Generation Interconnection

System Impact Study Report

for

Queue Project AF2-166

CLARK SUMMIT-EMLENTON 34 KV

12 MW Capacity / 20 MW Energy

February 2021

Table of Contents

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 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.

3 General

The Interconnection Customer (IC), has proposed a Solar generating facility located in Venango County, Pennsylvania. The installed facilities will have a total capability of 20 MW with 12 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is September 15, 2022. This study does not imply a TO commitment to this in-service date.

Queue Number	AF2-166
Project Name	CLARK SUMMIT-EMLENTON 34 KV
State	Pennsylvania
County	Venango
Transmission Owner	MAIT – PENELEC Zone
MFO	20
MWE	20
MWC	12
Fuel	Solar
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

AF2-166 will interconnect with the PENELEC distribution system via a tap on the Emlenton Substation 34.5 kV Clark Summit circuit #00499-51 at pole # OE-16851 (Attachment 1). The IC's proposed generating unit site is located at GPC: 41.2499560, -79.6816130.

Attachment 1 shows a one-line diagram of the proposed primary direct connection facilities for the AF2-166 generation project to connect to the Penelec distribution system. IC will be responsible for constructing all the facilities on its side of the POI, including the attachment facilities which connect the generator to the Penelec distribution system's direct connection facilities.

5 Cost Summary

The AF2-166 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	$269,100
Total System Network Upgrade Costs (Summer Peak)	$0
Total System Network Upgrade Costs(Light Load)	$0
Total System Network Upgrade Costs (TO Identified)	$0
Total Costs	**$269,100**

*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

AF2-166 will interconnect with the PENELEC distribution system via a tap on the Emlenton Substation 34.5 kV Clark Summit circuit #00499-51 at pole # OE-16851 (Attachment 1). The IC's proposed generating unit site is located at GPC: 41.2499560, -79.6816130

Attachment 1 shows a one-line diagram of the proposed primary direct connection facilities for the AF2-166 generation project to connect to the Penelec distribution system. IC will be responsible for constructing all the facilities on its side of the POI, including the attachment facilities which connect the generator to the Penelec distribution system's direct connection facilities.

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

Description	Total Cost
Tap the existing Emlenton 34.5kV Clark Summit line at an existing pole or interspersed pole on Penelec' s existing distribution circuit (00499-51) near pole OE-16851, new SCADA recloser tap to interconnect queue project AF2-166. Install 34.5 kV metering in customer's facilities. The customer will have to provide Penelec with permanent access/roadway to this off-road location/equipment. The customer is responsible to build their own line from their site to Penelec' s existing facilities.	$133,400
Emlenton 34.5kV SS. Adjust Remote Relay and Metering Settings.	$51,700
Haynie 34.5kV SS. Adjust Remote Relay and Metering Settings.	$45,600
Review customer drawings, create nameplates and update CD drawing.	$38,400
Total Physical Interconnection Costs	**$269,100**

7 Schedule

Based on the scope of work for the Direct and Non-Direct Connection facilities, it is expected to take a minimum of **14 months** after the signing of an Interconnection Construction Service Agreement 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 direct connection and that any distribution system outages will be allowed when requested.

The schedule for any 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

Penelec performed an analysis of its distribution system. The AF2-166 project did not contribute to any overloads on the distribution system.

9 Interconnection Customer Requirements

9.1 System Protection

An analysis was conducted to assess the impact of the Haynie-Clark Summit 34.5 kV (AF2-166) 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 Long Bridge Solar, LLC (Developer) constructing a generation facility tapping Penelec's Emlenton Substation 34.5 kV Clark Summit circuit #00499-51 at pole # OE-16851.

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

Long Bridge Solar, LLC 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. Long Bridge Solar, LLC 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/meter2) - (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 Analysis

The Queue Project AF2-166 was evaluated as a 20.0 MW (Capacity 12.0 MW) injection at the Haynies 34.5 kV substation in the PENELEC area. Project AF2-166 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF2-166 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	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
100587630	235197	01KARNSC	138.0	AP	235152	01BUTLER	138.0	AP	1	ATSI-P2-3-CEI-345-004D	breaker	179.0	212.88	214.49	AC	2.88
100587648	235240	01COLMBGPN	138.0	AP	235202	01KISKIV	138.0	AP	1	ATSI-P2-3-CEI-345-004D	breaker	151.0	173.69	174.73	AC	1.85
100587640	235282	01GAR RN	138.0	AP	235240	01COLMBGPN	138.0	AP	1	ATSI-P2-3-CEI-345-004D	breaker	151.0	181.23	182.26	AC	1.85
101100124	957160	AF2-010 TAP	115.0	PENELEC	200571	26UNION CY	115.0	PENELEC	1	PN-P1-2-PN-345-001	single	120.0	109.52	110.71	AC	1.56

11.4 Steady-State Voltage Requirements

To be determined in the Facilities Study phase.

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	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
101100302	200584	26GRANDVW	115.0	PENELEC	946400	AF1-304 TAP	115.0	PENELEC	1	PN-P1-2-PN-345-001	operation	149.0	137.55	137.57	AC	2.6
101100341	200585	26TITUSVIL	115.0	PENELEC	957160	AF2-010 TAP	115.0	PENELEC	1	PN-P1-2-PN-345-001	operation	120.0	100.85	103.0	AC	2.6
101100370	200586	26ECLIPSE	115.0	PENELEC	200576	26UTICA JT	115.0	PENELEC	1	PN-P1-2-PN-345-003	operation	277.0	99.13	101.01	AC	5.22
100588030	235139	01AL&D6T	138.0	AP	235138	01AL 4J	138.0	AP	1	PN-P1-2-PN-345-107T	operation	151.0	127.28	128.15	AC	1.55
100588031	235139	01AL&D6T	138.0	AP	235138	01AL 4J	138.0	AP	1	ATSI-P1-2-CEI-345-700T	operation	151.0	127.28	128.15	AC	1.55
100587910	235197	01KARNSC	138.0	AP	235152	01BUTLER	138.0	AP	1	ATSI-P1-2-CEI-345-700T	operation	179.0	211.16	212.76	AC	2.86
100587911	235197	01KARNSC	138.0	AP	235152	01BUTLER	138.0	AP	1	PN-P1-2-PN-345-107T	operation	179.0	211.16	212.76	AC	2.86
100587947	235203	01KISSNG	138.0	AP	235197	01KARNSC	138.0	AP	1	ATSI-P1-2-CEI-345-700T	operation	268.0	165.29	166.4	AC	3.02
100587948	235203	01KISSNG	138.0	AP	235197	01KARNSC	138.0	AP	1	PN-P1-2-PN-345-107T	operation	268.0	165.29	166.4	AC	3.02
100588036	235204	01KITTAN	138.0	AP	235139	01AL&D6T	138.0	AP	1	PN-P1-2-PN-345-107T	operation	151.0	123.22	124.09	AC	1.55

