Generation Interconnection

Feasibility Study Report

for

Queue Project AG1-385

MOTION-RIDGEWAY 46 KV

15.43 MW Capacity / 20 MW Energy

January 2021

Table of Contents

1 Introduction

This Feasibility Study has been prepared in accordance with the PJM Open Access Transmission Tariff, 36.2, as well as the Feasibility Study Agreement between the Interconnection Customer (IC), and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is APS – West Penn Power zone.

2 Preface

The intent of the feasibility study is to determine a plan, with ballpark cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the Interconnection Customer. The Interconnection Customer may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system.

In some instances a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection, may also contribute to the need for the same network reinforcement. Cost allocation rules for network upgrades can be found in PJM Manual 14A, Attachment B. The possibility of sharing the reinforcement costs with other projects may be identified in the feasibility study, but the actual allocation will be deferred until the impact study is performed.

The Interconnection Customer seeking to interconnect a wind or solar generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per Schedule H to the Interconnection Service Agreement and Section 8 of Manual 14D.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

3 General

The Interconnection Customer (IC), has proposed a Solar; Storage generating facility located in Washington County, Pennsylvania. The installed facilities will have a total capability of 20 MW with 15.43 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is March 01, 2022. This study does not imply a TO commitment to this in-service date.

Queue Number	AG1-385
Project Name	MOTION-RIDGEWAY 46 KV
State	Pennsylvania
County	Washington
Transmission Owner	APS-West Penn Power
MFO	20
MWE	20
MWC	15.43
Fuel	Solar; Storage
Basecase Study Year	2024

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

4 Point of Interconnection

AG1-385 will interconnect with the FirstEnergy, West Penn Power system. The interconnection of the project will be accomplished by tapping the Ridgway – Motion Control 46 kV line and constructing a one span tap. The transmission line tap will be located approximately 0.25 miles from Ridgway substation. The IC will be responsible for acquiring all easements, properties, and permits that may be required to construct both the new interconnection line tap and the associated Attachment facilities. The IC will also be responsible for the rough grade of the property and an access road to the proposed site. The project will also require non-direct connection upgrades at Ridgway substation.

Attachment 1 shows a one-line diagram of the proposed direct connection facilities for the AG1-385 generation project to connect to the FirstEnergy ("FE") transmission system. 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 transmission system.

5 Cost Summary

The AG1-385 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	$698,911
Total System Network Upgrade Costs (TO Identified)	$300,000
Total System Network Upgrade Costs (PJM Identified)	$38,119,398[1]
Total Costs	**$39,118,309**

This cost excludes a Federal Income Tax Gross Up charges. This tax may or may not be charged based on whether this project meets the eligibility requirements of IRS Notice 2016-36, 2016-25 I.R.B. (6/20/2016). If at a future date it is determined that the Federal Income Tax Gross charge is required, the Transmission Owner shall be reimbursed by the Interconnection Customer for such taxes.

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

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

6 Transmission Owner Scope of Work

The interconnection of the project will be accomplished by tapping the Ridgway – Motion Control 46 kV line and constructing a one span tap. The transmission line tap will be located approximately 0.25 miles from Ridgway substation. The IC will be responsible for acquiring all easements, properties, and permits that may be required to construct both the new interconnection line tap and the associated Attachment facilities. The IC will also be responsible for the rough grade of the property and an access road to the proposed site. The project will also require non-direct connection upgrades at Ridgway substation.

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

Description	Total Cost
Construct a one span 46 kV tap into the interconnection customer's substation & install a 600 A load break tap switch. Install FE owned 46 kV metering in the interconnection customer's substation.	$45,231
Construct a tap and install 2 - 46 kV 600 A load break network switches on the Ridgway - Motion Control 46 kV line.	$131,680
Upgrade relaying at Ridgway Substation.	$522,000
Total Physical Interconnection Costs	**$698,911**

7 Schedule

Based on the scope of work for the Attachment Facilities and the Direct and/or Non-Direct Connection facilities, it is expected to take a minimum of **24 months** after the signing of an Interconnection Agreement to complete the installation. This includes the requirement for the IC to make a preliminary payment that compensates FE for the first three months of the engineering design work that is related to the Attachment Facilities. Full initial payment is required for Non-Direct 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 network upgrades, and that all transmission system outages will be allowed when requested.

