



**Generation Interconnection
System Impact Study Report
for**

Queue Project AF1-086

MADERA-WESTOVER SOUTH 115 KV

20.54 MW Capacity / 109.9 MW Energy

August 2020

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1 Introduction

This System Impact Study has been prepared in accordance with the PJM Open Access Transmission Tariff, 205, as well as the System Impact Study Agreement between the Interconnection Customer (IC), and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is Mid-Atlantic Interstate Transmission, Inc. (MAIT, PENELEC Zone).

2 Preface

The intent of the System Impact Study is to determine a plan, with approximate cost and construction time estimates, to connect the subject generation interconnection project to the PJM network at a location specified by the Interconnection Customer. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system. All facilities required for interconnection of a generation interconnection project must be designed to meet the technical specifications (on PJM web site) for the appropriate transmission owner.

In some instances an Interconnection Customer may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection or merchant transmission upgrade, 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 System Impact Study is performed.

The System Impact 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.

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.

An Interconnection Customer 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.

3 General

The Interconnection Customer (IC), has proposed a Wind generating facility located in Clearfield County, Pennsylvania. The installed facilities will have a total capability of 109.9 MW with 20.54 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is December 31, 2022. This study does not imply a TO commitment to this in-service date.

Queue Number	AF1-086
Project Name	MADERA-WESTOVER SOUTH 115 KV
State	Pennsylvania
County	Clearfield
Transmission Owner	MAIT (PENELEC Zone)
MFO	109.9
MWE	109.9
MWC	20.54
Fuel	Wind
Basecase Study Year	2023

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

The interconnection of the project will be accomplished by constructing a new 115 kV three (3) breaker ring bus substation and looping the Garman - Shawville 115 kV line into the new station. The new substation will be located approximately 15.3 miles from Madera 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 Garman Substation, Glory Substation, Madera Substation, Shawville Substation, and Westover South Substation.

Attachment 1 shows a one-line diagram of the proposed primary Direct Connection facilities for the AF1-086 generation project to connect to the FirstEnergy ("FE") Transmission System. The IC will be responsible for constructing the facilities on its side of the POI, including the Attachment Facilities which connect the generator to the FE Transmission System's Direct Connection facilities.

5 Cost Summary

The AF1-086 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	\$ 10,434,500
Allocation towards System Network Upgrade Costs*	\$ 7,751,110
Total Costs	\$ 18,185,610

*As your project progresses through the study process and other projects modify their request or withdraw, then your cost allocation could change.

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.

Note 1: PJM Open Access Transmission Tariff (OATT) section 217.3A outline cost allocation rules. The rules are further clarified in PJM Manual 14A Attachment B. The allocation of costs for a network upgrade will start with the first Queue project to cause the need for the upgrade. Later queue projects will receive cost allocation contingent on their contribution to the violation and are allocated to the queues that have not closed less than 5 years following the execution of the first Interconnection Service Agreement which identifies the need for this upgrade.

Note 2: For customers with System Reinforcements listed: If your present cost allocation to a System Reinforcement indicates \$0, then please be aware that as changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc, the cost responsibilities can change and a cost allocation may be assigned to your project. In addition, although your present cost allocation to a System Reinforcement is presently \$0, your project may need this system reinforcement completed to be deliverable to the PJM system. If your project comes into service prior to completion of the system reinforcement, an interim deliverability study for your project will be required.

6 Transmission Owner Scope of Work

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

Description	Total Cost
Attachment Facility: Install 115 kV terminal position in new AF1-086 interconnection substation.	\$ 252,700
Direct Connection: Construct new 115 kV three breaker ring bus interconnection substation.	\$ 5,812,600
Non-Direct Connection: Loop the Garman - Shawville 115 kV line into the new interconnection substation.	\$ 384,600
Non-Direct Connection: Install communication equipment for SCADA.	\$ 211,800
Non-Direct Connection: Install fiber for communications.	\$ 1,258,800
Non-Direct Connection: Upgrade relaying and install anti-islanding at Shawville Substation.	\$ 355,500
Non-Direct Connection: Upgrade relaying and install anti-islanding at Garman Substation.	\$ 436,800
Non-Direct Connection: Install anti-islanding at Glory Substation.	\$ 310,600
Non-Direct Connection: Revise drawings and nameplates at Madera Substation.	\$ 53,200
Non-Direct Connection: Review drawings and nameplates at Westover South Substation.	\$ 53,200
Non-Direct Connection: Project Management, Construction Management Environmental, Right of Way, and SCADA.	\$ 1,271,200
Non-Direct Connection: Review drawings and provide nameplates for customer's switchyard.	\$ 28,900
Non-Direct Connection: Provide support for customer metering.	\$ 4,600
Total Physical Interconnection Costs	\$ 10,434,500

7 Schedule

Based on the scope of work for the Attachment Facilities and the Direct and/or Non-Direct Connection facilities, it is expected to take a minimum of **20 months** after the signing of an Interconnection Construction Service Agreement to complete the installation. This includes the requirement for the IC to make a preliminary payment that compensates FE for the first three months of the engineering design work that is related to the construction of the interconnection substation. 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 Direct Connection and network upgrades, and that all transmission 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.

8 Transmission Owner Analysis

FE performed an analysis of its underlying transmission <100 kV system. The AF1-086 project did not contribute to any overloads on the <100 kV FE Transmission 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 115 kV circuit breaker to protect the AF1-086 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 AF1-086 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 wind generation facility shall provide the Transmission Provider with site-specific meteorological data including:

- Wind speed (meters/second) – (Required)
- Wind direction (decimal degrees from true north) – (Required)
- Ambient air temperature (Fahrenheit) – (Required)
- Air Pressure (Hectopascals) – (Required)

- Humidity (Percent) (Accepted, not required)

10.3 Interconnected Transmission Owner 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>.

11 Summer Peak Analysis

The Queue Project AF1-086 was evaluated as a 109.9 MW (Capacity 20.5 MW) injection tapping the Westover to Madera 115 kV line in the PENELEC area. Project AF1-086 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-086 was studied with a commercial probability of 100.0 %. 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	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADIN G %	POST PROJECT LOADIN G %	AC/D C	MW IMPACT
42128585	200767	26HOMER CT	230.0	PENELEC	200795	26SHELOCT A	230.0	PENELEC	1	PN_P 4-500-002A	breaker	917.0	124.68	126.31	AC	17.91
42128586	200767	26HOMER CT	230.0	PENELEC	200795	26SHELOCT A	230.0	PENELEC	1	PN_P 4-500-002F	breaker	917.0	124.68	126.32	AC	17.91
42128595	200795	26SHELOCT A	230.0	PENELEC	200810	26KEYSTO NE	230.0	PENELEC	1	PN_P 4-500-002F	breaker	917.0	106.4	109.38	AC	31.32
42128596	200795	26SHELOCT A	230.0	PENELEC	200810	26KEYSTO NE	230.0	PENELEC	1	PN_P 4-500-002A	breaker	917.0	106.39	109.37	AC	31.32

