Generation Interconnection

Feasibility Study Report

for

Queue Project AE2-295

ELDRED 230 KV

25.7 MW Capacity / 174.8 MW Energy

July, 2019

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 Wind generating facility located in Schuylkill County, Pennsylvania. The installed facilities will have a total capability of 174.8 MW with 25.7 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is May 31, 2022. This study does not imply a TO commitment to this in-service date.

Queue Number	**AE2-295**
Project Name	ELDRED 230 KV
State	Pennsylvania
County	Schuylkill
Transmission Owner	PPL
MFO	174.8
MWE	174.8
MWC	25.7
Fuel	Wind
Basecase Study Year	2022

2.1 Point of Interconnection

AE2-295 will interconnect with the transmission system via one of the following options:

Option 1: a direct connection into the PPL Eldred 230/69kV Substation. The Point of Interconnection (POI) will be at the dead-end structure inside the PPL EU Eldred 230/69kV Substation.

Option 2: a direct connection into the Metropolitan Edison Company (METED) Fredericksburg 69kV substation.

2.2 Cost Summary

The AE2-295 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 0
Direct Connection Network Upgrade	$ 0
Non Direct Connection Network Upgrades	$15,078,000
Total Costs	$15,078,000

In addition, the AE2-295 project may be responsible for a contribution to the following costs

Description	Total Cost
System Upgrades	$ 120,000,000

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

3 Attachment Facilities

None

4 Direct Connection Cost Estimate

None

5 Non-Direct Connection Cost Estimate

The 230/69kV Eldred Substation will require an expansion to support the AE2-295 interconnection, resulting in a (2) bay and (5) circuit breaker arrangement.

Eldred Substation Expansion- Physical Electrical Work:

- Removal of existing 230kV Breakers and associated bay equipment along with structures.
- Removal of existing fence (~850 Feet)
- Bay 4 shall be installed with 3 circuit breakers leaving two line positions.
- The IPP line from the east will be terminated in one of the line position in bay 4 and the SUNB-ELDR from west will also be terminated in bay 4 in the other line position.
- Bay 3 shall be installed with 2 circuit breakers creating one line position for ELDR-FRAC 230kV line from the east.
- Install all required foundations, support structures, termination structures, cabling, raceway, bus work, grounding, and yard lighting.
- Install additional protection, control, and SCADA equipment in the control cubicle for the associated equipment.
- Provide testing, commissioning and start-up of all newly installed metering equipment.
- Develop all engineering packages including Bill Of Material, construction support and close-out in compliance with PPL EU Standards and Specs:
  - Verification of Rigid- and Strain- Bus Calculations. Verify new bus work shall be designed with appropriate structural and electrical properties to accommodate the ultimate fault levels.
  - Conduct AC and DC loading, short-circuit, coordination studies and arc-flash calculations
  - Conduct Lightning protection calculations
  - Conduct Cable and conduit sizing calculations
  - Validate Station Ground Grid design. Involves Grounding Study to determine safe step and touch voltages based on soil resistivity and grid resistance test
  - Evaluate equipment sizing
  - Evaluate Space availability in the Control Cubicle
  - Underground Cable (Power, Control and Fiber Optic) raceway and conduit design.
  - Complete AC and DC Station Service Infrastructure.
  - Yard lighting for the newly installed equipment.
  - Geotechnical Investigation and Site Survey
  - Equipment and Foundation Design including loading calculations.
  - Structural Steel Design Package including loading calculations.
  - Access Roads Design for the new line entry, as applicable.

Eldred Substation Expansion- Fiber:

- Install single 48 count OPGW
- Install fiber cable splice box mounted on the A-frame inside the Eldred Substation
- Terminate all fiber optic protection circuits from the IC to A-frame in the Eldred 230/69kV
- Install fiber optic cable between control cubicle fiber rack and relay and communication panels
- Install 1-1/4" inner duct within 3" conduit and new cable trench.
- Install new Patch Panel FOP of new fiber entry rack Install fiber optic cable between yard splice boxes and control cubicle fiber rack.
- Install fiber splicing and testing of fiber cable at both ends (PPL EU and IC).

