Generation Interconnection

Feasibility Study Report

for

Queue Project AF1-216

LYCOMING-LOCK HAVEN 69 KV

85.9 MW Capacity / 143.1 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 Lycoming County, Pennsylvania. The installed facilities will have a total capability of 143.1 MW with 85.9 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is May 31, 2021. This study does not imply a TO commitment to this in-service date.

Queue Number	AF1-216
Project Name	LYCOMING-LOCK HAVEN 69 KV
State	PA
County	Lycoming
Transmission Owner	PPL
MFO	143.1
MWE	143.1
MWC	85.9
Fuel	Solar
Basecase Study Year	2023

2.1 Point of Interconnection (POI)

AF1-216 will interconnect with the PPL EU transmission system via one of the following options:

Option 1: via the Lycoming-Lock Haven 3 & 4 69 kV lines:

The Point of Interconnection (POI) will be where the IC tap line terminates (with insulators) on the last PPL EU Attachment Facilities structure.

Option 2: via the Elimsport – Lycoming 1 230 kV Line

2.2 Cost Summary

The AF1-216 project will be responsible for the following costs for the physical interconnection:

Description	Total Cost
Attachment Facilities	$ 1,485,000
Direct Connection Network Upgrade	$ 0
Non Direct Connection Network Upgrades	$ 476,000
Total Costs	$ 1,961,000

In addition, the AF1-216 project may be responsible for a contribution to the following costs for Network Upgrades identified in this report:

Description	Total Cost
System Upgrades	$ 312,000,000

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

3 Transmission Owner Scope of Work

PPL EU will accommodate this interconnection by constructing a double circuit 69 kV tap off the existing Lycoming-Lock Haven 3 and 69 kV lines to the POI and perform remote end relay work at the Lycoming and Lock Haven Substations.

Study Assumptions

- Availability of optimal transmission line route
- Outage feasibility not assessed until Facilities Study
- No major environmental, real estate, or permitting issues
- IC is responsible for acquisition of easements, permits, and right of way for the Attachment Facilities

3.1 Attachment Facilities

69 kV Transmission Line Taps

The Attachment Facilities will connect to the Lycoming-Lock Haven 3&4 69 kV lines approximately 11.2 miles from the Lycoming 230/69 kV Substation. This scope of work is based on the IC collector substation GPS Coordinates: 41.186188°N, -77.218846°W.

- Install a double circuit 69 kV tap off the existing Lycoming-Lock Haven 3&4 69kV lines to the POI
- Replace existing LDE steel pole, grid 14660N37179, with a high-low style tap structure
- Install MOLBAB (Motor Operated Load Break Air Break switch) on each tap and POI termination pole
- From tap structure to POI terminal poles, install 300’ of wire utilizing 556 ACSR and OPGW

- Reframe two adjacent structures in the Lycoming-Lock Haven line to tension

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

Description	Total Cost
69 kV Transmission Line Tap	$ 1,485,000
Total Attachment Facility Costs	$ 1,485,000

3.2 Direct Connection Cost Estimate

None

3.3 Non-Direct Connection Cost Estimate

Remote End Work – Lycoming 230/69 kV Substation

- Model IC in CAPE and conduct a wide area short-circuit study two busses away from the IC facilities. Identify affected relays and revise settings as needed.
- Conduct a review of the IC relay settings and engineering package (submitted by IC to PPL EU).
- The following upgrades are required at the Lycoming substation*:*
    - Install DTT equipment.
    - Connect DTT equipment to new communication path installed between the *Lycoming* substation and the IC customer facilities.
    - Modify the existing Lock Haven line 3 69kV circuit breakers 17N and 17S and Lock Haven Line 4 69kV circuit breakers 5N and 5S protection and control schemes.
    - Modify the existing protective relay settings.
    - Modify the existing SCADA for new alarms.
    - Modify the existing Alarm Management System (AMS).
    - Install new cables and modify control wiring for the above.
    - Perform system checks and test equipment before placing in service.
    - Update all Lock Haven Line 3 and Lock Haven Line 4 line designations on equipment, panels, and drawings to reference the new IC customer.

Remote End Work – Lock Haven 230/69 kV Substation

- Install DTT equipment.
- Connect DTT equipment to new communication path installed between the Lock Haven substation and the IC customer facilities.
- Modify the existing Lycoming Line 3 69kV circuit breakers 4E and 4T and Lycoming Line 4 69kV circuit breakers 3E and 3T protection and control schemes.
- Modify the existing protective relay settings.
- Modify the existing SCADA for new alarms.