11.4 Steady-State Voltage Requirements

To be determined

11.5 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	CK T ID	CON T NAME	Type	Ratin g MVA	PRE PROJEC T LOADIN G %	POST PROJEC T LOADIN G %	AC D C	MW IMPAC T
41172659	200513	26LEWIST WN	230.0	PENELE C	208005	JUNI BU2	230.0	PPL	1	Base Case	operatio n	493.0	103.58	105.95	AC	13.13
41172680	200726	26SHAWVL 2	230.0	PENELE C	235248	01SHINGL	230.0	AP	1	AP-P1-3-WP-230-005	operatio n	554.0	107.5	109.05	AC	10.58
41172681	200726	26SHAWVL 2	230.0	PENELE C	235248	01SHINGL	230.0	AP	1	AP-P1-2-WP-230-005B	operatio n	554.0	107.53	109.08	AC	10.58
42410799	200767	26HOMER CT	230.0	PENELE C	200795	26SHELOCT A	230.0	PENELE C	1	PN-P1-3-PN-230-001T	operatio n	917.0	120.52	122.15	AC	17.94
42410800	200767	26HOMER CT	230.0	PENELE C	200795	26SHELOCT A	230.0	PENELE C	1	PN-P1-2-PN-230-025	operatio n	917.0	120.52	122.15	AC	17.94
42410801	200767	26HOMER CT	230.0	PENELE C	200795	26SHELOCT A	230.0	PENELE C	1	Base Case	operatio n	731.0	132.75	133.96	AC	10.56
42410815	200795	26SHELOCT A	230.0	PENELE C	200810	26KEYSTON E	230.0	PENELE C	1	PN-P1-2-PN-230-025	operatio n	917.0	101.37	104.35	AC	31.35
42410816	200795	26SHELOCT A	230.0	PENELE C	200810	26KEYSTON E	230.0	PENELE C	1	PN-P1-3-PN-230-001T	operatio n	917.0	101.37	104.35	AC	31.35
42410817	200795	26SHELOCT A	230.0	PENELE C	200810	26KEYSTON E	230.0	PENELE C	1	Base Case	operatio n	731.0	103.98	106.78	AC	23.58
41172691	200904	26EAGL VAL	115.0	PENELE C	200527	26TYRONE N	115.0	PENELE C	1	AP-P1-2-WP-230-323T	operatio n	191.0	114.46	116.89	AC	5.5
41172535	235248	01SHINGL	230.0	AP	200513	26LEWIST WN	230.0	PENELE C	1	Base Case	operatio n	491.0	118.79	120.82	AC	12.32
41172537	235248	01SHINGL	230.0	AP	200513	26LEWIST WN	230.0	PENELE C	1	PN-P1-2-PN-230-012A-A	operatio n	570.0	115.38	117.46	AC	14.36

11.6 System Reinforcements

ID	Idx	Facility	Upgrade Description	Cost	Cost Allocated to AF1-086	Upgrade Number																
42128586,42128585	1	26HOMER CT 230.0 kV - 26SHELOCTA 230.0 kV Ckt 1	<u>PENELEC</u> ProjectId : n6854 (PN-AF2-F-0005) Description : 1) Construct 500 kV yard consisting of three-500 kV breakers configured in a breaker-and-a-half layout (initially a ring bus) 2) Tap the Keystone - Conemaugh 500 kV line and loop into the new Homer City 500 kV yard 3) Install one 500/345 kV transformer 4) Install a new 345 kV breaker-and-a-half string using three new breakers Type : CON Total Cost : \$85,596,000 Time Estimate : 48 Months <table><tr><th>Queue</th><th>MW</th><th>Cost %</th><th>Cost \$</th></tr><tr><td>Unknown</td><td>437.07</td><td>80.40%</td><td>\$68,815,311</td></tr><tr><td>AF1-043</td><td>57.35</td><td>10.55%</td><td>\$9,029,579</td></tr><tr><td>AF1-086</td><td>49.23</td><td>9.06%</td><td>\$7,751,110</td></tr></table> This upgrade will need to be tested during the Facilities Study phase to ensure it does not cause any additional violations.	Queue	MW	Cost %	Cost \$	Unknown	437.07	80.40%	\$68,815,311	AF1-043	57.35	10.55%	\$9,029,579	AF1-086	49.23	9.06%	\$7,751,110	\$85,596,000	\$7,751,110	n6854
Queue	MW	Cost %	Cost \$																			
Unknown	437.07	80.40%	\$68,815,311																			
AF1-043	57.35	10.55%	\$9,029,579																			
AF1-086	49.23	9.06%	\$7,751,110																			
42128595,42128596	2	26SHELOCTA 230.0 kV - 26KEYSTONE 230.0 kV Ckt 1																				
			TOTAL COST	\$85,596,000	\$7,751,110																	

Note : For customers with System Reinforcements listed: If your present cost allocation to a System Reinforcement indicates \$0, then please be aware that as changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc, the cost responsibilities can change and a cost allocation may be assigned to your project. In addition, although your present cost allocation to a System Reinforcement is presently \$0, your project may need this system reinforcement completed to be deliverable to the PJM system. If your project comes into service prior to completion of the system reinforcement, an interim deliverability study for your project will be required.

11.7 Flow Gate Details

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".

11.7.1 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
42128586	200767	26HOMER CT	PENELEC	200795	26SHELOCTA	PENELEC	1	PN_P4-500-002F	breaker	917.0	124.68	126.32	AC	17.91

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
200503	26C.SLOPE (Deactivation : 07/06/2019)	29.3075	50/50	29.3075
200794	26CONEMAGH	0.5835	50/50	0.5835
200805	26COLVER13 (Deactivation : 01/09/2020)	14.2662	Adder	16.78
200809	26SITHE	2.8234	50/50	2.8234
200823	26MHP_X3-003	1.9125	Adder	2.25
200833	26SEWRDB34	34.4081	50/50	34.4081
200834	26SW_E13_K22	0.0913	50/50	0.0913
200835	26DSGENWIN	0.4453	50/50	0.4453
200837	26HOMER C1	48.6260	50/50	48.6260
200838	26HOMER C2	40.3441	50/50	40.3441
200839	26HOMER C3	42.7096	50/50	42.7096
200846	26FORWARD	0.3263	50/50	0.3263
200864	K-013 E	7.3702	50/50	7.3702
200883	Q-053 E	13.4102	50/50	13.4102
200886	26ARWF_N39	0.8721	50/50	0.8721
200888	26HIGHLAND	0.7174	50/50	0.7174
200889	26STNY CRK	0.5465	50/50	0.5465
200890	26BF_G21_K23	0.2184	50/50	0.2184
200891	26CSLMN_L13	0.3426	50/50	0.3426
200892	26LOOKOUT	0.3254	50/50	0.3254
200894	26K02	6.9834	Adder	8.22
200898	26AA1-106	2.6842	Adder	3.16
200905	26Q36	0.3985	50/50	0.3985
200915	26CHSTN_FL	0.3761	50/50	0.3761
200925	26R32	0.8277	50/50	0.8277
200945	26CT_V3-030	0.2076	50/50	0.2076
201477	26Y2-055	4.0330	Adder	4.74
202225	26SCI_S29B	0.1421	50/50	0.1421
203034	26NA_O38_P22	0.7631	50/50	0.7631
203909	26Z1-038	1.8879	Adder	2.22
203910	26Z1-091	2.4535	Adder	2.89
203999	P-047 E	12.9036	Adder	15.18
235003	AC1-025 E	0.1715	Adder	0.2
236828	01GRAYMONT	0.4639	Adder	0.55
290086	Q-036 E	8.9996	50/50	8.9996
292350	K-023	7.9542	50/50	7.9542
292542	L-013 1	7.7366	50/50	7.7366
293301	N-039 E	19.6966	50/50	19.6966
293393	V3-030E	6.1795	50/50	6.1795

