Revised

Generation Interconnection

System Impact Study Report

For

Queue Project AG1-040

MORGAN STREET-MOUNT HOPE 34.5 KV

12 MW Capacity / 20 MW Energy

December 2021

Revision 1

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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 PENELEC.

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 Revisions since August 2021 System Impact Study Report

The System Impact Study has been revised to reflect the new generator location and physical tap point on the Morgan Street- Mount Hope 34.5 kV line at pole MP-6352. The one line has been updated. The analysis results from the August 2021 report have not changed as the electrical POI in the load flow model is still the same (at Morgan Street 34.5 kV bus). The scope/cost/schedule will be updated in the Facilities Study.

4 General

The Interconnection Customer (IC), has proposed a Solar generating facility located in Crawford 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 December 01, 2022. This study does not imply a TO commitment to this in-service date.

Queue Number	**AG1-040**
Project Name	MORGAN STREET-MOUNT HOPE 34.5 KV
State	Pennsylvania
County	Crawford
Transmission Owner	PENELEC
MFO	20
MWE	20
MWC	12
Fuel	Solar
Basecase Study Year	2024

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

5 Point of Interconnection

AG1-040 will interconnect with the PENELEC on distribution system via a tap on the 34.5 kV Mount Hope circuit out of Morgan Street Substation at pole # **MP-6352**.

In January 2021 distribution reliability changes were made to the Morgan St. 34.5kV Mount Hope circuit #00235-52 that changed the normally open tie point with the Titusville 34.5kV Morgan St circuit #00235-51. The normally open tie was moved from pole MP-28251 to pole MP-15752. Because of this change AG1-040 will need to interconnect with PENELEC on distribution system via a tap on the 34.5 kV Mount Hope circuit at pole # MP-6352 to remain sourced for Morgan St. substation. Customer would be responsible to build to this location.

Distribution studies were reviewed to change the primary interconnection to the Titusville Substation 34.5kV Morgan St circuit #00235-51 but this would cause both substation transformers to be overloaded 150%. See existing PJM que for generation requests at Titusville.

Attachment 1 shows a one-line diagram of the proposed primary direct connection facilities for the AG1-040 generation project to connect to the Penelec distribution system.

6 Cost Summary

The AG1-040 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	$567,789.47
Allocation towards System Network Upgrade Costs (PJM Identified - Summer Peak)*	$0
Allocation towards System Network Upgrade Costs (PJM Identified - Light Load)*	$0
Allocation towards System Network Upgrade Costs (TO Identified)*	$0
Total Costs	**$567,789.47**

*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.

7 Transmission Owner Scope of Work

The AG1-040 will interconnect with the Penelec distribution system via a tap on the 34.5 kV Mount Hope circuit at pole #**MP-6352**. The IC will be responsible for acquiring all easements, properties, and permits that may be required to construct the new interconnection station and the associated facilities.

Attachment 1 shows a one-line diagram of the proposed primary direct connection facilities for the AG1-040 generation project to connect to the Penelec distribution system. The IC will be responsible for constructing all of the facilities on its side of the POI, including the attachment facilities which connect the generator to the FE distribution system's direct connection facilities.

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

Description	**Total Cost**
The proposed tap point was noted near pole # MP-6352 on the Morgan Street substation 34.5kV Mount Hope. Install SCADA Switch and 34.5kV metering.	$155,698.59
Line Terminal Upgrade. @ Morgan Street	$366,913.47
Customer Sub Review. @ AG1-040 Generation	$45,177.41
Total Physical Interconnection Costs	**$567,789.47**

8 Schedule

Based on the scope of work for the interconnection facilities, it is expected to take a minimum of **14 months** after the signing of an Interconnection Construction Service Agreement (or "Interconnection Agreement" if non-FERC) and construction kickoff call to complete the installation of the physical connection work. 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 interconnection work, and that all 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.

9 Transmission Owner Analysis

Penelec performed an analysis of its distribution system. The AG1-040 project did not contribute to any overloads on the distribution system.

10 Interconnection Customer Requirements

10.1 System Protection

An analysis was conducted to assess the impact of the Morgan Street-Mount Hope 34.5 kV (AG1-040) 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 Foundation Solar Partners, LLC (Developer) constructing a generation facility they call “Crouser Solar” tapping Penelec’s Morgan Street – 34.5kV Mount Hope circuit at pole MP-6352.

The 34.5kV interconnection proposal will require Developer to meet applicable "Technical Requirements" as outlined in First Energy's document titled “Technical Interconnection Requirements and Study Criteria for Distributed Energy Resources Interconnected to Distribution Systems". Anti-islanding system shall meet IEEE 1547 and UL 1741. Therefore no Direct Transfer Trip (DTT) will be required.

10.2 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.

10.3 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 Technical Interconnection Requirements and Study Criteria for Distributed Energy Resources Interconnected to Distribution Systems.

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

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 'Re-synchronizing 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.

10.4 Compliance Issues

Foundation Solar Partners, LLC will be responsible for meeting a power factor between 0.95 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. Foundation Solar Partners, 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.

11 Revenue Metering and SCADA Requirements

11.1 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.

11.2 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)

11.3 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/

12 Summer Peak Analysis

The Queue Project AG1-040 was evaluated as a 20.0 MW (Capacity 12.00 MW) injection at the Morgan Street #1 34.5 kV substation in the PENELEC area. Project AG1-040 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AG1-040 was studied with a commercial probability of 100.0 %. Potential network impacts were as follows:

12.1 Generation Deliverability

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

None.

12.2 Multiple Facility Contingency

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

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)

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONTNAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
16725921 1	235197	01KARNSC	138.0	AP	235152	01BUTLER	138.0	AP	1	ATSI-P2-3-CEI-345-004D	breaker	179.0	213.6	214.48	AC	1.87
16725922 3	235240	01COLMBGPN	138.0	AP	235202	01KISKIV	138.0	AP	1	ATSI-P2-3-CEI-345-004D	breaker	151.0	166.55	167.41	AC	1.54
16725922 1	235282	01GAR RN	138.0	AP	235240	01COLMBGPN	138.0	AP	1	ATSI-P2-3-CEI-345-004D	breaker	151.0	168.79	169.66	AC	1.54

12.4 Steady-State Voltage Requirements

None.