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

8 Transmission Owner Analysis[2]

8.1 Transmission Owner Identified Network Impacts to Distribution Facilities

Potential TO identified network impacts to Transmission Owner distribution facilities were as follows:

Idx	Overloaded Element	Contingency	Rating [MVA]	Loading Before %	Loading After %	Contribution [MW]
12	944880 AF1-153 TAP 46.0 236760 01RIDGWAY 46.0 1	Base Case	26	76.00	153.00	20

8.2 Transmission Owner Identified Network Impacts to Sub-Regional Facilities

Potential TO identified network impacts to Transmission Owner Sub-Regional facilities were as follows:

None.

8.3 System Reinforcements on Distribution Facilities

Idx	Facility	Upgrade ID	Upgrade Description	Cost
12	944880 AF1-153 TAP 46.0 236760 01RIDGWAY 46.0 1	WP-AG1-F-0042	Reconductor 0.5 miles of 3/0 ACSR to 556 ACSR. Time Estimate: 12 Cost: $300,000	$300,000
			TOTAL COST	**$300,000**

8.4 System Reinforcements on Sub-Regional Facilities

Idx	Facility	Upgrade ID	Upgrade Description	Cost
			TOTAL COST	$0

[2] For TO Distribution Facilities that need upgrades, the TO has applied their cost allocation rules. For TO Sub-Regional Facilities in need of upgrades, PJM Cost Allocation Criteria has been applied.

9 Interconnection Customer Requirements

9.1 System Protection

The IC must design its Customer Facilities in accordance with all applicable standards, including the standards in FE's "Requirements for Transmission Connected Facilities" document located at: http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx.

Preliminary Protection requirements will be provided as part of the Facilities Study. Detailed Protection Requirements will be provided once the project enters the construction phase.

The IC has not listed a standard GSU transformer winding configuration. The transformer must not be in violation of section 14.2.6 of FE's "Requirement for Transmission Connected Facilities" document and will not be accepted otherwise. The GSU transformer must have an ungrounded wye or delta connection on the high (utility) side.

9.2 Compliance Issues and Interconnection Customer Requirements

The proposed Customer Facilities must be designed in accordance with FE's "Requirements for Transmission Connected Facilities" document located at: http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx. In particular, the IC is responsible for the following:

1. The purchase and installation of a fully rated 46 kV circuit breaker to protect the AG1-385 generator lead line. A single circuit breaker must be used to protect this line; if the project has several GSU transformers, the individual GSU transformer breakers cannot be used to protect this line.

2. The purchase and installation of the minimum required FE generation interconnection relaying and control facilities. This includes over/under voltage protection, over/under frequency protection, and zero sequence voltage protection relays.

3. The purchase and installation of supervisory control and data acquisition ("SCADA") equipment to provide information in a compatible format to the FE Transmission System Control Center.

4. Compliance with the FE and PJM generator power factor and voltage control requirements.

5. The execution of a back-up service agreement to serve the customer load supplied from the AG1-385 generation project metering point when the units are out-of-service. This assumes the intent of the IC is to net the generation with the load.

The IC will also be required to meet all PJM, ReliabilityFirst, and NERC reliability criteria and operating procedures for standards compliance. For example, the IC will need to properly locate and report the over and under voltage and over and under frequency system protection elements for its units as well as the submission of the generator model and protection data required to satisfy the PJM and ReliabilityFirst audits.

Failure to comply with these requirements may result in a disconnection of service if the violation is found to compromise the reliability of the FE Transmission System.

9.3 Power Factor Requirements

The IC shall design its non-synchronous Customer Facility with the ability to maintain a power factor of at least 0.95 leading (absorbing VARs) to 0.95 lagging (supplying VARs) measured at the high-side of the facility substation transformer(s) connected to the FE Transmission System.

10 Revenue Metering and SCADA Requirements

10.1 PJM Requirements

The Interconnection Customer will be required to install equipment necessary to provide Revenue Metering (KWH, KVARH) and real time data (KW, KVAR) for IC's generating Resource. See PJM Manuals M-01 and M-14D, and PJM Tariff Section 8 of Attachment O.

