Generation Interconnection

Feasibility Study Report

for

Queue Project AG1-327

WEST WAYNESBORO-EAST WAYNESBORO 138 KV

23.7 MW Capacity / 35 MW Energy

January 2021

Table of Contents

1 Introduction 4
2 Preface 4
3 General 5
4 Point of Interconnection 6
5 Cost Summary 6
6 Transmission Owner Scope of Work 7
7 Schedule 8
8 Transmission Owner Analysis 8
9 Interconnection Customer Requirements 8
10 Revenue Metering and SCADA Requirements 8
10.1 PJM Requirements 9
10.2 Meteorological Data Reporting Requirements 10
10.3 Interconnected Transmission Owner Requirements 10
11 Summer Peak - Load Flow Analysis - Primary POI 11
11.1 Generation Deliverability 12
11.2 Multiple Facility Contingency 12
11.3 Contribution to Previously Identified Overloads 12
11.4 Potential Congestion due to Local Energy Deliverability 12
11.5 System Reinforcements - Summer Peak Load Flow - Primary POI 14
11.6 Flow Gate Details - Primary POI 15
11.6.1 Index 1 16
11.6.2 Index 2 18
11.6.3 Index 3 20
11.7 Queue Dependencies 22
11.8 Contingency Descriptions - Primary POI 23
12 Short Circuit Analysis - Primary POI 25
12.1 System Reinforcements - Short Circuit ..... **Error! Bookmark not defined.**
13 Summer Peak - Load Flow Analysis - Secondary POI 26
13.1 Generation Deliverability 27
13.2 Multiple Facility Contingency 27
13.3 Contribution to Previously Identified Overloads 27

13.4 Potential Congestion due to Local Energy Deliverability 27
13.5 Flow Gate Details - Secondary POI 28
13.6 Contingency Descriptions - Secondary POI 29
14 Affected Systems 30
14.1 NYISO 30
15 Attachment 1: One Line Diagram 31

1 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 APS.

2 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.

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.

3 General

The Interconnection Customer (IC), has proposed a Solar generating facility located in Franklin County, Pennsylvania. The installed facilities will have a total capability of 35 MW with 23.7 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is December 31, 2023. This study does not imply a TO commitment to this in-service date.

Queue Number	AG1-327
Project Name	WEST WAYNESBORO-EAST WAYNESBORO 138 KV
State	Pennsylvania
County	Franklin
Transmission Owner	APS
MFO	35
MWE	35
MWC	23.7
Fuel	Solar
Basecase Study Year	2024

Any new service customers who can feasibly be commercially operable prior to June 1st of the basecase study year are required to request interim deliverability analysis.

4 Point of Interconnection

AG1-327 will interconnect with the FirstEnergy, West Penn Power system. The interconnection of the project will be accomplished by constructing a new 138 kV three (3) breaker ring bus substation and looping the West Waynesboro – East Waynesboro 138 kV line into the new station. The new substation will be located approximately 2.4 miles from West Waynesboro Substation and 2.8 miles from East Waynesboro substation. The IC will be responsible for acquiring all easements, properties, and permits that may be required to construct both the new interconnection switching station and the associated facilities. The IC will also be responsible for the rough grade of the property and an access road to the proposed three-breaker ring bus site. The project will also require Non-Direct Connection upgrades at West Waynesboro Substation and Ringgold Substation.

Attachment 1 shows a one-line diagram of the proposed Direct Connection facilities for the AG1-327 generation project to connect to the FirstEnergy ("FE") Transmission System.

5 Cost Summary

The AG1-327 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	$13,692,000
Total System Network Upgrade Costs	$74,238,680[1]
Total Costs	$87,930,680

The costs provided above exclude the Contribution in Aid of Construction ("CIAC") Federal Income Tax Gross Up charge. If, at a future date, it is determined that the CIAC Federal Income Tax Gross charge is required, the Transmission Owner shall be reimbursed by the Interconnection Customer for such taxes.

This cost excludes a Federal Income Tax Gross Up charges. This tax may or may not be charged based on whether this project meets the eligibility requirements of IRS Notice 88-129. If at a future date it is determined that the Federal Income Tax Gross charge is required, the Transmission Owner shall be reimbursed by the Interconnection Customer for such taxes.

Cost allocations for any System Upgrades will be provided in the System Impact Study Report.

[1] This project currently causes and/or contributes to overloads of the Transmission System (see Summer Peak Load Flow Analysis section below) and therefore has potential to have cost allocation for the system reinforcements listed in the report. This will be re-evaluated in the System Impact phase. The results may vary with queue customers withdrawing from the queue and other generators deactivating over time. If a customer is the first to cause the need for a project (causes loading to exceed 100% of rating), then the customer is responsible. If a customer contributes to a facility that is already overloaded by a prior queue, then they may receive cost allocation.

