Subregional RTEP Committee – Western
FirstEnergy Supplemental Projects

May 22, 2020

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
Boardman-Lowellville #2 69 kV New Customer Need

Need Number: ATSI-2020-009

Process Stage: Need Meeting – 05/22/2020

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

New Customer Connection – A customer requested 69 kV transmission service for approximately 9 MW of total load near the Boardman-Lowellville #2 69 kV Line.

Requested In-Service Date: 11/26/2020

Legend	
345 kV	
138 kV	
69 kV	

ATSI Transmission Zone M-3 Process
Cedar Street-New Castle 138 kV New Customer Need

Need Number: ATSI-2020-010

Process Stage: Need Meeting – 05/22/2020

Supplemental Project Driver(s):

Customer Service

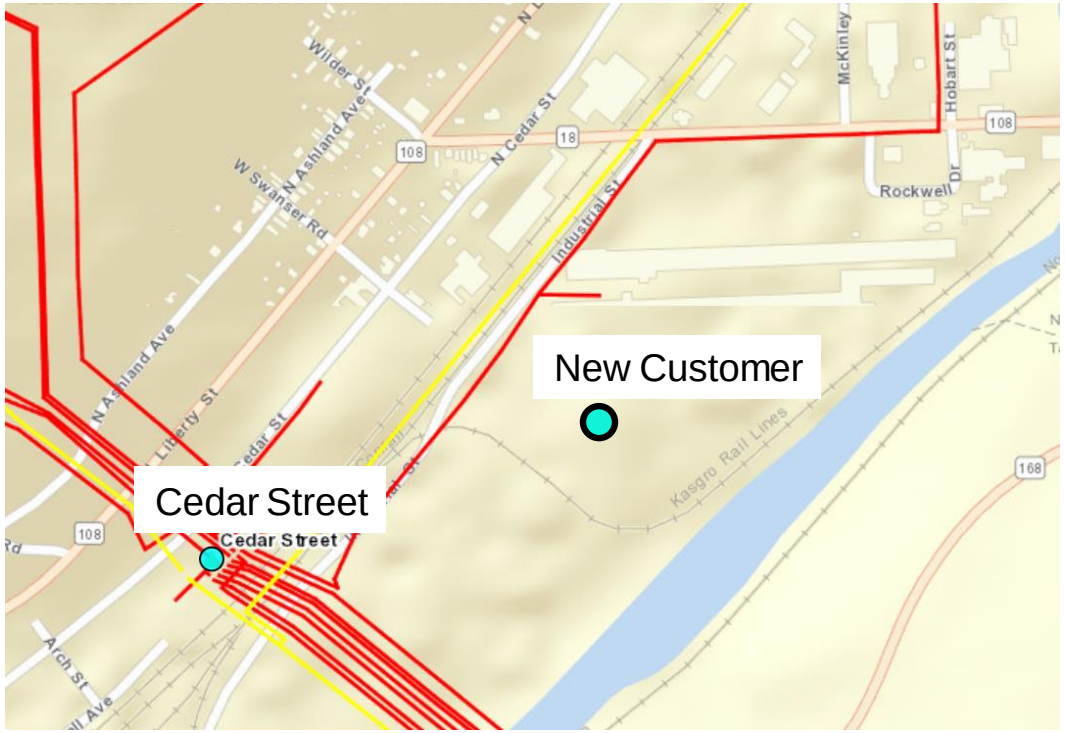
Specific Assumption Reference(s)

Modification of existing customer connection request evaluated per FirstEnergy's "Requirements for Transmission Connected Facilities" document and "Transmission Planning Criteria" document.

Problem Statement

New Customer Connection – A customer requested 138 kV transmission service for approximately 10 MW of total load near the New Castle-Cedar Street 138 kV Line.

Requested In-Service Date: 11/25/2020



Legend	
345 kV	
138 kV	
69 kV	

ATSI Transmission Zone M-3 Process
East Akron 138 kV Substation Need

Need Number: ATSI-2020-007

Process Stage: Need Meeting – 05/22/2020

Supplemental Project Driver(s):

Operational Flexibility and Efficiency
Equipment Material Condition, Performance and Risk
Infrastructure Resilience

Specific Assumption Reference(s):

Global Considerations

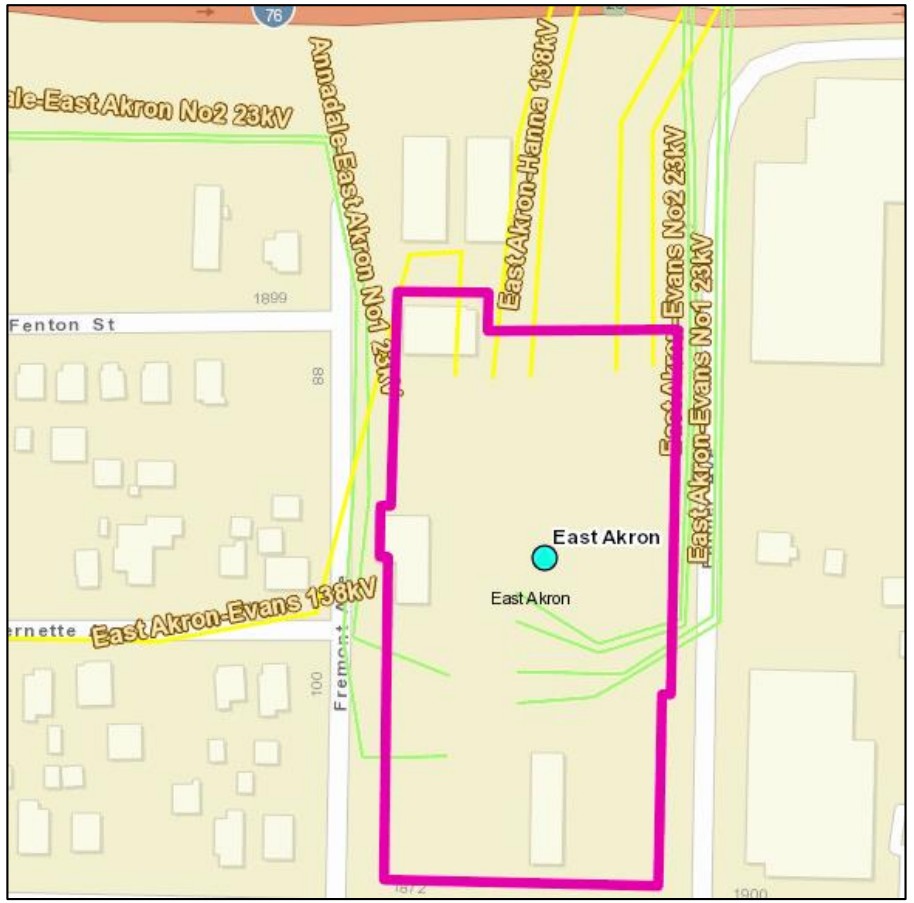
- System reliability and performance
- Load at risk in planning and operational scenarios

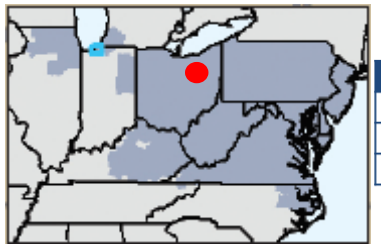
Substation Condition Rebuild/Replacement

- Increasing negative trend in maintenance findings and/or costs.
- Expected service life (at or beyond) or obsolescence

Add/Expand Bus Configuration

- Loss of substation bus adversely impacts transmission system performance
- Eliminate simultaneous outages to multiple networked elements under N-1 analysis
- Capability to perform system maintenance





Legend	
345 kV	
138 kV	
69 kV	

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ATSI Transmission Zone M-3 Process
East Akron 138 kV Substation Need

Need Number: ATSI-2020-007

Process Stage: Need Meeting – 05/22/2020

Problem Statement (continued)

East Akron 138 kV configuration and condition:

- East Akron 138 kV substation is a main and transfer bus configuration substation
  - A fault on the bus or between the bus and the circuit breaker will result in an outage of the entire bus or substation or a failure of a single circuit breaker or a failure of a relay to trip will result in an outage of the entire bus/substation and interrupt five 138 kV lines, two 138-23 kV transformers, and two 138-12.47 kV transformers. (Approximately 10,400 customers affected and 40 MW of load at risk)

Deteriorating control building and substation equipment:

- The control house was built more than 50 years ago.
  - Leaks, lacks HVAC, and has no security exits.

