Generation Interconnection

Feasibility Study Report

for

Queue Project AE1-132

MCCONNELLSBURG 138 KV

51 MW Capacity / 85 MW Energy

May 2019

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Introduction

This Feasibility Study has been prepared in accordance with the PJM Open Access Transmission Tariff, 36.2, as well as the Feasibility Study Agreement between the Interconnection Customer (IC), and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is Allegheny Power Systems (APS).

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. Cost allocation rules for network upgrades can be found in PJM Manual 14A, Attachment B. 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 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.

PJM utilizes manufacturer models to ensure the performance of turbines is properly captured during the simulations performed for stability verification and, where applicable, for compliance with low voltage ride through requirements. Turbine manufacturers provide such models to their customers. The list of manufacturer models PJM has already validated is contained in Attachment B of Manual 14G. Manufacturer models may be updated from time to time, for various reasons such as to reflect changes to the control systems or to more accurately represent the capabilities turbines and controls which are currently available in the field. Additionally, as new turbine models are developed, turbine manufacturers provide such new models which must be used in the conduct of these studies. PJM needs adequate time to evaluate the new models in order to reduce delays to the System Impact Study process timeline for the Interconnection Customer as well as other Interconnection Customers in the study group. Therefore, PJM will require that any Interconnection Customer with a new manufacturer model must supply that model to PJM, along with a $10,000 fully refundable deposit, no later than three (3) months prior to the starting date of the System Impact Study (See Section 4.3 for starting dates) for the Interconnection Request which shall specify the use of the new model. The Interconnection Customer will be required to submit a completed dynamic model study request form (Attachment B-1 of Manual 14G) in order to document the request for the study.

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 Solar generating facility located in Fulton County, McConnellsburg, Pennsylvania. The installed facilities will have a total capability of **85 MW** with **51 MW** of this output being recognized by PJM as Capacity. The proposed in-service date for this project is **December 31, 2021.** This study does not imply a TO commitment to this in-service date.

Queue Number	**AE1-132**
Project Name	MCCONNELLSBURG 138 KV
Interconnection Customer	
State	None
County	Fulton
Transmission Owner	APS
MFO	85
MWE	85
MWC	51
Fuel	Solar
Basecase Study Year	2022

Point of Interconnection

Primary POI: AE1-132 will interconnect with the APS transmission system at the McConnellsburg 138 kV substation. See Attachment 1 for project location and Attachment 2 for the one line diagram.

Secondary POI: The IC requested that a secondary POI be reviewed for network impacts (Option 2). The secondary POI chosen was a connection to the McConnellsburg- Warfordburg 138 kV line via a new 138 kV three breaker ring bus substation.

This report does not provide costs for the physical interconnection of Option 2. It was just analyzed for network impacts to the system. Results are shown in the "Network Impacts – Option 2" section of this report.

Cost Summary

The AE1-132 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$0
Direct Connection Network Upgrade	$0
Non Direct Connection Network Upgrades	$2,157,100
Total Costs	$2,157,100

In addition, the AE1-132 project may be responsible for a contribution to the following costs

Description	Total Cost
System Upgrades	$0

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

The 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, APS shall be reimbursed by the Interconnection Customer for such taxes. APS estimates the tax, if applicable, would be approximately $384,300.

The required Attachment Facilities, Direct Connection and Non-Direct Connection work for the interconnection of the AE1-132 generation project to the APS System is detailed in the following sections. The associated one-line with the generation project is shown in Attachment 2.

Note that the FE findings were made from a conceptual review of this project. A more detailed review of the connection facilities and their cost will be identified in a future study phase. Further note that the cost estimate data contained in this document should be considered high level estimates since it was produced without a detailed engineering review. The applicant will be responsible for the actual cost of construction.

FE herein reserves the right to return to any issues in this document and, upon appropriate justification, request additional monies to complete any reinforcements to the transmission systems.

Transmission Owner Scope of Work

Attachment Facilities

There is no Attachment Facility scope of work required for this project.

Direct Connection Cost Estimate

There is no Direct Connection scope of work required for this project.

Non-Direct Connection Cost Estimate

The interconnection will be accomplished by constructing a new 138 kV terminal at the McConnellsburg Substation 138 kV bus. The project will also require protection system upgrades at Cherry Run and Guildford Substations.