6 Transmission Owner Scope of Work

The interconnection of the project will be accomplished by constructing a new 138 kV three (3) breaker ring bus substation and looping the West Waynesboro – East Waynesboro 138 kV line into the new station. The new substation will be located approximately 2.4 miles from West Waynesboro Substation and 2.8 miles from East Waynesboro substation. The IC will be responsible for acquiring all easements, properties, and permits that may be required to construct both the new interconnection switching station and the associated facilities. The IC will also be responsible for the rough grade of the property and an access road to the proposed three-breaker ring bus site. The project will also require Non-Direct Connection upgrades at West Waynesboro Substation and Ringgold Substation.

The total physical interconnection costs is given in the table below:

Description	Total Cost
Install disconnect switch, dead-end structure, and associated facilities for generator lead line exit at interconnection substation.	$330,000
Construct 138 kV three breaker ring bus interconnection substation with SCADA control.	$6,190,000
Loop the Ringgold - West Waynesboro 138 kV line between West Waynesboro and East Waynesboro into the new substation.	$850,000
Install 2.4 miles of OPGW to West Waynesboro substation.	$2,189,000
Install 2.8 miles of OPGW to East Waynesboro substation.	$2,553,000
Upgrade relaying at West Waynesboro Substation.	$790,000
Upgrade relaying at Ringgold Substation.	$790,000
Total Physical Interconnection Costs	$13,692,000

7 Schedule

Based on the scope of work for the interconnection facilities, it is expected to take a minimum of **24 months** after the signing of an Interconnection Construction Service Agreement and construction kickoff call to complete the installation. This assumes 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 work and that all system outages will be allowed when requested.

The schedule for the required Network Impact Reinforcements will be more clearly identified in future study phases. The estimated time to complete each of the required reinforcements is identified in the "System Reinforcements" section of the report.

If the customer is ultimately responsible for network upgrades, then the schedule for those upgrades will be refined in future study phases. The customer would need to wait for those upgrades to be completed prior to commercial operation unless determined deliverable by an interim deliverability study. The elapsed time to complete any network upgrades is provided in the System Reinforcements table of this report[1].

8 Transmission Owner Analysis

FE performed an analysis of its underlying transmission <100 kV system. The AG1-327 project did not contribute to any overloads on the FE Transmission <100 kV System.

9 Interconnection Customer Requirements

9.1 System Protection

The IC must design its 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.

9.2 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 138 kV circuit breaker to protect the AG1-327 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 AG1-327 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 Transmission System.

9.3 Power Factor Requirements

The IC shall design its non-synchronous 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.

10 Revenue Metering and SCADA Requirements

10.1 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.

10.2 Meteorological Data Reporting Requirements

The solar generation facility shall provide the Transmission Provider with site-specific meteorological data including:

- Back Panel temperature (Fahrenheit) - (Required for plants with Maximum Facility Output of 3 MW or higher)
- Irradiance (Watts/meter^2) - (Required for plants with Maximum Facility Output of 3 MW or higher)
- Ambient air temperature (Fahrenheit) - (Accepted, not required)
- Wind speed (meters/second) - (Accepted, not required)
- Wind direction (decimal degrees from true north) - (Accepted, not required)

10.3 Interconnected Transmission Owner Requirements

The IC will be required to comply with all Interconnected Transmission Owner's revenue metering requirements for generation interconnection customers located at the following link:

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

11 Summer Peak - Load Flow Analysis - Primary POI

The Queue Project AG1-327 was evaluated as a 35.0 MW (Capacity 23.1 MW) injection tapping the West Waynesboro to East Waynesboro 138 kV line in the APS area. Project AG1-327 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AG1-327 was studied with a commercial probability of 53.0 %. Potential network impacts were as follows:

11.1 Generation Deliverability

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

None

11.2 Multiple Facility Contingency

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

None

11.3 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	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
165027986	200504	26CARLISLE	115.0	PENELEC	204528	27GARDNERS	115.0	METED	1	PL:10:P24:100548	bus	160.0	100.56	101.16	DC	2.12
165784455	200520	26ROXBURY	115.0	PENELEC	961480	AF2-439 TAP	115.0	PENELEC	1	PL:10:P24:100548	bus	159.0	109.94	110.53	DC	2.07
165988706	200520	26ROXBURY	115.0	PENELEC	961480	AF2-439 TAP	115.0	PENELEC	1	ME-P2-3-ME-230-005A	breaker	159.0	111.67	112.22	DC	1.93
165988707	200520	26ROXBURY	115.0	PENELEC	961480	AF2-439 TAP	115.0	PENELEC	1	PL:10:P45:102437	breaker	159.0	109.94	110.53	DC	2.07
165988708	200520	26ROXBURY	115.0	PENELEC	961480	AF2-439 TAP	115.0	PENELEC	1	ME-P2-3-ME-230-005C	breaker	159.0	108.88	109.44	DC	1.99
165784439	961480	AF2-439 TAP	115.0	PENELEC	200504	26CARLISLE	115.0	PENELEC	1	PL:10:P24:100548	bus	159.0	119.33	119.92	DC	2.07
165988680	961480	AF2-439 TAP	115.0	PENELEC	200504	26CARLISLE	115.0	PENELEC	1	ME-P2-3-ME-230-005A	breaker	159.0	120.44	120.98	DC	1.93
165988681	961480	AF2-439 TAP	115.0	PENELEC	200504	26CARLISLE	115.0	PENELEC	1	PL:10:P45:102437	breaker	159.0	119.33	119.92	DC	2.07
165988682	961480	AF2-439 TAP	115.0	PENELEC	200504	26CARLISLE	115.0	PENELEC	1	ME-P2-3-ME-230-005C	breaker	159.0	117.83	118.39	DC	1.99

