



# **Generation Interconnection**

## **Feasibility Study Report**

**for**

## **Queue Project AG1-481**

**WARREN 34.5 KV**

**15.53 MW Capacity / 15.53 MW Energy**

January 2021

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## 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 Mid-Atlantic Interstate Transmission, LLC (MAIT) (PENELEC Zone).

## 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; Storage generating facility located in Warren County, Pennsylvania. The installed facilities will have a total capability of 15.53 MW with 15.53 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is June 01, 2024. This study does not imply a TO commitment to this in-service date.

<b>Queue Number</b>	<b>AG1-481</b>
<b>Project Name</b>	WARREN 34.5 KV
<b>State</b>	Pennsylvania
<b>County</b>	Warren
<b>Transmission Owner</b>	MAIT (PENELEC)
<b>MFO</b>	15.5
<b>MWE</b>	15.53
<b>MWC</b>	15.53
<b>Fuel</b>	Solar; Storage
<b>Basecase Study Year</b>	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

AG1-481 will interconnect with the PENELEC distribution system via a tap on the Warren substation 34.5. kV #1 Eddy St. circuit #581-41 at/near pole # WE1-2A41 (Attachment 1). The IC's proposed generating unit site is located at GPC: 41.837303, -79.190865. Per FirstEnergy EP-02-280 (6/23/20) the maximum allowable single customer owned distributed energy resources (DER) located less than 2 miles from the distribution substation shall be limited to 50% maximum DER capacity for a 34.5kV distribution circuit which is 11MW. Maximum DER at the point of interconnection shall therefore **not exceed 5.5MW for this point of interconnection**. DER greater than 5.5MW will be required to have dedicated facilities from our substation.

The primary reason for this guideline is to maintain the operational flexibility of the distribution system. Large loads and large exports reduce the ability of distribution operations to reconfigure circuits during abnormal conditions, or maintenance scenarios. In addition, large loads and large exports from DER often require modifications to distribution system protection that may compromise system reliability.

## 5 Cost Summary

The AG1-481 project will be responsible for the following costs:

Description	Total Cost
<b>Total Physical Interconnection Costs</b>	\$3,437,000
<b>PJM Identified System Network Upgrade Costs</b>	\$23,880,252 <sup>1</sup>
<b>Total Costs</b>	\$27,317,252

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 2016-36, 2016-25 I.R.B. (6/20/2016). 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.

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<sup>1</sup> 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

AG1-481 will interconnect with the PENELEC distribution system via a tap on the Warren substation 34.5. kV #1 Eddy St. circuit #581-41 at/near pole # WE1-2A41 (Attachment 1). The IC's proposed generating unit site is located at GPC: 41.837303, -79.190865. Per FirstEnergy EP-02-280 (6/23/20) the maximum allowable single customer owned distributed energy resources (DER) located less than 2 miles from the distribution substation shall be limited to 50% maximum DER capacity for a 34.5kV distribution circuit which is 11MW. Maximum DER at the point of interconnection shall therefore **not exceed 5.5MW for this point of interconnection**. DER greater than 5.5MW will be required to have dedicated facilities from our substation.

Attachment 1 shows a one-line diagram of the proposed primary direct connection facilities for the AG1-481 generation project to connect to the Penelec distribution system.

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

Description	Total Cost
Proposed tap point at WE1-2A41 on existing pole or interspersed pole on existing Warren 34.5kV distribution circuit, add new SCADA switch, add new primary metering. The customer is responsible to build their own line from their site to Penelec's existing facilities.	\$137,000
Cost for Warren No.2 Transformer replacement due to overload condition. Modify line relay settings as needed.	\$ 3,300,000
<b>Total Physical Interconnection Costs</b>	<b>\$3,437,000</b>

## 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 any system outages will be allowed when requested.

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<sup>1</sup>.

## 8 Transmission Owner Analysis

Penelec performed an analysis of its distribution system. The AG1-481 project did contribute to overloads on the distribution system. Warren No.2 distribution transformer loads above SNPR transformer rating for the primary POI.

