Generation Interconnection

Queue Project AE1-186

Fayetteville 34.5 KV

Feasibility Study Report

Capacity : 12.6 MW / Energy : 20 MW

February, 2019

General

Interconnection Customer has proposed a new solar generating facility located in Franklin County, Pennsylvania. The installed facilities will have a total capability of 20 MW Energy with 12.6 MW of this output being recognized by PJM as Capacity Interconnection Rights. The proposed in-service date for this project is April 1, 2021. **This study does not imply a West Penn Power Company (Transmission Owner or WPP) commitment to this in-service date.**

Point of Interconnection

The AE1-188 solar facility will interconnect with the WPP distribution system by direct injection into the Fayetteville substation.

Network Impacts

The Queue Project AE1-188 was evaluated as a 20 MW (Capacity 12.6 MW) injection at the Fayetteville 34.5 kV substation in the APS area (West Penn Power, FirstEnergy). Project AE1-188 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE1-186 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis – 2022

Generation 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
813343	200532	26ROXBURY	PENELEC	200520	26ROXBURY	PENELEC	2	AP-P7-1-WPP-138-57	tower	150.0	119.48	121.82	DC	3.52
812166	235189	01GUILFD	AP	235136	01ANTRIM	AP	1	AP-P2-3-WP-138-	breaker	306.0	101.95	104.32	DC	7.25

								272T						
813444	235189	01GUILFD	AP	235187	01GRANDP	AP	1	AP-P7-1-WPP-138-57	tower	228.0	108.89	111.34	DC	5.59

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
811835	200532	26ROXBURY	PENELEC	200520	26ROXBURY	PENELEC	2	ME_P4-500-002H	breaker	150.0	132.32	133.96	DC	2.46

Short Circuit

None. (No overdutied circuit breakers identified)

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
812761	200532	26ROXBURY	PENELEC	200520	26ROXBURY	PENELEC	2	Base Case	operation	124.0	120.53	122.45	DC	2.38
812762	200532	26ROXBURY	PENELEC	200520	26ROXBURY	PENELEC	2	AP-P2-2-PE-138-074	operation	150.0	116.75	119.09	DC	3.52
813022	235189	01GUILFD	AP	235187	01GRANDP	AP	1	AP-P2-2-PE-138-071	operation	228.0	105.09	107.53	DC	5.56

System Reinforcements

Short Circuit

None.

Stability and Reactive Power Requirement

Will be determined at a later study stages.

Summer Peak Load Flow Analysis Reinforcements

ID	Index	Facility	Upgrade Description	Cost
812166	2	01GUILFD 138.0 kV - 01ANTRIM 138.0 kV Ckt 1	**AP** Description : a) Replace limiting substation components at Guilford Substation b) Replace wavetrap at Grand Point c) Replace breaker failure relays at Guilford on Antrim terminal Time Estimate : 14.0 Months Cost : $450,100	$450,100
813444	3	01GUILFD 138.0 kV - 01GRANDP 138.0 kV Ckt 1		
811835,813343	1	26ROXBURY 138.0 kV - 26ROXBURY 115.0 kV Ckt 2	**PENELEC** Description : Supplemental upgrade s1643: Replace the existing Roxbury 100 MVA 138/115 kV transformer with a 224 MVA unit. Convert Roxbury 115 kV substation into a four (4) breaker ring bus. The supplemental project has an projected in-service date of 12/31/2019. Time Estimate : Months Cost : $0	$0
			TOTAL COST	**$450,100**

Appendix 3: Flow Gate ID #811835 Details

PJM Queue Position: AE1-188

The following appendix contains 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.

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
811835	200532	26ROXBURY	PENELEC	200520	26ROXBURY	PENELEC	2	ME_P4-500-002H	breaker	150.0	132.32	133.96	DC	2.46

