



# **Generation Interconnection**

## **Feasibility Study Report**

**For**

**Queue Project AF2-082**

**DAUPHIN PG TIE - DAUPHIN JUNIATA TIE 69 KV**

**33 MW Capacity / 55 MW Energy**

July 2020

# Table of Contents

1	Introduction.....	3
2	Preface.....	3
3	General.....	3
4	Point of Interconnection.....	4
5	Cost Summary.....	4
6	Transmission Owner Scope of Work.....	5
6.1	Attachment Facilities Cost Estimate.....	5
6.2	Direct Connection Cost Estimate.....	6
6.3	Non-Direct Connection Cost Estimate.....	6
7	Schedule.....	7
8	Interconnection Customer Requirements.....	7
8.1	PPL EU Interconnection Requirements.....	7
8.2	IC Direct Transfer Trip (DTT) Requirements.....	7
9	Revenue Metering and SCADA Requirements.....	7
9.1	PJM Requirements.....	7
9.2	Meteorological Data Reporting Requirements.....	7
9.3	Interconnected Transmission Owner Requirements.....	8
10	Summer Peak - Load Flow Analysis.....	8
10.1	Generation Deliverability.....	8
10.2	Multiple Facility Contingency.....	8
10.3	Contribution to Previously Identified Overloads.....	8
10.4	Potential Congestion due to Local Energy Deliverability.....	9
10.5	System Reinforcements - Summer Peak Load Flow - Primary POI.....	9
10.6	Flow Gate Details.....	9
10.6.1	Index 1.....	10
10.7	Queue Dependencies.....	12
10.8	Contingency Descriptions.....	13
11	Short Circuit Analysis.....	13
12	Affected Systems.....	13
12.1	NYISO.....	13

## 1 Introduction

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

## 2 Preface

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

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

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

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

## 3 General

The Interconnection Customer (IC) has proposed a Solar generating facility located in Dauphin County, Pennsylvania. The installed facilities will have a total capability of 55 MW with 33 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is December 01, 2022. This study does not imply a TO commitment to this in-service date.

<b>Queue Number</b>	<b>AF2-082</b>
<b>Project Name</b>	DAUPHIN PG TIEDAUPHIN JUNIATA TIE 69 K
<b>State</b>	Pennsylvania
<b>County</b>	Dauphin
<b>Transmission Owner</b>	PPL
<b>MFO</b>	55
<b>MWE</b>	55
<b>MWC</b>	33
<b>Fuel</b>	Solar
<b>Basecase Study Year</b>	2023

New Service Customers proposing queue projects that can feasibly be commercially operable prior to June 1st of the basecase study year are required to request interim deliverability analysis.

#### 4 Point of Interconnection

AF2-082 will interconnect with the PPL EU transmission system via the **Sunbury - Dauphin 69 kV line**, 0.9 miles from the Dauphin PG Tie bus and 3.8 miles from the Dauphin Juniata Tie bus. The Point of Interconnection (POI) will be where the PPL EU tap line terminates (with insulators) at the first dead-end structure inside the IC substation.

#### 5 Cost Summary

The AF2-082 project will be responsible for the following costs:

<b>Description</b>	<b>Total Cost</b>
Total Physical Interconnection Costs	\$ 1,104,000
Total System Network Upgrade Costs	\$ 252,000
<b>Total Costs</b>	<b>\$ 1,356,000</b>

This cost excludes CIAC Tax Gross Up charges. Cost allocations for any System Upgrades will be provided in the System Impact Study Report.

## 6 Transmission Owner Scope of Work

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

Description	Total Cost
Attachment Facilities	\$ 869,400
Direct Connection Network Upgrade	\$ 0
Non Direct Connection Network Upgrades	\$ 234,600
Total Physical Interconnection Costs	\$ 1,104,000

PPL EU can accommodate this interconnection by constructing a new transmission line tap off the Sunbury – Dauphin 69 kV line and completing associated remote end relay work.

