Generation Interconnection

Feasibility Study Report

for

Queue Project AF1-311

MONTOUR 230 KV

57 MW Capacity / 150 MW Energy

January, 2020

1 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.

An Interconnection Customer with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

PJM utilizes manufacturer models to ensure the performance of turbines is properly captured during the simulations performed for stability verification and, where applicable, for compliance with low voltage ride through requirements. Turbine manufacturers provide such models to their customers. The list of manufacturer models PJM has already validated is contained in Attachment B of Manual 14G. Manufacturer models may be updated from time to time, for various reasons such as to reflect changes to the control systems or to more accurately represent the capabilities turbines and controls which are currently available in the field. Additionally, as new turbine models are developed, turbine manufacturers provide such new models which must be used in the conduct of these studies. PJM needs adequate time to evaluate the new models in order to reduce delays to the System Impact Study process timeline for the Interconnection Customer as well as other Interconnection Customers in the study group. Therefore, PJM will require that any Interconnection Customer with a new manufacturer model must supply that model to PJM, along with a $10,000 fully refundable deposit, no later than three (3) months prior to the starting date of the System Impact Study (See Section 4.3 for starting dates) for the Interconnection Request which shall specify the use of the new model. The Interconnection Customer will be required to submit a completed dynamic model study request form (Attachment B-1 of Manual 14G) in order to document the request for the study.

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.

2 General

The Interconnection Customer (IC) has proposed a Solar generating facility located in Montour County, Pennsylvania. The installed facilities will have a total capability of 150 MW with 57 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is September 30, 2022. **This study does not imply a TO commitment to this in-service date.**

Queue Number	**AF1-311**
Project Name	MONTOUR 230 KV
State	Pennsylvania
County	Montour
Transmission Owner	PPL
MFO	150
MWE	150
MWC	57
Fuel	Solar
Basecase Study Year	2023

2.1 Point of Interconnection

AF1-311 will interconnect with the PPL transmission system via one of the following options:

Option 1: via a direct connection into the Montour 230 kV substation.

The Point of Interconnection (POI) will be where the IC tap line terminates (with insulators) at the first dead-end structure inside the PPL EU substation.

Option 2: via a tap of the Montour – Columbia 230 kV line

2.2 Cost Summary

The AF1-311 project will be responsible for the following costs for the physical interconnection of the project:

Description	Total Cost
Attachment Facilities	$ 0
Direct Connection Network Upgrade	$ 0
Non Direct Connection Network Upgrades	$ 2,266,000
Total Costs	$ 2,266,000

In addition, the AF1-311 project may be responsible for a contribution to the following costs for Network Upgrades to mitigate any overloads identified in this report:

Description	Total Cost
System Upgrades	$ 282,000,000

Cost allocations for these upgrades will be provided in the System Impact Study Report.

3 Transmission Owner Scope of Work

PPL EU will expand the Montour 230 kV substation in order to accommodate the direct connection of AF1-311 by performing modifications to Bay 6.

Study Report Assumptions

- Existing Montour Control House has space to accommodate the Bay 6 expansion
- IC AE2-271 will interconnect to Bay 5
- IC is responsible for Attachment Facilities siting and ROW acquisition
- Outage feasibility not assessed until Facilities Study
- No major environmental, real estate, or permitting issues

3.1 Attachment Facilities

The interconnection customer is responsible for the construction of the generator lead line from the interconnection customer facility to the Point of Interconnection inside the Montour 230 kV Substation.

3.2 Direct Connection Cost Estimate

None

3.3 Non-Direct Connection Cost Estimate

Montour 230 kV Substation- Populate Existing Bay 6

- Populate the existing Bay Six (6) by adding two new circuit breakers and associated equipment to complete a full breaker and a half bay. The IC generator line will terminate in Bay 6 at the newly created line position dead-end structure.
- Route 48-count fiber terminated on the new A-frame structure and route it into the control cubicle

The total preliminary cost estimate for the Non-Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Total Cost
Montour Substation - Populate Existing Bay 6	$ 2,266,000
Total Non-Direct Connection Facility Costs	**$ 2,266,000**

4 Schedule

The estimated time to complete the scope of work is **18-24 months** after the PJM three-party Interconnection Service Agreement (ISA) and Interconnection Construction Service Agreement (ICSA) are signed and PPL EU receives Notice to Proceed from the IC.

5 Interconnection Customer Requirements

5.1 PPL EU Interconnection Requirements

PPL EU applicable technical standards that address requirements for interconnection of generation, transmission, and end user facilities can be found at the following link:

https://pjm.com/planning/design-engineering/to-tech-standards/private-ppl.aspx

6 Revenue Metering and SCADA Requirements

6.1 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.

6.2 PPL Requirements

Installation of revenue grade Bi-directional Metering Equipment will be required in the vicinity of the POI to measure kWh and kVARh. PPL EU will design and supply the required metering equipment; all installation costs would be borne by the IC including CTs/PTs. All metering equipment must meet applicable PPL EU tariff requirements as well as being compliant with all applicable requirements of the PJM agreements. The equipment must provide bidirectional revenue metering (kWh and kVARh) and real-time data (kW, kVAR, circuit breaker status, and generator bus voltages) for the IC's generating resource. The metering equipment should be housed in a control cabinet or similar enclosure and must be accessible to PPL EU metering personnel.

7 OPTION 1: Network Impacts

The Queue Project AF1-311 was evaluated as a 150.0 MW (Capacity 57.0 MW) injection at the **Montour 230 kV** substation in the PPL area. Project AF1-311 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-311 was studied with a commercial probability of 0.53. Potential network impacts were as follows:

Summer Peak Load Flow

8 Generation Deliverability

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

None

9 Multiple Facility Contingency

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

None

10 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
4231 1814	200022	SUSQHANA	500	PJM	200023	WESC OVLE	500	PJM	1	PJM500_PL_P42_000923	breaker	3112.0	118.78	119.51	DC	52.49
4231 1815	200022	SUSQHANA	500	PJM	200023	WESC OVLE	500	PJM	1	PJM500_PL_P42_000922	breaker	3112.0	118.78	119.51	DC	52.49
4231 1756	200023	WESCOVLE	500	PJM	200075	BREI	500	PJM	1	PJM500_PL_P42_000923	breaker	3112.0	124.65	125.5	DC	59.56
4231 1757	200023	WESCOVLE	500	PJM	200075	BREI	500	PJM	1	PJM500_PL_P42_000922	breaker	3112.0	124.65	125.5	DC	59.57
4231 2024	207968	ELIM	230	PPL	208109	SUNB	230	PPL	1	PL_P42_001388	breaker	537.0	100.5	105.91	DC	29.08
4231 1967	208034	MILT	230	PPL	208109	SUNB	230	PPL	1	PL_P42_000488	breaker	730.0	105.07	111.71	DC	48.52
4231 1968	208034	MILT	230	PPL	208109	SUNB	230	PPL	1	PL_P42_100989	breaker	730.0	105.07	111.71	DC	48.52
4281 6638	208034	MILT	230	PPL	208109	SUNB	230	PPL	1	PL_P71_101343	tower	730.0	108.27	113.69	DC	39.55
4263 1870	208040	MONT	230	PPL	208034	MILT	230	PPL	1	PL_P12_000218	single	739.0	101.59	103.99	DC	17.75
4263 1871	208040	MONT	230	PPL	208034	MILT	230	PPL	1	PL_P13_100455	single	739.0	101.59	103.99	DC	17.75
4281 6612	208040	MONT	230	PPL	208034	MILT	230	PPL	1	PL_P71_101343	tower	739.0	111.05	116.4	DC	39.55