Breaker and switch conditions:

- Oil circuit breakers B-253, B-46, B-22, B-43 are at/beyond expected service life (greater than 50 years old) with increasing maintenance concerns; compressor issues, deteriorated operating mechanisms and increasing maintenance trends.
- Breaker B-37, ABB 145 is 30 years old with increasing maintenance concerns;
- Disconnect switches are 20 years old and deteriorating due to age and usage (D-257, D-245, D-126 D-132)
- AirBreak switches are 20 years old and deteriorating due to age and usage (A-256, A-247, A-128, A-134)

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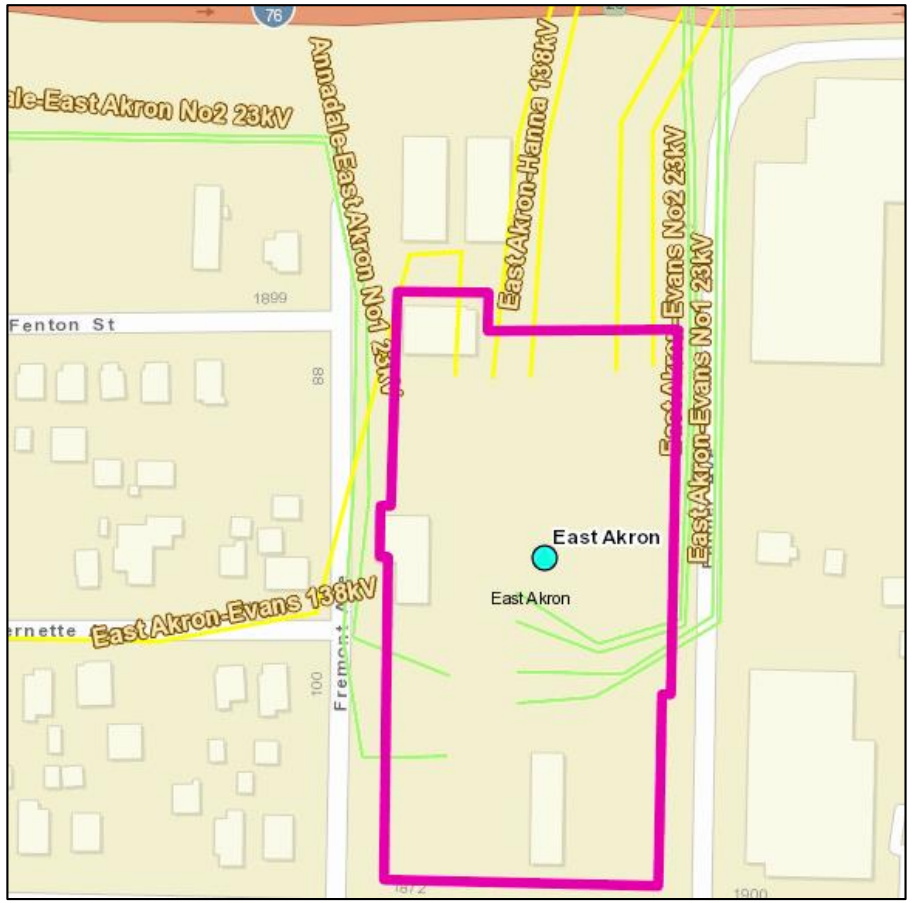
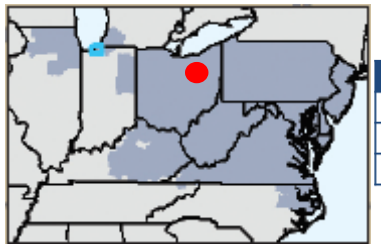




Legend	
345 kV	
138 kV	
69 kV	

ATSI Transmission Zone M-3 Process
East Akron 138 kV Substation Need

Need Number: ATSI-2020-007

Process Stage: Need Meeting – 05/22/2020

Problem Statement (continued)

- East Akron-West Ravenna 138 kV line has been previously identified on the list of mis-operation relays (s1972)
- Associated terminal equipment line arrestors, wave trap, line tuner, CCVTs:
  - Older equipment has slower operating times and can produce longer duration of fault current
  - O&M costs increasing due to maintenance of older equipment

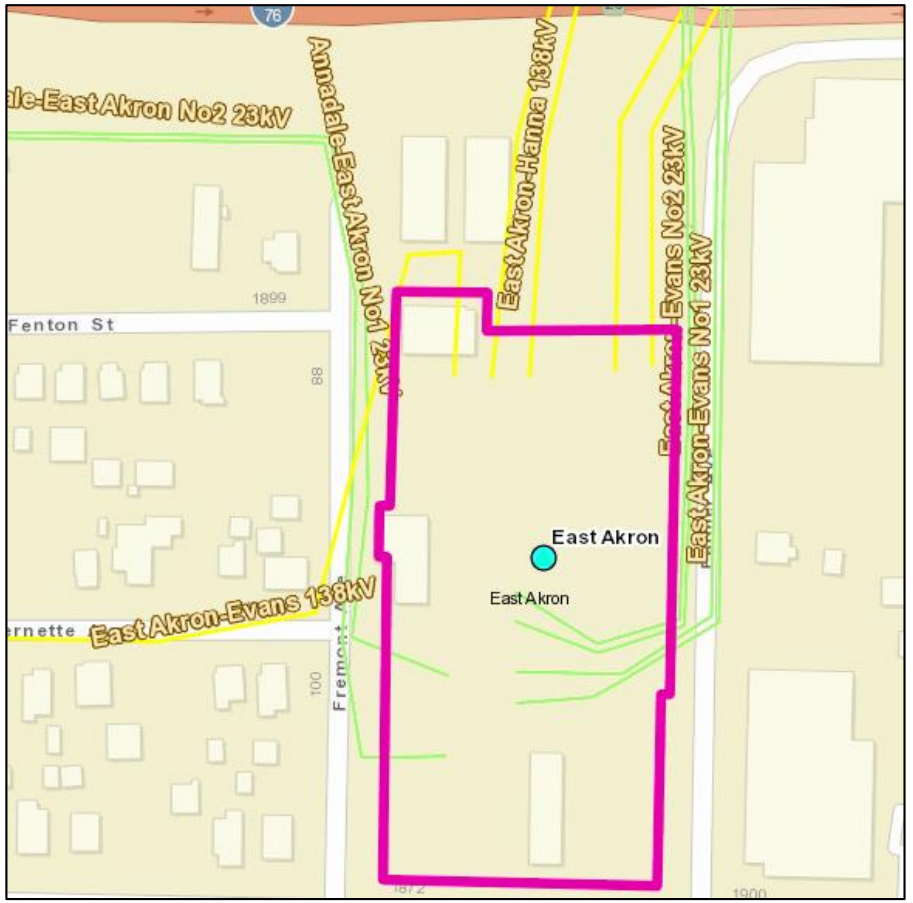
Power flow analysis:

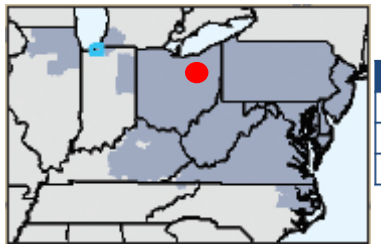
- Breaker B-22 overdutied (102.1%) of its interrupting rating in PJM's 2019 RTEP 2024 generation reactivation study
- Breaker B-43 overdutied (102.9%) of its interrupting rating in PJM's No-Harm analysis of ATSI-2019-10 (FESub5 project).
- Breaker B-46 overdutied (103.0%) of its interrupting rating in PJM's No-Harm analysis of ATSI-2019-10 (FESub5 project).

System Performance

Over the past five years:

The East Akron 138 kV lines or bus has experienced three momentary outages and seven sustained outages.