## 9 Interconnection Customer Requirements

### 9.1 System Protection

An analysis was conducted to assess the impact of the AG1-481 "Warren 34.5kV" Project on the system protection requirements in the area. The results of this review show that the following relay additions will be required:

Proposed single line diagrams show the IC constructing a generation facility tapping the Warren substation 34.5. kV #1 Eddy St. circuit #581-41 at/near pole # WE1-2A41. The 34.5kV interconnection proposal will require Developer to meet applicable "Technical Requirements" as outlined in First Energy's document titled "Technical Requirements for the Interconnection of Customer-Owned Generation to the FirstEnergy Distribution System". Anti-islanding system shall meet IEEE 1547 and UL 1741 Therefore no Direct Transfer Trip (DTT) will be required.

### 9.2 General Concerns

It is to be understood, for abnormal operation of the Penelec system, which could cause Developer's generation facility to be electrically isolated from the Penelec system synchronous source via the tripping of a interconnecting primary voltage line or device, Developer will, via Penelec's direction, be required to disconnect the generation from Penelec's system and remain disconnected (**units are required to be OFF LINE**), until the Penelec system normal circuitry is restored. These abnormal conditions will be reviewed by Penelec system operators as to the need for the generation facility to be disconnected.

### 9.3 Requirements for Owner's/Developer's generation IPP Facility

The proposed interconnection Owner's/Developer's facilities must be designed in accordance with the document titled *FirstEnergy Distribution Engineering Practices Interconnection of Customer-Owned Generation to the FirstEnergy Distribution System* dated 11/17/14 located at the following link:

<http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx>

The document is referred to as engineering practice EP (# 02-280) with section 4, part C specifically referencing the "interconnection technical requirements". Certain protection requirements are shown.

Additionally, Owner/Developer is responsible to provide adequate protection (for their equipment) under any distribution system operating condition' - which includes 'Separation from supply' (i.e. tripping of F.E. circuit breakers) and 'resynchronizing the generation after electric restoration of the supply' (i.e. reclosing of F.E. circuit breakers).

Owner's/Developer's protection must be designed to coordinate with the reclosing practices of FirstEnergy line protective devices. The generator must cease to energize the FirstEnergy circuit to which it is connected prior to reclosing of any (FE) automatic reclosing devices.

Owners/Developer's electrical protection and control schematics shall be provided to FE for consideration. FE may request modifications, if required, to meet the technical requirements.

### 9.4 Compliance Issues

Interconnection Customer (IC) will be responsible for meeting a power factor between 0.90 lagging (producing MVARs) to 0.95 leading (absorbing MVARs) and assure that voltage deviation will be less than 1.0 volt as measured at the POI under all Solar Gen operating conditions due to the inherent dynamic reactive power capability of this solar facility.

Generators with no inherent VAR (reactive power) control capability, or those that have a restricted VAR capability less than the defined requirements, must provide dynamic supplementary reactive support located at the generation facility with electrical characteristics equivalent to that provided by a similar sized synchronous generator. A Dynamic Reactive Compensation (either Static VAR Compensator (SVC) or STATCOM) or other method be applied in order to maintain the required specifications at the POI. Interconnection Customer (IC) is responsible for the installation of equipment on its side of the POI in order to adhere to the criteria stated above by FirstEnergy.

## 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<sup>2</sup>) - (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

The Queue Project AG1-481 was evaluated as a 15.5 MW (Capacity 15.5 MW) injection at the Warren #2 34.5 kV substation in the PENELEC area. Project AG1-481 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AG1-481 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)

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
164715800	235220	01MOSHAN	230.0	AP	942490	AE2-262 TAP	230.0	AP	1	AP-P1-3-WP-230-325T	single	688.0	99.89	100.11	DC	1.47

### 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
165822119	944300	AF1-098 TAP	115.0	PENELEC	200927	26FOURMILE	115.0	PENELEC	1	PN-P2-2-PN-230-009	bus	245.0	104.29	105.75	DC	3.58

### 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
167744744	200593	26GLADE	230.0	PENELEC	200811	26WARREN	230.0	PENELEC	1	Base Case	operation	520.0	165.95	167.49	DC	7.99
167744745	200593	26GLADE	230.0	PENELEC	200811	26WARREN	230.0	PENELEC	1	PN-P1-2-PN-345-003	operation	621.0	164.27	165.59	DC	8.17

