



**Generation Interconnection
System Impact Study Report
for
Queue Project AE2-133
PENNS TAP-RICHFIELD TIE 69 KV
8.4 MW Capacity / 20 MW Energy**

February 2020

1 Preface

The intent of the System Impact Study is to determine a plan, with approximate cost and construction time estimates, to connect the subject generation interconnection project to the PJM network at a location specified by the Interconnection Customer. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system. All facilities required for interconnection of a generation interconnection project must be designed to meet the technical specifications (on PJM web site) for the appropriate transmission owner.

In some instances an Interconnection Customer may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection or merchant transmission upgrade, may also contribute to the need for the same network reinforcement. The possibility of sharing the reinforcement costs with other projects may be identified in the Feasibility Study, but the actual allocation will be deferred until the System Impact Study is performed.

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

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

2 General

The Interconnection Customer (IC), has proposed a Solar generating facility located in Snyder County, Pennsylvania. The installed facilities will have a total capability of 20 MW with 8.4 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is March 5, 2021. **This study does not imply a TO commitment to this in-service date.**

Queue Number	AE2-133
Project Name	PENNS TAP-RICHFIELD TIE 69 KV
Interconnection Customer	Dynamic Energy Solutions LLC
State	Pennsylvania
County	Snyder
Transmission Owner	PPL
MFO	20
MWE	20
MWC	8.4
Fuel	Solar
Basecase Study Year	2022

2.1 Point of Interconnection

AE2-133 will interconnect with the PPL EU transmission system via the Sunbury-Middleburg #1 69 kV line, 0.9 miles from the Penns Tap and 4.77 miles from the Richfield Tie. The Point of Interconnection (POI) will be where the IC tap line terminates (with insulators) on the last PPL EU Attachment Facilities structure.

The scope of work provided in this Feasibility Study is for facilities to be constructed on the PPL EU side of the POI.

2.2 Cost Summary

The AE2-133 project will be responsible for the following costs for the physical interconnection:

Description	Total Cost
Attachment Facilities	\$ 1,430,000
Direct Connection Network Upgrade	\$ 0
Non-Direct Connection Network Upgrades	\$ 114,000
Total Costs	\$ 1,544,000

In addition, the AE2-133 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 ¹	\$ 0

3 Transmission Owner Scope of Work

PPL EU will construct a new 69 kV tap line from the Sunbury-Middleburg #1 69 kV line (future double circuit line) to the IC collector substation. The Sunbury-Middleburg line is operated radially and therefore remote end relay work is required at the Sunbury 69 kV Substation only.

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 and right of way for the Attachment Facilities
- OPGW availability for DTT is based on Supplemental Project s1036.3 completion. See Section 9.2.

3.1 Attachment Facilities

69 kV Transmission Line Tap

The Attachment Facilities will connect to the Sunbury-Middleburg 69 kV line. This scope of work is based on the IC collector substation GPS Coordinates: 40°47'26.61"N, 76°54'6.63"W.

- Intersperse a double circuit style tap pole at approximately grid 23197S53265 and tap the SUNB-MIDD #1 line off the arms.
- Install Motor Operated Load Break Air Break switch (MOLBAB) on tap to IPP.
- Install 0.6-mile single circuit transmission line to IC substation dead-end structure
- Install dual .567" 48 count OPGW on new tap to IC substation dead-end structure

¹ Stability analysis will be performed during the Facilities Study. Additional system upgrades may be identified to mitigate any stability concerns.

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	\$ 1,430,000
Total Attachment Facility Costs	\$ 1,430,000

3.2 Direct Connection Cost Estimate

None.

3.3 Non-Direct Connection Cost Estimate

Remote End Work – Sunbury 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 Sunbury substation:
 - Install DTT equipment.
 - Connect DTT equipment to new communication path installed between the Milton substation and the IC customer facilities.
 - Modify the existing Sunbury Middleburg #1 69kV circuit breakers 2S and 2T 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.

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 – Sunbury Substation	\$ 114,000
Total Non-Direct Connection Facility Costs	\$ 114,000

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 Sunbury 69 kV Substation. The IC may elect to connect additional DTT capabilities at Juniata 69 kV Substation. This would enable AE2-133 to generate to in the event an outage requires AE2-133 to operate radially in a different direction than the normal configuration. DTT at Juniata substation is not currently in the scope and estimate of this Feasibility Study. PPL EU can add this at the request of the IC during subsequent study phases.