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
293432	R-040 E	0.4352	50/50	0.4352
293603	O-018 E	16.2011	50/50	16.2011
293902	O-048 E	6.9630	50/50	6.9630
294515	O38_P22	17.2346	50/50	17.2346
294573	P-028 E	11.4750	Adder	13.5
294903	P-060 E	12.3425	50/50	12.3425
296332	R-032 E	18.6936	50/50	18.6936
913142	Y1-033 E OP1	5.3812	Adder	6.33
916202	Z1-069 E	10.2400	Adder	12.05
917672	Z2-108 E	4.3519	50/50	4.3519
918682	AA1-082 E	6.9534	Adder	8.18
919201	AA1-144 OP	19.7545	Adder	23.24
919491	AA2-000	58.9617	Adder	69.37
920341	AA2-132 (Suspended)	2.7193	Adder	3.2
922932	AB1-082 OP (Suspended)	3.7061	Adder	4.36
923443	AB1-160 E	2.9257	Adder	3.44
930511	AB1-092	2.1649	Adder	2.55
935191	AD1-154	2.4864	Adder	2.93
936421	AD2-055	4.4571	Adder	5.24
936991	AD2-133 C	4.0498	50/50	4.0498
936992	AD2-133 E	18.5234	50/50	18.5234
938351	AE1-053	2.4177	50/50	2.4177
938881	AE1-116	1.2894	50/50	1.2894
938951	AE1-123	2.1622	Adder	2.54
938991	AE1-128 C	21.8218	50/50	21.8218
938992	AE1-128 E	14.5478	50/50	14.5478
939171	AE1-147 C	1.3946	Adder	1.64
939172	AE1-147 E	0.9298	Adder	1.09
939291	AE1-160 C	1.4553	Adder	1.71
939292	AE1-160 E	0.8365	Adder	0.98
940201	AE2-001 C	1.3929	Adder	1.64
940202	AE2-001 E	0.9286	Adder	1.09
940681	AE2-055 C	1.3662	Adder	1.61
940682	AE2-055 E	0.9108	Adder	1.07
940861	AE2-074 C	2.8140	Adder	3.31
940862	AE2-074 E	3.7042	Adder	4.36
941191	AE2-113 C	10.7490	Adder	12.65
941192	AE2-113 E	11.5732	Adder	13.62
941231	AE2-117 C	1.9757	Adder	2.32
941232	AE2-117 E	1.3172	Adder	1.55
941241	AE2-118 C	1.9757	Adder	2.32
941242	AE2-118 E	1.3172	Adder	1.55
941261	AE2-120 C	1.3920	Adder	1.64
941262	AE2-120 E	0.9280	Adder	1.09
941271	AE2-121 C	0.7431	Adder	0.87
941272	AE2-121 E	0.4962	Adder	0.58
941321	AE2-126 C	1.7618	Adder	2.07
941322	AE2-126 E	1.1746	Adder	1.38
941331	AE2-129 C	2.0417	Adder	2.4
941332	AE2-129 E	1.3612	Adder	1.6
941351	AE2-131 C	2.0417	Adder	2.4
941352	AE2-131 E	1.3612	Adder	1.6

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
941421	AE2-139 C	7.3869	Adder	8.69
941422	AE2-139 E	4.9246	Adder	5.79
942121	AE2-224 C	21.0966	50/50	21.0966
942122	AE2-224 E	14.0644	50/50	14.0644
942351	AE2-248 C	1.1018	Adder	1.3
942352	AE2-248 E	0.7346	Adder	0.86
942491	AE2-262 C	6.1812	Adder	7.27
942492	AE2-262 E	4.1538	Adder	4.89
942501	AE2-263 C	5.8103	Adder	6.84
942502	AE2-263 E	3.8793	Adder	4.56
942511	AE2-264 C	11.1816	50/50	11.1816
942512	AE2-264 E	7.4544	50/50	7.4544
942811	AE2-299 C	3.4389	Adder	4.05
942812	AE2-299 E	13.7556	Adder	16.18
942961	AE2-316 C	5.5789	Adder	6.56
942962	AE2-316 E	7.9556	Adder	9.36
943151	AE2-344 C	6.2386	Adder	7.34
943152	AE2-344 E	4.1590	Adder	4.89
943351	AF1-006 C	1.2334	Adder	1.45
943352	AF1-006 E	0.6938	Adder	0.82
943711	AF1-039 C O1	1.4236	Adder	1.67
943712	AF1-039 E O1	0.9491	Adder	1.12
943751	AF1-043	13.3714	Adder	15.73
944001	AF1-068 C O1	1.4655	Adder	1.72
944002	AF1-068 E O1	0.8244	Adder	0.97
944181	AF1-086 C O1	2.8460	Adder	3.35
944182	AF1-086 E O1	12.3816	Adder	14.57
944261	AF1-094 C	1.2684	Adder	1.49
944262	AF1-094 E	0.8456	Adder	0.99
944281	AF1-096 C	1.3751	Adder	1.62
944282	AF1-096 E	0.9167	Adder	1.08
944301	AF1-098 C	5.2338	Adder	6.16
944302	AF1-098 E	3.4892	Adder	4.1
944311	AF1-099 C	9.3831	Adder	11.04
944312	AF1-099 E	6.2554	Adder	7.36
944321	AF1-100 C	19.6248	Adder	23.09
944322	AF1-100 E	13.0832	Adder	15.39
944381	AF1-103 O1	2.7800	Adder	3.27
944391	AF1-104 O1	1.7887	Adder	2.1
944411	AF1-106 O1	2.9607	Adder	3.48
944471	AF1-112 C	1.4723	Adder	1.73
944472	AF1-112 E	0.8282	Adder	0.97
944671	AF1-132 C O1	1.3721	Adder	1.61
944672	AF1-132 E O1	0.9147	Adder	1.08
944691	AF1-134 C O1	1.6917	Adder	1.99
944692	AF1-134 E O1	1.1278	Adder	1.33
944751	AF1-140 C	2.9110	50/50	2.9110
944752	AF1-140 E	1.9407	50/50	1.9407
944771	AF1-142 C	15.0129	Adder	17.66
944772	AF1-142 E	10.0086	Adder	11.77
944781	AF1-143 C	14.5062	50/50	14.5062
944782	AF1-143 E	9.6708	50/50	9.6708

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
944841	AF1-149 C	1.3919	Adder	1.64
944842	AF1-149 E	0.9279	Adder	1.09
944881	AF1-153 C O1	1.6077	Adder	1.89
944882	AF1-153 E O1	1.0718	Adder	1.26
944901	AF1-155 C	1.6067	Adder	1.89
944902	AF1-155 E	1.0711	Adder	1.26
945021	AF1-167 C	0.9238	Adder	1.09
945022	AF1-167 E	0.6170	Adder	0.73
945051	AF1-170 C	4.2165	Adder	4.96
945052	AF1-170 E	2.8110	Adder	3.31
945121	AF1-177	0.6950	Adder	0.82
945161	AF1-181	0.1051	Adder	0.12
945171	AF1-182	0.5252	Adder	0.62
945181	AF1-183	0.1375	Adder	0.16
945331	AF1-198	0.3963	Adder	0.47
945451	AF1-210 C	1.0117	Adder	1.19
945452	AF1-210 E	0.6745	Adder	0.79
945491	AF1-214 C	1.3920	Adder	1.64
945492	AF1-214 E	0.9280	Adder	1.09
945551	AF1-220 C	13.5270	Adder	15.91
945552	AF1-220 E	9.0229	Adder	10.62
945671	AF1-232 C O2	30.2952	50/50	30.2952
945672	AF1-232 E O2	16.3128	50/50	16.3128
945751	AF1-240 C O1	1.4919	Adder	1.76
945752	AF1-240 E O1	0.9946	Adder	1.17
946081	AF1-273 C O1	14.8976	50/50	14.8976
946082	AF1-273 E O1	9.9317	50/50	9.9317
946111	AF1-276 C	14.7782	50/50	14.7782
946112	AF1-276 E	7.2788	50/50	7.2788
946121	AF1-277 C	14.7782	50/50	14.7782
946122	AF1-277 E	7.2788	50/50	7.2788
946131	AF1-278 C	11.7784	50/50	11.7784
946132	AF1-278 E	5.8583	50/50	5.8583
946211	AF1-286 C O1	1.1991	Adder	1.41
946212	AF1-286 E O1	0.8142	Adder	0.96
946381	AF1-302 C	2.4362	Adder	2.87
946382	AF1-302 E	3.2483	Adder	3.82
946401	AF1-304 C	6.9885	Adder	8.22
946402	AF1-304 E	4.6590	Adder	5.48
946421	AF1-306 C	6.7765	Adder	7.97
946422	AF1-306 E	27.1058	Adder	31.89
946431	AF1-307 C	11.9417	50/50	11.9417
946432	AF1-307 E	7.9611	50/50	7.9611
946571	AF1-321 C O1	3.8557	50/50	3.8557
946572	AF1-321 E O1	2.5705	50/50	2.5705
NEWTON	NEWTON	0.7812	Confirmed LTF	0.7812
FARMERCITY	FARMERCITY	0.0409	Confirmed LTF	0.0409
PRAIRIE	PRAIRIE	1.9243	Confirmed LTF	1.9243
COFFEEN	COFFEEN	0.1438	Confirmed LTF	0.1438
CHEOAH	CHEOAH	0.4354	Confirmed LTF	0.4354
EDWARDS	EDWARDS	0.2408	Confirmed LTF	0.2408
TILTON	TILTON	0.4429	Confirmed LTF	0.4429