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 PROJE C T LOADIN G %	POST PROJE C T LOADIN G %	AC D C	MW IMPAC T
167744865	200811	26WARREN	230.0	PENELEC	200918	26ERIE S TIE	230.0	PENELEC	1	PN-P1-2-PN-115-100-A	operatio n	621.0	124.51	125.55	DC	6.38
166285100	944300	AF1-098 TAP	115.0	PENELEC	200927	26FOURMI LE	115.0	PENELEC	1	PN-P1-2-PN-230-003	operatio n	245.0	104.06	105.52	DC	3.58

### 11.5 System Reinforcements - Summer Peak Load Flow - Primary POI

ID	Idx	Facility	Upgrade Description	Cost
164715800	1	01MOSHAN 230.0 kV - AE2- 262 TAP 230.0 kV Ckt 1	<u>APS</u> WP-AG1-F-0027 (1079) : Replace 1033.5 ACSR 45/7 and 1272 ACSR 45/7 SCCIR & TL at Moshannon substation. Project Type : FAC Cost : \$130,252 Time Estimate : 12.0 Months	\$130,252
165822119	2	AF1-098 TAP 115.0 kV - 26FOURMILE 115.0 kV Ckt 1	<u>PENELEC</u> PN-AF2-F-0053A (1200) : Reconductor approximately 7.74 miles of line. Replace transmission line drops at Four Mile. Project Type : FAC Cost : \$23,750,000 Time Estimate : 42.0 Months	\$23,750,000
			<b>TOTAL COST</b>	<b>\$23,880,252<sup>1</sup></b>

## 11.6 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".

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### 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
164715800	235220	01MOSHAN	AP	942490	AE2-262 TAP	AP	1	AP-P1-3-WP-230-325T	single	688.0	99.89	100.11	DC	1.47

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
200642	26SENECA#1	4.0879	80/20	4.0879
200643	26SENECA#2	3.8608	80/20	3.8608
200644	26SENECA#3	0.4219	80/20	0.4219
200649	26PENNTech	1.1241	80/20	1.1241
200665	26SHAWVL 3	6.6076	80/20	6.6076
200666	26SHAWVL 4	6.4492	80/20	6.4492
200715	26SHAWVL 1	4.1304	80/20	4.1304
200722	26SHAWVL 2	4.2043	80/20	4.2043
200887	26ARMNA MT	0.1642	80/20	0.1642
200905	26Q36	0.1179	80/20	0.1179
200913	26SHAW-D	0.1764	80/20	0.1764
201201	26WRREN CT	0.8487	80/20	0.8487
203261	26BLOSSBCT	0.2427	80/20	0.2427
203283	26MANOR_T86	0.0133	80/20	0.0133
203349	26Z1-069 C	0.1630	80/20	0.1630
203351	26GROZ1-110	0.3459	80/20	0.3459
203352	26CANZ2-011	0.3394	80/20	0.3394
203922	X1-109 G1	4.2768	80/20	4.2768
203923	X1-109 G2	4.2768	80/20	4.2768
919201	AA1-144 OP	12.2413	80/20	12.2413
921642	AA2-000	95.9845	80/20	95.9845
930511	AB2-092	3.5243	80/20	3.5243
931091	AB1-160 C	0.0466	80/20	0.0466
936421	AD2-055	7.2559	80/20	7.2559
936991	AD2-133 C	1.6207	80/20	1.6207
939171	AE1-147 C	-4.6997	Adder	-5.53
940861	AE2-074 C	1.2874	80/20	1.2874
941191	AE2-113 C	7.9846	80/20	7.9846
941321	AE2-126 C	2.1254	80/20	2.1254
941331	AE2-129 C	1.5998	80/20	1.5998
941351	AE2-131 C (Suspended)	1.5998	80/20	1.5998
941421	AE2-139 C	4.9838	80/20	4.9838
942961	AE2-316 C	5.5049	80/20	5.5049
943751	AF1-043	21.7675	80/20	21.7675
944181	AF1-086 C O1	1.6058	80/20	1.6058
944321	AF1-100 C	37.3935	80/20	37.3935
944381	AF1-103 O1	1.8876	80/20	1.8876
944691	AF1-134 C	1.4954	80/20	1.4954
944881	AF1-153 C O1	2.2350	80/20	2.2350
944901	AF1-155 C	2.2187	80/20	2.2187
945121	AF1-177	0.0745	80/20	0.0745