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
100588037	235204	01KITTAN	138.0	AP	235139	01AL&D6T	138.0	AP	1	ATSI-P1-2-CEI-345-700T	operation	151.0	123.22	124.09	AC	1.55
100587954	235240	01COLMBGPN	138.0	AP	235202	01KISKIV	138.0	AP	1	ATSI-P1-2-CEI-345-700T	operation	151.0	169.2	170.23	AC	1.83
100587955	235240	01COLMBGPN	138.0	AP	235202	01KISKIV	138.0	AP	1	PN-P1-2-PN-345-107T	operation	151.0	169.2	170.23	AC	1.83
100587939	235282	01GAR RN	138.0	AP	235240	01COLMBGPN	138.0	AP	1	PN-P1-2-PN-345-107T	operation	151.0	176.69	177.72	AC	1.83
100587940	235282	01GAR RN	138.0	AP	235240	01COLMBGPN	138.0	AP	1	ATSI-P1-2-CEI-345-700T	operation	151.0	176.69	177.72	AC	1.83
101100120	957160	AF2-010 TAP	115.0	PENELEC	200571	26UNIONCY	115.0	PENELEC	1	PN-P1-2-PN-345-001	operation	120.0	142.31	144.32	AC	2.6
101100123	957160	AF2-010 TAP	115.0	PENELEC	200571	26UNIONCY	115.0	PENELEC	1	Base Case	operation	120.0	107.11	108.96	AC	2.32

11.6 System Reinforcements

ID	Idx	Facility	Upgrade Description	Cost	Cost Allocated to AF2-166	Upgrade Number
100587640	3	**01GAR RN 138.0 kV - 01COLMBGPN 138.0 kV Ckt 1**	**APS** **ProjectId : n6183 (WP-AG1-F-0017)** **Description : Reconductor 10.4 miles of 4/0 CU from Columbia Big Pine - Garretts Run Jct 138 kV (99 spans).** **Type : FAC** **Total Cost : $27,092,520** **Time Estimate : 48.0 Months** **Ratings : 261.0/311.0/311.0** **Queue Project AF2-166 presently does not receive cost allocation for this upgrade.** **Note 1: as changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc, Queue Project AF2-166 could receive cost allocation.** **Note 2: Although Queue Project AF2-166 may not have cost responsibility for this upgrade, Queue Project AF2-166 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AF2-166 comes into service prior to completion of the upgrade, Queue Project AF2-166 will need an interim study**	$27,092,520	$0	n6183

ID	Idx	Facility	Upgrade Description	Cost	Cost Allocated to AF2-166	Upgrade Number
100587630	1	**01KARNSC 138.0 kV - 01BUTLER 138.0 kV Ckt 1**	**APS** **ProjectId : n7170.1 (WP-AG1-F-0008A)** **Description : Replace 336 ACSR, 954 ACSR, & 1024.5 ACAR bus conductor at Karns City substation.** **Type : FAC** **Total Cost : $130,252** **Time Estimate : 12.0 Months** **Ratings : 141.0/182.0/182.0** **Queue Project AF2-166 presently does not receive cost allocation for this upgrade.** **Note 1: as changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc, Queue Project AF2-166 could receive cost allocation.** **Note 2: Although Queue Project AF2-166 may not have cost responsibility for this upgrade, Queue Project AF2-166 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AF2-166 comes into service prior to completion of the upgrade, Queue Project AF2-166 will need an interim study** **ProjectId : n7170.2 (WP-AG1-F-0008B)** **Description : Replace 350 CU, 1.00 IPS CU, & 954 ACSR bus conductor at Butler substation.** **Type : FAC** **Total Cost : $130,252** **Time Estimate : 12.0 Months** **Ratings : 160.0/192.0/192.0** **Queue Project AF2-166 presently does not receive cost allocation for this upgrade.** **Note 1: as changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc, Queue Project AF2-166 could receive cost allocation.** **Note 2: Although Queue Project AF2-166 may not have cost responsibility for this upgrade, Queue Project AF2-166 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AF2-166 comes into service prior to completion of the upgrade, Queue Project AF2-166 will need an interim study**	See Next Page	See Next Page	n7170.1, n7170.2, n7170.3, n7170.4, n7170.5, n7170.6, n7170.7, n7170.8, n7170.9, n7170.10