11.4 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	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
167677691	200504	26CARLISLE	115.0	PENELEC	204528	27GARDNERS	115.0	METED	1	Base Case	operation	133.0	99.94	100.64	DC	2.05
166223443	200520	26ROXBURY	115.0	PENELEC	961480	AF2-439 TAP	115.0	PENELEC	1	Base Case	operation	133.0	110.97	111.65	DC	2.0
166223444	200520	26ROXBURY	115.0	PENELEC	961480	AF2-439 TAP	115.0	PENELEC	1	ME-P1-3-ME-500-003T	operation	159.0	108.29	108.86	DC	2.0
166223445	200520	26ROXBURY	115.0	PENELEC	961480	AF2-439 TAP	115.0	PENELEC	1	ME-P1-2-ME-230-019	operation	159.0	108.29	108.86	DC	2.0
167938104	235189	01GUILFD	138.0	AP	235136	01ANTRIM	138.0	AP	1	AP-P1-2-WP-138-112-B	operation	306.0	105.54	107.22	DC	5.15
166223384	961480	AF2-439 TAP	115.0	PENELEC	200504	26CARLISLE	115.0	PENELEC	1	Base Case	operation	133.0	121.87	122.55	DC	2.0
166223385	961480	AF2-439 TAP	115.0	PENELEC	200504	26CARLISLE	115.0	PENELEC	1	ME-P1-2-ME-230-019	operation	159.0	117.28	117.84	DC	2.0
166223386	961480	AF2-439 TAP	115.0	PENELEC	200504	26CARLISLE	115.0	PENELEC	1	ME-P1-3-ME-500-003T	operation	159.0	117.28	117.84	DC	2.0

11.5 System Reinforcements - Summer Peak Load Flow - Primary POI

ID	Idx	Facility	Upgrade Description	Cost
165027986	1	26CARLISLE 115.0 kV - 27GARDNERS 115.0 kV Ckt 1	**METED** ME-AG1-F-0005A (2155) : Reconductor line with larger conductor (13.1 miles). Project Type : FAC Cost : $31,738,680 Time Estimate : 50.0 Months **PENELEC** PN-AG1-F-0035C (2301) : Reconductor 7.54 miles of line. Project Type : FAC Cost : $18,480,000 Time Estimate : 44.0 Months	$50,218,680
165784455,165988708,165988707,165988706	2	26ROXBURY 115.0 kV - AF2-439 TAP 115.0 kV Ckt 1	**PENELEC** PN-AG1-F-0026A (2261) : Reconductor 2.59 miles of line. Project Type : FAC Cost : $6,380,000 Time Estimate : 30.0 Months	$6,380,000
165988682,165988680,165988681,165784439	3	AF2-439 TAP 115.0 kV - 26CARLISLE 115.0 kV Ckt 1	**PENELEC** PN-AG1-F-0020A (2246) : Upgrade relaying at Carlisle Pike Project Type : FAC Cost : $800,000 Time Estimate : 12.0 Months PN-AG1-F-0020B (2247) : Reconductor 6.82 miles of line. Please line drops at Carlisle Pike substation. Project Type : FAC Cost : $16,840,000 Time Estimate : 42.0 Months	$17,640,000
			TOTAL COST	**$74,238,680**[1]

11.6 Flow Gate Details - Primary POI

The following indices contain additional information about each facility presented in the body of the report. For each index, a description of the flowgate and its contingency was included for convenience. The intent of the indices is to provide more details on which projects/generators have contributions to the flowgate in question. All New Service Queue Requests, through the end of the Queue under study, that are contributors to a flowgate will be listed in the indices. Please note that there may be contributors that are subsequently queued after the queue under study that are not listed in the indices. Although this information is not used "as is" for cost allocation purposes, it can be used to gage the impact of other projects/generators. It should be noted the project/generator MW contributions presented in the body of the report are Full MW Impact contributions which are also noted in the indices column named "Full MW Impact", whereas the loading percentages reported in the body of the report, take into consideration the PJM Generator Deliverability Test rules such as commercial probability of each project as well as the ramping impact of "Adder" contributions. The MW Impact found and used in the analysis is shown in the indices column named "Gendeliv MW Impact".