Upon completion of s1036.3, PPL EU will have OPGW on the Sunbury-Middleburg #1 69 kV line available for DTT to the Sunbury 69 kV Substation. PPL EU assumes strands of this fiber will be used for the independent communication pathway. However, the IC may choose to procure a third-party communication circuit at its own discretion in lieu of the OPGW.

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 Network Impacts

The Queue Project AE2-133 was evaluated as a 20.0 MW (Capacity 8.4 MW) injection tapping the **Penns Tap-Richfield Tie 69kV line** in the PPL area. Project AE2-133 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE2-133 was studied with a commercial probability of 1.00. 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)

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
2049460	938390	AE1-058 TAP	230.0	PPL	208072	SIEG	230.0	PPL	1	PL:1A:P42:000922	breaker	628.0	99.96	100.27	AC	2.32
2049461	938390	AE1-058 TAP	230.0	PPL	208072	SIEG	230.0	PPL	1	PL:1A:P42:000923	breaker	628.0	99.96	100.27	AC	2.32

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)

None

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.

None

12 System Reinforcements

ID	Index	Facility	Upgrade Description	Cost	AE2-133 Cost Allocation	Upgrade Number
2049460, 2049461	1	AE1-058 TAP 230.0 kV - SIEG 230.0 kV Ckt 1	<p>Queue Project AE2-133 presently does not meet the cost allocation threshold and therefore does not receive cost allocation for the below upgrade:</p> <p>Rebuild the AE1-058-SIEGFRIED 230 kV line segment of the Frackville – Siegfried 230 kV line Time: 72 Months Rating after the upgrade: 665/821/821</p> <p>Note 1: As changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc., Queue Project AE2-133 could become the driver of the facility overload and could be responsible for the upgrade.</p> <p>Note 2: Although Queue Project AE2-133 may not have cost responsibility for this upgrade, Queue Project AE2-133 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AE2-133 intends to come into service prior to completion of the upgrade, Queue Project AE2-133 will need an interim deliverability study.</p>	\$69,000,000	\$0	N6406
			TOTAL COST	\$69,000,000	\$0	

13 Stability and Reactive Power Requirement for Low Voltage Ride Through

Stability Analysis will be performed during the Facilities Study. **Additional reinforcements may be identified to mitigate stability concerns.**

14 Light Load Analysis

Not Required

15 Affected Systems

None

Short Circuit

16 Short Circuit

The following Breakers are over duty:

None

17 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.

17.1 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
2049461	938390	AE1-058 TAP	PPL	208072	SIEG	PPL	1	PL:1A:P42:000923	breaker	628.0	99.96	100.27	AC	2.32