Eldred Substation Expansion- Protection and Control:

Develop all engineering packages including BOM, construction support and close-out in compliance with PPL EU Standards and Specs:

- 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.
- Develop relay protection scheme documents at Eldred switchyard to allow for IC direct connection.
- Develop relay settings for the new bay interconnection line at Eldred Switchyard.
- Modify existing SCADA RTU to add new alarm points for IC connection.
- Review and coordinate all relay settings from the IC.
- Revise protective relay settings at Frackville Substation as needed
- Revise protective relay settings at Sunbury Substation as needed
- Provide testing, commissioning and start-up of all metering equipment.

230kV Transmission Line Relocations:

- Relocate the Sunbury-Eldred 230kV the line to the new west bus of the rebuilt Eldred 230kV yard.
- Remove structures 36238S51054, 36229S51020, 36231S51018, and 36227S51022.
- Route the SUNB-ELDR 230kV into the new west bus section.
- Install new three pole structure with custom foundation poles to tap the SUNB-ELDR 230kV line.
- Install new full dead-end 90-degree foundation dead-end structure.
- Install 0.15 miles of new single circuit 230kV line utilizing 1590 ACSR and dual 48 count OPGW.
- Relocated the Eldred- Frackville 230kV line to the new east bus of the rebuilt Eldred 230kV yard.
- Remove structures 36247S51020, 36249S51022, 36251S51024, and 36251S51048.
- Route the ELDR-FRAC 230kv line into the new west bus section.
- Install new three pole structure with custom foundation poles to tap the ELDR-FRAC 230kV line.
- Install new full dead-end 90 degree foundation dead-end structure.
- Install new single circuit 230kV line utilizing 1590 ACSR and dual 48 count OPGW.
- There is existing 48 count OPGW installed on both the SUNB-ELDR and EDLR-FRAC 230kV lines.
- Install dual 48 count fiber on new line route and terminate on new dead-end structures. Tie fiber into existing fiber on the SUNB-ELDR and EDLR-FRAC 230kV lines.

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
Eldred 230 kV Substation Expansion	$12,196,000
230kV Transmission Line Relocations	$2,882,000
Total Non-Direct Connection Facility Costs	$15,078,000

6 Transmission Owner Study Assumptions

- Outage feasibility not assessed until Facilities Study
- No major environmental, real estate or permitting issues
- IC is responsible for acquisition of easements and right of way for the attachment facilities
- PPL EU assumed ownership of meter assumed to be in the Eldred 230/69kV Substation, as reflected in Attachment 2

7 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.

8 Interconnection Customer Requirements

8.1 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

8.2 IC Protective Relaying Requirements

At a minimum, the IC shall install the following relaying equipment at their substation for protection of the One (1) 230kV generator lead line:

- One (1) SEL-411L relay for primary protection
- One (1) SEL-421 relay for backup protection
- One (1) SEL-2411 relay for DTT*

The above relaying equipment shall communicate with their respective matching relaying equipment, via individually dedicated fiber optic circuits, at Eldred Switchyard (Bay 3).

In addition, the IC will need to ensure that the protection and control equipment at its facilities also conform to interconnecting PPL EU requirements. This includes DTT, Intertie Protective Relaying (IPR) and Point of Contact (POC) relaying equipment.

8.3 IC Direct Transfer Trip (DTT) Requirements

PPL EU will require an independent communication path, for Direct Transfer Trip (DTT) of the IC Intertie Protective Relaying (IPR) Fault Interrupting Devices (FIDs), consisting of one communication circuit with the Eldred 230/69 kV Substation. PPL EU currently has fiber communication paths available at Eldred Substation, therefore assumes strands of fiber will be used to establish the required independent pathway.

8.4 IC Substation IPR and POC Fault Interrupting Device (FID) Requirements

Based on the latest conceptual single line diagram provided by the IC, one (1) 230V rated circuit breakers in this case will serve as the IPR & POC FID. It shall be equipped with dual trip coils and capable of interrupting worst-case scenario fault currents with a rated speed of two (2) cycles or less. The IPR & POC FID circuit breaker shall be operated by their respective Primary & Backup line protection (SEL-411L), DTT (SEL-4llL), and IPR & POC relaying equipment.

8.5 IC Voice Communication Circuit Requirements

PPL EU will require an independent communication path for one (1) voice circuit. The IC will be responsible to procure one (1) normal dialup telephone line for voice communication.

Phone lines tend to be long lead-time items and must be in place and operational for equipment testing. The IC should investigate with the local phone company the possibility of obtaining this type of service at their facility.

