# Generation Interconnection

# Feasibility Study Report

# for

# Queue Project AG1-076

# FOSTORIA CENTRAL 138 KV

# 46 MW Capacity / 0 MW Energy

January 2021

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## 1 Introduction

This Feasibility Study has been prepared in accordance with the PJM Open Access Transmission Tariff, 36.2, as well as the Feasibility Study Agreement between the Interconnection Customer (IC), and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is AEP.

## 2 Preface

The intent of the feasibility study is to determine a plan, with ballpark cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the Interconnection Customer. The Interconnection Customer may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system.

In some instances a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection, may also contribute to the need for the same network reinforcement. Cost allocation rules for network upgrades can be found in PJM Manual 14A, Attachment B. The possibility of sharing the reinforcement costs with other projects may be identified in the feasibility study, but the actual allocation will be deferred until the impact study is performed.

The Interconnection Customer seeking to interconnect a wind or solar generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per Schedule H to the Interconnection Service Agreement and Section 8 of Manual 14D.

An Interconnection Customer with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

## 3 General

The Interconnection Customer (IC) has proposed an uprate to a planned Solar generating facility located in Hancock, Ohio. This project is an increase to the Interconnection Customer's AD1-070 project, which will share the same point of interconnection. The AG1-076 queue position is a 0 MW uprate (46 MW Capacity uprate) to the previous project. The total installed facilities will have a capability of 205 MW with 82 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this uprate project is December 29, 2023. This study does not imply a TO commitment to this in-service date.

| Queue Number | AG1-076 |
|---|---|
| Project Name | FOSTORIA CENTRAL 138 KV |
| State | Ohio |
| County | Hancock |
| Transmission Owner | AEP |
| MFO | 205 |
| MWE | 0 |
| MWC | 46 |
| Fuel | Solar |
| Basecase Study Year | 2024 |

Any new service customers who can feasibly be commercially operable prior to June 1st of the basecase study year are required to request interim deliverability analysis.

## 4 Point of Interconnection

AG1-076 will interconnect with the AEP transmission system as an uprate to AD1-070 at the Fostoria Central 138 kV substation.

## 5 Cost Summary

The AG1-076 project will be responsible for the following costs:

| Description | Total Cost |
|---|---|
| **Total Physical Interconnection Costs** | $0 |
| **Total System Network Upgrade Costs** | $0 |
| **Total Costs** | $0 |

This cost excludes a Federal Income Tax Gross Up charges. This tax may or may not be charged based on whether this project meets the eligibility requirements of IRS Notice 2016-36, 2016-25 I.R.B. (6/20/2016). If at a future date it is determined that the Federal Income Tax Gross charge is required, the Transmission Owner shall be reimbursed by the Interconnection Customer for such taxes.

Cost allocations for any System Upgrades will be provided in the System Impact Study Report.

Note: These cost estimates assume that no relaying upgrades are required to accommodate this project. During later study phases, AEP/PJM may determine that relaying upgrades may be required depending on final project schedules for the existing project.

## 6 Transmission Owner Scope of Work

The total physical interconnection costs is given in the table below:

| Description | Total Cost |
|---|---|
| **Total Physical Interconnection Costs** | $0 |

# 7 Interconnection Customer Requirements

It is understood that the Interconnection Customer (IC) is responsible for all costs associated with this interconnection. The costs above are reimbursable to the Transmission Owner. The cost of the IC's generating plant and the costs for the line connecting the generating plant to the Point of Interconnection are not included in this report; these are assumed to be the IC's responsibility.

The Generation Interconnection Agreement does not in or by itself establish a requirement for the Transmission Owner to provide power for consumption at the developer's facilities. A separate agreement may 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. It is the responsibility of the developer to contact the local service provider to determine if a local service agreement is required.

1. An Interconnection Customer entering the New Services Queue on or after October 1, 2012 with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

2. The Interconnection Customer may be required to install and/or pay for metering as necessary to properly track real time output of the facility as well as installing metering which shall be used for billing purposes. See Section 8 of Appendix 2 to the Interconnection Service Agreement as well as Section 4 of PJM Manual 14D for additional information.