11.6.1 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
165027986	200504	26CARLISLE	PENELEC	204528	27GARDNERS	METED	1	PL:10:P24:100548	bus	160.0	100.56	101.16	DC	2.12

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
200870	26C_T85_W218	0.3757	50/50	0.3757
203905	26W1-045 C	0.2399	50/50	0.2399
237329	01CHBRG_I12	0.5202	50/50	0.5202
901242	W1-045 E OP1	1.3251	50/50	1.3251
930822	AB1-127 E	0.3881	Adder	0.46
930832	AB1-128 E	0.3881	Adder	0.46
933977	**AD1-020 EBAT (Suspended)**	**1.3794**	**Merchant Transmission**	**1.3794**
934371	AD1-061 C	0.3669	Adder	0.43
934372	AD1-061 E	0.3186	Adder	0.37
936061	AD2-009 C	2.4854	Adder	2.92
936062	AD2-009 E	1.1316	Adder	1.33
936471	AD2-062 C O1	10.9654	50/50	10.9654
936472	AD2-062 E O1	5.4929	50/50	5.4929
938384	AE1-071-C	14.1867	50/50	14.1867
938385	AE1-071-E	8.6811	50/50	8.6811
938753	AE1-101 C1	1.9142	Adder	2.25
938754	AE1-101 C2	0.9571	Adder	1.13
938756	AE1-101 E1	3.9517	Adder	4.65
938757	AE1-101 E2	1.9729	Adder	2.32
939033	AE1-132 C	2.6352	Adder	3.1
939034	AE1-132 E	1.7568	Adder	2.07
939591	AE1-188 C	0.6808	Adder	0.8
939592	AE1-188 E	0.3999	Adder	0.47
940671	**AE2-054 C (Suspended)**	**0.5756**	**Adder**	**0.68**
940672	**AE2-054 E (Suspended)**	**0.3837**	**Adder**	**0.45**
945011	AF1-166 C	0.5644	Adder	0.66
945012	AF1-166 E	0.3763	Adder	0.44
945441	AF1-209 C O1	0.5609	Adder	0.66
945442	AF1-209 E O1	0.3739	Adder	0.44
945591	AF1-224 C	0.4269	Adder	0.5
945592	AF1-224 E	0.2161	Adder	0.25
958071	AF2-101 C	-0.2674	Adder	-0.31
958221	AF2-116 C	0.6872	Adder	0.81
958222	AF2-116 E	0.3462	Adder	0.41
958231	AF2-117 C	2.1961	Adder	2.58
958232	AF2-117 E	1.0978	Adder	1.29
958551	AF2-146 C	1.8602	50/50	1.8602
958552	AF2-146 E	1.2402	50/50	1.2402
958571	AF2-148 C	1.5119	50/50	1.5119
958572	AF2-148 E	1.0080	50/50	1.0080
958601	AF2-151 C	-0.2638	Adder	-0.31

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
958871	AF2-178	1.1561	50/50	1.1561
958881	AF2-179	0.3411	Adder	0.4
958891	AF2-180	0.3411	Adder	0.4
958931	AF2-184	0.2800	Adder	0.33
959223	AF2-213 BAT	4.6893	Merchant Transmission	4.6893
959241	AF2-215 C	0.1578	Adder	0.19
959242	AF2-215 E	0.1052	Adder	0.12
959381	AF2-229 C	3.2312	50/50	3.2312
959382	AF2-229 E	2.6976	50/50	2.6976
959773	AF2-268 BAT	0.1026	Merchant Transmission	0.1026
959842	AF2-275 E	0.1764	Adder	0.21
959852	AF2-276 E	0.1764	Adder	0.21
961481	AF2-439 C	8.0462	50/50	8.0462
961482	AF2-439 E	7.4273	50/50	7.4273
962082	AG1-052 BAT	0.6306	Merchant Transmission	0.6306
963901	AG1-243 C	0.2010	Adder	0.45
963902	AG1-243 E	0.1082	Adder	0.24
964641	AG1-327 C O1	0.6309	Adder	1.4
964642	AG1-327 E O1	0.3250	Adder	0.72
964693	AG1-332 BAT	0.1049	Merchant Transmission	0.1049
965963	AG1-465 BAT	2.9426	Merchant Transmission	2.9426
966041	AG1-473 C	0.7851	Adder	1.74
966042	AG1-473 E	0.5234	Adder	1.16
966152	AG1-484 BAT	3.8508	50/50	3.8508
966172	AG1-486 BAT	0.5437	Merchant Transmission	0.5437
966461	AG1-515 C	0.1450	Adder	0.32
966462	AG1-515 E	0.2176	Adder	0.48
WEC	WEC	0.1304	Confirmed LTF	0.1304
LGEE	LGEE	0.2576	Confirmed LTF	0.2576
CPLE	CPLE	0.2355	Confirmed LTF	0.2355
CBM-W2	CBM-W2	3.5930	Confirmed LTF	3.5930
NY	NY	0.2030	Confirmed LTF	0.2030
TVA	TVA	0.5502	Confirmed LTF	0.5502
O-066	O-066	6.4608	Confirmed LTF	6.4608
SIGE	SIGE	0.1437	Confirmed LTF	0.1437
CBM-S2	CBM-S2	3.7584	Confirmed LTF	3.7584
CBM-S1	CBM-S1	0.1505	Confirmed LTF	0.1505
G-007	G-007	1.0133	Confirmed LTF	1.0133
MEC	MEC	0.6499	Confirmed LTF	0.6499
LAGN	LAGN	0.6895	Confirmed LTF	0.6895
CBM-W1	CBM-W1	5.8744	Confirmed LTF	5.8744