12.5 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
166114817	200575	26MRGAN ST	115.0	PENELEC	200573	26VENGO JT	115.0	PENELEC	1	PN-P1-2-PN-345-001	operation	149.0	95.98	101.63	AC	8.3
167797863	235197	01KARNSC	138.0	AP	235152	01BUTLER	138.0	AP	1	PN-P1-2-PN-345-107T	operation	179.0	211.67	212.55	AC	1.86
167797864	235197	01KARNSC	138.0	AP	235152	01BUTLER	138.0	AP	1	ATSI-P1-2-CEI-345-700T	operation	179.0	211.67	212.55	AC	1.86
167797909	235240	01COLMBG PN	138.0	AP	235202	01KISKIV	138.0	AP	1	PN-P1-2-PN-345-107T	operation	151.0	162.9	163.76	AC	1.53
167797910	235240	01COLMBG PN	138.0	AP	235202	01KISKIV	138.0	AP	1	ATSI-P1-2-CEI-345-700T	operation	151.0	162.9	163.76	AC	1.53
167797897	235282	01GAR RN	138.0	AP	235240	01COLMBG PN	138.0	AP	1	PN-P1-2-PN-345-107T	operation	151.0	165.14	166.0	AC	1.53
167797898	235282	01GAR RN	138.0	AP	235240	01COLMBG PN	138.0	AP	1	ATSI-P1-2-CEI-345-700T	operation	151.0	165.14	166.0	AC	1.53

12.6 System Reinforcements

ID	Idx	Facility	Upgrade Description	Cost	Cost Allocated to AG1-040	Upgrade Number
167259211	1	**01KARNSC 138.0 kV - 01BUTLER 138.0 kV Ckt 1**	**APS** **Project Id: n7170.1 (WP-AG1-S-0008A)** **Description:** Replace 336 ACSR, 954 ACSR, & 1024.5 ACAR bus conductor at Karns City substation. **Type :** FAC **Total Cost :** $260,505 **Time Estimate :** 12.0 Months **Ratings :** 141.0/182.0/182.0 Queue Project AG1-040 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 AG1-040 could receive cost allocation. Note 2: Although Queue Project AG1-040 may not have cost responsibility for this upgrade, Queue Project AG1-040 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AG1-040 comes into service prior to completion of the upgrade, Queue Project AG1-040 will need an interim study **Project Id: n7170.2 (WP-AG1-S-0008B)** **Description:** Replace 350 CU, 1.00 IPS CU, & 954 ACSR bus conductor at Butler substation. **Type :** FAC **Total Cost :** $260,505 **Time Estimate :** 12.0 Months **Ratings :** 160.0/192.0/192.0 Queue Project AG1-040 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 AG1-040 could receive cost allocation. Note 2: Although Queue Project AG1-040 may not have cost responsibility for this upgrade, Queue Project AG1-040 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AG1-040 comes into service prior to completion of the upgrade, Queue Project AG1-040 will need an interim study	See Next Page	$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 AG1-040	Upgrade Number
167259211	1	**01KARNSC 138.0 kV - 01BUTLER 138.0 kV Ckt 1**	**APS (contd...)** **Project Id: n7170.3 (WP-AG1-S-0008C)** **Description: Replace 336 ACSR line risers at Butler substation.** **Type : FAC** **Total Cost : $130,253** **Time Estimate : 12.0 Months** **Ratings : 160.0/192.0/192.0** **Queue Project AG1-040 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 AG1-040 could receive cost allocation.** **Note 2: Although Queue Project AG1-040 may not have cost responsibility for this upgrade, Queue Project AG1-040 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AG1-040 comes into service prior to completion of the upgrade, Queue Project AG1-040 will need an interim study** **Project Id: n7170.4 (WP-AG1-S-0008D)** **Description: Replace 336 ACSR line risers at Karns City substation.** **Type : FAC** **Total Cost : $130,253** **Time Estimate : 12.0 Months** **Ratings : 160.0/192.0/192.0** **Queue Project AG1-040 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 AG1-040 could receive cost allocation.** **Note 2: Although Queue Project AG1-040 may not have cost responsibility for this upgrade, Queue Project AG1-040 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AG1-040 comes into service prior to completion of the upgrade, Queue Project AG1-040 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 AG1-040	Upgrade Number
167259211	1	01KARNSC 138.0 kV - 01BUTLER 138.0 kV Ckt 1	**APS (Contd...)** **Project Id: n7170.5 (WP-AG1-S-0008E)** **Description:** Reconductor 15.6 miles of 336 ACSR on the Butler - Karns City 138 kV line (102 spans). **Type :** FAC **Total Cost :** $53,090,919 **Time Estimate :** 60.0 Months **Ratings :** 164.0/206.0/206.0 Queue Project AG1-040 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 AG1-040 could receive cost allocation. Note 2: Although Queue Project AG1-040 may not have cost responsibility for this upgrade, Queue Project AG1-040 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AG1-040 comes into service prior to completion of the upgrade, Queue Project AG1-040 will need an interim study **Project Id: n7170.6 (WP-AG1-S-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 AG1-040 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 AG1-040 could receive cost allocation. Note 2: Although Queue Project AG1-040 may not have cost responsibility for this upgrade, Queue Project AG1-040 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AG1-040 comes into service prior to completion of the upgrade, Queue Project AG1-040 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 AG1-040	Upgrade Number
167259211	1	01KARNSC 138.0 kV - 01BUTLER 138.0 kV Ckt 1	APS (Contd...) Project Id: n7170.7 (WP-AG1-F-0008G) Description: Replace 600 A line side and bus side disconnects at Butler substation. Project Type : FAC Total Cost : $130,252 Time Estimate : 12.0 Months Ratings : 196.0/222.0/222.0 Queue Project AG1-040 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 AG1-040 could receive cost allocation. Note 2: Although Queue Project AG1-040 may not have cost responsibility for this upgrade, Queue Project AG1-040 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AG1-040 comes into service prior to completion of the upgrade, Queue Project AG1-040 will need an interim study Project Id: n7170.8 (WP-AG1-F-0008H) Description: Replace relaying (WT,ZR) at Butler Substaiton. Project Type : FAC Total Cost : $455,884 Time Estimate : 12.0 Months Ratings : 299.0/306.0/306.0 Queue Project AG1-040 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 AG1-040 could receive cost allocation. Note 2: Although Queue Project AG1-040 may not have cost responsibility for this upgrade, Queue Project AG1-040 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AG1-040 comes into service prior to completion of the upgrade, Queue Project AG1-040 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 AG1-040	Upgrade Number
167259211	1	**01KARNSC 138.0 kV - 01BUTLER 138.0 kV Ckt 1**	**APS (cont'd)** **Project Id: n7170.9 (WP-AG1-S-0008I)** **Description: Replace relaying (RT, OR, WT, MT) at Karns City substation.** **Type : FAC** **Total Cost : $1,132,155** **Time Estimate : 12.0 Months** **Ratings : 299.0/360.0/360.0** **Queue Project AG1-040 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 AG1-040 could receive cost allocation.** **Note 2: Although Queue Project AG1-040 may not have cost responsibility for this upgrade, Queue Project AG1-040 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AG1-040 comes into service prior to completion of the upgrade, Queue Project AG1-040 will need an interim study** **Project Id: n7170.10 (WP-AG1-S-0008J)** **Description: Replace 1200 A circuit breaker at Karns City substation.** **Type : FAC** **Total Cost : $606,586** **Time Estimate : 12.0 Months** **Ratings : 329.0/413.0/413.0** **Queue Project AG1-040 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 AG1-040 could receive cost allocation.** **Note 2: Although Queue Project AG1-040 may not have cost responsibility for this upgrade, Queue Project AG1-040 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AG1-040 comes into service prior to completion of the upgrade, Queue Project AG1-040 will need an interim study**	$57,264,340	$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 AG1-040	Upgrade Number
167259223	2	**01COLMBGPN 138.0 kV - 01KISKIV 138.0 kV Ckt 1**	**APS** **Project Id : n6214 (WP-AG1-S-0018A)** **Description : Reconductor 3.7 miles of 4/0 CU.** **Type : FAC** **Total Cost : $12,790,769** **Time Estimate : 36.0 Months** **Ratings : 191.0/191.0/191.0** **Queue Project AG1-040 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 AG1-040 could receive cost allocation.** **Note 2: Although Queue Project AG1-040 may not have cost responsibility for this upgrade, Queue Project AG1-040 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AG1-040 comes into service prior to completion of the upgrade, Queue Project AG1-040 will need an interim study** **Project Id: n7171.1 (WP-AG1-S-0018B)** **Description : Replace relays (RT) at Kiski Valley substation.** **Type : FAC** **Total Cost : $976,894** **Time Estimate : 12.0 Months** **Ratings : 225.0/295.0/295.0** **Queue Project AG1-040 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 AG1-040 could receive cost allocation.** **Note 2: Although Queue Project AG1-040 may not have cost responsibility for this upgrade, Queue Project AG1-040 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AG1-040 comes into service prior to completion of the upgrade, Queue Project AG1-040 will need an interim study**	$13,767,663	$0	n6214, n7171.1

