Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AB1-179

Sabinsville-Wellsboro 34kV

February 2016

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 located Tioga County, Pennsylvania. The installed facilities will have a total capability of 19.9 MW with 19.9 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is December 2017. **This study does not imply a Pennsylvania Electric Company (Penelec) commitment to this in-service date.**

Point of Interconnection

AB1-179 will interconnect with the Penelec system along the Sabinsville-Wellsboro 34.5kV line.

Cost Summary

The AB1-179 project will be responsible for the following costs:

Description	Cost	Tax (if applicable)	Total Cost
Attachment Facilities	$ 0	$ 0	$ 0
Direct Connection Network Upgrades	$ 112,200	$ 40,600	$ 152,800
Non Direct Connection Network Upgrades	$ 653,100	$ 202,200	$ 855,300
Total Costs	**$ 765,300**	**$ 242,800**	**$ 1,008,100**

In addition, the AB1-179 project may be responsible for a contribution to the following costs:

Description	Cost	Tax (if applicable)	Total Cost
New System Upgrades	$ 0	$ 0	$ 0
Previously Identified Upgrades	$ 11,615,000	$ 3,605,800	$ 15,220,800
Total Costs	**$ 11,615,000**	**$ 3,605,800**	**$ 15,220,800**

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.

Direct Connection Cost Estimate

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

Description	Activity Cost	Tax (if applicable)	Total Cost
Region Line Tap on Wellsboro 34.5 kV line AB1-179 Point of Interconnection including costs associated with 34.5 kV Metering Package.	$ 112,200	$ 40,600	$ 152,800
Total Direct Connection Facility Costs	**$ 112,200**	**$ 40,600**	**$ 152,800**

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	Activity Cost	Tax (if applicable)	Total Cost
Sabinsville SS. Install sync check and anti-islanding relaying.	$ 326,600	$ 101,100	$ 427,700
Wellsboro SS. Install sync check and anti-islanding relaying.	$ 326,500	$ 101,100	$ 427,600
Total Non- Direct Connection Facility Costs	**$ 653,100**	**$ 202,200**	**$ 855,300**

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. In addition to the FE facilities, IMG Development, LLC will also be responsible for meeting all criteria as specified in the applicable sections of the "FE Requirements for Transmission Connected Facilities" document including:

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 execution of a back-up service agreement with the electric distribution company to serve the customer load supplied from the AB1-179 generation project interconnection point when the units are out-of-service. This assumes the intent of IMG Development, LLC is to net the generation with the load.

11. The rough grade of the property for the AB1-179 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

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.

Penelec 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

Network Impacts

The Queue Project AB1-179 was evaluated as a 19.9 MW (Capacity 19.9 MW) injection at the Sabinsville 34.5kV substation in the Penelec area. Project AB1-179 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AB1-179 was studied with a commercial probability of 53% using a 2019 Summer Peak case. Potential network impacts were as follows:

Contingency Descriptions

The following contingencies resulted in overloads:

Contingency Name	Description
APS_B_G698	CONTINGENCY 'APS_B_G698' / 200663 TWOMILE 115 235234 01POTTER 115 1 OPEN BRANCH FROM BUS 200663 TO BUS 235234 CKT 1 END
B_PN115-LX-#146_B	CONTINGENCY 'B_PN115-LX-#146_B' /* N36-GOLD-POTTER 115 KV PATH DISCONNECT BRANCH FROM BUS 916200 TO BUS 200670 CKT 1 /* Z1-069 TAP-26SABINSVI END
B_PN115-SX-#58A	CONTINGENCY 'B_PN115-SX-#58A' /* FUTURE MANSFIELD-MAINESBRG 115 KV DISCONNECT BRANCH FROM BUS 200672 TO BUS 200929 CKT 1F /* MANSFIEL 115.00 MAINESBRG115.00 END
C2_PN230-SB-8C1	CONTINGENCY 'C2_PN230-SB-8C1' /* FUTURE GLADE 230 KV STUCK CB - CB5 (WARREN #1/FOREST) DISCONNECT BRANCH FROM BUS 200581 TO BUS 200593 CKT 1 OPEN BRANCH FROM BUS 200593 TO BUS 200811 CKT 1 /* GLADE - WARREN #1 230KV END
C2_PN345-SB-8A1	CONTINGENCY 'C2_PN345-SB-8A1' /* FUTURE MAINESBURG 345KV SB OPEN BRANCH FROM BUS 200930 TO BUS 200929 CKT 2F /* MAINESBURG 345/115KV XFMR OPEN BRANCH FROM BUS 200930 TO BUS 130757 CKT 1 /* MAINESBURG - WATERCURE ROAD 345KV OPEN BUS 203426 /* MAINESBURG FSS END
C2_PN345-SB-8B1_A	CONTINGENCY 'C2_PN345-SB-8B1_A' /* FUTURE MAINESBURG 345KV SB OPEN BRANCH FROM BUS 200930 TO BUS 200929 CKT 2F /* MAINESBURG 345/115KV XFMR OPEN BRANCH FROM BUS 200930 TO BUS 920780 CKT 1F /* MAINESBURG - RENOVO 345KV OPEN BUS 203426 /* MAINESBURG FSS END