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
McConnellsburg Substation: Install 138 kV circuit breaker and standard line relaying	$1,403,300
Guildford Substation: Install carrier equipment and line relaying	$ 376,900
Cherry Run Substation: Install carrier equipment and line relaying	$ 376,900
Total Non-Direct Connection Facility Costs	**$2,157,100**

Incremental Capacity Transfer Rights (ICTRs)

Will be determined at a later study phase.

Schedule

Based on the extent of the FE interconnection work required to support this project, it is expected to take a minimum of **twenty-four (24) months** from the date of a fully executed Interconnection Construction Service Agreement to complete the installation required for the AE1-132 Project. This includes the requirement for IC to make a preliminary payment to FE which funds the cost of the non-direct connection work identified. It further assumes that IC will provide all rights-of-way, permits, easements, etc. that will be needed. A further assumption is 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 connection work, and that all system outages will be allowed when requested.

Note that the FE findings were made from a conceptual review of this project. A more detailed review of the connection facilities and their cost will be identified in the System Impact Study. Further note that the cost estimate data contained in this document should be considered as only rough order of magnitude since it was produced without a detailed engineering review. The applicant will be responsible for the actual cost of construction. FE herein reserves the right to return to any issues in this document and, upon appropriate justification, request additional monies to complete any reinforcements to the transmission, subtransmission, or distribution systems.

Transmission Owner Analysis

Power Flow Analysis

PJM performed a power flow analysis of the transmission system using a 2022 summer peak load flow model and the results were verified by FE. Additionally, FE performed an analysis of its underlying transmission <100 kV system. At the Primary POI, the AE1-132 project contributes to overloads on the FE transmission system as shown in the "Network Impacts – Option 1" section of this report. The estimated cost of system reinforcements necessary to mitigate these overloads are also provided.

Short Circuit Analysis

PJM performed a short circuit analysis and the results were verified by FE. The connection of AE1-132 project to the system does not result in any newly overdutied circuit breakers on the FE transmission system and does not have a significant fault current contribution to existing overdutied circuit breakers.

Stability Analysis

PJM will be responsible for completing a dynamic stability analysis, if necessary, as part of the System Impact Study. The results of this analysis will be reviewed by FE. Should stability concerns be identified in PJM's study, FE will develop appropriate system reinforcement(s) and included the estimated cost of any reinforcement(s) in FE's System Impact Study report.

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.

Interconnection Customer Requirements

Compliance Issues and Interconnection Customer Requirements

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. In particular, the IC is responsible for the following:

1. The purchase and installation of a fully rated [PRI POI VOLTAGE] kV circuit breaker to protect the AE1-132 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.

2. 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.

3. 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.

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

5. The execution of a back-up service agreement to serve the customer load supplied from the AE1-132 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.

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.

Power Factor Requirements

The IC shall design its Solar/Battery Storage Customer Facility with the ability to maintain a power factor of at least 0.95 leading (absorbing VARs) to 0.95 lagging (supplying VARs) measured at the high-side of the facility substation transformer(s) connected to the FE transmission system.

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 Section 8 of Attachment O.

APS Requirements

The IC will be required 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.

Network Impacts – Option 1

The Queue Project AE1-132 was evaluated as a 85 MW (Capacity 51 MW) injection at the McConnellsburg 138 kV substation in the APS area. Project AE1-132 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE1-132 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Load Flow

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
696343	200532	26ROXBURY	PENELEC	200520	26ROXBURY	PENELEC	2	AP-P7-1-WPP-138-57	tower	150.0	97.48	108.15	DC	16.01
695166	235189	01GUILFD	AP	235136	01ANTRIM	AP	1	AP-P2-3-WP-138-272T	breaker	306.0	76.37	90.83	DC	44.23
696444	235189	01GUILFD	AP	235187	01GRANDP	AP	1	AP-P7-1-WPP-138-57	tower	228.0	80.18	96.46	DC	37.1

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
694835	200532	26ROXBURY	PENELEC	200520	26ROXBURY	PENELEC	2	ME_P4-500-002H	breaker	150.0	117.97	124.79	DC	10.23

