Generation Interconnection

Feasibility Study Report

for

Queue Project AF2-333

MONTOUR 230 KV

12 MW Capacity / 20 MW Energy

July 2020

Table of Contents

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), 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.

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.

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 an uprate to a planned Solar generating facility located in Montour, Pennsylvania. This project is an increase to the Interconnection Customer's AF2-332 project and will

share the same point of interconnection. The AF2-333 queue position is a 20 MW energy (12 MW Capacity) uprate to the previous project. The total installed facilities will have a capability of 120 MW with 72 MW of this output being recognized by PJM as Capacity.

The project capability is summarized in the table below:

Description	Maximum Facility Output (MW)	Capacity Interconnection Rights (MW)
Existing (AF2-332)	100	60
Requested (AF2-333) Increase	20	12
Total	120	72

The proposed in-service date for this uprate project is December 31, 2023. This study does not imply a TO commitment to this in-service date.

Queue Number	AF2-333
Project Name	MONTOUR 230 KV
State	Pennsylvania
County	Montour
Transmission Owner	PPL
MFO	120
MWE	20
MWC	12
Fuel	Solar
Basecase Study Year	2023

New Service Customers who 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

AF2-333 will interconnect with the PPL transmission system via one of the following options:

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

Option 2: via a tap of Montour – Saegers #1 230 kV line

5 Cost Summary

The AF2-333 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	$0[1]
Total System Network Upgrade Costs	$0
Total Costs	**$0**

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 Transmission Owner physical interconnection scope is provided in this report for reference. Cost for the physical interconnection will be borne by AF2-331.

PPL EU will populate existing Montour 230 kV Bay 7 with one circuit breaker and associated equipment to complete a full breaker-and-a-half bay to accommodate a new line position for AF2-331.

Risks and Assumptions

- No major environmental, real estate, siting, geotechnical, 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.
- PPL EU Supplemental Project s1106 is in service prior to construction of the AF2-331 interconnection facilities.
- Pennsylvania Public Utility Commission will approve the PPL EU-prepared/submitted Letter of Notification for the PPL EU owned Attachment Facilities.
-

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

Description	Total Cost
Attachment Facilities	$ 325,000
Direct Connection Network Upgrade	$ 0
Non Direct Connection Network Upgrades	$ 1,476,000
Total Costs	$ 1,801,000

[1] Cost for the physical interconnection are borne by the AF2-331 interconnection request.

6.1 Attachment Facilities

230 kV Transmission Line Tap

PPL EU will construct the Attachment Facilities from the dead-end structure inside the Montour Substation to a PPL EU owned termination structure (POI structure) outside the Montour Substation. The IC will be responsible for constructing the Attachment Facilities from the POI structure to their collector substation.

PPL EU and the IC will need to consider the required spacing and easements for AE2-271 and AF1-311 which are connecting adjacent to AF2-331 in Bays 5 and 6, respectively. Each request will have a POI as an H-frame dead-end structure outside the Montour Substation.

For the purposes of this report, PPL EU is assuming the conductor spacing and clearances is sufficient to accommodate AF2-331. If during detailed design, spacing is determined not to be adequate, PPL EU will need to design an underground solution and/or relocate existing PPL EU assets. This evaluation will occur during the Facilities Study.

PPL EU will perform the following work for the Attachment Facilities:

- Install one (1) H-frame terminal tension structure with custom foundation and fiber splice box outside the Montour Substation.
- Route 48-ct fiber ADSS from the splice box on the above structure underground to the control cubicle inside the Montour Substation.
- 260 ft. of 1590 ACSR conductor from the substation dead-end structure to the H-frame structure outside the Montour Substation.
- Submit a Letter of Notification to, and receive approval from, the Pennsylvania Public Utility Commission for siting of the PPL EU owned Attachment Facilities.

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
230 kV Transmission Line Tap	$ 325,000
Total Attachment Facility Costs	$ 325,000

6.2 Direct Connection Cost Estimate

None

6.3 Non-Direct Connection Cost Estimate

Montour 230 kV Substation- Populate Existing Bay 7

- Populate the existing Bay 7 by adding one (1) new circuit breakers and associated equipment to complete a full breaker and a half bay. The Attachment Facilities will terminate in Bay 7 at the newly created line position dead-end structure.
- Route 48-count fiber terminated on the new A-frame structure in the substation and route it into the control cubicle.

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

Description	Total Cost
Montour Substation – Populate Existing Bay 7	$ 1,476,000
Total Non-Direct Connection Facility Costs	$ 1,476,000

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

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 EU 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.

9.3 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

10 Summer Peak - Load Flow Analysis - Primary POI

The Queue Project AF2-333 was evaluated as a 20.0 MW (Capacity 12.0 MW) injection at the **Montour 230 kV substation** in the PPL area. Project AF2-333 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF2-333 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)

None

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.

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
99602661	200022	SUSQHANA	500	PJM	200023	WESCOVLE	500	PJM	1	PJM500_PL_P12_000083	operation	3486.0	99.91	100.0	DC	7.18

10.5 Contingency Descriptions - Primary POI

Contingency Name	Contingency Definition
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

11 Short Circuit Analysis - Primary POI

To be performed during the System Impact Study

12 Summer Peak - Load Flow Analysis - Secondary POI

The Queue Project AF2-333 was evaluated as a 20.0 MW (Capacity 12.0 MW) injection tapping the **Montour to Saegers 230 kV line** in the PPL area. Project AF2-333 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF2-333 was studied with a commercial probability of 53.0 %. Potential network impacts were as follows:

12.1 Generation Deliverability

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

None

12.2 Multiple Facility Contingency

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

None

12.3 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)

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
155594566	207968	ELIM	230.0	PPL	208109	SUNB	230.0	PPL	1	PL_P42_001365	breaker	537.0	111.44	112.82	DC	7.36
155594567	207968	ELIM	230.0	PPL	208109	SUNB	230.0	PPL	1	PL_P42_100989	breaker	537.0	110.95	112.35	DC	7.52
156395471	207968	ELIM	230.0	PPL	208109	SUNB	230.0	PPL	1	PL_P71_100487-B	tower	537.0	141.58	145.11	DC	18.95

12.4 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

12.5 Flow Gate Details - Secondary POI

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".