Bus #	Bus	MW Impact
235723	01GUILF1	1.04
235724	01GUILF2	1.04
237329	01CHBRG_I12	0.97
905554	W4-102 E	0.64
918661	AA1-080 C	0.13
918662	AA1-080 E	0.07
918731	AA1-092 C	0.52
918732	AA1-092 E	0.26
918761	AA1-095 C	0.36
918762	AA1-095 E	0.18
918771	AA1-096 C	0.13
918772	AA1-096 E	0.07
923871	AB2-027 C	0.17
923872	AB2-027 E	0.29
924482	AB2-097 E	0.61
930781	AB1-123 C O1	0.38
930782	AB1-123 E O1	0.62
930821	AB1-127 C	1.02
930822	AB1-127 E	1.66
930831	AB1-128 C	1.02
930832	AB1-128 E	1.66
933251	AC2-136 C	0.32
933252	AC2-136 E	0.36
933973	AD1-020 BAT	1.13
934362	AD1-060 E	0.85
934371	AD1-061 C	0.85
934372	AD1-061 E	1.39
936061	AD2-009 C	5.79
936062	AD2-009 E	2.64
936471	AD2-062 C O1	20.79

Bus #	Bus	MW Impact
936472	AD2-062 E O1	10.42
936871	AD2-110	1.85
938751	AE1-101 C	13.54
938752	AE1-101 E	6.67
939031	AE1-132 C O1	6.14
939032	AE1-132 E O1	4.09
939081	AE1-136 C	4.44
939082	AE1-136 E	2.94
939111	AE1-140 C O1	2.34
939112	AE1-140 E O1	1.56
939591	AE1-188 C	1.55
939592	AE1-188 E	0.91
CARR	CARR	0.44
CBM-S1	CBM-S1	1.75
CBM-S2	CBM-S2	1.08
CBM-W1	CBM-W1	2.69
CBM-W2	CBM-W2	12.43
CIN	CIN	1.2
CPLE	CPLE	0.46
G-007	G-007	1.26
IPL	IPL	0.77
LGEE	LGEE	0.35
MEC	MEC	2.31
MECS	MECS	1.44
O-066	O-066	4.32
RENSSELAER	RENSSELAER	0.35
WEC	WEC	0.32

Appendix 4: Flow Gate ID #812166 Details

PJM Queue Position: AE1-188

The following appendix contains 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.

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
812166	235189	01GUILFD	AP	235136	01ANTRIM	AP	1	AP-P2-3-WP-138-272T	breaker	306.0	101.95	104.32	DC	7.25

Bus #	Bus	MW Impact
235723	01GUILF1	5.0
235724	01GUILF2	5.0
237577	01ROUTE 16	0.48
925851	AC1-064	0.04
930821	AB1-127 C	3.85
930822	AB1-127 E	6.29
930831	AB1-128 C	3.85
930832	AB1-128 E	6.29
934361	AD1-060 C	0.2
934362	AD1-060 E	2.09
934371	AD1-061 C	3.14
934372	AD1-061 E	5.13
936061	AD2-009 C	25.03
936062	AD2-009 E	11.4
936471	AD2-062 C O1	39.62
936472	AD2-062 E O1	19.84
936871	AD2-110	8.89
938751	AE1-101 C	61.6
938752	AE1-101 E	30.34
939031	AE1-132 C O1	26.54
939032	AE1-132 E O1	17.69
939081	AE1-136 C	20.47
939082	AE1-136 E	13.56
939591	AE1-188 C	4.57
939592	AE1-188 E	2.68
CARR	CARR	0.05
CBM-S1	CBM-S1	0.08
CBM-S2	CBM-S2	0.05
CBM-W1	CBM-W1	0.12
CBM-W2	CBM-W2	0.54

Bus #	Bus	MW Impact
CIN	CIN	0.05
CPLE	CPLE	0.02
G-007	G-007	0.16
IPL	IPL	0.03
LGEE	LGEE	0.02
MEC	MEC	0.1
MECS	MECS	0.06
O-066	O-066	0.52
RENSSELAER	RENSSELAER	0.04
WEC	WEC	0.01

Appendix 5: Flow Gate ID #813444 Details

PJM Queue Position: AE1-188

The following appendix contains 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.