11.6.2 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
165988706	200520	26ROXBURY	PENELEC	961480	AF2-439 TAP	PENELEC	1	ME-P2-3-ME-230-005A	breaker	159.0	111.67	112.22	DC	1.93

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
237329	01CHBRG_I12	0.4706	50/50	0.4706
901242	W1-045 E OP1	0.3063	Adder	0.36
930822	AB1-127 E	0.3508	Adder	0.41
930832	AB1-128 E	0.3508	Adder	0.41
933977	**AD1-020 EBAT (Suspended)**	**2.1736**	**50/50**	**2.1736**
934371	AD1-061 C	0.3320	Adder	0.39
934372	AD1-061 E	0.2883	Adder	0.34
936061	AD2-009 C	2.2487	Adder	2.65
936062	AD2-009 E	1.0238	Adder	1.2
936471	AD2-062 C O1	9.9066	50/50	9.9066
936472	AD2-062 E O1	4.9626	50/50	4.9626
938384	AE1-071-C	12.4256	50/50	12.4256
938385	AE1-071-E	7.6034	50/50	7.6034
938753	AE1-101 C1	1.7324	Adder	2.04
938754	AE1-101 C2	0.8662	Adder	1.02
938756	AE1-101 E1	3.5765	Adder	4.21
938757	AE1-101 E2	1.7856	Adder	2.1
939033	AE1-132 C	2.3842	Adder	2.8
939034	AE1-132 E	1.5895	Adder	1.87
939591	AE1-188 C	0.6143	Adder	0.72
939592	AE1-188 E	0.3608	Adder	0.42
940671	**AE2-054 C (Suspended)**	**0.5208**	**Adder**	**0.61**
940672	**AE2-054 E (Suspended)**	**0.3472**	**Adder**	**0.41**
945011	AF1-166 C	0.5102	Adder	0.6
945012	AF1-166 E	0.3401	Adder	0.4
945441	AF1-209 C O1	0.5070	Adder	0.6
945442	AF1-209 E O1	0.3380	Adder	0.4
945591	AF1-224 C	0.3852	Adder	0.45
945592	AF1-224 E	0.1950	Adder	0.23
958071	AF2-101 C	-0.2947	Adder	-0.35
958221	AF2-116 C	0.6218	Adder	0.73
958222	AF2-116 E	0.3132	Adder	0.37
958231	AF2-117 C	1.9863	Adder	2.34
958232	AF2-117 E	0.9929	Adder	1.17
958551	AF2-146 C	1.4569	50/50	1.4569
958552	AF2-146 E	0.9713	50/50	0.9713
958571	AF2-148 C	1.2580	50/50	1.2580
958572	AF2-148 E	0.8387	50/50	0.8387
958601	AF2-151 C	-0.2906	Adder	-0.34
958871	AF2-178	0.2673	Adder	0.31

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
958881	AF2-179	0.3083	Adder	0.36
958891	AF2-180	0.3083	Adder	0.36
958931	AF2-184	0.2534	Adder	0.3
959223	AF2-213 BAT	4.9280	Merchant Transmission	4.9280
959241	AF2-215 C	0.1427	Adder	0.17
959242	AF2-215 E	0.0951	Adder	0.11
959381	AF2-229 C	0.7469	Adder	0.88
959382	AF2-229 E	0.6236	Adder	0.73
959773	AF2-268 BAT	0.1617	50/50	0.1617
959842	AF2-275 E	0.1595	Adder	0.19
959852	AF2-276 E	0.1595	Adder	0.19
962082	AG1-052 BAT	0.6605	Merchant Transmission	0.6605
963901	AG1-243 C	0.1817	Adder	0.4
963902	AG1-243 E	0.0978	Adder	0.22
964641	AG1-327 C O1	0.5731	Adder	1.27
964642	AG1-327 E O1	0.2952	Adder	0.66
964693	AG1-332 BAT	0.1533	Merchant Transmission	0.1533
965963	AG1-465 BAT	3.9252	Merchant Transmission	3.9252
966152	AG1-484 BAT	4.2560	50/50	4.2560
966172	AG1-486 BAT	1.6170	50/50	1.6170
966461	AG1-515 C	0.1313	Adder	0.29
966462	AG1-515 E	0.1969	Adder	0.44
WEC	WEC	0.0936	Confirmed LTF	0.0936
LGEE	LGEE	0.1860	Confirmed LTF	0.1860
CPLE	CPLE	0.1870	Confirmed LTF	0.1870
CBM-W2	CBM-W2	2.6253	Confirmed LTF	2.6253
NY	NY	0.1924	Confirmed LTF	0.1924
TVA	TVA	0.4074	Confirmed LTF	0.4074
O-066	O-066	4.4485	Confirmed LTF	4.4485
SIGE	SIGE	0.1005	Confirmed LTF	0.1005
CBM-S2	CBM-S2	2.9232	Confirmed LTF	2.9232
CBM-S1	CBM-S1	0.1110	Confirmed LTF	0.1110
G-007	G-007	0.6919	Confirmed LTF	0.6919
MEC	MEC	0.4688	Confirmed LTF	0.4688
LAGN	LAGN	0.5093	Confirmed LTF	0.5093
CBM-W1	CBM-W1	4.1639	Confirmed LTF	4.1639