All installation, maintenance, and monthly lease or billing charges for communications facilities are the responsibility of the IC.

9 Revenue Metering and SCADA Requirements

9.1 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.

9.2 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.

10 OPTION 1: Network Impacts

The Queue Project AE2-295 was evaluated as a 174.8 MW (Capacity 25.7 MW) injection at the **Eldred 230kV substation** in the PPL area. Project AE2-295 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE2-295 was studied with a commercial probability of 0.53. Potential network impacts were as follows:

Summer Peak Load Flow

11 Generation Deliverability

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

None

12 Multiple Facility Contingency

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

None

13 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	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
7377789	200022	SUSQHANA	PJM	200023	WESCOVLE	PJM	1	PL:1A:P42:000923	breaker	3112.0	106.37	107.22	DC	58.3
7377790	200022	SUSQHANA	PJM	200023	WESCOVLE	PJM	1	PL:1A:P42:000922	breaker	3112.0	106.37	107.22	DC	58.3
7377784	200023	WESCOVLE	PJM	200075	BREI	PJM	1	PL:1A:P42:000923	breaker	3112.0	106.46	107.41	DC	65.19
7377785	200023	WESCOVLE	PJM	200075	BREI	PJM	1	PL:1A:P42:000922	breaker	3112.0	106.46	107.41	DC	65.19
8524729	938390	AE1-058 TAP	PPL	208072	SIEG	PPL	1	PL:1A:P42:000922	breaker	628.0	106.68	112.76	DC	38.12
8524730	938390	AE1-058 TAP	PPL	208072	SIEG	PPL	1	PL:1A:P42:000923	breaker	628.0	106.68	112.76	DC	38.12
8524731	938390	AE1-058 TAP	PPL	208072	SIEG	PPL	1	PL:18:P42:000129	breaker	628.0	106.26	108.94	DC	37.2
8524732	938390	AE1-058 TAP	PPL	208072	SIEG	PPL	1	PL:08:P42:000130	breaker	628.0	106.26	108.94	DC	37.2
8524733	938390	AE1-058 TAP	PPL	208072	SIEG	PPL	1	PL:10:P42:100576	breaker	628.0	106.26	108.94	DC	37.2

14 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	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
7378499	200021	SUNBURY	PJM	200009	JUNIATA	PJM	1	PL:28:P12:000080	operation	3112.0	117.74	118.96	DC	84.14
7378504	200021	SUNBURY	PJM	200009	JUNIATA	PJM	1	Base Case	operation	2707.0	106.0	107.21	DC	72.77
7378691	200022	SUSQHANA	PJM	200023	WESCOVLE	PJM	1	PL:08:P12:000083	operation	3112.0	106.24	107.1	DC	59.38
7378685	200023	WESCOVLE	PJM	200075	BREI	PJM	1	PL:08:P12:000083	operation	3112.0	106.36	107.33	DC	65.99
8525135	938390	AE1-058 TAP	PPL	208072	SIEG	PPL	1	PL:08:P12:000083	operation	628.0	106.21	108.89	DC	37.2

15 System Reinforcements

ID	Index	Facility	Upgrade Description	Cost
7377784, 7377785	2	WESCOVLE 500.0 kV - BREI 500.0 kV Ckt 1	No reinforcement is needed. This is not a valid violation	$0
8524732, 8524730, 8524731, 8524729, 8524733	3	AE1-058 TAP 230.0 kV - SIEG 230.0 kV Ckt 1	Reinforcement # R-PL-0003 (336) : Rebuild FRAC-SIEG 230kV line Project Type : FACILITY Cost : $120,000,000 Time Estimate : 36-60 Months	$120,000,000
7377789, 7377790	1	SUSQHANA 500.0 kV - WESCOVLE 500.0 kV Ckt 1	No reinforcement is needed. This is not a valid violation	$0
			TOTAL COST	**$120,000,000**

NOTE:

If "No reinforcement is needed. This is not a valid violation" was provided as the Upgrade Description for a facility in the System Reinforcements table then that facility met one of the following conditions:

- The loading on the facility at your queue position was less than 100%; therefore, the facility is not yet overloaded, but may be overloaded by end of the AE2 queue.
- The TO reviewed their ratings on the facility and determined that the current rating was greater than the rating in PJM's model. This new rating was greater than the loading at your queue position making the violation invalid.
- The TO reviewed the contingency and determined that contingency was not valid; therefore the violation is invalid. Any contingency corrections will be assessed and corrected in the AE2 System Impact Study phase.