10.2 Meteorological Data Reporting Requirements

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

- Back Panel temperature (Fahrenheit) - (Required for plants with Maximum Facility Output of 3 MW or higher)
- Irradiance (Watts/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 FE revenue metering requirements for generation interconnection customers which can be found in FE's "Requirements for Transmission Connected Facilities" document located at: http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx

11 Summer Peak - Load Flow Analysis

The Queue Project AG1-385 was evaluated as a 20.0 MW (Capacity 15.4 MW) injection tapping the Ridgeway to Motion 46 kV line in the APS area. Project AG1-385 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AG1-385 was studied with a commercial probability of 53.0 %. Potential network impacts were as follows:

11.1 Generation Deliverability

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

None.

11.2 Multiple Facility Contingency

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

None.

11.3 Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
167415527	235174	01ELKO	138.0	AP	235237	01RIDGWY	138.0	AP	1	AP-P2-3-WP-230-447	breaker	133.0	140.51	143.04	DC	3.36
166016797	941190	AE2-113 TAP	115.0	PENELEC	200668	26FARMVLY	115.0	PENELEC	1	PN-P2-3-PN-230-8M_SUM_WIN	breaker	160.0	125.79	126.33	DC	1.91

11.4 Potential Congestion due to Local Energy Deliverability

PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.

Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which shall study all overload conditions associated with the overloaded element(s) identified.

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
164598615	235151	01BURMA	115.0	AP	200583	26PINEY	115.0	PENELEC	1	PN-P1-2-PN-345-003	operation	277.0	99.89	100.06	DC	1.06
164598614	235175	01ELKO	230.0	AP	235158	01CARB	230.0	AP	1	AP-P1-3-WP-230-001	operation	510.0	99.49	100.23	DC	3.75

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
167967963	235197	01KARNSC	138.0	AP	235152	01BUTLER	138.0	AP	1	PN-P1-2-PN-345-107T	operation	179.0	235.59	236.04	DC	1.79
167967964	235197	01KARNSC	138.0	AP	235152	01BUTLER	138.0	AP	1	ATSI-P1-2-CEI-345-700T	operation	179.0	235.59	236.04	DC	1.79
166246937	941190	AE2-113 TAP	115.0	PENELEC	200668	26FARMVLY	115.0	PENELEC	1	PN-P1-2-PN-230-006	operation	160.0	110.57	111.11	DC	1.91

11.5 System Reinforcements - Summer Peak Load Flow - Primary POI

ID	Idx	Facility	Upgrade Description	Cost
167415527	1	**01ELKO 138.0 kV - 01RIDGWY 138.0 kV Ckt 1**	**APS** **WP-AG1-F-0015A (839) : Replace 4/0 CU bus conductor at Ridgway substation.** **Project Type : FAC** **Cost : $130,252** **Time Estimate : 12.0 Months** **WP-AG1-F-0015B (840) : Replace 4/0 CW line riser at Ridgway substation.** **Project Type : FAC** **Cost : $130,252** **Time Estimate : 12.0 Months** **WP-AG1-F-0015C (841) : Reconductor 8.89 miles of 4/0 CW. (63 spans).** **Project Type : FAC** **Cost : $23,158,894** **Time Estimate : 48.0 Months**	$23,419,398
166016797	2	**AE2-113 TAP 115.0 kV - 26FARM VLY 115.0 kV Ckt 1**	**PENELEC** **PN-AG1-F-0012A (2186) : Reconductor 5.6 miles of line.** **Project Type : FAC** **Cost : $13,700,000** **Time Estimate : 36.0 Months** **PN-AG1-F-0012B (2187) : Replace substation conductor at Farmers Valley** **Project Type : FAC** **Cost : $200,000** **Time Estimate : 12.0 Months** **PN-AG1-F-0012C (2188) : Adjust line relaying at Farmers Valley** **Project Type : FAC** **Cost : $800,000** **Time Estimate : 12.0 Months**	$14,700,000
			TOTAL COST	**$38,119,398**

11.6 Flow Gate Details

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

11.6.1 Index 1

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
167415527	235174	01ELKO	AP	235237	01RIDGWY	AP	1	AP-P2-3-WP-230-447	breaker	133.0	140.51	143.04	DC	3.36

