Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AE1-053

Meyersdale North

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 an uprate to an existing wind generating facility located in Somerset County, PA. This uprate request is to install a battery storage facility to the existing windfarm. This project requests an increase to the install capability of 0 MW (Energy) with 10 MW of this output being recognized by PJM as capacity. The installed facilities will have a total capability of 30 MW (Energy) with 16 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is September 1, 2020. **This study does not imply a Penelec commitment to this in-service date.**

Clarification of rights:

	MWE	MWC	MFO
Existing (G21/K23)	**30**	**6**	**30**
AE1-030	**0**	**10**	**30**
Total	**30**	**16**	**30**

Point of Interconnection

AE1-053 will interconnect with the Penelec Transmission system along the Meyersdale North 115kV Substation (Existing POI).

Cost Summary

The AE1-053 project will be responsible for the following costs:

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

In addition, the AE1-053 project may be responsible for a contribution to the following costs:

Description	Total Cost
System Upgrades	$ 16,249,700
Total Costs	**$ 16,249,700**

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

General Information

Interconnected Transmission Owner ("TO"): n/a

Impacted TO(s) (if applicable): Mid-Atlantic Interstate Transmission, LLC ("MAIT")

PJM Zone: Penelec

FE Operating Company or Planning Region: Penelec

Customer Connection Request

Requested Backfeed Date: n/a

Requested Commercial Operation Date: 9/1/2020

This study does not imply a FirstEnergy commitment to these dates.

New Facilities		Existing Facilities	
Capacity:	10 MW	Capacity:	6 MW
Energy:	0 MW	Energy:	30 MW
MFO[1]:	30 MW	MFO:	30 MW
Fuel:	Battery and Wind	Prior Queue Position(s):	G21/K23

Point of Interconnection

Primary Point of Interconnection: Meyersdale North 115 kV Substation

Attachment Facilities

No Attachment Facilities are required to support this interconnection request.

[1] Maximum Facility Output

Direct Connection Cost Estimate

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

Non-Direct Connection Cost Estimate

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

Transmission Owner Scope of Work

Primary POI

The IC is proposing to install a 20 MW battery storage project behind the existing meter point for the G21/K23 wind project. The battery storage will be used to increase the capacity of the combined projects from 6 MW to 16 MW. An increase in the MFO of the plant is not being proposed with this project and will remain at 30 MW. No modification of the FE connection facilities are required to accommodate this capacity increase.

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 proposed Customer Facilities must be designed in accordance with FE's "Requirements for Transmission Connected Facilities" document located at: http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx. If not already existing, the IC is responsible for the following:

5. The purchase and installation of a fully rated 115 kV circuit breaker to protect the AE1-053 generator lead line. A single circuit breaker must be used to protect this line; if the

project has several GSU transformers, the individual GSU transformer breakers cannot be used to protect this line.

6. 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.

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. Compliance with the FE and PJM generator power factor and voltage control requirements.

9. The execution of a back-up service agreement to serve the customer load supplied from the AE1-053 generation project metering point when the units are out-of-service. This assumes the intent of the IC is to net the generation with the load.

10. The IC will also be required to meet all PJM, ReliabilityFirst, and NERC reliability criteria and operating procedures for standards compliance. For example, the IC will need to properly locate and report the over and under voltage and over and under frequency system protection elements for its units as well as the submission of the generator model and protection data required to satisfy the PJM and ReliabilityFirst audits. Failure to comply with these requirements may result in a disconnection of service if the violation is found to compromise the reliability of the FE system.

11. The Customer Facility shall retain its existing ability to maintain a power factor of at least 1.0 unity to 0.96 leading (absorbing VARs) measured at the generator's terminals.

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.

Network Impacts

The Queue Project AE1-053 which is an uprate to the G21 and K23 queue projects was evaluated as a 0 MW (Capacity 10 MW) injection at the G21 / K23 600 V bus in the PENELEC area. Project AE1-053 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability

Councils, and Transmission Owners). Project AE1-053 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 Definition
Base Case	
PN-P2-2-PN-115-002	CONTINGENCY 'PN-P2-2-PN-115-002' /* SOMERSET #1 115KV BUS FAULT DISCONNECT BRANCH FROM BUS 200744 TO BUS 200743 CKT 1 /* 26SOMERST 115 26HOOVERSV 115 DISCONNECT BRANCH FROM BUS 200744 TO BUS 202637 CKT 1 /* 26SOMERST 115 26PRIDE 115 DISCONNECT BRANCH FROM BUS 202637 TO BUS 200745 CKT 1 /* 26PRIDE 115 26ALLEGHEN 115 /* CONTINGENCY LINE ADDED FOR AE1 BUILD DISCONNECT BRANCH FROM BUS 200744 TO BUS 200746 CKT 1 /* 26SOMERST 115 26ROCKWOOD 115 DISCONNECT BRANCH FROM BUS 200744 TO BUS 200774 CKT 1 /* 26SOMERST 115 26SOMRSET123 END
AP-P2-2-MP-138-101-A	CONTINGENCY 'AP-P2-2-MP-138-101-A' /* ALBRIGHT-138-SOUTH DISCONNECT BRANCH FROM BUS 235120 TO BUS 235320 CKT 1 /* 01ALBRIG 138 01DENVER 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235402 CKT 1 /* 01ALBRIG 138 01SNOW T 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 934440 CKT 1 /* 01ALBRIG 138 AD1-068 TAP 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235485 CKT 1 /* 01ALBRIG 138 01METTIK 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235305 CKT 1 /* 01ALBRIG 138 01 106 J 138 END
AP-P2-3-MP-138-159	CONTINGENCY 'AP-P2-3-MP-138-159' /* ALBRIGHT-DENVER STK BKR AT ALBRIGHT DISCONNECT BRANCH FROM BUS 235120 TO BUS 235320 CKT 1 /* 01ALBRIG 138 01DENVER 138 DISCONNECT BRANCH FROM BUS 235320 TO BUS 235810 CKT 1 /* 01DENVER 138 01INT COAL 138 DISCONNECT BRANCH FROM BUS 235338 TO BUS 235810 CKT 1 /* 01GRAFTN 138 01INT COAL 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 934440 CKT 1 /* 01ALBRIG 138 AD1-068 TAP 138 /* CONTINGENCY LINE ADDED FOR AE1 BUILD DISCONNECT BRANCH FROM BUS 235120 TO BUS 235402 CKT 1 /* 01ALBRIG 138 01SNOW T 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235492 CKT 1 /* 01ALBRIG 138 01MTZION 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235305 CKT 1 /* 01ALBRIG 138 01 106 J 138 END
AP-P2-3-MP-138-153	CONTINGENCY 'AP-P2-3-MP-138-153' /* OAK PARK-KELSO GAP STK BKR AT ALBRIGHT DISCONNECT BRANCH FROM BUS 235120 TO BUS 235485 CKT 1 /* 01ALBRIG 138 01METTIK 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235492 CKT 1 /* 01ALBRIG 138 01MTZION 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235305 CKT 1 /* 01ALBRIG 138 01 106 J 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 235320 CKT 1 /* 01ALBRIG 138 01DENVER 138 DISCONNECT BRANCH FROM BUS 235120 TO BUS 934440 CKT 1 /* 01ALBRIG 138 AD1-068 TAP 138 /* CONTINGENCY LINE ADDED FOR AE1 BUILD DISCONNECT BRANCH FROM BUS 235120 TO BUS 235402 CKT 1 /* 01ALBRIG 138 01SNOW T 138 DISCONNECT BRANCH FROM BUS 235402 TO BUS 235403 CKT 1 /* 01SNOW T 138 01SNWYCK 138 DISCONNECT BRANCH FROM BUS 235402 TO BUS 235497 CKT 1 /* 01SNOW T 138 01OAKPRK 138 DISCONNECT BRANCH FROM BUS 235403 TO BUS 237273 CKT 1 /* 01SNWYCK 138 01SNOW C 66 DISCONNECT BRANCH FROM BUS 235497 TO BUS 237313 CKT 1 /* 01OAKPRK 138 01KELSOG 138 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)

None.

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)

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
83988	200746	26ROCKWOOD	PENELEC	200744	26SOMERST	PENELEC	1	AP-P2-3-MP-138-153	breaker	179.0	135.83	140.16	DC	7.75
83989	200746	26ROCKWOOD	PENELEC	200744	26SOMERST	PENELEC	1	AP-P2-3-MP-138-159	breaker	179.0	134.69	139.01	DC	7.74

Note: Please see Attachment 1 for projects providing impacts to flowgate violations. The values in the Reference column correspond to the proper table in the Attachment.