11 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
4263 1817	200021	SUNBURY	500	PJM	200009	JUNIATA	500	PJM	1	PJM500_PL_P12_000080	operation	3732.0	113.1	113.97	DC	71.86
4263 1819	200021	SUNBURY	500	PJM	200009	JUNIATA	500	PJM	1	Base Case	operation	2939.0	113.16	114.09	DC	60.57
4263 1654	200022	SUSQHANA	500	PJM	200023	WESCO VLE	500	PJM	1	PJM500_PL_P12_000083	operation	3112.0	118.52	119.27	DC	53.27
4263 1598	200023	WESCOVLE	500	PJM	200075	BREI	500	PJM	1	PJM500_PL_P12_000083	operation	3112.0	124.47	125.33	DC	60.12
4263 1886	208034	MILT	230	PPL	208109	SUNB	230	PPL	1	PL_P13_100455	operation	730.0	102.25	108.65	DC	46.71
4263 1887	208034	MILT	230	PPL	208109	SUNB	230	PPL	1	PL_P12_000218	operation	730.0	102.25	108.65	DC	46.71
4263 1867	208040	MONT	230	PPL	208034	MILT	230	PPL	1	PL_P12_000218	operation	739.0	107.73	114.05	DC	46.71
4263 1868	208040	MONT	230	PPL	208034	MILT	230	PPL	1	PL_P13_100455	operation	739.0	107.73	114.05	DC	46.71
4263 1608	938390	AE1-058 TAP	230	PPL	208072	SIEG	230	PPL	1	PJM500_PL_P12_000083	operation	628.0	121.81	122.85	DC	14.44

12 System Reinforcements

ID	Index	Facility	Upgrade Description	Cost
42311757, 42311756	2	**WESCOVLE 500.0 kV - BREI 500.0 kV Ckt 1**	**R-PL-0004 : Build new Sunbury-Dauphin 230kV Line and Rebuild Dauphin 230kV Yard** **Project Type : FACILITY** **Cost : $141,000,000** **Time Estimate : 80 Months**	$141,000,000
42311967, 42816638, 42311968	4	**MILT 230.0 kV - SUNB 230.0 kV Ckt 1**	**R-PL-0002 (12) : Rebuild and add second circuit from MONTOUR-MILTON 230kV line and MILTON-SUNBURY 230kV** **Project Type : CON** **Cost : $92,000,000** **Time Estimate : 48 Months**	$92,000,000
42311814, 42311815	1	**SUSQHANA 500.0 kV - WESCOVLE 500.0 kV Ckt 1**	**R-PL-0004 : Build new SUNBURY-DAUPHIN 230kV Line and Rebuild DAUP 230kV Yard** **Project Type : FACILITY** **Cost : $141,000,000** **Time Estimate : 80 Months**	Cost is included in Index 2 reinforcement above
42312024	3	**ELIM 230.0 kV - SUNB 230.0 kV Ckt 1**	**R-PL-0005 (5) : Rebuild SUNBURY-ELIMSPORT 230kV Line** **Project Type : FACILITY** **Cost : $49,000,000** **Time Estimate : 48.0 Months**	$49,000,000
42631871, 42631870, 42816612	5	**MONT 230.0 kV - MILT 230.0 kV Ckt 1**	**R-PL-0002 (2) : Rebuild and add second circuit from MONTOUR-MILTON 230kV line and MILTON-SUNBURY 230kV Line** **Project Type : CON** **Cost : $92,000,000** **Time Estimate : 48 Months**	Cost is included in Index 4 reinforcement above
			TOTAL COST	**$282,000,000**

13 Flow Gate Details

The following indices contain additional information about each flowgate presented in the body of the report. For each index, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact. It should be noted the generator contributions presented in the appendices sections are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.

13.1 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
42311815	200022	SUSQHANA	PJM	200023	WESCOVLE	PJM	1	PJM500_PL_P42_000922	breaker	3112.0	118.78	119.51	DC	52.49

Bus #	Bus	MW Impact
200038	SUSQ 2	58.0391
200083	FRPO 1	27.7769
200084	FRPO 2	27.7769
200823	26MHP_X3-003	2.8796
203907	26Y2-042	3.1724
203909	26Z1-038	2.8816
203910	26Z1-091	2.3081
208930	HUST 11	12.6958
208931	HUST 12	13.7775
208932	HUST 13	12.6958
208933	HUST 10	22.5450
209006	**NEPC IPP (Deactivation : 10/24/18)**	**6.1239**
209019	VIKI IPP	4.6720
209022	**WHFR IPP (Deactivation : 03/01/20)**	**11.4701**
211369	W1-111 BAT	0.0236
211375	BEAC	4.7107
211418	BUMO	3.2038
211770	PEFO 1	6.7356
211771	PEFO 2	6.7356
292935	U2-015E OP1	21.4411
294573	P-028 E	17.2778
917662	Z2-107 E	2.3337
918521	AA1-066	4.9381
918602	AA1-077 E	18.4360
918682	AA1-082 E	6.3938
919201	AA1-144 OP	17.7940
920651	AA2-171 E	12.8275
920711	AA2-182 C	398.4890
921653	AA2-008 E	17.0597
923673	AB1-182 E	5.1903
924291	AB2-074 C	17.3345
924292	AB2-074 E	25.6958
925951	AC1-071 C	1.9160
925952	AC1-071 E	12.8268
932691	AC2-092	28.7443
938331	AE1-051	2.3337
938391	AE1-058 C	61.5591
938392	AE1-058 E	61.5591
938401	AE1-059 C O1	62.2965
938402	AE1-059 E O1	62.2965
939521	AE1-181 C	6.3594
939522	AE1-181 E	4.2396

Bus #	Bus	MW Impact
939891	AE1-225 C O1	2.7448
939892	AE1-225 E O1	3.0368
940561	AE2-042 C O1	14.2114
940562	AE2-042 E O1	7.0450
940592	AE2-046 E	6.1239
940721	AE2-059 C	2.5508
940722	AE2-059 E	3.5225
940941	AE2-084 C	2.5508
940942	AE2-084 E	3.5225
941161	AE2-110 C	2.5308
941162	AE2-110 E	3.4949
941171	AE2-111 C	2.3447
941172	AE2-111 E	3.2379
941371	AE2-133 C	2.2403
941372	AE2-133 E	3.0938
942281	AE2-241 C	2.5308
942282	AE2-241 E	3.4949
942561	AE2-271 C O1	18.1428
942562	AE2-271 E O1	12.0754
942721	AE2-288	84.0212
942771	AE2-295 C O1	7.2174
942772	AE2-295 E O1	41.8720
943311	AF1-002 C	0.3131
943312	AF1-002 E	0.4323
943721	AF1-040 C	0.1548
943722	AF1-040 E	2.9404
945511	AF1-216 C1O1	6.8215
945512	AF1-216 E1O1	4.5424
945521	AF1-216 C2O1	6.8215
945522	AF1-216 E2O1	4.5424
945611	AF1-226 C	2.3473
945612	AF1-226 E	3.2415
945701	AF1-235	251.6558
945761	AF1-241 C	1.4292
945762	AF1-241 E	0.9528
946471	AF1-311 C O1	8.9852
946472	AF1-311 E O1	14.6600
946691	AF1-333 C O1	1.8686
946692	AF1-333 E O1	1.2458
946751	AF1-339 C O1	5.6059
946752	AF1-339 E O1	3.7373
946761	AF1-271A C	1.5786
946762	AF1-271A E	1.0524
DUCKCREEK	DUCKCREEK	2.4619
NEWTON	NEWTON	2.3112
FARMERCITY	FARMERCITY	0.1209
G-007A	G-007A	2.9058
VFT	VFT	15.4155
PRAIRIE	PRAIRIE	5.5922
COFFEEN	COFFEEN	1.1363
EDWARDS	EDWARDS	0.7473
CHEOAH	CHEOAH	1.1236