16 Flow Gate Details

The following appendices contain additional information about each flowgate presented in the body of the report. For each appendix, 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.

16.1 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
7377790	200022	SUSQHANA	PJM	200023	WESCOVLE	PJM	1	PL:1A:P42:000922	breaker	3112.0	106.37	107.22	DC	58.3

Bus #	Bus	MW Impact
200038	SUSQ 2	42.91
200083	FRPO 1	26.73
200084	FRPO 2	26.73
200823	26MHP_X3-003	10.24
208930	SNBY 6	11.26
208931	SNBY 7	12.22
208932	SNBY 5	11.26
208933	SNBY 8	20.0
208945	LOHA CT	0.62
209006	NEPC IPP	14.66
209018	SUNBIPCT	1.63
210706	HOLD	5.61
211064	PSPA	2.08
211375	BEAC	5.64
292935	U2-015 E	25.64
294573	P-028 E	20.72
916351	Z1-091	2.75
917661	WAYM E	15.68
918431	AA1-057	5.91
918602	AA1-077 E	22.28
918682	AA1-082 E	7.65
919201	AA1-144 O1	21.2
919512	AA2-008 E	20.48
919532	PEFO 1 E	6.05
919542	PEFO 2 E	6.05
920711	AA2-182 C	404.99
920712	AA2-182 E	21.97
924291	AB2-074 C	20.73
924292	AB2-074 E	26.11
925951	AC1-071 C	2.32
925952	AC1-071 E	15.54
926081	AC1-087 C	0.79
926082	AC1-087 E	1.29
926681	AC1-151 C	2.14
926682	AC1-151 E	3.5
931942	AB1-182 E	6.16
932691	AC2-092	29.1
935071	AD1-143 C1	1.21
935072	AD1-143 E1	7.25
935081	AD1-143 C2	0.04
935082	AD1-143 E2	1.01
935091	AD1-143 C3	1.19
935092	AD1-143 E3	7.11

Bus #	Bus	MW Impact
935101	AD1-143 C4	0.04
935102	AD1-143 E4	1.0
938331	AE1-051	1.5
938391	AE1-058 C	72.61
938392	AE1-058 E	72.61
938401	AE1-059 C O1	73.83
938402	AE1-059 E O1	73.83
938981	AE1-127 C	6.67
938982	AE1-127 E	8.33
939521	AE1-181 C	7.61
939522	AE1-181 E	5.07
939891	AE1-225 C O1	3.49
939892	AE1-225 E O1	3.86
940561	AE2-042 C O1	17.17
940562	AE2-042 E O1	8.51
940592	AE2-046 E	7.36
940711	AE2-058 C	3.08
940712	AE2-058 E	4.26
940721	AE2-059 C	3.08
940722	AE2-059 E	4.26
940801	AE2-067 C	3.46
940802	AE2-067 E	0.02
940941	AE2-084 C	3.08
940942	AE2-084 E	4.26
941161	AE2-110 C	3.03
941162	AE2-110 E	4.18
941171	AE2-111 C	3.1
941172	AE2-111 E	4.28
941371	AE2-133 C	3.12
941372	AE2-133 E	4.31
942281	AE2-241 C	3.03
942282	AE2-241 E	4.18
942291	AE2-242 C	15.13
942292	AE2-242 E	20.89
942301	AE2-243 C	0.65
942302	AE2-243 E	4.01
942311	AE2-244 C	0.65
942312	AE2-244 E	4.01
942561	AE2-271 C	21.74
942562	AE2-271 E	14.47
942581	AE2-274	0.17
942721	AE2-288	85.39
942771	AE2-295 C O1	8.57
942772	AE2-295 E O1	49.73
BLUEG	BLUEG	11.76
CALDERWOOD	CALDERWOOD	1.33
CANNELTON	CANNELTON	0.72
CATAWBA	CATAWBA	0.87
CBM-N	CBM-N	4.81
CHEOAH	CHEOAH	1.22
CHILHOWEE	CHILHOWEE	0.43
COFFEEN	COFFEEN	1.24

