Revised Generation Interconnection Facilities Study Report For Queue Project AE2-297 Madison - Tanners Creek 138 kV Henry County, Indiana 152.5 MW Energy / 91.5 MW Capacity

December 2021

1 Facilities Study Summary

1.1 Project Description

The Interconnection Customer (IC) proposes to install PJM project AE2-297, a 152.5 MW (91.5 MW Capacity) Solar generating facility in Henry County, Indiana (Figure 2). The point of interconnection for the generating facility will be a new station (to be named Shankatank) cut into the Madison - Tanners Creek 138 kV circuit.

1.2 Amendments/Changes to the Impact Study Report

Below are the results of the network upgrades identified in the AE2-297 System Impact Study Report and their associated reinforcements. The results of the Impact Study are predicated on a 2022 transmission system based upon PJM's best assumptions at the present time for load growth and connection of proposed new generation additions. This project may be subject to additional studies which may affect the network upgrade costs assigned to the AE2-297 project.

1. **Pipe Creek – Grntta 138kV line – PJM Network Upgrade Number n6329**
   And
   AD2-071 Tap – Pipe Creek 138kV line – PJM Network Upgrade Number n6329

   The following Supplemental Network Upgrade identified in PJM's Regional Transmission Expansion Plan alleviates these overloads:

   s2092 – Deer Creek – Makahoy 138kV line rebuild

2. **Delaware - Hogan 138 kV – PJM Network Upgrade Number n5799**

   The following Supplemental Network Upgrades identified in PJM's Regional Transmission Expansion Plan alleviates these overloads:

   S0738 – Delaware-Hogan riser upgrades
   s1498 – Delaware-Madison 138 kV line rebuild
   s1854.1 – Arnold Hogan 138kV substation upgrades

3. **Dearborn – Pierce 345kV line – PJM Network Upgrade Number n7881**

   OVEC performed a sag study and identified the following network upgrade – which is further defined in Section 3 of this Facilities Study Report. The AE2-297 project will be initially responsible for 100% of the identified network upgrade cost because other queue projects also contribute to the need for the same network reinforcement. The PJM Cost allocation rules

© PJM Interconnection 2021. All rights reserved.

(found in PJM Manual 14A, Attachment B) for network upgrades would apply for this reinforcement and an allocation towards this upgrade cost will be assigned to other eligible Interconnection Customers should they decide to move forward with their projects.

Dearborn – Pierce 345kV line – Replace two (2) dead end structures at two (2) Ohio River crossings, one (1) additional dead end structure at the Dearborn 345 kV line exit, and 16 tangent structures on the Dearborn - Pierce 345 kV circuit. PJM Network Upgrade Number n7881.

1.3 Interconnection Customer Schedule

PJM and AEP understand that the Interconnection Customer has established the following schedule dates:

Receive back feed power from AEP: 5/15/2022

Generation Commercial Operation Date: 9/30/2022

1.4a AEP's Scope of Work to Facilitate Interconnection

Detailed **AEP** Scope of Work is covered in Section 2.0 of this report

Interconnection Customer has requested the Option to Build. Therefore, AEP's Scope of Work will consist of the following:

- AEP will perform a review of the Interconnection Customer's Option to Build design documents and drawings.
- AEP will review and revise (as needed) the remote-end station protection schemes and settings.
- AEP will construct 138 kV line extensions in the clear from the proposed dead-end structure 1 at the existing Madison - Tanners Creek 138 kV circuit Right of Way to the new Shankatank three breaker ring bus station and perform final connection of the circuit to the station.
- AEP Protection and Control Engineering will perform a P&C equipment checkout and end-to-end testing.
- AEP will provide construction oversight.

1.4b OVEC's Scope of Work to Facilitate Interconnection to the AEP Transmission System

Detailed **OVEC** Scope of Work is covered in Section 3.0 of this report

- OVEC will replace two (2) dead end structures at two (2) Ohio River crossings, one (1) additional dead end structure at the Dearborn 345 kV line exit, and 16 tangent structures on the Dearborn - Pierce 345 kV circuit.
- OVEC will perform a protection and controls checkout including end-to-end testing.

1.5 Description of Transmission Owner Facilities Included in the Facilities Study

© PJM Interconnection 2021. All rights reserved.

1.5.1 Direct Connection Work

- AEP Protection and Control Engineering will perform a P&C equipment checkout and end-to-end testing.
- AEP will provide construction oversight.