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
200649	26PENNTECH	0.8436	50/50	0.8436
941191	AE2-113 C	4.8293	Adder	5.68
941192	AE2-113 E	5.1996	Adder	6.12
941321	AE2-126 C	0.5959	Adder	0.7
941322	AE2-126 E	0.3973	Adder	0.47
942961	AE2-316 C	7.4122	50/50	7.4122
942962	AE2-316 E	10.5698	50/50	10.5698
944381	AF1-103 O1	1.2182	Adder	1.43
944901	AF1-155 C	-4.4987	Adder	-5.29
945451	AF1-210 C	-0.4081	Adder	-0.48
946111	AF1-276 C	3.5759	Adder	4.21
946112	AF1-276 E	1.7613	Adder	2.07
946121	AF1-277 C	3.5759	Adder	4.21
946122	AF1-277 E	1.7613	Adder	2.07
946131	AF1-278 C	2.8522	Adder	3.36
946132	AF1-278 E	1.4175	Adder	1.67
946381	AF1-302 C	3.2368	50/50	3.2368
946382	AF1-302 E	4.3157	50/50	4.3157
946421	AF1-306 C	9.5632	50/50	9.5632
946422	AF1-306 E	38.2529	50/50	38.2529
959823	AF2-273 BAT	0.0820	Merchant Transmission	0.0820
963571	AG1-206 C	0.2247	Adder	0.5
963572	AG1-206 E	0.1210	Adder	0.27
964341	AG1-296 C	0.9657	50/50	0.9657
964342	AG1-296 E	0.5200	50/50	0.5200
965203	AG1-385 BAT	3.3649	50/50	3.3649
966121	AG1-481	0.5014	Adder	1.11
WEC	WEC	0.0296	Confirmed LTF	0.0296
LGEE	LGEE	0.0528	Confirmed LTF	0.0528
CPLE	CPLE	0.0116	Confirmed LTF	0.0116
CBM-W2	CBM-W2	0.6720	Confirmed LTF	0.6720
TVA	TVA	0.0910	Confirmed LTF	0.0910
O-066	O-066	1.3797	Confirmed LTF	1.3797
SIGE	SIGE	0.0304	Confirmed LTF	0.0304
CBM-S2	CBM-S2	0.3236	Confirmed LTF	0.3236
CBM-S1	CBM-S1	0.0258	Confirmed LTF	0.0258
G-007	G-007	0.2153	Confirmed LTF	0.2153
MEC	MEC	0.1382	Confirmed LTF	0.1382
LAGN	LAGN	0.1172	Confirmed LTF	0.1172
CBM-W1	CBM-W1	1.5001	Confirmed LTF	1.5001

11.6.2 Index 2

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
166016797	941190	AE2-113 TAP	PENELEC	200668	26FARM VLY	PENELEC	1	PN-P2-3-PN-230-8M_SUM_WIN	breaker	160.0	125.79	126.33	DC	1.91