### Risks and Assumptions

- No major environmental, real estate, or permitting issues.
- IC is responsible for acquisition of easements, permits, and right of way for any Direct Connection Network Upgrades and Attachment Facilities per PPL EU standards and requirements.
- PPL EU will perform all grading, site preparation, and establish access roads for the PPL EU owned Attachment Facilities per PPL EU standards and requirements.
- The customer proposed a POI at approximately 40.5820510, -76.9076980 which would require all new PPL structures to be located on adjacent properties. A new POI has been proposed about 200 ft southwest along the line. See Attachment 2 for proposed path.

### 6.1 Attachment Facilities Cost Estimate

#### 69 kV Transmission Line Tap

PPL EU will tap the Sunbury – Dauphin 69 kV line at or near GPS Coordinates: 40.5820510, -76.9076980. PPL EU will extend the tap southwest towards the IC site. PPL EU will install a motor operated switch and POI termination structure. The IC must build the remainder of the Attachment Facilities from the POI termination structure to the IC substation. The IC is responsible for procuring 100 ft. ROW for these facilities. For the purposes of this Feasibility Study Report cost estimate, PPL EU is assuming all engineering and construction responsibility for land development activities, including grading, site preparation, and new access road. During the Facilities Study phase, PPL EU and the IC will review land development activities, and the IC may choose to perform some, or all, of these activities. The cost estimate will be updated accordingly and included in the Facilities Study Report.

PPL EU work will consist of installing the following:

- Install one (1) new single circuit, tension, custom steel/foundation, tap pole structure.
- Install one (1) new single circuit, direct-embed, steel, motor operated switch structure.

- Install one (1) new single circuit, direct-embed, steel, tension structure to the dead-end inside the substation.
- New circuit will consist of three (3) phase 556.6 kcmil 24/7 ACSR conductor from the tap pole to the substation dead-end and 144-ct optical ground wire (OPGW).

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	\$ 869,400
<b>Total Attachment Facility Costs</b>	<b>\$ 869,400</b>

## 6.2 Direct Connection Cost Estimate

None.

## 6.3 Non-Direct Connection Cost Estimate

### Remote End Relay Work – Sunbury 69 kV Substation

- Complete remote end relay work at Sunbury 69 kV substation for Direct Transfer Trip.
- 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).

### Sunbury – Dauphin 69 kV Modifications to tie in the AF2-082 Attachment Facilities

- Tie the new AF2-082 Attachment Facilities into the Sunbury - Dauphin 69 kV line.
- Remove (1) structure on the 746 – Sunbury – Dauphin 69 kV line at 23379S45582.
- Break one (1) fiber and complete a section throw onto the new substation by installing two (2) new fiber splice boxes on structures 23343S45538 and the new tap pole.

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 Relay Work – Sunbury 69 kV Substation	\$ 138,000
Sunbury – Dauphin 69 kV Modifications to tie in the AF2-082 Attachment Facilities	\$ 96,600
<b>Total Non-Direct Connection Facility Costs</b>	<b>\$ 234,600</b>

## 7 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.

## 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 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 breakers 10S and 10T. The IC may elect to obtain DTT to the Dauphin 69 kV Substation. This would enable AF2-082 to generate to the Dauphin 69 kV Substation in the event the Sunbury – Dauphin 69 kV line is ever operated in network or an outage requires AF2-082 to operate radially with the Dauphin 69 kV Substation. DTT with the Dauphin 69 kV substation is not currently in the scope and estimate of this report. PPL EU can evaluate this at the request of the IC during subsequent study phases from both a cost and interconnection analysis perspective.

PPL EU currently has OPGW on the Sunbury - Dauphin 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 and expense in lieu of the OPGW.

## 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 Meteorological Data Reporting Requirements

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

- Temperature (degrees Fahrenheit)
- Atmospheric pressure (hectopascals)
- Irradiance
- Forced outage data

### 9.3 Interconnected Transmission Owner 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 Summer Peak - Load Flow Analysis

The Queue Project AF2-082 was evaluated as a 55.0 MW (Capacity 33.0 MW) injection tapping **the Dauphin PG Tie 69 to Dauphin Juniata Tie 69 kV line** in the PPL area. Project AF2-082 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF2-082 was studied with a commercial probability of 53.0 %. Potential network impacts were as follows:

### 10.1 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 LOADIN G %	POST PROJECT LOADIN G %	AC/D C	MW IMPACT
98668463	200011	KEYSTONE	500.0	PJM	235104	01CABOT	500.0	AP	1	AP-P1-2-WP-500-008	single	2598.0	99.93	100.19	DC	6.66

### 10.2 Multiple Facility Contingency

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

None

### 10.3 Contribution to Previously Identified Overloads

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

None

## 10.4 Potential Congestion due to Local Energy Deliverability

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

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

None

## 10.5 System Reinforcements - Summer Peak Load Flow - Primary POI

ID	Idx	Facility	Upgrade Description	Cost
98668463	1	KEYSTONE 500.0 kV - 01CABOT 500.0 kV Ckt 1	<u>PJM</u> PJM-AF1-F-0003 (1911) : <b>Replace 3000 Amp Generic Wave Trap at Keystone</b> Project Type : <b>FAC</b> Cost : <b>\$252,000</b> Time Estimate : <b>12.0 Months</b>	\$252,000
			<b>TOTAL COST</b>	<b>\$252,000</b>

## 10.6 Flow Gate Details

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

## 10.6.1 Index 1

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC DC	MW IMPACT
98668463	200011	KEYSTONE	PJM	235104	01CABOT	AP	1	AP-P1-2-WP-500-008	single	2598.0	99.93	100.19	DC	6.66

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
200030	CONE G1	47.0438	80/20	47.0438
200031	CONE G2	47.0107	80/20	47.0107
200032	KEYS G1	59.0035	80/20	59.0035
200033	KEYS G2	59.0173	80/20	59.0173
200103	AA1-076 CT1	15.6559	80/20	15.6559
200104	AA1-076 CT2	15.6559	80/20	15.6559
200105	AA1-076 ST	20.8745	80/20	20.8745
200833	26SEWRDB34	18.5322	80/20	18.5322
200906	26KEYSTN#3	0.5307	80/20	0.5307
208930	HUST 11	7.9444	80/20	7.9444
208931	HUST 12	8.6213	80/20	8.6213
208932	HUST 13	7.9444	80/20	7.9444
208933	HUST 10	14.1075	80/20	14.1075
208945	LOHA CT	0.4811	80/20	0.4811
208948	WILL CT	0.9396	80/20	0.9396
209018	SUNBIPCT	1.2536	80/20	1.2536
209019	VIKI IPP	3.2301	80/20	3.2301
235619	01SBEND1	11.0185	80/20	11.0185
235620	01SBEND2	11.0116	80/20	11.0116
235621	01SBEND3	11.1360	80/20	11.1360
235622	01SBEND4	11.0324	80/20	11.0324
920651	AA2-171 E	7.6416	80/20	7.6416
920711	AA2-182 C (Withdrawn : 05/04/2020)	201.7798	80/20	201.7798
924291	AB2-074 C (Withdrawn : 05/04/2020)	10.3265	80/20	10.3265
926301	AC1-108	5.2186	80/20	5.2186
934711	AD1-099	4.8388	80/20	4.8388
936891	AD2-113 C	24.2848	80/20	24.2848
936901	AD2-114 C	160.2960	80/20	160.2960
939891	AE1-225 C O1	1.8977	80/20	1.8977
940561	AE2-042 C O1	9.3488	80/20	9.3488
940721	AE2-059 C	1.6780	80/20	1.6780
940731	AE2-060 C	1.6969	80/20	1.6969
940941	AE2-084 C	1.6780	80/20	1.6780
941171	AE2-111 C	1.6959	80/20	1.6959
941371	AE2-133 C	1.6959	80/20	1.6959
942771	AE2-295 C O1	5.0950	80/20	5.0950
943721	AF1-040 C	0.2019	80/20	0.2019
945511	AF1-216 C1O1	8.5471	80/20	8.5471
945521	AF1-216 C2	8.5471	80/20	8.5471
946691	AF1-333 C O1	2.4112	80/20	2.4112