- Modify the existing Alarm Management System (AMS).
- Install new cables and modify control wiring for the above.
- Perform system checks and test equipment before placing in service.
- Update all Lycoming Line 3 and Lycoming Line 4 line designations on equipment, panels, and drawings to reference the new IC customer.

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
Remote End Work at Lycoming Substation	$ 238,000
Remote End Work at Lock Haven Substation	$ 238,000
Total Non-Direct Connection Facility Costs	$ 476,000

4 Schedule

The estimated time to complete the scope of work is **12-18 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

5.2 IC Direct Transfer Trip (DTT) Requirements

PPL EU will require an independent communication path, for DTT of the IC Intertie Protective Relaying (IPR) Fault Interrupting Devices (FIDs), consisting of one communication circuit with the Lycoming 69kV substation and Lock Haven 69kV substation.

PPL EU does not have OPGW available on the Lycoming-Lock Haven 3 & 4 69 kV lines available for DTT to the Lycoming and Lock Haven 230/69 kV Substations. PPL EU assumes that the IC will procure the independent communication path through a third-party provider. Upon request, PPL EU will evaluate the feasibility of installing OPGW on the Lycoming-Lock Haven 3 & 4 69 kV lines for DTT.

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 AF1-216 was evaluated as a 143.1 MW (Capacity 85.9 MW) injection tapping the Lycoming – Woolrich 69kV line and the Lycoming – First Quality Tap 69 kV line in the PPL area. Project AF1-216 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-216 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)

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
42536775	208040	MONT	230.0	PPL	208034	MILT	230.0	PPL	1	PL_P12_000218	single	739.0	99.45	101.31	DC	13.71
42536776	208040	MONT	230.0	PPL	208034	MILT	230.0	PPL	1	PL_P13_100455	single	739.0	99.45	101.31	DC	13.71

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
4223 2917	200022	SUSQHANA	500	PJM	200023	WESCOVLE	500	PJM	1	PJM500_PL_P4 2_000923	breaker	3112	109.9	110.61	DC	50.45
4223 2918	200022	SUSQHANA	500	PJM	200023	WESCOVLE	500	PJM	1	PJM500_PL_P4 2_000922	breaker	3112	109.9	110.61	DC	50.45
4223 2859	200023	WESCOVLE	500	PJM	200075	BREI	500	PJM	1	PJM500_PL_P4 2_000923	breaker	3112	114.84	115.65	DC	56.95
4223 2860	200023	WESCOVLE	500	PJM	200075	BREI	500	PJM	1	PJM500_PL_P4 2_000922	breaker	3112	114.84	115.65	DC	56.95
4253 6504	200023	WESCOVLE	500	PJM	200075	BREI	500	PJM	1	PJM500_PL_P1 2_000083	single	3112	105.09	106.2	DC	34.62
4223 3070	208034	MILT	230	PPL	208109	SUNB	230	PPL	1	PL_P42_000488	breaker	730	102.2	104.69	DC	18.13
4223 3071	208034	MILT	230	PPL	208109	SUNB	230	PPL	1	PL_P42_100989	breaker	730	102.2	104.69	DC	18.13
4253 6514	938390	AE1-058 TAP	230	PPL	208072	SIEG	230	PPL	1	PJM500_PL_P1 2_000083	single	628	103.78	105.17	DC	8.71

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
42536722	200021	SUNBURY	500	PJM	200009	JUNIATA	500	PJM	1	PJM500_PL_P12_000080	operation	3732	100.37	102.28	DC	71.63
42536724	200021	SUNBURY	500	PJM	200009	JUNIATA	500	PJM	1	Base Case	operation	2939	98.85	100.92	DC	61.23
42536559	200022	SUSQHANA	500	PJM	200023	WESCOVLE	500	PJM	1	PJM500_PL_P12_000083	operation	3112	109.69	110.41	DC	51.47
42536503	200023	WESCOVLE	500	PJM	200075	BREI	500	PJM	1	PJM500_PL_P12_000083	operation	3112	114.72	115.55	DC	57.68
42536791	208034	MILT	230	PPL	208109	SUNB	230	PPL	1	PL_P13_100455	operation	730	98.66	101.79	DC	22.85
42536792	208034	MILT	230	PPL	208109	SUNB	230	PPL	1	PL_P12_000218	operation	730	98.66	101.79	DC	22.85
42536772	208040	MONT	230	PPL	208034	MILT	230	PPL	1	PL_P12_000218	operation	739	104.18	107.27	DC	22.85
42536773	208040	MONT	230	PPL	208034	MILT	230	PPL	1	PL_P13_100455	operation	739	104.18	107.27	DC	22.85
42536513	938390	AE1-058 TAP	230	PPL	208072	SIEG	230	PPL	1	PJM500_PL_P12_000083	operation	628	115.93	116.98	DC	14.51