ID	Idx	Facility	Upgrade Description	Cost	Cost Allocated to AF2-166	Upgrade Number
100587630	1	**01KARNSC 138.0 kV - 01BUTLER 138.0 kV Ckt 1**	**APS (cont'd)** **ProjectId : n7170.3 (WP-AG1-F-0008C)** **Description : Replace 336 ACSR line risers at Butler substation.** **Type : FAC** **Total Cost : $130,252** **Time Estimate : 12.0 Months** **Ratings : 160.0/192.0/192.0** **Queue Project AF2-166 presently does not receive cost allocation for this upgrade.** **Note 1: as changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc, Queue Project AF2-166 could receive cost allocation.** **Note 2: Although Queue Project AF2-166 may not have cost responsibility for this upgrade, Queue Project AF2-166 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AF2-166 comes into service prior to completion of the upgrade, Queue Project AF2-166 will need an interim study** **ProjectId : n7170.4 (WP-AG1-F-0008D)** **Description : Replace 336 ACSR line risers at Karns City substation.** **Type : FAC** **Total Cost : $130,252** **Time Estimate : 12.0 Months** **Ratings : 160.0/192.0/192.0** **Queue Project AF2-166 presently does not receive cost allocation for this upgrade.** **Note 1: as changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc, Queue Project AF2-166 could receive cost allocation.** **Note 2: Although Queue Project AF2-166 may not have cost responsibility for this upgrade, Queue Project AF2-166 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AF2-166 comes into service prior to completion of the upgrade, Queue Project AF2-166 will need an interim study**	See Next Page	See Next Page	n7170.1, n7170.2, n7170.3, n7170.4, n7170.5, n7170.6, n7170.7, n7170.8, n7170.9, n7170.10

ID	Idx	Facility	Upgrade Description	Cost	Cost Allocated to AF2-166	Upgrade Number
100587630	1	**01KARNSC 138.0 kV - 01BUTLER 138.0 kV Ckt 1**	**APS (cont'd)** **ProjectId : n7170.5 (WP-AG1-F-0008E)** **Description : Reconductor 15.6 miles of 336 ACSR on the Butler - Karns City 138 kV line (102 spans).** **Type : FAC** **Total Cost : $40,638,780** **Time Estimate : 60.0 Months** **Ratings : 164.0/206.0/206.0** **Queue Project AF2-166 presently does not receive cost allocation for this upgrade.** **Note 1: as changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc, Queue Project AF2-166 could receive cost allocation.** **Note 2: Although Queue Project AF2-166 may not have cost responsibility for this upgrade, Queue Project AF2-166 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AF2-166 comes into service prior to completion of the upgrade, Queue Project AF2-166 will need an interim study** **ProjectId : n7170.6 (WP-AG1-F-0008F)** **Description : Replace 600 A line side and bus side disconnects at Butler substation.** **Type : FAC** **Total Cost : $390,758** **Time Estimate : 12.0 Months** **Ratings : 196.0/222.0/222.0** **Queue Project AF2-166 presently does not receive cost allocation for this upgrade.** **Note 1: as changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc, Queue Project AF2-166 could receive cost allocation.** **Note 2: Although Queue Project AF2-166 may not have cost responsibility for this upgrade, Queue Project AF2-166 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AF2-166 comes into service prior to completion of the upgrade, Queue Project AF2-166 will need an interim study**	See Next Page	See Next Page	n7170.1, n7170.2, n7170.3, n7170.4, n7170.5, n7170.6, n7170.7, n7170.8, n7170.9, n7170.10

ID	Idx	Facility	Upgrade Description	Cost	Cost Allocated to AF2-166	Upgrade Number
100587630	1	**01KARNSC 138.0 kV - 01BUTLER 138.0 kV Ckt 1**	**APS (cont'd)** **ProjectId : n7170.7 (WP-AG1-F-0008G)** **Description : Replace 350 CU wire to WT at Butler substation.** **Type : FAC** **Total Cost : $130,252** **Time Estimate : 12.0 Months** **Ratings : 196.0/222.0/222.0** **Queue Project AF2-166 presently does not receive cost allocation for this upgrade.** **Note 1: as changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc, Queue Project AF2-166 could receive cost allocation.** **Note 2: Although Queue Project AF2-166 may not have cost responsibility for this upgrade, Queue Project AF2-166 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AF2-166 comes into service prior to completion of the upgrade, Queue Project AF2-166 will need an interim study** **ProjectId : n7170.8 (WP-AG1-F-0008H)** **Description : Replace relaying (WT, ZR) at Butler substation.** **Type : FAC** **Total Cost : $455,884** **Time Estimate : 12.0 Months** **Ratings : 299.0/306.0/306.0** **Queue Project AF2-166 presently does not receive cost allocation for this upgrade.** **Note 1: as changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc, Queue Project AF2-166 could receive cost allocation.** **Note 2: Although Queue Project AF2-166 may not have cost responsibility for this upgrade, Queue Project AF2-166 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AF2-166 comes into service prior to completion of the upgrade, Queue Project AF2-166 will need an interim study**	See Next Page	See Next Page	n7170.1, n7170.2, n7170.3, n7170.4, n7170.5, n7170.6, n7170.7, n7170.8, n7170.9, n7170.10

ID	Idx	Facility	Upgrade Description	Cost	Cost Allocated to AF2-166	Upgrade Number
100587630	1	**01KARNSC 138.0 kV - 01BUTLER 138.0 kV Ckt 1**	**APS (cont'd)** **ProjectId : n7170.9 (WP-AG1-F-0008I)** **Description : Replace relaying (RT, OR, WT, MT) at Karns City substation.** **Type : FAC** **Total Cost : $455,884** **Time Estimate : 12.0 Months** **Ratings : 299.0/360.0/360.0** **Queue Project AF2-166 presently does not receive cost allocation for this upgrade.** **Note 1: as changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc, Queue Project AF2-166 could receive cost allocation.** **Note 2: Although Queue Project AF2-166 may not have cost responsibility for this upgrade, Queue Project AF2-166 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AF2-166 comes into service prior to completion of the upgrade, Queue Project AF2-166 will need an interim study** **ProjectId : n7170.10 (WP-AG1-F-0008J)** **Description : Replace 1200 A circuit breaker at Karns City substation.** **Type : FAC** **Total Cost : $781,515** **Time Estimate : 12.0 Months** **Ratings : 329.0/413.0/413.0** **Queue Project AF2-166 presently does not receive cost allocation for this upgrade.** **Note 1: as changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc, Queue Project AF2-166 could receive cost allocation.** **Note 2: Although Queue Project AF2-166 may not have cost responsibility for this upgrade, Queue Project AF2-166 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AF2-166 comes into service prior to completion of the upgrade, Queue Project AF2-166 will need an interim study**	$43,374,082	$0	n7170.1, n7170.2, n7170.3, n7170.4, n7170.5, n7170.6, n7170.7, n7170.8, n7170.9, n7170.10

