

Subregional RTEP Committee – Western FirstEnergy Supplemental Projects

November 22, 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 M-3 Process Multiple Relay Misoperation Needs

Need Number: ATSI-2019-Multiple (See next slide)

Process Stage: Need Meeting 11/22/2019

Project Driver:

Equipment Material Condition, Performance and Risk

Specific Assumption References:

Global Factors

- System reliability and performance
- Substation / line equipment limits

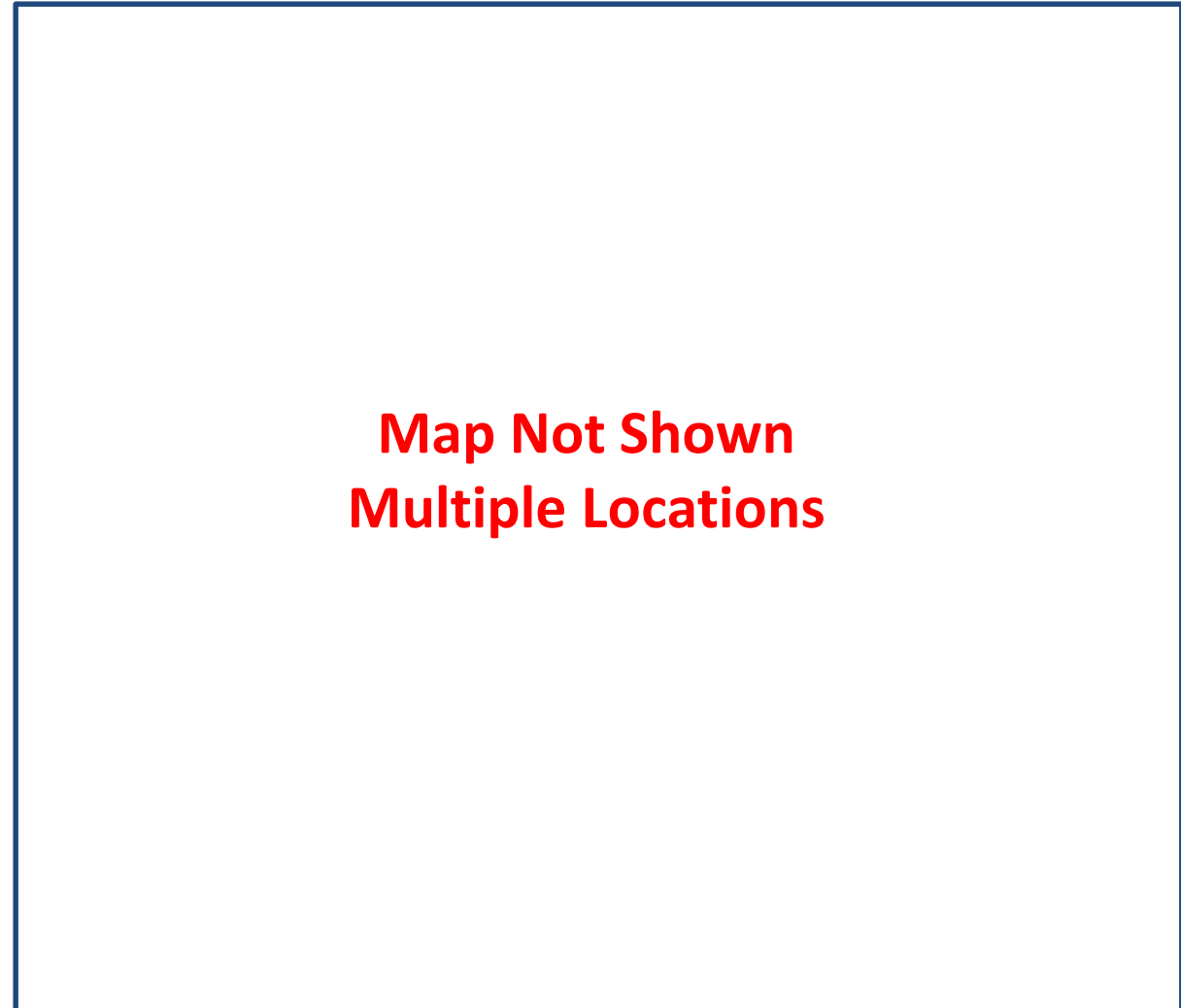
Upgrade Relay Schemes

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

Problem Statement:

- 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cases the protection equipment cannot be repaired due to a lack of replacement parts and available expertise in the outdated technology.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.

Continued on next page...



**Map Not Shown
Multiple Locations**

...Continued from previous page

ATSI-2019	Transmission Line / Substation Locations	Existing Line/Terminal Equipment MVA Rating (SN / SE)	Existing Conductor/Transformer MVA Rating (SN / SE)	Limiting Terminal Equipment
-72	Eber-Swanton 138 kV Line	327 / 396	327 / 420	Substation Conductor (Winter Ratings) @ Swanton
-73	Eastlake-Lloyd 138 kV Q12 Line	103 / 132	148 / 151	Substation Conductor, Relay, CTs @ Lloyd
-74	Chamberlin-Hudson East 138 kV Line	226 / 249	226 / 286	Relay (Winter Ratings) @ Chamberlin
-75	Eastlake-Nottingham 138 kV Q11 Line	324 / 382	324 / 395	Meter, Relay @ Eastlake
-76	Maclean-Lemoyne 138 kV Line	329 / 413	376 / 465	Disconnect Switch @ Maclean
-77	Clinton-CPP 138 kV Line	187 / 222	194 / 237	Substation Conductor @ Clinton
-78	Eastlake-Jordon 138 kV Q14 Line	261 / 317	273 / 332	Substation Conductor, Meter, Relay @ Eastlake & Jordon
-79	Beaver-West Lorain 345 kV Line	1370 / 1720	1560 / 1900	Substation Conductor, Disconnect Switch @ Beaver

Need Number: ATSI-2019-Multiple (See next slide)

Process Stage: Need Meeting 11/22/2019

Project Driver:

Equipment Material Condition, Performance and Risk

Specific Assumption References:

Global Factors

- System reliability and performance
- Substation / line equipment limits

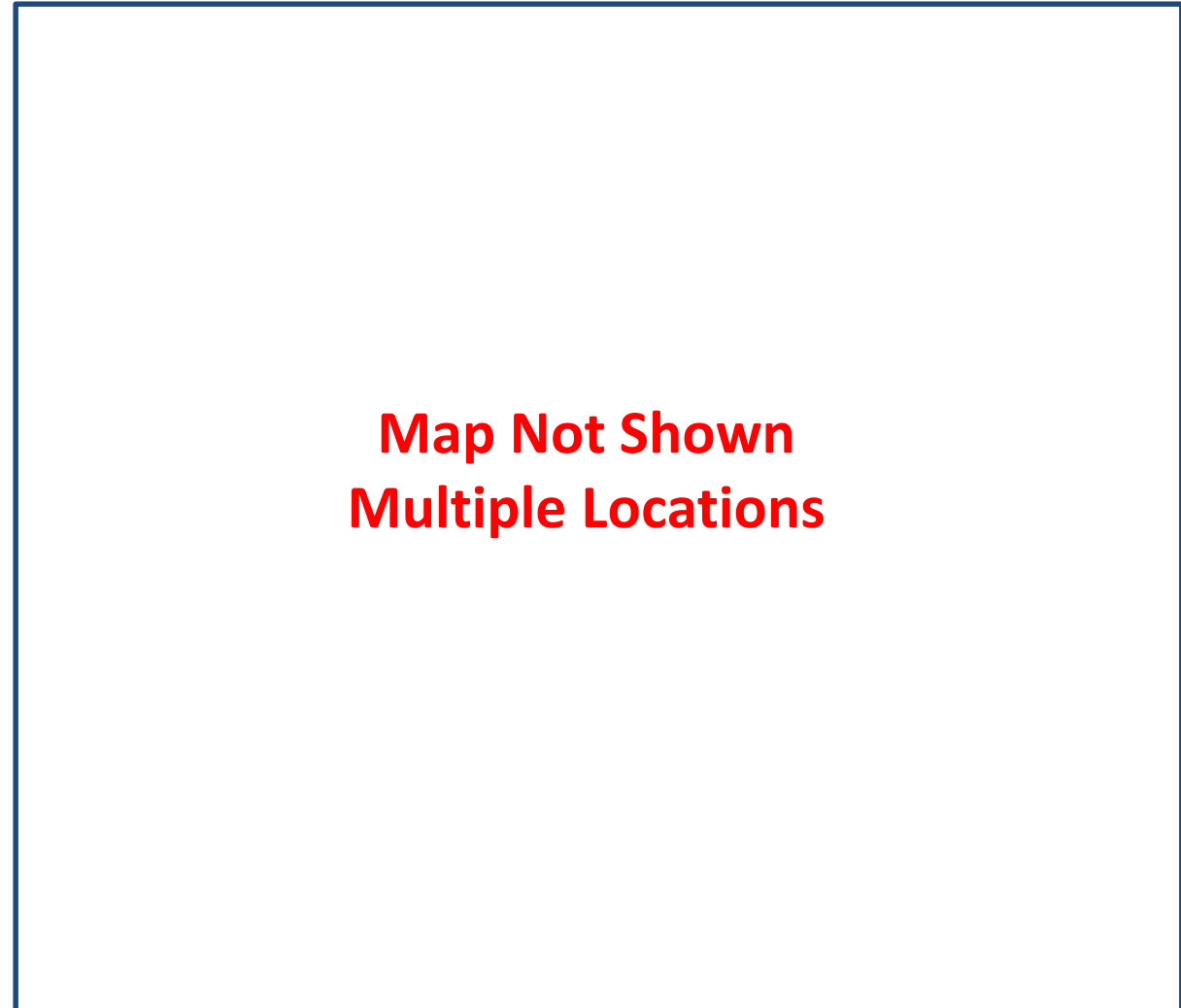
Upgrade Relay Schemes

- Bus protection schemes which rely on remote clearing.
- Protection system with single point of failure.
- Relay schemes that have a history of misoperation.
- Obsolete firmware or software.

Problem Statement:

- FirstEnergy has identified protection schemes on networked lines and buses using a certain vintage of relays that have a history of misoperation.
- Schemes protecting these facilities have no local backup so failures impact a larger portion of the system.
- 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.

Continued on next page...



**Map Not Shown
Multiple Locations**

...Continued from previous page

ATSI-2019	Transmission Line / Substation Locations	Existing Line/Terminal Equipment MVA Rating (SN / SE)	Existing Conductor/Transformer MVA Rating (SN / SE)	Limiting Terminal Equipment
- 080	Bluebell 138 kV Bus Protection	100 / 100	164 / 206	Relays @ Bluebell
- 081	Maysville 69 kV Bus Protection	143 / 143	153 / 184	Relays @ Maysville

Need Number: ATSI-2019-082
Process Stage: Need Meeting – 11/22/2019

Supplemental Project Driver(s):
Customer Service

Specific Assumption Reference(s)

Customer connection request will be evaluated per FirstEnergy’s “Requirements for Transmission Connected Facilities” document and “Transmission Planning Criteria” document.