11.6.3 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
165988680	961480	AF2-439 TAP	PENELEC	200504	26CARLISLE	PENELEC	1	ME-P2-3-ME-230-005A	breaker	159.0	120.44	120.98	DC	1.93

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
237329	01CHBRG_I12	0.4706	50/50	0.4706
901242	W1-045 E OP1	0.3063	Adder	0.36
930822	AB1-127 E	0.3508	Adder	0.41
930832	AB1-128 E	0.3508	Adder	0.41
933977	**AD1-020 EBAT (Suspended)**	**2.1736**	**50/50**	**2.1736**
934371	AD1-061 C	0.3320	Adder	0.39
934372	AD1-061 E	0.2883	Adder	0.34
936061	AD2-009 C	2.2487	Adder	2.65
936062	AD2-009 E	1.0238	Adder	1.2
936471	AD2-062 C O1	9.9066	50/50	9.9066
936472	AD2-062 E O1	4.9626	50/50	4.9626
938384	AE1-071-C	12.4256	50/50	12.4256
938385	AE1-071-E	7.6034	50/50	7.6034
938753	AE1-101 C1	1.7324	Adder	2.04
938754	AE1-101 C2	0.8662	Adder	1.02
938756	AE1-101 E1	3.5765	Adder	4.21
938757	AE1-101 E2	1.7856	Adder	2.1
939033	AE1-132 C	2.3842	Adder	2.8
939034	AE1-132 E	1.5895	Adder	1.87
939591	AE1-188 C	0.6143	Adder	0.72
939592	AE1-188 E	0.3608	Adder	0.42
940671	**AE2-054 C (Suspended)**	**0.5208**	**Adder**	**0.61**
940672	**AE2-054 E (Suspended)**	**0.3472**	**Adder**	**0.41**
945011	AF1-166 C	0.5102	Adder	0.6
945012	AF1-166 E	0.3401	Adder	0.4
945441	AF1-209 C O1	0.5070	Adder	0.6
945442	AF1-209 E O1	0.3380	Adder	0.4
945591	AF1-224 C	0.3852	Adder	0.45
945592	AF1-224 E	0.1950	Adder	0.23
958071	AF2-101 C	-0.2947	Adder	-0.35
958221	AF2-116 C	0.6218	Adder	0.73
958222	AF2-116 E	0.3132	Adder	0.37
958231	AF2-117 C	1.9863	Adder	2.34
958232	AF2-117 E	0.9929	Adder	1.17
958551	AF2-146 C	1.4569	50/50	1.4569
958552	AF2-146 E	0.9713	50/50	0.9713
958571	AF2-148 C	1.2580	50/50	1.2580
958572	AF2-148 E	0.8387	50/50	0.8387
958601	AF2-151 C	-0.2906	Adder	-0.34
958871	AF2-178	0.2673	Adder	0.31