12 System Reinforcements

ID	Index	Facility	Upgrade Description	Cost
42232859, 42536504, 42232860	3	**WESCOVLE 500.0 kV - BREI 500.0 kV Ckt 1**	**R-PL-0004 : Build new SUNBURY-DAUPHIN 230kV Line and Rebuild the DAUPHIN 230kV Yard** **Project Type : FACILITY** **Cost : $141,000,000** **Time Estimate : 80.0 Months**	$141,000,000
42536514	5	**AE1-058 TAP 230.0 kV - SIEG 230.0 kV Ckt 1**	**R-PL-0003 (13) : Rebuild FRACKVILLE-SIEGFRIED 230kV Line** **Project Type : FACILITY** **Cost : $79,000,000** **Time Estimate : 72.0 Months**	$79,000,000
42232918, 42232917	2	**SUSQHANA 500.0 kV - WESCOVLE 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 : 80.0 Months**	In index 3 cost
42233071, 42233070	4	**MILT 230.0 kV - SUNB 230.0 kV Ckt 1**	**R-PL-0002 (2) : Rebuild and add second circuit from MONTOUR-MILTON 230kV and MILTON-SUNBURY 230kV** **Project Type : CONTINGENCY** **Cost : $92,000,000** **Time Estimate : 48.0 Months**	$92,000,000
42536776, 42536775	1	**MONT 230.0 kV - MILT 230.0 kV Ckt 1**	**R-PL-0002 (2) : Rebuild and add second circuit from MONTOUR-MILTON 230kV and MILTON-SUNBURY 230kV** **Project Type : CONTINGENCY** **Cost : $92,000,000** **Time Estimate : 48.0 Months**	In index 4 cost
			TOTAL COST	**$312,000,000**

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
42536776	208040	MONT	PPL	208034	MILT	PPL	1	PL_P13_100455	single	739.0	99.45	101.31	DC	13.71

Bus #	Bus	MW Impact
208911	MONT G1	32.9690
208912	**MONT G2 (Deactivation : 02/18/19)**	**33.3950**
208918	SUSQ 1	10.5325
208943	HARW CT	0.2583
208944	JENK CT	0.2519
208945	LOHA CT	0.2750
208948	WILL CT	0.6718
208972	BECR K09	0.0468
209006	**NEPC IPP (Deactivation : 10/24/18)**	**1.7186**
209023	WIENIPP1	0.5499
209025	WIENIPP3	0.5425
209026	WIENIPP4	0.2731
211418	BUMO	0.9104
212369	PATRIOT 1	12.8676
212370	PATRIOT 2	12.8676
234304	HUN GEN3	0.2948
234305	HUN GEN4	0.4473
234311	HUN GEN5	0.4914
234312	HUN GEN6	0.4884
938401	AE1-059 C O1	13.2200
939521	AE1-181 C	1.7847
942561	AE2-271 C O1	18.9954
943311	AF1-002 C	0.2654
945511	AF1-216 C1O1	6.8574
945521	AF1-216 C2O1	6.8565
945761	AF1-241 C	2.0549
946471	AF1-311 C O1	17.7498
DUCKCREEK	DUCKCREEK	0.7439
NEWTON	NEWTON	0.6931
FARMERCITY	FARMERCITY	0.0361
G-007A	G-007A	1.0549
VFT	VFT	3.3540
PRAIRIE	PRAIRIE	1.6660
COFFEEN	COFFEEN	0.3409
EDWARDS	EDWARDS	0.2261
CHEOAH	CHEOAH	0.3208
TILTON	TILTON	0.4070
MADISON	MADISON	0.0040
GIBSON	GIBSON	0.3527
CALDERWOOD	CALDERWOOD	0.3186
BLUEG	BLUEG	1.1215
TRIMBLE	TRIMBLE	0.3595
CATAWBA	CATAWBA	0.2226