Problem Statement

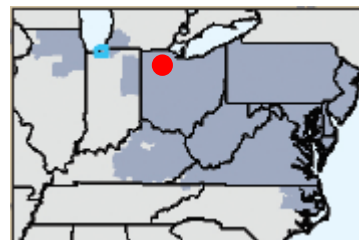
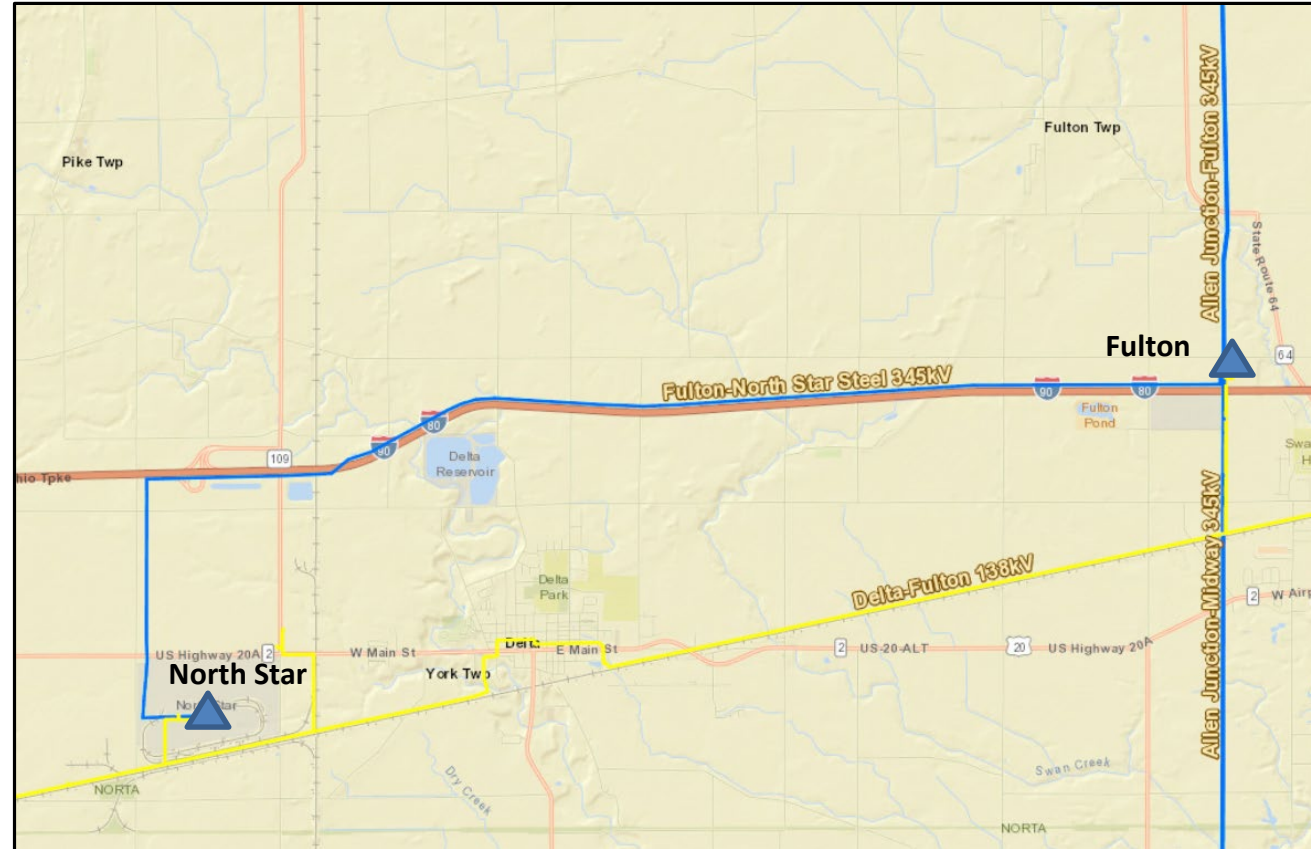
Existing Customer Connection – Load Increase

An existing transmission customer (North Star BlueScope Steel) is requesting load demand increase for the existing 345/34.5 kV substation to a new peak of 300 MVA on the Fulton-North Star Steel 345 kV line.

Requested In-Service Date: 03/01/2021

The customer is also requesting load demand increase for its existing 138/34.5 kV substation to a new peak load of 40 MVA on the Delta-Wauseon 138 kV line.

Requested In-Service Date: 11/01/2020



Legend	
345 kV	
138 kV	
69 kV	

Need Number: ATSI-2019-083
Process Stage: Need Meeting – 11/22/2019

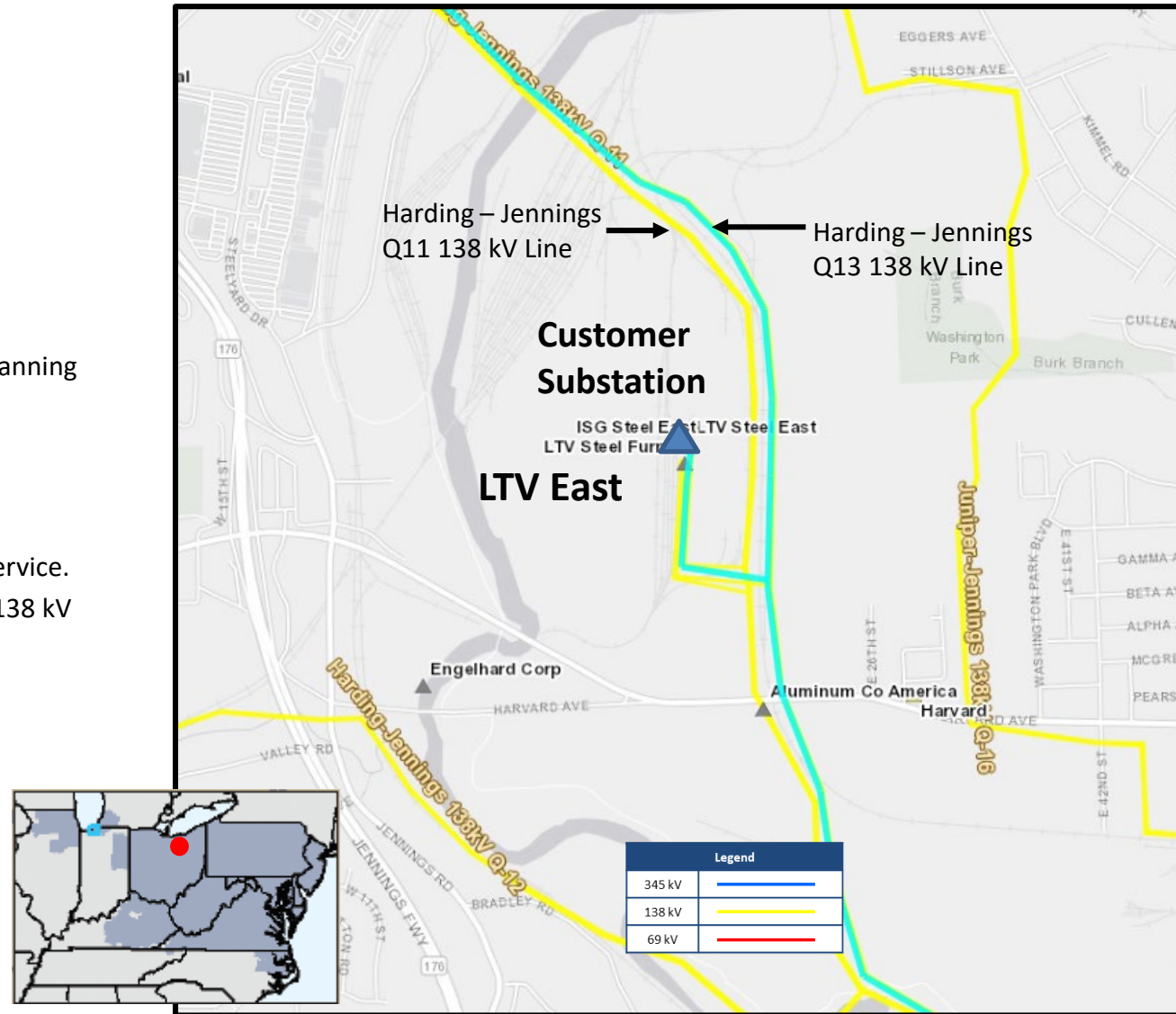
Supplemental Project Driver(s):
Customer Service

Specific Assumption Reference(s)
 Modification of existing customer connection request evaluated per FirstEnergy’s “Requirements for Transmission Connected Facilities” document and “Transmission Planning Criteria” document.

Problem Statement
 Existing Customer Connection – Service Modification
 – The existing customer requested modification to their current 138 kV transmission service.
 – The request is to move some of their existing load from the Harding – Jennings Q13 138 kV line to the Harding – Jennings Q11 138 kV line.

This request is not for a load increase, but will result in a system topology change.

Requested In-Service Date: 02/01/2020



Need Number: ATSI-2019-084
Process Stage: Need Meeting – 11/22/2019

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

Specific Assumption Reference(s)

Global

- Increasing negative trend in maintenance findings and/or costs
- Failure risk, to the extent caused by asset design characteristics, or history industry/company performance data, or application design error
- Expected service life (at or beyond) or obsolescence

Circuit Breaker and other fault interrupting devices

- Condition of interrupting media (oil, gas, etc.)

Switches

- Blade and jaw assembly
- Switch degradation

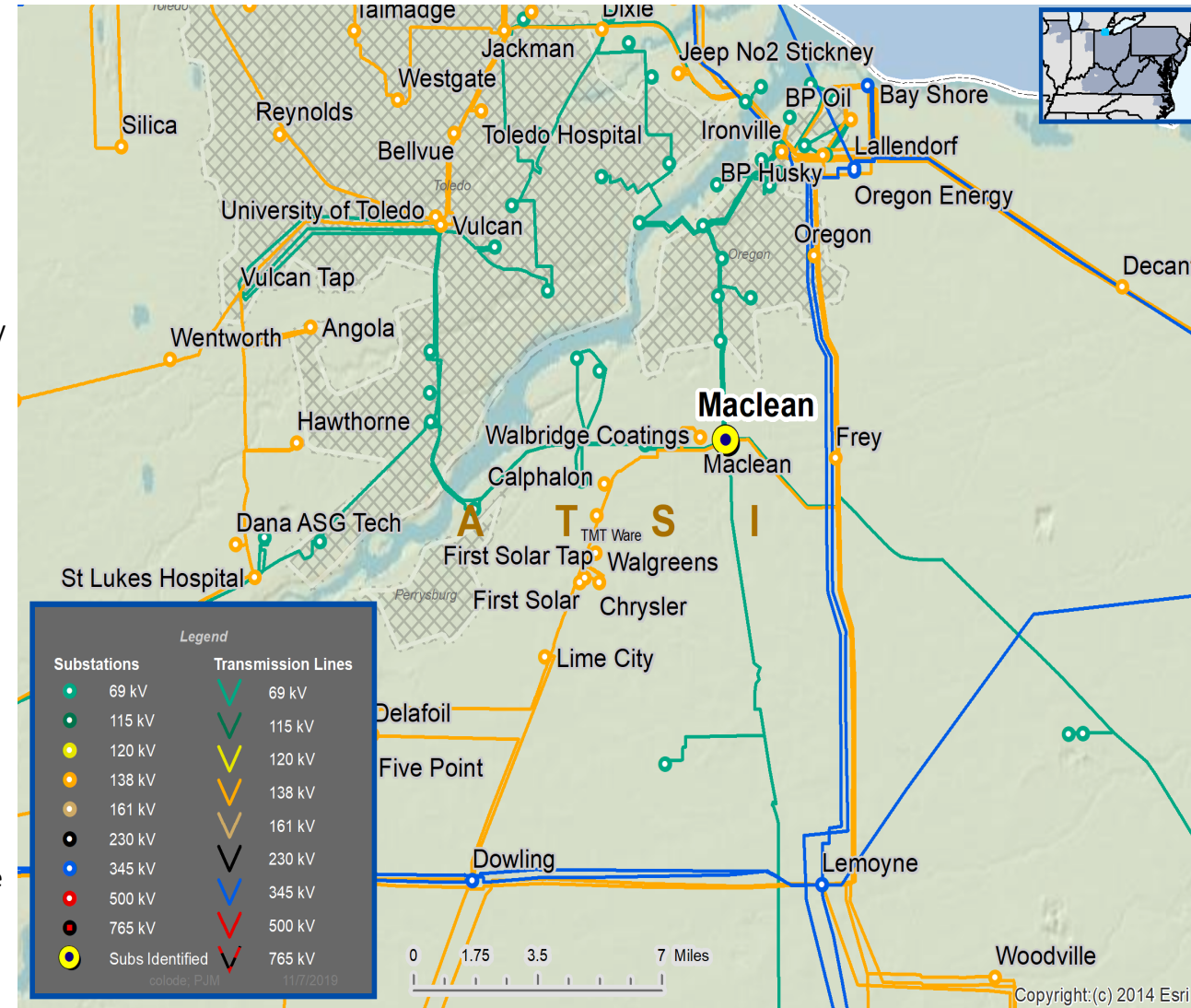
Upgrade Relay Schemes

- Bus protection schemes which rely on remote clearing
- Protection system with single point of failure
- Relay schemes that have a history of misoperation

Problem Statement

Maclean 138 kV Substation – Breakers and Protection Schemes

- Breakers B132203 and B13204 Oil Circuit Breakers (OCB) are at/beyond expected service life (greater than 30 years) with increasing maintenance concerns; severe hydraulic leaks, oil quality issues, and increasing maintenance trends.
- The electromechanical relays provide limited bus protection with single point of failure.
- The bus PTs are at/beyond expected service life (greater than 40 years).



