Generation Interconnection

System Impact Study Report

for

Queue Project AE2-126

DUBOIS-CURWENSVILLE 34.5 KV

12 MW Capacity / 20 MW Energy

February 2020

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1 Introduction

This System Impact Study has been prepared in accordance with the PJM Open Access Transmission Tariff, 205, as well as the System Impact Study Agreement between **Glidepath Ventures, LLC,** the Interconnection Customer (IC), and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is Mid-Atlantic Interstate Transmission ("MAIT" in Pennsylvania Electric Company (Penelec) zone).

2 Preface

The intent of the System Impact Study is to determine a plan, with approximate cost and construction time estimates, to connect the subject generation interconnection project to the PJM network at a location specified by the Interconnection Customer. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system. All facilities required for interconnection of a generation interconnection project must be designed to meet the technical specifications (on PJM web site) for the appropriate transmission owner.

In some instances an Interconnection Customer may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection or merchant transmission upgrade, may also contribute to the need for the same network reinforcement. 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 System Impact Study is performed.

The System Impact 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.

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.

3 General

The Interconnection Customer (IC), has proposed a Solar generating facility located in Clearfield County, Pennsylvania. The installed facilities will have a total capability of 20 MW with 12 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is September 1, 2021. This study does not imply a TO commitment to this in-service date.

Queue Number	AE2-126
Project Name	DUBOIS-CURWENSVILLE 34.5 KV
Interconnection Customer	Glidepath Ventures, LLC
State	Pennsylvania
County	Clearfield
Transmission Owner	PENELEC
MFO	20
MWE	20
MWC	12
Fuel	Solar
Basecase Study Year	2022

4 Point of Interconnection

AE2-126 will interconnect with the Penelec distribution system via a tap on the 34.5 kV Curwensville circuit at pole # DC-31421. The IC's proposed generating unit site is approximately 2.0 miles south of Rockton, PA., near 1636 Viaduct Road.

Attachment 1 shows a one-line diagram of the proposed primary direct connection facilities for the AE2-126 generation project to connect to the Penelec distribution system. Attachment 2 provides the proposed location for the point of interconnection (POI). IC will be responsible for constructing all of the facilities on its side of the POI, including the attachment facilities which connect the generator to the Penelec distribution system's direct connection facilities.

5 Cost Summary

The AE2-126 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 142,900
Direct Connection Network Upgrade	$ 0
Non Direct Connection Network Upgrades	$ 79,400
System Upgrades	$ 0
Total Costs	**$ 222,300**

The costs provided above exclude the Contribution in Aid of Construction ("CIAC") Federal Income Tax Gross Up charge. If, at a future date, it is determined that the CIAC Federal Income Tax Gross charge is required, the Transmission Owner shall be reimbursed by the Interconnection Customer for such taxes.

The required Attachment Facilities and Direct and Non-Direct Connection work for the interconnection of the AE2-126 generation project to the Penelec Distribution System is detailed in the following sections. The associated one-line with the generation project Attachment Facilities and the Primary Direct Connection facilities are shown in Attachment 1.

Note: PJM Open Access Transmission Tariff (OATT) section 217.3A outline cost allocation rules. The rules are further clarified in PJM Manual 14A Attachment B. The allocation of costs for a network upgrade will start with the first Queue project to cause the need for the upgrade. Later queue projects will receive cost allocation contingent on their contribution to the violation and are allocated to the queues that have not closed less than 5 years following the execution of the first Interconnection Service Agreement which identifies the need for this upgrade.

6 Transmission Owner Scope of Work

The AE2-119 project will interconnect with the Penelec distribution system via a tap on the 34.5 kV Curwensville circuit at pole # DC-31421. The IC will be responsible for acquiring all easements, properties, and permits that may be required to construct the new interconnection station and the associated facilities.

Attachment 1 shows a one-line diagram of the proposed primary direct connection facilities for the AE2-126 generation project to connect to the Penelec distribution system. Attachment 2 provides the proposed location for the point of interconnection. The IC will be responsible for constructing all of the facilities on its side of the POI, including the attachment facilities which connect the generator to the FE distribution system's direct connection facilities.

7 Attachment Facilities

There are no attachment facility costs associated with this project.

Description	Total Cost
Tap point DC-31421 on Dubois-Curwensville 34.5 kV, add SCADA recloser, and primary metering	$ 142,900
Total Attachment Facilities Costs	**$ 142,900**

8 Direct Connection Cost Estimate

Direct Connection scope of work not required.