ID	Idx	Facility	Upgrade Description	Cost	Cost Allocated to AG1-040	Upgrade Number
167259221	3	**01GAR RN 138.0 kV - 01COLMBGPN 138.0 kV Ckt 1**	**APS** **ProjectId : n6183 (WP-AG1-S-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 : $35,480,781** **Time Estimate : 48.0 Months** **Ratings : 261.0/311.0/311.0** **Queue Project AG1-040 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 AG1-040 could receive cost allocation.** **Note 2: Although Queue Project AG1-040 may not have cost responsibility for this upgrade, Queue Project AG1-040 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AG1-040 comes into service prior to completion of the upgrade, Queue Project AG1-040 will need an interim study**	$35,480,781	$0	n6183
			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.

12.7 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".

12.7.1 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
167259211	235197	01KARNSC	AP	235152	01BUTLER	AP	1	ATSI-P2-3-CEI-345-004D	breaker	179.0	213.6	214.48	AC	1.87

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
200608	26PINEY #1	0.77	80|50	0.77
200662	26SCRUB GR	1.75	80|50	1.75
235030	01MHNG-T155	0.17	80|50	0.17
236828	01GRAYMONT	0.17	Adder	0.2
290086	Q-036 E	1.7	Adder	2.0
293393	V3-030E	1.24	Adder	1.46
915951	Y3-092 FTIR	95.09	Adder	111.87
916202	Z1-069 E	2.69	Adder	3.16
921642	AA2-000	21.55	Adder	25.35
930511	AB2-092	0.79	Adder	0.93
931092	AB1-160 E	0.77	Adder	0.91
936421	AD2-055	1.63	Adder	1.92
936991	AD2-133 C	0.77	Adder	0.91
936992	AD2-133 E	3.5	Adder	4.12
938951	AE1-123	2.79	80|50	2.79
939171	AE1-147 C	0.52	Adder	0.61
939172	AE1-147 E	0.35	Adder	0.41
939291	AE1-160 C	1.5	80|50	1.5
939292	AE1-160 E	0.86	80|50	0.86
940201	AE2-001 C	0.52	Adder	0.61
940202	AE2-001 E	0.34	Adder	0.4
940861	AE2-074 C	0.77	Adder	0.91
940862	AE2-074 E	1.01	Adder	1.19
941191	AE2-113 C	3.5	Adder	4.12
941192	AE2-113 E	3.28	Adder	3.86
941261	AE2-120 C	0.52	Adder	0.61
941262	AE2-120 E	0.34	Adder	0.4
941271	AE2-121 C	0.28	Adder	0.33
941272	AE2-121 E	0.18	Adder	0.21
941321	AE2-126 C	0.67	Adder	0.79
941322	AE2-126 E	0.45	Adder	0.53
941331	AE2-129 C	0.56	Adder	0.66
941332	AE2-129 E	0.37	Adder	0.44
941351	**AE2-131 C (Suspended)**	**0.56**	**Adder**	**0.66**
941352	**AE2-131 E (Suspended)**	**0.37**	**Adder**	**0.44**
942491	AE2-262 C	2.43	Adder	2.86
942492	AE2-262 E	1.63	Adder	1.92
942501	AE2-263 C	2.28	Adder	2.68
942502	AE2-263 E	1.52	Adder	1.79
942811	AE2-299 C	2.07	Adder	2.44
942812	AE2-299 E	8.27	Adder	9.73
942961	AE2-316 C	4.35	80|50	4.35
942962	AE2-316 E	5.15	80|50	5.15