Need Number: ATSI-2019-085
Process Stage: Need Meeting – 11/22/2019

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

Specific Assumption Reference(s)

Global

- System reliability and performance
- Substation/line equipment limits
- Failure risk, to the extent caused by asset design characteristics, or history industry/company performance data, or application design error
- Expected service life (at or beyond) or obsolescence

Circuit Breaker and other fault interrupting devices

- Operating Mechanism

Switches

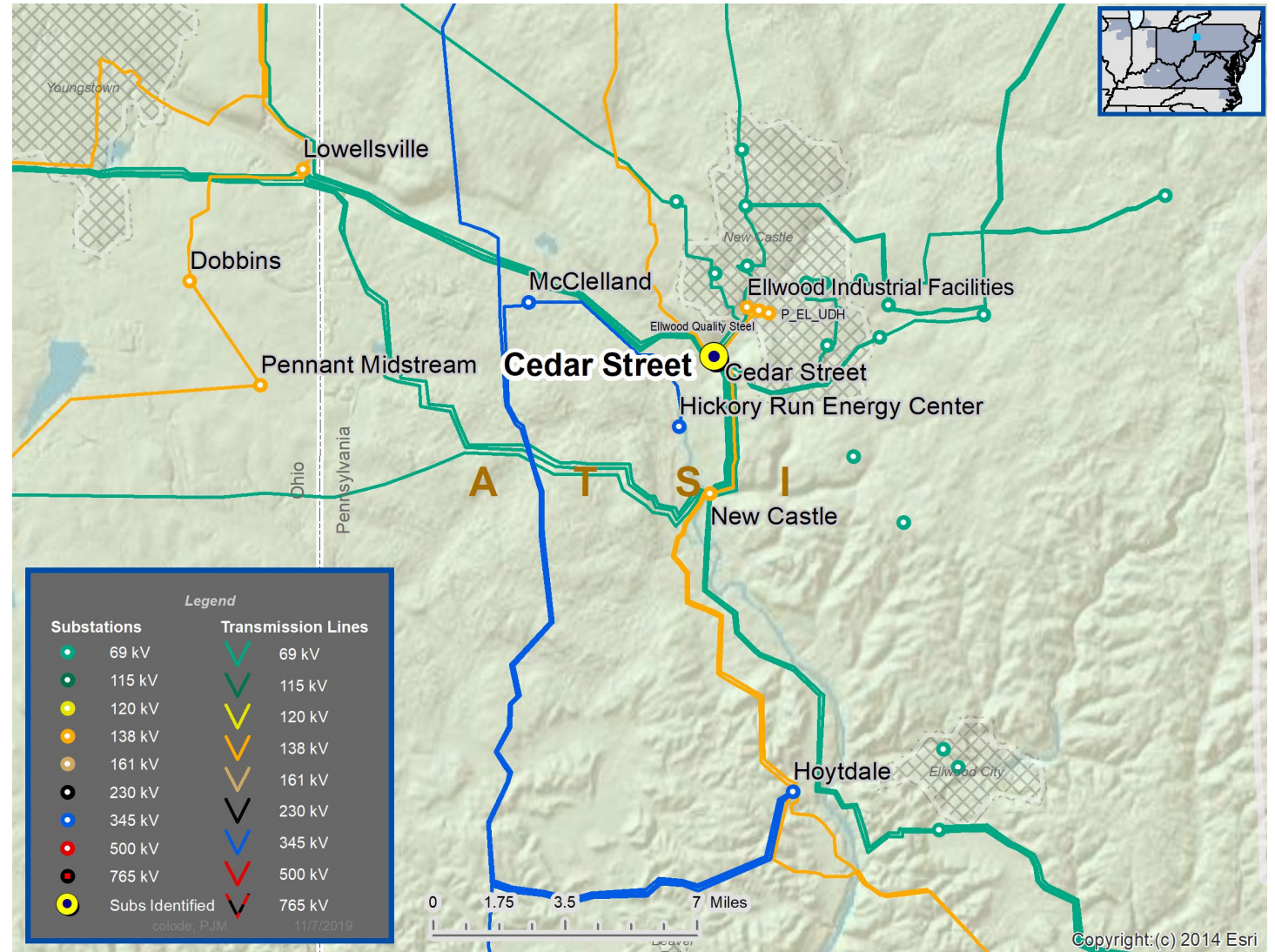
- Blade and jaw assembly
- Operating mechanism

Station Protection and Control

- Electromechanical relays

Devices used for panel, telemetry, and revenue metering

- Potential Transformers (PTs)



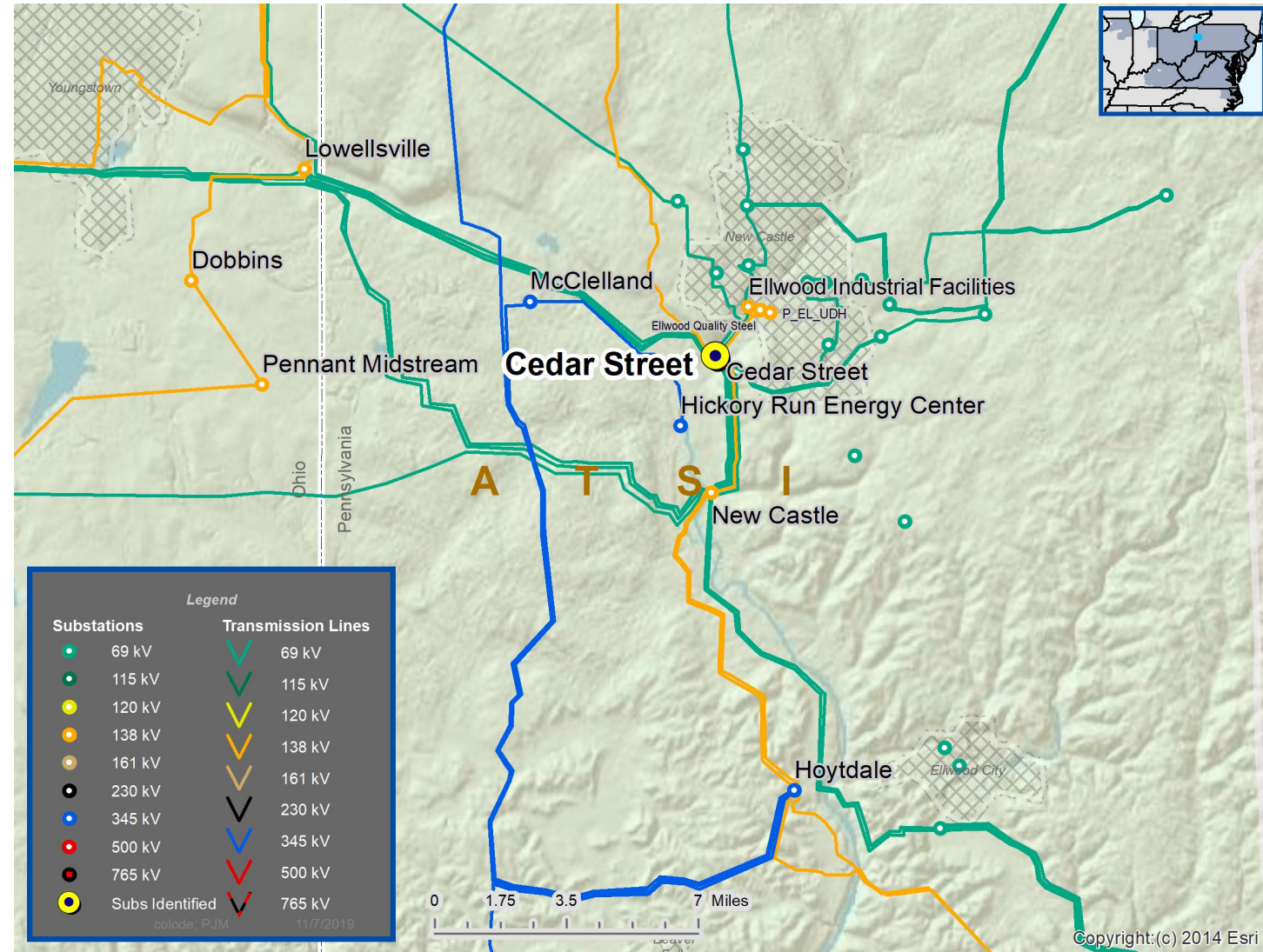
Copyright:(c) 2014 Esri

Need Number: ATSI-2019-085
Process Stage: Need Meeting – 11/22/2019

Problem Statement

Cedar 138/69 kV Street Substation – Breakers, Relays, and Control Building

- Breaker B-26 69 kV Bus Tie Breaker and disconnect switches are at/beyond expected service life (greater than 52 years) with increasing maintenance concerns; deteriorated operating mechanism, spare part availability, and increasing maintenance trends.
- North and South bus PTs are deteriorating and at/beyond expected service life (greater than 40 years).
- Transformer 138/69 kV #1, bus protection, and line exit relays are electromechanical and prone to misoperation.
 - Cedar Street – Shenango 138 kV Line
 - Cedar Street – New Castle 138 kV Line
 - Cedar Street – New Castle #1, #2 and #3 69 kV Lines
 - Cedar Street – Frisco #1 and #2 69 kV Lines
 - Cedar Street – McDowell 69 kV Line
 - Cedar Street – Grant Street 69 kV Line
 - Cedar Street – New Wilmington 69 kV Line
 - Cedar Street – Lowellville North 69 kV Line
 - Cedar Street – Lowellville South 69 kV Line
 - Cedar Street – Columbiana 69 kV Line