Legend	
345 kV	
138 kV	
69 kV	

ATSI Transmission Zone M-3 Process
Barberton 138 kV Substation Need

Need Number: ATSI-2020-008

Process Stage: Need Meeting – 05/22/2020

Supplemental Project Driver(s):

Operational Flexibility and Efficiency
Equipment Material Condition, Performance and Risk
Infrastructure Resilience

Specific Assumption Reference(s)

Global Considerations

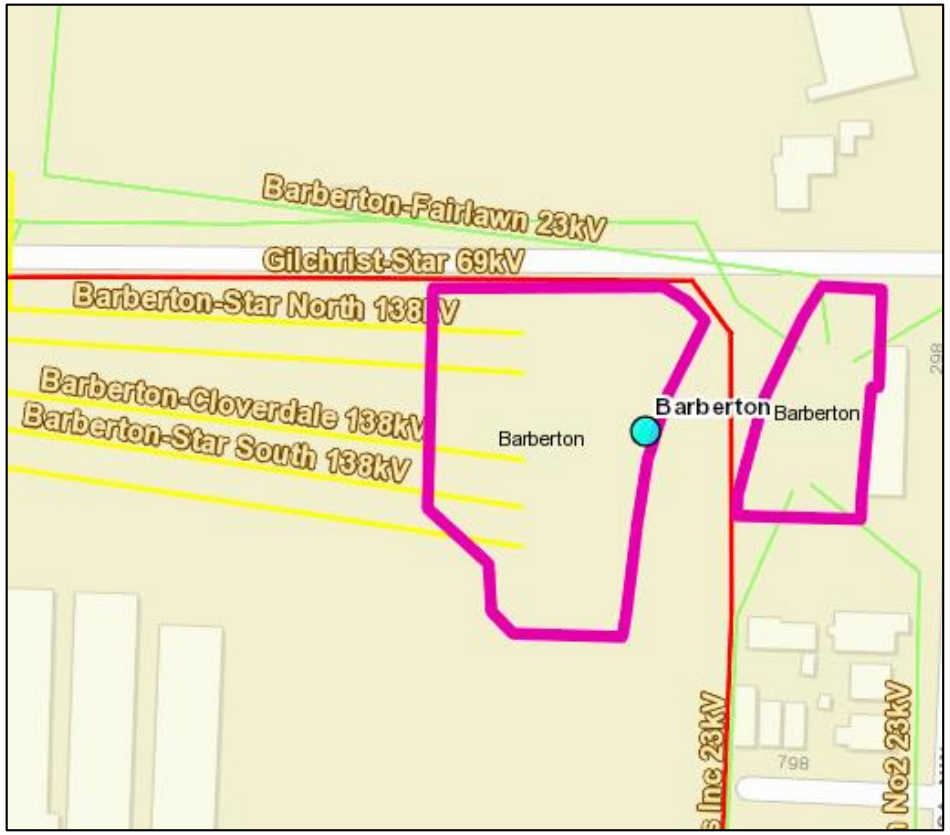
- System reliability and performance
- Load at risk in planning and operational scenarios

Substation Condition Rebuild/Replacement

- Increasing negative trend in maintenance findings and/or costs.
- Expected service life (at or beyond) or obsolescence

Add/Expand Bus Configuration

- Loss of substation bus adversely impacts transmission system performance
- Eliminate simultaneous outages to multiple networked elements under N-1 analysis
- Capability to perform system maintenance



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ATSI Transmission Zone M-3 Process
Barberton 138 kV Substation Need

Need Number: ATSI-2020-008

Process Stage: Need Meeting – 05/22/2020

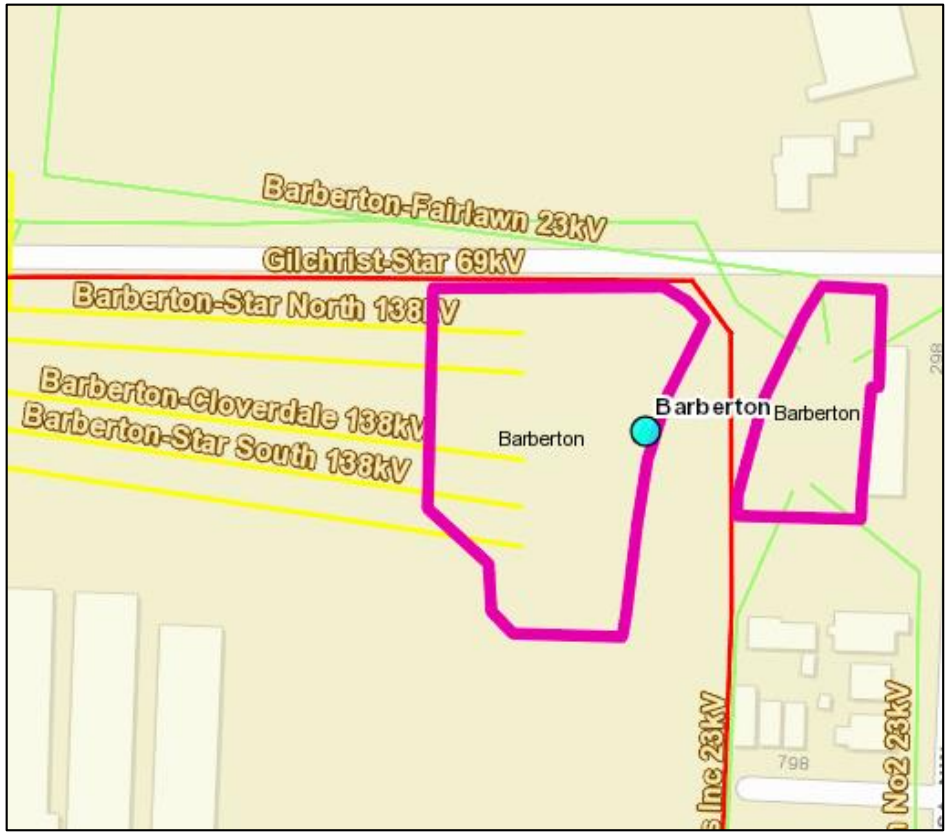
Problem Statement (continued)

Barberton 138 kV configuration and condition:

- Barberton 138 kV substation is a main and transfer bus configuration substation
  - A fault on the bus or between the bus and the circuit breaker or a failure of a single circuit breaker or a failure of a relay to trip will result in an outage of the entire bus or substation interrupting five 138 kV lines and two 138-23 kV transformers

Deteriorating control building and substation equipment:

- The control house was built in 1927 , 93 years old.
  - Does not have space for new cables and additional panels.
  - The cables from the 138 kV yard run through an older tunnel under the railroad property to the control house in the distribution yard. The cables in the tunnel can't be removed because they are encased in mineral deposits.
  - The control house has the panels on the second story and poses a challenge to replace and/or maintain the panels.



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ATSI Transmission Zone M-3 Process
Barberton 138 kV Substation Need

Need Number: ATSI-2020-008

Process Stage: Need Meeting – 05/22/2020

Problem Statement (continued)

Breaker conditions:

- Oil circuit breakers (OCB) B-124, B-37, B-45, and B-74 are at/beyond expected service life (greater than 45 years) with increasing maintenance concerns; air leaks, deteriorated operating mechanisms, CCPD failures, deteriorated bushings, and increasing maintenance trends
- Associated terminal equipment line arrestors, wave trap, line tuner, CCVTs:
  - Older equipment has slower operating times and can produce longer duration of fault current
  - O&M cost increasing due to maintenance of older equipment