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
958881	AF2-179	0.3083	Adder	0.36
958891	AF2-180	0.3083	Adder	0.36
958931	AF2-184	0.2534	Adder	0.3
959223	AF2-213 BAT	4.9280	Merchant Transmission	4.9280
959241	AF2-215 C	0.1427	Adder	0.17
959242	AF2-215 E	0.0951	Adder	0.11
959381	AF2-229 C	0.7469	Adder	0.88
959382	AF2-229 E	0.6236	Adder	0.73
959773	AF2-268 BAT	0.1617	50/50	0.1617
959842	AF2-275 E	0.1595	Adder	0.19
959852	AF2-276 E	0.1595	Adder	0.19
961481	AF2-439 C	7.5080	50/50	7.5080
961482	AF2-439 E	6.9305	50/50	6.9305
962082	AG1-052 BAT	0.6605	Merchant Transmission	0.6605
963901	AG1-243 C	0.1817	Adder	0.4
963902	AG1-243 E	0.0978	Adder	0.22
964641	AG1-327 C O1	0.5731	Adder	1.27
964642	AG1-327 E O1	0.2952	Adder	0.66
964693	AG1-332 BAT	0.1533	Merchant Transmission	0.1533
965963	AG1-465 BAT	3.9252	Merchant Transmission	3.9252
966152	AG1-484 BAT	4.2560	50/50	4.2560
966172	AG1-486 BAT	1.6170	50/50	1.6170
966461	AG1-515 C	0.1313	Adder	0.29
966462	AG1-515 E	0.1969	Adder	0.44
WEC	WEC	0.0936	Confirmed LTF	0.0936
LGEE	LGEE	0.1860	Confirmed LTF	0.1860
CPLE	CPLE	0.1870	Confirmed LTF	0.1870
CBM-W2	CBM-W2	2.6253	Confirmed LTF	2.6253
NY	NY	0.1924	Confirmed LTF	0.1924
TVA	TVA	0.4074	Confirmed LTF	0.4074
O-066	O-066	4.4485	Confirmed LTF	4.4485
SIGE	SIGE	0.1005	Confirmed LTF	0.1005
CBM-S2	CBM-S2	2.9232	Confirmed LTF	2.9232
CBM-S1	CBM-S1	0.1110	Confirmed LTF	0.1110
G-007	G-007	0.6919	Confirmed LTF	0.6919
MEC	MEC	0.4688	Confirmed LTF	0.4688
LAGN	LAGN	0.5093	Confirmed LTF	0.5093
CBM-W1	CBM-W1	4.1639	Confirmed LTF	4.1639

11.7 Queue Dependencies

The Queue Projects below are listed in one or more indices for the overloads identified in your report. These projects contribute to the loading of the overloaded facilities identified in your report. The percent overload of a facility and cost allocation you may have towards a particular reinforcement could vary depending on the action of these earlier projects. The status of each project at the time of the analysis is presented in the table. This list may change as earlier projects withdraw or modify their requests.

Queue Number	Project Name	Status
AB1-127	St. Thomas-Guilford 34.5kV	In Service
AB1-128	St. Thomas-Mercersburg 34.5kV	In Service
AD1-020	Hunterstown-Lincoln 115 kV	Suspended
AD1-061	McConnelsburg-Mercersburg 34 kV	Active
AD2-009	McConnellsburg 138 kV	Active
AD2-062	Roxbury-Greene 138 kV	Active
AE1-071	Shade Gap-Roxbury 115 kV	Active
AE1-101	McConnellsburg-Texas Eastern 138 kV	Active
AE1-132	McConnellsburg 138 kV	Active
AE1-188	Fayetteville 34.5 kV	Engineering and Procurement
AE2-054	Warfordsburg 34 kV	Suspended
AF1-166	Target-Chambers No.5 34.5 kV	Engineering and Procurement
AF1-209	Guilford 34.5 kV	Active
AF1-224	Fayetteville 34.5 kV	Engineering and Procurement
AF2-101	Allen 13.2 kV	Engineering and Procurement
AF2-116	McConnellsburg 138 kV	Active
AF2-117	Warfordsburg-McConnellsburg 138 kV	Active
AF2-146	Hill Valley-Valley REC 46 kV	Active
AF2-148	Shade Gap-Three Springs KTS 23 kV	Active
AF2-151	Dillsburg 13.2 kV	Engineering and Procurement
AF2-178	Roxbury 23 kV II	In Service
AF2-179	St. Thomas-Mercersburg 34.5 kV II	In Service
AF2-180	St. Thomas-Guilford 34.5 kV II	In Service
AF2-184	McConnelsburg-Mercersburg 34 kV II	Active
AF2-213	Zions View-Smith Street 115 kV	Active
AF2-215	Saint Thomas-LeMasters Junction 34.5 kV	Engineering and Procurement
AF2-229	Roxbury 23 kV	Active
AF2-268	Orrtanna 13.2 kV	Engineering and Procurement
AF2-275	Guilford 12.47 kV	Active
AF2-276	Guilford 12.47 kV	Active
AF2-439	Roxbury-Carlisle 115 kV	Active
AG1-052	Zionsview-Middletown 115 kV II	Active
AG1-243	Guilford-Fayetteville 34.5 kV	Active
AG1-327	West Waynesboro-East Waynesboro 138 kV	Active
AG1-332	Oxford 13.2 kV	Active
AG1-465	North Hanover-Gitts Run 115 kV	Active
AG1-473	Shingletown-Lewistown 230 kV	Active
AG1-484	Mountain 115 kV	Active
AG1-486	Orrtanna 115 kV	Active
AG1-515	Guilford 138 kV	Active
W1-045	Roxbury 23 kV	In Service