Need Number: ATSI-2019-086
Process Stage: Need Meeting – 11/22/2019

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

Specific Assumption Reference(s)
Global

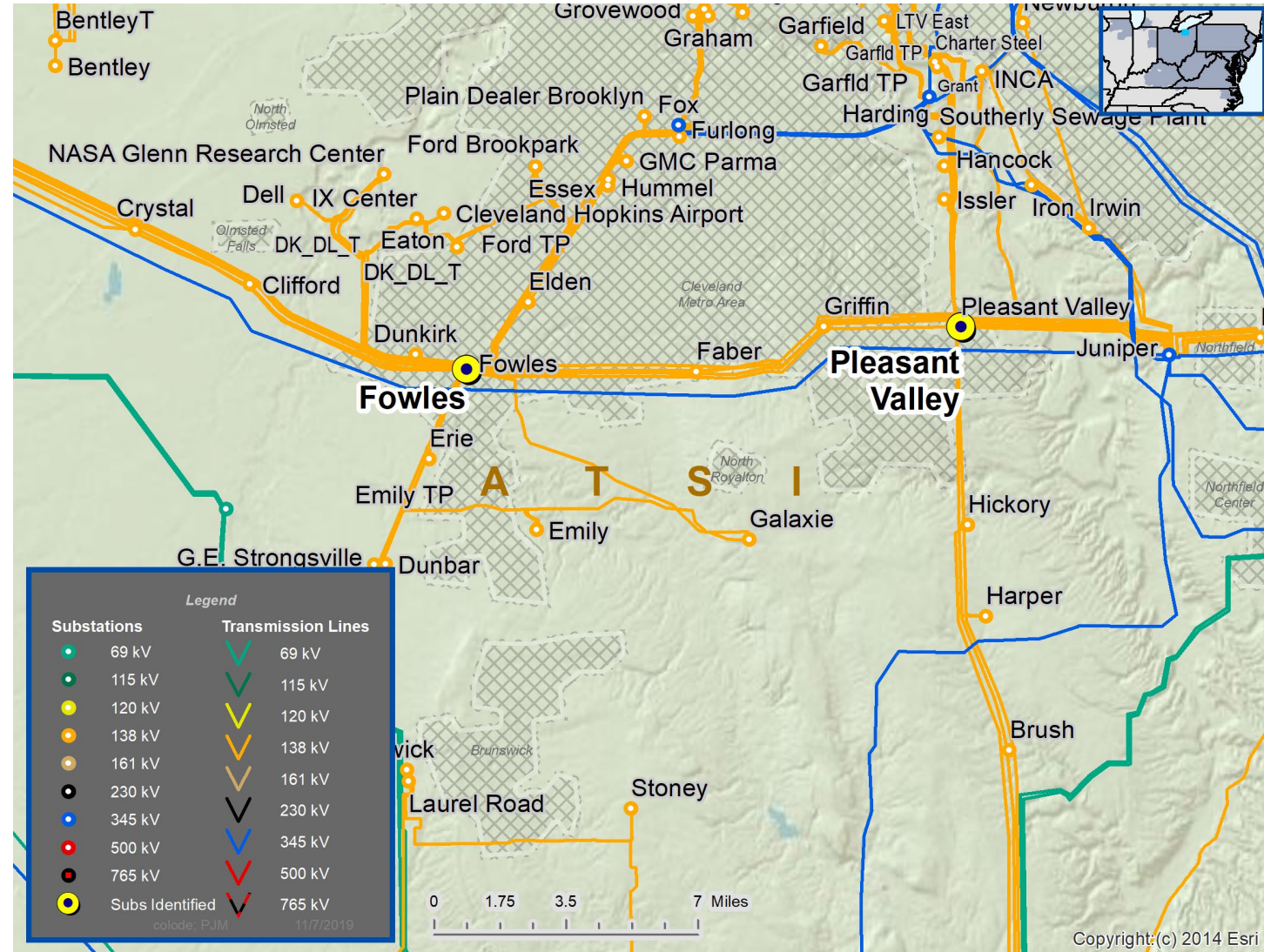
- System reliability and performance
- Substation/line equipment limits
- Failure risk, to the extent caused by asset design characteristics, or history industry/company performance data, or application design error
- Expected service life (at or beyond) or obsolescence

Circuit Breaker and other fault interrupting devices

- Condition of interrupting media (oil, gas, etc.)

Station Protection and Control

- Electromechanical relays



Need Number: ATSI-2019-086
Process Stage: Need Meeting – 11/22/2019

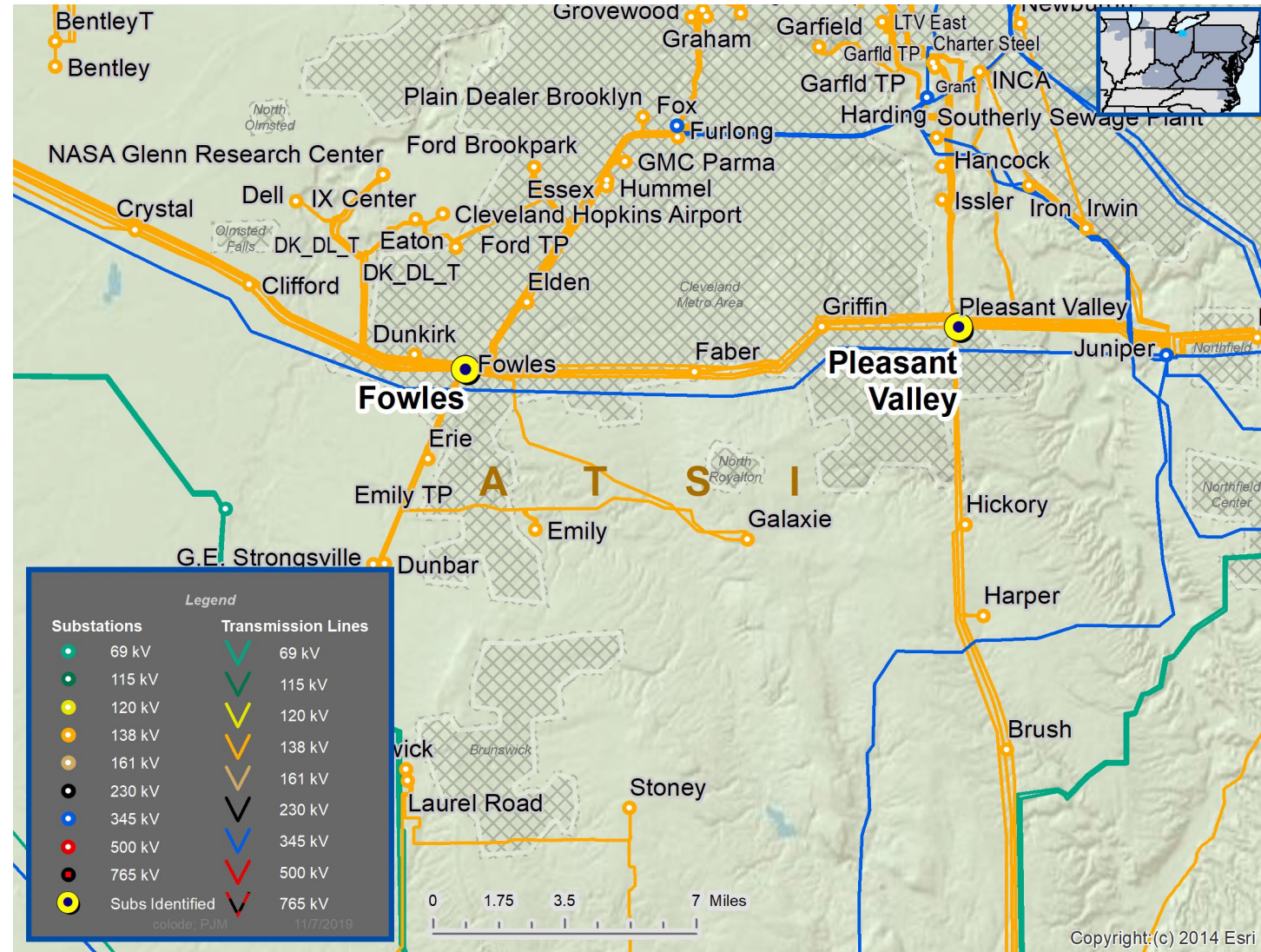
Problem Statement

Fowles 138 kV Substation – Breaker and substation equipment

- Breaker B-8 Oil Circuit Breaker (OCB) is at/beyond expected service life (greater than 60 years) with increasing maintenance concerns; hot spots, oil leaks, and increasing maintenance trends.
- CTs and disconnect switches are at/beyond expected service life.
- Relays are electromechanical and prone to misoperation

Pleasant Valley 138 kV Substation – Breakers and Substation Equipment

- Breaker B-1 Oil Circuit Breaker (OCB) is at/beyond expected service life (greater than 30 years) with increasing maintenance concerns; hot spots and deteriorated oil within the tank, deterioration of terminal block wiring in the cabinet.
- CTs and disconnect switches are at/beyond expected service life.



Copyright:(c) 2014 Esri

Need Number: ATSI-2019-087
Process Stage: Need Meeting – 11/22/2019

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

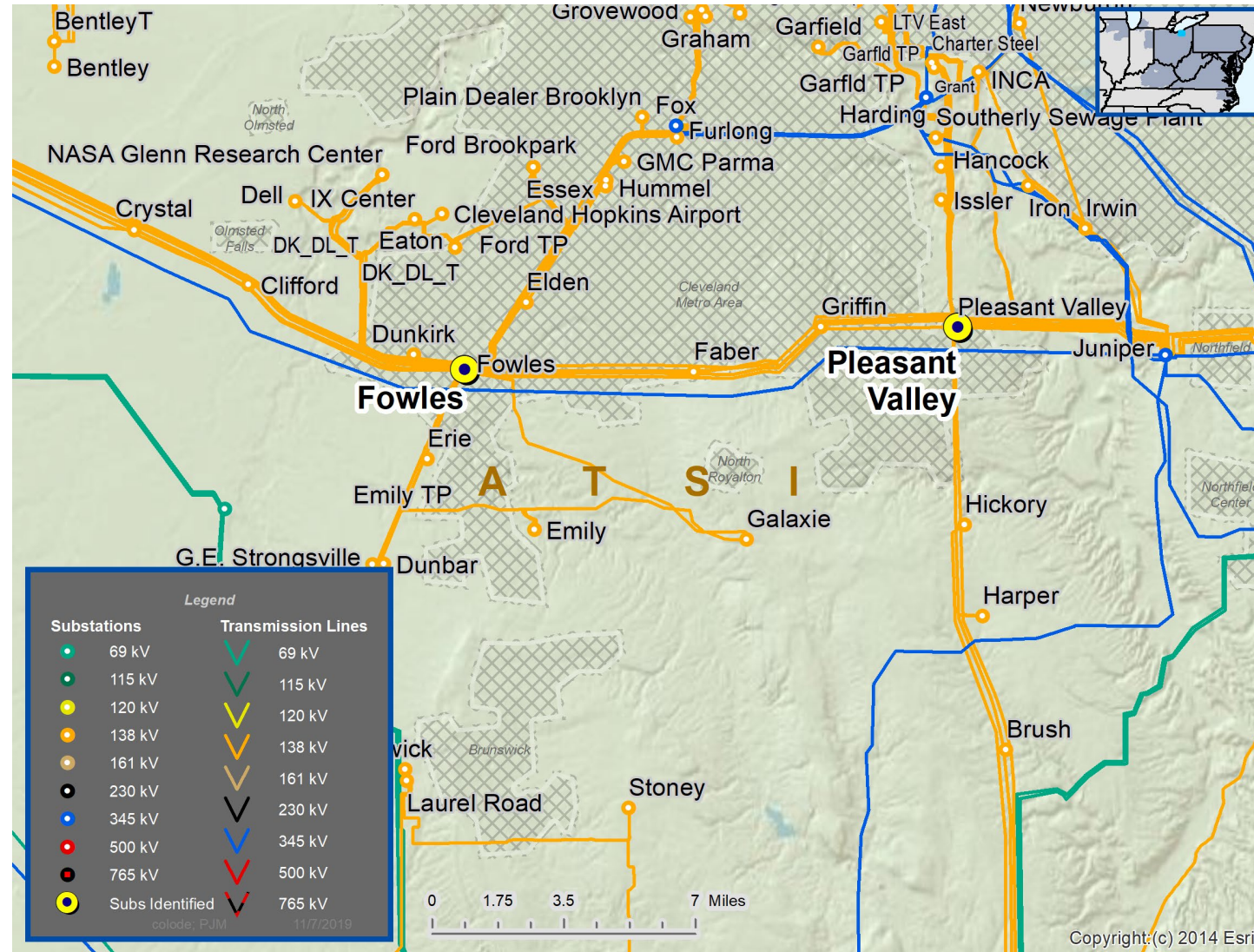
Specific Assumption Reference(s)
Global

- System reliability and performance
 - Substation/line equipment limits
 - Expected service life (at or beyond) or obsolescence
- Switches*
- Stick-operated line and/or bus switch – Blade and jaw assembly.
- Station System Protection and Control*
- Electro-mechanical relays – Capability
- Upgrade Relay Schemes*
- Relay schemes that have a history of misoperation

Problem Statement

Cloverdale Substation – Breakers, Relays, and Control Building

- The transformer 138/69 kV relaying is electro-mechanical and is prone to misoperation. The substation disconnects D264, D262, D195, D193 and D192 have deteriorating blades and jaws.
- Transformer Breaker B-191 Oil Circuit Breaker (OCB) is aging greater than 30 years with increasing replacement concerns.



