadsworth Muni 138 kV Line	221 / 262	233 / 282	Substation Conductor / Drops
049	West Akron-Babb 138 kV Line	190 / 223	200 / 242	Line Relay, Wave-trap, Substation Conductor / Drops

ATSI Transmission Zone

Solution Statement

ATSI-2019-	Transmission Line / Substation Locations	New MVA Line Rating (SN / SE)	Scope of Work	Estimate Costs ($ M)	Target ISD
026	Allen Junction-Vulcan 138 kV Line	308 / 376 (Vulcan-Toledo U Tap)	Vulcan: replace 138 kV breaker B-13397, disconnect switches, relay panel, CCVTs, line tuner, and wave trap. Allen Junction: replace 138 kV breaker B-13377, disconnect switches, relay panel, CCVTs, line tuner, and wave trap	$ 0.9 M	11/01/2019
027	Avery 138 / 69 kV Substation	177 / 177 (Transformer)	Avery: Replace Avery 138 / 69 kV transformer relaying, substation conductor and disconnect switches.	$0.3 M	12/16/2019
028	Bayshore-GM Powertrain 138 kV Line	278 / 343	Replace Bayshore 238 kV Breaker, disconnect switches, wave trap, line tuner, CCVTs.	$0.6 M	11/1/2019
029	Bayshore-Jeep 138 kV Line	279 / 365	Bayshore : Replace Jeep 138 kV Line relaying, replace CCVT, Wave Trap and Line Tuner.	$0.6 M	12/31/2019
030	Blue Jacket-Kirby 138 kV Line	278 / 339 (Blue Jacket Upgrade)	Kirby: Replace Blue Jacket - Kirby 138kV Line relaying, CCVT, Line Tuner	$0.4 M	12/1/2021
031	Carlisle-Gates 138 kV Line	233 / 282	Carlisle: Replace Carlisle-Gates 138 kV Line Relaying, Breaker B-67, disconnect switches, Wave Trap, Line Tuner, upgrade substation conductor. Gates: Replace Carlisle-Gates 138 kV Line Relaying, Breakers B-18 & B-22, disconnect switches, Wave Trap, Line Tuner, upgrade substation conductor	$2.0 M	3/31/2020
032	Cedar Street-New Castle 138 kV Line	370 / 452	Cedar Street: Replace 138 kV Cedar Street – New castle Line relaying	$0.2 M	4/1/2020
033	East Akron-West Ravenna 138 kV Line	200 / 242	East Akron: Replace 138 kV Line Relaying, AirBreak Switch A-102, Disconnect switches, CCVT, metering, upgrade Substation conductor West Ravenna: Replace 138 kV Line Relaying, AirBreak Switch A-39, Disconnect switches, CCVT, metering, upgrade Substation conductor	$0.9 M	12/1/2021
034	GM Defiance-Richland #1 138 kV Line	216 / 264	GM Defiance: Replace GM Defiance-Richland #1 138 kV Line relaying, line conductor, disconnect switch, Remove Wave Trap and coupling capacitor Richland: Replace GM-Defiance-Richland #1 138 kV Line relaying, line conductor, Breaker B-13242, disconnect switch	$0.6 M	2/15/2022
035	GM Defiance-Richland #2 138 kV Line	216 / 264	GM Defiance: Replace GM Defiance-Richland #2 138 kV Line relaying, GOAB switch 13277, Wavetrap, Line Tuner, PT's, CCVT,upgrade substation conductor Richland: Replace GM Defiance-Richland #2 138 kV line relaying, breaker B-13243, disconnect switch, CCVT, Wavetrap, Line Tuner, upgrade substation conductor	$1.1 M	3/30/2022