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
G-007	G-007	0.1102	Confirmed LTF	0.1102
MADISON	MADISON	0.0282	Confirmed LTF	0.0282
GIBSON	GIBSON	0.3986	Confirmed LTF	0.3986
CALDERWOOD	CALDERWOOD	0.4314	Confirmed LTF	0.4314
BLUEG	BLUEG	1.2968	Confirmed LTF	1.2968
TRIMBLE	TRIMBLE	0.4157	Confirmed LTF	0.4157
CATAWBA	CATAWBA	0.3325	Confirmed LTF	0.3325

11.7.2 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
42128596	200795	26SHELOCTA	PENELEC	200810	26KEYSTONE	PENELEC	1	PN_P4-500-002A	breaker	917.0	106.39	109.37	AC	31.32

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
200636	26IUP CO-G	0.8511	50/50	0.8511
200794	26CONEMAGH	0.6898	50/50	0.6898
200805	26COLVER13 (Deactivation : 01/09/2020)	29.3945	Adder	34.58
200809	26SITHE	2.7279	50/50	2.7279
200833	26SEWRDB34	35.7461	50/50	35.7461
200837	26HOMER C1	46.9800	50/50	46.9800
200838	26HOMER C2	39.3959	50/50	39.3959
200839	26HOMER C3	41.7057	50/50	41.7057
200846	26FORWARD	0.3542	50/50	0.3542
200864	K-013 E	8.0005	50/50	8.0005
200883	Q-053 E	12.7826	Adder	15.04
200888	26HIGHLAND	0.7898	50/50	0.7898
200894	26K02	7.3352	Adder	8.63
200898	26AA1-106	2.7517	Adder	3.24
200925	26R32	0.9114	50/50	0.9114
201477	26Y2-055	4.2378	Adder	4.99
202158	26CON.GEN1	0.1430	50/50	0.1430
203910	26Z1-091	2.4598	Adder	2.89
203999	P-047 E	12.9399	Adder	15.22
235003	AC1-025 E	0.1896	Adder	0.22
236828	01GRAYMONT	0.5134	Adder	0.6
290086	Q-036 E	8.8046	Adder	10.36
292350	K-023	7.3612	Adder	8.66
292542	L-013 1	7.1599	Adder	8.42
293301	N-039 E	17.3242	Adder	20.38
293393	V3-030E	7.5683	Adder	8.9
293432	R-040 E	0.4027	Adder	0.47
293603	O-018 E	17.8381	50/50	17.8381
293902	O-048 E	6.4439	Adder	7.58
294515	O38_P22	15.1587	Adder	17.83
294903	P-060 E	11.4440	Adder	13.46
296332	R-032 E	20.5824	50/50	20.5824
913142	Y1-033 E OP1	5.8826	Adder	6.92
916202	Z1-069 E	10.3345	Adder	12.16
917672	Z2-108 E	4.0274	Adder	4.74
918682	AA1-082 E	7.0424	Adder	8.29
919201	AA1-144 OP	20.0523	Adder	23.59
919491	AA2-000	64.1801	Adder	75.51
920341	AA2-132 (Suspended)	2.7247	Adder	3.21

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
922932	AB1-082 OP (Suspended)	3.7658	Adder	4.43
923443	AB1-160 E	2.9527	Adder	3.47
930511	AB1-092	2.3565	Adder	2.77
935191	AD1-154	4.1157	Adder	4.84
936421	AD2-055	4.8516	Adder	5.71
936991	AD2-133 C	3.9621	Adder	4.66
936992	AD2-133 E	18.1222	Adder	21.32
938351	AE1-053	2.2375	Adder	2.63
938881	AE1-116	1.1908	Adder	1.4
938951	AE1-123	2.8408	Adder	3.34
938991	AE1-128 C	20.3300	Adder	23.92
938992	AE1-128 E	13.5534	Adder	15.95
939171	AE1-147 C	1.5440	Adder	1.82
939172	AE1-147 E	1.0293	Adder	1.21
939291	AE1-160 C	1.7167	Adder	2.02
939292	AE1-160 E	0.9868	Adder	1.16
940201	AE2-001 C	1.5419	Adder	1.81
940202	AE2-001 E	1.0280	Adder	1.21
940681	AE2-055 C	1.5098	Adder	1.78
940682	AE2-055 E	1.0065	Adder	1.18
940861	AE2-074 C	2.8593	Adder	3.36
940862	AE2-074 E	3.7639	Adder	4.43
941191	AE2-113 C	11.2986	Adder	13.29
941192	AE2-113 E	12.1650	Adder	14.31
941231	AE2-117 C	2.0750	Adder	2.44
941232	AE2-117 E	1.3833	Adder	1.63
941241	AE2-118 C	2.0750	Adder	2.44
941242	AE2-118 E	1.3833	Adder	1.63
941261	AE2-120 C	1.5408	Adder	1.81
941262	AE2-120 E	1.0272	Adder	1.21
941271	AE2-121 C	0.8228	Adder	0.97
941272	AE2-121 E	0.5494	Adder	0.65
941321	AE2-126 C	2.0254	Adder	2.38
941322	AE2-126 E	1.3503	Adder	1.59
941331	AE2-129 C	2.3942	Adder	2.82
941332	AE2-129 E	1.5962	Adder	1.88
941351	AE2-131 C	2.3942	Adder	2.82
941352	AE2-131 E	1.5962	Adder	1.88
941421	AE2-139 C	7.5796	Adder	8.92
941422	AE2-139 E	5.0531	Adder	5.94
942121	AE2-224 C	21.7056	50/50	21.7056
942122	AE2-224 E	14.4704	50/50	14.4704
942351	AE2-248 C	1.2185	Adder	1.43
942352	AE2-248 E	0.8124	Adder	0.96
942491	AE2-262 C	6.8773	Adder	8.09
942492	AE2-262 E	4.6216	Adder	5.44
942501	AE2-263 C	6.4647	Adder	7.61
942502	AE2-263 E	4.3162	Adder	5.08
942511	AE2-264 C	9.9519	Adder	11.71
942512	AE2-264 E	6.6346	Adder	7.81
942811	AE2-299 C	3.6132	Adder	4.25
942812	AE2-299 E	14.4530	Adder	17.0