Bus #	Bus	MW Impact
COTTONWOOD	COTTONWOOD	5.03
DUCKCREEK	DUCKCREEK	2.69
EDWARDS	EDWARDS	1.22
ELMERSMITH	ELMERSMITH	1.24
FARMERCITY	FARMERCITY	0.82
G-007A	G-007A	2.78
GIBSON	GIBSON	0.49
HAMLET	HAMLET	1.45
NEWTON	NEWTON	3.24
NYISO	NYISO	20.72
PRAIRIE	PRAIRIE	6.09
SANTEETLA	SANTEETLA	0.36
SMITHLAND	SMITHLAND	0.49
TATANKA	TATANKA	1.48
TILTON	TILTON	1.47
TRIMBLE	TRIMBLE	1.31
TVA	TVA	4.21
UNIONPOWER	UNIONPOWER	1.88
VFT	VFT	17.14

16.2 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
7377785	200023	WESCOVLE	PJM	200075	BREI	PJM	1	PL:1A:P42:000922	breaker	3112.0	106.46	107.41	DC	65.19

Bus #	Bus	MW Impact
200038	SUSQ 2	43.38
200083	FRPO 1	27.05
200084	FRPO 2	27.05
200823	26MHP_X3-003	10.85
208930	SNBY 6	11.68
208931	SNBY 7	12.67
208932	SNBY 5	11.68
208933	SNBY 8	20.74
208945	LOHA CT	0.67
209006	NEPC IPP	17.38
209018	SUNBIPCT	1.75
210706	HOLD	5.98
211064	PSPA	2.82
211375	BEAC	6.68
292935	U2-015 E	29.75
294573	P-028 E	21.96
916351	Z1-091	2.91
917661	WAYM E	16.7
918431	AA1-057	6.33
918602	AA1-077 E	23.72
919512	AA2-008 E	22.1
919532	PEFO 1 E	9.59
919542	PEFO 2 E	9.59
920711	AA2-182 C	419.94
920712	AA2-182 E	22.78
924291	AB2-074 C	21.49
924292	AB2-074 E	27.08
925951	AC1-071 C	2.52
925952	AC1-071 E	16.88
926081	AC1-087 C	1.07
926082	AC1-087 E	1.75
926681	AC1-151 C	2.54
926682	AC1-151 E	4.14
931942	AB1-182 E	6.69
932691	AC2-092	29.44
935071	AD1-143 C1	1.63
935072	AD1-143 E1	9.77
935081	AD1-143 C2	0.06
935082	AD1-143 E2	1.37
935091	AD1-143 C3	1.61
935092	AD1-143 E3	9.67
935101	AD1-143 C4	0.06
935102	AD1-143 E4	1.35

Bus #	Bus	MW Impact
938331	AE1-051	1.59
938391	AE1-058 C	86.22
938392	AE1-058 E	86.22
938401	AE1-059 C O1	79.38
938402	AE1-059 E O1	79.38
938981	AE1-127 C	7.46
938982	AE1-127 E	9.32
939521	AE1-181 C	9.02
939522	AE1-181 E	6.01
939712	AE1-202 E	1.15
939891	AE1-225 C O1	3.74
939892	AE1-225 E O1	4.13
940561	AE2-042 C O1	18.44
940562	AE2-042 E O1	9.14
940592	AE2-046 E	8.72
940711	AE2-058 C	3.31
940712	AE2-058 E	4.57
940721	AE2-059 C	3.31
940722	AE2-059 E	4.57
940801	AE2-067 C	3.66
940802	AE2-067 E	0.02
940941	AE2-084 C	3.31
940942	AE2-084 E	4.57
941161	AE2-110 C	3.27
941162	AE2-110 E	4.51
941171	AE2-111 C	3.33
941172	AE2-111 E	4.59
941371	AE2-133 C	3.34
941372	AE2-133 E	4.62
941751	AE2-175 C O1	11.0
941752	AE2-175 E O1	7.33
942281	AE2-241 C	3.27
942282	AE2-241 E	4.51
942291	AE2-242 C	16.34
942292	AE2-242 E	22.56
942301	AE2-243 C	0.69
942302	AE2-243 E	4.26
942311	AE2-244 C	0.69
942312	AE2-244 E	4.26
942561	AE2-271 C	23.51
942562	AE2-271 E	15.64
942581	AE2-274	0.23
942721	AE2-288	88.55
942771	AE2-295 C O1	9.59
942772	AE2-295 E O1	55.61
BLUEG	BLUEG	13.65
CALDERWOOD	CALDERWOOD	1.53
CANNELTON	CANNELTON	0.83
CATAWBA	CATAWBA	1.0
CBM-N	CBM-N	5.27
CHEOAH	CHEOAH	1.4
CHILHOWEE	CHILHOWEE	0.5