ATSI Transmission Zone

Solution Statement – Continued from previous slide

ATSI-2019-	Transmission Line / Substation Locations	New MVA Line Rating (SN / SE)	Scope of Work	Estimate Costs ($ M)	Target ISD
036	Greenfield-New Departure 138 kV Line	200 / 242	Greenfield: Replace Greenfield-New Departure 138 kV Line Relaying, disconnect switches, substation conductor New Departure: Replace Greenfield-New Departure 138 kV Line Relaying, breakers B-17 & B-20, disconnect switches, substation conductor	$0.8 M	6/1/2020
037	Hanna-West Ravenna #1 138 kV Line	324 / 395	Hanna: Replace Hanna-West Ravenna 138 kV Line Relaying, Breaker B-7, Disconnect switches West Ravenna: Replace Hanna-West Ravenna 138 kV Line Relaying, disconnect switches, tuner	$0.7 M	4/1/2020
038	Hoytdale-Maple 138 kV Line	278 / 339	Maple: Replace Hoytdale-Maple 138 kV Line relaying, breaker B-22, disconnect switches, AB-switch, wave trap, tuner, CCVTs Hoytdale: Replace Hoytdale-Maple 138 kV Line relaying, breaker B-2, disconnect switches, AB-switch, CCVTs, Wavetrap, line tuner	$1.1 M	12/31/2019
039	Hyatt-Tangy 345 kV Line	1560 / 1900 (Hyatt Upgrade)	Tangy: Replace Hyatt-Tangy 345 kV Line relaying, upgrade substation conductor	$0.2 M	6/1/2020
040	Ivanhoe-Mahoningside 138 kV Line	200 / 242	Ivanhoe: Replace Ivanhoe-Mahoningside 138 kV line relaying, disconnect switches, Wave trap, line tuner, and CCVTs Mahoningside: Replace Ivanhoe-Mahoningside 138 kV Line relaying, breaker B-63, disconnect switch, CCVTs, Wave trap, line tuner	$1.2 M	3/31/2021
041	Ivanhoe-Packard 138 kV Line	200 / 242	Ivanhoe: Replace Ivanhoe-Packard 138 kV line relaying, breaker B-9, disconnect switches, CCVTs, Wave trap, line tuner, upgrade substation conductor Packard: Replace Ivanhoe-Packard 138 kV line relaying, breaker B-10, Airbreak Switch, disconnect switches, CCVTs, Wave trap, line tuner, upgrade substation conductor	$1.5 M	12/1/2021
042	Jennings-LTV West Q-12 138 kV Line	256 / 262	Jennings: Replace Jennings-LTV Wesst Q-12 138 kV line relaying, disconnect switch	$0.2 M	6/1/2020
043	Jennings-LTV West Q-14 138 kV Line	256 / 262	Jennings: Repalce Jennigns-LTV West Q-14 138 kV line relaying, breaker B-7, discounnect switches, CCVT's	$0.5 M	12/1/2020
044	Kirby-Tangy 138 kV Line	278 / 339	Kirby: Replace Kirby-Tangy 138 kV line relaying Tangy: Replace Kirby-Tangy 1378 kV line relaying, disconnect switches, CCVTs	$0.8 M	3/31/2021

ATSI Transmission Zone

Solution Statement – Continued from previous slide

ATSI-2019-	Transmission Line / Substation Locations	New MVA Line Rating (SN / SE)	Scope of Work	Estimate Costs ($ M)	Target ISD
045	Midway-Levis Park 138 kV Line	308 / 376	Midway: Replace Midway-Levis Park 138 kV line relaying, breaker 13300, CCVTs, wavetrap, line tuner, disconnect switches Levis Park: Replace Midway-Levis Park 138 kV line relaying, breaker 13336, CCVTs, wavetrap, line tuner, disconnect switches	$1.0 M	12/31/2019
046	Midway-Napoleon 138 kV Line	161 / 194	Midway: Replace Midway-Napoleon 138 kV line relaying, breaker 13304, disconnect switch, CCVT's Wavetrap, line tuner Napoleon: Replace Midway-Napoleon 138 kV line relaying	$0.8 M	6/1/2020
047	Salt Springs-Riverbend 138 kV Line	N/A	Cancelled Project – To be completed under ATSI-2019-003	N/A	N/A
048	Star-Wadsworth Muni 138 kV Line	N/A	Cancelled Project – To be completed under PJM Supplemental # s1695	N/A	N/A
049	West Akron-Babb 138 kV Line	200 / 242	West Akron: Replace West Akron-Babb 138 kV line relaying, breaker b-159, disconnect switches, ab switch, CCVTs, upgrade substation conductor Babb: Replace West Akron-Babb 138 kV line relaying, breaker, b-95, disconnect switch, AB switch, CCVTs, upgrade substation conductor	$0.9 M	6/01/2021

Alternatives Considered:
- Maintain existing condition and elevated risk of failure

Project ISD: See Summary Tables

Status: All projects are Conceptual

No Diagrams Required
All work is within the substation

Appendix

High level M-3 Meeting Schedule

Assumptions

Activity	Timing
Posting of TO Assumptions Meeting information	20 days before Assumptions Meeting
Stakeholder comments	10 days after Assumptions Meeting

Needs

Activity	Timing
TOs and Stakeholders Post Needs Meeting slides	10 days before Needs Meeting
Stakeholder comments	10 days after Needs Meeting

Solutions

Activity	Timing
TOs and Stakeholders Post Solutions Meeting slides	10 days before Solutions Meeting
Stakeholder comments	10 days after Solutions Meeting

Submission of Supplemental Projects & Local Plan

Activity	Timing
Do No Harm (DNH) analysis for selected solution	Prior to posting selected solution
Post selected solution(s)	Following completion of DNH analysis
Stakeholder comments	10 days prior to Local Plan Submission for integration into RTEP
Local Plan submitted to PJM for integration into RTEP	Following review and consideration of comments received after posting of selected solutions

Revision History

3/15/2019 – V1 – Original version posted to pjm.com

3/20/2019 – V2 – Corrected Need Reference on Slide 51

4/4/2019 – V3

ATSI-2019-001 – Removed the auto-sectionalizing scheme at Axtel from the solution and added a note to reference the scheme
ATSI-2019-004 – Henrietta-Amherst 69 kV line ratings corrected
ATSI-2019-007 – Corrected transformer rating, summer normal (SN) line rating on the Jackman-Vulcan 69 kV line, and in-service date
ATSI-2019-025 – Corrected the reference to the normally open (N.O.) airswitch