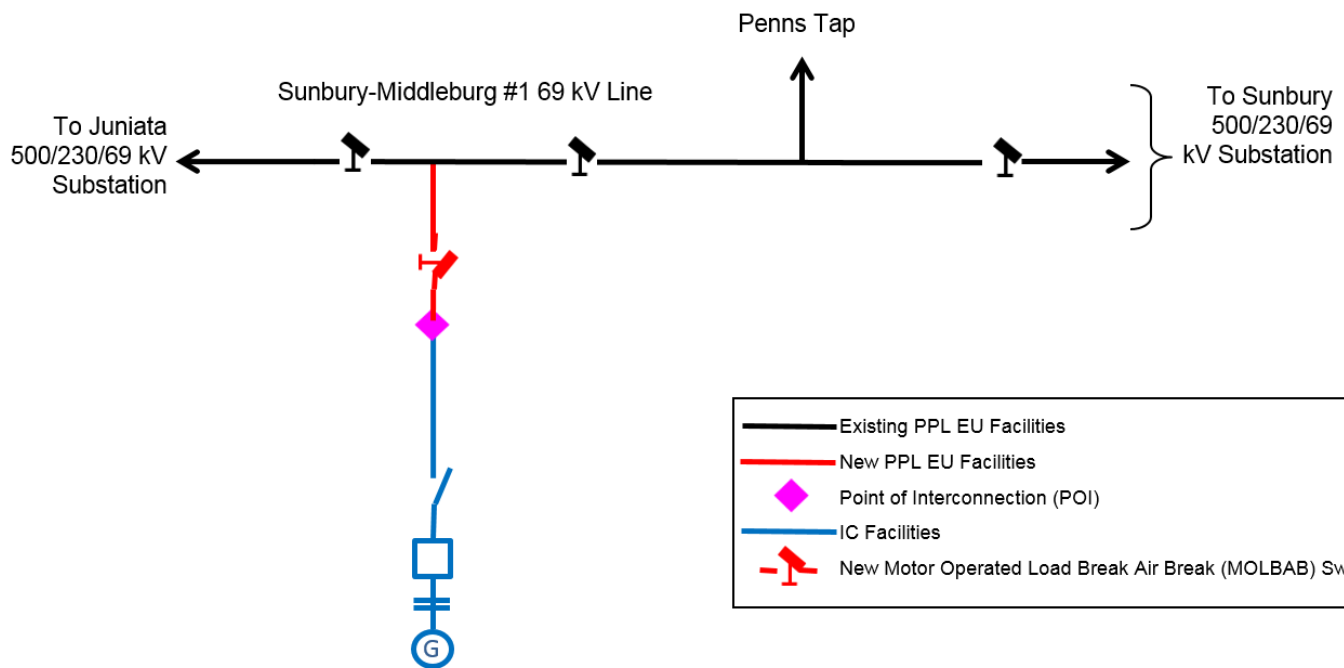
Bus #	Bus	MW Impact
208941	FISH CT	0.8903
208981	FOWH IPP	1.2369
209013	SCEN IPP	2.7344
209021	WEST IPP	0.9414
209022	WHFR IPP (Deactivation : 03/01/20)	1.3672
211064	PSPA	0.6521
212099	BRMO IPP	0.3766
212174	INGE	0.2317
918431	AA1-057	1.5406
919512	AA2-008 E	4.9138
920711	AA2-182 C	68.1716
920712	AA2-182 E	3.6982
924291	AB2-074 C	3.4888
924292	AB2-074 E	4.3959
926081	AC1-087 C	0.2478
926082	AC1-087 E	0.4043
935071	AD1-143 C1	0.4043
935072	AD1-143 E1	2.4231
935081	AD1-143 C2	0.0166
935082	AD1-143 E2	0.3992
935091	AD1-143 C3	0.3694
935092	AD1-143 E3	2.2139
935101	AD1-143 C4	0.0152
935102	AD1-143 E4	0.3647
938391	AE1-058 C	87.6175
938392	AE1-058 E	87.6175
939712	AE1-202 E (Withdrawn : 11/04/2019)	0.2349
939891	AE1-225 C O1	0.9216
939892	AE1-225 E O1	1.0196
940561	AE2-042 C	4.4009
940562	AE2-042 E	2.1816
940721	AE2-059 C	0.7899
940722	AE2-059 E	1.0908
940941	AE2-084 C	0.7899
940942	AE2-084 E	1.0908
941161	AE2-110 C	0.8095
941162	AE2-110 E	1.1178
941171	AE2-111 C	0.8097
941172	AE2-111 E	1.1182
941371	AE2-133 C	0.8286
941372	AE2-133 E	1.1443

Bus #	Bus	MW Impact
942281	AE2-241 C	0.8095
942282	AE2-241 E	1.1178
942561	AE2-271 C	5.0795
942562	AE2-271 E	3.3863
942581	AE2-274	0.0522
942721	AE2-288	14.3740
942771	AE2-295 C	5.6047
942772	AE2-295 E	32.5157
DUCKCREEK	DUCKCREEK	0.2430
NEWTON	NEWTON	0.2931
CHILHOWEE	CHILHOWEE	0.0402
G-007	G-007	0.6331
TVA	TVA	0.3868
PRAIRIE	PRAIRIE	0.5528
O-066	O-066	5.2023
COFFEEN	COFFEEN	0.1120
EDWARDS	EDWARDS	0.1102
CHEOAH	CHEOAH	0.1126
TILTON	TILTON	0.1329
SANTEETLA	SANTEETLA	0.0332
SMITHLAND	SMITHLAND	0.0448
CBM-N	CBM-N	0.1155
COTTONWOOD	COTTONWOOD	0.4620
HAMLET	HAMLET	0.1380
BLUEG	BLUEG	1.0621
UNIONPOWER	UNIONPOWER	0.1741
CANNELTON	CANNELTON	0.0652
GIBSON	GIBSON	0.0439
CALDERWOOD	CALDERWOOD	0.1228
FARMERCITY	FARMERCITY	0.0749
TRIMBLE	TRIMBLE	0.1180
CATAWBA	CATAWBA	0.0822
NYISO	NYISO	0.4847

18 Contingencies

Contingency Name	Contingency Definition
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

Attachment 1
Single Line Diagram



Attachment 2

Project Location