Short Circuit

(Summary of impacted circuit breakers)

None

NYISO

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

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	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
84539	200746	26ROCKWOOD	PENELEC	200744	26SOMERST	PENELEC	1	AP-P2-2-MP-138-101-A	operation	179.0	134.12	138.44	DC	7.73
84543	200746	26ROCKWOOD	PENELEC	200744	26SOMERST	PENELEC	1	Base Case	operation	148.0	112.62	117.34	DC	6.99
84731	200746	26ROCKWOOD	PENELEC	202650	26HIGHPOINT	PENELEC	1	PN-P2-2-PN-115-002	operation	174.0	104.4	110.14	DC	10.0

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
84567	200747	26PENN-MAR	PENELEC	913000	Y1-003 TAP	PENELEC	1	PN-P2-2-PN-115-002	operation	167.0	129.98	135.97	DC	10.0
84437	200762	26GARRETT	PENELEC	235470	01GARRET	AP	1	PN-P2-2-PN-115-002	operation	160.0	147.91	154.15	DC	10.0
85666	200762	26GARRETT	PENELEC	235470	01GARRET	AP	1	PN-P2-2-PN-115-002	operation	160.0	147.91	154.15	DC	10.0
84507	200856	26LICK RUN	PENELEC	200746	26ROCKWOOD	PENELEC	1	Base Case	operation	137.0	134.42	141.72	DC	10.0
84624	202650	26HIGHPOINT	PENELEC	200747	26PENN-MAR	PENELEC	1	PN-P2-2-PN-115-002	operation	174.0	121.12	126.87	DC	10.0
85833	235469	01GARRET	AP	934440	AD1-068 TAP	AP	1	PN-P2-2-PN-115-002	operation	191.0	112.33	116.0	DC	7.01
85761	235470	01GARRET	AP	235469	01GARRET	AP	1	PN-P2-2-PN-115-002	operation	196.0	120.74	125.84	DC	10.0
84566	913000	Y1-003 TAP	PENELEC	200762	26GARRETT	PENELEC	1	PN-P2-2-PN-115-002	operation	167.0	129.98	135.97	DC	10.0
85668	934440	AD1-068 TAP	AP	235120	01ALBRIG	AP	1	PN-P2-2-PN-115-002	operation	191.0	147.77	151.44	DC	7.01
85673	934440	AD1-068 TAP	AP	235120	01ALBRIG	AP	1	Base Case	operation	164.0	108.89	110.17	DC	2.11

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
83988,83989	1	26ROCKWOOD 115.0 kV - 26SOMERST 115.0 kV Ckt 1	PENELEC Description : Reconductor line. Upgrade terminal equipment at Rockwood and Somerset substations. Time Estimate : 21.0 Months Cost : $16,249,700	$16,249,700
			TOTAL COST	$16,249,700

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.

Index 1

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
83988	200746	26ROCKWOOD	PENELEC	200744	26SOMERST	PENELEC	1	AP-P2-3-MP-138-153	breaker	179.0	135.83	140.16	DC	7.75

Bus #	Bus	MW Impact
200813	26YOUGH	0.63
200835	26DSGENWIN	8.06
200840	26DEEPCRK1	0.78
200841	26DEEPCRK2	0.78
200890	26BF_G21_K23	0.68
200891	26CSLMN_L13	1.07
200892	26LOOKOUT	1.01
235098	U2-073A E	14.33
235099	U2-073B E	6.27
235530	01TR_Y2_073A	0.37
235531	01TR_Y2_073B	0.16
236001	01WARRIOR RN	4.21
237312	01DANS_S-014	2.57
237319	01FMR_U2-030	0.14
290229	S-014 E	10.28
292350	K-023	24.8
292542	L-013 1	24.8
293432	R-040 E	1.4
293902	O-048 E	22.32
913141	Y1-033 C OP1	0.58
913142	Y1-033 E OP1	22.64
917091	Z2-013	0.14
917672	Z2-108 E	15.5
918812	AA1-100 E	1.49
923971	AB2-038	0.09
924001	AB2-041 C	0.08
924002	AB2-041 E	1.86
929522	U2-030 E	5.61

Bus #	Bus	MW Impact
932981	AC2-122 C	14.73
932982	AC2-122 E	24.03
933951	AD1-018 C	1.11
933952	AD1-018 E	1.81
934441	AD1-068 C	4.47
934442	AD1-068 E	25.93
938351	AE1-053	7.75
CARR	CARR	0.22
CBM-S1	CBM-S1	0.58
CBM-S2	CBM-S2	0.36
CBM-W1	CBM-W1	0.79
CBM-W2	CBM-W2	4.03
CIN	CIN	0.38
CPLE	CPLE	0.15
G-007	G-007	0.32
IPL	IPL	0.25
LGEE	LGEE	0.11
MEC	MEC	0.73
MECS	MECS	0.33
O-066	O-066	1.13
RENSSELAER	RENSSELAER	0.17
WEC	WEC	0.1