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
4223291 8	20002 2	SUSQHAN A	PJM	20002 3	WESCOVL E	PJM	1	PJM500_PL_P42_00092 2	breake r	3112. 0	109.9	110.61	DC	50.45

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

Bus #	Bus	MW Impact
939521	AE1-181 C	6.3594
939522	AE1-181 E	4.2396
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

Bus #	Bus	MW Impact
EDWARDS	EDWARDS	0.7473
CHEOAH	CHEOAH	1.1236
TILTON	TILTON	1.3469
GIBSON	GIBSON	1.1728
CALDERWOOD	CALDERWOOD	1.1148
BLUEG	BLUEG	3.7324
TRIMBLE	TRIMBLE	1.1959
CATAWBA	CATAWBA	0.8109

13.3 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
42232860	200023	WESCOVLE	PJM	200075	BREI	PJM	1	PJM500_PL_P42_000922	breaker	3112.0	114.84	115.65	DC	56.95

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

13.4 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
42233071	208034	MILT	PPL	208109	SUNB	PPL	1	PL_P42_100989	breaker	730.0	102.2	104.69	DC	18.13

Bus #	Bus	MW Impact
208911	MONT G1	34.2469
208912	**MONT G2 (Deactivation : 02/18/19)**	**34.6894**
208945	LOHA CT	0.2149
208948	WILL CT	0.5387
209006	**NEPC IPP (Deactivation : 10/24/18)**	**1.5216**
211369	W1-111 BAT	0.0059
211375	BEAC	1.1705
211418	BUMO	0.8059
212369	PATRIOT 1	10.6103
212370	PATRIOT 2	10.6103
292935	U2-015E OP1	5.3932
921653	AA2-008 E	11.3276
923673	AB1-182 E	1.1414
938401	AE1-059 C O1	11.7130
938402	AE1-059 E O1	11.7130
939521	AE1-181 C	1.5801
939522	AE1-181 E	1.0534
940561	AE2-042 C O1	29.3314
940562	AE2-042 E O1	14.5404
940592	AE2-046 E	1.5216
940721	AE2-059 C	5.2646
940722	AE2-059 E	7.2702
940941	AE2-084 C	5.2646
940942	AE2-084 E	7.2702
942561	AE2-271 C O1	19.7317
942562	AE2-271 E O1	13.1329
943311	AF1-002 C	0.2760
943312	AF1-002 E	0.3811
943723	AF1-040 BAT	1.7534
945511	AF1-216 C1O1	5.4422
945512	AF1-216 E1O1	3.6239
945521	AF1-216 C2O1	5.4413
945522	AF1-216 E2O1	3.6233
945761	AF1-241 C	1.6874
945762	AF1-241 E	1.1249
946471	AF1-311 C O1	18.4378
946472	AF1-311 E O1	30.0827
DUCKCREEK	DUCKCREEK	0.7462
NEWTON	NEWTON	0.6963
FARMERCITY	FARMERCITY	0.0362
G-007A	G-007A	1.1508
VFT	VFT	3.6314
PRAIRIE	PRAIRIE	1.6712

Bus #	Bus	MW Impact
COFFEEN	COFFEEN	0.3425
EDWARDS	EDWARDS	0.2268
CHEOAH	CHEOAH	0.3218
TILTON	TILTON	0.4082
MADISON	MADISON	0.0040
GIBSON	GIBSON	0.3538
CALDERWOOD	CALDERWOOD	0.3196
BLUEG	BLUEG	1.1249
TRIMBLE	TRIMBLE	0.3606
CATAWBA	CATAWBA	0.2233

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
42536514	938390	AE1-058 TAP	PPL	208072	SIEG	PPL	1	PJM500_PL_P12_000083	single	628.0	103.78	105.17	DC	8.71