Contingency Name	Description
C5_PN230-TW-#2A	CONTINGENCY 'C5_PN230-TW-#2A' /* GLADE-FOREST & GLADE-LEWIS RUN 230 KV DISCONNECT BRANCH FROM BUS 200581 TO BUS 200593 CKT 1 DISCONNECT BRANCH FROM BUS 200593 TO BUS 200704 CKT 1 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)

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution	Ref
1	LFFB	C2_PN230-SB-8C1	PENELEC	26FARM VLY-26RIDGWAY 115 kV line	200668	200582	1	DC	141.17	142.47	ER	160	2.09	1
2	DCTL	C5_PN230-TW-#2A	PENELEC	26FARM VLY-26RIDGWAY 115 kV line	200668	200582	1	DC	106.42	107.73	ER	160	2.1	
3	N-1	B_PN115-SX-#58A	PENELEC	26SABINSVI-Z1-069 TAP 115 kV line	200670	916200	1	DC	109.17	120.5	ER	157	17.77	2
4	N-1	APS_B_G698	PENELEC	26MANSFIEL-26MAINESBURG 115 kV line	200672	200929	1F	DC	120.31	131.08	ER	179	19.27	3
5	Non	Non	PENELEC	26MANSFIEL-26MAINESBURG 115 kV line	200672	200929	1F	DC	122.6	130.68	NR	140	11.31	

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution	Ref
6	N-1	B_PN115-LX-#146_B	PENELEC	26MANSFIEL-26MAINESBURG 115 kV line	200672	200929	1F	DC	107.82	118.58	ER	179	19.27	
7	LFFB	C2_PN345-SB-8A1	PENELEC	26EVERT DR-26SOUTH TR 115 kV line	200885	200673	1F	DC	102.88	106.09	ER	242	7.79	4
8	LFFB	C2_PN345-SB-8B1_A	PENELEC	26EVERT DR-26SOUTH TR 115 kV line	200885	200673	1F	DC	102.88	106.09	ER	242	7.79	
9	N-1	B_PN115-SX-#58A	PENELEC	Z1-069 TAP-26GOLD 115 kV line	916200	200669	1	DC	118.93	130.26	ER	157	17.77	5

Note: Please see Attachment 3 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.

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.

New System Reinforcements

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

None.

Contribution to Previously Identified System Reinforcements

(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)

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
#1, #2	Farmers Valley – Ridgway 115kV Line	**Farmers Valley and Ridgway SSs.** Adjust Remote Relay Settings at Farmers Valley and Ridgway 115 kV substations & upgrade line equipment. **Farmers Valley - Ridgway 115kV Reconductor, 5.5 miles.** Reconductor 5.5 miles, from structure #234 to Farmers Valley Substation, with 336 kcmil ACSS, replacing the existing 336 kcmil ACSR.		**$ 5,537,100**
#3	Sabinsville	**Sabinsville SS** - Replace 115kV Niles Valley Line Disconnect Switch		**$ 82,200**
#4, #5, #6	Mansfield	**Mansfield SS.** Reconductor Mainesburg 115-kV Line drops & bus with 795 AAC.		**$ 123,900**
#7, #8, #9	Everts Drive – South Troy 115kV Line	**Everts Drive - South Troy 115kV line - Rebuild 3.16 miles.** Rebuild 3.16 miles of 636 ACSR with 1033 ACSS high temperature conductor.		**$ 5,871,800**
			Total New Network Upgrades	**$ 11,615,000**

Attachment 1. Project Location

Attachment 2. Single Line Diagram

Attachment 3. Flowgate Details

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.