# 8 Revenue Metering and SCADA Requirements

## 8.1 PJM Requirements

The Interconnection Customer will be required to install equipment necessary to provide Revenue Metering (KWH, KVARH) and real time data (KW, KVAR) for IC's generating Resource. See PJM Manuals M-01 and M-14D, and PJM Tariff Section 8 of Attachment O.

## 8.2 Meteorological Data Reporting Requirements

The solar generation facility shall provide the Transmission Provider with site-specific meteorological data including:

- Back Panel temperature (Fahrenheit) - (Required for plants with Maximum Facility Output of 3 MW or higher)
- Irradiance (Watts/meter2) - (Required for plants with Maximum Facility Output of 3 MW or higher)
- Ambient air temperature (Fahrenheit) - (Accepted, not required)
- Wind speed (meters/second) - (Accepted, not required)
- Wind direction (decimal degrees from true north) - (Accepted, not required)

## 8.3 Interconnected Transmission Owner Requirements

The IC will be required to comply with all Interconnected Transmission Owner's revenue metering requirements for generation interconnection customers located at the following link:

http://www.pjm.com/planning/design-engineering/to-tech-standards/

## 9 Summer Peak - Load Flow Analysis

The Queue Project AG1-076 was evaluated as a 0.0 MW (Capacity 46.0 MW) injection tapping the Fostoria Central 138 kV line in the AEP area. Project AG1-076 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AG1-076 was studied with a commercial probability of 53.0 %.  Potential network impacts were as follows:

## 9.1 Generation Deliverability

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

None

## 9.2 Multiple Facility Contingency

(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)

None

## 9.3 Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

None

## 9.4 Potential Congestion due to Local Energy Deliverability

PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.

Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which shall study all overload conditions associated with the overloaded element(s) identified.