9 Non-Direct Connection Cost Estimate

The total preliminary cost estimate for the Non-Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Total Cost
Dubois 34.5kV SS. Adjust Remote Relay and Metering Settings.	$ 39,700
Curwensville 34.5kV SS. Adjust Remote Relay and Metering Settings.	$ 39,700
Total Non-Direct Connection Facility Costs	**$ 79,400**

10 Schedule

Based on the scope of work for the Direct and Non-Direct Connection facilities, it is expected to take a minimum of **6 months** after the signing of an Interconnection Construction Service Agreement to complete the installation. This includes the requirement for the IC to make a preliminary payment that compensates FE for the first three months of the engineering design work that is related to the construction of the Attachment Facilities. Full initial deposit is required for Non-Direct Connection work. This assumes that there will be no environmental issues with any of the new properties associated with this project, that there will be no delays in acquiring the necessary permits for implementing the defined direct connection and that any distribution system outages will be allowed when requested.

11 Transmission Owner Analysis

Penelec performed an analysis of its distribution system. The AE2-126 project did not contribute to any overloads on the distribution system.

12 Interconnection Customer Requirements

12.1 System Protection

An analysis was conducted to assess the impact of the Dubois-Curwensville 34.5 kV (AE2-126) Project on the system protection requirements in the area. The results of this review show that the following relay additions will be required:

Proposed single line diagrams show Glidepath Ventures, LLC (Developer) constructing a generation facility they call **"UN-Viaduct"** tapping Penelec's Dubois - 34.5kV Curwensville at pole DC-31421.

The 34.5kV interconnection proposal will require Developer to meet applicable "Technical Requirements" as outlined in First Energy's document titled "Technical Requirements for the Interconnection of Customer-Owned Generation to the FirstEnergy Distribution System". Anti-islanding system shall meet IEEE 1547 and UL 1741 therefore no Direct Transfer Trip (DTT) will be required.

Protection requirements are included in the "Technical Requirements" document.

12.2 General Concerns

It is to be understood, for abnormal operation of the Penelec system, which could cause Developer's generation facility to be electrically isolated from the Penelec system synchronous source via the tripping of a interconnecting primary voltage line or device, Developer will, via Penelec's direction, be required to disconnect the generation from Penelec's system and remain disconnected (**units are required to be OFF LINE**), until the Penelec system normal circuitry is restored. These abnormal conditions will be reviewed by Penelec system operators as to the need for the generation facility to be disconnected.

12.3 Requirements for Owner's/Developer's generation IPP Facility

The proposed interconnection Owner's/Developer's facilities must be designed in accordance with the document titled *FirstEnergy Distribution Engineering Practices Interconnection of Customer-Owned Generation to the FirstEnergy Distribution System* dated 11/17/14 located at the following link:

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

The document is referred to as engineering practice EP(# 02-280) with section 4 part C specifically referencing the "interconnection technical requirements". Certain protection requirement are shown.

Additionally, Owner/Developer is responsible to provide adequate protection (for their equipment) under any distribution system operating condition' - which includes 'Separation from supply' (i.e. tripping of F.E. circuit breakers) and 'Re-synchronizing the generation after electric restoration of the supply' (i.e. reclosing of F.E. circuit breakers).

Owner's/Developer's protection must be designed to coordinate with the reclosing practices of FirstEnergy line protective devices. The generator must cease to energize the FirstEnergy circuit to which it is connected prior to reclosing of any (FE) automatic reclosing devices.

Owners/Developer's electrical protection and control schematics shall be provided to FE for consideration. FE may request modifications, if required, to meet the technical requirements.

12.4 Compliance Issues

IC will be responsible for meeting a power factor between 0.90 lagging (producing MVARs) to 0.95 leading (absorbing MVARs) and assure that voltage deviation will be less than 1.0 volt as measured at the POI under all Solar Gen operating conditions due to the inherent dynamic reactive power capability of this solar facility.

Generators with no inherent VAR (reactive power) control capability, or those that have a restricted VAR capability less than the defined requirements, must provide dynamic supplementary reactive support located at the generation facility with electrical characteristics equivalent to that provided by a similar sized synchronous generator. A Dynamic Reactive Compensation (either Static VAR Compensator (SVC) or STATCOM) or other method be applied in order to maintain the required specifications at the POI. Glidepath Ventures, LLC is responsible for the installation of equipment on its side of the POI in order to adhere to the criteria stated above by FirstEnergy.

13 Revenue Metering and SCADA Requirements

13.1 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.