ID	Idx	Facility	Upgrade Description	Cost	Cost Allocated to AF2-166	Upgrade Number
100587648	2	**01COLMBGPN 138.0 kV - 01KISKIV 138.0 kV Ckt 1**	**APS** **ProjectId : n6214 (WP-AG1-F-0018A)** **Description : Reconductor 3.7 miles of 4/0 CU.** **Type : FAC** **Total Cost : $9,638,685** **Time Estimate : 36.0 Months** **Ratings : 191.0/191.0/191.0** **Queue Project AF2-166 presently does not receive cost allocation for this upgrade.** **Note 1: as changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc, Queue Project AF2-166 could receive cost allocation.** **Note 2: Although Queue Project AF2-166 may not have cost responsibility for this upgrade, Queue Project AF2-166 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AF2-166 comes into service prior to completion of the upgrade, Queue Project AF2-166 will need an interim study** **ProjectId : n7171.1 (WP-AG1-F-0018B)** **Description : Replace relays (RT) at Kiski Valley substation.** **Type : FAC** **Total Cost : $455,884** **Time Estimate : 12.0 Months** **Ratings : 225.0/295.0/295.0** **Queue Project AF2-166 presently does not receive cost allocation for this upgrade.** **Note 1: as changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc, Queue Project AF2-166 could receive cost allocation.** **Note 2: Although Queue Project AF2-166 may not have cost responsibility for this upgrade, Queue Project AF2-166 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AF2-166 comes into service prior to completion of the upgrade, Queue Project AF2-166 will need an interim study**	$10,094,569	$0	n6214, n7171.1
101100124	4	**AF2-010 TAP 115.0 kV - 26UNION CY 115.0 kV Ckt 1**	**PENELEC** **No Violation. PENELEC current applicable emergency rating is B: 172 MVA.**	$0	$0	N/A
			TOTAL COST	**$80,561,171**	**$0**	

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
100587630	235197	01KARNSC	AP	235152	01BUTLER	AP	1	ATSI-P2-3-CEI-345-004D	breaker	179.0	212.88	214.49	AC	2.88

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
200608	26PINEY #1	0.8526	50/50	0.8526
200662	26SCRUB GR	1.7816	50/50	1.7816
201477	26Y2-055	1.6819	Adder	1.98
235030	01MHNG-T155	0.1725	50/50	0.1725
293393	V3-030E	1.2541	Adder	1.48
915951	Y3-092 FTIR	92.1100	Merchant Transmission	92.1100
916202	Z1-069 E	2.5032	Adder	2.94
919491	AA2-000	21.4760	Adder	25.27
923443	AB1-160 E	0.7152	Adder	0.84
930511	AB1-092	0.7885	Adder	0.93
935191	**AD1-154 (Withdrawn : 02/04/2021)**	**2.3410**	**50/50**	**2.3410**
936421	AD2-055	1.6235	Adder	1.91
938951	AE1-123	2.8310	50/50	2.8310
939291	AE1-160 C	1.4743	50/50	1.4743
939292	AE1-160 E	0.8475	50/50	0.8475
940861	AE2-074 C	0.7260	Adder	0.85
940862	AE2-074 E	0.9557	Adder	1.12
941191	AE2-113 C	3.3852	Adder	3.98
941192	AE2-113 E	3.6448	Adder	4.29
941321	**AE2-126 C (Suspended)**	**0.6515**	**Adder**	**0.77**
941322	**AE2-126 E (Suspended)**	**0.4343**	**Adder**	**0.51**
941331	AE2-129 C	0.5508	Adder	0.65
941332	AE2-129 E	0.3672	Adder	0.43
941351	**AE2-131 C (Suspended)**	**0.5508**	**Adder**	**0.65**
941352	**AE2-131 E (Suspended)**	**0.3672**	**Adder**	**0.43**
942491	AE2-262 C	2.3673	Adder	2.79
942492	AE2-262 E	1.5908	Adder	1.87
942501	AE2-263 C	2.2252	Adder	2.62
942502	AE2-263 E	1.4857	Adder	1.75
942811	AE2-299 C	1.8996	Adder	2.23
942812	AE2-299 E	7.5986	Adder	8.94
942961	AE2-316 C	4.3232	50/50	4.3232
942962	AE2-316 E	6.1648	50/50	6.1648
943151	AE2-344 C	4.3878	Adder	5.16
943152	AE2-344 E	2.9252	Adder	3.44
943351	AF1-006 C	0.8631	Adder	1.02
943352	AF1-006 E	0.4855	Adder	0.57
943751	AF1-043	4.8704	Adder	5.73
944181	AF1-086 C O1	1.0969	Adder	1.29