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
945161	AF1-181	0.0303	80/20	0.0303
945171	AF1-182	0.1509	80/20	0.1509
945181	AF1-183	0.0339	80/20	0.0339
945331	AF1-198	0.0319	80/20	0.0319
946111	AF1-276 C	6.0159	80/20	6.0159
946121	AF1-277 C	6.0159	80/20	6.0159
946131	AF1-278 C	4.7984	80/20	4.7984
946381	AF1-302 C	2.4039	80/20	2.4039
946421	AF1-306 C	9.8053	80/20	9.8053
957451	AF2-039 C	1.5094	80/20	1.5094
957941	AF2-088 C	0.7267	80/20	0.7267
958271	AF2-121 C	1.5998	80/20	1.5998
959061	AF2-197 C O1	2.7002	80/20	2.7002
959471	AF2-238 C	0.8846	80/20	0.8846
959481	AF2-239 C	0.7222	80/20	0.7222
959741	AF2-265 C	0.6340	80/20	0.6340
960041	AF2-295 C	2.2187	80/20	2.2187
960051	AF2-296 C	1.4954	80/20	1.4954
960271	AF2-318 C	0.7807	80/20	0.7807
961211	AF2-412	8.3395	80/20	8.3395
962411	AG1-090 C O1	7.9992	80/20	7.9992
962951	AG1-144 C	1.5998	80/20	1.5998
963571	AG1-206 C	1.1361	80/20	1.1361
963891	AG1-242 C	0.8100	80/20	0.8100
964341	AG1-296 C	0.7663	80/20	0.7663
964451	AG1-308 C O1	1.2407	80/20	1.2407
965121	AG1-377 C O1	1.5998	80/20	1.5998
965131	AG1-378 C O1	1.5998	80/20	1.5998
965201	AG1-385 C	2.8738	80/20	2.8738
965241	AG1-389 C O1	0.9533	80/20	0.9533
965251	AG1-390 C O1	0.9533	80/20	0.9533
965261	AG1-391 C O1	0.9533	80/20	0.9533
965271	AG1-392 C O1	1.9066	80/20	1.9066
965301	AG1-395 C	2.0558	80/20	2.0558
966121	AG1-481	1.4657	80/20	1.4657
WEC	WEC	0.1364	Confirmed LTF	0.1364
LGEE	LGEE	0.2513	Confirmed LTF	0.2513
CPL	CPL	0.0334	Confirmed LTF	0.0334
CBM-W2	CBM-W2	3.1360	Confirmed LTF	3.1360
TVA	TVA	0.4214	Confirmed LTF	0.4214
SIGE	SIGE	0.1697	Confirmed LTF	0.1697
CBM-S2	CBM-S2	1.3050	Confirmed LTF	1.3050
CBM-S1	CBM-S1	0.1212	Confirmed LTF	0.1212
MEC	MEC	0.6420	Confirmed LTF	0.6420
LAGN	LAGN	0.5442	Confirmed LTF	0.5442
CBM-W1	CBM-W1	6.6595	Confirmed LTF	6.6595

## 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
165822119	944300	AF1-098 TAP	PENELEC	200927	26FOURMILE	PENELEC	1	PN-P2-2-PN-230-009	bus	245.0	104.29	105.75	DC	3.58