| ID | FROM BUS# | FROM BUS | kV | FROM BUS AREA | TO BUS# | TO BUS | kV | TO BUS AREA | CKT ID | CONT NAME | Type | Rating MVA | PRE PROJECT LOADING % | POST PROJECT LOADING % | AC\|DC | MW IMPACT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **168087783** | 242935 | 05E LIMA | 345.0 | AEP | 242945 | 05SW LIM | 345.0 | AEP | 1 | AEP_P2-1_242939 05MARYSV 345 945620 AF1-227 TAP 345 1-A | operation | 971.0 | 112.79 | 115.12 | DC | 22.58 |
| **168087900** | 242936 | 05FOSTOR | 345.0 | AEP | 242935 | 05E LIMA | 345.0 | AEP | 1 | Base Case | operation | 1025.0 | 107.1 | 108.49 | DC | 31.41 |
| **168087901** | 242936 | 05FOSTOR | 345.0 | AEP | 242935 | 05E LIMA | 345.0 | AEP | 1 | AEP_P1-2_#2749_554-A | operation | 1318.0 | 105.91 | 107.31 | DC | 40.61 |
| **168087788** | 242984 | 05CHATFL | 138.0 | AEP | 932050 | AC2-015 TAP | 138.0 | AEP | 1 | AEP_P1-2_#7105_8900707 | operation | 167.0 | 129.03 | 132.24 | DC | 11.89 |
| **168087762** | 243006 | 05FOSTOR | 138.0 | AEP | 939160 | AE1-146 TAP | 138.0 | AEP | 2 | AEP_P1-2_#7757_11500705-B | operation | 204.0 | 121.52 | 138.19 | DC | 34.01 |
| **168087862** | 243006 | 05FOSTOR | 138.0 | AEP | 960840 | AF2-375 TAP | 138.0 | AEP | 1 | AEP_P1-2_#7761_20858-B | operation | 245.0 | 104.57 | 119.01 | DC | 35.39 |
| **168087835** | 243008 | 05FREMCT | 138.0 | AEP | 243009 | 05FRMNT | 138.0 | AEP | 1 | PJM_PLANT FREMONT | operation | 251.0 | 116.76 | 119.18 | DC | 13.48 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **168087685** | 243039 | 05MELMOR | 138.0 | AEP | 242984 | 05CHATFL | 138.0 | AEP | 1 | AEP_P1-2_#7105_8900707 | operation | 167.0 | 165.71 | 169.19 | DC | 12.92 |
| **168087727** | 243039 | 05MELMOR | 138.0 | AEP | 243024 | 05HOWARD | 138.0 | AEP | 1 | AEP_P1-2_#15237 | operation | 167.0 | 151.06 | 154.48 | DC | 12.65 |
| **168087993** | 247172 | 05EBERSO | 138.0 | AEP | 243059 | 05NFINDL | 138.0 | AEP | 1 | Base Case | operation | 167.0 | 89.64 | 102.32 | DC | 21.19 |
| **164232810** | 907200 | AD1-103 TAP | 345.0 | ATSI | 238569 | 02BEAVER | 345.0 | ATSI | 1 | ATSI-P1-2-OEC-345-810 | operation | 1742.0 | 101.14 | 101.75 | DC | 23.77 |
| **169551488** | 932050 | AC2-015 TAP | 138.0 | AEP | 243024 | 05HOWARD | 138.0 | AEP | 1 | AEP_P1-2_#7105_8900707 | operation | 167.0 | 162.29 | 165.5 | DC | 11.89 |
| **169551539** | 939160 | AE1-146 TAP | 138.0 | AEP | 247172 | 05EBERSO | 138.0 | AEP | 2 | AEP_P1-2_#7757_11500705-B | operation | 204.0 | 145.54 | 162.21 | DC | 34.01 |
| **169551541** | 939160 | AE1-146 TAP | 138.0 | AEP | 247172 | 05EBERSO | 138.0 | AEP | 2 | Base Case | operation | 150.0 | 102.38 | 107.87 | DC | 18.28 |
| **169857652** | 945620 | AF1-227 TAP | 345.0 | AEP | 242939 | 05MARYSV | 345.0 | AEP | 1 | Base Case | operation | 897.0 | 108.19 | 109.18 | DC | 19.59 |
| **169857716** | 960840 | AF2-375 TAP | 138.0 | AEP | 247172 | 05EBERSO | 138.0 | AEP | 1 | AEP_P1-2_#7761_20858-B | operation | 245.0 | 118.47 | 132.92 | DC | 35.39 |
| **169857718** | 960840 | AF2-375 TAP | 138.0 | AEP | 247172 | 05EBERSO | 138.0 | AEP | 1 | Base Case | operation | 167.0 | 105.96 | 118.79 | DC | 21.42 |

## 9.5 System Reinforcements

None

## 9.6 Flow Gate Details

The following indices contain additional information about each facility presented in the body of the report. For each index, a description of the flowgate and its contingency was included for convenience. The intent of the indices is to provide more details on which projects/generators have contributions to the flowgate in question. All New Service Queue Requests, through the end of the Queue under study, that are contributors to a flowgate will be listed in the indices. Please note that there may be contributors that are subsequently queued after the queue under study that are not listed in the indices. Although this information is not used "as is" for cost allocation purposes, it can be used to gage the impact of other projects/generators. It should be noted the project/generator MW contributions presented in the body of the report are Full MW Impact contributions which are also noted in the indices column named "Full MW Impact", whereas the loading percentages reported in the body of the report, take into consideration the PJM Generator Deliverability Test rules such as commercial probability of each project as well as the ramping impact of "Adder" contributions. The MW Impact found and used in the analysis is shown in the indices column named "Gendeliv MW Impact".

