Generation Interconnection

Feasibility Study Report

for

Queue Project AF1-015

EASTON-STEELE 138 KV

6.3 MW Capacity / 15 MW Energy

January, 2020

Table of Contents

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.

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 an uprate to an existing Solar generating facility located in Talbot County, MD. This projects requests an uprate of 15 MW with 6.3 MW this output being recognized by PJM as Capacity. The installed facilities will have a total capability of 66 MW with 26 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is November 30, 2021. This study does not imply a TO commitment to this in-service date.

Queue Number	AF1-015
Project Name	EASTON-STEELE 138 KV
State	Maryland
County	Talbot
Transmission Owner	DPL
MFO	66
MWE	15
MWC	6.3
Fuel	Solar
Basecase Study Year	2023

2.1 Point of Interconnection

AF1-015 will be interconnecting to the Easton – Steele 138 kV line via the new 3-breaker ring bus substation that will be established as part of a previous queue project.

2.2 Cost Summary

The AF1-015 project will be responsible for the following costs associated with the physical interconnection of the project:

Description	Total Cost
Attachment Facilities	$0
Direct Connection Network Upgrade	$0
Non Direct Connection Network Upgrades	$0
Total Costs	$0

DPL reserves the right to reassess issues presented in this document and, upon appropriate justification, submit additional costs related to the AF1-015 project.

In addition, the AF1-015 project may be responsible for a contribution to the following costs associated with network upgrades:

Description	Total Cost
System Upgrades	$700,000

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

3 Transmission Owner Scope of Work

No additional work is needed to accommodate this interconnection.

3.1 Interconnection Customer Scope of Direct Connection Work

The IC is responsible for all design and construction related to activities on their side of the Point of Interconnection. Site preparation, including grading and an access road, as necessary, is assumed to be by the IC. Route selection, line design, and right-of-way acquisition of the direct connect facilities is not included in this report and is the responsibility of the IC. Protective relaying and metering design and installation must comply with DPL's applicable standards. The IC is also required to provide revenue metering and real-time telemetering data to PJM in conformance with the requirements contained in PJM Manuals M-01 and M-14 and the PJM Tariff.

3.2 DPL Interconnection Customer Scope of Direct Connection Work Requirements

DPL requires that an IC circuit breaker is located within 500 feet of the DPL substation to facilitate the relay protection scheme between DPL and the IC at the Point of Interconnection (POI).

4 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.

None.

5 Direct Connection Cost Estimate

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

None.

6 Non-Direct Connection Cost Estimate

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.

None.

7 Interconnection Customer Requirements

7.1 Special Operating Requirements

1. DPL will require the capability to remotely disconnect the generator from the grid by communication from its System Operations facility. Such disconnection may be facilitated by a generator breaker, or other method depending upon the specific circumstances and the evaluation by DPL.
2. DPL reserves the right to charge the Interconnection Customer operation and maintenance expenses to maintain the Interconnection Customer attachment facilities, including metering and telecommunications facilities, owned by DPL.
3. Interconnection Customer shall design its non-synchronous generation facility with the ability to maintain a power factor between 0.95 leading and 0.95 lagging measured at the generator terminals.

8 Revenue Metering and SCADA Requirements

8.1 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.

8.1.1 Meteorological Data Reporting Requirement

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

8.2 DPL Requirements

8.2.1 Required Relaying and Communications

Relaying and communications will be established as part of the previous queue project. No additional work will be required.

8.2.2 Metering

Metering will be established as part of the previous queue project. No additional work will be required.