Copyright:(c) 2014 Esri

Need Number: ATSI-2019-088
Process Stage: Need Meeting – 11/22/2019

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

Specific Assumption Reference(s)

Global

- System reliability and performance
- Load and/or Customer at risk on single transmission line.
- Increasing negative trend in maintenance findings and/or costs
- Failure risk, to the extent caused by asset design characteristics, or history industry/company performance data, or application design error
- Expected service life (at or beyond) or obsolescence

Automatic Sectionalizing Schemes

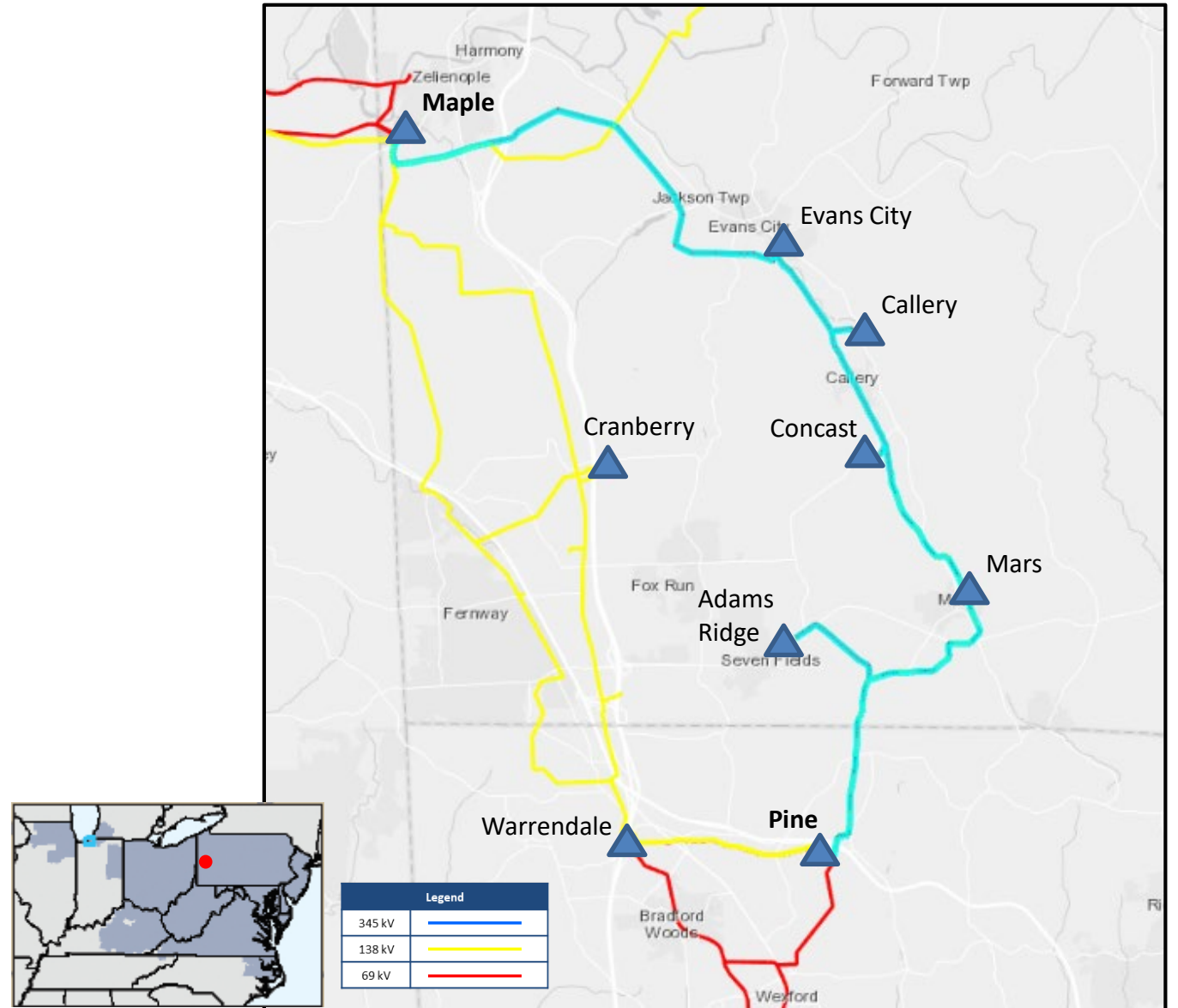
- Evaluate load at risk and/or customers impacted

Circuit Breaker and other fault interrupting devices

- Condition of interrupting media (oil, gas, etc.)
- Operating mechanism

Upgrade Relay Schemes

- Bus protection schemes which rely on remote clearing
- Protection system with single point of failure
- Relay schemes that have a history of misoperation



Need Number: ATSI-2019-088
Process Stage: Need Meeting – 11/22/2019

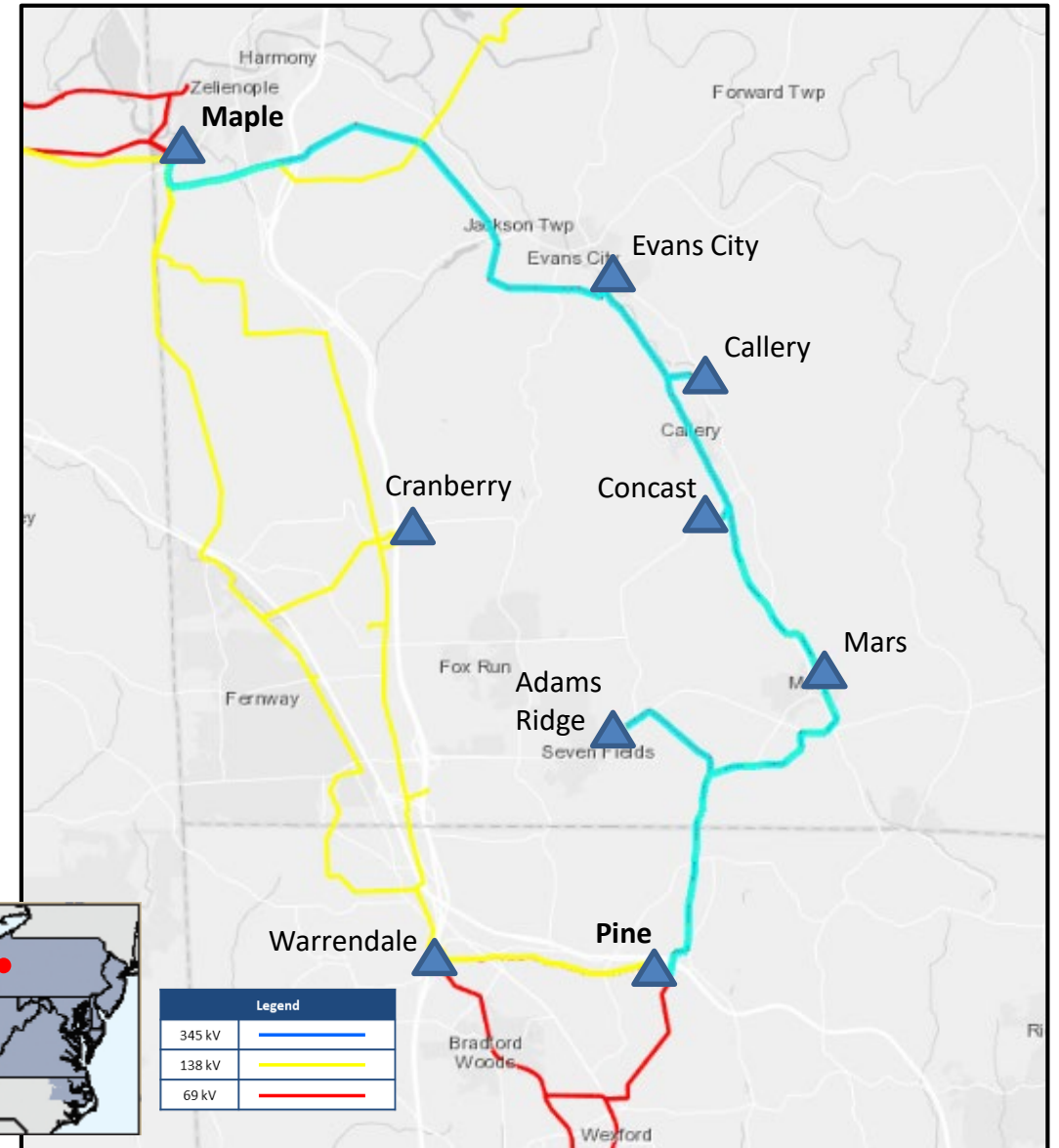
Problem Statement

Maple-Pine 69 kV Line

- The existing 69 kV transmission line is approximately 18 miles long with approximately 45 MWs of load and 11,500 customers at risk. The largest customer and load base at risk is located at Mars substation (22 MWs / 5,300 Customers).
- Overall line condition is adequate based on recent line inspection results.
- System performance over the past five years: 5 momentary / 6 sustained

Pine 69 kV Substation – Breakers and Protection Schemes

- Several SF6 breakers at Pine substation at/beyond expected service life with increasing maintenance concerns;
 - Breaker B-18 has history of SF6 leaks
 - Breaker B-14 has history of SF6 leaks and has had air tank issues
 - Breaker B-22 has experienced a bushing failure and repairs
 - Breaker B-26 has had a bushing, air receiver, pilot valve and a lower pressure cut-off valve issues
- The transfer line and bus protection electro-mechanical relays are prone to mis-operate due to components failing without warning.



Need Number: ATSI-2019-089
Process Stage: Need Meeting – 11/22/2019

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

Specific Assumption Reference(s)

Global

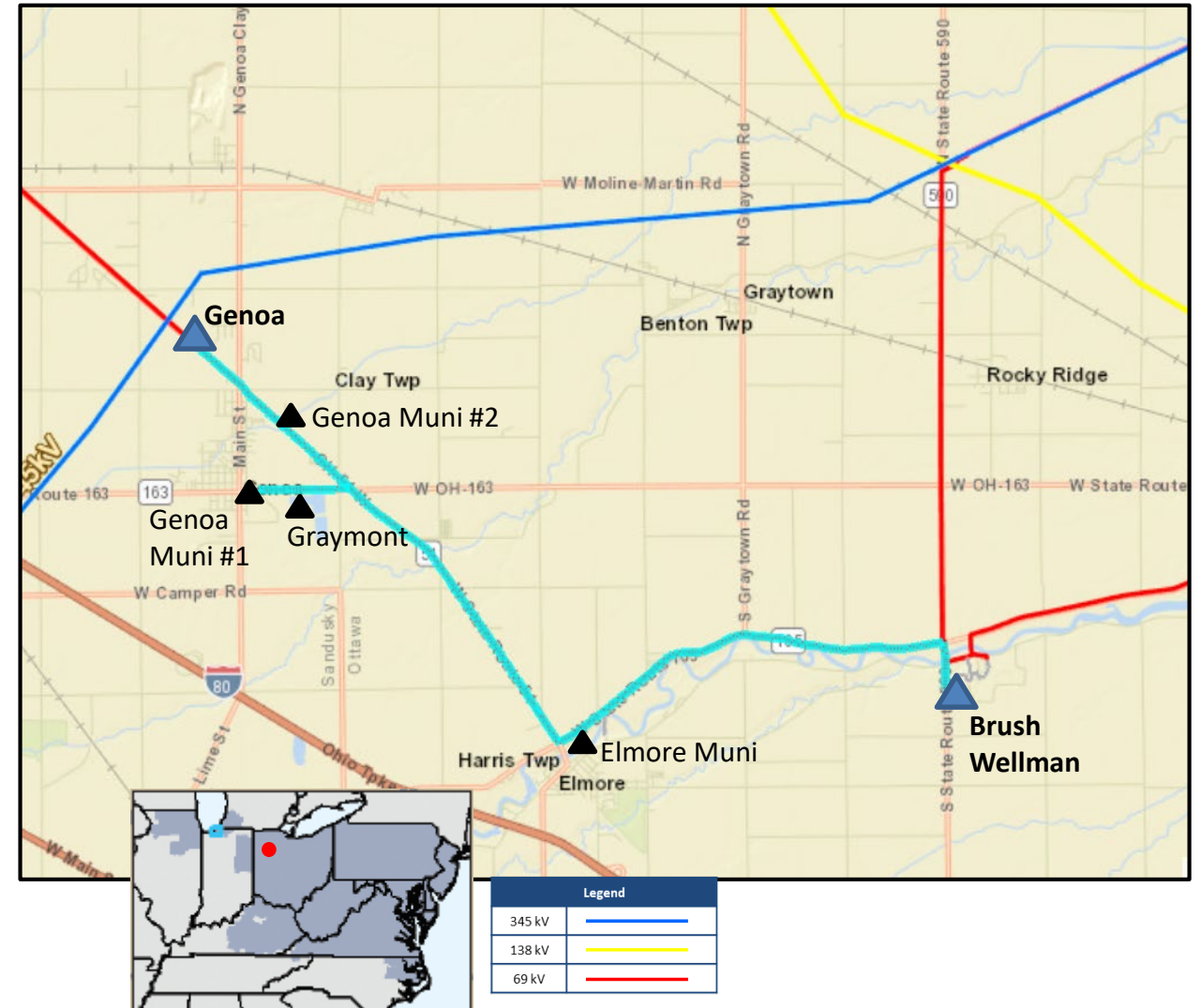
- System reliability and performance
- Line condition rebuild / replacement*
- Age/condition of wood pole transmission line structures
- Age/condition of steel tower or steel pole transmission line structures
- Age/condition of transmission line conductors

Problem Statement

Brush Wellman-Genoa 69kV

The existing 69 kV transmission line is approximately 11.4 miles long with approximately 20 MWs of load and 2,592 customers at risk. It has four transmission service connection points.