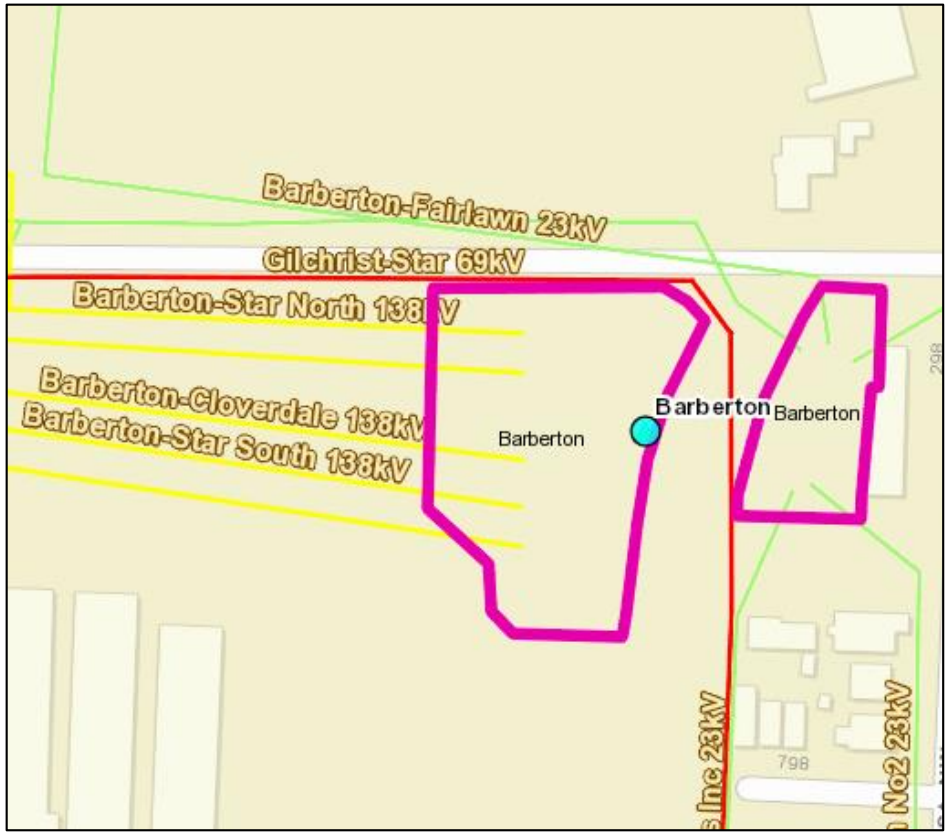
Protection Scheme:

- Barberton 138 kV breakers B-124, B-37, B-45, B-74, B-75 do not have enough CTs for separate inputs to a primary and backup differential scheme.

System Performance

Over the past five years:

The Barberton 138 kV lines or bus has experienced four momentary outages and nine sustained outages.



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 M-3 Process
Abbe-Johnson # 1 69 kV Switch Solution

Need Number: ATSI-2020-006
Process Stage: Solution Meeting – 05/22/2020
Previously Presented: Need Meeting – 04/20/2020

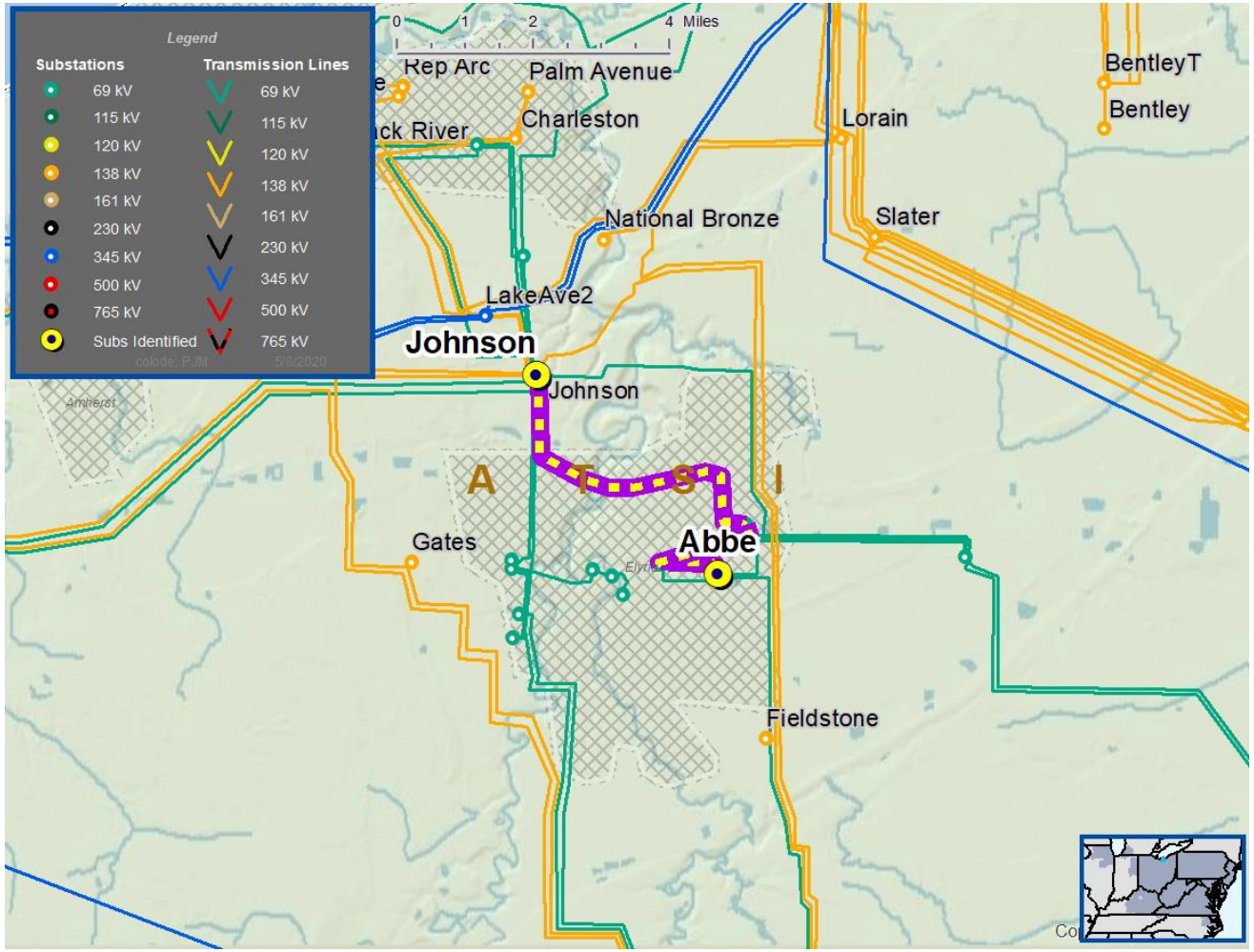
Project Driver:
Equipment Material Condition, Performance and Risk
Operational Flexibility and Efficiency
Infrastructure Resilience

Specific Assumption References:
Global Factors
- System reliability and performance
- Substation / line equipment limits

Problem Statement

Abbe – Johnson #1 69 kV switch (A-47)

- Switch originally installed in 1982
- Corrosion on operating mechanism
- Existing KPF switch is obsolete and no longer supported by the manufacturer
- Undesirable design with vertical operating rod
- Transmission line ratings are limited by the existing switch rating



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ATSI Transmission Zone M-3 Process
Abbe-Johnson # 1 69 kV Switch Solution

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ATSI-2020	Transmission Line / Substation Locations	Existing Line/Terminal Equipment MVA Rating (SN / SE)	Existing Conductor/Transformer MVA Rating (SN / SE)	Limiting Terminal Equipment
-006	Abbe-Johnson #1 69 kV Line switch A-47	82 / 103	110/134	Switch A-47

ATSI Transmission Zone M-3 Process
Abbe-Johnson # 1 69 kV Switch Solution

Need Number: ATSI-2020-006
Process Stage: Solution Meeting – 05/22/2020
Previously Presented: Need Meeting – 04/20/2020

Proposed Solution:

Abbe – Johnson #1 69 kV switch (A-47)

- Replace switch A-47 on the Abbe – Johnson #1 69 kV Line with a 1200 A quick break switch with whip

Transmission Line Ratings:

- Abbe – Johnson #1 69 kV Line
  - Before Proposed Solution: 82 MVA SN / 103 MVA SE
  - After Proposed Solution: 110 MVA SN / 134 MVA SE

Alternatives Considered:

- Maintain existing condition and risk of failure.

Estimated Project Cost: $0.32M
Projected IS Date: 06/29/2020
Status: Engineering

No changes in topology;
No bubble diagram required.