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
942961	AE2-316 C	6.1707	Adder	7.26
942962	AE2-316 E	8.7995	Adder	10.35
943351	AF1-006 C	1.3092	Adder	1.54
943352	AF1-006 E	0.7364	Adder	0.87
943711	AF1-039 C O1	1.5562	Adder	1.83
943712	AF1-039 E O1	1.0375	Adder	1.22
943751	AF1-043	14.5549	Adder	17.12
944001	AF1-068 C O1	1.6205	Adder	1.91
944002	AF1-068 E O1	0.9115	Adder	1.07
944181	AF1-086 C O1	4.9756	Adder	5.85
944182	AF1-086 E O1	21.6467	Adder	25.47
944261	AF1-094 C	1.4070	Adder	1.66
944262	AF1-094 E	0.9380	Adder	1.1
944281	AF1-096 C	1.6221	Adder	1.91
944282	AF1-096 E	1.0814	Adder	1.27
944301	AF1-098 C	5.5366	Adder	6.51
944302	AF1-098 E	3.6910	Adder	4.34
944311	AF1-099 C	10.4398	Adder	12.28
944312	AF1-099 E	6.9599	Adder	8.19
944321	AF1-100 C	22.1684	Adder	26.08
944322	AF1-100 E	14.7789	Adder	17.39
944381	AF1-103 O1	2.9213	Adder	3.44
944411	AF1-106 O1	2.9735	Adder	3.5
944471	AF1-112 C	1.6285	Adder	1.92
944472	AF1-112 E	0.9160	Adder	1.08
944671	AF1-132 C O1	1.5169	Adder	1.78
944672	AF1-132 E O1	1.0113	Adder	1.19
944691	AF1-134 C O1	2.5567	Adder	3.01
944692	AF1-134 E O1	1.7045	Adder	2.01
944751	AF1-140 C	2.7420	Adder	3.23
944752	AF1-140 E	1.8280	Adder	2.15
944771	AF1-142 C	16.7037	Adder	19.65
944772	AF1-142 E	11.1358	Adder	13.1
944781	AF1-143 C	13.4247	Adder	15.79
944782	AF1-143 E	8.9498	Adder	10.53
944841	AF1-149 C	1.5406	Adder	1.81
944842	AF1-149 E	1.0271	Adder	1.21
944881	AF1-153 C O1	1.7969	Adder	2.11
944882	AF1-153 E O1	1.1980	Adder	1.41
944901	AF1-155 C	1.7965	Adder	2.11
944902	AF1-155 E	1.1977	Adder	1.41
945021	AF1-167 C	1.1068	Adder	1.3
945022	AF1-167 E	0.7392	Adder	0.87
945121	AF1-177	0.7303	Adder	0.86
945161	AF1-181	0.1191	Adder	0.14
945171	AF1-182	0.5955	Adder	0.7
945181	AF1-183	0.1610	Adder	0.19
945331	AF1-198	0.4003	Adder	0.47
945451	AF1-210 C	1.2133	Adder	1.43
945452	AF1-210 E	0.8088	Adder	0.95
945491	AF1-214 C	1.5408	Adder	1.81
945492	AF1-214 E	1.0272	Adder	1.21

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
945551	AF1-220 C	15.0152	Adder	17.66
945552	AF1-220 E	10.0156	Adder	11.78
945671	AF1-232 C O2	28.0511	Adder	33.0
945672	AF1-232 E O2	15.1044	Adder	17.77
945751	AF1-240 C O1	2.4694	Adder	2.91
945752	AF1-240 E O1	1.6463	Adder	1.94
946071	AF1-272 C O1	25.5856	50/50	25.5856
946072	AF1-272 E O1	17.0570	50/50	17.0570
946081	AF1-273 C O1	13.8000	Adder	16.24
946082	AF1-273 E O1	9.2000	Adder	10.82
946111	AF1-276 C	12.8177	Adder	15.08
946112	AF1-276 E	6.3132	Adder	7.43
946121	AF1-277 C	12.8177	Adder	15.08
946122	AF1-277 E	6.3132	Adder	7.43
946131	AF1-278 C	10.2159	Adder	12.02
946132	AF1-278 E	5.0812	Adder	5.98
946211	AF1-286 C O1	1.2043	Adder	1.42
946212	AF1-286 E O1	0.8177	Adder	0.96
946381	AF1-302 C	2.6946	Adder	3.17
946382	AF1-302 E	3.5928	Adder	4.23
946401	AF1-304 C	8.3380	Adder	9.81
946402	AF1-304 E	5.5587	Adder	6.54
946421	AF1-306 C	7.4918	Adder	8.81
946422	AF1-306 E	29.9671	Adder	35.26
946431	AF1-307 C	14.0556	50/50	14.0556
946432	AF1-307 E	9.3704	50/50	9.3704
946571	AF1-321 C O1	4.1760	50/50	4.1760
946572	AF1-321 E O1	2.7840	50/50	2.7840
NEWTON	NEWTON	0.6468	Confirmed LTF	0.6468
FARMERCITY	FARMERCITY	0.0340	Confirmed LTF	0.0340
PRAIRIE	PRAIRIE	1.6118	Confirmed LTF	1.6118
O-066	O-066	1.5187	Confirmed LTF	1.5187
COFFEEN	COFFEEN	0.1187	Confirmed LTF	0.1187
CHEOAH	CHEOAH	0.3859	Confirmed LTF	0.3859
EDWARDS	EDWARDS	0.1957	Confirmed LTF	0.1957
TILTON	TILTON	0.3616	Confirmed LTF	0.3616
G-007	G-007	0.3609	Confirmed LTF	0.3609
MADISON	MADISON	0.0161	Confirmed LTF	0.0161
GIBSON	GIBSON	0.3298	Confirmed LTF	0.3298
CALDERWOOD	CALDERWOOD	0.3812	Confirmed LTF	0.3812
BLUEG	BLUEG	1.0798	Confirmed LTF	1.0798
TRIMBLE	TRIMBLE	0.3456	Confirmed LTF	0.3456
CATAWBA	CATAWBA	0.3045	Confirmed LTF	0.3045

11.8 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
AA1-082	E. Towanda 230kV	In Service
AA1-106	Grover II 34.5kV	Withdrawn
AA1-144	East Towanda-Grover 230kV	Engineering and Procurement
AA2-000	N/A	N/A
AA2-132	Thompson 34.5kV	Suspended
AB1-082	Potter 46kV	Suspended
AB1-092	Moshannon-East Towanda 230kV	Active
AB1-160	Gold-Sabinsville 115kV	In Service
AC1-025	Dale Summit	In Service
AD1-154	Timblin 34.5 kV	Active
AD2-055	Moshannon-East Towanda 230 kV	Active
AD2-133	Eagle Valley 115kV	Active
AD2-166	Ironwood 230kV	Partially in Service - Under Construction
AE1-053	Meyersdale North	Active
AE1-071	Shade Gap-Roxbury 115 kV	Active
AE1-116	Somerset Windpower 23 kV	Active
AE1-123	Emlenton 34.5 kV	Engineering and Procurement
AE1-128	Bedford North-Wills Mounain 115 kV	Active
AE1-147	Bellefonte 46 kV	Engineering and Procurement
AE1-160	Venango 34.5 kV	Engineering and Procurement
AE2-001	Nittany-Zion 46 kV	Active
AE2-055	Shingletown-Boalsburg 46 kV	Engineering and Procurement
AE2-074	Potter 46 kV	Active
AE2-113	Farmers Valley-Ridgeway 115 kV	Active
AE2-117	ABW Tap-Alexandria 46 kV	Active
AE2-118	ABW Tap-Williamsburg 46 kV	Active
AE2-120	Graymont-Zion 46 kV	Active
AE2-121	Milesburg-Tanney Junction 46 kV	Active
AE2-126	Dubois-Curwensville 34.5 kV	Active
AE2-129	Philipsburg-Clarence 34.5 kV	Active
AE2-131	Philipsburg-Karthaus 34.5	Active
AE2-139	East Towanda-Grover 230 kV	Active
AE2-224	Bearrock-Johnstown 230 kV	Active
AE2-248	Fillmore-Thompson Farm 46 kV	Active
AE2-262	Moshannon-Milesburg 230 kV	Active
AE2-263	Moshannon-Milesburg 230 kV	Active
AE2-264	Altoona-Raystown 230 kV	Active
AE2-299	Erie East 230 kV	Active
AE2-316	Brookville-Squab Hollow 138 kV	Active