9 Network Impacts

The Queue Project AF1-015 was evaluated as a 15.0 MW (Capacity 6.3 MW) injection as an uprate to a previous queue project tapping the Easton to Steele 138 kV line in the DPL area. Project AF1-015 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-015 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Load Flow

10 Generation Deliverability

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

None

11 Multiple Facility Contingency

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

None

12 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
40943263	232107	TOWNSEND	138.0	DP&L	232106	MIDLTNTP	138.0	DP&L	1	DPL_P7_1_DBL_1NCB_FSA	tower	348.0	109.09	110.37	DC	4.55

13 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

14 System Reinforcements

ID	Index	Facility	Upgrade Description	Cost
40943263	1	TOWNSEND 138.0 kV - MIDLTNTP 138.0 kV Ckt 1	dt13808r0001 (2187) : To mitigate the (DP&L) TOWNSEND to MIDLTNTP 138 kV line (from bus 232107 to bus 232106 ckt 1) overload, it will require increasing the emergency rating of the Townsend to Middletown Tap 138 kV line by rebuilding the circuit. The rebuild will include the installation of new poles, foundations, insulators, and conductor. It will also require substation reinforcements at Townsend & Middletown Tap Substation. Project Type : FAC Cost : $700,000 Time Estimate : 36-48 Months	$700,000
			TOTAL COST	$700,000

15 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.

15.1 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
4094326 3	23210 7	TOWNSEN D	DP&L	23210 6	MIDLTNT P	DP& L	1	DPL_P7_1_DBL_1NCB_FS A	towe r	348.0	109.09	110.37	DC	4.55

Bus #	Bus	MW Impact
232404	W1-003 C	0.4366
232405	W1-003 E	0.9087
232406	W1-004 FULL	0.4366
232407	W1-004 E	0.9087
232408	W1-005 C	0.4366
232409	W1-005 E	0.9087
232410	W1-006 C	0.4366
232411	W1-006 E	0.9087
232412	X1-032 E	0.8189
232417	X3-008 C	0.2675
232418	X3-008 E	3.1267
232422	X3-066 FULL	0.1337
232423	X3-066 E	1.5629
232424	Y1-079 C	0.1971
232425	Y1-079 E	2.3034
232426	Y1-080 FULL	0.0420
232427	Y1-080 E	0.4931
232428	Y3-058 C	0.1681
232429	Y3-058 E	1.9648
232433	Z2-076 E	0.3207
232435	Z2-077 E	0.3207
232436	AB1-176 C	1.4285
232813	VAUGHN	0.0935
232902	EASTMUNI	2.9988
232907	VN8	4.8246
232910	NRG_G1	1.4723
232911	NRG_G2	1.4723
232915	OH NUG4	0.9330
232916	OH NUG5	0.9330
232919	VN10	0.3351
232922	**MR3 (Deativation : 06/01/21)**	**9.0792**
232926	CRISFLD1	0.2867
293670	O-025 C	0.1725
917082	Z2-012 E	2.1255
918831	AA1-102	1.0753
919831	AA2-069	40.1444
923282	AB1-137 C	0.6588
923283	AB1-137 E	0.2823
923322	AB1-141 C OP	5.7556
923323	AB1-141 E OP	2.6859
923332	AB1-142 C OP	5.7556
923603	AB1-176 E	2.3528

Bus #	Bus	MW Impact
923921	AB2-032 C	5.7982
923922	AB2-032 E	2.7286
923951	AB2-036 C	12.6900
923952	AB2-036 E	20.7621
924681	AB2-120 C OP	6.5068
924682	AB2-120 E OP	10.6164
924781	AB2-130 C OP	5.4743
924782	AB2-130 E OP	8.9317
924801	AB2-133 C OP	11.5576
924802	AB2-133 E OP	14.6584
924821	AB2-135 C	12.3167
924822	AB2-135 E	14.0468
924831	AB2-136 C	5.9503
924832	AB2-136 E	6.3102
924971	AB2-153 C	3.2402
924972	AB2-153 E	5.2866
925151	AB2-172 C OP	4.7908
925152	AB2-172 E OP	7.8166
925251	AB2-179 C OP	26.8562
925252	AB2-179 E OP	8.8568
925261	AB2-180 C	2.9578
925262	AB2-180 E	1.2676
925271	AB2-185 C OP	5.2011
925272	AB2-185 E OP	2.2291
926131	AC1-091 C	0.6411
926132	AC1-091 E	1.0515
926141	AC1-092 C	0.6411
926142	AC1-092 E	1.0515
926151	AC1-093 C	0.6069
926152	AC1-093 E	1.0002
926161	AC1-094 C	0.5129
926162	AC1-094 E	0.8463
926171	AC1-095 C	0.3248
926172	AC1-095 E	0.5215
927031	AC1-190 C	8.7507
927032	AC1-190 E	3.7503
927191	AC1-213 C	0.6593
927192	AC1-213 E	0.4327
930201	AB1-056 C	9.9397
930202	AB1-056 E	28.3065
930881	AB1-137 C	0.6588
930882	AB1-137 E	0.2823
930932	AB1-142 E OP	2.6859
932161	AC2-023 C	5.6964
932162	AC2-023 E	4.1487
933631	AC2-185 C	1.2994
933632	AC2-185 E	2.1200
933641	AC2-186 C	3.1346
933642	AC2-186 E	5.1143
936611	AD2-076 C O1	8.1859
936612	AD2-076 E O1	13.3560
936691	AD2-088 C	3.7888