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
200649	26PENNTECH	1.5387	50/50	1.5387
235003	AC1-025 E	0.0786	Adder	0.09
236828	01GRAYMONT	0.2175	Adder	0.26
290086	Q-036 E	1.7241	Adder	2.03
921642	AA2-000	20.9211	Adder	24.61
930511	AB2-092	0.7682	Adder	0.9
936421	AD2-055	1.5815	Adder	1.86
936991	AD2-133 C	0.7759	Adder	0.91
936992	AD2-133 E	3.5487	Adder	4.17
939171	AE1-147 C	0.6562	Adder	0.77
939172	AE1-147 E	0.4374	Adder	0.51
940201	AE2-001 C	0.6541	Adder	0.77
940202	AE2-001 E	0.4361	Adder	0.51
940681	**AE2-055 C (Suspended)**	**0.6221**	**Adder**	**0.73**
940682	**AE2-055 E (Suspended)**	**0.4147**	**Adder**	**0.49**
941191	AE2-113 C	33.8240	50/50	33.8240
941192	AE2-113 E	36.4176	50/50	36.4176
941261	AE2-120 C	0.6530	Adder	0.77
941262	AE2-120 E	0.4353	Adder	0.51
941271	AE2-121 C	0.3508	Adder	0.41
941272	AE2-121 E	0.2342	Adder	0.28
941321	AE2-126 C	1.9456	50/50	1.9456
941322	AE2-126 E	1.2970	50/50	1.2970
941331	AE2-129 C	0.6925	Adder	0.81
941332	AE2-129 E	0.4617	Adder	0.54
941351	**AE2-131 C (Suspended)**	**0.6925**	**Adder**	**0.81**
941352	**AE2-131 E (Suspended)**	**0.4617**	**Adder**	**0.54**
942351	AE2-248 C	0.5084	Adder	0.6
942352	AE2-248 E	0.3389	Adder	0.4
942491	AE2-262 C	3.1765	Adder	3.74
942492	AE2-262 E	2.1346	Adder	2.51
942501	AE2-263 C	2.9859	Adder	3.51
942502	AE2-263 E	1.9935	Adder	2.35
942961	AE2-316 C	2.2774	Adder	2.68
942962	AE2-316 E	3.2476	Adder	3.82
943751	AF1-043	4.7445	Adder	5.58
944001	**AF1-068 C O1 (Withdrawn : 12/15/2020)**	**0.6736**	**Adder**	**0.79**
944002	**AF1-068 E O1 (Withdrawn : 12/15/2020)**	**0.3789**	**Adder**	**0.45**
944311	AF1-099 C	4.8219	Adder	5.67

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
944312	AF1-099 E	3.2146	Adder	3.78
944321	AF1-100 C	10.8235	Adder	12.73
944322	AF1-100 E	7.2157	Adder	8.49
944382	AF1-103 BAT	1.1770	Merchant Transmission	1.1770
944471	AF1-112 C	0.6389	Adder	0.75
944472	AF1-112 E	0.4260	Adder	0.5
944671	**AF1-132 C O1 (Withdrawn : 12/15/2020)**	**0.6292**	**Adder**	**0.74**
944672	**AF1-132 E O1 (Withdrawn : 12/15/2020)**	**0.4195**	**Adder**	**0.49**
944691	AF1-134 C	0.5831	Adder	0.69
944692	AF1-134 E	0.3888	Adder	0.46
944771	AF1-142 C	7.7150	Adder	9.08
944772	AF1-142 E	5.1433	Adder	6.05
944881	AF1-153 C O1	0.9734	Adder	1.15
944882	AF1-153 E O1	0.6489	Adder	0.76
944901	AF1-155 C	0.9669	Adder	1.14
944902	AF1-155 E	0.6446	Adder	0.76
945491	**AF1-214 C (Withdrawn : 12/03/2020)**	**0.6530**	**Adder**	**0.77**
945492	**AF1-214 E (Withdrawn : 12/03/2020)**	**0.4353**	**Adder**	**0.51**
946381	AF1-302 C	0.9945	Adder	1.17
946382	AF1-302 E	1.3260	Adder	1.56
946421	AF1-306 C	5.7301	50/50	5.7301
946422	AF1-306 E	22.9206	50/50	22.9206
957451	AF2-039 C	0.6136	Adder	0.72
957452	AF2-039 E	0.4091	Adder	0.48
957941	AF2-088 C	0.2954	Adder	0.35
957942	AF2-088 E	0.1970	Adder	0.23
958271	AF2-121 C	0.6925	Adder	0.81
958272	AF2-121 E	0.4617	Adder	0.54
960022	AF2-293 E	0.0639	Adder	0.08
960041	AF2-295 C	0.9669	Adder	1.14
960042	AF2-295 E	0.6446	Adder	0.76
960051	AF2-296 C	0.5831	Adder	0.69
960052	AF2-296 E	0.3888	Adder	0.46
962411	AG1-090 C O1	1.8351	Adder	4.07
962412	AG1-090 E O1	1.2234	Adder	2.72
962951	AG1-144 C	0.3670	Adder	0.81
962952	AG1-144 E	0.2447	Adder	0.54
963571	AG1-206 C	1.1736	50/50	1.1736
963572	AG1-206 E	0.6320	50/50	0.6320
963891	AG1-242 C	0.1674	Adder	0.37
963892	AG1-242 E	0.0901	Adder	0.2
964031	AG1-257 C	0.2353	Adder	0.52
964032	AG1-257 E	0.3288	Adder	0.73
964041	AG1-258 C	0.2353	Adder	0.52
964042	AG1-258 E	0.3288	Adder	0.73
964341	AG1-296 C	0.1602	Adder	0.36
964342	AG1-296 E	0.0863	Adder	0.19
964451	AG1-308 C O1	0.2778	Adder	0.62