Queue Number	Project Name	Status
AE2-344	Edinboro South-Venango Junction 115 kV	Active
AF1-006	Fairview East 34.5 kV	Active
AF1-039	Listonburg-Highpoint 24.9 kV	Active
AF1-043	Moshannon-East Towanda 230 kV	Active
AF1-068	Boalsburg-Centre Hall 46 kV	Active
AF1-086	Madera-Westover South 115 kV	Active
AF1-094	Union City-Cambridge Springs 34.5 kV	Active
AF1-096	Titusville-Oil Creek 34.5 kV	Active
AF1-098	Four Mile Jct-Corry East 115 kV	Active
AF1-099	Moshannon-Milesburg 230 kV	Active
AF1-100	Shawville-Moshannon 230 kV	Active
AF1-103	Warren 34.5 kV	Active
AF1-104	Erie West 34.5 kV	Active
AF1-106	East Sayre 34.5 kV	Active
AF1-112	Centre Hall-Boalsburg 46 kV	Active
AF1-132	Shingletown-Boalsburg 46 kV	Active
AF1-134	Philipsburg-Madera 34.5 kV	Active
AF1-140	Claysburg 23 kV	Engineering and Procurement
AF1-142	Moshannon-Milesburg 230 kV	Active
AF1-143	Lick Run 115 kV	Active
AF1-149	Graymont-Zion 46 kV	Active
AF1-153	Motion-Ridgeway 46 kV	Active
AF1-155	Paper City-Wilcox 46 kV	Engineering and Procurement
AF1-167	West Freedom-C&K Coal 25 kV	Active
AF1-170	Springboro-Venango Junction 115 kV	Active
AF1-177	Warren 115 kV	Partially in Service - Under Construction
AF1-181	Shawville 3 230 kV	Partially in Service - Under Construction
AF1-182	Shawville 4 230 kV	Partially in Service - Under Construction
AF1-183	Shawville 1 230 kV	Partially in Service - Under Construction
AF1-198	Blossburg #1 CT 34.5 kV	Partially in Service - Under Construction
AF1-210	Burma 23 kV	Engineering and Procurement
AF1-214	Nittany-Zion 46 kV	Active
AF1-220	Ridgeway-Whetstone 115 kV	Active
AF1-232	Allegheny-Somerset 115 kV	Active
AF1-240	Timblin 34.5 kV	Active
AF1-272	Lucerne 115 kV	Active
AF1-273	Allegheny 115 kV	Active
AF1-276	Lewis Run-Pierce Brook 230 kV	Active
AF1-277	Lewis Run-Pierce Brook 2 230 kV	Active
AF1-278	Lewis Run-Pierce Brook 3 230 kV	Active
AF1-286	East Sayre 34.5 kV II	Active
AF1-302	Brookville-Squab Hollow 138 kV	Active
AF1-304	Titusville-Grandview 115 kV	Active
AF1-306	Squab Hollow 230 kV	Active
AF1-307	Seward-Jackson Rd 115 kV	Active
AF1-321	Hooversville 115 kV I	Active
V3-030	St. Benedict-Patton 46kV	In Service
W1-045	Roxbury 23 kV	In Service
X3-003	Mehoopany II 115 kV	In Service
Y1-033	Penn Mar-Rock Wood 115kV	In Service
Y2-055	Elm Street 34.5kV	Withdrawn
Z1-038	Florey Knob 34.5kV	Withdrawn

Queue Number	Project Name	Status
Z1-069	Gold-Sabinsville 115kV	In Service
Z1-091	Lenox 34kV	Withdrawn
Z2-108	Meyersdale North 115kV	In Service

11.9 Contingency Descriptions

Contingency Name	Contingency Definition
PL_P21_000305	CONTINGENCY 'PL_P21_000305' /* JUNI-DAUP 230KV PATHEND
PN-P2_3-PN-230-0252-B	CONTINGENCY 'PN-P2_3-PN-230-0252-B' /* SHELOCTA 230 KV STUCK BREAKER (KEYSTONE/HOMER CITY) OPEN BRANCH FROM BUS 200795 TO BUS 200810 CKT 1 /* 26SHELOCTA 230.00 26KEYSTONE 230.00 OPEN BRANCH FROM BUS 200795 TO BUS 200767 CKT 1 /* 26SHELOCTA 230.00 26HOMER CT 230.00 END
AP-P2-3-WP-230-443T *	CONTINGENCY 'AP-P2-3-WP-230-443T *' / UPDATED CON AJK 3-31-16 DISCONNECT BRANCH FROM BUS 200726 TO BUS 235175 CKT 1 DISCONNECT BRANCH FROM BUS 235175 TO BUS 235236 CKT 1 DISCONNECT BUS 235158 END
PN-P2_3-PN-230-0252-A	CONTINGENCY 'PN-P2_3-PN-230-0252-A' /* SHELOCTA 230 KV STUCK BREAKER (KEYSTONE/XFMR) OPEN BRANCH FROM BUS 200795 TO BUS 200810 CKT 1 /* 26SHELOCTA 230.00 26KEYSTONE 230.00 OPEN BRANCH FROM BUS 200795 TO BUS 200739 CKT 2 /* 26SHELOCTA 230.00 26SHELOCTA 115.00 END
AP-P1-2-WP-230-005B	CONTINGENCY 'AP-P1-2-WP-230-005B' /* QUEUE AE2-262 - MOSHANNON 230KV DISCONNECT BRANCH FROM BUS 942490 TO BUS 235219 CKT 1 /* AE2-262 TAP 230 01MILESB 230 END
PN-P2-2-PN-230-007T	CONTINGENCY 'PN-P2-2-PN-230-007T' /* LEWISTOWN #2 230KV BUS DISCONNECT BRANCH FROM BUS 200513 TO BUS 200531 CKT 2 /* 26LEWISTWN 230 26YEAGRTWN 230 DISCONNECT BRANCH FROM BUS 200513 TO BUS 235248 CKT 1 /* 26LEWISTWN 230 01SHINGL 230 DISCONNECT BRANCH FROM BUS 200513 TO BUS 200517 CKT 1 /* 26LEWISTWN 230 26RAYSTOWN 230 END
PL_P12_000196	CONTINGENCY 'PL_P12_000196' /* JUNI-DAUP 230KV LINE DISCONNECT BRANCH FROM BUS 207955 TO BUS 208005 CKT 1 /* DAUP TR2-JUNI BU2 230 DISCONNECT BRANCH FROM BUS 207955 TO BUS 209866 CKT 2 /* DAUP TR2-DAUP 230-69 END