Bus #	Bus	MW Impact
COFFEEN	COFFEEN	1.44
COTTONWOOD	COTTONWOOD	5.82
DUCKCREEK	DUCKCREEK	3.12
EDWARDS	EDWARDS	1.42
ELMERSMITH	ELMERSMITH	1.44
FARMERCITY	FARMERCITY	0.96
G-007A	G-007A	3.92
GIBSON	GIBSON	0.56
HAMLET	HAMLET	1.66
NEWTON	NEWTON	3.77
NYISO	NYISO	22.68
PRAIRIE	PRAIRIE	7.07
SANTEETLA	SANTEETLA	0.41
SMITHLAND	SMITHLAND	0.57
TATANKA	TATANKA	1.72
TILTON	TILTON	1.71
TRIMBLE	TRIMBLE	1.52
TVA	TVA	4.87
UNIONPOWER	UNIONPOWER	2.18
VFT	VFT	22.72

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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
8524730	938390	AE1-058 TAP	PPL	208072	SIEG	PPL	1	PL:1A:P42:000923	breaker	628.0	106.68	112.76	DC	38.12

Bus #	Bus	MW Impact
208941	FISH CT	0.82
208981	FOWH IPP	1.14
209013	SCEN IPP	2.52
209021	WEST IPP	0.87
209022	WHFR IPP	1.26
211064	PSPA	0.77
212099	BRMO IPP	0.35
212174	INGE	0.21
918431	AA1-057	1.81
919512	AA2-008 E	5.78
920711	AA2-182 C	80.19
920712	AA2-182 E	4.35
924291	AB2-074 C	4.1
924292	AB2-074 E	5.17
926081	AC1-087 C	0.29
926082	AC1-087 E	0.48
935071	AD1-143 C1	0.48
935072	AD1-143 E1	2.85
935081	AD1-143 C2	0.02
935082	AD1-143 E2	0.4
935091	AD1-143 C3	0.43
935092	AD1-143 E3	2.6
935101	AD1-143 C4	0.02
935102	AD1-143 E4	0.36
938391	AE1-058 C	87.62
938392	AE1-058 E	87.62
938981	AE1-127 C	4.37
938982	AE1-127 E	5.47
939712	AE1-202 E	0.27
939891	AE1-225 C O1	1.08
939892	AE1-225 E O1	1.2
940561	AE2-042 C O1	5.18
940562	AE2-042 E O1	2.57
940711	AE2-058 C	0.93
940712	AE2-058 E	1.28
940721	AE2-059 C	0.93
940722	AE2-059 E	1.28
940941	AE2-084 C	0.93
940942	AE2-084 E	1.28
941161	AE2-110 C	0.95
941162	AE2-110 E	1.31

Bus #	Bus	MW Impact
941171	AE2-111 C	0.95
941172	AE2-111 E	1.32
941371	AE2-133 C	0.97
941372	AE2-133 E	1.35
942281	AE2-241 C	0.95
942282	AE2-241 E	1.31
942291	AE2-242 C	4.76
942292	AE2-242 E	6.58
942561	AE2-271 C	5.98
942562	AE2-271 E	3.98
942581	AE2-274	0.06
942721	AE2-288	16.91
942771	AE2-295 C O1	5.6
942772	AE2-295 E O1	32.51
BLUEG	BLUEG	1.07
CALDERWOOD	CALDERWOOD	0.12
CANNELTON	CANNELTON	0.07
CATAWBA	CATAWBA	0.08
CBM-N	CBM-N	0.11
CHEOAH	CHEOAH	0.11
CHILHOWEE	CHILHOWEE	0.04
COFFEEN	COFFEEN	0.11
COTTONWOOD	COTTONWOOD	0.46
DUCKCREEK	DUCKCREEK	0.24
EDWARDS	EDWARDS	0.11
ELMERSMITH	ELMERSMITH	0.11
FARMERCITY	FARMERCITY	0.08
G-007	G-007	0.63
GIBSON	GIBSON	0.04
HAMLET	HAMLET	0.14
NEWTON	NEWTON	0.29
NYISO	NYISO	0.48
O-066	O-066	5.21
PRAIRIE	PRAIRIE	0.56
SANTEETLA	SANTEETLA	0.03
SMITHLAND	SMITHLAND	0.04
TATANKA	TATANKA	0.13
TILTON	TILTON	0.13
TRIMBLE	TRIMBLE	0.12
TVA	TVA	0.39
UNIONPOWER	UNIONPOWER	0.17