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
964452	AG1-308 E O1	0.3883	Adder	0.86
965121	AG1-377 C O1	0.3670	Adder	0.81
965122	AG1-377 E O1	0.2447	Adder	0.54
965131	AG1-378 C O1	0.3670	Adder	0.81
965132	AG1-378 E O1	0.2447	Adder	0.54
965201	AG1-385 C	0.6634	Adder	1.47
965202	AG1-385 E	0.1965	Adder	0.44
965301	AG1-395 C	0.4716	Adder	1.05
965302	AG1-395 E	0.1401	Adder	0.31
966122	AG1-481 BAT	0.4772	Merchant Transmission	0.4772
G-007A	G-007A	0.5922	Confirmed LTF	0.5922
VFT	VFT	1.5803	Confirmed LTF	1.5803
CALDERWOOD	CALDERWOOD	0.0601	Confirmed LTF	0.0601
NY	NY	0.4761	Confirmed LTF	0.4761
PRAIRIE	PRAIRIE	0.4004	Confirmed LTF	0.4004
CHEOAH	CHEOAH	0.0601	Confirmed LTF	0.0601
CBM-N	CBM-N	0.2820	Confirmed LTF	0.2820
COTTONWOOD	COTTONWOOD	0.2856	Confirmed LTF	0.2856
HAMLET	HAMLET	0.0445	Confirmed LTF	0.0445
GIBSON	GIBSON	0.0890	Confirmed LTF	0.0890
BLUEG	BLUEG	0.2778	Confirmed LTF	0.2778
TRIMBLE	TRIMBLE	0.0896	Confirmed LTF	0.0896
CATAWBA	CATAWBA	0.0319	Confirmed LTF	0.0319

11.7 Queue Dependencies

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

Queue Number	Project Name	Status
AA2-000	N/A	N/A
AB2-092	Bergen 138kV	Partially in Service - Under Construction
AC1-025	Dale Summit	In Service
AD2-055	Moshannon-East Towanda 230 kV	Active
AD2-133	Eagle Valley 115kV	Active
AE1-147	Bellefonte 46 kV	Engineering and Procurement
AE2-001	Nittany-Zion 46 kV	Active
AE2-055	Shingletown-Boalsburg 46 kV	Suspended
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
AE2-248	Fillmore-Thompson Farm 46 kV	Active
AE2-262	Moshannon-Milesburg 230 kV	Active
AE2-263	Moshannon-Milesburg 230 kV	Active
AE2-316	Brookville-Squab Hollow 138 kV	Active
AF1-043	Moshannon-East Towanda 230 kV	Active
AF1-068	Boalsburg-Centre Hall 46 kV	Withdrawn
AF1-099	Moshannon-Milesburg 230 kV	Active
AF1-100	Shawville-Moshannon 230 kV	Active
AF1-103	Warren 34.5 kV	Active
AF1-112	Centre Hall-Boalsburg 46 kV	Active
AF1-132	Shingletown-Boalsburg 46 kV	Withdrawn
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
AF1-210	Burma 23 kV	Engineering and Procurement
AF1-214	Nittany-Zion 46 kV	Withdrawn
AF1-276	Lewis Run-Pierce Brook 230 kV	Active
AF1-277	Lewis Run-Pierce Brook 2 230 kV	Active
AF1-278	Lewis Run-Pierce Brook 3 230 kV	Active
AF1-302	Brookville-Squab Hollow 138 kV	Active
AF1-306	Squab Hollow 230 kV	Active
AF2-039	Shawville-Clearfield 34.5 kV	Active
AF2-088	Shawville-Clearfield 34.5 kV II	Active
AF2-121	Philipsburg-Shawville 34.5 kV	Active