1.5.2 Non-Direct Connection Work

AEP

- AEP will construct 138 kV line extensions in the clear from the proposed dead-end structure 1 at the existing Madison - Tanners Creek 138 kV circuit Right of Way to the new Shankatank three breaker ring bus station and perform final connection of the circuit to the Shankatank station.
- AEP will review the protection and control settings at the Madison station and adjust as needed.
- AEP will review the protection and control settings at the Tanners Creek station and adjust as needed.

OVEC

- OVEC will replace two (2) dead end structures at two (2) Ohio River crossings, one (1) additional dead end structure at the Dearborn 345 kV line exit, and 16 tangent structures on the Dearborn - Pierce 345 kV circuit.
- OVEC will perform a protection and controls checkout including end-to-end testing.

1.5.3 Attachment Facilities Work

- No Attachment Facilities work will be required for this project.

1.5.4 Network Upgrade Work

Due to system overloads found during the PJM studies, the following network reinforcements are required:

- **Delaware - Hogan 138 kV**
  - **N5799 -** Replace the Hogan riser on the Delaware - Hogan 138 kV facility.
    - Queue project AE2-297 will be the driver for this project, in the event the previously identified AEP Supplemental project s0738 is cancelled.
    - AEP project **s0738** will replace the Hogan riser. Additional AEP project **s1854.1** further upgrades the Hogan station, and s1498 upgrades the Delaware-Madison 138 kV DCT-line, including the 138 kV through-path at Hogan. Should AE2-297 choose to come online prior to the completion of **s0738, s1498, and s1854.1,** an interim deliverability study will be required. At the time of this report, work on these supplemental projects is expected to be completed prior to May 2022.

© PJM Interconnection 2021. All rights reserved.

The OVEC network upgrade is also required and is covered in 1.5.2 Non-Direct Connection Work

1.6a Total Cost of AEP Facilities Included in the Facilities Study:

Attachment Facilities	**$0**
Direct Connection Facilities	**$681,392.99**
Non-Direct Connection Facilities	**$867,960.00**
Network Upgrade Facilities	**$0**
Total Cost	**$1,549,352.99**

The estimates do not include the impact that delays in obtaining ROW, permits, or other approvals may have.

1.6b Total Cost of OVEC Facilities Included in the Facilities Study:

Attachment Facilities	$0.00
Direct Connection Facilities	$0.00
Non-Direct Connection Facilities	$11,382,644.00
Total Cost	$11,382,644.00

© PJM Interconnection 2021. All rights reserved.

1.7a Summary of Schedule Milestones for Completion of the AEP Work Included in Facilities Study:

Option to Build Process

Task (Option to Build Process)	Dates*
Design Review (At 30%, 60%, 90%, Complete)	Q4 2021, Q1 2022, Q2 2022, End of Q2 2022
Outage Request Submitted	Q4 2021
Transmission Line Analysis	Q3 2021
Construction Management	Q2 2022
Transmission Line Cut-Over	Q4 2022
P&C	Q4 2022

*The dates given in this schedule represents milestones AEP anticipates being able to meet using business as usual efforts. AEP will endeavor to advance the dates provided above, but cannot commit to earlier dates.

Assumptions

- **ISA and ICSA executed by 07/2/2021**
- The scopes, estimates, and schedules provided in this report are based on the IC's stated intention to elect the Option to Build.
- **Estimates provided are based on a table top process without the benefit of the results of site specific engineering studies (e.g., soil borings, environmental survey, ground grid, etc.), unless otherwise provided by the interconnection customer.**
- **System conditions must allow scheduled outages to occur.**
- **The customer will obtain, at its cost, all necessary provisions for the AEP direct connection facilities.**
- **The customer will perform site development and road construction in accordance with AEP specifications as required for this interconnection.**
- **The customer will provide a site acceptable to AEP (for transfer in Fee Simple) and any required additional easements for the 138 kV station and line work to enable access to all facilities and structures.**
- **The customer will have their construction and required checkout complete prior to the start of the interconnection to the proposed 138 kV station and any required testing outages.**
- **Other assumptions specific to the queue position(s) addressed in this study:**

© PJM Interconnection 2021. All rights reserved.