<b>Bus #</b>	<b>Bus</b>	<b>Gendeliv MW Impact</b>	<b>Type</b>	<b>Full MW Impact</b>
946731	AF1-337 C	2.4112	80/20	2.4112
946741	AF1-338 C	2.4112	80/20	2.4112
946751	AF1-339 C O1	2.4112	80/20	2.4112
946761	AF1-271A C	2.0592	80/20	2.0592
957881	AF2-082 C	6.6620	80/20	6.6620
957991	AF2-093 C	0.3596	80/20	0.3596
958511	AF2-145 C1	3.0447	80/20	3.0447
958521	AF2-145 C2	3.0447	80/20	3.0447
959421	AF2-233 C O1	2.4228	80/20	2.4228
959431	AF2-234 C O1	4.8454	80/20	4.8454
960701	AF2-361 C	7.0704	80/20	7.0704
NEWTON	NEWTON	11.9678	Confirmed LTF	11.9678
FARMERCITY	FARMERCITY	0.6126	Confirmed LTF	0.6126
G-007A	G-007A	42.3614	Confirmed LTF	42.3614
VFT	VFT	114.8293	Confirmed LTF	114.8293
CALDERWOOD	CALDERWOOD	4.6211	Confirmed LTF	4.6211
PRAIRIE	PRAIRIE	28.0178	Confirmed LTF	28.0178
CHEOAH	CHEOAH	4.6256	Confirmed LTF	4.6256
EDWARDS	EDWARDS	3.9882	Confirmed LTF	3.9882
TILTON	TILTON	7.1719	Confirmed LTF	7.1719
MADISON	MADISON	1.0705	Confirmed LTF	1.0705
GIBSON	GIBSON	6.1321	Confirmed LTF	6.1321
BLUEG	BLUEG	19.5057	Confirmed LTF	19.5057
TRIMBLE	TRIMBLE	6.2645	Confirmed LTF	6.2645
CATAWBA	CATAWBA	2.6897	Confirmed LTF	2.6897
AC1-056	AC1-056	11.1060	LTF	11.1060

## 10.7 Queue Dependencies

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

Queue Number	Project Name	Status
AA1-076	Hunterstown-Conemaugh 500kV	In Service
AA2-171	Sunbury #1 500kV	In Service
AA2-182	Sunbury #2 500kV	Withdrawn
AB2-074	Sunbury #2 500kV	Withdrawn
AC1-056	PJM-AMIL	Confirmed
AC1-108	Hunterstown-Conemaugh 500kV	In Service
AD1-099	South Bend 500 kV	In Service
AD2-113	South Bend 500kV	Engineering and Procurement
AD2-114	South Bend 500kV	Engineering and Procurement
AE1-225	Columbia-Sunbury 69 kV	Active
AE2-042	Milton 69 kV	Active
AE2-059	Derry Tap-Derry Bus 69 kV	Active
AE2-060	Mifflintown Bus-Mifflintown Tap 69 kV	Active
AE2-084	Derry Tap-Derry Bus 69 kV	Active
AE2-111	Beavertown Tap-Beavertown Weaving Tap 69kV	Active
AE2-133	Penns Tap-Richfield Tie 69 kV	Active
AE2-295	Eldred 230 kV	Active
AF1-040	Dauphin-Pine Grove 69 kV	Active
AF1-216	Lycoming-Lock Haven 69 kV	Active
AF1-271A	Gratz 69 kV	Active
AF1-333	Laurelton-Mifflinburg 69 kV	Active
AF1-337	Laurelton-Mifflinburg 69 kV	Active
AF1-338	Laurelton-Mifflinburg 69 kV	Active
AF1-339	Laurelton-Mifflinburg 69 kV	Active
AF2-082	Dauphin PG Tie-Dauphin Juniata Tie 69 kV	Active
AF2-093	Derry 12.47 kV	Active
AF2-145	Lycoming-Lock Haven 69 kV	Active
AF2-233	Penns-Richfield Tie #1 69 kV	Active
AF2-234	Sunbury Yard #1-Richfield Tie #2 69 kV	Active
AF2-361	Mifflintown-Walker 69 kV	Active

## 10.8 Contingency Descriptions

Contingency Name	Contingency Definition
AP-P1-2-WP-500-008	CONTINGENCY 'AP-P1-2-WP-500-008' /* SOUTH BEND

## 11 Short Circuit Analysis

Short circuit analysis will be performed during the System Impact Study

## 12 Affected Systems

### 12.1 NYISO

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