- 83% of the wood poles failed recent line inspection.
- Typical age of the line components is 59 years.
- Six (6) obsolete line switches
- System performance over the past five years: 1 momentary / 0 sustained



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

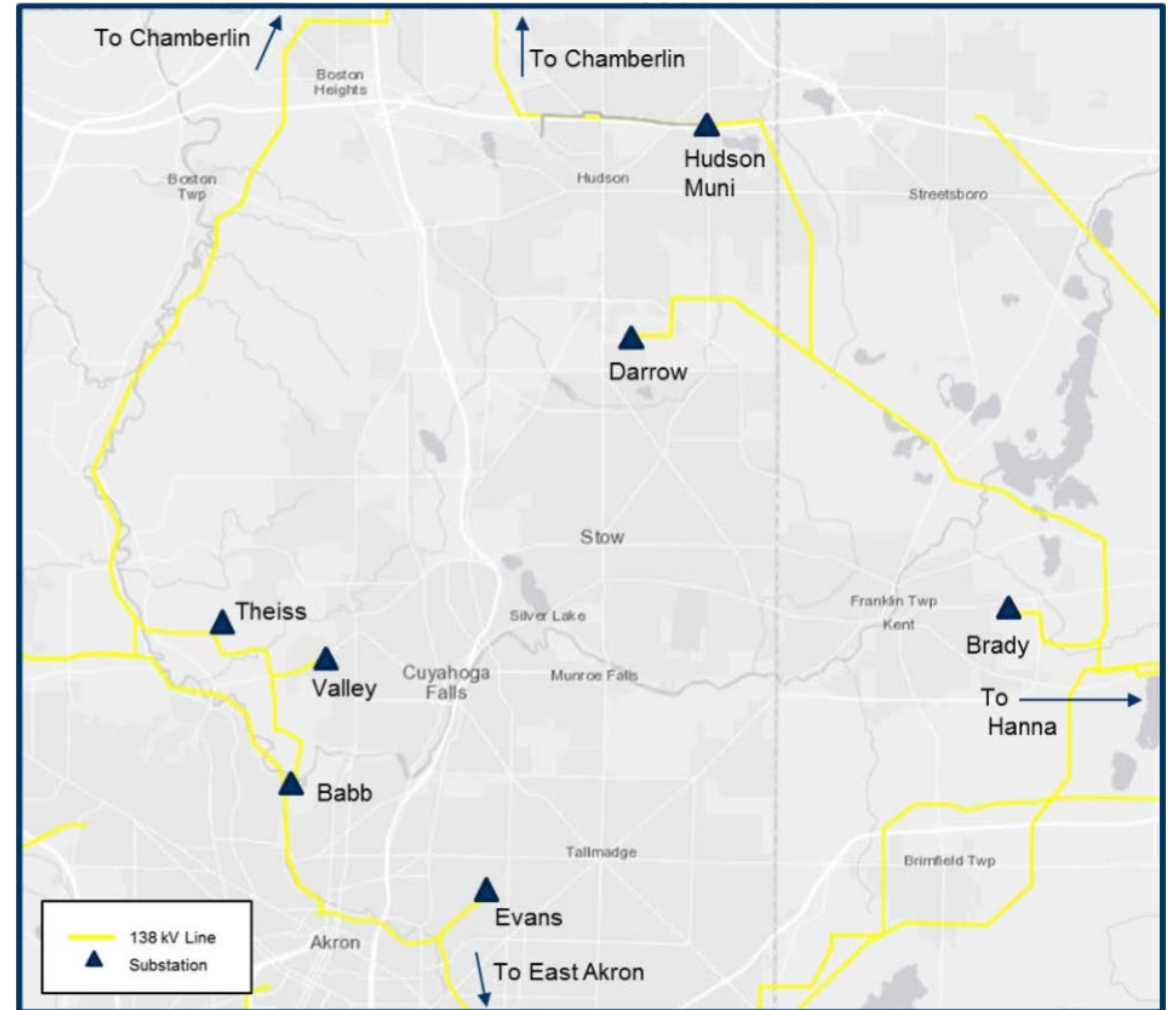
Need Number: ATSI-2019-010
Process Stage: Solutions Meeting – 11/22/2019
Previously Presented: Need Meeting – 01/11/2019

Supplemental 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 line



Need Number: ATSI-2019-010
Process Stage: Solutions Meeting – 11/22/2019
Previously Presented: Need Meeting – 01/11/2019

Problem Statement

Valley & Thiess 138 kV Substation Area

The Valley and Thiess 138 kV substations are presently owned by Cuyahoga Falls Municipality with transmission service from the ATSI Babb-Chamberlin 138 kV line.

- A transmission line outage of the double circuit networked 138 kV tap (approximately 1 mile) to Valley substation could result in approximately 86 MW and 25,000 Customers interrupted for an extended period of time.
- The loss of the Chamberlin-Thiess 138 kV line, followed by the loss of the Babb-Valley 138 kV line (N-1-1) could result in approximately 106 MW and 25,000 customers interrupted for an extended period of time.

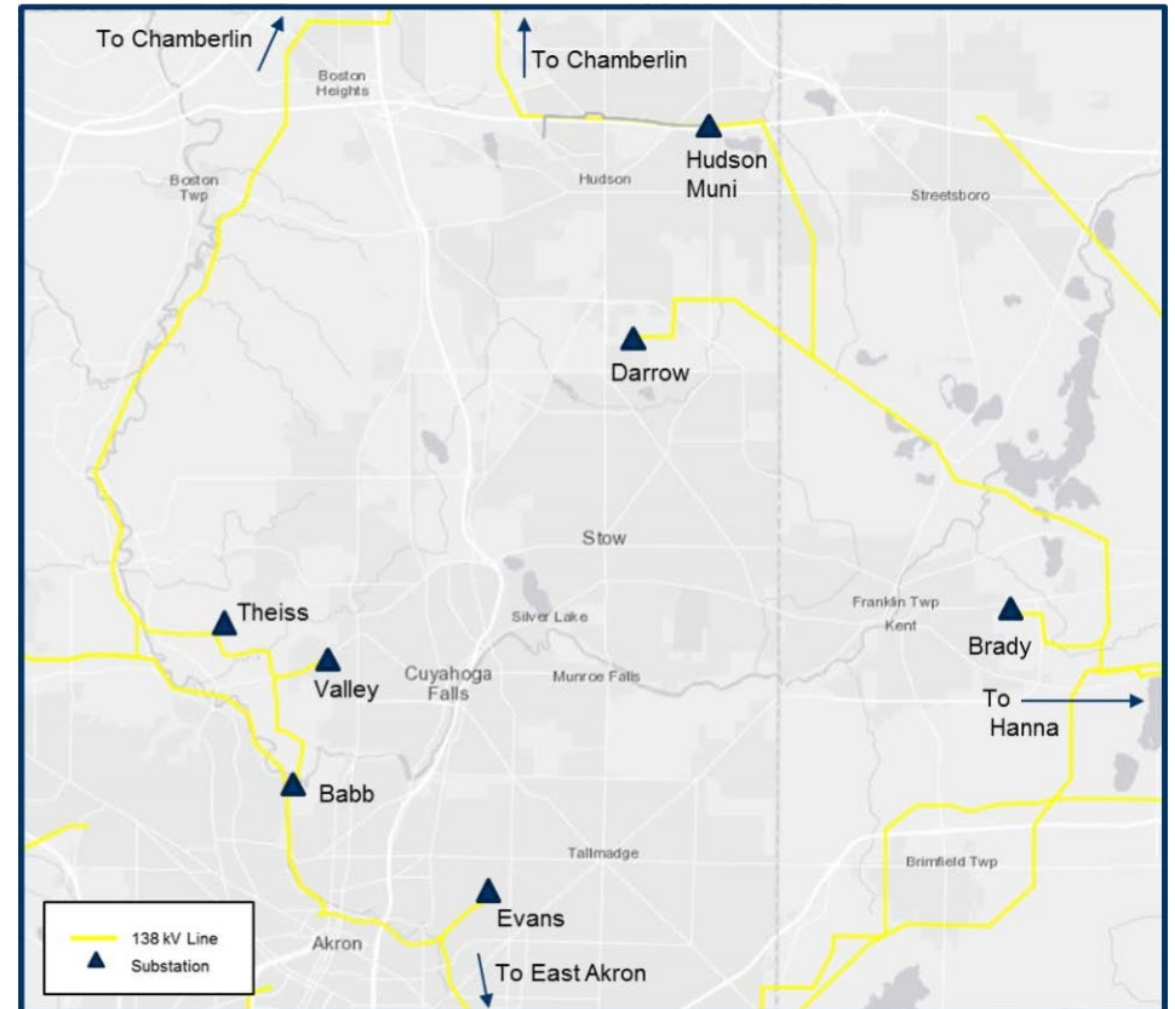
Evans & Darrow 138 kV Substation Area

- The loss of the Babb-Evans 138 kV line, followed by the loss of the East Akron-Evans 138 kV line (N-1-1) results in approximately 25 MW and 4,834 customers interrupted.
- The loss of the Chamberlin-Hudson Muni 138 kV line, followed by the loss of the Brady-Hanna 138 kV line (N-1-1), results in approximately 61 MW and 18,800 customers interrupted. Post-contingency voltage drops below 0.92 p.u. in the Darrow substation area.

System Performance

Over the past five years:

- The Chamberlin-Thiess 138 kV line has experienced five (5) outages (3 sustained, 2 momentary)
- The Thiess-Valley 138 kV line has experienced one (1) outage (1 sustained, 0 momentary)
- The Chamberlin-Hudson Muni 138 kV line has experienced four (4) outages (2 sustained, 2 momentary)
- The Babb-Evans 138 kV line has experienced one (1) outage (1 sustained, 0 momentary)





ATSI Transmission Zone M-3 Process Cuyahoga Falls 138 kV Planning Area- Solution

Need Number: ATSI-2019-010
Process Stage: Solutions Meeting – 11/22/2019

Proposed Solution:

New 138 kV Line & Sub 5 Expansion

- Build FE Sub 5 138kV four (4) breaker ring bus adjacent to the CF Sub5 substation
- Cuyahoga Falls Muni to expand CF Sub 5 substation to a 138/23 kV substation
- Convert Evans 138kV substation into five (future 6) breaker ring bus
- Convert the proposed Darrow five (future 6) breaker ring bus (s1708) into six breaker ring bus
- Build a new 138kV line from Evans to new FE Sub5 (Approximately 4.4 miles)
- Build a new 138kV line from Darrow to new FE Sub5 (Approximately 6.6 miles)
- Add a 28 MVAR 138 kV capacitor bank at Theiss substation.