Additional Assumptions (Option to Build Process)

- **The customer will use firms from the AEP approved list that have experience in the transmission region the POI is located in.**
- **The customer will follow the requirements specified in 'AEP Siting, Permitting, Right of Way, and Real Estate Requirements for Independent Power Producers exercising the Option to Build', available at:**
  https://www.aep.com/assets/docs/requiredpostings/TransmissionStudies/docs/2019/MerchantGenerationGuidelinesPJMoptiontoBuild.pdf

Transmission Outage Plan

No transmission outage plan has been specified at this time.

Note that all 138 kV outages are subject to PJM and AEP Operations BES outage scheduling requirements.

1.7b Summary of Schedule Milestones for Completion of the OVEC Work Included in Facilities Study:

Standard Process

Task	Dates
Engineering Start	1st Q 2022
Material Ordered	1st Q 2023
Construction Start (Grading & Below Grade)	4th Q 2023
Construction Start (Above Grade)	1st Q 2024
Outage Requests Made By	2nd Q 2022
Outage (Structure Foundations)	4th Q 2023
Outage (Cut-in & Testing)	4th Q 2023 – 2nd Q 2024
TO Upgrade In-Service Date	4-5-24

Assumptions

- **Construction agreements are fully executed by 12/31/2021.**
- **Outage requests are approved by OVEC and PJM Operations.**

© PJM Interconnection 2021. All rights reserved.

- **System conditions must allow scheduled outages to occur.**
- **Required review and approvals from the authorities having jurisdiction are completed in a timely manner, especially in regard to the two crossings of the Ohio River.**

© PJM Interconnection 2021. All rights reserved.

2. AEP Transmission Owner Facilities Study Results

2.1 Transmission Lines - New

- AEP will construct 138 kV line extensions in the clear from the proposed dead-end structure 1 at the existing Madison - Tanners Creek 138 kV circuit Right of Way to the new Shankatank three breaker ring bus station and perform final connection of the circuit to the station.

2.2 Transmission Line – Upgrades (OVEC)

- No transmission line upgrades will be required for this project.

2.3 Station Facilities – New (AEP)

- AEP will provide construction oversight during the Interconnection Customer construction of the Shankatank station.
- AEP will perform a protection and controls checkout including end-to-end testing following completion of the Interconnection Customer's construction of the Shankatank station.

2.4 Station Facilities - Upgrades

- Protective relay settings at AEP's Madison and Tanners Creek remote end stations will need to be reviewed and updated (as needed) to coordinate with the proposed Shankatank 138 kV station.

2.5 Metering & Communications

Standard 138 kV metering will be installed at the proposed Shankatank 138 kV station. A standard station communication scheme will be used. All metering equipment shall meet the requirements as specified by AEP in the 'AEP Metering and Telemetering Requirements for AEP Transmission Customers' document (SS-490011). Communication requirements are published in the 'AEP SCADA RTU Requirements at Transmission Interconnection Facilities' (SS-500000).

The Generation Interconnection Agreement does not in or by itself establish a requirement for American Electric Power to provide power for consumption at the developer's facilities. A separate agreement must be reached with the local utility that provides service in the area to ensure that infrastructure is in place to meet this demand and proper metering equipment is installed. The metering work above and beyond the cost indicated below does not include any

© PJM Interconnection 2021. All rights reserved.

potential work or cost to address metering requirements of the local service provider. It is the responsibility of the developer to contact the local service provider to obtain a local service agreement. This is required prior to energization.

2.6 Environmental, Real Estate, and Permitting Issues

The Interconnection customer is expected to obtain, at its cost, all necessary permits and provisions for the IPP station connecting to the proposed Shankatank 138 kV station.

2.7 System Modeling and Operating Requirements

In addition to the IPP modeling requirements imposed by PJM as part of the Generation Interconnection process, the following system modeling parameters are required to be supplied by the Interconnection Customer to AEP:

- None

© PJM Interconnection 2021. All rights reserved.