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
944182	AF1-086 E O1	4.7723	Adder	5.61
944261	AF1-094 C	0.9127	Adder	1.07
944262	AF1-094 E	0.6085	Adder	0.72
944281	AF1-096 C	1.3931	50/50	1.3931
944282	AF1-096 E	0.9287	50/50	0.9287
944301	AF1-098 C	2.9490	Adder	3.47
944302	AF1-098 E	1.9660	Adder	2.31
944311	AF1-099 C	3.5935	Adder	4.23
944312	AF1-099 E	2.3957	Adder	2.82
944321	AF1-100 C	7.7354	Adder	9.1
944322	AF1-100 E	5.1569	Adder	6.07
944381	AF1-103 O1	1.1601	Adder	1.36
944391	AF1-104 O1	1.4831	Adder	1.74
944691	AF1-134 C O1	0.6278	Adder	0.74
944692	AF1-134 E O1	0.4185	Adder	0.49
944771	AF1-142 C	5.7496	Adder	6.76
944772	AF1-142 E	3.8331	Adder	4.51
944881	AF1-153 C O1	0.8874	Adder	1.04
944882	AF1-153 E O1	0.5916	Adder	0.7
944901	AF1-155 C	0.8962	Adder	1.05
944902	AF1-155 E	0.5974	Adder	0.7
945021	AF1-167 C	1.5108	50/50	1.5108
945022	AF1-167 E	1.0091	50/50	1.0091
945051	AF1-170 C	3.2735	Adder	3.85
945052	AF1-170 E	2.1823	Adder	2.57
945121	AF1-177	0.2900	Adder	0.34
945161	AF1-181	0.0413	Adder	0.05
945171	AF1-182	0.2064	Adder	0.24
945181	AF1-183	0.0512	Adder	0.06
945451	AF1-210 C	1.7109	50/50	1.7109
945452	AF1-210 E	1.1406	50/50	1.1406
945751	AF1-240 C O1	1.4046	50/50	1.4046
945752	AF1-240 E O1	0.9364	50/50	0.9364
946111	AF1-276 C	3.5189	Adder	4.14
946112	AF1-276 E	1.7332	Adder	2.04
946121	AF1-277 C	3.5189	Adder	4.14
946122	AF1-277 E	1.7332	Adder	2.04
946131	AF1-278 C	2.8046	Adder	3.3
946132	AF1-278 E	1.3950	Adder	1.64
946381	AF1-302 C	1.8878	50/50	1.8878
946382	AF1-302 E	2.5171	50/50	2.5171
946401	AF1-304 C	7.3032	50/50	7.3032
946402	AF1-304 E	4.8688	50/50	4.8688
946421	AF1-306 C	3.0276	Adder	3.56
946422	AF1-306 E	12.1105	Adder	14.25
957161	AF2-010 C	3.5483	Adder	4.17
957162	AF2-010 E	2.3913	Adder	2.81
957451	AF2-039 C	0.4120	Adder	0.48
957452	AF2-039 E	0.2747	Adder	0.32
957571	AF2-051 C	2.5767	Adder	3.03
957572	AF2-051 E	1.3274	Adder	1.56
957941	AF2-088 C	0.1984	Adder	0.23

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
957942	AF2-088 E	0.1322	Adder	0.16
958271	AF2-121 C	0.5508	Adder	0.65
958272	AF2-121 E	0.3672	Adder	0.43
958361	AF2-130 C	1.7261	50/50	1.7261
958362	AF2-130 E	1.1507	50/50	1.1507
958731	AF2-164 C O1	3.9711	Adder	4.67
958732	AF2-164 E O1	2.6474	Adder	3.11
958741	AF2-165 C	1.5401	50/50	1.5401
958742	AF2-165 E	1.0267	50/50	1.0267
958751	AF2-166 C	1.7261	50/50	1.7261
958752	AF2-166 E	1.1507	50/50	1.1507
959441	AF2-235 C	0.6965	50/50	0.6965
959442	AF2-235 E	0.4644	50/50	0.4644
959521	AF2-243 C	1.1551	50/50	1.1551
959522	AF2-243 E	0.7700	50/50	0.7700
959822	AF2-273 E	0.6772	50/50	0.6772
960041	AF2-295 C	0.8962	Adder	1.05
960042	AF2-295 E	0.5974	Adder	0.7
960051	AF2-296 C	0.6278	Adder	0.74
960052	AF2-296 E	0.4185	Adder	0.49
960891	AF2-380 C	3.6787	50/50	3.6787
960892	AF2-380 E	2.4525	50/50	2.4525
NEWTON	NEWTON	0.7178	Confirmed LTF	0.7178
FARMERCITY	FARMERCITY	0.0368	Confirmed LTF	0.0368
G-007A	G-007A	1.9995	Confirmed LTF	1.9995
VFT	VFT	5.5341	Confirmed LTF	5.5341
GIBSON	GIBSON	0.3669	Confirmed LTF	0.3669
PRAIRIE	PRAIRIE	1.6841	Confirmed LTF	1.6841
COFFEEN	COFFEEN	0.1333	Confirmed LTF	0.1333
CHEOAH	CHEOAH	0.2828	Confirmed LTF	0.2828
EDWARDS	EDWARDS	0.2390	Confirmed LTF	0.2390
TILTON	TILTON	0.4290	Confirmed LTF	0.4290
MADISON	MADISON	0.0524	Confirmed LTF	0.0524
CALDERWOOD	CALDERWOOD	0.2823	Confirmed LTF	0.2823
BLUEG	BLUEG	1.1649	Confirmed LTF	1.1649
TRIMBLE	TRIMBLE	0.3740	Confirmed LTF	0.3740
CATAWBA	CATAWBA	0.1694	Confirmed LTF	0.1694

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
100587648	235240	01COLMBGPN	AP	235202	01KISKIV	AP	1	ATSI-P2-3-CEI-345-004D	breaker	151.0	173.69	174.73	AC	1.85

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
201477	26Y2-055	1.3831	Adder	1.63
235030	01MHNG-T155	0.1947	50/50	0.1947
235134	01AL&D6	0.1817	50/50	0.1817
915951	Y3-092 FTIR	82.4500	Merchant Transmission	82.4500
935191	**AD1-154 (Withdrawn : 02/04/2021)**	**1.1934**	**Adder**	**1.4**
938951	AE1-123	1.4679	Adder	1.73
939291	AE1-160 C	0.8838	Adder	1.04
939292	AE1-160 E	0.5080	Adder	0.6
941191	AE2-113 C	2.7696	Adder	3.26
941192	AE2-113 E	2.9819	Adder	3.51
942811	AE2-299 C	1.5697	Adder	1.85
942812	AE2-299 E	6.2788	Adder	7.39
942961	AE2-316 C	3.5012	Adder	4.12
942962	AE2-316 E	4.9928	Adder	5.87
943151	AE2-344 C	3.7128	Adder	4.37
943152	AE2-344 E	2.4752	Adder	2.91
943351	AF1-006 C	0.7333	Adder	0.86
943352	AF1-006 E	0.4125	Adder	0.49
944261	AF1-094 C	0.7007	Adder	0.82
944262	AF1-094 E	0.4672	Adder	0.55
944281	AF1-096 C	0.8351	Adder	0.98
944282	AF1-096 E	0.5567	Adder	0.65
944301	AF1-098 C	2.4345	Adder	2.86
944302	AF1-098 E	1.6230	Adder	1.91
944381	AF1-103 O1	0.9540	Adder	1.12
944391	AF1-104 O1	1.3056	Adder	1.54
944881	AF1-153 C O1	0.6707	Adder	0.79
944882	AF1-153 E O1	0.4471	Adder	0.53
944901	AF1-155 C	0.6761	Adder	0.8
944902	AF1-155 E	0.4507	Adder	0.53
945021	AF1-167 C	0.9702	50/50	0.9702
945022	AF1-167 E	0.6480	50/50	0.6480
945051	AF1-170 C	2.8395	Adder	3.34
945052	AF1-170 E	1.8930	Adder	2.23
945121	AF1-177	0.2385	Adder	0.28
945451	AF1-210 C	1.2703	50/50	1.2703
945452	AF1-210 E	0.8468	50/50	0.8468
945751	AF1-240 C O1	0.7160	Adder	0.84
945752	AF1-240 E O1	0.4774	Adder	0.56