Estimated Project Cost: \$44 M

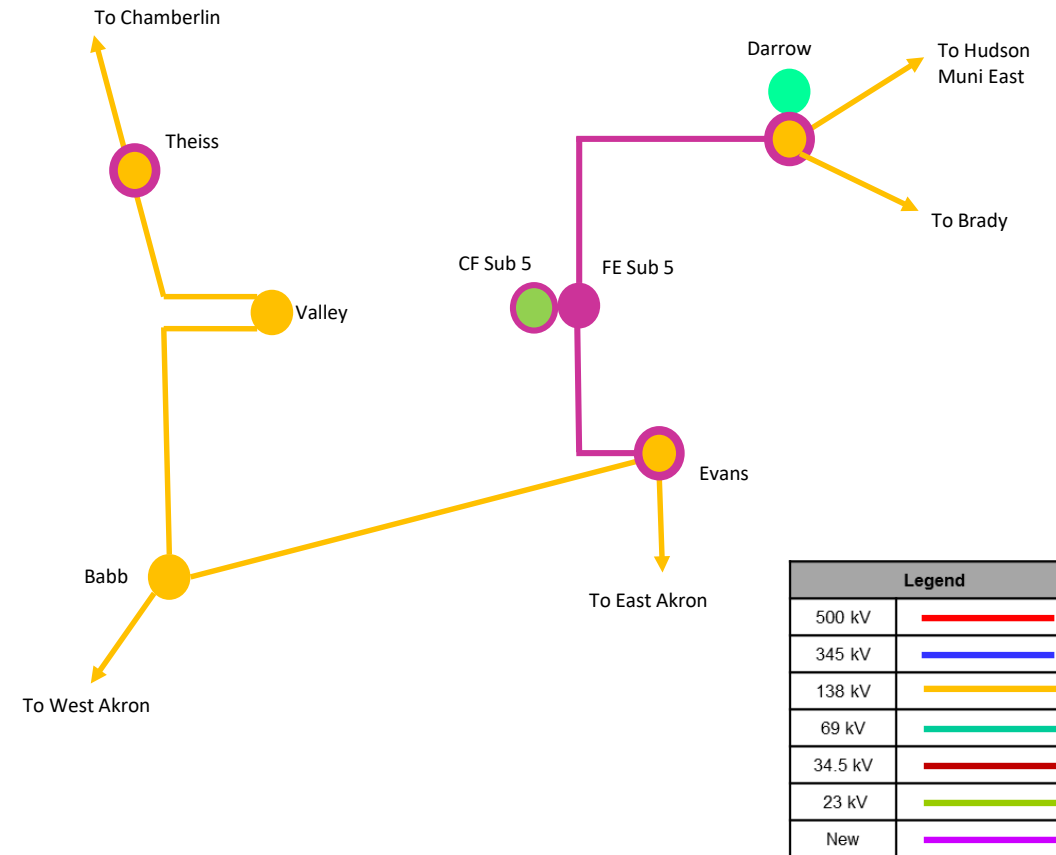
Transmission Line Ratings:

- Darrow-FE Sub 5 138 kV Line
 - After Proposed Solution: 278 MVA SN / 339 MVA SE
- Evans-FE Sub 5 138 kV Line
 - After Proposed Solution: 278 MVA SN / 339 MVA SE

Alternatives Considered:

- Bring a third 138 kV transmission line into Valley substation. This alternative was not selected due to lack of route diversity, limited substation expansion, limited easement rights, and siting concerns.

Projected In-Service: 06/01/2025
Project Status: Conceptual
Model: 2018 Series 2023 Summer RTEP 50/50



Need Number: ATSI-2019-058
Process Stage: Solutions Meeting – 11/22/2019
Previously Presented: Need Meeting – 07/24/2019

Project Driver:
Customer Service

Specific Assumption References:

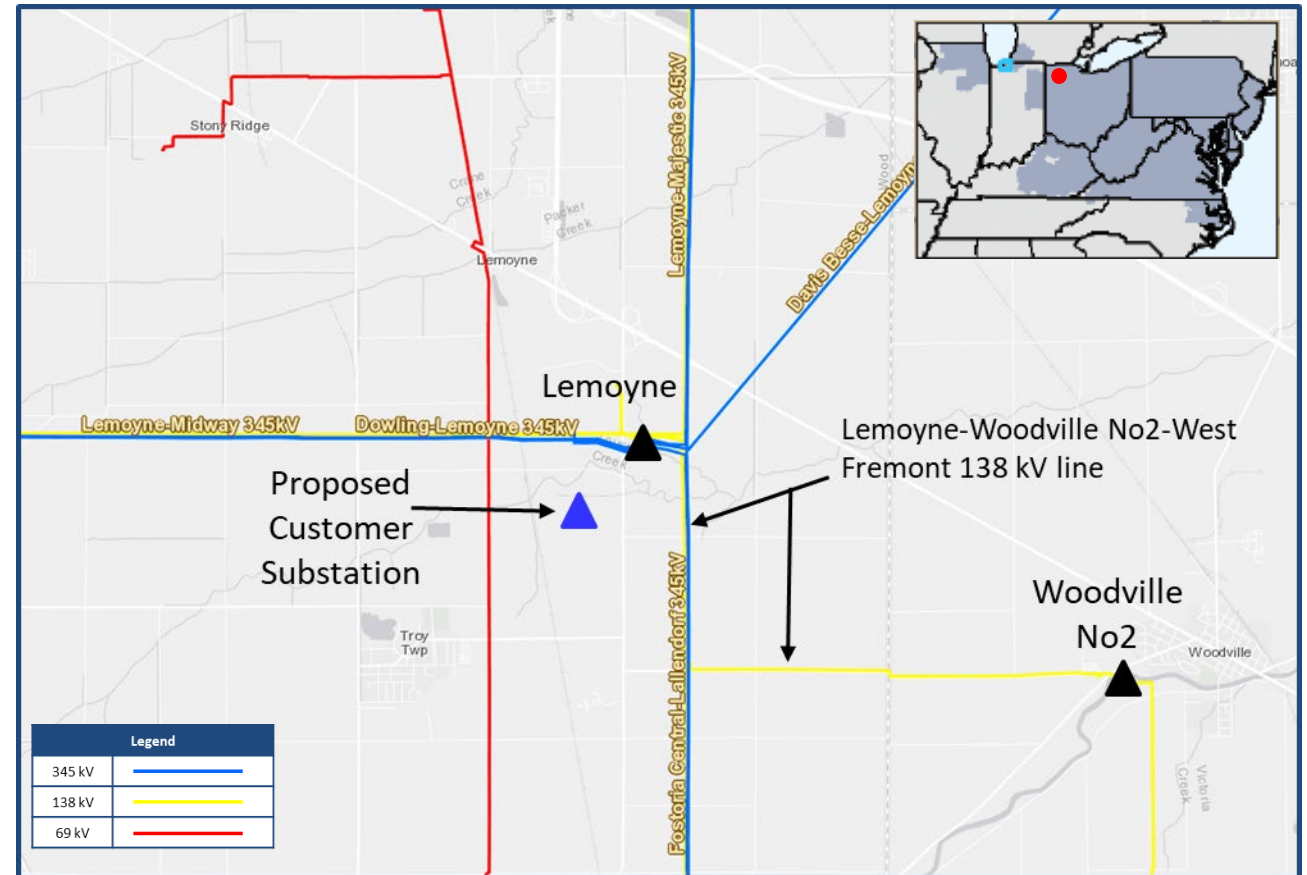
New customer connection request evaluated per FirstEnergy’s “Requirements for Transmission Connected Facilities” document and “Transmission Planning Criteria” document.

Problem Statement:

New Customer Connection

- A customer requested a 138 kV transmission service for a 138/12.47 kV substation with approximately 10.0 MVA of load near Lemoyne substation.

Requested In-Service Date: 03/01/2020



Need Number: ATSI-2019-058
Process Stage: Solutions Meeting – 11/22/2019

Proposed Solution:

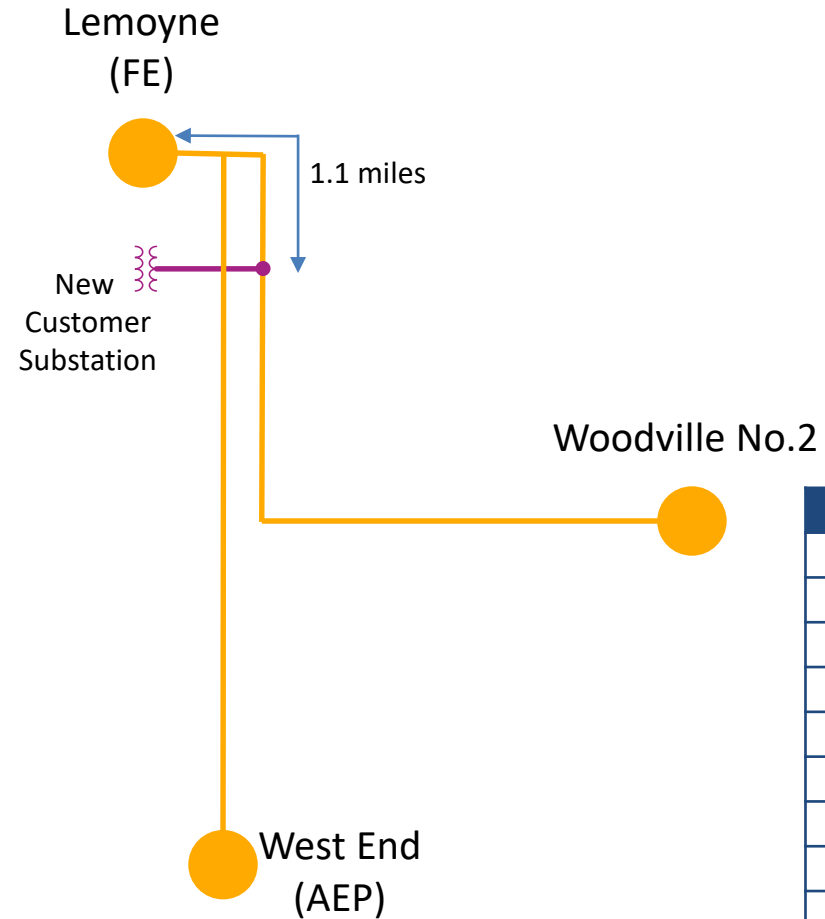
- Tap the Lemoyne-Woodville No. 2 138 kV line approximately 1.1 miles from Lemoyne (FE) substation and build a 138 kV line, approximately 0.3 miles, to the proposed customer substation.
- Install two (2) 138 kV in-line switches with SCADA control on both sides of the new tap connection
- Install one (1) 138 kV in-line switch on the line extension towards the customer substation

Estimated Project Cost: \$ 1.6M

Alternatives Considered:

- None (obligation to serve)

Projected In-Service: 03/01/2020
Project Status: Conceptual
Model: 2018 Series 2023 Summer RTEP 50/50



Legend	
500 kV	
345 kV	
230 kV	
138 kV	
115 kV	
69 kV	
46 kV	
34.5 kV	
23 kV	
New	

Need Number: ATSI-2019-Multiple (See next slide)
Process Stage: Solutions Meeting – 11/22/2019
Previously Presented: Need Meeting – 07/24/2019

Project Driver:

Equipment Material Condition, Performance and Risk

Specific Assumption References:

Line Condition Rebuild/Replacement

- Age/condition of wood pole transmission line structures
- Age/condition of steel tower or steel pole transmission line structures
- Age/condition of transmission line conductors

System Performance Projects

- Substation/line equipment limits

Problem Statement:

- Line sections are exhibiting deterioration, increasing maintenance needs.
- Transmission line is approaching end of life
- Transmission line ratings are limited by terminal equipment.

Continued on next page...