Bus #	Bus	MW Impact
200038	SUSQ 2	6.4552
208911	MONT G1	10.1935
208912	**MONT G2 (Deactivation : 02/18/19)**	**10.3252**
208930	HUST 11	2.7700
208931	HUST 12	3.0060
208932	HUST 13	2.7700
208933	HUST 10	4.9189
208941	FISH CT	1.0794
208945	LOHA CT	0.1988
208948	WILL CT	0.3868
208981	FOWH IPP	1.3261
208982	GLBT IPP	3.1611
209013	SCEN IPP	3.3153
209018	SUNBIPCT	0.5323
209019	VIKI IPP	1.6949
209021	WEST IPP	1.0093
209022	**WHFR IPP (Deactivation : 03/01/20)**	**11.8757**
209027	LOR2_Q27	0.7710
212099	BRMO IPP	0.2143
212174	INGE	0.1894
212266	LOR1	0.2120
212369	PATRIOT 1	5.2819
212370	PATRIOT 2	5.2819
920651	AA2-171 E	3.2926
920711	AA2-182 C	86.9432
924291	AB2-074 C	4.4495
938391	AE1-058 C	89.1925
939891	AE1-225 C O1	0.9957
940561	AE2-042 C O1	4.8957
940721	AE2-059 C	0.8787
940941	AE2-084 C	0.8787
941161	AE2-110 C	0.9536
941171	AE2-111 C	0.8538
941371	AE2-133 C	0.8188
942281	AE2-241 C	0.9536
942561	AE2-271 C O1	5.8731
942721	AE2-288	18.3319
942771	AE2-295 C O1	5.6997
943311	AF1-002 C	0.1165
943721	AF1-040 C	0.1059
945511	AF1-216 C1O1	4.3556

Bus #	Bus	MW Impact
945521	AF1-216 C2O1	4.3556
945611	AF1-226 C	1.6687
945701	AF1-235	54.9068
945761	AF1-241 C	0.8946
946471	AF1-311 C O1	5.4880
946691	AF1-333 C O1	1.2503
946751	AF1-339 C O1	3.7508
946761	AF1-271A C	1.0805
DUCKCREEK	DUCKCREEK	0.2844
NEWTON	NEWTON	0.2654
FARMERCITY	FARMERCITY	0.0138
PRAIRIE	PRAIRIE	0.6406
COFFEEN	COFFEEN	0.1305
EDWARDS	EDWARDS	0.0864
CHEOAH	CHEOAH	0.1251
TILTON	TILTON	0.1556
GIBSON	GIBSON	0.1349
CALDERWOOD	CALDERWOOD	0.1242
BLUEG	BLUEG	0.4305
TRIMBLE	TRIMBLE	0.1380
CATAWBA	CATAWBA	0.0879

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_P13_100455	CONTINGENCY 'PL_P13_100455' /* COLUMBIA 230/69KV TRAN 2 OUT DISCONNECT BUS 207943 /* 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
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_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_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_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
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 AF1-216 was evaluated as a 143.1 MW (Capacity 85.9 MW) injection tapping the **Elimsport to Lycoming 230 kV line** in the PPL area. Project AF1-216 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-216 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)

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
42536776	208040	MONT	230.0	PPL	208034	MILT	230.0	PPL	1	PL_P13_100455	single	739.0	99.45	101.63	DC	16.11
54435539	208040	MONT	230.0	PPL	208034	MILT	230.0	PPL	1	PL_P12_000218-A	single	739.0	99.45	101.63	DC	16.11
54435540	208040	MONT	230.0	PPL	208034	MILT	230.0	PPL	1	PL_P12_000218-B	single	739.0	99.51	101.69	DC	16.11

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
42233126	207968	ELIM	230.0	PPL	208109	SUNB	230.0	PPL	1	PL_P42_001406	breaker	537.0	82.29	107.49	DC	135.32
42233127	207968	ELIM	230.0	PPL	208109	SUNB	230.0	PPL	1	PL_P42_001388	breaker	537.0	89.92	100.11	DC	54.78
42765791	207968	ELIM	230.0	PPL	208109	SUNB	230.0	PPL	1	PL_P71_100487	tower	537.0	82.29	107.49	DC	135.32