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
946111	AF1-276 C	2.9449	Adder	3.46
946112	AF1-276 E	1.4505	Adder	1.71
946121	AF1-277 C	2.9449	Adder	3.46
946122	AF1-277 E	1.4505	Adder	1.71
946131	AF1-278 C	2.3471	Adder	2.76
946132	AF1-278 E	1.1674	Adder	1.37
946381	AF1-302 C	1.5289	Adder	1.8
946382	AF1-302 E	2.0386	Adder	2.4
946401	AF1-304 C	4.3172	Adder	5.08
946402	AF1-304 E	2.8781	Adder	3.39
946421	AF1-306 C	2.4100	Adder	2.84
946422	AF1-306 E	9.6398	Adder	11.34
957161	AF2-010 C	2.7104	Adder	3.19
957162	AF2-010 E	1.8266	Adder	2.15
957571	AF2-051 C	2.1868	Adder	2.57
957572	AF2-051 E	1.1265	Adder	1.33
958361	AF2-130 C	0.9419	Adder	1.11
958362	AF2-130 E	0.6279	Adder	0.74
958731	AF2-164 C O1	3.7361	Adder	4.4
958732	AF2-164 E O1	2.4907	Adder	2.93
958741	AF2-165 C	0.9045	Adder	1.06
958742	AF2-165 E	0.6030	Adder	0.71
958751	AF2-166 C	0.9419	Adder	1.11
958752	AF2-166 E	0.6279	Adder	0.74
959441	AF2-235 C	0.4175	Adder	0.49
959442	AF2-235 E	0.2784	Adder	0.33
959521	AF2-243 C	0.6784	Adder	0.8
959522	AF2-243 E	0.4523	Adder	0.53
959822	AF2-273 E	0.4771	50/50	0.4771
960041	AF2-295 C	0.6761	Adder	0.8
960042	AF2-295 E	0.4507	Adder	0.53
960891	AF2-380 C	0.5148	Adder	0.61
960892	AF2-380 E	0.3432	Adder	0.4
NEWTON	NEWTON	0.5372	Confirmed LTF	0.5372
FARMERCITY	FARMERCITY	0.0277	Confirmed LTF	0.0277
G-007A	G-007A	1.6111	Confirmed LTF	1.6111
VFT	VFT	4.4763	Confirmed LTF	4.4763
GIBSON	GIBSON	0.2746	Confirmed LTF	0.2746
PRAIRIE	PRAIRIE	1.2708	Confirmed LTF	1.2708
COFFEEN	COFFEEN	0.0998	Confirmed LTF	0.0998
CHEOAH	CHEOAH	0.2232	Confirmed LTF	0.2232
EDWARDS	EDWARDS	0.1774	Confirmed LTF	0.1774
TILTON	TILTON	0.3194	Confirmed LTF	0.3194
MADISON	MADISON	0.0343	Confirmed LTF	0.0343
CALDERWOOD	CALDERWOOD	0.2227	Confirmed LTF	0.2227
BLUEG	BLUEG	0.8749	Confirmed LTF	0.8749
TRIMBLE	TRIMBLE	0.2810	Confirmed LTF	0.2810
CATAWBA	CATAWBA	0.1400	Confirmed LTF	0.1400

11.7.3 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
100587640	235282	01GARRN	AP	235240	01COLMBGPN	AP	1	ATSI-P2-3-CEI-345-004D	breaker	151.0	181.23	182.26	AC	1.85

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
201477	26Y2-055	1.3831	Adder	1.63
235030	01MHNG-T155	0.1947	50/50	0.1947
235134	01AL&D6	0.1817	50/50	0.1817
915951	Y3-092 FTIR	82.4500	Merchant Transmission	82.4500
935191	**AD1-154 (Withdrawn : 02/04/2021)**	**1.1934**	**Adder**	**1.4**
938951	AE1-123	1.4679	Adder	1.73
939291	AE1-160 C	0.8838	Adder	1.04
939292	AE1-160 E	0.5080	Adder	0.6
941191	AE2-113 C	2.7696	Adder	3.26
941192	AE2-113 E	2.9819	Adder	3.51
942811	AE2-299 C	1.5697	Adder	1.85
942812	AE2-299 E	6.2788	Adder	7.39
942961	AE2-316 C	3.5012	Adder	4.12
942962	AE2-316 E	4.9928	Adder	5.87
943151	AE2-344 C	3.7128	Adder	4.37
943152	AE2-344 E	2.4752	Adder	2.91
943351	AF1-006 C	0.7333	Adder	0.86
943352	AF1-006 E	0.4125	Adder	0.49
944261	AF1-094 C	0.7007	Adder	0.82
944262	AF1-094 E	0.4672	Adder	0.55
944281	AF1-096 C	0.8351	Adder	0.98
944282	AF1-096 E	0.5567	Adder	0.65
944301	AF1-098 C	2.4345	Adder	2.86
944302	AF1-098 E	1.6230	Adder	1.91
944381	AF1-103 O1	0.9540	Adder	1.12
944391	AF1-104 O1	1.3056	Adder	1.54
944881	AF1-153 C O1	0.6707	Adder	0.79
944882	AF1-153 E O1	0.4471	Adder	0.53
944901	AF1-155 C	0.6761	Adder	0.8
944902	AF1-155 E	0.4507	Adder	0.53
945021	AF1-167 C	0.9702	50/50	0.9702
945022	AF1-167 E	0.6480	50/50	0.6480
945051	AF1-170 C	2.8395	Adder	3.34
945052	AF1-170 E	1.8930	Adder	2.23
945121	AF1-177	0.2385	Adder	0.28
945451	AF1-210 C	1.2703	50/50	1.2703
945452	AF1-210 E	0.8468	50/50	0.8468
945751	AF1-240 C O1	0.7160	Adder	0.84
945752	AF1-240 E O1	0.4774	Adder	0.56