Bus #	Bus	MW Impact
TILTON	TILTON	1.3469
GIBSON	GIBSON	1.1728
CALDERWOOD	CALDERWOOD	1.1148
BLUEG	BLUEG	3.7324
TRIMBLE	TRIMBLE	1.1959
CATAWBA	CATAWBA	0.8109

13.2 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
42311757	200023	WESCOVLE	PJM	200075	BREI	PJM	1	PJM500_PL_P42_000922	breaker	3112.0	124.65	125.5	DC	59.57

Bus #	Bus	MW Impact
200038	SUSQ 2	60.4519
200083	FRPO 1	28.9584
200084	FRPO 2	28.9584
200823	26MHP_X3-003	3.1827
203907	26Y2-042	3.5142
203909	26Z1-038	3.1853
203910	26Z1-091	2.5433
208930	HUST 11	13.6520
208931	HUST 12	14.8152
208932	HUST 13	13.6520
208933	HUST 10	24.2430
209006	**NEPC IPP (Deactivation : 10/24/18)**	**7.8475**
209019	VIKI IPP	5.2269
209022	**WHFR IPP (Deactivation : 03/01/20)**	**13.9325**
211369	W1-111 BAT	0.0302
211375	BEAC	6.0365
211418	BUMO	3.9931
211770	PEFO 1	12.4388
211771	PEFO 2	12.4388
292935	U2-015E OP1	26.7233
294573	P-028 E	19.0964
917662	Z2-107 E	2.5922
918521	AA1-066	5.1482
918602	AA1-077 E	20.4787
920651	AA2-171 E	13.7937
920711	AA2-182 C	428.5024
921653	AA2-008 E	19.3122
923673	AB1-182 E	5.9473
924291	AB2-074 C	18.6401
924292	AB2-074 E	27.6312
925951	AC1-071 C	2.1808
925952	AC1-071 E	14.5993
926081	AC1-087 C	0.8027
926082	AC1-087 E	1.3096
932691	AC2-092	29.9670
935071	AD1-143 C1	1.2083
935072	AD1-143 E1	7.2411
935081	AD1-143 C2	0.0422
935082	AD1-143 E2	1.0139
935091	AD1-143 C3	1.2083
935092	AD1-143 E3	7.2411
935101	AD1-143 C4	0.0422
935102	AD1-143 E4	1.0139

Bus #	Bus	MW Impact
938331	AE1-051	2.5922
938391	AE1-058 C	78.2701
938392	AE1-058 E	78.2701
938401	AE1-059 C O1	70.4947
938402	AE1-059 E O1	70.4947
939521	AE1-181 C	8.1493
939522	AE1-181 E	5.4329
939712	**AE1-202 E (Withdrawn : 11/04/2019)**	**1.0319**
939891	AE1-225 C O1	3.0708
939892	AE1-225 E O1	3.3975
940561	AE2-042 C O1	16.0059
940562	AE2-042 E O1	7.9345
940592	AE2-046 E	7.8475
940721	AE2-059 C	2.8729
940722	AE2-059 E	3.9673
940941	AE2-084 C	2.8729
940942	AE2-084 E	3.9673
941161	AE2-110 C	2.8669
941162	AE2-110 E	3.9591
941171	AE2-111 C	2.6219
941172	AE2-111 E	3.6207
941371	AE2-133 C	2.5041
941372	AE2-133 E	3.4580
941751	AE2-175 C O1	11.2518
941752	AE2-175 E O1	7.5012
942281	AE2-241 C	2.8669
942282	AE2-241 E	3.9591
942561	AE2-271 C O1	20.5896
942562	AE2-271 E O1	13.7039
942581	AE2-274	0.1690
942721	AE2-288	90.3495
942771	AE2-295 C O1	8.5143
942772	AE2-295 E O1	49.3962
943311	AF1-002 C	0.3612
943312	AF1-002 E	0.4988
943721	AF1-040 C	0.1731
943722	AF1-040 E	3.2897
945191	AF1-184	0.0738
945511	AF1-216 C1O1	7.7001
945512	AF1-216 E1O1	5.1274
945521	AF1-216 C2O1	7.7001
945522	AF1-216 E2O1	5.1274
945611	AF1-226 C	2.6591
945612	AF1-226 E	3.6721
945701	AF1-235	270.6100
945761	AF1-241 C	1.6172
945762	AF1-241 E	1.0781
946471	AF1-311 C O1	10.1969
946472	AF1-311 E O1	16.6371
946691	AF1-333 C O1	2.0968
946692	AF1-333 E O1	1.3978
946751	AF1-339 C O1	6.2903

Bus #	Bus	MW Impact
946752	AF1-339 E O1	4.1935
946761	AF1-271A C	1.7660
946762	AF1-271A E	1.1774
DUCKCREEK	DUCKCREEK	2.9352
NEWTON	NEWTON	2.7550
FARMERCITY	FARMERCITY	0.1441
G-007A	G-007A	5.2769
VFT	VFT	23.0007
PRAIRIE	PRAIRIE	6.6667
COFFEEN	COFFEEN	1.3545
EDWARDS	EDWARDS	0.8908
CHEOAH	CHEOAH	1.3418
TILTON	TILTON	1.6052
GIBSON	GIBSON	1.3978
CALDERWOOD	CALDERWOOD	1.3310
BLUEG	BLUEG	4.4494
TRIMBLE	TRIMBLE	1.4258
CATAWBA	CATAWBA	0.9699

13.3 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
42312024	207968	ELIM	PPL	208109	SUNB	PPL	1	PL_P42_001388	breaker	537.0	100.5	105.91	DC	29.08

Bus #	Bus	MW Impact
208911	MONT G1	20.5268
208912	**MONT G2 (Deactivation : 02/18/19)**	**20.7920**
208945	LOHA CT	0.5852
208948	WILL CT	1.3833
209006	**NEPC IPP (Deactivation : 10/24/18)**	**1.2745**
211369	W1-111 BAT	0.0049
211375	BEAC	0.9804
211418	BUMO	0.6684
212369	PATRIOT 1	16.1389
212370	PATRIOT 2	16.1389
292935	U2-015E OP1	4.4732
921653	AA2-008 E	17.2300
923673	AB1-182 E	0.9285
939521	AE1-181 C	1.3235
939522	AE1-181 E	0.8824
940561	AE2-042 C O1	9.0726
940562	AE2-042 E O1	4.4976
940592	AE2-046 E	1.2745
940721	AE2-059 C	1.6284
940722	AE2-059 E	2.2488
940941	AE2-084 C	1.6284
940942	AE2-084 E	2.2488
941161	AE2-110 C	1.0437
941162	AE2-110 E	1.4413
942281	AE2-241 C	1.0437
942282	AE2-241 E	1.4413
942561	AE2-271 C O1	11.8267
942562	AE2-271 E O1	7.8715
943311	AF1-002 C	0.0879
943312	AF1-002 E	0.1214
943723	AF1-040 BAT	1.9740
945511	AF1-216 C1O1	14.3114
945512	AF1-216 E1O1	9.5298
945521	AF1-216 C2O1	14.3097
945522	AF1-216 E2O1	9.5287
945611	AF1-226 C	1.8265
945612	AF1-226 E	2.5223
945761	AF1-241 C	2.8963
945762	AF1-241 E	1.9309
946471	AF1-311 C O1	11.0512
946472	AF1-311 E O1	18.0308
DUCKCREEK	DUCKCREEK	0.6805
NEWTON	NEWTON	0.6340