Bus #	Bus	MW Impact
936692	AD2-088 E	2.5259
938651	AE1-087 C	4.0344
938652	AE1-087 E	1.0086
938891	AE1-117 C O1	6.5111
938892	AE1-117 E O1	17.3367
938901	AE1-118 C O1	6.5160
938902	AE1-118 E O1	17.3498
939151	AE1-145	3.4241
939361	AE1-167 C O1	1.0272
939362	AE1-167 E O1	0.8560
939621	AE1-192 C O1	8.0563
939622	AE1-192 E O1	3.9425
941021	AE2-093 C	5.9724
941022	AE2-093 E	9.4892
941181	AE2-112 C	2.8400
941182	AE2-112 E	4.6337
941971	AE2-209 C	7.7484
941972	AE2-209 E	5.4004
942441	AE2-257 C	5.1643
942442	AE2-257 E	13.6149
942821	AE2-301 C	0.4519
942822	AE2-301 E	1.6024
943361	AF1-007 C	0.1554
943362	AF1-007 E	0.4417
943441	AF1-015 C	1.9100
943442	AF1-015 E	2.6376
943651	AF1-036 C	3.6929
943652	AF1-036 E	5.0997
943761	AF1-044 C	6.8159
943762	AF1-044 E	9.4124
944921	AF1-157 C O1	1.3016
944922	AF1-157 E O1	0.8677
945661	AF1-231 C	0.6906
945662	AF1-231 E	1.0359
945781	AF1-243	0.4542
945791	AF1-244	1.6434
945931	AF1-258	0.6761
945941	AF1-259	0.3361
946041	AF1-269	2.5828
DUCKCREEK	DUCKCREEK	0.2061
NEWTON	NEWTON	0.1923
FARMERCITY	FARMERCITY	0.0100
NY	NY	0.0647
PRAIRIE	PRAIRIE	0.4624
O-066	O-066	0.5914
COFFEEN	COFFEEN	0.0946
EDWARDS	EDWARDS	0.0627
CHEOAH	CHEOAH	0.0901
TILTON	TILTON	0.1128
G-007	G-007	0.0645
GIBSON	GIBSON	0.0977
CALDERWOOD	CALDERWOOD	0.0895

Bus #	Bus	MW Impact
BLUEG	BLUEG	0.3107
TRIMBLE	TRIMBLE	0.0996
CATAWBA	CATAWBA	0.0637

16 Contingency Definitions

Contingency Name	Contingency Definition
DPL_P7_1_DBL_1NCB_FSA	CONTINGENCY 'DPL_P7_1_DBL_1NCB_FSA' /* #1 & #2 KEENEY-STEELE 230 OPEN LINE FROM BUS 231003 TO BUS 232000 CKT 1 OPEN LINE FROM BUS 231003 TO BUS 923960 CKT 2 OPEN LINE FROM BUS 232000 TO BUS 923960 CKT 2 DISCONNECT BUS 923961 DISCONNECT BUS 923962 END

Short Circuit

17 Short Circuit

The following Breakers are overduty:

None