Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AE1-123

Emlenton 34.5 kV

March 2019

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. 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 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.

General

The Interconnection Customer (IC), has proposed a Natural Gas generating facility (reciprocating engines) located in Shippenville, PA. The proposed generating unit site is approximately 2.9 miles southeast of Shippenville, PA., off Rt. 322 (Attachment 1). The installed facilities will have a total capability of 18MW with 18MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is September 30, 2018. **This study does not imply a Mid Atlantic Interstate Transmission (MAIT – Penelec) commitment to this in-service date.**

Point of Interconnection

AE1-123 will interconnect with the MAIT distribution system along the Emlenton 34.5kV circuit at pole # 6K5835134.5.

Cost Summary

The AE1-123 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 0
Direct Connection Network Upgrades	$ 0
Non Direct Connection Network Upgrades	$ 122,100
Total Costs	**$ 122,100**

The transmission and substation costs given above exclude the Contribution in Aid of Construction ("CIAC") Federal Income Tax Gross up charge. If at a future date Federal CIAC taxes are deemed necessary by the IRS for this project, MAIT shall be reimbursed by the

Interconnection Customer for such taxes. MAIT estimates the tax, if applicable, would be approximately $21,500.

In addition, the AE1-123 project may be responsible for a contribution to the following costs:

Description	Total Cost
New System Upgrades	$ 0
Previously Identified Upgrades	$ 0
Total Costs	**$ 0**

Cost allocations for these upgrades will be provided in the System Impact Study Report.

Attachment Facilities

No Attachment Facilities are required to support this interconnection request.

Direct Connection Cost Estimate

No Direct Connection Facilities are required to support this interconnection request.

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
Install anti-islanding scheme @ Piney SS	$ 122,100
Total Non-Direct Connection Facility Costs	**$ 122,100**

Estimated Lead Time: 0.5 year from signed IA

Notes:

- Detailed Engineering & Construction Estimates TBD via Facility Study
- The above estimates do not include 1) property costs and site development up to rough grade which is to be provided by the developer, and 2) generation SCADA to be provided by the developer.

Attachment 2 provides a conceptual one-line of the direct connection facilities.

Transmission Owner Scope of Work

It was proposed that the project be studied as an interconnection into the First Energy distribution system as a tap on the 34.5 kV Emlenton circuit. The IC has submitted a "Generation Interconnection Feasibility Study Agreement" to PJM and a proposed single line diagram (see Attachment 7) that identifies their proposal.

The IC is responsible for constructing all of the facilities on its side of the point of interconnection, on the line to the generating plant. The IC will also be responsible for the modifications at the tap that are required due to connecting the facility.

The proposed interconnection facilities must be designed in accordance with the FirstEnergy "Requirements for Transmission Connected Facilities" document and "Technical Requirements for the Interconnection of Customer-Owned generation to the FirstEnergy Distribution System" document.

The 34.5kV interconnection point will require the installation of a Penelec installed/owned radio controlled switch (which will act as the disconnect point between First Energy and the generator interconnection).

Interconnection metering is also required for this generation connection. The 34.5 kV revenue quality metering equipment shall be designed, furnished and installed by FirstEnergy. The Interconnection Customer will be responsible for designing, furnishing and installing a SCADA RTU in their generation substation and obtaining the telecommunication circuits from the RTU to the Penelec Data Center. The connection to the Penelec Data Center will be to provide MW, MVAR and 34.5kV voltage at The IC generation substation. Please reference the FirstEnergy Metering Requirements for Interconnection Customers, for more details on the metering requirements for FirstEnergy. This document can be found on the FE website at:

Interconnection Customer Requirements

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.

3. The Interconnection Customer seeking to interconnect a wind generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per item 5.iv. of Schedule H to the Interconnection Service Agreement.

4. The purchase and installation of the minimum required FE generation interconnection relaying and control facilities. This includes over/under voltage protection, over/under frequency protection, and zero sequence voltage protection relays.

5. The installation of a Penelec provided 34.5 kV interconnection metering instrument transformer. FE will provide the ratio and accuracy specifications based on the customer load and generation levels.

6. The installation of a Penelec provided revenue class meter for each unit to measure the power delivered in compliance with the FE standards.

7. The purchase and installation of supervisory control and data acquisition (SCADA) equipment to provide information in a compatible format to the FE Transmission System Control Center.