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
42232917	200022	SUSQHANA	500	PJM	200023	WESCOVLE	500	PJM	1	PJM500_PL_P42_000923	breaker	3112.0	109.9	110.61	DC	50.62
42232918	200022	SUSQHANA	500	PJM	200023	WESCOVLE	500	PJM	1	PJM500_PL_P42_000922	breaker	3112.0	109.9	110.61	DC	50.62
42232859	200023	WESCOVLE	500	PJM	200075	BREI	500	PJM	1	PJM500_PL_P42_000923	breaker	3112.0	114.84	115.66	DC	57.19
42232860	200023	WESCOVLE	500	PJM	200075	BREI	500	PJM	1	PJM500_PL_P42_000922	breaker	3112.0	114.84	115.66	DC	57.2
42536504	200023	WESCOVLE	500	PJM	200075	BREI	500	PJM	1	PJM500_PL_P12_000083	single	3112.0	105.09	106.21	DC	34.75
42233071	208034	MILT	230	PPL	208109	SUNB	230	PPL	1	PL_P42_100989	breaker	730.0	102.2	105.17	DC	21.65
42536514	938390	AE1-058 TAP	230	PPL	208072	SIEG	230	PPL	1	PJM500_PL_P12_000083	single	628.0	103.76	105.14	DC	8.67

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
42536722	200021	SUNBURY	500	PJM	200009	JUNIATA	500	PJM	1	PJM500_PL_P12_000080	operation	3732	100.37	101.23	DC	71.44
42536559	200022	SUSQHANA	500	PJM	200023	WESCOVLE	500	PJM	1	PJM500_PL_P12_000083	operation	3112	109.69	110.42	DC	51.59
42536503	200023	WESCOVLE	500	PJM	200075	BREI	500	PJM	1	PJM500_PL_P12_000083	operation	3112	114.72	115.55	DC	57.89
42536791	208034	MILT	230	PPL	208109	SUNB	230	PPL	1	PL_P13_100455	operation	730	98.66	102.33	DC	26.83
54435604	208034	MILT	230	PPL	208109	SUNB	230	PPL	1	PL_P12_000218-A	operation	730	98.66	102.33	DC	26.83
42536773	208040	MONT	230	PPL	208034	MILT	230	PPL	1	PL_P13_100455	operation	739	104.18	107.81	DC	26.83
54435534	208040	MONT	230	PPL	208034	MILT	230	PPL	1	PL_P12_000218-A	operation	739	104.18	107.81	DC	26.83
42536513	938390	AE1-058 TAP	230	PPL	208072	SIEG	230	PPL	1	PJM500_PL_P12_000083	operation	628	115.92	116.96	DC	14.44

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.

21.1 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
54435540	208040	MONT	PPL	208034	MILT	PPL	1	PL_P12_000218-B	single	739.0	99.51	101.69	DC	16.11

Bus #	Bus	MW Impact
208911	MONT G1	32.9690
208912	**MONT G2 (Deactivation : 02/18/19)**	**33.3950**
208918	SUSQ 1	10.5325
208943	HARW CT	0.2583
208944	JENK CT	0.2519
208945	LOHA CT	0.2750
208948	WILL CT	0.6718
208972	BECR K09	0.0468
209006	**NEPC IPP (Deactivation : 10/24/18)**	**1.7186**
209023	WIENIPP1	0.5499
209025	WIENIPP3	0.5425
209026	WIENIPP4	0.2731
211418	BUMO	0.9104
212369	PATRIOT 1	12.8676
212370	PATRIOT 2	12.8676
234304	HUN GEN3	0.2948
234305	HUN GEN4	0.4473
234311	HUN GEN5	0.4914
234312	HUN GEN6	0.4884
938401	AE1-059 C O1	13.2200
939521	AE1-181 C	1.7847
942561	AE2-271 C O1	18.9954
943311	AF1-002 C	0.2654
945511	AF1-216 C O2	16.1063
945761	AF1-241 C	2.0549
DUCKCREEK	DUCKCREEK	0.7439
NEWTON	NEWTON	0.6931
FARMERCITY	FARMERCITY	0.0361
G-007A	G-007A	1.0549
VFT	VFT	3.3540
PRAIRIE	PRAIRIE	1.6660
COFFEEN	COFFEEN	0.3409
EDWARDS	EDWARDS	0.2261
CHEOAH	CHEOAH	0.3208
TILTON	TILTON	0.4070
MADISON	MADISON	0.0040
GIBSON	GIBSON	0.3527
CALDERWOOD	CALDERWOOD	0.3186
BLUEG	BLUEG	1.1215
TRIMBLE	TRIMBLE	0.3595
CATAWBA	CATAWBA	0.2226

21.2 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
42765791	207968	ELIM	PPL	208109	SUNB	PPL	1	PL_P71_100487	tower	537.0	82.29	107.49	DC	135.32