ATSI Transmission Zone M-3 Process
Salt Springs 138 kV Substation Solution

Need Number: ATSI-2019-068
Process Stage: Solution Meeting – 05/22/2020
Previously Presented: Need Meeting – 07/24/2019

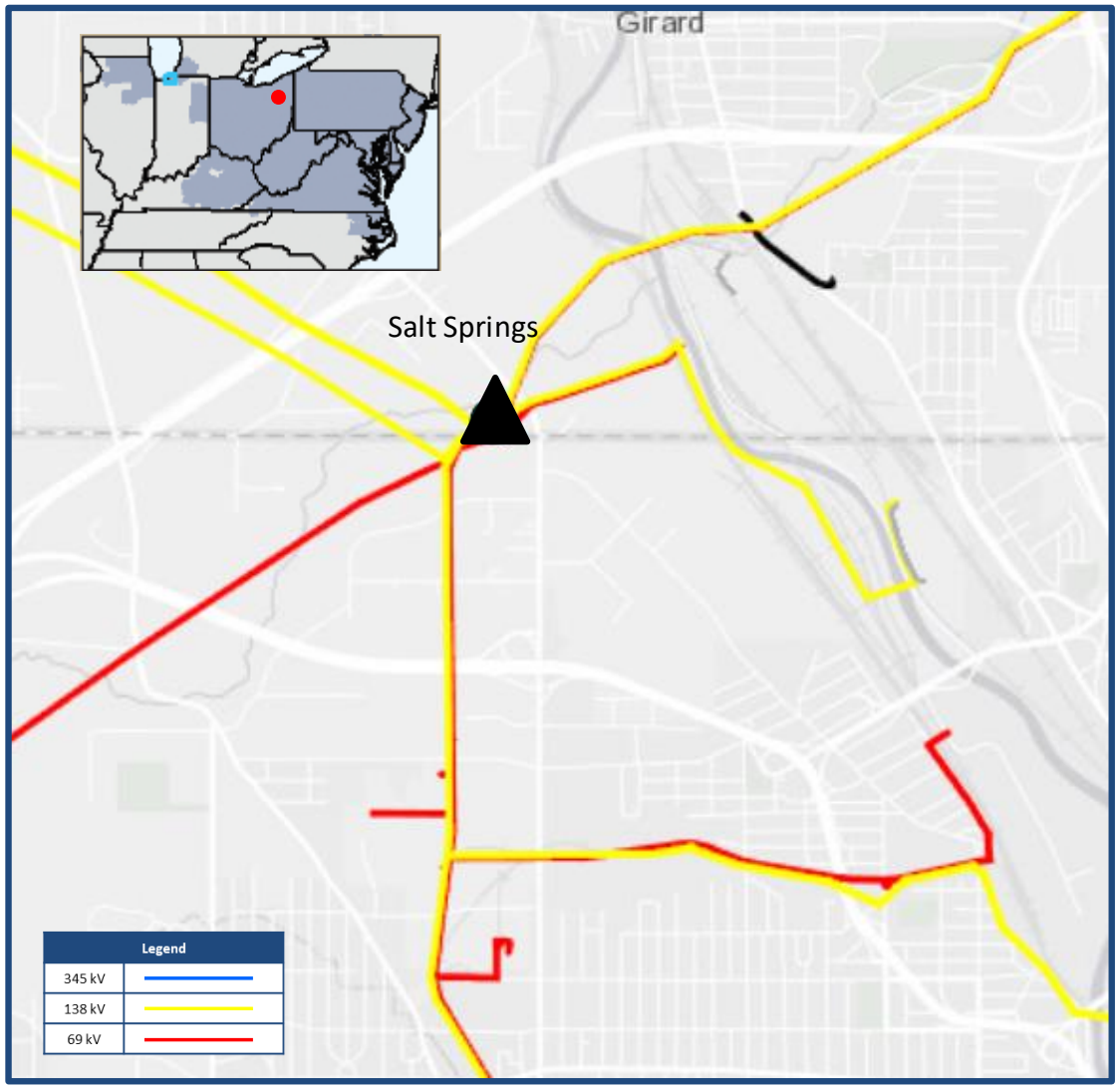
Project Driver:
Operational Flexibility and Efficiency
Equipment Material Condition, Performance and Risk
Infrastructure Resilience

Specific Assumption References:
Global Factors
- System reliability and performance
- Substation / line equipment limits
- Load at risk in planning and operational scenarios

Substation Condition Rebuild/Replacement
- Circuit breakers and other fault interrupting devices

Add/Expand Bus Configuration
- Loss of substation bus adversely impacts transmission system performance.
- Eliminate simultaneous outages to multiple networked elements
- Capability to perform system maintenance

Upgrade Relay Schemes
- Bus protection schemes
- Relay schemes that have a history of misoperation



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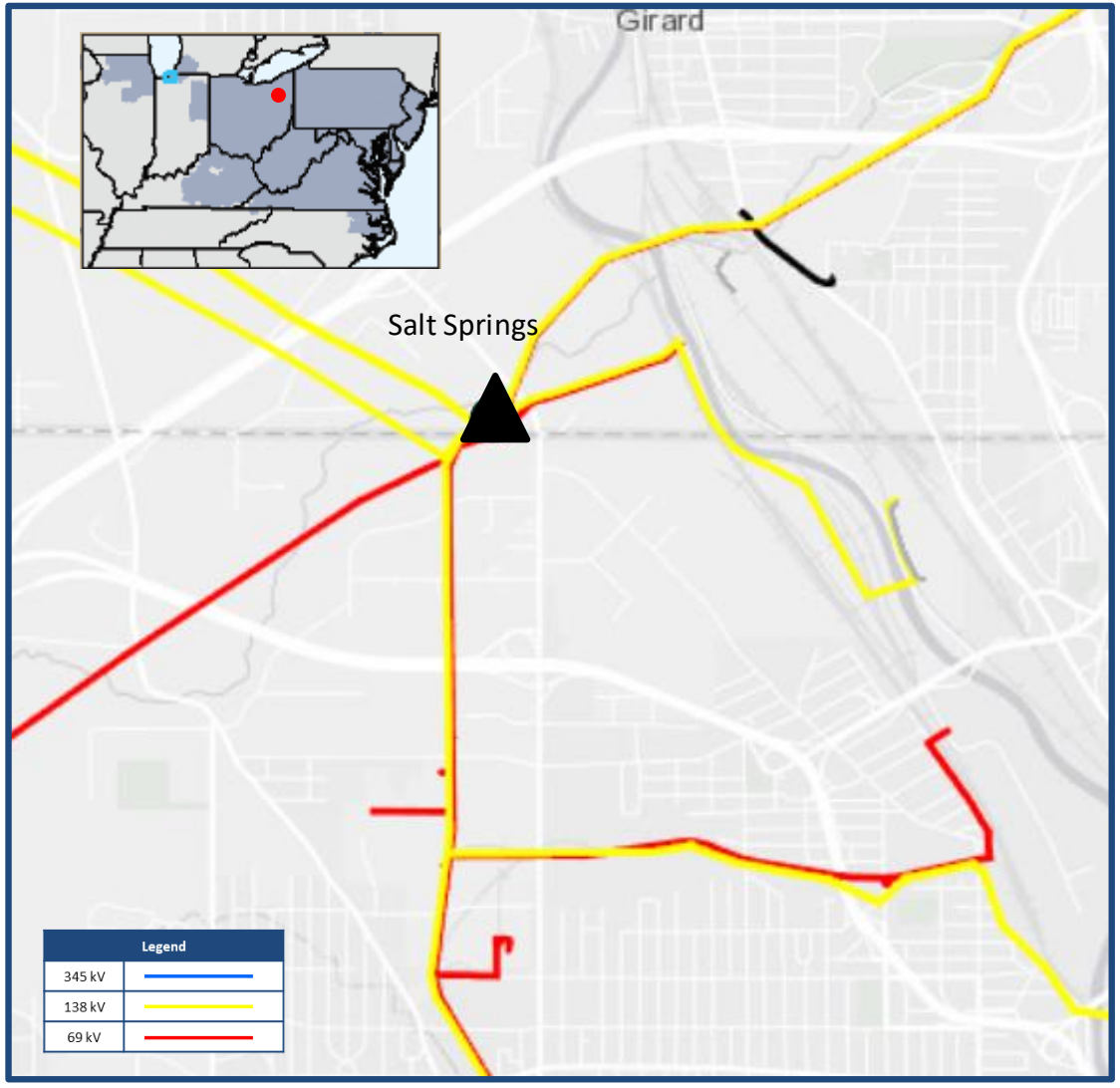
ATSI Transmission Zone M-3 Process
Salt Springs 138 kV Substation Solution