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
200642	26SENECA#1	5.2531	50/50	5.2531
200643	26SENECA#2	4.9612	50/50	4.9612
200644	26SENECA#3	0.5421	50/50	0.5421
201201	26WRREN CT	2.0713	50/50	2.0713
940861	AE2-074 C	0.7236	Adder	0.85
940862	AE2-074 E	0.9525	Adder	1.12
941191	AE2-113 C	3.6848	Adder	4.34
941192	AE2-113 E	3.9673	Adder	4.67
941321	AE2-126 C	0.5859	Adder	0.69
941322	AE2-126 E	0.3906	Adder	0.46
942813	AE2-299 BAT	10.8640	Merchant Transmission	10.8640
944301	AF1-098 C	37.3142	50/50	37.3142
944302	AF1-098 E	24.8762	50/50	24.8762
944381	AF1-103 O1	4.6066	50/50	4.6066
944392	AF1-104 BAT	1.0200	Merchant Transmission	1.0200
944881	AF1-153 C O1	0.5374	Adder	0.63
944882	AF1-153 E O1	0.3583	Adder	0.42
944901	AF1-155 C	0.5337	Adder	0.63
944902	AF1-155 E	0.3558	Adder	0.42
945121	AF1-177	0.1817	50/50	0.1817
946111	AF1-276 C	5.1733	Adder	6.09
946112	AF1-276 E	2.5481	Adder	3.0
946121	AF1-277 C	5.1733	Adder	6.09
946122	AF1-277 E	2.5481	Adder	3.0
946131	AF1-278 C	4.1263	Adder	4.85
946132	AF1-278 E	2.0508	Adder	2.41
946421	AF1-306 C	2.6932	Adder	3.17
946422	AF1-306 E	10.7729	Adder	12.67
960041	AF2-295 C	0.5337	Adder	0.63
960042	AF2-295 E	0.3558	Adder	0.42
963571	AG1-206 C	0.1789	Adder	0.4
963572	AG1-206 E	0.0963	Adder	0.21
965201	AG1-385 C	0.3663	Adder	0.81
965202	AG1-385 E	0.1085	Adder	0.24
965862	AG1-455 BAT	1.0299	Merchant Transmission	1.0299
966121	AG1-481	3.5770	50/50	3.5770
966773	AG1-548 BAT	0.8917	Merchant Transmission	0.8917
G-007A	G-007A	1.3090	Confirmed LTF	1.3090
VFT	VFT	3.5927	Confirmed LTF	3.5927
CALDERWOOD	CALDERWOOD	0.1744	Confirmed LTF	0.1744
PRAIRIE	PRAIRIE	1.1107	Confirmed LTF	1.1107

<b>Bus #</b>	<b>Bus</b>	<b>Gendeliv MW Impact</b>	<b>Type</b>	<b>Full MW Impact</b>
<b>CHEOAH</b>	CHEOAH	0.1747	Confirmed LTF	0.1747
<b>CBM-N</b>	CBM-N	0.7008	Confirmed LTF	0.7008
<b>COTTONWOOD</b>	COTTONWOOD	0.8127	Confirmed LTF	0.8127
<b>HAMLET</b>	HAMLET	0.1455	Confirmed LTF	0.1455
<b>GIBSON</b>	GIBSON	0.2441	Confirmed LTF	0.2441
<b>BLUEG</b>	BLUEG	0.7656	Confirmed LTF	0.7656
<b>TRIMBLE</b>	TRIMBLE	0.2454	Confirmed LTF	0.2454
<b>CATAWBA</b>	CATAWBA	0.0987	Confirmed LTF	0.0987

## 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
AA1-144	East Towanda-Grover 230kV	Engineering and Procurement
AA2-000	N/A	N/A
AB1-160	Gold-Sabinsville 115kV	In Service
AB2-092	Bergen 138kV	Partially in Service - Under Construction
AD2-055	Moshannon-East Towanda 230 kV	Active
AD2-133	Eagle Valley 115kV	Active
AE1-147	Bellefonte 46 kV	Engineering and Procurement
AE2-074	Potter 46 kV	Active
AE2-113	Farmers Valley-Ridgeway 115 kV	Active
AE2-126	Dubois-Curwensville 34.5 kV	Engineering and Procurement
AE2-129	Philipsburg-Clarence 34.5 kV	Engineering and Procurement
AE2-131	Philipsburg-Karthaus 34.5	Suspended
AE2-139	East Towanda-Grover 230 kV	Active
AE2-299	Erie East 230 kV	Active
AE2-316	Brookville-Squab Hollow 138 kV	Active
AF1-043	Moshannon-East Towanda 230 kV	Active
AF1-086	Madera-Westover South 115 kV	Active
AF1-098	Four Mile Jct-Corry East 115 kV	Active
AF1-100	Shawville-Moshannon 230 kV	Active
AF1-103	Warren 34.5 kV	Active
AF1-104	Erie West 34.5 kV	Active
AF1-134	Philipsburg-Madera 34.5 kV	Active
AF1-153	Motion-Ridgeway 46 kV	Active
AF1-155	Paper City-Wilcox 46 kV	Engineering and Procurement
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
AF1-276	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
AF1-302	Brookville-Squab Hollow 138 kV	Active
AF1-306	Squab Hollow 230 kV	Active
AF2-039	Shawville-Clearfield 34.5 kV	Active
AF2-088	Shawville-Clearfield 34.5 kV II	Active
AF2-121	Philipsburg-Shawville 34.5 kV	Active
AF2-197	East Towanda 115 kV	Active
AF2-238	Mansfield-South Troy 34.5 kV	Active
AF2-239	Wyalusing-Hollenback WRC 34.5 kV	Active
AF2-265	South Troy-Athens 34.5 kV	Active
AF2-295	Wilcox-Paper City 46 kV	Active
AF2-296	Madera 34.5 kV	Active