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
943151	AE2-344 C	5.28	Adder	6.21
943152	AE2-344 E	3.52	Adder	4.14
943351	AF1-006 C	0.93	Adder	1.09
943352	AF1-006 E	0.52	Adder	0.61
943751	AF1-043	4.89	Adder	5.75
944181	AF1-086 C O1	1.07	Adder	1.26
944182	AF1-086 E O1	4.67	Adder	5.49
944261	AF1-094 C	0.97	Adder	1.14
944262	AF1-094 E	0.64	Adder	0.75
944281	AF1-096 C	1.42	80|50	1.42
944282	AF1-096 E	0.94	80|50	0.94
944301	AF1-098 C	3.21	Adder	3.78
944302	AF1-098 E	2.14	Adder	2.52
944311	AF1-099 C	3.68	Adder	4.33
944312	AF1-099 E	2.46	Adder	2.89
944321	AF1-100 C	7.92	Adder	9.32
944322	AF1-100 E	5.28	Adder	6.21
944381	AF1-103 O1	1.24	Adder	1.46
944391	AF1-104 O1	1.57	Adder	1.85
944691	AF1-134 C	0.62	Adder	0.73
944692	AF1-134 E	0.42	Adder	0.49
944771	AF1-142 C	5.9	Adder	6.94
944772	AF1-142 E	3.93	Adder	4.62
944881	AF1-153 C O1	0.9	Adder	1.06
944882	AF1-153 E O1	0.6	Adder	0.71
944901	**AF1-155 C (Suspended)**	**0.91**	**Adder**	**1.07**
944902	**AF1-155 E (Suspended)**	**0.61**	**Adder**	**0.72**
945021	AF1-167 C	1.5	80|50	1.5
945022	AF1-167 E	1.01	80|50	1.01
945051	AF1-170 C	3.6	Adder	4.24
945052	AF1-170 E	2.4	Adder	2.82
945451	AF1-210 C	1.71	80|50	1.71
945452	AF1-210 E	1.14	80|50	1.14
945751	AF1-240 C O1	1.38	80|50	1.38
945752	AF1-240 E O1	0.92	80|50	0.92
946111	AF1-276 C	3.74	Adder	4.4
946112	AF1-276 E	1.84	Adder	2.16
946121	AF1-277 C	3.74	Adder	4.4
946122	AF1-277 E	1.84	Adder	2.16
946131	AF1-278 C	2.98	Adder	3.51
946132	AF1-278 E	1.48	Adder	1.74
946221	**AF1-287 C (Withdrawn : 05/24/2021)**	**0.91**	**Adder**	**1.07**
946222	**AF1-287 E (Withdrawn : 05/24/2021)**	**0.61**	**Adder**	**0.72**
946381	AF1-302 C	1.9	80|50	1.9
946382	AF1-302 E	2.53	80|50	2.53
946401	AF1-304 C	7.62	80|50	7.62
946402	AF1-304 E	5.08	80|50	5.08
946421	AF1-306 C	3.1	Adder	3.65
946422	AF1-306 E	12.42	Adder	14.61
946771	AF1-217 C	0.91	Adder	1.07
946772	AF1-217 E	0.61	Adder	0.72
957161	AF2-010 C	3.75	Adder	4.41
957162	AF2-010 E	2.53	Adder	2.98

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
957451	AF2-039 C	0.42	Adder	0.49
957452	AF2-039 E	0.28	Adder	0.33
957941	AF2-088 C	0.2	Adder	0.24
957942	AF2-088 E	0.13	Adder	0.15
958271	AF2-121 C	0.56	Adder	0.66
958272	AF2-121 E	0.37	Adder	0.44
958361	AF2-130 C	1.71	80|50	1.71
958362	AF2-130 E	1.14	80|50	1.14
958731	AF2-164 C O1	3.98	Adder	4.68
958732	AF2-164 E O1	2.65	Adder	3.12
958741	AF2-165 C	1.55	80|50	1.55
958742	AF2-165 E	1.03	80|50	1.03
958751	AF2-166 C	1.71	80|50	1.71
958752	AF2-166 E	1.14	80|50	1.14
959441	AF2-235 C	0.71	80|50	0.71
959442	AF2-235 E	0.47	80|50	0.47
959521	AF2-243 C	1.16	80|50	1.16
959522	AF2-243 E	0.77	80|50	0.77
959822	AF2-273 E	0.68	80|50	0.68
960022	AF2-293 E	0.05	Adder	0.06
960041	AF2-295 C	0.91	Adder	1.07
960042	AF2-295 E	0.61	Adder	0.72
960051	AF2-296 C	0.62	Adder	0.73
960052	AF2-296 E	0.42	Adder	0.49
960891	AF2-380 C	3.68	80|50	3.68
960892	AF2-380 E	2.46	80|50	2.46
961971	AG1-040 C	0.95	Adder	1.12
961972	AG1-040 E	0.64	Adder	0.75
962411	AG1-090 C O1	3.73	Adder	4.39
962412	AG1-090 E O1	0.93	Adder	1.09
962511	AG1-100 C	0.92	Adder	1.08
962512	AG1-100 E	0.62	Adder	0.73
962891	AG1-138 C	0.68	80|50	0.68
962892	AG1-138 E	0.04	80|50	0.04
962901	AG1-139 C	0.61	80|50	0.61
962902	AG1-139 E	0.03	80|50	0.03
962911	AG1-140 C	0.12	Adder	0.14
962912	AG1-140 E	0.05	Adder	0.06
963441	AG1-193 C	1.37	80|50	1.37
963442	AG1-193 E	0.91	80|50	0.91
963481	AG1-197 C	0.72	Adder	0.85
963482	AG1-197 E	0.48	Adder	0.56
963491	AG1-198 C	0.58	Adder	0.68
963492	AG1-198 E	0.39	Adder	0.46
963531	AG1-202 C	0.51	Adder	0.6
963532	AG1-202 E	0.26	Adder	0.31
963571	AG1-206 C	0.2	Adder	0.24
963572	AG1-206 E	0.11	Adder	0.13
963891	AG1-242 C	0.34	Adder	0.4
963892	AG1-242 E	0.18	Adder	0.21
963991	AG1-253 C	0.17	Adder	0.2
963992	AG1-253 E	0.08	Adder	0.09
964341	AG1-296 C	0.73	80|50	0.73
964342	AG1-296 E	0.39	80|50	0.39
964411	AG1-303 C O1	2.22	Adder	2.61