Need Number: ATSI-2019-068
Process Stage: Solution Meeting – 05/22/2020
Previously Presented: Need Meeting – 07/24/2019

Problem Statement (continued)

Salt Springs 138 kV Substation

- System analysis shows that after a Salt Springs 138 kV Bus Fault a substantial amount of load is at risk (roughly 133 MW).
- Bus blocking scheme in place is complicated and requires multiple relays to all function properly for every internal and external fault.
- The 138 kV breakers B35, B56, B40, B2, B42, B45 do not have enough CTs for separate inputs to a primary and backup differential scheme.
- Relays on the Salt Springs-Riverbend 138 kV Line and the relays on the Salt Springs-Masury 138 kV Line have a history of misoperation.
- Breakers B35 and B45 are oil circuit breakers over 45 years old



ATSI Transmission Zone M-3 Process
Salt Springs 138 kV Substation Solution

Need Number: ATSI-2019-068
Process Stage: Solution Meeting – 05/22/2020
Previously Presented: Need Meeting – 07/24/2019

Proposed Solution:

Salt Springs Breaker and a Half

- Convert Salt Springs to a breaker-and-a-half substation by installing ten 138 kV breakers (replacing six existing 138 kV breakers: B35, B2, B42, B45, B56, B40)
- Install new control building
- Expand substation to allow for conversion of Salt Springs to a breaker-and-a-half
- Install new relays and CVT's
- Upgrade substation conductor at Masury, Niles, and Salt Springs

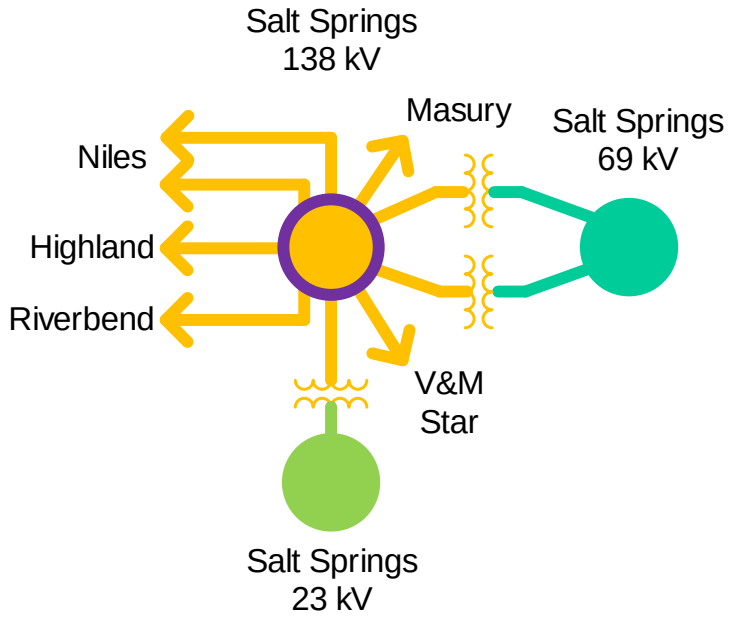
Transmission Line Ratings:

- **Masury-Salt Springs 138 kV Line**
  - Before Proposed Solution: 128 MVA SN / 165 MVA SE
  - After Proposed Solution: 185 MVA SN / 189 MVA SE
- **Niles-Salt Springs #1 138 kV Line**
  - Before Proposed Solution: 240 MVA SN / 310 MVA SE
  - After Proposed Solution: 278 MVA SN / 339 MVA SE
- **Niles-Salt Springs #2 138 kV Line**
  - Before Proposed Solution: 225 MVA SN / 295 MVA SE
  - After Proposed Solution: 278 MVA SN / 339 MVA SE

Alternative Considered:

- Maintain existing system configuration
- Build additional 138 kV feed for V&M Star Steel from Riverbend (2.5 miles) and constructing a three-breaker ring bus near V&M Star Steel

Estimated Project Cost: $19.6M
Projected In-Service: 6/1/2024
Status: Conceptual



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

ATSI Transmission Zone M-3 Process
Sharon Substation 138 kV Solution

Need Number: ATSI-2019-069
Process Stage: Solution Meeting – 05/22/2020
Previously Presented: Need Meeting – 07/24/2019

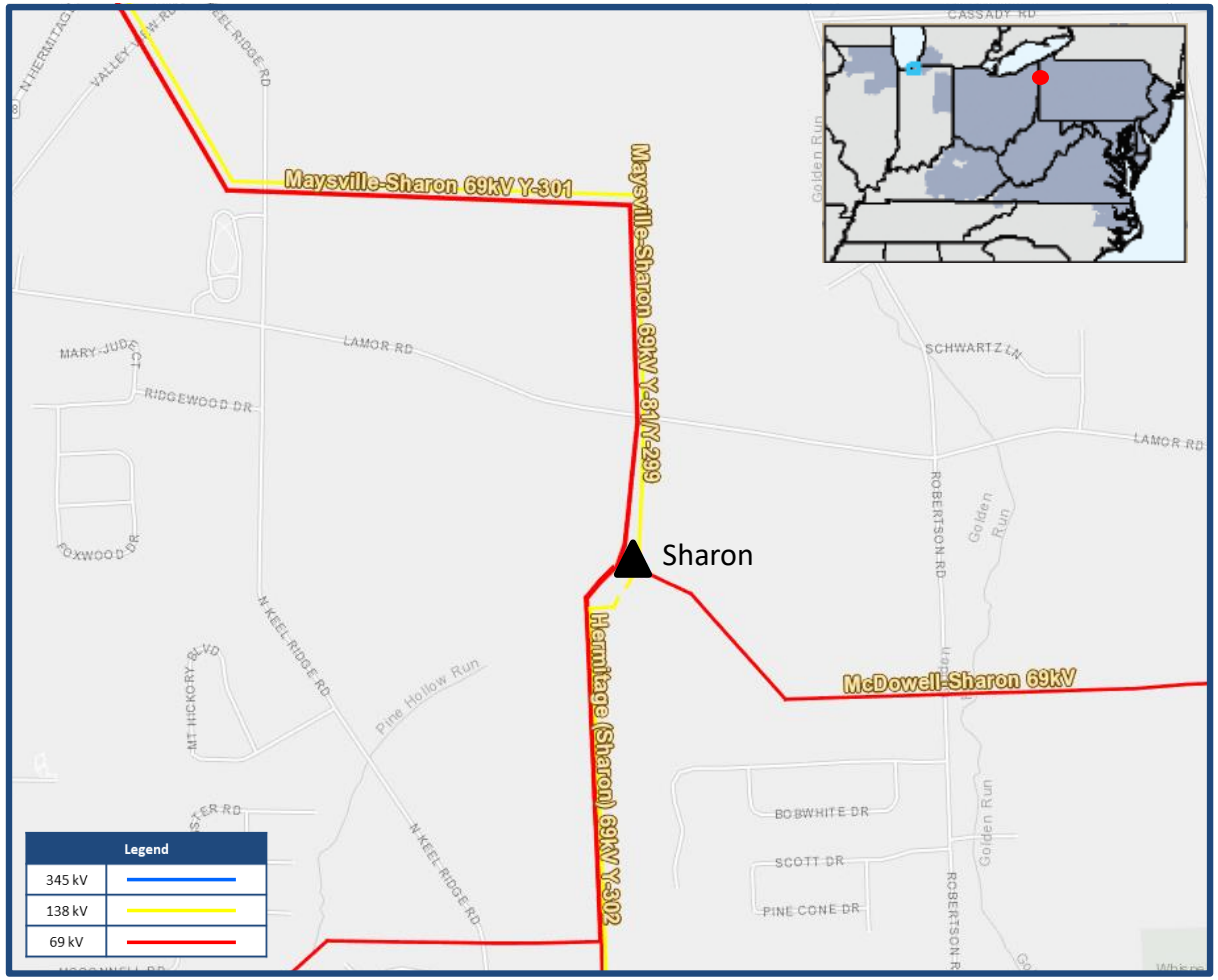
Project Driver:
Equipment Material Condition, Performance and Risk
Operational Flexibility and Efficiency
Infrastructure Resilience