Bus #	Bus	MW Impact
FARMERCITY	FARMERCITY	0.0330
G-007A	G-007A	1.4289
VFT	VFT	4.3538
PRAIRIE	PRAIRIE	1.5214
COFFEEN	COFFEEN	0.3118
EDWARDS	EDWARDS	0.2068
CHEOAH	CHEOAH	0.2918
TILTON	TILTON	0.3723
MADISON	MADISON	0.0040
GIBSON	GIBSON	0.3227
CALDERWOOD	CALDERWOOD	0.2902
BLUEG	BLUEG	1.0260
TRIMBLE	TRIMBLE	0.3289
CATAWBA	CATAWBA	0.2020

13.4 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
42816638	208034	MILT	PPL	208109	SUNB	PPL	1	PL_P71_101343	tower	730.0	108.27	113.69	DC	39.55

Bus #	Bus	MW Impact
208911	MONT G1	27.9125
208912	**MONT G2 (Deactivation : 02/18/19)**	**28.2731**
209006	**NEPC IPP (Deactivation : 10/24/18)**	**1.5587**
211369	W1-111 BAT	0.0060
211375	BEAC	1.1990
211418	BUMO	0.8196
212369	PATRIOT 1	14.0753
212370	PATRIOT 2	14.0753
292935	U2-015E OP1	5.4849
921653	AA2-008 E	15.0269
923673	AB1-182 E	1.1458
938401	AE1-059 C O1	11.8192
938402	AE1-059 E O1	11.8192
939521	AE1-181 C	1.6187
939522	AE1-181 E	1.0791
940561	AE2-042 C O1	27.1403
940562	AE2-042 E O1	13.4541
940592	AE2-046 E	1.5587
940721	AE2-059 C	4.8713
940722	AE2-059 E	6.7271
940941	AE2-084 C	4.8713
940942	AE2-084 E	6.7271
941161	AE2-110 C	1.2384
941162	AE2-110 E	1.7102
942281	AE2-241 C	1.2384
942282	AE2-241 E	1.7102
942561	AE2-271 C O1	16.0820
942562	AE2-271 E O1	10.7038
943311	AF1-002 C	0.2510
943312	AF1-002 E	0.3466
943723	AF1-040 BAT	2.6434
945611	AF1-226 C	2.1672
945612	AF1-226 E	2.9928
946471	AF1-311 C O1	15.0275
946472	AF1-311 E O1	24.5185
DUCKCREEK	DUCKCREEK	0.7692
NEWTON	NEWTON	0.7167
FARMERCITY	FARMERCITY	0.0373
G-007A	G-007A	1.6615
VFT	VFT	5.0697
PRAIRIE	PRAIRIE	1.7203
COFFEEN	COFFEEN	0.3525
EDWARDS	EDWARDS	0.2338

Bus #	Bus	MW Impact
CHEOAH	CHEOAH	0.3303
TILTON	TILTON	0.4208
MADISON	MADISON	0.0060
GIBSON	GIBSON	0.3647
CALDERWOOD	CALDERWOOD	0.3280
BLUEG	BLUEG	1.1596
TRIMBLE	TRIMBLE	0.3717
CATAWBA	CATAWBA	0.2285

13.5 Index 5

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
42816612	208040	MONT	PPL	208034	MILT	PPL	1	PL_P71_101343	tower	739.0	111.05	116.4	DC	39.55

Bus #	Bus	MW Impact
208911	MONT G1	27.9125
208912	**MONT G2 (Deactivation : 02/18/19)**	**28.2731**
209006	**NEPC IPP (Deactivation : 10/24/18)**	**1.5587**
211369	W1-111 BAT	0.0060
211375	BEAC	1.1990
211418	BUMO	0.8196
212369	PATRIOT 1	14.0753
212370	PATRIOT 2	14.0753
292935	U2-015E OP1	5.4849
921653	AA2-008 E	15.0269
923673	AB1-182 E	1.1458
938401	AE1-059 C O1	11.8192
938402	AE1-059 E O1	11.8192
939521	AE1-181 C	1.6187
939522	AE1-181 E	1.0791
940592	AE2-046 E	1.5587
941161	AE2-110 C	1.2384
941162	AE2-110 E	1.7102
942281	AE2-241 C	1.2384
942282	AE2-241 E	1.7102
942561	AE2-271 C O1	16.0820
942562	AE2-271 E O1	10.7038
943311	AF1-002 C	0.2510
943312	AF1-002 E	0.3466
943723	AF1-040 BAT	2.6434
945611	AF1-226 C	2.1672
945612	AF1-226 E	2.9928
946471	AF1-311 C O1	15.0275
946472	AF1-311 E O1	24.5185
DUCKCREEK	DUCKCREEK	0.7692
NEWTON	NEWTON	0.7167
FARMERCITY	FARMERCITY	0.0373
G-007A	G-007A	1.6615
VFT	VFT	5.0697
PRAIRIE	PRAIRIE	1.7203
COFFEEN	COFFEEN	0.3525
EDWARDS	EDWARDS	0.2338
CHEOAH	CHEOAH	0.3303
TILTON	TILTON	0.4208
MADISON	MADISON	0.0060
GIBSON	GIBSON	0.3647
CALDERWOOD	CALDERWOOD	0.3280
BLUEG	BLUEG	1.1596

Bus #	Bus	MW Impact
TRIMBLE	TRIMBLE	0.3717
CATAWBA	CATAWBA	0.2285

Affected Systems

14 Affected Systems

14.1 LG&E

LG&E Impacts to be determined during later study phases (as applicable).

14.2 MISO

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

14.3 TVA

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

14.4 Duke Energy Progress

Duke Energy Progress Impacts to be determined during later study phases (as applicable).

14.5 NYISO

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

Contingency Name	Contingency Definition
PL_P42_100989	CONTINGENCY 'PL_P42_100989' /* MONT 230 4T BF COLUMBIA & SAEGERS TIE CB DISCONNECT BUS 207943 /* /* COLU-MONT & COLU T2 DISCONNECT BRANCH FROM BUS 208040 TO BUS 212397 CKT 1 /* /* MONT-SAEG 230 PROJECT B1602 END
PL_P13_100455	CONTINGENCY 'PL_P13_100455' /* COLUMBIA 230/69KV TRAN 2 OUT DISCONNECT BUS 207943 /* END
PJM500_PL_P12_000080	CONTINGENCY 'PJM500_PL_P12_000080' /* SUSQ-WESC 500KV LINE DISCONNECT BRANCH FROM BUS 200022 TO BUS 200023 CKT 1 /* SUSQHANA-WESCOVLE 500 END
PL_P42_000488	CONTINGENCY 'PL_P42_000488' /* MONT-COLU 230 KV STUCK BREAKER CONNECTED TO MONT-SAEG2 LINE DISCONNECT BRANCH FROM BUS 208040 TO BUS 212397 CKT 2 /* MONT-SAEG 230 DISCONNECT BRANCH FROM BUS 207943 TO BUS 208040 CKT 1 /* COLU TR2-MONT 230 DISCONNECT BRANCH FROM BUS 207943 TO BUS 212093 CKT 2 /* COLU TR2-COLU 230-69 END
PL_P12_000218	CONTINGENCY 'PL_P12_000218' /* MONT-COLU 230 KV LINE DISCONNECT BRANCH FROM BUS 207943 TO BUS 208040 CKT 1 /* COLU TR2-MONT 230 DISCONNECT BRANCH FROM BUS 207943 TO BUS 212093 CKT 2 /* COLU TR2-COLU 230-69 END
PJM500_PL_P12_000083	CONTINGENCY 'PJM500_PL_P12_000083' /* JUNI-SUNB 500KV LINE DISCONNECT BRANCH FROM BUS 200009 TO BUS 200021 CKT 1 /* JUNIATA-SUNBURY 500 END
PL_P71_101343	CONTINGENCY 'PL_P71_101343' /* SAEGERS-CLINTON & SAEGERS-ELIMSPORT 230 KV TOWER DISCONNECT BRANCH FROM BUS 212397 TO BUS 207968 CKT 1 /* /* SAEG-ELIM DISCONNECT BRANCH FROM BUS 207937 TO BUS 212397 CKT 1 /* /* SAEG-CLIN END
PL_P42_001388	CONTINGENCY 'PL_P42_001388' /* SUNB 230KV YARD 3T BF - MILT-SUNB AND SUNB-CWSA DISCONNECT BRANCH FROM BUS 208109 TO BUS 208034 CKT 1 /* /* SUNB-MILT 230KV LINE DISCONNECT BRANCH FROM BUS 208109 TO BUS 207935 CKT 1 /* /* SUNB-CWSA 230KV LINE END
PJM500_PL_P42_000922	CONTINGENCY 'PJM500_PL_P42_000922' /* SUNBURY 500KV YARD 3N BF DISCONNECT BRANCH FROM BUS 200021 TO BUS 208109 CKT 24 /* /* T24 DISCONNECT BRANCH FROM BUS 200021 TO BUS 200009 CKT 1 /* /* JUNIATA-SUNBURY 500KV LINE END