Bus #	Bus	MW Impact
208945	LOHA CT	1.5401
208948	WILL CT	3.4640
212369	PATRIOT 1	50.5890
212370	PATRIOT 2	50.5890
921653	AA2-008 E	54.0092
945511	AF1-216 C O2	81.2279
945512	AF1-216 E O2	54.0889
945761	AF1-241 C	8.5278
945762	AF1-241 E	5.6852
946691	AF1-333 C O2	3.4337
946692	AF1-333 E O2	2.2891
946751	AF1-339 C O2	10.3010
946752	AF1-339 E O2	6.8674
DUCKCREEK	DUCKCREEK	0.4710
NEWTON	NEWTON	0.4395
FARMERCITY	FARMERCITY	0.0229
NY	NY	0.2350
PRAIRIE	PRAIRIE	1.0564
O-066	O-066	2.8358
COFFEEN	COFFEEN	0.2162
EDWARDS	EDWARDS	0.1431
CHEOAH	CHEOAH	0.2047
TILTON	TILTON	0.2577
G-007	G-007	0.4378
GIBSON	GIBSON	0.2233
CALDERWOOD	CALDERWOOD	0.2033
BLUEG	BLUEG	0.7100
TRIMBLE	TRIMBLE	0.2276
CATAWBA	CATAWBA	0.1431

21.3 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
42232918	200022	SUSQHANA	PJM	200023	WESCOVLE	PJM	1	PJM500_PL_P42_000922	breaker	3112.0	109.9	110.61	DC	50.62

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	17.0592
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

21.4 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
42232860	200023	WESCOVLE	PJM	200075	BREI	PJM	1	PJM500_PL_P42_000922	breaker	3112.0	114.84	115.66	DC	57.2

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 (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 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

21.5 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
42233071	208034	MILT	PPL	208109	SUNB	PPL	1	PL_P42_100989	breaker	730.0	102.2	105.17	DC	21.65

Bus #	Bus	MW Impact
208911	MONT G1	34.2469
208912	**MONT G2 (Deactivation : 02/18/19)**	**34.6894**
208945	LOHA CT	0.2149
208948	WILL CT	0.5387
209006	**NEPC IPP (Deactivation : 10/24/18)**	**1.5216**
211369	W1-111 BAT	0.0059
211375	BEAC	1.1705
211418	BUMO	0.8059
212369	PATRIOT 1	10.6103
212370	PATRIOT 2	10.6103
292935	U2-015E OP1	5.3932
921653	AA2-008 E	11.3276
923673	AB1-182 E	1.1414
938401	AE1-059 C O1	11.7130
938402	AE1-059 E O1	11.7130
939521	AE1-181 C	1.5801
939522	AE1-181 E	1.0534
940561	AE2-042 C O1	29.3314
940562	AE2-042 E O1	14.5404
940592	AE2-046 E	1.5216
940721	AE2-059 C	5.2646
940722	AE2-059 E	7.2702
940941	AE2-084 C	5.2646
940942	AE2-084 E	7.2702
942561	AE2-271 C O1	19.7317
942562	AE2-271 E O1	13.1329
943311	AF1-002 C	0.2760
943312	AF1-002 E	0.3811
943723	AF1-040 BAT	1.7534
945511	AF1-216 C O2	12.9975
945512	AF1-216 E O2	8.6549
945761	AF1-241 C	1.6874
945762	AF1-241 E	1.1249
946471	AF1-311 C O2	18.4378
946472	AF1-311 E O2	30.0827
DUCKCREEK	DUCKCREEK	0.7462
NEWTON	NEWTON	0.6963
FARMERCITY	FARMERCITY	0.0362
G-007A	G-007A	1.1508
VFT	VFT	3.6314
PRAIRIE	PRAIRIE	1.6712
COFFEEN	COFFEEN	0.3425
EDWARDS	EDWARDS	0.2268

Bus #	Bus	MW Impact
CHEOAH	CHEOAH	0.3218
TILTON	TILTON	0.4082
MADISON	MADISON	0.0040
GIBSON	GIBSON	0.3538
CALDERWOOD	CALDERWOOD	0.3196
BLUEG	BLUEG	1.1249
TRIMBLE	TRIMBLE	0.3606
CATAWBA	CATAWBA	0.2233

21.6 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
42536514	938390	AE1-058 TAP	PPL	208072	SIEG	PPL	1	PJM500_PL_P12_000083	single	628.0	103.76	105.14	DC	8.67