Queue Number	Project Name	Status
AF2-318	East Towanda-New Albany 34.5 kV	Active
AF2-412	Mainesburg 115 kV	Active
AG1-090	Philipsburg 115 kV	Active
AG1-144	Phillipsburg 34.5 kV	Active
AG1-206	Snyder Twp 34.5 kV	Active
AG1-242	Beccaria 34.5 kV	Active
AG1-296	Snyder Township 34.5 kV	Active
AG1-308	Shawville-Philipsburg 115 kV	Active
AG1-377	Philipsburg 115 kV	Active
AG1-378	Philipsburg 115 kV	Active
AG1-385	Motion-Ridgeway 46 kV	Active
AG1-389	Gold 115 kV I	Active
AG1-390	Gold 115 kV II	Active
AG1-391	Gold 115 kV III	Active
AG1-392	Gold 115 kV IV	Active
AG1-395	Philipsburg-Karthaus 34.5 kV 2	Active
AG1-455	Springboro-Venango Junction 115 kV	Active
AG1-481	Warren 34.5 kV	Active
AG1-548	Erie South-Union City 115 kV	Active
X1-109	E. Towanda 230kV	In Service
Z1-069	Gold-Sabinsville 115kV	In Service
Z1-110	Grover 34kV	In Service
Z2-011	Canton 34.5kV	In Service

## 11.8 Contingency Descriptions

Contingency Name	Contingency Definition
<b>PN-P1-2-PN-230-003</b>	CONTINGENCY 'PN-P1-2-PN-230-003' /* ERIE SOUTH - WARREN 230KV DISCONNECT BRANCH FROM BUS 200918 TO BUS 200811 CKT 1 /* 26ERIE S TIE230 26WARREN 230 END
<b>PN-P1-2-PN-345-003</b>	CONTINGENCY 'PN-P1-2-PN-345-003' /* HANDSOME LAKE - WAYNE 345KV DISCONNECT BRANCH FROM BUS 200826 TO BUS 200595 CKT 1 /* 26HANDSMLK 345 26WAYNE 345 END
<b>PN-P1-2-PN-115-100-A</b>	CONTINGENCY 'PN-P1-2-PN-115-100-A' /* CORRY EAST - FOUR MILE JCT. 115KV LINE DISCONNECT BRANCH FROM BUS 200927 TO BUS 944300 CKT 1 /* 26FOURMILE 115 AF1-098 TAP 115 END
<b>AP-P1-3-WP-230-325T</b>	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
<b>Base Case</b>	
<b>PN-P2-2-PN-230-009</b>	CONTINGENCY 'PN-P2-2-PN-230-009' /* ERIE SOUTH 230KV TIE BUS DISCONNECT BRANCH FROM BUS 200918 TO BUS 200819 CKT ZB /* 26ERIE S TIE230 26ERIE SE 230 DISCONNECT BRANCH FROM BUS 200918 TO BUS 200568 CKT ZB /* 26ERIE S TIE230 26ERIE SO. 230 DISCONNECT BRANCH FROM BUS 200918 TO BUS 200811 CKT 1 /* 26ERIE S TIE230 26WARREN 230 DISCONNECT BUS 200918 /* 26ERIE S TIE230 END

## 12 Short Circuit Analysis

The following Breakers are overdutied:

None

## **13 Affected Systems**

### **13.1 NYISO**

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

### **13.2 MISO**

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

**14 Attachment 1: One Line Diagram**