Contingency Name	Contingency Definition
PJM500_PL_P42_000923	CONTINGENCY 'PJM500_PL_P42_000923' /* SUNBURY 500KV YARD 3T BF DISCONNECT BRANCH FROM BUS 200021 TO BUS 208109 CKT 25 /* /* T25 DISCONNECT BRANCH FROM BUS 200021 TO BUS 200009 CKT 1 /* /* JUNIATA-SUNBURY 500KV LINE END
Base Case	

Short Circuit

15 Short Circuit

The following Breakers are over duty:

None

16 OPTION 2: Network Impacts

The Queue Project AF1-311 was evaluated as a 150.0 MW (Capacity 57.0 MW) injection tapping the **Montour to Columbia 230 kV** line in the **PPL** area. Project AF1-311 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-311 was studied with a commercial probability of 0.53. Potential network impacts were as follows:

Summer Peak Load Flow

17 Generation Deliverability

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

None

18 Multiple Facility Contingency

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

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
42312026	207968	ELIM	230	PPL	208109	SUNB	230.0	PPL	1	PL_P42_001365	breaker	537.0	95.99	100.19	DC	22.54
54667408	946470	AF1-311 TAP	230	PPL	207943	COLU TR2	230.0	PPL	1	PL_P71_101751	tower	1195.0	94.14	100.62	DC	77.51

19 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
4231 1814	200022	SUSQHANA	500	PJM	200023	WESCOVLE	500	PJM	1	PJM500_PL_P42_000923	breaker	3112	118.78	119.52	DC	52.58
4231 1815	200022	SUSQHANA	500	PJM	200023	WESCOVLE	500	PJM	1	PJM500_PL_P42_000922	breaker	3112	118.78	119.52	DC	52.58
4231 1756	200023	WESCOVLE	500	PJM	200075	BREI	500	PJM	1	PJM500_PL_P42_000923	breaker	3112	124.65	125.51	DC	59.66
4231 1757	200023	WESCOVLE	500	PJM	200075	BREI	500	PJM	1	PJM500_PL_P42_000922	breaker	3112	124.65	125.51	DC	59.66
4231 2024	207968	ELIM	230	PPL	208109	SUNB	230	PPL	1	PL_P42_001388	breaker	537	101.82	106.95	DC	27.58
4231 1968	208034	MILT	230	PPL	208109	SUNB	230	PPL	1	PL_P42_100989	breaker	730	105.55	112.19	DC	48.52
4281 6638	208034	MILT	230	PPL	208109	SUNB	230	PPL	1	PL_P71_101343	tower	730	108.27	113.34	DC	37.03
4263 1871	208040	MONT	230	PPL	208034	MILT	230	PPL	1	PL_P13_100455	single	739	101.91	104.31	DC	17.75
4281 6612	208040	MONT	230	PPL	208034	MILT	230	PPL	1	PL_P71_101343	tower	739	111.06	116.08	DC	37.03
5451 3071	208040	MONT	230	PPL	208034	MILT	230	PPL	1	PL_P12_000218-A	single	739	101.91	104.31	DC	17.75

20 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
4263 1817	200021	SUNBURY	500	PJM	200009	JUNIATA	500	PJM	1	PJM500_PL_P12_000080	operation	3732	112.06	112.93	DC	71.92
4263 1819	200021	SUNBURY	500	PJM	200009	JUNIATA	500	PJM	1	Base Case	operation	2939	112.03	112.96	DC	60.6
4263 1654	200022	SUSQHANA	500	PJM	200023	WESCOVLE	500	PJM	1	PJM500_PL_P12_000083	operation	3112	118.52	119.27	DC	53.34
4263 1598	200023	WESCOVLE	500	PJM	200075	BREI	500	PJM	1	PJM500_PL_P12_000083	operation	3112	124.47	125.33	DC	60.2
4263 2081	207968	ELIM	230	PPL	208109	SUNB	230	PPL	1	PL_P12_001346	operation	537	95.59	100.31	DC	25.37
4263 1886	208034	MILT	230	PPL	208109	SUNB	230	PPL	1	PL_P13_100455	operation	730	102.8	109.19	DC	46.71
5451 3136	208034	MILT	230	PPL	208109	SUNB	230	PPL	1	PL_P12_000218-A	operation	730	102.8	109.19	DC	46.71
4263 1868	208040	MONT	230	PPL	208034	MILT	230	PPL	1	PL_P13_100455	operation	739	108.27	114.59	DC	46.71
5451 3066	208040	MONT	230	PPL	208034	MILT	230	PPL	1	PL_P12_000218-A	operation	739	108.27	114.59	DC	46.71
4263 1608	938390	AE1-058 TAP	230	PPL	208072	SIEG	230	PPL	1	PJM500_PL_P12_000083	operation	628	121.79	122.85	DC	14.82

21 Flow Gate Details

The following indices contain additional information about each flowgate presented in the body of the report. For each index, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact. It should be noted the generator contributions presented in the appendices sections are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.

22.1 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
42312024	207968	ELIM	PPL	208109	SUNB	PPL	1	PL_P42_001388	breaker	537.0	101.82	106.95	DC	27.58

Bus #	Bus	MW Impact
208911	MONT G1	20.5268
208912	**MONT G2 (Deativation : 02/18/19)**	**20.7920**
208945	LOHA CT	0.5852
208948	WILL CT	1.3833
209006	**NEPC IPP (Deativation : 10/24/18)**	**1.2745**
211369	W1-111 BAT	0.0049
211375	BEAC	0.9804
211418	BUMO	0.6684
212369	PATRIOT 1	16.1389
212370	PATRIOT 2	16.1389
292935	U2-015E OP1	4.4732
921653	AA2-008 E	17.2300
923673	AB1-182 E	0.9285
939521	AE1-181 C	1.3235
939522	AE1-181 E	0.8824
940561	AE2-042 C O1	9.0726
940562	AE2-042 E O1	4.4976
940592	AE2-046 E	1.2745
940721	AE2-059 C	1.6284
940722	AE2-059 E	2.2488
940941	AE2-084 C	1.6284
940942	AE2-084 E	2.2488
941161	AE2-110 C	1.0437
941162	AE2-110 E	1.4413
942281	AE2-241 C	1.0437
942282	AE2-241 E	1.4413
942561	AE2-271 C O1	11.8267
942562	AE2-271 E O1	7.8715
943311	AF1-002 C	0.0879
943312	AF1-002 E	0.1214
943723	AF1-040 BAT	1.9740
945511	AF1-216 C O2	32.8817
945512	AF1-216 E O2	21.8956
945611	AF1-226 C	1.8265
945612	AF1-226 E	2.5223
945761	AF1-241 C	2.8963
945762	AF1-241 E	1.9309
946471	AF1-311 C O2	10.4789
946472	AF1-311 E O2	17.0971
DUCKCREEK	DUCKCREEK	0.6805
NEWTON	NEWTON	0.6340
FARMERCITY	FARMERCITY	0.0330
G-007A	G-007A	1.4289