2.8 Summary of Results of Study

Cost Estimates for AEP

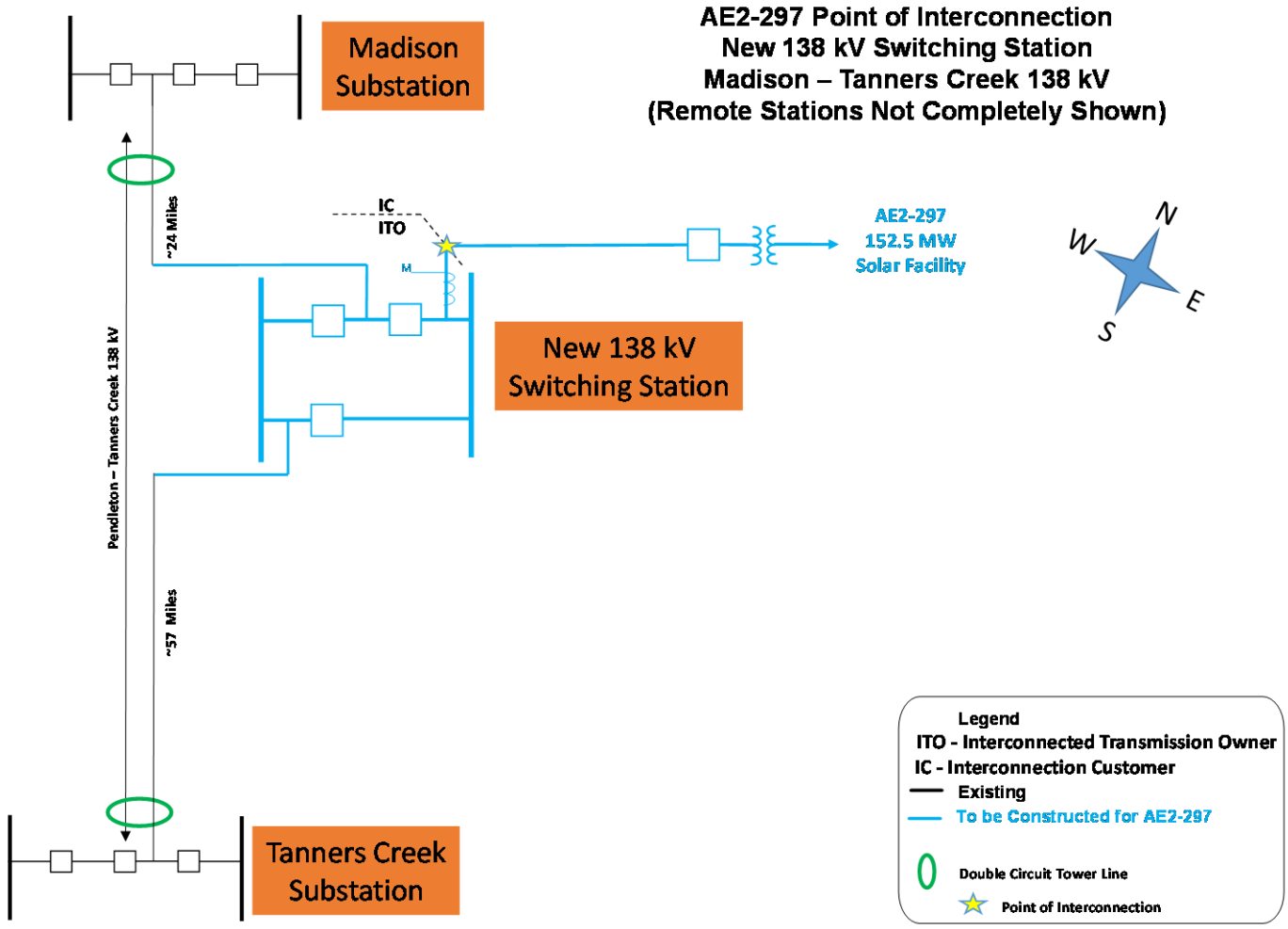
Task	Network Upgrade Number	Engineering	Material	Construction	Other	TOTAL
Shankatank Station Construction Oversite	n7243.2	$116,876.33	$92,120.33	$255,528.34	$216,868.00	**$681,393.00**
Tanners Creek – Madison 138kV T-line Cut In	n7243.3	$141,371.66	$178,703.66	$328,260.66	$125,346.00	**$773,682.00**
Madison 138kV Substation – Modify relay settings	n7243.4	$12,060.67	$6,917.67	$6,391.67	$21,769.00	**$47,139.00**
Tanners Creek 138kV Substation – Modify relay settings	**n7243.5**	**$12,060.67**	**$6,917.67**	**$6,391.67**	**$21,769.00**	**$47,139.00**
TOTAL		**$282,369.33**	**$284,659.33**	**$596,572.33**	**$385,752.00**	**$1,549,353.00**

2.9 Information Required for Interconnection Service Agreement

Description	DCF Facility	NUF Facility	ATF Facility	TOTAL
Direct Material	$92,120.34	$192,539.00	$0.00	**$284,659.34**
Direct Labor	$372,404.66	$506,537.00	$0.00	**$878,941.66**
Indirect Material	$43,007.27	$46,513.91	$0.00	**$89,521.18**
Indirect Labor	$173,860.73	$122,370.09	$0.00	**$296,230.82**
TOTAL	**$681,393.00**	**$867,960.00**	**$0.00**	**$1,549,353.00**

© PJM Interconnection 2021. All rights reserved.