8. The establishment of dedicated communication circuits for SCADA report to the FE Transmission System Control Center.

9. A compliance with the FE and PJM generator power factor and voltage control requirements.

10. The rough grade of the property for the AE1-123 Interconnection 34.5 kV tap pole and an access road for the delivery of equipment to this site. The above requirements are in addition to any metering and telecommunications required by PJM as specified in PJM Manuals M-01 and M-14D

11. The execution of a back-up retail service agreement with the electric distribution company to serve the customer load supplied from the Emlenton 34.5 kV generation project interconnection point when the units are out-of-service.

12. Providing all easements, properties and permits that may be required to construct the associated facilities. The schedule above is based on the assumption 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 any necessary permits, and that PJM will allow all Transmission system outages when requested.

13. The IC will be responsible for meeting a power factor between 0.95 leading (absorbing MVARs) and 0.90 lagging (producing MVARs) to assure that voltage deviation will be less than 1.0 volt as measured at the POI under all Generator operating conditions.

Revenue Metering and SCADA Requirements

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 Sections 24.1 and 24.2.

Metering

The IC will be require to comply with all FE revenue metering requirements for generation interconnection customers which can be found in FE's "Requirements for Transmission Connected Facilities" document located at: http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx.

FE Requirements

The Interconnection Customer will be required to comply with all FE Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the "FirstEnergy Requirements for Transmission Connected Facilities" document located at the following links:

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

System Protection

The IC must design it's Customer Facilities in accordance with all applicable standards, including the standards in FE's "Requirements for Transmission Connected Facilities" document located at: http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx. Preliminary Protection requirements will be provided as part of the Facilities Study. Detailed Protection Requirements will be provided once the project enters the construction phase.

System Protection Analysis

An analysis was conducted to assess the impact of the Emlenton (AE1-123) 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 the IC constructing a generation facility called Emlenton 34.5kV, connecting behind the Interconnection Customer's primary metering point, effectively tapping Penelec's Piney 34.5kV Emlenton Circuit.

The 34.5kV interconnection proposal will require the IC 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".

Protection requirements are included in that document.

Meeting the protection requirements for this application will include (but not be limited to):

Voltage and synch check

FirstEnergy designed, provided, & installed, at the IC expense, modifications to Penelec's Piney Substation, to add 34.5kV system voltage and synchronism checking equipment for the 34.5kV Emlenton Circuit Breaker (CB), and located on the substation relay panel. This equipment will connect to existing potential transformer secondary outputs.

DTT

Also, meeting the protection requirements (for anti-island protection) will involve installation of a Direct Transfer Trip (DTT) system. the IC shall pay for and provide overall system equipment design, and installation (except for the connection to Penelec equipment as covered below). The DTT system type and design shall be subject to FirstEnergy's approval. Due to the significant size of the proposed generation .vs. Penelec's circuit loading, a fiber optic communication DTT system is strongly preferred.

The DTT system shall include transmitter/receiver equipment. The transmitter equipment, so as to receive CB status (from Penelec's 34.5kV Emlenton CB at Piney Substation) will be located in local proximity to this Penelec equipment. Hardware, which will provide CB status to the DTT transmitter, will be designed, provided by, and installed by FirstEnergy, at Interconnection Customer's expense.

A receiver shall be located at The IC Emlenton generation facility to receive the tripping signal. Tripping of the Interconnection Customer's Emlenton generator would be required (via the DTT) for an open, or trip out, condition of Penelec's Emlenton CB mentioned above.

Tripping of the The IC Emlenton generator would be required for a loss of DTT communication channel between the transmitters and receiver, as well as for times of nonfunctional DTT transmitter/receiver terminals. The IC Emlenton generator will not re-connect to the Penelec system until full integrity of the DTT system is restored.
The IC shall provide RTU normal/alarm operational status of the DTT system to the Penelec Load Dispatch Office. This monitoring shall be a continuous monitoring of the communication channel and operational readiness of the transmitter/receiver terminals, i.e., overall system integrity.

Maintenance and upkeep of the DTT system will be at The IC expense.

General Concerns

It is to be understood by The IC (and subsequent operator), for any abnormal 34.5kV operation of the Penelec system which would cause The IC Emlenton generation facility to be electrically isolated from Penelec's Piney Substation via the normal 34.5kV circuit, The IC Emlenton generator will disconnect, and remain disconnected, from the Penelec system until the normal 34.5kV circuit is restored.