## 9.7 Queue Dependencies

The Queue Projects below are listed in one or more indices for the overloads identified in your report. These projects contribute to the loading of the overloaded facilities identified in your report. The percent overload of a facility and cost allocation you may have towards a particular reinforcement could vary depending on the action of these earlier projects. The status of each project at the time of the analysis is presented in the table. This list may change as earlier projects withdraw or modify their requests.

| Queue Number | Project Name | Status |
|---|---|---|
| **AB1-107** | Bayshore-GM Powertrain 138 kV & Lallendorf 345kV | Suspended |
| **AC1-051** | Willard-S. Greenwich 69kV | Withdrawn |
| **AC2-015** | Chatfield-Howard 138kV | Active |
| **AC2-103** | Beaver-Davis Besse 345 kV I | Engineering and Procurement |
| **AD1-070** | Fostoria Central 138 kV | Active |
| **AD1-103** | Beaver-Davis Besse 345 kV II | Active |
| **AD1-118** | Lemoyne | Active |
| **AD2-136** | Melmore Tap 138kV | Active |
| **AE1-119** | Lemoyne 345 kV | Active |
| **AE1-146** | Ebersole #2-Fostoria Central 138 kV | Active |
| **AE2-072** | East Leipsic-Richland 138 kV | Active |
| **AE2-174** | Seneca 138 kV | Active |
| **AE2-176** | Groton 138 kV Solar | Active |
| **AE2-181** | Snyder 69kV | Active |
| **AE2-282** | East Fayette 138 kV | Active |
| **AF1-063** | Lockwood Road 138 kV | Active |
| **AF1-064** | Weston 69 kV | Active |
| **AF1-120** | East Fayette 2 138 kV | Active |
| **AF1-205** | Napolean Muni 138 kV | Active |
| **AF1-206** | East Fayette 138 kV | Active |
| **AF1-229** | Galion-South Berwick 345 kV | Active |
| **AF2-004** | Beaver 345 kV | Active |
| **AF2-005** | Beaver 138 kV | Active |
| **AF2-126** | Weston 69 kV II | Active |
| **AF2-127** | Lockwood Road 138 kV | Active |
| **AF2-321** | Stryker-Ridgeville 138 kV | Active |
| **AF2-375** | Ebersole-Fostoria 138 kV | Active |
| **AG1-056** | Stryker-Ridgeville 138 kV | Active |
| **AG1-076** | Fostoria Central 138 kV | Active |
| **AG1-199** | Allen Junction 345 kV | Active |
| **AG1-319** | Northside 138 kV | Active |
| **AG1-358** | Howard-Melmore 138 kV | Active |
| **AG1-425** | Groton 138 kV | Active |
| **AG1-500** | Beaver 345 kV | Active |
| **AG1-501** | Beaver 138 kV | Active |
| **U4-028** | Fostoria Central-Greenlawn-Howard 138kV | Suspended |
| **U4-029** | Fostoria Central-Greenlawn-Howard 138kV | Suspended |
| **V4-010** | Tiffin Center 138kV | Engineering and Procurement |

| | | |
|---|---|---|
| **Y1-069** | Bay Shore-Fostoria Central 345kV & Bayshore-Monroe 345kV | In Service |