**Map Not Shown
Multiple Locations**



ATSI Transmission Zone M-3 Process Multiple Line Rehab / Rebuild Solution

Problem Statement:

ATSI-2019-	Transmission Line / Substation Locations	Existing Circuit MVA Rating (SN / SE)	Existing Conductor MVA Rating (SN / SE)	Limiting Terminal Equipment	Length of Line (miles)	Identified Structures (end of life / total)	Failure reasons
McDowell – Sharon (Y-300) 69 kV Line (18.8 Miles)							
-059	McDowell – Dept. of Corrections	47 / 48	47 / 56	Relay	6.0	195 / 235 (83% Failure Rate)	Woodpecker holes, decay and age
	Dept. of Corrections – Mercer Forge	47 / 56	47 / 56	-	1.0		
	Mercer Forge – Reznor Tap	47 / 56	47 / 56	-	0.3		
	Reznor Tap – Mercer Tap	47 / 56	47 / 56	-	1.1		
	Mercer Tap – Sharon 69kV	72 / 72	80 / 96	Relay	10.4		
East Springfield – London 69 kV Line (29.7 Miles)							
-060	East Springfield – Titus Tap	45 / 48	45 / 54	Relay	4.7	273 / 449 (61% Failure Rate)	Decay/rot and age
	Titus Tap – Plattsburg Tap	45 / 54	45 / 54	-	5.6		
	Plattsburg Tap – London Cor. Tap	45 / 54	45 / 54	-	7.5		
	London Cor. Tap – Big Plain Tap	76 / 92	76 / 92	-	11.1		
	Big Plain Tap – London 69kV Line	76 / 92	76 / 92	-	0.8		
Darrow – Shalersville 69 kV Line (11.2 Miles)							
-061	Darrow – Little Tikes Tap	76 / 92	76 / 92	-	0.7	59 / 178 (33% Failure Rate)	Decay, woodpecker holes, and age
	Little Tikes Tap – Streetsboro	76 / 92	76 / 92	-	4.3		
	Streetsboro – Streetsboro	76 / 92	76 / 92	-	1.8		
	Streetsboro – Aurora Plastics Tap	82 / 103	100 / 121	Switch	2.2		
	Aurora Plastics Tap – Shalersville	100 / 104	100 / 121	Relay	2.2		

Continued on next page...



ATSI Transmission Zone M-3 Process Multiple Line Rehab / Rebuild Solution

... Continued from previous page

Problem Statement:

ATSI-2019-	Transmission Line / Substation Locations	Existing Circuit MVA Rating (SN / SE)	Existing Conductor MVA Rating (SN / SE)	Limiting Terminal Equipment	Length of Line (miles)	Identified Structures (end of life / total)	Failure reasons
Clark – Navistar 69 kV Line (11.3 Miles)							
-062	Clark – Ferncliff 69kV Line	76 / 92	76 / 92	-	2.9	93 / 185 (50% Failure Rate)	Age, woodpecker holes, grounding not present.
	Ferncliff – Ridgewood 69kV Line	76 / 92	76 / 92	-	1.0		
	Ridgewood – Navistar 69kV Line	45 / 54	45 / 54	-	7.4		

Proposed Solution:

ATSI-2019	Transmission Line / Substation Locations	New MVA Line Rating (SN / SE)	Proposed Solution	Estimated Costs (\$ M)	Target ISD
ATSI-2019-059	McDowell – Sharon (Y-300) 69 kV Line (18.8 Miles)		<ul style="list-style-type: none"> • Under development 	\$ ---	mm/dd/yyyy
ATSI-2019-060	East Springfield – London 69 kV Line (29.7 Miles)		<ul style="list-style-type: none"> • Under development 	\$ ---	mm/dd/yyyy
ATSI-2019-061	Darrow – Shalersville 69 kV Line (11.2 Miles)	100 / 121	<ul style="list-style-type: none"> • Rebuild approx. 6.7 miles of wood pole construction from Darrow substation to Streetsboro substation. • Rehab balance of line (approx. 4.5 miles) and correct open maintenance items • Replace two (2) line switches to conform with present standards • Upgrade relaying at remote terminal ends. 	\$9.3M	12/30/2023
ATSI-2019-062	Clark – Navistar 69 kV Line (11.3 Miles)	76 / 92	<ul style="list-style-type: none"> • Rebuild approx. 3.9 miles of wood pole construction from Clark substation to Ridgewood substation tap; utilize existing conductor. • Rebuild approx. 3.1 miles of wood pole construction from structure 65 to Navistar substation; reconductor to match existing conductor. • Rehab balance of line (approximately 4.3 miles) including select pole replacements and structure/tower repairs. • Upgrade terminal end equipment 	\$11.2M	12/30/2023

Alternatives Considered:

- Maintain existing condition and elevated risk of failure

Projected In-Service: See table

Project Status: Conceptual (All Projects)

Model: N/A

No changes in topology; No bubble diagram required.



ATSI Transmission Zone M-3 Process Multiple Relay Misoperation Solution

Need Number: ATSI-2019-Mutiple (See next slide)
Process Stage: Solution Meeting – 11/22/2019
Previously Presented: Need Meeting – 07/24/2019

Project Driver:

Equipment Material Condition, Performance and Risk

Specific Assumption References:

Global Factors

- System reliability and performance
- Substation / line equipment limits

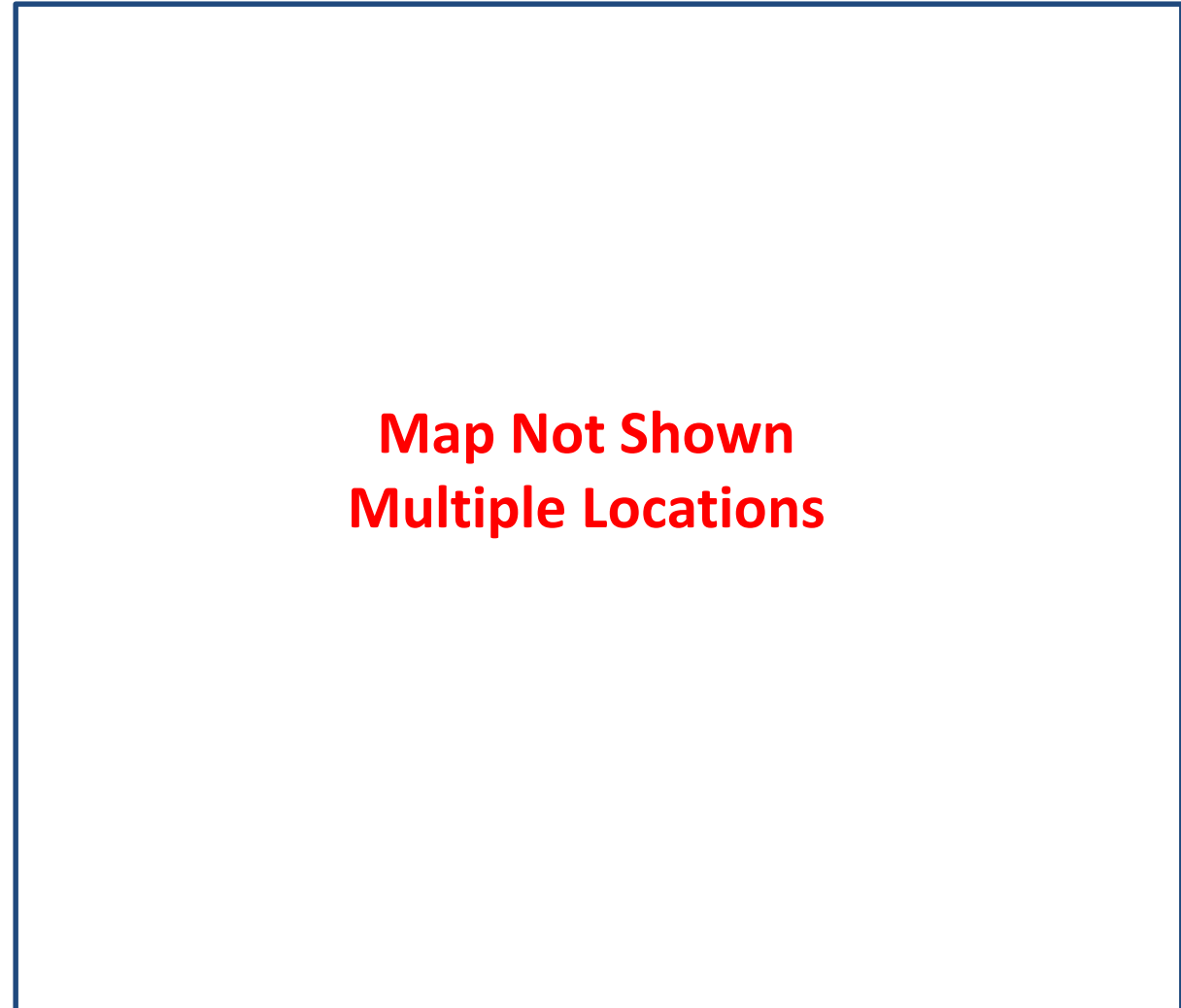
Upgrade Relay Schemes

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

Problem Statement:

- 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.

Continued on next page...



**Map Not Shown
Multiple Locations**

...Continued from previous page

Problem Statement

ATSI-2019-	Transmission Line / Substation Locations	Existing Line/Terminal Equipment MVA Rating (SN / SE)	Existing Conductor/Transformer MVA Rating (SN / SE)	Limiting Terminal Equipment
-063	Avery Substation No.1 Transformer 138/69 kV	153 / 153	177 / 209	Line Relay, Substation Conductor
-064	Cloverdale – Canton Central 138kV Line	161 / 194 (S) 182 / 210 (W)	161 / 194 (S) 182 / 230 (W)	Line Relay (Winter Ratings)
-065	Evergreen – Ivanhoe 138kV Line	200 / 242 (S) 226 / 249 (W)	200 / 242 (S) 226 / 286 (W)	Line Relay (Winter Rating)
-066	Hoytdale – New Castle #2 138kV Line	329 / 373	425 / 522	Relay, Substation Conductor, Disconnect Switch
-067	Crossland – Shenango #2 138kV	215 / 215	278 / 339	Relay, Substation Conductor

Proposed Solution:

ATSI-2019-	Transmission Line / Substation Locations	New MVA Line Rating (SN / SE)	Proposed Solution	Estimated Costs (\$ M)	Target ISD
-063	Avery Substation No.1 Transformer 138/69 kV	177 / 209	<ul style="list-style-type: none"> Replace transformer relaying on Avery #1 transformer, substation conductor, and upgrade disconnect switch. 	\$ 0.6	12/31/2020
-064	Cloverdale – Canton Central 138kV Line	161 / 194 (S) 182 / 230 (W)	<ul style="list-style-type: none"> Replace line relaying on the Cloverdale terminal end; upgrade existing disconnect switches and replace one air break switch; replace substation conductors at Cloverdale; replace terminal end breaker at Cloverdale (B100) with SF6 breaker due to existing condition. 	\$ 0.8	06/01/2021
-065	Evergreen – Ivanhoe 138kV Line	200 / 242 (S) 226 / 286 (W)	<ul style="list-style-type: none"> Replace line relaying at Evergreen and Ivanhoe terminal ends; upgrade existing disconnect switches, CCVTs, wave-traps, and terminal end breakers at Evergreen (B23) and Ivanhoe (B8) with SF6 breakers due to existing condition 	\$ 2.4	04/01/2021
-066	Hoytdale – New Castle #2 138kV Line	425 / 522	<ul style="list-style-type: none"> Replace line relaying on the Hoytdale and New Castle terminal ends; upgrade existing disconnect switches at Hoytdale and one air break switch at New Castle; replace substation conductors at Hoytdale and New Castle; replace terminal end breaker at Hoytdale (B14) with SF6 breaker due to existing condition. 	\$ 0.5	12/31/2021
-067	Crossland – Shenango #2 138kV	278 / 339	<ul style="list-style-type: none"> Replace line relaying on Crossland-Shenango terminal ends; replace disconnect switches and substation conductors at Shenango and Crossland, replace one air break switch and terminal end breakers at Shenango (B14 and B18) due to existing condition. 	\$ 1.0	12/01/2020

Alternatives Considered:

- Maintain existing condition and elevated risk of failure

Projected In-Service: See table

Project Status: Conceptual (All Projects)

Model: N/A

No changes in topology; No bubble diagram required.