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
946111	AF1-276 C	2.9449	Adder	3.46
946112	AF1-276 E	1.4505	Adder	1.71
946121	AF1-277 C	2.9449	Adder	3.46
946122	AF1-277 E	1.4505	Adder	1.71
946131	AF1-278 C	2.3471	Adder	2.76
946132	AF1-278 E	1.1674	Adder	1.37
946381	AF1-302 C	1.5289	Adder	1.8
946382	AF1-302 E	2.0386	Adder	2.4
946401	AF1-304 C	4.3172	Adder	5.08
946402	AF1-304 E	2.8781	Adder	3.39
946421	AF1-306 C	2.4100	Adder	2.84
946422	AF1-306 E	9.6398	Adder	11.34
957161	AF2-010 C	2.7104	Adder	3.19
957162	AF2-010 E	1.8266	Adder	2.15
957571	AF2-051 C	2.1868	Adder	2.57
957572	AF2-051 E	1.1265	Adder	1.33
958361	AF2-130 C	0.9419	Adder	1.11
958362	AF2-130 E	0.6279	Adder	0.74
958731	AF2-164 C O1	3.7361	Adder	4.4
958732	AF2-164 E O1	2.4907	Adder	2.93
958741	AF2-165 C	0.9045	Adder	1.06
958742	AF2-165 E	0.6030	Adder	0.71
958751	AF2-166 C	0.9419	Adder	1.11
958752	AF2-166 E	0.6279	Adder	0.74
959441	AF2-235 C	0.4175	Adder	0.49
959442	AF2-235 E	0.2784	Adder	0.33
959521	AF2-243 C	0.6784	Adder	0.8
959522	AF2-243 E	0.4523	Adder	0.53
959822	AF2-273 E	0.4771	50/50	0.4771
960041	AF2-295 C	0.6761	Adder	0.8
960042	AF2-295 E	0.4507	Adder	0.53
960891	AF2-380 C	0.5148	Adder	0.61
960892	AF2-380 E	0.3432	Adder	0.4
NEWTON	NEWTON	0.5372	Confirmed LTF	0.5372
FARMERCITY	FARMERCITY	0.0277	Confirmed LTF	0.0277
G-007A	G-007A	1.6111	Confirmed LTF	1.6111
VFT	VFT	4.4763	Confirmed LTF	4.4763
GIBSON	GIBSON	0.2746	Confirmed LTF	0.2746
PRAIRIE	PRAIRIE	1.2708	Confirmed LTF	1.2708
COFFEEN	COFFEEN	0.0998	Confirmed LTF	0.0998
CHEOAH	CHEOAH	0.2232	Confirmed LTF	0.2232
EDWARDS	EDWARDS	0.1774	Confirmed LTF	0.1774
TILTON	TILTON	0.3194	Confirmed LTF	0.3194
MADISON	MADISON	0.0343	Confirmed LTF	0.0343
CALDERWOOD	CALDERWOOD	0.2227	Confirmed LTF	0.2227
BLUEG	BLUEG	0.8749	Confirmed LTF	0.8749
TRIMBLE	TRIMBLE	0.2810	Confirmed LTF	0.2810
CATAWBA	CATAWBA	0.1400	Confirmed LTF	0.1400

11.7.4 Index 4

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
101100124	957160	AF2-010 TAP	PENELEC	200571	26UNION CY	PENELEC	1	PN-P1-2-PN-345-001	single	120.0	109.52	110.71	AC	1.56

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
200608	26PINEY #1	0.4414	80/20	0.4414
200662	26SCRUB GR	1.8261	80/20	1.8261
935191	**AD1-154 (Withdrawn : 02/04/2021)**	**1.1522**	**80/20**	**1.1522**
938951	AE1-123	1.4657	80/20	1.4657
939291	AE1-160 C	4.6012	80/20	4.6012
944281	AF1-096 C	4.3476	80/20	4.3476
945751	AF1-240 C O1	0.6913	80/20	0.6913
946401	AF1-304 C	17.1816	80/20	17.1816
957161	AF2-010 C	32.4116	80/20	32.4116
958361	AF2-130 C	1.5571	80/20	1.5571
958741	AF2-165 C	1.9696	80/20	1.9696
958751	AF2-166 C	1.5571	80/20	1.5571
959441	AF2-235 C	2.1738	80/20	2.1738
959521	AF2-243 C	1.4772	80/20	1.4772
NEWTON	NEWTON	0.2138	Confirmed LTF	0.2138
FARMERCITY	FARMERCITY	0.0110	Confirmed LTF	0.0110
G-007A	G-007A	0.4843	Confirmed LTF	0.4843
VFT	VFT	1.2964	Confirmed LTF	1.2964
GIBSON	GIBSON	0.1087	Confirmed LTF	0.1087
PRAIRIE	PRAIRIE	0.4908	Confirmed LTF	0.4908
COFFEEN	COFFEEN	0.0401	Confirmed LTF	0.0401
CHEOAH	CHEOAH	0.0671	Confirmed LTF	0.0671
EDWARDS	EDWARDS	0.0749	Confirmed LTF	0.0749
TILTON	TILTON	0.1317	Confirmed LTF	0.1317
MADISON	MADISON	0.0040	Confirmed LTF	0.0040
CALDERWOOD	CALDERWOOD	0.0671	Confirmed LTF	0.0671
BLUEG	BLUEG	0.3368	Confirmed LTF	0.3368
TRIMBLE	TRIMBLE	0.1085	Confirmed LTF	0.1085
CATAWBA	CATAWBA	0.0322	Confirmed LTF	0.0322