Bus #	Bus	MW Impact
200038	SUSQ 2	6.4552
208911	MONT G1	10.1935
208912	**MONT G2 (Deactivation : 02/18/19)**	**10.3252**
208930	HUST 11	2.7700
208931	HUST 12	3.0060
208932	HUST 13	2.7700
208933	HUST 10	4.9189
208941	FISH CT	1.0794
208945	LOHA CT	0.1988
208948	WILL CT	0.3868
208981	FOWH IPP	1.3261
208982	GLBT IPP	3.1611
209013	SCEN IPP	3.3153
209018	SUNBIPCT	0.5323
209019	VIKI IPP	1.6949
209021	WEST IPP	1.0093
209022	**WHFR IPP (Deactivation : 03/01/20)**	**11.8757**
209027	LOR2_Q27	0.7710
212099	BRMO IPP	0.2143
212174	INGE	0.1894
212266	LOR1	0.2120
212369	PATRIOT 1	5.2819
212370	PATRIOT 2	5.2819
920651	AA2-171 E	3.2926
920711	AA2-182 C	86.9432
924291	AB2-074 C	4.4495
938391	AE1-058 C	89.1925
939891	AE1-225 C O1	0.9957
940561	AE2-042 C O1	4.8957
940721	AE2-059 C	0.8787
940941	AE2-084 C	0.8787
941161	AE2-110 C	0.9536
941171	AE2-111 C	0.8538
941371	AE2-133 C	0.8188
942281	AE2-241 C	0.9536
942561	AE2-271 C O1	5.8731
942721	AE2-288	18.3319
942771	AE2-295 C O1	5.6997
943311	AF1-002 C	0.1165
943721	AF1-040 C	0.1059
945511	AF1-216 C O2	8.6699

Bus #	Bus	MW Impact
945611	AF1-226 C	1.6687
945701	AF1-235	54.9068
945761	AF1-241 C	0.8946
946471	AF1-311 C O2	5.6299
946691	AF1-333 C O2	1.2515
946751	AF1-339 C O2	3.7544
946761	AF1-271A C	1.0805
DUCKCREEK	DUCKCREEK	0.2844
NEWTON	NEWTON	0.2654
FARMERCITY	FARMERCITY	0.0138
PRAIRIE	PRAIRIE	0.6406
COFFEEN	COFFEEN	0.1305
EDWARDS	EDWARDS	0.0864
CHEOAH	CHEOAH	0.1251
TILTON	TILTON	0.1556
GIBSON	GIBSON	0.1349
CALDERWOOD	CALDERWOOD	0.1242
BLUEG	BLUEG	0.4305
TRIMBLE	TRIMBLE	0.1380
CATAWBA	CATAWBA	0.0879

Affected Systems

22 Affected Systems

22.1 LG&E

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

22.2 MISO

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

22.3 TVA

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

22.4 Duke Energy Progress

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

22.5 NYISO

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

Contingency Name	Contingency Definition
PL_P13_100455	CONTINGENCY 'PL_P13_100455' /* COLUMBIA 230/69KV TRAN 2 OUT DISCONNECT BUS 207943 /* 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
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_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_P12_000218-B	CONTINGENCY 'PL_P12_000218-B' /* MONT-COLU 230 KV LINE DISCONNECT BRANCH FROM BUS 946470 TO BUS 208040 CKT 1 /* AF1-311 TAP-MONT 230 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
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
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
PL_P42_001406	CONTINGENCY 'PL_P42_001406' /* SAEGERS 2T BF - MONT SAEG 1 AND SAEG-CLIN DISCONNECT BRANCH FROM BUS 208040 TO BUS 212397 CKT 2 /* /* MONT-SAEG 1 230KV LINE DISCONNECT BRANCH FROM BUS 208040 TO BUS 212397 CKT 1 /* /* MONT-SAEG 1 230KV LINE END

Contingency Name	Contingency Definition
PL_P71_100487	CONTINGENCY 'PL_P71_100487' /* MONT-SAEG #1 & 2 230KV LINES OUT DISCONNECT BRANCH FROM BUS 212397 TO BUS 208040 CKT 2 /* /* MONT-SAEG 2 DISCONNECT BRANCH FROM BUS 212397 TO BUS 208040 CKT 1 /* /* MONT-SAEG 1 END

Short Circuit

23 Short Circuit

The following Breakers are over duty

None