Specific Assumption References:
Global Factors
- System reliability and performance
- Substation / line equipment limits
- Increasing negative trend in maintenance findings and/or costs
- Expected service life (at or beyond) or obsolescence

Substation Condition Rebuild / Replacement
- Circuit breakers and other fault interrupting equipment

Problem Statement

Sharon 138 kV Substation
- Increasing maintenance costs for 138 kV breakers B-48 and B-60
- Breakers B-48 and B-60 are over 30 years old
- CCVT's are over 25 years old



ATSI Transmission Zone M-3 Process
Sharon Substation 138 kV Solution

Need Number: ATSI-2019-069
Process Stage: Solution Meeting – 05/22/2020
Previously Presented: Need Meeting – 07/24/2019

Proposed Solution:

Sharon Substation 138 kV Breakers

- Upgrade Sharon 138 kV breaker B48 and B60, and associated disconnect switches
- Upgrade relays associated with B48
- Replace the B48 CCVT and the Sharon-Shenango 138 kV Line CCVT
- Upgrade substation conductor to exceed transmission line ratings

Transmission Line Ratings:

- **Sharon 138 kV North Bus-South Bus**
  - Before Proposed Solution: 191 MVA SN / 191 MVA SE
  - After Proposed Solution: 278 MVA SN / 339 MVA SE
- **Sharon-Shenango 138 kV Line**
  - Before Proposed Solution: 176 MVA SN / 229 MVA SE
  - After Proposed Solution: 265 MVA SN / 316 MVA SE

Alternative Considered:

- Maintain existing equipment and risk of failure

Estimated Project Cost: $1.3 M

Projected In-Service: 12/31/2021

Status: Conceptual

No changes in topology;
No bubble diagram required.

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

ATSI Transmission Zone M-3 Process
Magellan New Customer Solution

Need Number: ATSI-2020-003
Process Stage: Solution Meeting – 05/22/2020
Previously Presented: Need Meeting – 04/20/2020

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:
New Customer Connection – A customer requested 138 kV transmission service for approximately 95 MVA of total load near the Highland-GM Lordstown 138 kV Line.

Requested In-Service Date: 07/01/2021

Legend	
345 kV	
138 kV	
69 kV	

ATSI Transmission Zone M-3 Process
Magellan New Customer Solution

Need Number: ATSI-2020-003
Process Stage: Solution Meeting – 05/22/2020
Previously Presented: Need Meeting – 04/20/2020

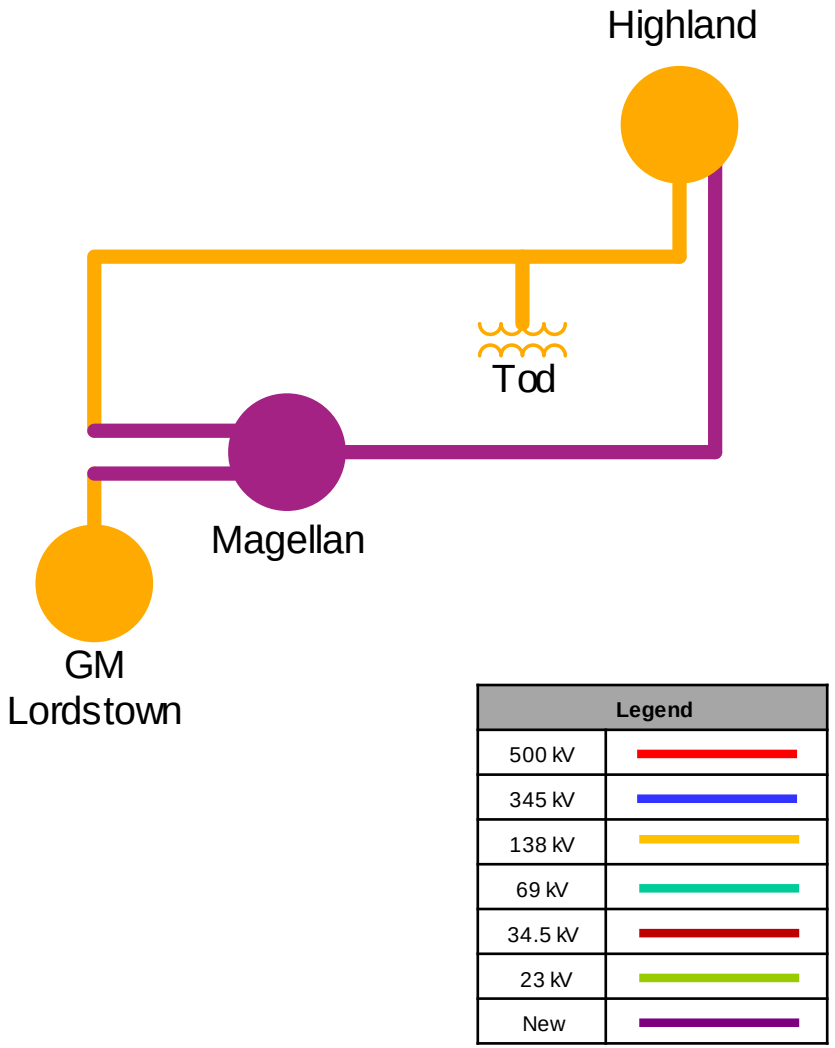
Proposed Solution

Magellan 138 kV Breaker and a Half

- Construct a 138 kV 11-breaker breaker-and-a-half (future 12-breaker) substation
- Loop the Highland-GM Lordstown 138 kV Line by building approximately 0.5 miles of 138 line using 795 ACSR near structure 3069
- Provide three 138 kV metering package
- Install two capacitors totaling 86.4 MVAR @ 144.1 kV (multiple step)
- Build roughly 3.5 miles of 138 kV line from Highland to Magellan using 795 ACSR utilizing an open arm position on the Highland-Lordstown #1 345 kV Line

Transmission Line Ratings:

- **Highland-Magellan #1 138 kV Line**
  - After Proposed Solution: 329 MVA SN / 413 MVA SE
- **Highland-Magellan #2 138 kV Line**
  - After Proposed Solution: 275 MVA SN / 333 MVA SE
- **GM Lordstown-Magellan 138 kV Line**
  - After Proposed Solution: 267 MVA SN / 352 MVA SE



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ATSI Transmission Zone M-3 Process
Magellan New Customer Solution

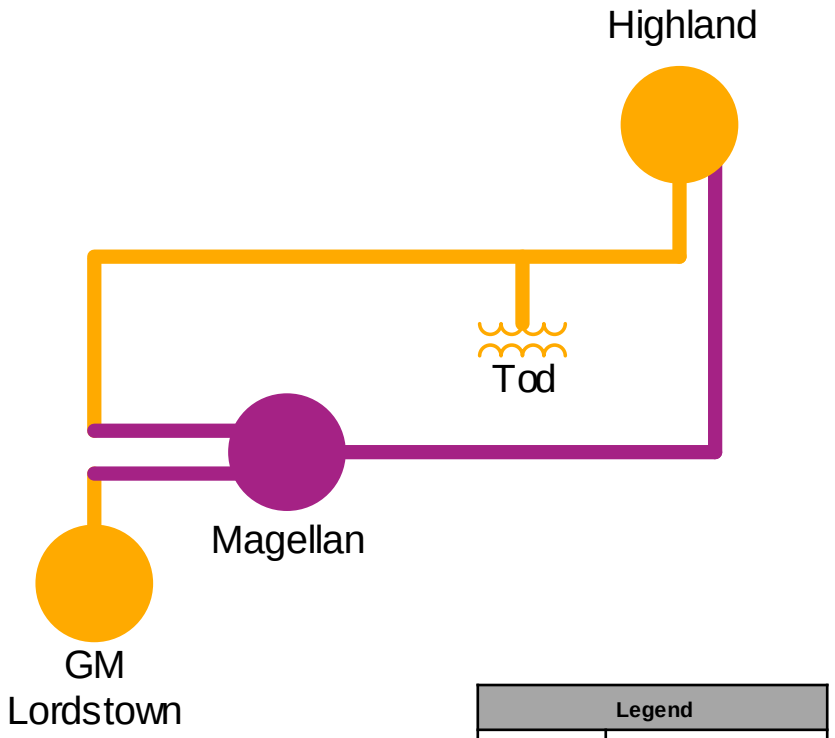
Need Number: ATSI-2020-003
Process Stage: Solution Meeting – 05/22/2020
Previously Presented: Need Meeting – 04/20/2020