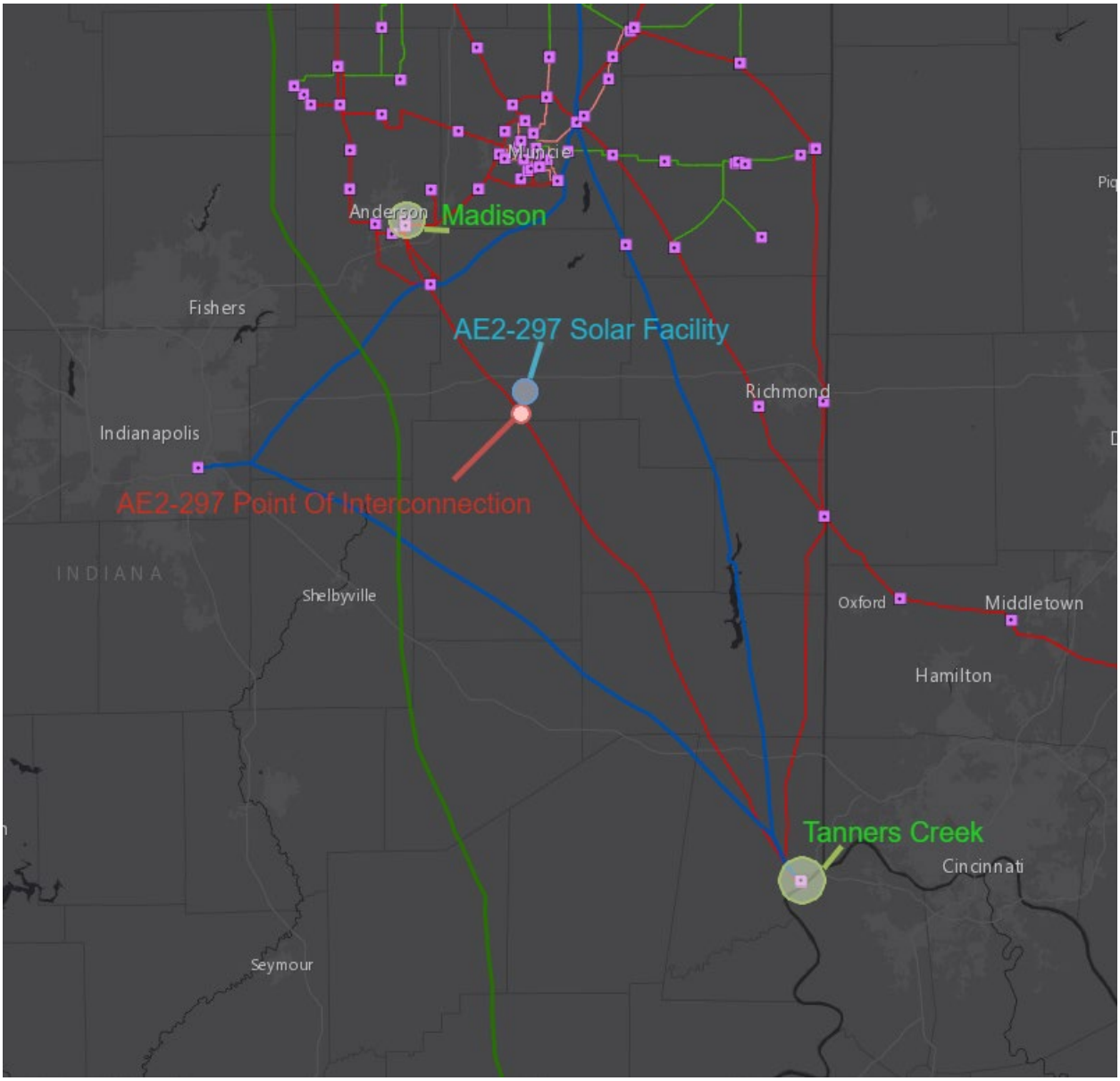
Figure 1: Point of Interconnection One-Line Diagram



The Point of Interconnection is the first structure outside of AEP's Shankatank 138 kV station (such structure being located in Interconnection Customer's 34.5-138 kV Collector Substation) with the Interconnected Transmission Owner owning the first span of conductors, and the Interconnection Customer owning the first structure.