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
964412	AG1-303 E O1	1.48	Adder	1.74
964451	AG1-308 C O1	0.4	Adder	0.47
964452	AG1-308 E O1	0.56	Adder	0.66
965121	AG1-377 C O1	0.56	Adder	0.66
965122	AG1-377 E O1	0.37	Adder	0.44
965131	AG1-378 C O1	0.56	Adder	0.66
965132	AG1-378 E O1	0.37	Adder	0.44
965241	AG1-392C C O	0.58	Adder	0.68
965242	AG1-392C E O	0.39	Adder	0.46
965251	AG1-392B C O	0.58	Adder	0.68
965252	AG1-392B E O	0.39	Adder	0.46
965261	AG1-392A C O	1.16	Adder	1.36
965262	AG1-392A E O	0.77	Adder	0.91
965271	AG1-392 C O1	1.16	Adder	1.36
965272	AG1-392 E O1	0.77	Adder	0.91
965861	AG1-455	2.71	Adder	3.19
966121	AG1-481	0.96	Adder	1.13
966771	AG1-548 C	9.11	Adder	10.72
966772	AG1-548 E	2.77	Adder	3.26
LTFEXP_AC1-056	LTFEXP_AC1-056->LTFIMP_AC1-056	0.6555	Confirmed LTF	0.6555
LTFEXP_AC1-131	LTFEXP_AC1-131->LTFIMP_AC1-131	0.3074	Confirmed LTF	0.3074
LTFEXP_BlueG	LTFEXP_BlueG->LTFIMP_BlueG	1.1504	Confirmed LTF	1.1504
LTFEXP_CALDERWOOD	LTFEXP_CALDERWOOD->LTFIMP_CALDERWOOD	0.2778	Confirmed LTF	0.2778
LTFEXP_CATAWBA	LTFEXP_CATAWBA->LTFIMP_CATAWBA	0.1662	Confirmed LTF	0.1662
LTFEXP_CBM-N	LTFEXP_CBM-N->LTFIMP_CBM-N	1.0343	LTF/CBM	1.0343
LTFEXP_CHEOAH	LTFEXP_CHEOAH->LTFIMP_CHEOAH	0.2783	Confirmed LTF	0.2783
LTFEXP_COTTONWOOD	LTFEXP_COTTONWOOD->LTFIMP_COTTONWOOD	1.2498	Confirmed LTF	1.2498
LTFEXP_G-007A	LTFEXP_G-007A->LTFIMP_G-007A	1.8907	LTF/CMTX	1.8907
LTFEXP_GIBSON	LTFEXP_GIBSON->LTFIMP_GIBSON	0.3625	Confirmed LTF	0.3625
LTFEXP_HAMLET	LTFEXP_HAMLET->LTFIMP_HAMLET	0.2512	Confirmed LTF	0.2512
LTFEXP_LGE-0012019	LTFEXP_LGE-0012019->LTFIMP_LGE-0012019	0.0192	Confirmed LTF	0.0192
LTFEXP_PRAIRIE	LTFEXP_PRAIRIE->LTFIMP_PRAIRIE	1.6574	Confirmed LTF	1.6574
LTFEXP_TRIMBLE	LTFEXP_TRIMBLE->LTFIMP_TRIMBLE	0.3694	Confirmed LTF	0.3694
LTFEXP_VFT	LTFEXP_VFT->LTFIMP_VFT	5.217	Confirmed LTF	5.217

12.7.2 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
167259223	235240	01COLMBGPN	AP	235202	01KISKIV	AP	1	ATSI-P2-3-CEI-345-004D	breaker	151.0	166.55	167.41	AC	1.54

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
235030	01MHNG-T155	0.18	80|50	0.18
235134	01AL&D6	0.19	80|50	0.19
915951	Y3-092 FTIR	82.3	Adder	96.82
936881	AD2-112 C	-2.17	Adder	-2.55
936882	AD2-112 E	-0.86	Adder	-1.01
938951	AE1-123	1.41	Adder	1.66
939291	AE1-160 C	0.88	Adder	1.04
939292	AE1-160 E	0.51	Adder	0.6
941191	AE2-113 C	2.81	Adder	3.31
941192	AE2-113 E	2.63	Adder	3.09
942811	AE2-299 C	1.67	Adder	1.96
942812	AE2-299 E	6.67	Adder	7.85
942961	AE2-316 C	3.44	Adder	4.05
942962	AE2-316 E	4.07	Adder	4.79
943151	AE2-344 C	4.34	Adder	5.11
943152	AE2-344 E	2.9	Adder	3.41
943351	AF1-006 C	0.77	Adder	0.91
943352	AF1-006 E	0.43	Adder	0.51
944261	AF1-094 C	0.73	Adder	0.86
944262	AF1-094 E	0.48	Adder	0.56
944281	AF1-096 C	0.83	Adder	0.98
944282	AF1-096 E	0.55	Adder	0.65
944301	AF1-098 C	2.58	Adder	3.04
944302	AF1-098 E	1.72	Adder	2.02
944381	AF1-103 O1	1.0	Adder	1.18
944391	AF1-104 O1	1.34	Adder	1.58
944881	AF1-153 C O1	0.67	Adder	0.79
944882	AF1-153 E O1	0.44	Adder	0.52
944901	**AF1-155 C (Suspended)**	**0.67**	**Adder**	**0.79**
944902	**AF1-155 E (Suspended)**	**0.45**	**Adder**	**0.53**
945021	AF1-167 C	0.94	80|50	0.94
945022	AF1-167 E	0.63	80|50	0.63
945051	AF1-170 C	3.01	Adder	3.54
945052	AF1-170 E	2.01	Adder	2.36
945451	AF1-210 C	1.24	80|50	1.24
945452	AF1-210 E	0.82	80|50	0.82
945751	AF1-240 C O1	0.69	Adder	0.81
945752	AF1-240 E O1	0.46	Adder	0.54
946111	AF1-276 C	3.07	Adder	3.61
946112	AF1-276 E	1.51	Adder	1.78
946121	AF1-277 C	3.07	Adder	3.61
946122	AF1-277 E	1.51	Adder	1.78