13.1.1 Meteorological Data Reporting Requirement

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

- Temperature (degrees Fahrenheit)
- Atmospheric pressure (hectopascals)
- Irradiance
- Forced outage data

13.2 PENELEC Requirements

Glidepath Ventures, LLC will be required to comply with all FE Revenue Metering Requirements for Generation Interconnection Customers. These FE requirements are the following:

The FE operating company (Penelec) shall provide, own, operate, test, and maintain the revenue metering equipment at the Interconnection Customer's (IC) expense. The revenue metering equipment includes, but is not limited to, current transformers, voltage transformers, secondary wires, meter socket, bidirectional revenue meter, and associated devices. The IC shall mount the instrument transformers unless otherwise agreed to by Penelec. The instrument transformers and meter socket shall be installed in a location that is readily accessible to authorized Penelec representatives. Penelec will provide the IC access to bidirectional kWh and kVARh pulses from the Penelec meter at the IC's expense if requested. The IC shall, at its expense, install, own, operate, test, and maintain any metering and telemetry equipment that may be required to provide real-time meter data to FE or PJM.

14 Network Impacts

The Queue Project AE2-126 was evaluated as a 20.0 MW (Capacity 12.0 MW) injection through a tap on the 34.5 kV Philipsburg circuit at pole # 1235-C21 in the MAIT (PENELEC) area. Project AE2-126 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE2-126 was studied with a commercial probability of 100%. Potential network impacts were as follows:

Summer Peak Load Flow

14.1 Generation Deliverability

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

None

14.2 Multiple Facility Contingency

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

None

14.3 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

14.4 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	CONTNAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
16092736	200904	26EAGL VAL	115.0	PENELEC	200527	26TYRONE N	115.0	PENELEC	1	AP-P1-2-WP-230-323T	operation	191.0	85.87	87.15	AC	2.47

15 System Reinforcements

None.

15.1 Queue Dependencies

Queue Number	Project Name	Status
AE2-263	Moshannon-Milesburg 230 kV	Active
AE2-121	Milesburg-Tanney Junction 46 kV	Active
AE2-263	Moshannon-Milesburg 230 kV	Active
AE2-121	Milesburg-Tanney Junction 46 kV	Active
AE2-120	Graymont-Zion 46 kV	Active
AE2-120	Graymont-Zion 46 kV	Active
AE2-113	Farmers Valley-Ridgeway 115 kV	Active
AE2-113	Farmers Valley-Ridgeway 115 kV	Active
G-007A	N/A	N/A
AB1-092	Moshannon-East Towanda 230kV	Active
AE2-262	Moshannon-Milesburg 230 kV	Active
AE2-262	Moshannon-Milesburg 230 kV	Active
AE2-001	Nittany-Zion 46 kV	Active
AE2-001	Nittany-Zion 46 kV	Active
AD2-133	Eagle Valley 115kV	Active
AE2-126	Dubois-Curwensville 34.5 kV	Active
Q-036	N/A	N/A
AA2-000	N/A	N/A
AD2-133	Eagle Valley 115kV	Active
O-066	N/A	N/A
AE1-147	Bellefonte 46 kV	Active
AE1-147	Bellefonte 46 kV	Active
AE2-119	Shawville-Phillipsburg 34.5 kV	Active
AE2-248	Fillmore-Thompson Farm 46 kV	Active
AE2-119	Shawville-Phillipsburg 34.5 kV	Active
AE2-248	Fillmore-Thompson Farm 46 kV	Active
AE2-131	Philipsburg-Karthaus 34.5	Active
G-007	N/A	N/A
AE2-129	Philipsburg-Clarence 34.5 kV	Active
AE2-129	Philipsburg-Clarence 34.5 kV	Active
AE2-131	Philipsburg-Karthaus 34.5	Active
AE2-055	Shingletown-Boalsburg 46 kV	Active
AD2-055	Moshannon-East Towanda 230 kV	Active
AE2-055	Shingletown-Boalsburg 46 kV	Active
AE2-126	Dubois-Curwensville 34.5 kV	Active
AE2-316	Brookville-Squab Hollow 138 kV	Active
AE2-316	Brookville-Squab Hollow 138 kV	Active
AC1-025	Dale Summit	In Service

Affected Systems

16 Affected Systems

16.1 LG&E

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

16.2 MISO

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

16.3 TVA

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

16.4 Duke Energy Progress

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

16.5 NYISO

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

17 Contingency Definitions

Contingency Name	Contingency Definition
AP-P1-2-WP-230-323T	CONTINGENCY 'AP-P1-2-WP-230-323T' /* SHINGLETOWN-LEWISTOWN 230KV APS-PN TIE DISCONNECT BRANCH FROM BUS 235248 TO BUS 200513 CKT 1 /* 01SHINGL 230 26LEWISTWN 230 END

Short Circuit

18 Short Circuit

The following Breakers are overdutied:

None.