12.5.1 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
156395471	207968	ELIM	PPL	208109	SUNB	PPL	1	PL_P71_100487-B	tower	537.0	141.58	145.11	DC	18.95

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
208945	LOHA CT	1.9036	50/50	1.9036
208948	WILL CT	4.2815	50/50	4.2815
212369	PATRIOT 1	62.5268	50/50	62.5268
212370	PATRIOT 2	62.5268	50/50	62.5268
921653	AA2-008 E	54.0178	50/50	54.0178
945511	AF1-216 C1O1	36.5947	50/50	36.5947
945512	AF1-216 E1O1	24.3681	50/50	24.3681
945521	AF1-216 C2	36.5917	50/50	36.5917
945522	AF1-216 E2	24.3661	50/50	24.3661
946691	AF1-333 C O1	3.6655	50/50	3.6655
946692	AF1-333 E O1	2.4437	50/50	2.4437
946731	AF1-337 C	3.6655	50/50	3.6655
946732	AF1-337 E	2.4437	50/50	2.4437
946741	AF1-338 C	3.6655	50/50	3.6655
946742	AF1-338 E	2.4437	50/50	2.4437
946751	AF1-339 C O1	3.6655	50/50	3.6655
946752	AF1-339 E O1	2.4437	50/50	2.4437
958461	AF2-140	28.4304	50/50	28.4304
958511	AF2-145 C1	13.0361	50/50	13.0361
958512	AF2-145 E1	8.6907	50/50	8.6907
958521	AF2-145 C2	13.0350	50/50	13.0350
958522	AF2-145 E2	8.6900	50/50	8.6900
959932	AF2-284 E	1.8954	50/50	1.8954
959982	AF2-289 E	2.8430	50/50	2.8430
960401	AF2-331 C O2	28.4304	50/50	28.4304
960402	AF2-331 E O2	18.9536	50/50	18.9536
960411	AF2-332 C O2	28.4304	50/50	28.4304
960412	AF2-332 E O2	18.9536	50/50	18.9536
960421	AF2-333 C O2	11.3722	50/50	11.3722
960422	AF2-333 E O2	7.5814	50/50	7.5814
960431	AF2-334 C O2	11.3722	50/50	11.3722
960432	AF2-334 E O2	7.5814	50/50	7.5814
961362	AF2-427 E	2.8430	50/50	2.8430
NEWTON	NEWTON	0.4234	Confirmed LTF	0.4234
FARMERCITY	FARMERCITY	0.0221	Confirmed LTF	0.0221
CALDERWOOD	CALDERWOOD	0.1958	Confirmed LTF	0.1958
NY	NY	0.2267	Confirmed LTF	0.2267
PRAIRIE	PRAIRIE	1.0177	Confirmed LTF	1.0177
O-066	O-066	2.7418	Confirmed LTF	2.7418
CHEOAH	CHEOAH	0.1972	Confirmed LTF	0.1972
EDWARDS	EDWARDS	0.1379	Confirmed LTF	0.1379
TILTON	TILTON	0.2482	Confirmed LTF	0.2482

G-007	G-007	0.4233	Confirmed LTF	0.4233
GIBSON	GIBSON	0.2151	Confirmed LTF	0.2151
BLUEG	BLUEG	0.6840	Confirmed LTF	0.6840
TRIMBLE	TRIMBLE	0.2193	Confirmed LTF	0.2193
CATAWBA	CATAWBA	0.1379	Confirmed LTF	0.1379

12.6 Contingency Descriptions - Secondary POI

Contingency Name	Contingency Definition
PL_P42_100989	CONTINGENCY 'PL_P42_100989' /* MONT 230 4T BF COLUMBIA & SAEGERS TIE CB DISCONNECT BUS 207943 /* /* COLU-MONT & COLU T2 DISCONNECT BRANCH FROM BUS 208040 TO BUS 960400 CKT 1 /* /* MONT-AF2-331 TAP 230 PROJECT B1602 END
PL_P71_100487-B	CONTINGENCY 'PL_P71_100487-B' /* MONT-SAEG #1 & 2 230KV LINES OUT DISCONNECT BRANCH FROM BUS 212397 TO BUS 208040 CKT 2 /* /* MONT-SAEG 2 DISCONNECT BRANCH FROM BUS 960400 TO BUS 208040 CKT 1 /* /* AF2-331 TAP-SAEG 1 END
PL_P42_001365	CONTINGENCY 'PL_P42_001365' /* MONT 230KV 3T BF - MONT-SAEG 1 AND MONT-MILT DISCONNECT BRANCH FROM BUS 208040 TO BUS 960400 CKT 1 /* /* MONT-AF2-331 TAP 230KV LINE DISCONNECT BRANCH FROM BUS 208040 TO BUS 208034 CKT 1 /* /* MONT-MILT 230KV LINE END

13 Affected Systems

13.1 NYISO

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