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
946131	AF1-278 C	2.45	Adder	2.88
946132	AF1-278 E	1.22	Adder	1.44
946221	AF1-287 C (Withdrawn : 05/24/2021)	0.75	Adder	0.88
946222	AF1-287 E (Withdrawn : 05/24/2021)	0.5	Adder	0.59
946381	AF1-302 C	1.5	Adder	1.76
946382	AF1-302 E	2.0	Adder	2.35
946401	AF1-304 C	4.36	Adder	5.13
946402	AF1-304 E	2.91	Adder	3.42
946421	AF1-306 C	2.42	Adder	2.85
946422	AF1-306 E	9.67	Adder	11.38
946771	AF1-217 C	0.75	Adder	0.88
946772	AF1-217 E	0.5	Adder	0.59
957161	AF2-010 C	2.81	Adder	3.31
957162	AF2-010 E	1.89	Adder	2.22
958361	AF2-130 C	0.91	Adder	1.07
958362	AF2-130 E	0.61	Adder	0.72
958731	AF2-164 C O1	3.62	Adder	4.26
958732	AF2-164 E O1	2.41	Adder	2.84
958741	AF2-165 C	0.89	Adder	1.05
958742	AF2-165 E	0.59	Adder	0.69
958751	AF2-166 C	0.91	Adder	1.07
958752	AF2-166 E	0.61	Adder	0.72
959441	AF2-235 C	0.42	Adder	0.49
959442	AF2-235 E	0.28	Adder	0.33
959521	AF2-243 C	0.66	Adder	0.78
959522	AF2-243 E	0.44	Adder	0.52
959822	AF2-273 E	0.46	80|50	0.46
960041	AF2-295 C	0.67	Adder	0.79
960042	AF2-295 E	0.45	Adder	0.53
960891	AF2-380 C	0.5	Adder	0.59
960892	AF2-380 E	0.33	Adder	0.39
961971	AG1-040 C	0.79	Adder	0.93
961972	AG1-040 E	0.52	Adder	0.61
962511	AG1-100 C	0.76	Adder	0.89
962512	AG1-100 E	0.51	Adder	0.6
962891	AG1-138 C	0.36	Adder	0.42
962892	AG1-138 E	0.02	Adder	0.02
962901	AG1-139 C	0.35	Adder	0.41
962902	AG1-139 E	0.02	Adder	0.02
962911	AG1-140 C	0.09	Adder	0.11
962912	AG1-140 E	0.04	Adder	0.05
963441	AG1-193 C	0.88	Adder	1.04
963442	AG1-193 E	0.59	Adder	0.69
963481	AG1-197 C	0.6	Adder	0.71
963482	AG1-197 E	0.4	Adder	0.47
963491	AG1-198 C	0.44	Adder	0.52
963492	AG1-198 E	0.29	Adder	0.34
963531	AG1-202 C	0.43	Adder	0.51
963532	AG1-202 E	0.22	Adder	0.26
963571	AG1-206 C	0.16	Adder	0.19
963572	AG1-206 E	0.08	Adder	0.09
963991	AG1-253 C	0.14	Adder	0.16
963992	AG1-253 E	0.07	Adder	0.08

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
964341	AG1-296 C	0.7	80|50	0.7
964342	AG1-296 E	0.38	80|50	0.38
964411	AG1-303 C O1	1.82	Adder	2.14
964412	AG1-303 E O1	1.22	Adder	1.44
965861	AG1-455	2.27	Adder	2.67
966121	AG1-481	0.77	Adder	0.91
966453	AG1-514 BAT	0.51	Adder	0.6
966771	AG1-548 C	6.9	Adder	8.12
966772	AG1-548 E	2.1	Adder	2.47
LTFEXP_AC1-056	LTFEXP_AC1-056->LTFIMP_AC1-056	0.4712	Confirmed LTF	0.4712
LTFEXP_AC1-131	LTFEXP_AC1-131->LTFIMP_AC1-131	0.2534	Confirmed LTF	0.2534
LTFEXP_BlueG	LTFEXP_BlueG->LTFIMP_BlueG	0.8285	Confirmed LTF	0.8285
LTFEXP_CALDERWOOD	LTFEXP_CALDERWOOD->LTFIMP_CALDERWOOD	0.2099	Confirmed LTF	0.2099
LTFEXP_CATAWBA	LTFEXP_CATAWBA->LTFIMP_CATAWBA	0.1315	Confirmed LTF	0.1315
LTFEXP_CBM-N	LTFEXP_CBM-N->LTFIMP_CBM-N	0.8035	LTF/CBM	0.8035
LTFEXP_CHEOAH	LTFEXP_CHEOAH->LTFIMP_CHEOAH	0.2106	Confirmed LTF	0.2106
LTFEXP_COTTONWOOD	LTFEXP_COTTONWOOD->LTFIMP_COTTONWOOD	0.9244	Confirmed LTF	0.9244
LTFEXP_G-007A	LTFEXP_G-007A->LTFIMP_G-007A	1.4572	LTF/CMTX	1.4572
LTFEXP_GIBSON	LTFEXP_GIBSON->LTFIMP_GIBSON	0.2602	Confirmed LTF	0.2602
LTFEXP_HAMLET	LTFEXP_HAMLET->LTFIMP_HAMLET	0.2035	Confirmed LTF	0.2035
LTFEXP_LGE-0012019	LTFEXP_LGE-0012019->LTFIMP_LGE-0012019	0.0097	Confirmed LTF	0.0097
LTFEXP_PRAIRIE	LTFEXP_PRAIRIE->LTFIMP_PRAIRIE	1.1992	Confirmed LTF	1.1992
LTFEXP_TRIMBLE	LTFEXP_TRIMBLE->LTFIMP_TRIMBLE	0.2659	Confirmed LTF	0.2659
LTFEXP_VFT	LTFEXP_VFT->LTFIMP_VFT	4.0304	Confirmed LTF	4.0304