Stability

19 Stability Analysis and Reactive Power Assessment

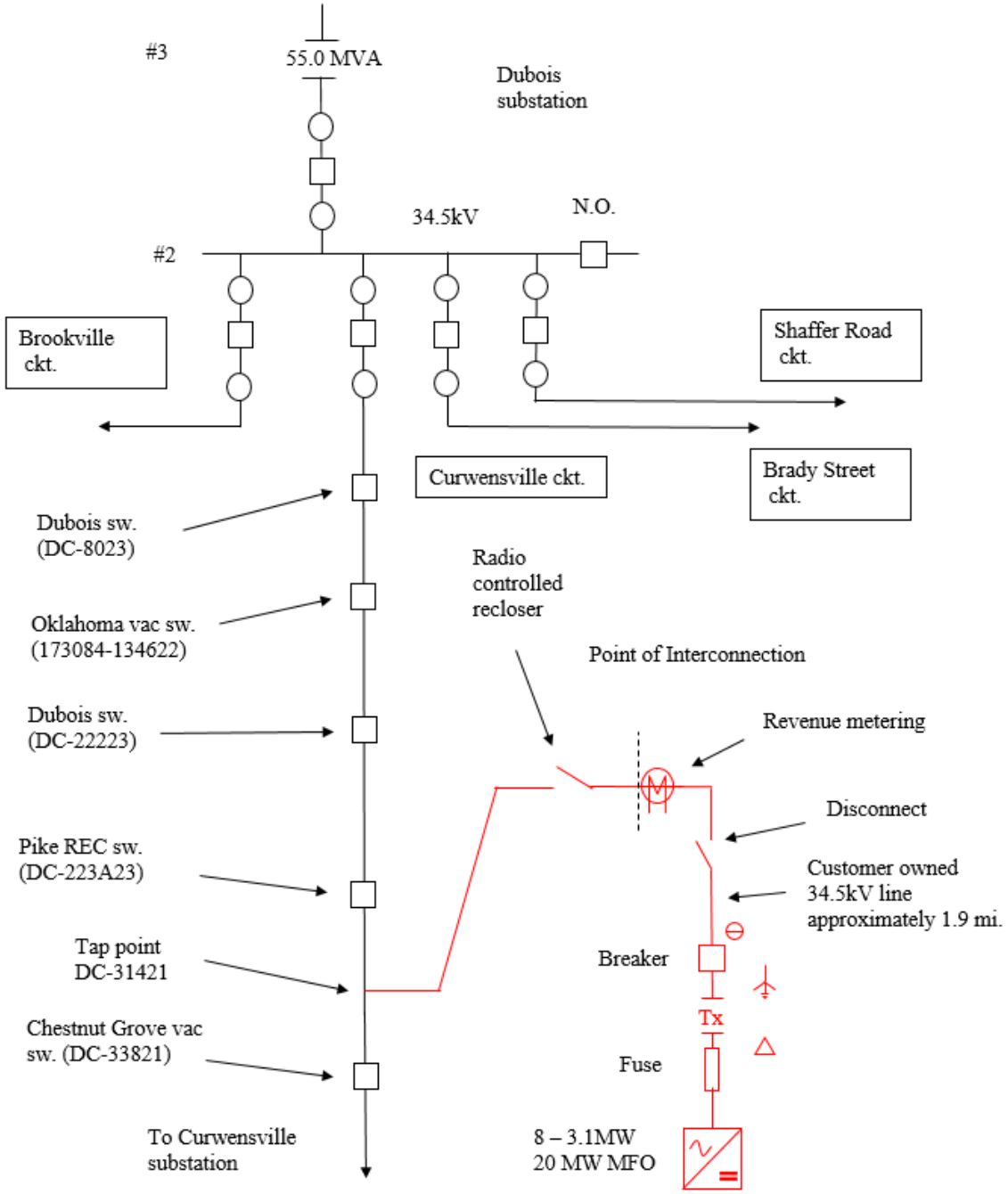
Not required.

Light Load

20 Light Load Analysis

Not applicable to solar projects.

21 Attachment 1 – One Line



22 Attachment 2 – Project Location