Bus #	Bus	MW Impact
VFT	VFT	4.3538
PRAIRIE	PRAIRIE	1.5214
COFFEEN	COFFEEN	0.3118
EDWARDS	EDWARDS	0.2068
CHEOAH	CHEOAH	0.2918
TILTON	TILTON	0.3723
MADISON	MADISON	0.0040
GIBSON	GIBSON	0.3227
CALDERWOOD	CALDERWOOD	0.2902
BLUEG	BLUEG	1.0260
TRIMBLE	TRIMBLE	0.3289
CATAWBA	CATAWBA	0.2020

22.2 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
54667408	946470	AF1-311 TAP	PPL	207943	COLU TR2	PPL	1	PL_P71_101751	tower	1195.0	94.14	100.62	DC	77.51

Bus #	Bus	MW Impact
208911	MONT G1	51.4514
208912	**MONT G2 (Deativation : 02/18/19)**	**52.1161**
208945	LOHA CT	0.6369
208948	WILL CT	1.3751
209018	SUNBIPCT	0.5594
209019	VIKI IPP	1.7811
212369	PATRIOT 1	22.4576
212370	PATRIOT 2	22.4576
921653	AA2-008 E	23.9759
939891	AE1-225 C O1	1.0464
939892	AE1-225 E O1	1.1577
940561	AE2-042 C O1	13.3132
940562	AE2-042 E O1	6.5997
940721	AE2-059 C	2.3895
940722	AE2-059 E	3.2999
940941	AE2-084 C	2.3895
940942	AE2-084 E	3.2999
941171	AE2-111 C	0.9000
941172	AE2-111 E	1.2428
941371	AE2-133 C	0.8714
941372	AE2-133 E	1.2034
942561	AE2-271 C O1	29.6442
942562	AE2-271 E O1	19.7304
943721	AF1-040 C	0.1113
943722	AF1-040 E	2.1151
945511	AF1-216 C O2	31.8637
945512	AF1-216 E O2	21.2178
945761	AF1-241 C	3.6797
945762	AF1-241 E	2.4532
946471	AF1-311 C O2	29.4547
946472	AF1-311 E O2	48.0577
946691	AF1-333 C O2	2.1893
946692	AF1-333 E O2	1.4595
946751	AF1-339 C O2	6.5678
946752	AF1-339 E O2	4.3786
946761	AF1-271A C	1.1355
946762	AF1-271A E	0.7570
DUCKCREEK	DUCKCREEK	0.4191
NEWTON	NEWTON	0.3922
FARMERCITY	FARMERCITY	0.0205
NY	NY	0.7255

Bus #	Bus	MW Impact
PRAIRIE	PRAIRIE	0.9454
O-066	O-066	9.4819
COFFEEN	COFFEEN	0.1929
EDWARDS	EDWARDS	0.1274
CHEOAH	CHEOAH	0.1862
TILTON	TILTON	0.2293
G-007	G-007	1.3603
GIBSON	GIBSON	0.1987
CALDERWOOD	CALDERWOOD	0.1844
BLUEG	BLUEG	0.6319
TRIMBLE	TRIMBLE	0.2026
CATAWBA	CATAWBA	0.1323

22.3 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
4231181 5	20002 2	SUSQHAN A	PJM	20002 3	WESCOVL E	PJM	1	PJM500_PL_P42_00092 2	breake r	3112. 0	118.78	119.52	DC	52.58

Bus #	Bus	MW Impact
200038	SUSQ 2	58.0391
200083	FRPO 1	27.7769
200084	FRPO 2	27.7769
200823	26MHP_X3-003	2.8796
203907	26Y2-042	3.1724
203909	26Z1-038	2.8816
203910	26Z1-091	2.3081
208930	HUST 11	12.6958
208931	HUST 12	13.7775
208932	HUST 13	12.6958
208933	HUST 10	22.5450
209006	**NEPC IPP (Deativation : 10/24/18)**	**6.1239**
209019	VIKI IPP	4.6720
209022	**WHFR IPP (Deativation : 03/01/20)**	**11.4701**
211369	W1-111 BAT	0.0236
211375	BEAC	4.7107
211418	BUMO	3.2038
211770	PEFO 1	6.7356
211771	PEFO 2	6.7356
292935	U2-015E OP1	21.4411
294573	P-028 E	17.2778
917662	Z2-107 E	2.3337
918521	AA1-066	4.9381
918602	AA1-077 E	18.4360
918682	AA1-082 E	6.3938
919201	AA1-144 OP	17.7940
920651	AA2-171 E	12.8275
920711	AA2-182 C	398.4890
921653	AA2-008 E	17.0592
923673	AB1-182 E	5.1903
924291	AB2-074 C	17.3345
924292	AB2-074 E	25.6958
925951	AC1-071 C	1.9160
925952	AC1-071 E	12.8268
932691	AC2-092	28.7443
938331	AE1-051	2.3337
938391	AE1-058 C	61.5591
938392	AE1-058 E	61.5591
938401	AE1-059 C O1	62.2965
938402	AE1-059 E O1	62.2965
939521	AE1-181 C	6.3594
939522	AE1-181 E	4.2396

Bus #	Bus	MW Impact
939891	AE1-225 C O1	2.7448
939892	AE1-225 E O1	3.0368
940561	AE2-042 C O1	14.2114
940562	AE2-042 E O1	7.0450
940592	AE2-046 E	6.1239
940721	AE2-059 C	2.5508
940722	AE2-059 E	3.5225
940941	AE2-084 C	2.5508
940942	AE2-084 E	3.5225
941161	AE2-110 C	2.5307
941162	AE2-110 E	3.4948
941171	AE2-111 C	2.3447
941172	AE2-111 E	3.2379
941371	AE2-133 C	2.2403
941372	AE2-133 E	3.0938
942281	AE2-241 C	2.5307
942282	AE2-241 E	3.4948
942561	AE2-271 C O1	18.1423
942562	AE2-271 E O1	12.0750
942721	AE2-288	84.0212
942771	AE2-295 C O1	7.2174
942772	AE2-295 E O1	41.8720
943311	AF1-002 C	0.3131
943312	AF1-002 E	0.4323
943721	AF1-040 C	0.1548
943722	AF1-040 E	2.9404
945511	AF1-216 C O2	13.6890
945512	AF1-216 E O2	9.1154
945611	AF1-226 C	2.3472
945612	AF1-226 E	3.2414
945701	AF1-235	251.6558
945761	AF1-241 C	1.4292
945762	AF1-241 E	0.9528
946471	AF1-311 C O2	9.0019
946472	AF1-311 E O2	14.6872
946691	AF1-333 C O2	1.8673
946692	AF1-333 E O2	1.2449
946751	AF1-339 C O2	5.6020
946752	AF1-339 E O2	3.7347
946761	AF1-271A C	1.5786
946762	AF1-271A E	1.0524
DUCKCREEK	DUCKCREEK	2.4619
NEWTON	NEWTON	2.3112
FARMERCITY	FARMERCITY	0.1209
G-007A	G-007A	2.9058
VFT	VFT	15.4155
PRAIRIE	PRAIRIE	5.5922
COFFEEN	COFFEEN	1.1363
EDWARDS	EDWARDS	0.7473
CHEOAH	CHEOAH	1.1236
TILTON	TILTON	1.3469
GIBSON	GIBSON	1.1728