11.8 Contingency Descriptions - Primary POI

Contingency Name	Contingency Definition
ME-P1-2-ME-230-019	CONTINGENCY 'ME-P1-2-ME-230-019' /* LINE 27HUNTRSTN 230.0 TO 27HUNTRST1 230.0 CIRCUIT 1 DISCONNECT BRANCH FROM BUS 204501 TO BUS 204575 CKT 1 /* 27HUNTRSTN 230 27HUNTRST1 230 END
PL:10:P45:102437	CONTINGENCY 'PL:10:P45:102437' /* JUNI BU2 230KV BUS; BUS_SEC_1-2 CB @ JUNI 230KV DISCONNECT BUS 208004 /* JUNI BU1 230 DISCONNECT BUS 208005 /* JUNI BU2 230 END
PL:10:P24:100548	CONTINGENCY 'PL:10:P24:100548' /* JUNI 230KV BUS_SEC_1-2 CB DISCONNECT BUS 208005 /* JUNI BU2 230 DISCONNECT BUS 208004 /* JUNI BU1 230 /* JUNI BU1 230 END
ME-P2-3-ME-230-005A	CONTINGENCY 'ME-P2-3-ME-230-005A' /* HUNTRSTOWN-JACKSON_ HUNTRSTWN BK1 (HUNTRSTWN-105392) DISCONNECT BRANCH FROM BUS 204575 TO BUS 204502 CKT 1 /* 27HUNTRST1 230 27JACKSON 230 DISCONNECT BRANCH FROM BUS 204575 TO BUS 204501 CKT 1 /* 27HUNTRST1 230 27HUNTRSTN 230 DISCONNECT BRANCH FROM BUS 200026 TO BUS 204501 CKT 1 /* HUNTERTN 500 27HUNTRSTN 230 DISCONNECT BUS 204501 /* 27HUNTRSTN 230 END
ME-P2-3-ME-230-005C	CONTINGENCY 'ME-P2-3-ME-230-005C' /* HUNTRSTOWN BK1_ HUNTRSTOWN BK4 (HUNTRSTWN-B1) DISCONNECT BRANCH FROM BUS 204575 TO BUS 204501 CKT 1 /* 27HUNTRST1 230 27HUNTRSTN 230 DISCONNECT BRANCH FROM BUS 200026 TO BUS 204501 CKT 1 /* HUNTERTN 500 27HUNTRSTN 230 DISCONNECT BRANCH FROM BUS 204575 TO BUS 204539 CKT 4 /* 27HUNTRST1 230 27HUNTRSTN 115 DISCONNECT BUS 204501 /* 27HUNTRSTN 230 END

Contingency Name	Contingency Definition
AP-P1-2-WP-138-112-B	CONTINGENCY 'AP-P1-2-WP-138-112-B' /* CHERRY RUN - MCCONNELSBURG 138KV DISCONNECT BRANCH FROM BUS 958230 TO BUS 235267 CKT 1 /* AF2-117 TAP 138 01WARFOR 138 DISCONNECT BRANCH FROM BUS 235267 TO BUS 235453 CKT 1 /* 01WARFOR 138 01CHERYR 138 DISCONNECT BRANCH FROM BUS 235267 TO BUS 236686 CKT 2 /* 01WARFOR 138 01WARFORDS 35 END
ME-P1-3-ME-500-003T	CONTINGENCY 'ME-P1-3-ME-500-003T' /* TRAN HUNTERTN 500.00 TO 27HUNTRSTN 230.00 CIRCUIT 1 DISCONNECT BRANCH FROM BUS 200026 TO BUS 204501 CKT 1 /* HUNTERTN 500 27HUNTRSTN 230 END
Base Case	

12 Short Circuit Analysis - Primary POI

The following Breakers are overdutied:

None

13 Summer Peak - Load Flow Analysis - Secondary POI

The Queue Project AG1-327 was evaluated as a 35.0 MW (Capacity 23.1 MW) injection tapping the East Waynesboro to Ringgold 138 kV line in the APS area. Project AG1-327 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AG1-327 was studied with a commercial probability of 53.0 %. Potential network impacts were as follows:

13.1 Generation Deliverability

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

None

13.2 Multiple Facility Contingency

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

None

13.3 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

13.4 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

13.5 Flow Gate Details - Secondary POI

The following indices contain additional information about each facility presented in the body of the report. For each index, a description of the flowgate and its contingency was included for convenience. The intent of the indices is to provide more details on which projects/generators have contributions to the flowgate in question. All New Service Queue Requests, through the end of the Queue under study, that are contributors to a flowgate will be listed in the indices. Please note that there may be contributors that are subsequently queued after the queue under study that are not listed in the indices. Although this information is not used "as is" for cost allocation purposes, it can be used to gage the impact of other projects/generators. It should be noted the project/generator MW contributions presented in the body of the report are Full MW Impact contributions which are also noted in the indices column named "Full MW Impact", whereas the loading percentages reported in the body of the report, take into consideration the PJM Generator Deliverability Test rules such as commercial probability of each project as well as the ramping impact of "Adder" contributions. The MW Impact found and used in the analysis is shown in the indices column named "Gendeliv MW Impact".

None

13.6 Contingency Descriptions - Secondary POI

None

14 Affected Systems

14.1 NYISO

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

14.2 MISO

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

15 Attachment 1: One Line Diagram