Affected Systems

17 Affected Systems

17.1 LG&E

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

17.2 MISO

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

17.3 TVA

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

17.4 Duke Energy Progress

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

17.5 NYISO

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

Contingency Name	Contingency Definition
PL:10:P42:100576	CONTINGENCY 'PL:10:P42:100576' /* AT JUNIATA 500SUB SUNBURY 500KV S.CB FAILED DISCONNECT BRANCH FROM BUS 200009 TO BUS 200183 CKT 1 /* /* JUNIATA CAP 500 KV DISCONNECT BRANCH FROM BUS 200009 TO BUS 208004 CKT 1 /* /* JUNIATA 500-230 KV BK1 DISCONNECT BRANCH FROM BUS 200009 TO BUS 200021 CKT 1 /* /*JUNIATA-SUNBURY 500 KV (SHOULD BE FAULTED) END
PL:18:P42:000129	CONTINGENCY 'PL:18:P42:000129' /* JUNI-SUNB 500KV STUCK BREAKER CONNECTED TO TR2 DISCONNECT BRANCH FROM BUS 200009 TO BUS 208005 CKT 2 /* JUNIATA-JUNI BU2 500-230 DISCONNECT BRANCH FROM BUS 200009 TO BUS 200021 CKT 1 /* JUNIATA-SUNBURY 500 END
Base Case	
PL:08:P12:000083	CONTINGENCY 'PL:08:P12:000083' /* JUNI-SUNB 500KV LINE DISCONNECT BRANCH FROM BUS 200009 TO BUS 200021 CKT 1 /* JUNIATA-SUNBURY 500 END
PL:28:P12:000080	CONTINGENCY 'PL:28:P12:000080' /* SUSQ-WESC 500KV LINE DISCONNECT BRANCH FROM BUS 200022 TO BUS 200023 CKT 1 /* SUSQHANA-WESCOVLE 500 END
PL:08:P42:000130	CONTINGENCY 'PL:08:P42:000130' /* JUNI-SUNB 500KV STUCK BREAKER CONNECTED TO TR1 DISCONNECT BRANCH FROM BUS 200009 TO BUS 208004 CKT 1 /* JUNIATA-JUNI BU1 500-230 DISCONNECT BRANCH FROM BUS 200009 TO BUS 200021 CKT 1 /* JUNIATA-SUNBURY 500 END
PL:1A:P42:000923	CONTINGENCY 'PL:1A:P42:000923' /* SUNBURY 500KV YARD 3T BF DISCONNECT BRANCH FROM BUS 200021 TO BUS 200009 CKT 1 /* /* JUNIATA-SUNBURY 500KV LINE DISCONNECT BRANCH FROM BUS 200021 TO BUS 208109 CKT 25 /* /* T25 END
PL:1A:P42:000922	CONTINGENCY 'PL:1A:P42:000922' /* SUNBURY 500KV YARD 3N BF DISCONNECT BRANCH FROM BUS 200021 TO BUS 200009 CKT 1 /* /* JUNIATA-SUNBURY 500KV LINE DISCONNECT BRANCH FROM BUS 200021 TO BUS 208109 CKT 24 /* /* T24 END

Short Circuit

18 Short Circuit

The following Breakers are over duty

None

19 OPTION 2: Network Impacts

The Queue Project AE2-295 was evaluated as a 174.8 MW (Capacity 25.7 MW) injection at **Fredericksburg 69kV substation** in the METED area. Project AE2-295 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE2-295 was studied with a commercial probability of 0.53. Potential network impacts were as follows:

Summer Peak Load Flow

19 Generation Deliverability

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

None

20 Multiple Facility Contingency

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

None

21 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)

None

22 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.

None

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).

Short Circuit

24 Short Circuit

The following Breakers are over duty

None