Bus #	Bus	MW Impact
CALDERWOOD	CALDERWOOD	1.1148
BLUEG	BLUEG	3.7324
TRIMBLE	TRIMBLE	1.1959
CATAWBA	CATAWBA	0.8109

22.4 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
42311757	200023	WESCOVLE	PJM	200075	BREI	PJM	1	PJM500_PL_P42_000922	breaker	3112.0	124.65	125.51	DC	59.66

Bus #	Bus	MW Impact
200038	SUSQ 2	60.4519
200083	FRPO 1	28.9584
200084	FRPO 2	28.9584
200823	26MHP_X3-003	3.1827
203907	26Y2-042	3.5140
203909	26Z1-038	3.1853
203910	26Z1-091	2.5433
208930	HUST 11	13.6520
208931	HUST 12	14.8152
208932	HUST 13	13.6520
208933	HUST 10	24.2430
209006	**NEPC IPP (Deativation : 10/24/18)**	**7.8475**
209019	VIKI IPP	5.2269
209022	**WHFR IPP (Deativation : 03/01/20)**	**13.9325**
211369	W1-111 BAT	0.0302
211375	BEAC	6.0365
211418	BUMO	3.9931
211770	PEFO 1	12.4388
211771	PEFO 2	12.4388
292935	U2-015E OP1	26.7233
294573	P-028 E	19.0964
917662	Z2-107 E	2.5922
918521	AA1-066	5.1482
918602	AA1-077 E	20.4787
920651	AA2-171 E	13.7937
920711	AA2-182 C	428.5024
921653	AA2-008 E	19.3122
923673	AB1-182 E	5.9473
924291	AB2-074 C	18.6401
924292	AB2-074 E	27.6312
925951	AC1-071 C	2.1808
925952	AC1-071 E	14.5993
926081	AC1-087 C	0.8027
926082	AC1-087 E	1.3096
932691	AC2-092	29.9670
935071	AD1-143 C1	1.2083
935072	AD1-143 E1	7.2411
935081	AD1-143 C2	0.0422
935082	AD1-143 E2	1.0139
935091	AD1-143 C3	1.2083
935092	AD1-143 E3	7.2411
935101	AD1-143 C4	0.0422
935102	AD1-143 E4	1.0139

Bus #	Bus	MW Impact
938331	AE1-051	2.5922
938391	AE1-058 C	78.2701
938392	AE1-058 E	78.2701
938401	AE1-059 C O1	70.4947
938402	AE1-059 E O1	70.4947
939521	AE1-181 C	8.1493
939522	AE1-181 E	5.4329
939712	**AE1-202 E (Withdrawn : 11/04/2019)**	**1.0319**
939891	AE1-225 C O1	3.0708
939892	AE1-225 E O1	3.3975
940561	AE2-042 C O1	16.0059
940562	AE2-042 E O1	7.9345
940592	AE2-046 E	7.8475
940721	AE2-059 C	2.8729
940722	AE2-059 E	3.9673
940941	AE2-084 C	2.8729
940942	AE2-084 E	3.9673
941161	AE2-110 C	2.8669
941162	AE2-110 E	3.9591
941171	AE2-111 C	2.6219
941172	AE2-111 E	3.6207
941371	AE2-133 C	2.5041
941372	AE2-133 E	3.4580
941751	AE2-175 C O1	11.2518
941752	AE2-175 E O1	7.5012
942281	AE2-241 C	2.8669
942282	AE2-241 E	3.9591
942561	AE2-271 C O1	20.5896
942562	AE2-271 E O1	13.7039
942581	AE2-274	0.1690
942721	AE2-288	90.3495
942771	AE2-295 C O1	8.5143
942772	AE2-295 E O1	49.3962
943311	AF1-002 C	0.3612
943312	AF1-002 E	0.4988
943721	AF1-040 C	0.1731
943722	AF1-040 E	3.2897
945191	AF1-184	0.0738
945511	AF1-216 C O2	15.4672
945512	AF1-216 E O2	10.2995
945611	AF1-226 C	2.6591
945612	AF1-226 E	3.6721
945701	AF1-235	270.6100
945761	AF1-241 C	1.6172
945762	AF1-241 E	1.0781
946471	AF1-311 C O2	10.2131
946472	AF1-311 E O2	16.6635
946691	AF1-333 C O2	2.0949
946692	AF1-333 E O2	1.3966
946751	AF1-339 C O2	6.2846
946752	AF1-339 E O2	4.1898
946761	AF1-271A C	1.7660

Bus #	Bus	MW Impact
946762	AF1-271A E	1.1774
DUCKCREEK	DUCKCREEK	2.9352
NEWTON	NEWTON	2.7550
FARMERCITY	FARMERCITY	0.1441
G-007A	G-007A	5.2769
VFT	VFT	23.0007
PRAIRIE	PRAIRIE	6.6667
COFFEEN	COFFEEN	1.3545
EDWARDS	EDWARDS	0.8908
CHEOAH	CHEOAH	1.3418
TILTON	TILTON	1.6052
GIBSON	GIBSON	1.3978
CALDERWOOD	CALDERWOOD	1.3310
BLUEG	BLUEG	4.4494
TRIMBLE	TRIMBLE	1.4258
CATAWBA	CATAWBA	0.9699

22.5 Index 5

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
42816638	208034	MILT	PPL	208109	SUNB	PPL	1	PL_P71_101343	tower	730.0	108.27	113.34	DC	37.03

Bus #	Bus	MW Impact
208911	MONT G1	27.9125
208912	**MONT G2 (Deativation : 02/18/19)**	**28.2731**
209006	**NEPC IPP (Deativation : 10/24/18)**	**1.5587**
211369	W1-111 BAT	0.0060
211375	BEAC	1.1990
211418	BUMO	0.8196
212369	PATRIOT 1	14.0753
212370	PATRIOT 2	14.0753
292935	U2-015E OP1	5.4849
921653	AA2-008 E	15.0269
923673	AB1-182 E	1.1458
938401	AE1-059 C O1	11.8192
938402	AE1-059 E O1	11.8192
939521	AE1-181 C	1.6187
939522	AE1-181 E	1.0791
940561	AE2-042 C O1	27.1403
940562	AE2-042 E O1	13.4541
940592	AE2-046 E	1.5587
940721	AE2-059 C	4.8713
940722	AE2-059 E	6.7271
940941	AE2-084 C	4.8713
940942	AE2-084 E	6.7271
941161	AE2-110 C	1.2384
941162	AE2-110 E	1.7102
942281	AE2-241 C	1.2384
942282	AE2-241 E	1.7102
942561	AE2-271 C O1	16.0820
942562	AE2-271 E O1	10.7038
943311	AF1-002 C	0.2510
943312	AF1-002 E	0.3466
943723	AF1-040 BAT	2.6434
945611	AF1-226 C	2.1672
945612	AF1-226 E	2.9928
946471	AF1-311 C O2	14.0716
946472	AF1-311 E O2	22.9589
DUCKCREEK	DUCKCREEK	0.7692
NEWTON	NEWTON	0.7167
FARMERCITY	FARMERCITY	0.0373
G-007A	G-007A	1.6615
VFT	VFT	5.0697
PRAIRIE	PRAIRIE	1.7203
COFFEEN	COFFEEN	0.3525
EDWARDS	EDWARDS	0.2338