Appendix 1

(PENELEC - PENELEC) The 26FARM VLY-26RIDGWAY 115 kV line (from bus 200668 to bus 200582 ckt 1) loads from 141.17% to 142.47% (DC power flow) of its emergency rating (160 MVA) for the line fault with failed breaker contingency outage of 'C2_PN230-SB-8C1'. This project contributes approximately 2.09 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
236828	01GRAYMONT	-0.27
200642	26SENECA#1	2.51
200643	26SENECA#2	2.34
200644	26SENECA#3	0.33
292391	T-121 C	3.96
292392	T-121 E	15.83
LTF	Z1-019	17.45
916201	Z1-069 C	1.45
916202	Z1-069 E	6.17

Bus Number	Bus Name	Full Contribution
916311	Z1-087	5.23
919971	AA2-081	1.51
920241	AA2-120 OP	13.06
930411	AB1-082 OP	3.28
LTF	AB1-100	11.29
931091	AB1-160 C	0.41
931092	AB1-160 E	1.76
931291	AB1-179	2.09

Appendix 2

(PENELEC - PENELEC) The 26SABINSVI-Z1-069 TAP 115 kV line (from bus 200670 to bus 916200 ckt 1) loads from 109.17% to 120.5% (DC power flow) of its emergency rating (157 MVA) for the single line contingency outage of 'B_PN115-SX-#58A'. This project contributes approximately 17.77 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
203261	26BLOSSBCT	0.87
916541	Z1-110	1.83
917072	Z2-011	1.83
918871	AA1-106	1.83

Bus Number	Bus Name	Full Contribution
919971	AA2-081	17.3
920241	AA2-120 OP	212.56
931291	AB1-179	17.77

Appendix 3

(PENELEC - PENELEC) The 26MANSFIEL-26MAINESBURG 115 kV line (from bus 200672 to bus 200929 ckt 1F) loads from 120.31% to 131.08% (DC power flow) of its emergency rating (179 MVA) for the single line contingency outage of 'APS_B_G698'. This project contributes approximately 19.27 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
203261	26BLOSSBCT	0.99
292391	T-121 C	23.24
916201	Z1-069 C	12.88
916541	Z1-110	1.97
917072	Z2-011	1.97
918871	AA1-106	1.97

Bus Number	Bus Name	Full Contribution
919971	AA2-081	19.27
920241	AA2-120 OP	242.03
930411	AB1-082 OP	19.27
931091	AB1-160 C	3.68
931291	AB1-179	19.27

Appendix 4

(PENELEC - PENELEC) The 26EVERT DR-26SOUTH TR 115 kV line (from bus 200885 to bus 200673 ckt 1F) loads from 102.88% to 106.09% (DC power flow) of its emergency rating (242 MVA) for the line fault with failed breaker contingency outage of 'C2_PN345-SB-8A1'. This project contributes approximately 7.79 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
200887	26ARMNA MT	1.15
203261	26BLOSSBCT	0.52
200888	P-047 E	54.27
292391	T-121 C	5.12
292392	T-121 E	20.49
297050	V2-019 E	0.34
916201	Z1-069 C	5.06

Bus Number	Bus Name	Full Contribution
916202	Z1-069 E	21.57
919971	AA2-081	9.52
920241	AA2-120 OP	137.06
930411	AB1-082 OP	4.25
931091	AB1-160 C	1.45
931092	AB1-160 E	6.16
931291	AB1-179	7.79

Appendix 5

(PENELEC - PENELEC) The Z1-069 TAP-26GOLD 115 kV line (from bus 916200 to bus 200669 ckt 1) loads from 118.93% to 130.26% (DC power flow) of its emergency rating (157 MVA) for the single line contingency outage of 'B_PN115-SX-#58A'. This project contributes approximately 17.77 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
203261	26BLOSSBCT	0.87
916201	Z1-069 C	11.92
916541	Z1-110	1.83
917072	Z2-011	1.83
918871	AA1-106	1.83

Bus Number	Bus Name	Full Contribution
919971	AA2-081	17.3
920241	AA2-120 OP	212.56
931091	AB1-160 C	3.41
931291	AB1-179	17.77