Contingency Name	Contingency Definition
PN-P2-3-PN-230-14BT	CONTINGENCY 'PN-P2-3-PN-230-14BT' /* LEWISTOWN STUCK 230KV BREAKER B5 (RAYSTOWN) DISCONNECT BRANCH FROM BUS 200513 TO BUS 200517 CKT 1 /* 26LEWISTWN 230 26RAYSTOWN 230 DISCONNECT BRANCH FROM BUS 200517 TO BUS 200539 CKT 1 /* 26RAYSTOWN 230 26RAYSTOWN 46 DISCONNECT BRANCH FROM BUS 200513 TO BUS 235248 CKT 1 /* 26LEWISTWN 230 01SHINGL 230 DISCONNECT BRANCH FROM BUS 200513 TO BUS 200531 CKT 2 /* 26LEWISTWN 230 26YEAGRTWN 230 DISCONNECT BRANCH FROM BUS 200513 TO BUS 200512 TO BUS 200548 CKT 1/* 26LEWISTWN 230 26LEWISTWN 115 26LEWISTWN 46.00 END
PN_P4-500-002A	CONTINGENCY 'PN_P4-500-002A' /* CONEMAUGH 500KV BKR 1 DISCONNECT BRANCH FROM BUS 200005 TO BUS 200912 CKT 3 /* CONEM-GH 500 26CONEMAGH 230 DISCONNECT BUS 200031 /* CONE G2 22 END
PN-P2-3-PN-115-55A	CONTINGENCY 'PN-P2-3-PN-115-55A' /* 683 DISCONNECT BRANCH FROM BUS 200520 TO BUS 938380 CKT 1 /* 26ROXBURY 115 AE1-071 TAP 115 DISCONNECT BRANCH FROM BUS 200860 TO BUS 200520 CKT 3 /* 26ROXB SB2 23 26ROXBURY 115 DISCONNECT BRANCH FROM BUS 200504 TO BUS 200520 CKT 1 /* 26CARLISLE 115 26ROXBURY 115 DISCONNECT BRANCH FROM BUS 200504 TO BUS 202803 CKT 2 /* 26CARLISLE 115 26CARL PK2 23 DISCONNECT BRANCH FROM BUS 200532 TO BUS 200520 CKT 2 /* 26ROXBURY 138 26ROXBURY 115 DISCONNECT BRANCH FROM BUS 200520 TO BUS 200554 CKT 1 /* 26ROXBURY 115 26ROXB SB1 23 END
PN-P2-3-PN-230-14FT	CONTINGENCY 'PN-P2-3-PN-230-14FT' /* LEWISTOWN STUCK 230KV BREAKER B34 (YEAGERTWON #2) DISCONNECT BRANCH FROM BUS 200513 TO BUS 200517 CKT 1 /* 26LEWISTWN 230 26RAYSTOWN 230 DISCONNECT BRANCH FROM BUS 200513 TO BUS 235248 CKT 1 /* 26LEWISTWN 230 01SHINGL 230 DISCONNECT BRANCH FROM BUS 200513 TO BUS 200531 CKT 2 /* 26LEWISTWN 230 26YEAGRTWN 230 DISCONNECT BRANCH FROM BUS 200513 TO BUS 200512 TO BUS 200548 CKT 2/* 26LEWISTWN 230 26LEWISTWN 115 26LEWISTWN 46.00 DISCONNECT BRANCH FROM BUS 200531 TO BUS 200550 CKT 2 /* 26YEAGRTWN 230 26YEAGRTWN 46 DISCONNECT BRANCH FROM BUS 200513 TO BUS 200512 CKT 3 /* 26LEWISTWN 230 26LEWISTWN 115 END

Contingency Name	Contingency Definition
PN_P4-500-002F	CONTINGENCY 'PN_P4-500-002F' /* CONEMAUGH 500KV BKR 6 DISCONNECT BRANCH FROM BUS 200005 TO BUS 200912 CKT 3 /* CONEM-GH 500 26CONEMAGH 230 DISCONNECT BUS 200030 /* CONE G1 22 END
PN-P2_3-PN-230-0252-C	CONTINGENCY 'PN-P2_3-PN-230-0252-C' /* SHELOCTA 230 KV STUCK BREAKER (HOMER CITY/XFMR) OPEN BRANCH FROM BUS 200795 TO BUS 200767 CKT 1 /* 26SHELOCTA 230.00 26HOMER CT 230.00 OPEN BRANCH FROM BUS 200795 TO BUS 200739 CKT 2 /* 26SHELOCTA 230.00 26SHELOCTA 115.00 END
PL_P42_000451	CONTINGENCY 'PL_P42_000451' /* JUNI-DAUP 230KV STUCK BREAKER CONNECTED TO JUNI TR4 DISCONNECT BRANCH FROM BUS 208005 TO BUS 209997 CKT 4 /* JUNI BU2-JUNI 230- 69 DISCONNECT BRANCH FROM BUS 207955 TO BUS 208005 CKT 1 /* DAUP TR2-JUNI BU2 230 DISCONNECT BRANCH FROM BUS 207955 TO BUS 209866 CKT 2 /* DAUP TR2-DAUP 230-69 END
PN-P2-4-PN-230-14GT	CONTINGENCY 'PN-P2-4-PN-230-14GT' /* LEWISTOWN STUCK 230KV BUS TIE BREAKER DISCONNECT BRANCH FROM BUS 200513 TO BUS 235248 CKT 1 /* 26LEWISTWN 230 01SHINGL 230 DISCONNECT BRANCH FROM BUS 200513 TO BUS 200517 CKT 1 /* 26LEWISTWN 230 26RAYSTOWN 230 DISCONNECT BRANCH FROM BUS 200513 TO BUS 200512 TO BUS 200548 CKT 1/* 26LEWISTWN 230 26LEWISTWN 115 26LEWISTWN 46.00 DISCONNECT BRANCH FROM BUS 200513 TO BUS 200512 TO BUS 200548 CKT 2/* 26LEWISTWN 230 26LEWISTWN 115 26LEWISTWN 46.00 DISCONNECT BRANCH FROM BUS 200513 TO BUS 200512 CKT 3 /* 26LEWISTWN 230 26LEWISTWN 115 DISCONNECT BRANCH FROM BUS 200513 TO BUS 200531 CKT 1 /* 26LEWISTWN 230 26YEAGRTWN 230 DISCONNECT BRANCH FROM BUS 200513 TO BUS 200531 CKT 2 /* 26LEWISTWN 230 26YEAGRTWN 230 DISCONNECT BRANCH FROM BUS 200513 TO BUS 208005 CKT 1 /* 26LEWISTWN 230 JUNI BU2 230 REDUCE BUS 200513 SHUNT BY 100 PERCENT /* 26LEWISTWN 230 END
PN-P1-2-PN-115-094-A	CONTINGENCY 'PN-P1-2-PN-115-094-A' /* ROXBURY - SHADE GAP 115KV DISCONNECT BRANCH FROM BUS 200520 TO BUS 938380 CKT 1 /* 26ROXBURY 115 AE1-071 TAP 115 END

Contingency Name	Contingency Definition
PN-P2-2-PN-115-032	CONTINGENCY 'PN-P2-2-PN-115-032' /* ROXBURY 115KV BUS FAULT DISCONNECT BUS 200520 /* 26ROXBURY 115 END
AP-P2-2-WP-230-001T	CONTINGENCY 'AP-P2-2-WP-230-001T' DISCONNECT BRANCH FROM BUS 235175 TO BUS 235158 CKT 1 DISCONNECT BRANCH FROM BUS 235175 TO BUS 235236 CKT 1 DISCONNECT BRANCH FROM BUS 235175 TO BUS 200726 CKT 1 END
AP-P1-3-WP-230-326T	CONTINGENCY 'AP-P1-3-WP-230-326T' /* SHINGLETOWN #82 230/46KV XFMR DISCONNECT BRANCH FROM BUS 235248 TO BUS 236711 CKT 82 /* 01SHINGL 230 01SHINGLTN 46 DISCONNECT BRANCH FROM BUS 235248 TO BUS 200513 CKT 1 /* 01SHINGL 230 26LEWISTWN 230 DISCONNECT BRANCH FROM BUS 235248 TO BUS 235970 CKT 1 /* 01SHINGL 230 01DALE 230 DISCONNECT BUS 237058 /*SHINGLETOWN 230 KV CAPACITOR END
AP-P1-2-WP-230-322T	CONTINGENCY 'AP-P1-2-WP-230-322T' /* SHINGLETOWN-SHAWVILLE 230KV APS-PN TIE DISCONNECT BRANCH FROM BUS 235248 TO BUS 200726 CKT 1 /* 01SHINGL 230 26SHAWVL 2 230 END
PN-P1_2-PN-230-0103	CONTINGENCY 'PN-P1_2-PN-230-0103' /* SHELOCTA - KEYSTONE 230 KV LINE OPEN BRANCH FROM BUS 200795 TO BUS 200810 CKT 1 /* 26SHELOCTA 230.00 26KEYSTONE 230.00 END
AP-P2-3-WP-230-460T	CONTINGENCY 'AP-P2-3-WP-230-460T' /* 467 DISCONNECT BRANCH FROM BUS 200513 TO BUS 235248 CKT 1 /* 26LEWISTWN 230 01SHINGL 230 DISCONNECT BRANCH FROM BUS 200726 TO BUS 235248 CKT 1 /* 26SHAWVL 2 230 01SHINGL 230 DISCONNECT BRANCH FROM BUS 235248 TO BUS 235970 CKT 1 /* 01SHINGL 230 01DALE 230 DISCONNECT BRANCH FROM BUS 236711 TO BUS 235248 CKT 81 /* 01SHINGLTN 46 01SHINGL 230 DISCONNECT BRANCH FROM BUS 236711 TO BUS 235248 CKT 82 /* 01SHINGLTN 46 01SHINGL 230 END