## 9.8 Contingency Descriptions

| Contingency Name | Contingency Definition |
|---|---|
| **AEP_P1-2_#7105_8900707** | CONTINGENCY 'AEP_P1-2_#7105_8900707'<br>OPEN BRANCH FROM BUS 243024 TO BUS 243039 CKT 1 / 243024 05HOWARD 138 243039 05MELMOR 138 1<br>END |
| **AEP_P1-2_#7757_11500705-B** | CONTINGENCY 'AEP_P1-2_#7757_11500705-B'<br>OPEN BRANCH FROM BUS 960840 TO BUS 247172 CKT 1 / 960840 AF2-375 TAP 138 247172 05EBERSO 138 1<br>END |
| **ATSI-P1-2-OEC-345-810** | CONTINGENCY 'ATSI-P1-2-OEC-345-810' /* LINE 02HAYES TO 02DAV-BE 345 CK 1<br>DISCONNECT BRANCH FROM BUS 239289 TO BUS 238654 CKT 1 /* 02HAYES 345 02DAV-BE 345<br>END |
| **AEP_P1-2_#7761_20858-B** | CONTINGENCY 'AEP_P1-2_#7761_20858-B'<br>OPEN BRANCH FROM BUS 939160 TO BUS 247172 CKT 2 / 939160 AE1-146 TAP 138 247172 05EBERSO 138 2<br>END |
| **AEP_P2-1_242939 05MARYSV 345 945620 AF1-227 TAP 345 1-A** | CONTINGENCY 'AEP_P2-1_242939 05MARYSV 345 945620 AF1-227 TAP 345 1-A'<br>OPEN BRANCH FROM BUS 242939 TO BUS 945620 CKT 1<br>END |
| **PJM_PLANT FREMONT** | CONTINGENCY 'PJM_PLANT FREMONT'<br>REMOVE MACHINE 1 FROM BUS 238601<br>REMOVE MACHINE 2 FROM BUS 238602<br>REMOVE MACHINE 3 FROM BUS 238603<br>END |
| **AEP_P1-2_#15237** | CONTINGENCY 'AEP_P1-2_#15237'<br>OPEN BRANCH FROM BUS 242984 TO BUS 243039 CKT 1 / 242984 05CHATFL 138 243039 05MELMOR 138 1<br>OPEN BRANCH FROM BUS 242984 TO BUS 245656 CKT 1 / 242984 05CHATFL 138 245656 05CHATFIEL 69.0 1<br>OPEN BRANCH FROM BUS 245655 TO BUS 245656 CKT 1 / 245655 05CARROTHR 69.0 245656 05CHATFIEL 69.0 1<br>OPEN BRANCH FROM BUS 245656 TO BUS 247380 CKT 1 / 245656 05CHATFIEL 69.0 247380 05NEW WASHSS69.0 1<br>OPEN BRANCH FROM BUS 242984 TO BUS 932050 CKT 1 / 242984 05CHATFL 138 932050 AC2-015 TAP 138 1<br>OPEN BRANCH FROM BUS 932050 TO BUS 243024 CKT 1 / 932050 AC2-015 TAP 138 243024 05HOWARD 138 1<br>END |

| | |
|---|---|
| **ATSI-P7-1-OEC-345-004_NON** | CONTINGENCY 'ATSI-P7-1-OEC-345-004_NON' /* DB - BAVER & DB - HAYES 345<br>DISCONNECT BRANCH FROM BUS 238654 TO BUS 907200 CKT 1 /* 02DAV-BE 345 AD1-103 345<br>DISCONNECT BRANCH FROM BUS 907200 TO BUS 238569 CKT 1 /* AD1-103 345 02BEAVER 345<br>DISCONNECT BRANCH FROM BUS 238654 TO BUS 239289 CKT 1 /* 02DAV-BE 345 02HAYES 345<br>END |
| **ATSI-P2-3-OEC-345-002** | CONTINGENCY 'ATSI-P2-3-OEC-345-002' /* BEAVER 345KV BRK B-121<br>DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 1 /* 02BEAVER 345 02LAKEAVE 345<br>DISCONNECT BRANCH FROM BUS 238569 TO BUS 238607 CKT 1 /* 02BEAVER 345 02CARLIL 345<br>END |
| **Base Case** | |
| **AEP_P1-2_#2749_554-A** | CONTINGENCY 'AEP_P1-2_#2749_554-A'<br>OPEN BRANCH FROM BUS 238745 TO BUS 945640 CKT 1 / 238745 02GALION 345 945640 AF1-229 TAP 345 1<br>END |

## 10 Short Circuit Analysis

The following Breakers are overdutied

None

# 11 Affected Systems

## 11.1 TVA

TVA Impacts to be determined during later study phases (as applicable).

## 11.2 Duke Energy Progress

Duke Energy Progress Impacts to be determined during later study phases (as applicable).

## 11.3 MISO

MISO Impacts to be determined during later study phases (as applicable).

## 11.4 LG&E

LG&E Impacts to be determined during later study phases (as applicable).

# 12 Attachment 1: One Line Diagram and Project Site Location

**AG1-076 Point of Interconnection Fostoria Central 138 kV Circuit**
**Single-line Diagram**