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
695761	200532	26ROXBURY	PENELEC	200520	26ROXBURY	PENELEC	2	Base Case	operation	124.0	103.64	111.66	DC	9.94
695762	200532	26ROXBURY	PENELEC	200520	26ROXBURY	PENELEC	2	AP-P2-2-PE-138-074	operation	150.0	94.75	105.42	DC	16.01
696022	235189	01GUILFD	AP	235187	01GRANDP	AP	1	AP-P2-2-PE-138-071	operation	228.0	76.41	92.67	DC	37.06

System Reinforcements

ID	Index	Facility	Upgrade Description	Cost
695166	2	**01GUILFD 138.0 kV - 01ANTRIM 138.0 kV Ckt 1**	Description : No Violation. Facility loading does not exceed 100%.	$0
696444	3	**01GUILFD 138.0 kV - 01GRANDP 138.0 kV Ckt 1**	Description : No Violation. Facility loading does not exceed 100%.	$0
694835,696343	1	**26ROXBURY 138.0 kV - 26ROXBURY 138.0 kV Ckt 2**	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 a projected in-service date of 12/31/2019.	$0
		TOTAL COST		$0

Flow Gate 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.

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
694835	200532	26ROXBURY	PENELEC	200520	26ROXBURY	PENELEC	2	ME_P4-500-002H	breaker	150.0	117.97	124.79	DC	10.23

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
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

Bus #	Bus	MW Impact
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

Index 2

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
695166	235189	01GUILFD	AP	235136	01ANTRIM	AP	1	AP-P2-3-WP-138-272T	breaker	306.0	76.37	90.83	DC	44.23

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
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

Index 3

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
696444	235189	01GUILFD	AP	235187	01GRANDP	AP	1	AP-P7-1-WPP-138-57	tower	228.0	80.18	96.46	DC	37.1

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
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

Contingency Definitions

Contingency Name	Contingency Defintion
ME_P4-500-002H	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
AP-P7-1-WPP-138-57	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
AP-P2-3-WP-138-272T	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

Short Circuit

Short Circuit

The following Breakers are overduty:

None.

Network Impacts – Option 2

The Queue Project AE1-132 was evaluated as a 85 MW (Capacity 51 MW) injection tapping the McConnellsburg to Warfordburg 138kV line in the APS area. Project AE1-132 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE1-132 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Load Flow

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
685700	200532	26ROXBURY	PENELEC	200520	26ROXBURY	PENELEC	2	AP-P7-1-WPP-138-57	tower	150.0	96.7	106.98	DC	15.42
684612	235189	01GUILFD	AP	235136	01ANTRIM	AP	1	AP-P2-3-WP-138-272T	breaker	306.0	76.37	90.77	DC	44.07
685776	235189	01GUILFD	AP	235187	01GRANDP	AP	1	AP-P7-1-WPP-138-57	tower	228.0	80.36	96.82	DC	37.53

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
684294	200532	26ROXBURY	PENELEC	200520	26ROXBURY	PENELEC	2	ME_P4-500-002H	breaker	150.0	118.18	124.87	DC	10.03

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
685156	200532	26ROXBURY	PENELEC	200520	26ROXBURY	PENELEC	2	Base Case	operation	124.0	103.49	111.34	DC	9.73
685157	200532	26ROXBURY	PENELEC	200520	26ROXBURY	PENELEC	2	AP-P2-2-PE-138-074	operation	150.0	94.04	104.32	DC	15.42
685355	235189	01GUILFD	AP	235187	01GRANDP	AP	1	AP-P2-2-PE-138-071	operation	228.0	76.61	93.05	DC	37.49

Flow Gate 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.