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
813444	235189	01GUILFD	AP	235187	01GRANDP	AP	1	AP-P7-1-WPP-138-57	tower	228.0	108.89	111.34	DC	5.59

Bus #	Bus	MW Impact
235723	01GUILF1	4.14
235724	01GUILF2	4.14
237577	01ROUTE 16	0.43
918731	AA1-092 C	0.61
918732	AA1-092 E	0.31
925851	AC1-064	0.03
930821	AB1-127 C	3.11
930822	AB1-127 E	5.08
930831	AB1-128 C	3.11
930832	AB1-128 E	5.08
934361	AD1-060 C	0.18
934362	AD1-060 E	1.88
934371	AD1-061 C	2.66
934372	AD1-061 E	4.34
936061	AD2-009 C	21.0
936062	AD2-009 E	9.56
936871	AD2-110	7.37
938751	AE1-101 C	51.38
938752	AE1-101 E	25.31
939031	AE1-132 C O1	22.26
939032	AE1-132 E O1	14.84
939081	AE1-136 C	17.05
939082	AE1-136 E	11.3
939591	AE1-188 C	3.52
939592	AE1-188 E	2.07
CARR	CARR	0.15
CBM-S1	CBM-S1	0.56
CBM-S2	CBM-S2	0.35
CBM-W1	CBM-W1	0.85
CBM-W2	CBM-W2	3.98

Bus #	Bus	MW Impact
CIN	CIN	0.38
CPLE	CPLE	0.15
G-007	G-007	0.43
IPL	IPL	0.25
LGEE	LGEE	0.11
MEC	MEC	0.73
MECS	MECS	0.45
O-066	O-066	1.47
RENSSELAER	RENSSELAER	0.12
WEC	WEC	0.1

Appendix 6: Contingencies List

PJM Queue Position: AE1-188

Contingency Name	Contingency Definition
ME_P4-500-002H	CONTINGENCY 'ME_P4-500-002H' /* HUNTERSTOWN 500 KV STUCK CB - CBB11392 DISCONNECT BRANCH FROM BUS 200026 TO BUS 200004 CKT 1 /* HUNTERTN 500 CNASTONE 500 DISCONNECT BRANCH FROM BUS 200026 TO BUS 204501 CKT 1 /* HUNTERTN 500 27HUNTRSTN 230 END
AP-P7-1-WPP-138-57	CONTINGENCY 'AP-P7-1-WPP-138-57' /* 42 DISCONNECT BRANCH FROM BUS 235136 TO BUS 235189 CKT 1 /* 01ANTRIM 138 01GUILFD 138 DISCONNECT BRANCH FROM BUS 235136 TO BUS 235503 CKT 1 /* 01ANTRIM 138 01REID 138 END
AP-P2-2-PE-138-074	CONTINGENCY 'AP-P2-2-PE-138-074' /* 265 DISCONNECT BRANCH FROM BUS 235136 TO BUS 235503 CKT 1 /* 01ANTRIM 138 01REID 138 END
AP-P2-3-WP-138-272T	CONTINGENCY 'AP-P2-3-WP-138-272T' /* 281 DISCONNECT BRANCH FROM BUS 235180 TO BUS 235187 CKT 1 /* 01FAYETT 138 01GRANDP 138 DISCONNECT BRANCH FROM BUS 235187 TO BUS 235189 CKT 1 /* 01GRANDP 138 01GUILFD 138 DISCONNECT BRANCH FROM BUS 235187 TO BUS 235557 CKT 1 /* 01GRANDP 138 01LETTER 138 DISCONNECT BRANCH FROM BUS 235187 TO BUS 237009 CKT ZB /* 01GRANDP 138 01GRANDP CAP138 DISCONNECT BRANCH FROM BUS 235187 TO BUS 237331 CKT 1 /* 01GRANDP 138 01GRANDPOI 69 DISCONNECT BRANCH FROM BUS 235188 TO BUS 235557 CKT 1 /* 01GREENE 138 01LETTER 138 DISCONNECT BRANCH FROM BUS 200532 TO BUS 936470 CKT 1 /* 26ROXBURY 138 AD2-062 TAP 138 /* CONTINGENCY LINE ADDED FOR AE1 BUILD END
AP-P2-2-PE-138-071	CONTINGENCY 'AP-P2-2-PE-138-071' /* 40 DISCONNECT BRANCH FROM BUS 235503 TO BUS 235561 CKT 1 /* 01REID 138 01NIPETN 138 DISCONNECT BRANCH FROM BUS 235443 TO BUS 235503 CKT 1 /* 01ANTITM 138 01REID 138 DISCONNECT BRANCH FROM BUS 235136 TO BUS 235503 CKT 1 /* 01ANTRIM 138 01REID 138 END
Base Case	