© PJM Interconnection 2021. All rights reserved.

Figure 2: Point of Interconnection Map



© PJM Interconnection 2021. All rights reserved.

3. OVEC Transmission Owner Facilities Study Results

3.1 Transmission Lines - New

- No new transmission lines will be required for this project.

3.2 Transmission Line - Upgrades

- OVEC will replace two (2) dead end structures at two (2) Ohio River crossings, one (1) additional dead end structure at the Dearborn 345 kV line exit, and 16 tangent structures on the Dearborn - Pierce 345 kV circuit.

3.3 Station Facilities - New

- No new OVEC station facilities will be required for this project.

3.4 Station Facilities - Upgrades

- No OVEC station facility upgrades will be required for this project.

3.5 Metering & Communications

None (OVEC)

3.6 Environmental, Real Estate, and Permitting Issues

Minimal Environmental, Real Estate or Permitting issues are anticipated for most of the OVEC line upgrade scope. Potential issues identified are primarily associated with the two Ohio River crossings.

3.7 System Modeling and Operating Requirements

None

© PJM Interconnection 2021. All rights reserved.

3.8 Summary of Results of Study

Task	Engineering	Material	Construction	Other	TOTAL
Replace 16 tangent structures, 3 dead end structures, and conductor over one Ohio river crossing.	$926,495.67	$3,144,531.67	$6,135,596.66	$1,176,020.00	$11,382,644.00
TOTAL	$926,495.67	$3,144,531.67	$6,135,596.66	$1,176,020.00	**$11,382,644.00**

3.9 Information Required for Interconnection Service Agreement

Description	DCF Facility	NUF Facility	ATF Facility	TOTAL
Direct Material	$0.00	$3,144,531.67	$0.00	$3,144,531.67
Direct Labor	$0.00	$7,062,092.32	$0.00	$7,062,092.32
Indirect Material	$0.00	$364,034.64	$0.00	$364,034.64
Indirect Labor	$0.00	$811,985.37	$0.00	$811,985.37
TOTAL	$0.00	$11,382,644.00	$0.00	**$11,382,644.00**

© PJM Interconnection 2021. All rights reserved.

Figure 3: Network Upgrade One-Line Diagram

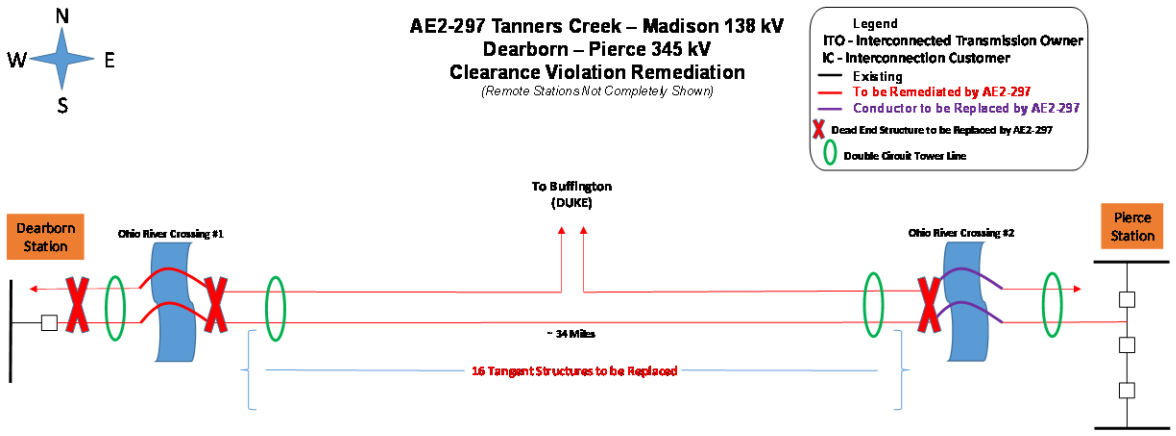


Figure 4: Network Upgrade Map