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
684294	200532	26ROXBURY	PENELEC	200520	26ROXBURY	PENELEC	2	ME_P4-500-002H	breaker	150.0	118.18	124.87	DC	10.03

Bus #	Bus	MW Impact
235723	01GUILF1	1.02
235724	01GUILF2	1.02
237329	01CHBRG_I12	0.94
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	1.01
930822	AB1-127 E	1.64
930831	AB1-128 C	1.01
930832	AB1-128 E	1.64
933251	AC2-136 C	0.32
933252	AC2-136 E	0.37
933973	AD1-020 BAT	1.14
934362	AD1-060 E	0.84
934371	AD1-061 C	0.84
934372	AD1-061 E	1.37
936061	AD2-009 C	5.69
936062	AD2-009 E	2.59
936471	AD2-062 C O1	20.59
936472	AD2-062 E O1	10.31
936871	AD2-110	1.82
938751	AE1-101 C	13.3
938752	AE1-101 E	6.55
939031	AE1-132 C O2	6.02
939032	AE1-132 E O2	4.01
939081	AE1-136 C	4.36
939082	AE1-136 E	2.89
939111	AE1-140 C O2	2.44
939112	AE1-140 E O2	1.63

Bus #	Bus	MW Impact
939591	AE1-188 C	1.55
939592	AE1-188 E	0.91
CARR	CARR	0.45
CBM-S1	CBM-S1	1.76
CBM-S2	CBM-S2	1.08
CBM-W1	CBM-W1	2.7
CBM-W2	CBM-W2	12.47
CIN	CIN	1.21
CPLE	CPLE	0.47
G-007	G-007	1.27
IPL	IPL	0.77
LGEE	LGEE	0.35
MEC	MEC	2.31
MECS	MECS	1.44
O-066	O-066	4.34
RENSSELAER	RENSSELAER	0.35
WEC	WEC	0.32

Index 2

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
684612	235189	01GUILFD	AP	235136	01ANTRIM	AP	1	AP-P2-3-WP-138-272T	breaker	306.0	76.37	90.77	DC	44.07

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 O2	26.44
939032	AE1-132 E O2	17.63
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
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

Index 3

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
685776	235189	01GUILFD	AP	235187	01GRANDP	AP	1	AP-P7-1-WPP-138-57	tower	228.0	80.36	96.82	DC	37.53

Bus #	Bus	MW Impact
235723	01GUILF1	4.21
235724	01GUILF2	4.21
237577	01ROUTE 16	0.44
918731	AA1-092 C	0.62
918732	AA1-092 E	0.31
925851	AC1-064	0.03
930821	AB1-127 C	3.16
930822	AB1-127 E	5.15
930831	AB1-128 C	3.16
930832	AB1-128 E	5.15
934361	AD1-060 C	0.18
934362	AD1-060 E	1.91
934371	AD1-061 C	2.7
934372	AD1-061 E	4.4
936061	AD2-009 C	21.31
936062	AD2-009 E	9.7
936871	AD2-110	7.48
938751	AE1-101 C	52.17
938752	AE1-101 E	25.69
939031	AE1-132 C O2	22.52
939032	AE1-132 E O2	15.01
939081	AE1-136 C	17.31
939082	AE1-136 E	11.47
939591	AE1-188 C	3.56
939592	AE1-188 E	2.09
CARR	CARR	0.15
CBM-S1	CBM-S1	0.55
CBM-S2	CBM-S2	0.34
CBM-W1	CBM-W1	0.83
CBM-W2	CBM-W2	3.87
CIN	CIN	0.37
CPLE	CPLE	0.14
G-007	G-007	0.43
IPL	IPL	0.24
LGEE	LGEE	0.11
MEC	MEC	0.72
MECS	MECS	0.44
O-066	O-066	1.45
RENSSELAER	RENSSELAER	0.12
WEC	WEC	0.1

Contingency Definition

Contingency Name	Contingency Defintion
ME_P4-500-002H	CONTINGENCY 'AEP_P1-2_#768' OPEN BRANCH FROM BUS 241901 TO BUS 242936 CKT 1 / 241901 02LALLEND
AP-P7-1-WPP-138-57	CONTINGENCY 'AEP_P1-2_#768' OPEN BRANCH FROM BUS 241901 TO BUS 242936 CKT 1 / 241901 02LALLEND
AP-P2-3-WP-138-272T	CONTINGENCY 'AEP_P1-2_#768' OPEN BRANCH FROM BUS 241901 TO BUS 242936 CKT 1 / 241901 02LALLEND

Short Circuit

Short Circuit

The following Breakers are overduty:

None.

Attachment 1

AE1-132: McConnellsburg 138 kV
Project Location

Attachment 2

AE1-132: McConnellsburg 138 kV
One Line Diagram