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
AA2-000	N/A	N/A
AB1-092	Moshannon-East Towanda 230kV	Active
AB1-160	Gold-Sabinsville 115kV	In Service
AD1-154	Timblin 34.5 kV	Withdrawn
AD2-055	Moshannon-East Towanda 230 kV	Active
AE1-123	Emlenton 34.5 kV	Engineering and Procurement
AE1-160	Venango 34.5 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	Suspended
AE2-129	Philipsburg-Clarence 34.5 kV	Engineering and Procurement
AE2-131	Philipsburg-Karthaus 34.5	Suspended
AE2-262	Moshannon-Milesburg 230 kV	Active
AE2-263	Moshannon-Milesburg 230 kV	Active
AE2-299	Erie East 230 kV	Active
AE2-316	Brookville-Squab Hollow 138 kV	Active
AE2-344	Edinboro South-Venango Junction 115 kV	Active
AF1-006	Fairview East 34.5 kV	Active
AF1-043	Moshannon-East Towanda 230 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
AF1-134	Philipsburg-Madera 34.5 kV	Active
AF1-142	Moshannon-Milesburg 230 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
AF1-210	Burma 23 kV	Engineering and Procurement
AF1-240	Timblin 34.5 kV	Active

Queue Number	Project Name	Status
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
AF1-304	Titusville-Grandview 115 kV	Active
AF1-306	Squab Hollow 230 kV	Active
AF2-010	Union City-Titusville 115 kV	Active
AF2-039	Shawville-Clearfield 34.5 kV	Active
AF2-051	Geneva 115 kV	Active
AF2-088	Shawville-Clearfield 34.5 kV II	Active
AF2-121	Philipsburg-Shawville 34.5 kV	Active
AF2-130	Wolfs Corners 34.5 kV	Active
AF2-164	Handsome Lake 345 kV	Active
AF2-165	Clark Summit-Emlenton 34.5 kV	Active
AF2-166	Clark Summit-Emlenton 34 kV	Active
AF2-235	Titusville-Oil Creek 34.5 kV	Active
AF2-243	Clark Summit 34.5 kV	Active
AF2-273	Sligo 25 kV	Engineering and Procurement
AF2-295	Wilcox-Paper City 46 kV	Active
AF2-296	Madera 34.5 kV	Active
AF2-380	Karns City-Bear Creek 25 kV	Active
V3-030	St. Benedict-Patton 46kV	In Service
Y2-055	Elm Street 34.5kV	Withdrawn
Y3-092	Erie West 345kV	Engineering and Procurement
Z1-069	Gold-Sabinsville 115kV	In Service

11.9 Contingency Descriptions

Contingency Name	Contingency Definition
ATSI-P2-3-CEI-345-004D	CONTINGENCY 'ATSI-P2-3-CEI-345-004D' /* ERIE WEST 345KV BKR 8 DISCONNECT BRANCH FROM BUS 200599 TO BUS 200600 CKT 1 /* 26ERIE W 345 26ERIE SO 345 DISCONNECT BRANCH FROM BUS 200599 TO BUS 238547 CKT 1 /* 26ERIE W 345 02AT 345 DISCONNECT BRANCH FROM BUS 238547 TO BUS 239036 CKT 1 /* 02AT 345 02PERRY 345 DISCONNECT BRANCH FROM BUS 238547 TO BUS 239082 CKT 1 /* 02AT 345 02S8-ATT 345 DISCONNECT BUS 200600 /* 26ERIE SO 345 DISCONNECT BUS 238547 /* 02AT 345 END
PN-P1-2-PN-345-003	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
PN-P1-2-PN-345-001	CONTINGENCY 'PN-P1-2-PN-345-001' /* ERIE WEST - WAYNE 345KV DISCONNECT BRANCH FROM BUS 200599 TO BUS 200595 CKT 1 /* 26ERIE W 345 26WAYNE 345 END
ATSI-P1-2-CEI-345-700T	CONTINGENCY 'ATSI-P1-2-CEI-345-700T' /* PN/ATSI ERIE WEST - ASHTABULA - PERRY 345KV DISCONNECT BRANCH FROM BUS 239036 TO BUS 238547 CKT 1 /* 02PERRY 345 02AT 345 DISCONNECT BRANCH FROM BUS 238547 TO BUS 239082 CKT 1 /* 02AT 345 02S8-ATT 345 DISCONNECT BRANCH FROM BUS 239082 TO BUS 238544 CKT 8 /* 02S8-ATT 345 02ASH_3 138 DISCONNECT BRANCH FROM BUS 238547 TO BUS 200599 CKT 1 /* 02AT 345 26ERIE W 345 END
Base Case	

Contingency Name	Contingency Definition
PN-P1-2-PN-345-107T	CONTINGENCY 'PN-P1-2-PN-345-107T' /* ERIE WEST - ASHTABULA - PERRY 345KV DISCONNECT BRANCH FROM BUS 200599 TO BUS 238547 CKT 1 /* 26ERIE W 345 02AT 345 DISCONNECT BRANCH FROM BUS 238547 TO BUS 239082 CKT 1 /* 02AT 345 02S8-ATT 345 DISCONNECT BRANCH FROM BUS 238547 TO BUS 239036 CKT 1 /* 02AT 345 02PERRY 345 DISCONNECT BUS 238547 /* 02AT 345 END

12 Light Load Analysis

Not required.

13 Short Circuit Analysis

The following Breakers are overdutied:

None.

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)

Not required.

15 Affected Systems

15.1 NYISO

None.

16 Attachment 1: One Line Diagram