Contingency Name	Contingency Definition
PN-P2-3-PN-230-14CT	CONTINGENCY 'PN-P2-3-PN-230-14CT' /* LEWISTOWN STUCK 230KV BREAKER - SHINGLETOWN DISCONNECT BRANCH FROM BUS 200513 TO BUS 200517 CKT 1 /* 26LEWISTWN 230 26RAYSTOWN 230 DISCONNECT BRANCH FROM BUS 200513 TO BUS 235248 CKT 1 /* 26LEWISTWN 230 01SHINGL 230 DISCONNECT BRANCH FROM BUS 200513 TO BUS 200531 CKT 2 /* 26LEWISTWN 230 26YEAGRTWN 230 DISCONNECT BRANCH FROM BUS 200513 TO BUS 200512 TO BUS 200548 CKT 2/* 26LEWISTWN 230 26LEWISTWN 115 26LEWISTWN 46.00 DISCONNECT BRANCH FROM BUS 200513 TO BUS 200512 CKT 3 /* 26LEWISTWN 230 26LEWISTWN 115 END
PN-P1-3-PN-500-001AT	CONTINGENCY 'PN-P1-3-PN-500-001AT' /* KEYSTONE #3 500/230 KV XFMR OPEN BRANCH FROM BUS 200011 TO BUS 200810 CKT 3 /* KEYSTONE 500.00 26KEYSTONE 230.00 END
AP-P1-3-WP-230-325T	CONTINGENCY 'AP-P1-3-WP-230-325T' /* SHINGLETOWN #81 230/46KV XFMR DISCONNECT BRANCH FROM BUS 235248 TO BUS 236711 CKT 81 /* 01SHINGL 230 01SHINGLTN 46 DISCONNECT BRANCH FROM BUS 235248 TO BUS 200726 CKT 1 /* 01SHINGL 230 26SHAWVL 2 230 END
Base Case	
PN-P1-2-PN-230-025	CONTINGENCY 'PN-P1-2-PN-230-025' /* CONEMAUGH - SEWARD 230KV DISCONNECT BRANCH FROM BUS 200912 TO BUS 200793 CKT 1 /* 26CONEMAGH 230 26SEWARD 2 230 END
PJM500_PN_P4-500-001A	CONTINGENCY 'PJM500_PN_P4-500-001A' /* KEYSTONE 500KV BKR 1 DISCONNECT BRANCH FROM BUS 200011 TO BUS 200810 CKT 3 /* KEYSTONE 500 26KEYSTONE 230 REMOVE MACHINE H FROM BUS 200033 /* KEYS G2 20 REMOVE MACHINE L FROM BUS 200033 /* KEYS G2 20 DISCONNECT BUS 200033 /* KEYS G2 20 END
AP-P1-3-WP-230-005	CONTINGENCY 'AP-P1-3-WP-230-005' /* MILESBERG #82 230/46KV XFMR DISCONNECT BRANCH FROM BUS 235219 TO BUS 236745 CKT 82 /* 01MILESB 230 01MILESBG 46 DISCONNECT BRANCH FROM BUS 942490 TO BUS 235219 CKT 1 /* AE2-262 TAP 230 01MILESB 230 END

Contingency Name	Contingency Definition
PJM500_PN_P4-500-001D	CONTINGENCY 'PJM500_PN_P4-500-001D' /* KEYSTONE 500KV BKR 4 DISCONNECT BRANCH FROM BUS 200011 TO BUS 200810 CKT 3 /* KEYSTONE 500 26KEYSTONE 230 REMOVE MACHINE H FROM BUS 200032 /* KEYS G1 20 REMOVE MACHINE L FROM BUS 200032 /* KEYS G1 20 DISCONNECT BUS 200032 /* KEYS G1 20 END
AP-P2-3-WP-230-446T	CONTINGENCY 'AP-P2-3-WP-230-446T' /* ELKO-MOSHANNON STK BKR AT ELKO DISCONNECT BRANCH FROM BUS 200726 TO BUS 235175 CKT 1 /* 26SHAWVL 2 230 01ELKO 230 DISCONNECT BRANCH FROM BUS 235158 TO BUS 235175 CKT 1 /* 01CARB 230 01ELKO 230 DISCONNECT BRANCH FROM BUS 235175 TO BUS 235236 CKT 1 /* 01ELKO 230 01QUEHAN 230 DISCONNECT BRANCH FROM BUS 235220 TO BUS 235236 CKT 1 /* 01MOSHAN 230 01QUEHAN 230 DISCONNECT BRANCH FROM BUS 235236 TO BUS 236732 CKT 81 /* 01QUEHAN 230 01QUEHANNA 46 END
PN-P1-2-PN-230-012A-A	CONTINGENCY 'PN-P1-2-PN-230-012A-A' /* QUEUE AA1-144 - MARSHALL 230KV DISCONNECT BRANCH FROM BUS 200857 TO BUS 200701 CKT 1 /* 26MARSHALL 230 26GROVER 230 DISCONNECT BRANCH FROM BUS 200701 TO BUS 941420 CKT 1 /* 26GROVER 230 AE2- 139 TAP 230 DISCONNECT BRANCH FROM BUS 200701 TO BUS 200702 CKT 1 /* 26GROVER 230 26GROVER 35 END
AP-P1-2-WP-230-323T	CONTINGENCY 'AP-P1-2-WP-230-323T' /* SHINGLETOWN-LEWISTOWN 230KV APS-PN TIE DISCONNECT BRANCH FROM BUS 235248 TO BUS 200513 CKT 1 /* 01SHINGL 230 26LEWISTWN 230 END
PN-P1-3-PN-230-001T	CONTINGENCY 'PN-P1-3-PN-230-001T' /* CONEMAUGH #1 500/230KV XFMR DISCONNECT BRANCH FROM BUS 200005 TO BUS 200912 CKT 3 /* CONEM-GH 500 26CONEMAGH 230 END
PL_P12_100598	CONTINGENCY 'PL_P12_100598' /* JUNIATA-DAUPHIN 230 LINE & DAUPHIN TR2 OUT DISCONNECT BRANCH FROM BUS 207955 TO BUS 207953 CKT 1 /* /*DAUP 230 CB DISCONNECT BRANCH FROM BUS 208005 TO BUS 207955 CKT 1 /* /*JUNI-DAUP 230 DISCONNECT BRANCH FROM BUS 207955 TO BUS 209866 CKT 2 /* /*DAUP T2 END

12 Light Load Analysis

The Queue Project AF1-086 was evaluated as a 109.9 MW injection tapping the Westover to Madera 115 kV line in the PENELEC area. Project AF1-086 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-086 was studied with a commercial probability of 100.0 %. Potential network impacts were as follows:

12.1 Light Load Deliverability

(Single or N-1 contingencies)

None

12.2 Multiple Facility Contingency

(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies)

None

12.3 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

12.4 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

12.5 System Reinforcements

None

13 Short Circuit Analysis

The following Breakers are overdutied:

None.

Note: n6854 will need to be tested during the Facilities Study phase to ensure it does not cause any additional violations

13.1 System Reinforcements - Short Circuit

None.

14 Stability and Reactive Power

(Summary of the VAR requirements based upon the results of the dynamic studies)

To be determined in the Facilities Study Phase.

15 Affected Systems

15.1 NYISO

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

16 Attachment 1: One Line Diagram