Bus #	Bus	MW Impact
CHEOAH	CHEOAH	0.3303
TILTON	TILTON	0.4208
MADISON	MADISON	0.0060
GIBSON	GIBSON	0.3647
CALDERWOOD	CALDERWOOD	0.3280
BLUEG	BLUEG	1.1596
TRIMBLE	TRIMBLE	0.3717
CATAWBA	CATAWBA	0.2285

22.6 Index 6

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
42816612	208040	MONT	PPL	208034	MILT	PPL	1	PL_P71_101343	tower	739.0	111.06	116.08	DC	37.03

Bus #	Bus	MW Impact
208911	MONT G1	27.9125
208912	**MONT G2 (Deativation : 02/18/19)**	**28.2731**
209006	**NEPC IPP (Deativation : 10/24/18)**	**1.5587**
211369	W1-111 BAT	0.0060
211375	BEAC	1.1990
211418	BUMO	0.8196
212369	PATRIOT 1	14.0753
212370	PATRIOT 2	14.0753
292935	U2-015E OP1	5.4849
921653	AA2-008 E	15.0269
923673	AB1-182 E	1.1458
938401	AE1-059 C O1	11.8192
938402	AE1-059 E O1	11.8192
939521	AE1-181 C	1.6187
939522	AE1-181 E	1.0791
940592	AE2-046 E	1.5587
941161	AE2-110 C	1.2384
941162	AE2-110 E	1.7102
942281	AE2-241 C	1.2384
942282	AE2-241 E	1.7102
942561	AE2-271 C O1	16.0820
942562	AE2-271 E O1	10.7038
943311	AF1-002 C	0.2510
943312	AF1-002 E	0.3466
943723	AF1-040 BAT	2.6434
945611	AF1-226 C	2.1672
945612	AF1-226 E	2.9928
946471	AF1-311 C O2	14.0716
946472	AF1-311 E O2	22.9589
DUCKCREEK	DUCKCREEK	0.7692
NEWTON	NEWTON	0.7167
FARMERCITY	FARMERCITY	0.0373
G-007A	G-007A	1.6615
VFT	VFT	5.0697
PRAIRIE	PRAIRIE	1.7203
COFFEEN	COFFEEN	0.3525
EDWARDS	EDWARDS	0.2338
CHEOAH	CHEOAH	0.3303
TILTON	TILTON	0.4208
MADISON	MADISON	0.0060
GIBSON	GIBSON	0.3647
CALDERWOOD	CALDERWOOD	0.3280
BLUEG	BLUEG	1.1596

Bus #	Bus	MW Impact
TRIMBLE	TRIMBLE	0.3717
CATAWBA	CATAWBA	0.2285

Affected Systems

23 Affected Systems

23.1 LG&E

LG&E Impacts to be determined during later study phases (as applicable).

23.2 MISO

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

23.3 TVA

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

23.4 Duke Energy Progress

Duke Energy Progress Impacts to be determined during later study phases (as applicable).

23.5 NYISO

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

Contingency Name	Contingency Definition
PL_P42_100989	CONTINGENCY 'PL_P42_100989' /* MONT 230 4T BF COLUMBIA & SAEGERS TIE CB DISCONNECT BUS 207943 /* /* COLU-MONT & COLU T2 DISCONNECT BRANCH FROM BUS 208040 TO BUS 212397 CKT 1 /* /* MONT-SAEG 230 PROJECT B1602 END
PL_P13_100455	CONTINGENCY 'PL_P13_100455' /* COLUMBIA 230/69KV TRAN 2 OUT DISCONNECT BUS 207943 /* END
PJM500_PL_P12_000080	CONTINGENCY 'PJM500_PL_P12_000080' /* SUSQ-WESC 500KV LINE DISCONNECT BRANCH FROM BUS 200022 TO BUS 200023 CKT 1 /* SUSQHANA-WESCOVLE 500 END
PL_P42_001388	CONTINGENCY 'PL_P42_001388' /* SUNB 230KV YARD 3T BF - MILT-SUNB AND SUNB-CWSA DISCONNECT BRANCH FROM BUS 208109 TO BUS 208034 CKT 1 /* /* SUNB-MILT 230KV LINE DISCONNECT BRANCH FROM BUS 208109 TO BUS 207935 CKT 1 /* /* SUNB-CWSA 230KV LINE END
PL_P12_001346	CONTINGENCY 'PL_P12_001346' /* MONT-MILT 230KV LINE DISCONNECT BRANCH FROM BUS 208040 TO BUS 208034 CKT 1 /* /* MONT-MILT END
PJM500_PL_P12_000083	CONTINGENCY 'PJM500_PL_P12_000083' /* JUNI-SUNB 500KV LINE DISCONNECT BRANCH FROM BUS 200009 TO BUS 200021 CKT 1 /* JUNIATA-SUNBURY 500 END
PL_P71_101343	CONTINGENCY 'PL_P71_101343' /* SAEGERS-CLINTON & SAEGERS-ELIMSPORT 230 KV TOWER DISCONNECT BRANCH FROM BUS 212397 TO BUS 207968 CKT 1 /* /* SAEG-ELIM DISCONNECT BRANCH FROM BUS 207937 TO BUS 212397 CKT 1 /* /* SAEG-CLIN END
PL_P12_000218-A	CONTINGENCY 'PL_P12_000218-A' /* MONT-COLU 230 KV LINE DISCONNECT BRANCH FROM BUS 207943 TO BUS 946470 CKT 1 /* COLU TR2-AF1-311 TAP 230 DISCONNECT BRANCH FROM BUS 207943 TO BUS 212093 CKT 2 /* COLU TR2-COLU 230-69 END
PL_P42_001365	CONTINGENCY 'PL_P42_001365' /* MONT 230KV 3T BF - MONT-SAEG 1 AND MONT-MILT DISCONNECT BRANCH FROM BUS 208040 TO BUS 212397 CKT 1 /* /* MONT-SAEG 1 230KV LINE DISCONNECT BRANCH FROM BUS 208040 TO BUS 208034 CKT 1 /* /* MONT-MILT 230KV LINE END
PJM500_PL_P42_000922	CONTINGENCY 'PJM500_PL_P42_000922' /* SUNBURY 500KV YARD 3N BF DISCONNECT BRANCH FROM BUS 200021 TO BUS 208109 CKT 24 /* /* T24 DISCONNECT BRANCH FROM BUS 200021 TO BUS 200009 CKT 1 /* /* JUNIATA-SUNBURY 500KV LINE END

Contingency Name	Contingency Definition
PJM500_PL_P42_000923	CONTINGENCY 'PJM500_PL_P42_000923' /* SUNBURY 500KV YARD 3T BF DISCONNECT BRANCH FROM BUS 200021 TO BUS 208109 CKT 25 /* /* T25 DISCONNECT BRANCH FROM BUS 200021 TO BUS 200009 CKT 1 /* /* JUNIATA-SUNBURY 500KV LINE END
Base Case	
PL_P71_101751	CONTINGENCY 'PL_P71_101751' /* MONT-BETA 1 & 2 DISCONNECT BRANCH FROM BUS 207915 TO BUS 208040 CKT 1 /* MONT-BETA 1 DISCONNECT BRANCH FROM BUS 207915 TO BUS 208040 CKT 2 /* MONT-BETA 2 END

Short Circuit

24 Short Circuit

The following Breakers are over duty

None