12.7.3 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
167259221	235282	01GARRN	AP	235240	01COLMBGPN	AP	1	ATSI-P2-3-CEI-345-004D	breaker	151.0	168.79	169.66	AC	1.54

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
235030	01MHNG-T155	0.18	80|50	0.18
235134	01AL&D6	0.19	80|50	0.19
915951	Y3-092 FTIR	82.3	Adder	96.82
936881	AD2-112 C	-2.17	Adder	-2.55
936882	AD2-112 E	-0.86	Adder	-1.01
938951	AE1-123	1.41	Adder	1.66
939291	AE1-160 C	0.88	Adder	1.04
939292	AE1-160 E	0.51	Adder	0.6
941191	AE2-113 C	2.81	Adder	3.31
941192	AE2-113 E	2.63	Adder	3.09
942811	AE2-299 C	1.67	Adder	1.96
942812	AE2-299 E	6.67	Adder	7.85
942961	AE2-316 C	3.44	Adder	4.05
942962	AE2-316 E	4.07	Adder	4.79
943151	AE2-344 C	4.34	Adder	5.11
943152	AE2-344 E	2.9	Adder	3.41
943351	AF1-006 C	0.77	Adder	0.91
943352	AF1-006 E	0.43	Adder	0.51
944261	AF1-094 C	0.73	Adder	0.86
944262	AF1-094 E	0.48	Adder	0.56
944281	AF1-096 C	0.83	Adder	0.98
944282	AF1-096 E	0.55	Adder	0.65
944301	AF1-098 C	2.58	Adder	3.04
944302	AF1-098 E	1.72	Adder	2.02
944381	AF1-103 O1	1.0	Adder	1.18
944391	AF1-104 O1	1.34	Adder	1.58
944881	AF1-153 C O1	0.67	Adder	0.79
944882	AF1-153 E O1	0.44	Adder	0.52
944901	**AF1-155 C (Suspended)**	**0.67**	**Adder**	**0.79**
944902	**AF1-155 E (Suspended)**	**0.45**	**Adder**	**0.53**
945021	AF1-167 C	0.94	80|50	0.94
945022	AF1-167 E	0.63	80|50	0.63
945051	AF1-170 C	3.01	Adder	3.54
945052	AF1-170 E	2.01	Adder	2.36
945451	AF1-210 C	1.24	80|50	1.24
945452	AF1-210 E	0.82	80|50	0.82
945751	AF1-240 C O1	0.69	Adder	0.81
945752	AF1-240 E O1	0.46	Adder	0.54
946111	AF1-276 C	3.07	Adder	3.61
946112	AF1-276 E	1.51	Adder	1.78
946121	AF1-277 C	3.07	Adder	3.61
946122	AF1-277 E	1.51	Adder	1.78

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
946131	AF1-278 C	2.45	Adder	2.88
946132	AF1-278 E	1.22	Adder	1.44
946221	AF1-287 C (Withdrawn : 05/24/2021)	0.75	Adder	0.88
946222	AF1-287 E (Withdrawn : 05/24/2021)	0.5	Adder	0.59
946381	AF1-302 C	1.5	Adder	1.76
946382	AF1-302 E	2.0	Adder	2.35
946401	AF1-304 C	4.36	Adder	5.13
946402	AF1-304 E	2.91	Adder	3.42
946421	AF1-306 C	2.42	Adder	2.85
946422	AF1-306 E	9.67	Adder	11.38
946771	AF1-217 C	0.75	Adder	0.88
946772	AF1-217 E	0.5	Adder	0.59
957161	AF2-010 C	2.81	Adder	3.31
957162	AF2-010 E	1.89	Adder	2.22
958361	AF2-130 C	0.91	Adder	1.07
958362	AF2-130 E	0.61	Adder	0.72
958731	AF2-164 C O1	3.62	Adder	4.26
958732	AF2-164 E O1	2.41	Adder	2.84
958741	AF2-165 C	0.89	Adder	1.05
958742	AF2-165 E	0.59	Adder	0.69
958751	AF2-166 C	0.91	Adder	1.07
958752	AF2-166 E	0.61	Adder	0.72
959441	AF2-235 C	0.42	Adder	0.49
959442	AF2-235 E	0.28	Adder	0.33
959521	AF2-243 C	0.66	Adder	0.78
959522	AF2-243 E	0.44	Adder	0.52
959822	AF2-273 E	0.46	80|50	0.46
960041	AF2-295 C	0.67	Adder	0.79
960042	AF2-295 E	0.45	Adder	0.53
960891	AF2-380 C	0.5	Adder	0.59
960892	AF2-380 E	0.33	Adder	0.39
961971	AG1-040 C	0.79	Adder	0.93
961972	AG1-040 E	0.52	Adder	0.61
962511	AG1-100 C	0.76	Adder	0.89
962512	AG1-100 E	0.51	Adder	0.6
962891	AG1-138 C	0.36	Adder	0.42
962892	AG1-138 E	0.02	Adder	0.02
962901	AG1-139 C	0.35	Adder	0.41
962902	AG1-139 E	0.02	Adder	0.02
962911	AG1-140 C	0.09	Adder	0.11
962912	AG1-140 E	0.04	Adder	0.05
963441	AG1-193 C	0.88	Adder	1.04
963442	AG1-193 E	0.59	Adder	0.69
963481	AG1-197 C	0.6	Adder	0.71
963482	AG1-197 E	0.4	Adder	0.47
963491	AG1-198 C	0.44	Adder	0.52
963492	AG1-198 E	0.29	Adder	0.34
963531	AG1-202 C	0.43	Adder	0.51
963532	AG1-202 E	0.22	Adder	0.26
963571	AG1-206 C	0.16	Adder	0.19
963572	AG1-206 E	0.08	Adder	0.09
963991	AG1-253 C	0.14	Adder	0.16
963992	AG1-253 E	0.07	Adder	0.08