Queue Number	Project Name	Status
AF2-273	Sligo 25 kV	Engineering and Procurement
AF2-293	Beech Creek 12.47 kV	Active
AF2-295	Wilcox-Paper City 46 kV	Active
AF2-296	Madera 34.5 kV	Active
AG1-090	Philipsburg 115 kV	Active
AG1-144	Phillipsburg 34.5 kV	Active
AG1-206	Snyder Twp 34.5 kV	Active
AG1-242	Beccaria 34.5 kV	Active
AG1-257	Madisonburg Jct-Millheim 46 kV	Active
AG1-258	Madisonburg Jct-Millheim 46 kV	Active
AG1-296	Snyder Township 34.5 kV	Active
AG1-308	Shawville-Philipsburg 115 kV	Active
AG1-377	Philipsburg 115 kV	Active
AG1-378	Philipsburg 115 kV	Active
AG1-385	Motion-Ridgeway 46 kV	Active
AG1-395	Philipsburg-Karthaus 34.5 kV 2	Active
AG1-481	Warren 34.5 kV	Active

11.8 Contingency Descriptions

Contingency Name	Contingency Definition
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-P2-3-PN-230-8M_SUM_WIN	CONTINGENCY 'PN-P2-3-PN-230-8M_SUM_WIN' /* GLADE STUCK BREAKER B42 (FOREST/SENECA) DISCONNECT BRANCH FROM BUS 200581 TO BUS 200593 CKT 1 /* 26FOREST 230 26GLADE 230 DISCONNECT BRANCH FROM BUS 200593 TO BUS 200594 CKT 1 /* 26GLADE 230 26SENECA 230 DISCONNECT BRANCH FROM BUS 200594 TO BUS 200642 CKT 1 /* 26SENECA 230 26SENECA#1 14 DISCONNECT BRANCH FROM BUS 200594 TO BUS 200643 CKT 1 /* 26SENECA 230 26SENECA#2 14 DISCONNECT BRANCH FROM BUS 200594 TO BUS 200644 CKT 1 /* 26SENECA 230 26SENECA#3 14 REMOVE MACHINE 1G FROM BUS 200642 /* 26SENECA#1 14 REMOVE MACHINE 2G FROM BUS 200643 /* 26SENECA#2 14 REMOVE MACHINE 3 FROM BUS 200644 /* 26SENECA#3 14 END
PN-P1-2-PN-230-006	CONTINGENCY 'PN-P1-2-PN-230-006' /* GLADE - FOREST 230KV DISCONNECT BRANCH FROM BUS 200593 TO BUS 200581 CKT 1 /* 26GLADE 230 26FOREST 230 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
AP-P1-3-WP-230-001	CONTINGENCY 'AP-P1-3-WP-230-001' /* ELKO #1 230/138KV XFMR DISCONNECT BRANCH FROM BUS 235174 TO BUS 235175 CKT 1 /* 01ELKO 138 01ELKO 230 DISCONNECT BRANCH FROM BUS 235175 TO BUS 235971 CKT 1 /* 01ELKO 230 01SQUABHLLW 230 END

Contingency Name	Contingency Definition
AP-P2-3-WP-230-447	CONTINGENCY 'AP-P2-3-WP-230-447' /* 456 DISCONNECT BRANCH FROM BUS 235971 TO BUS 235175 CKT 1 /* 01SQUABHLLW 230 01ELKO 230 DISCONNECT BRANCH FROM BUS 235174 TO BUS 235175 CKT 1 /* 01ELKO 138 01ELKO 230 DISCONNECT BRANCH FROM BUS 235157 TO BUS 235159 CKT 1 /* 01CARB 138 01CARB J 138 DISCONNECT BRANCH FROM BUS 235159 TO BUS 235174 CKT 1 /* 01CARB J 138 01ELKO 138 DISCONNECT BRANCH FROM BUS 235159 TO BUS 235286 CKT 1 /* 01CARB J 138 01WILLAM 138 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

12 Short Circuit Analysis

The following Breakers are overdutied:

None.

12.1 System Reinforcements - Short Circuit

No short circuit impacts were identified for this project.

13 Affected Systems

13.1 NYISO

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