Alternatives Considered:

- Provide service via 5-breaker ring bus (criteria violations identified)
- Provide service via a 345/138 kV substation (not needed for studied load level)

Estimated Project Cost: $31.8 M

Projected In-Service: 07/01/2021
Status: Engineering
Model: 2019 Series 2024 Summer RTEP 50/50



ATSI Transmission Zone M-3 Process
Streetsboro 69 kV Area Solution

Need Number: ATSI-2020-001

Process Stage: Solution Meeting – 05/22/2020

Previously Presented: Needs Meeting – 01/17/2020

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

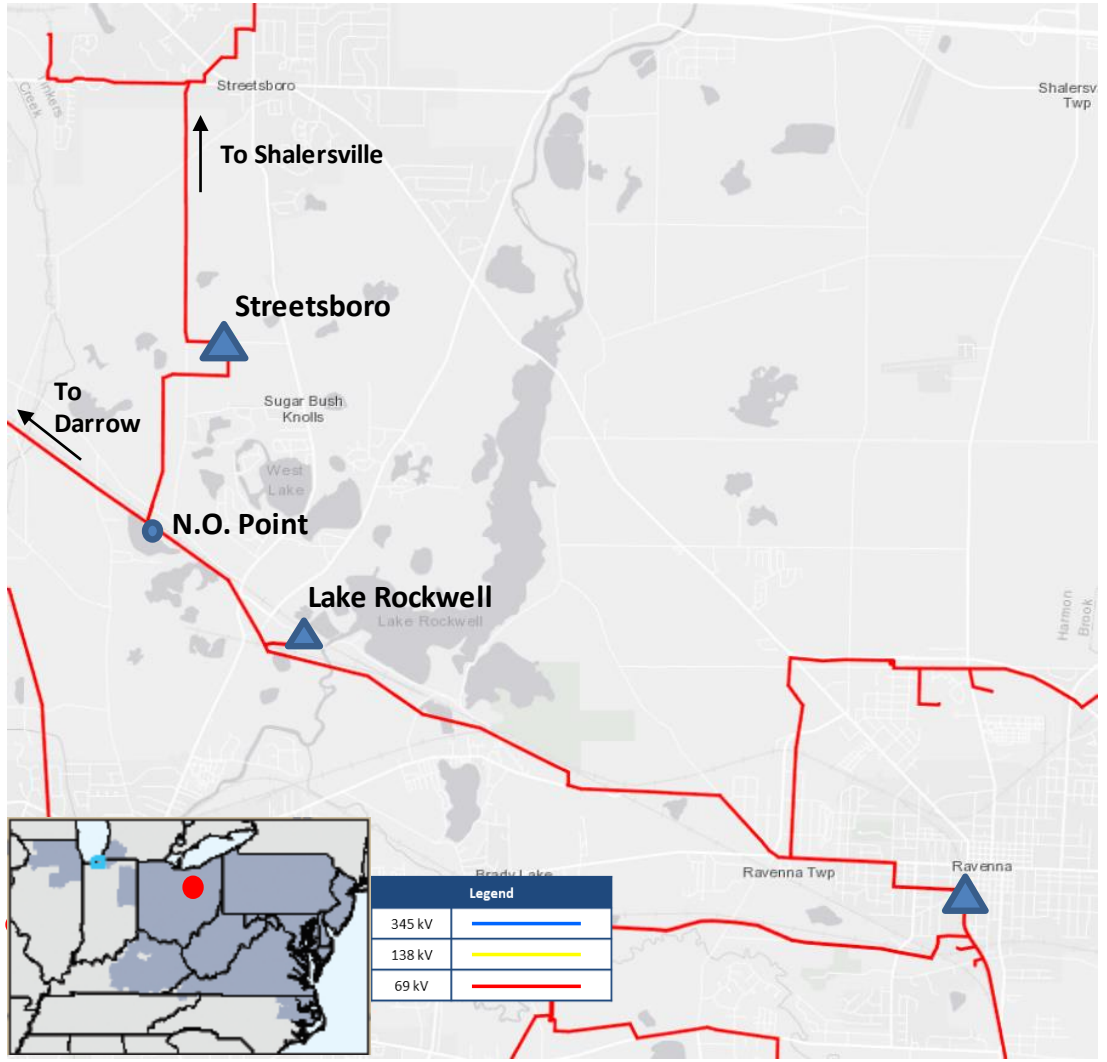
Automatic Sectionalizing Schemes

- Load at risk and/or customers affected

Problem Statement

Streetsboro 69 kV Substation and System Configuration

- Streetsboro is a straight 69 kV bus with no breakers or interrupting devices.
- The Ravenna-Lake Rockwell 69 kV line (approximately 7.59 miles) is a radial line; normally open point near Streetsboro substation.
- Customers and load at risk: Approximately 5,000 customers / 25 MWs



ATSI Transmission Zone M-3 Process
Streetsboro 69 kV Area Solution

Need Number: ATSI-2020-001

Process Stage: Solution Meeting – 5/22/2020

Previously Presented: Needs Meeting – 01/17/2020

Proposed Solution:

Related to supplemental project s1212

Convert the Streetsboro 69 kV straight bus to a five-circuit breaker ring bus. Build a double circuit approximately 1.8 miles 69 kV line from Streetsboro sub to eliminate the three terminal line and create Darrow-Streetsboro (~6.7 miles) and Ravenna-Streetsboro (~8.6 miles) 69 kV lines.

Transmission Line Ratings:

- Darrow-Streetsboro 69 kV Line
  - After Proposed Solution: 76 MVA SN / 92 MVA SE
- Ravenna-Streetsboro 69 kV Line
  - After Proposed Solution: 45 MVA SN / 54 MVA SE

Alternatives Considered:

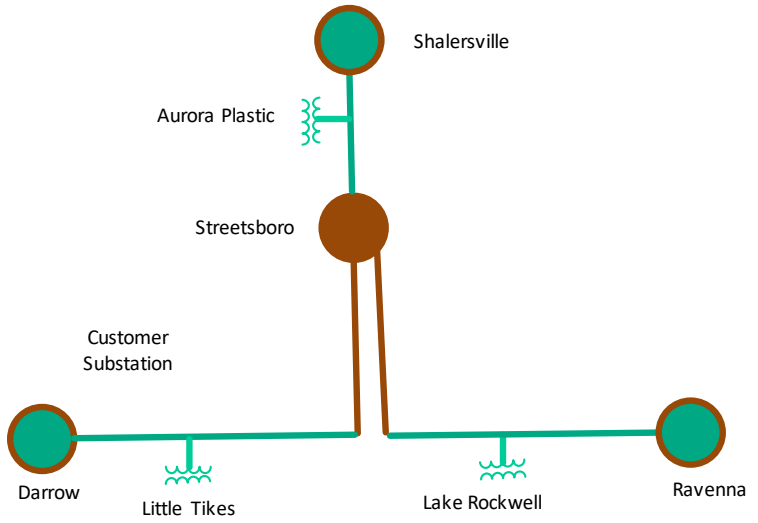
Keep the existing configuration with elevated risk

Estimated Project Cost: $10.1 M

Projected In-Service: June 1, 2020

Project Status: Construction

Model: 2019 RTEP 2024 case



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

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

5/12/2020 – V1 – Original version posted to pjm.com