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
964341	AG1-296 C	0.7	80|50	0.7
964342	AG1-296 E	0.38	80|50	0.38
964411	AG1-303 C O1	1.82	Adder	2.14
964412	AG1-303 E O1	1.22	Adder	1.44
965861	AG1-455	2.27	Adder	2.67
966121	AG1-481	0.77	Adder	0.91
966453	AG1-514 BAT	0.51	Adder	0.6
966771	AG1-548 C	6.9	Adder	8.12
966772	AG1-548 E	2.1	Adder	2.47
LTFEXP_AC1-056	LTFEXP_AC1-056->LTFIMP_AC1-056	0.4712	Confirmed LTF	0.4712
LTFEXP_AC1-131	LTFEXP_AC1-131->LTFIMP_AC1-131	0.2534	Confirmed LTF	0.2534
LTFEXP_BlueG	LTFEXP_BlueG->LTFIMP_BlueG	0.8285	Confirmed LTF	0.8285
LTFEXP_CALDERWOOD	LTFEXP_CALDERWOOD->LTFIMP_CALDERWOOD	0.2099	Confirmed LTF	0.2099
LTFEXP_CATAWBA	LTFEXP_CATAWBA->LTFIMP_CATAWBA	0.1315	Confirmed LTF	0.1315
LTFEXP_CBM-N	LTFEXP_CBM-N->LTFIMP_CBM-N	0.8035	LTF/CBM	0.8035
LTFEXP_CHEOAH	LTFEXP_CHEOAH->LTFIMP_CHEOAH	0.2106	Confirmed LTF	0.2106
LTFEXP_COTTONWOOD	LTFEXP_COTTONWOOD->LTFIMP_COTTONWOOD	0.9244	Confirmed LTF	0.9244
LTFEXP_G-007A	LTFEXP_G-007A->LTFIMP_G-007A	1.4572	LTF/CMTX	1.4572
LTFEXP_GIBSON	LTFEXP_GIBSON->LTFIMP_GIBSON	0.2602	Confirmed LTF	0.2602
LTFEXP_HAMLET	LTFEXP_HAMLET->LTFIMP_HAMLET	0.2035	Confirmed LTF	0.2035
LTFEXP_LGE-0012019	LTFEXP_LGE-0012019->LTFIMP_LGE-0012019	0.0097	Confirmed LTF	0.0097
LTFEXP_PRAIRIE	LTFEXP_PRAIRIE->LTFIMP_PRAIRIE	1.1992	Confirmed LTF	1.1992
LTFEXP_TRIMBLE	LTFEXP_TRIMBLE->LTFIMP_TRIMBLE	0.2659	Confirmed LTF	0.2659
LTFEXP_VFT	LTFEXP_VFT->LTFIMP_VFT	4.0304	Confirmed LTF	4.0304

12.8 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
AB1-160	Gold-Sabinsville 115kV	In Service
AB2-092	Bergen 138kV	Partially in Service - Under Construction
AC1-056	PJM-AMIL	Confirmed
AC1-131	PJM-CPLE	Confirmed
AD2-055	Moshannon-East Towanda 230 kV	Active
AD2-112	Springdale CC II 138kV	Engineering and Procurement
AD2-133	Eagle Valley 115kV	Engineering and Procurement
AE1-123	Emlenton 34.5 kV	Engineering and Procurement
AE1-147	Bellefonte 46 kV	Engineering and Procurement
AE1-160	Venango 34.5 kV	Engineering and Procurement
AE2-001	Nittany-Zion 46 kV	Active
AE2-074	Potter 46 kV	Active
AE2-113	Farmers Valley-Ridgeway 115 kV	Active
AE2-120	Graymont-Zion 46 kV	Active
AE2-121	Milesburg-Tanney Junction 46 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
AE2-262	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	Suspended
AF1-167	West Freedom-C&K Coal 25 kV	Active
AF1-170	Springboro-Venango Junction 115 kV	Active
AF1-210	Burma 23 kV	Engineering and Procurement

Queue Number	Project Name	Status
AF1-217	Edinboro -Cambridge Springs 34.5 kV	Engineering and Procurement
AF1-240	Timblin 34.5 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
AF1-287	Edinboro South 34.5 kV II	Withdrawn
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
AF2-088	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
AF2-293	Beech Creek 12.47 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
AG1-040	Morgan Street-Mount Hope 34.5 kV	Active
AG1-090	Philipsburg 115 kV	Active
AG1-100	Venango-Saegertown 34.5 kV	Active
AG1-138	Wolfs Corners 34.5 kV	Active
AG1-139	Clark Summit-Emlenton 34.5 kV	Active
AG1-140	Union City 34.5 kV	Engineering and Procurement
AG1-193	Utica Junction 34.5 kV	Active
AG1-197	Morgan Street-Cochranton 34.5 kV	Active
AG1-198	Union City 34.5 kV	Active
AG1-202	Springboro 12.47 kV	Active
AG1-206	Snyder Twp 34.5 kV	Active
AG1-242	Beccaria 34.5 kV	Active
AG1-253	Erie East-Union City 34.5 kV	Active
AG1-296	Snyder Township 34.5 kV	Active
AG1-303	Geneva 115 kV	Active
AG1-308	Shawville-Philipsburg 34.5 kV	Active
AG1-377	Philipsburg 115 kV	Active
AG1-378	Philipsburg 115 kV	Active
AG1-392	Gold 115 kV IV	Active
AG1-392A	Gold 115 kV III	Active
AG1-392B	Gold 115 kV II	Active
AG1-455	Springboro-Venango Junction 115 kV	Active
AG1-481	Warren 34.5 kV	Active
AG1-514	Springdale CT III 138 kV	Active
AG1-548	Erie South-Union City 115 kV	Active
V3-030	St. Benedict-Patton 46kV	In Service
Y3-092	Erie West 345kV	Engineering and Procurement
Z1-069	Gold-Sabinsville 115kV	In Service

12.9 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-345-001	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
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
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

13 Light Load Analysis

Not required for solar projects.

14 Short Circuit Analysis

The following Breakers are overdutied:

None.

14.1 System Reinforcements - Short Circuit

None.

15 Stability and Reactive Power

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

Stability analysis is not required for this project.

16 Affected Systems

16.1 NYISO

This project has been identified by PJM as having greater than 3% DFAX contribution (or 10% DFAX for over 500kV) to flow gates in the NYISO area. NYISO is evaluating the need for an affected system study. Results will be provided in the Facilities phase. (Reference PJM Manual 14A Section 4.2.4 for Affected System Coordination.)

17 Attachment 1: One Line Diagram