Notes

The proposed interconnection Owners/developers facilities must be designed in accordance with the Generator Interconnection Technical Requirement for Distribution Connection Facilities document located at either of the following links:

www.firstenergycorp.com/feconnect

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

Additional Note: F.E.’s policy, (as noted in F.E. (Engineering Practices)) EP (# 02-280 C 3.11)

Generator owner 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).

Generator owner 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.

Network Impacts

The Queue Project AE1-123 was evaluated as a 18 MW (Capacity 18 MW) injection at the Piney 34.5 kV substation in the PENELEC area. Project AE1-123 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE1-123 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis – 2022

Contingency Descriptions

The following contingencies resulted in overloads:

Contingency Name	Contingency Defintion
PN-P2-3-PN-345-004J	CONTINGENCY 'EKPC_P4-5_OWEN N44-808' /* SPURLOCK OPEN BRANCH FROM BUS 324293 TO BUS 342007 CKT 1 /* 324293 4OWEN C 138.00 342007 2OWEN CO 69.000 OPEN BRANCH FROM BUS 324290 TO BUS 324293 CKT 1 /* 324290 4OWC TAP 138.00 324293 4OWEN C 138.00 OPEN BRANCH FROM BUS 324253 TO BUS 324290 CKT 1 /* 324253 4GHENT 138.00 324290 4OWC TAP 138.00 OPEN BRANCH FROM BUS 324290 TO BUS 324305 CKT 1 /* 324290 4OWC TAP 138.00 324305 4SCOTTKU 138.00 END

Generator Deliverability

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

None

Multiple Facility Contingency

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

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
676419	200585	26TITUSVIL	PENELEC	200571	26UNION CY	PENELEC	1	PN-P2-3-PN-345-004J	breaker	120.0	78.47	79.02	DC	1.46

Note: Please see 0 for projects providing impacts to flowgate violations. The values in the Reference column correspond to the proper table in the Attachment.

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

Short Circuit

(Summary of impacted circuit breakers)

None

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.

None

System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, initially caused by the addition of this project generation)

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)

ID	Index	Facility	Upgrade Description	Cost
676419	1	26TITUSVIL 115.0 kV - 26UNION CY 115.0 kV Ckt 1	Description : No Violation. Facility loading does not exceed 100%.	$0
		TOTAL COST	$0	

Attachment 1. Flowgate Details

Appendices

The following appendices contain additional information about each flowgate presented in the body of the report. For each appendix, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact.

It should be noted the generator contributions presented in the appendices sections are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.

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ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
676419	200585	26TITUSVIL	PENELEC	200571	26UNION CY	PENELEC	1	PN-P2-3-PN-345-004J	breaker	120.0	78.47	79.02	DC	1.46

Bus #	Bus	MW Impact
200662	26SCRUB GR	1.69
935191	AD1-154	1.14
938951	AE1-123	1.46
939291	AE1-160 C	4.62
939292	AE1-160 E	2.65
939381	AE1-169 C O1	16.06
939382	AE1-169 E O1	10.71
BAYOU	BAYOU	0.17
BIG_CAJUN1	BIG_CAJUN1	0.26
BIG_CAJUN2	BIG_CAJUN2	0.53
BLUEG	BLUEG	0.98
CALDERWOOD	CALDERWOOD	0.08
CANNELTON	CANNELTON	0.06
CARR	CARR	0.07
CATAWBA	CATAWBA	0.04
CHEOAH	CHEOAH	0.07
CHILHOWEE	CHILHOWEE	0.03
CHOCTAW	CHOCTAW	0.17
COFFEEN	COFFEEN	0.11
COTTONWOOD	COTTONWOOD	0.69
DEARBORN	DEARBORN	0.31
DUCKCREEK	DUCKCREEK	0.24
EDWARDS	EDWARDS	0.11
ELMERSMITH	ELMERSMITH	0.1
FARMERCITY	FARMERCITY	0.07

Bus #	Bus	MW Impact
G-007A	G-007A	0.4
GIBSON	GIBSON	0.04
HAMLET	HAMLET	0.1
NEWTON	NEWTON	0.28
O-066A	O-066A	0.18
PRAIRIE	PRAIRIE	0.5
RENSSELAER	RENSSELAER	0.05
SANTEETLA	SANTEETLA	0.02
SMITHLAND	SMITHLAND	0.04
TATANKA	TATANKA	0.13
TILTON	TILTON	0.13
TRIMBLE	TRIMBLE	0.11
TVA	TVA	0.28
UNIONPOWER	UNIONPOWER	0.12
VFT	VFT	1.07