Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AC1-041

"Mt. Olive 12 kV"

March 2017

Preface

The intent of the Feasibility 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.

Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The Interconnection Customer may be 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.

PJM utilizes manufacturer models to ensure the performance of turbines is properly captured during the simulations performed for stability verification. Turbine manufacturers provide such models to their customers. The list of manufacturer models PJM has already validated is contained in Attachment G-2 of Manual 14A. 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 2.2.2. of Manual 14A 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 G-1 of Manual 14A) in order to document the request for the study.

General

The Interconnection Customer (IC), has proposed a 5 MW (1.9 MWC) solar generating facility to be located in Worcester County, Maryland. PJM studied AC1-041 as a 5 MW injection into the Delmarva Power and Light Company (DPL) system at the Choptank Electric Cooperative's (CEC) Mt. Olive 69 kV Substation. The project was evaluated for compliance with reliability criteria for summer peak conditions in 2020. The planned in-service date, as requested by the IC during the project kick-off call, is May 1, 2018.

Point of Interconnection

The Interconnection Customer requested a distribution level interconnection. Distribution facilities in the area of the AC1-041 project are owned by the Choptank Electric Cooperative (CEC). As a result, AC1-041 will interconnect with the CEC system at the Mt. Olive Substation. The DPL system feeds the Mt. Olive Substation (see Attachment 1).

Transmission Owner Scope of Direct Connection Work

There is no DPL Attachment Facility work required for the AC1-041 project. The IC must contact CEC for the work scope and schedule.

Interconnection Customer Scope of Work

The Interconnection Customer assumes full responsibility for design and construction of all facilities associated with the AC1-041 generating station and the direct connection line on the IC side of the Point of Interconnection.

Revenue metering specifications will be established by CEC. The IC will be required to install metering and telemetry equipment to provide revenue metering and real-time telemetry data to PJM. The requirements for this equipment are listed in Appendix 2, Section 8 of Attachment O to the PJM Tariff, as well as PJM Manuals 01 and 14D.

It is the IC's responsibility to send the data that PJM and DPL requires directly to PJM. The IC will grant permission for PJM to send DPL the following telemetry that the IC sends to PJM: real time MW, MVAR, volts, amperes, generator status, and interval MWH and MVARH.

Transmission Network Impacts

Potential transmission network impacts are as follows:

Contingency Descriptions:

The following contingencies resulted in overloads:

Contingency Name	Description
DP15	CONTINGENCY 'DP15' /*INDIAN RIVER BUS BREAKER TO PINEY GROVE DISCONNECT BRANCH FROM BUS 232007 TO BUS 232006 CKT 1 /*PINEY GR INDRIV 4 230 230 DISCONNECT BRANCH FROM BUS 232007 TO BUS 232128 CKT 1 /*PINEY GR PINEY GR 230 138 DISCONNECT BRANCH FROM BUS 232006 TO BUS 232004 CKT 1 /*MILFORD INDIAN RIVER 230 230 END
CKT 23002	CONTINGENCY 'CKT 23002' DISCONNECT BUS 232007 /INDIAN RIVER - PINEY GROVE 230 & PNY GRV AT-20 XFMER END

Summer Peak Analysis - 2020

Generator Deliverability

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

None

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

None.

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)

	Contingency		Affected		Bus			Power	Loading %		Rating		MW	
#	Type	Name	Area	Facility Description	From	To	Circuit	Flow	Initial	Final	Type	MVA	Contribution	Ref
1	LFFB	DP15	DP&L - DP&L	PINEY_69-M HERMON 69 kV line	232274	232272	1	DC	110.99	112.01	ER	174	1.78	1

Steady-State Voltage Requirements

To be determined during the later study phases.

Short Circuit
(Summary of impacted circuit breakers)

No issues identified.

Affected System Analysis & Mitigation

Delivery of Energy Portion of Interconnection Request
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.

Only the most severely overloaded conditions are listed. 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 will study all overload conditions associated with the overloaded element(s) identified.

	Contingency		Affected		Bus			Power	Loading %		Rating		MW	
#	Type	Name	Area	Facility Description	From	To	Circuit	Flow	Initial	Final	Type	MVA	Contribution	Ref
2	LFFB	CKT 23002	DP&L - DP&L	PINEY_69-M HERMON 69 kV line	232274	232272	1	DC	110.67	111.7	ER	174	1.79	

Light Load Analysis – 2020

Light Load Studies to be conducted during later study phases (as required by PJM Manual 14B).

Summer Peak Load Flow Analysis Reinforcements

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, initially caused by the addition of this project generation).

None.

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
1	PINEY_69-M HERMON 69 kV line	In order to mitigate the overloads of facilities above, the following reinforcements are required: Rebuilding of the Piney Grove – Mount Hermon 69 kV transmission line and substation reinforcements at Piney Grove Substation and Mount Hermon Substation. The estimated schedule duration is **3 years a**nd the estimated cost is **$9,688,000**	TBD	**$ 9,688,000**

Steady-State Voltage Requirements

To be performed during later study phases.

Short Circuit

No issues identified.

Stability and Reactive Power Requirement

To be performed during later study phases.

Light Load Analysis - 2020

Light Load Studies to be conducted during later study phases (as required by PJM Manual 14B)

Appendices

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.

Appendix 1

(DP&L - DP&L) The PINEY_69-M HERMON 69 kV line (from bus 232274 to bus 232272 ckt 1) loads from 110.99% to 112.01% (**DC power flow**) of its emergency rating (174 MVA) for the line fault with failed breaker contingency outage of 'DP15'. This project contributes approximately 1.78 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
232905	BAYVIEW1	0.58
232926	CRISFLD1	0.36
232912	OH NUG1	2.06
232913	OH NUG2	2.03
232914	OH NUG3	2.06
232915	OH NUG4	2.06
232916	OH NUG5	2.06
232917	OH NUG6	2.05
232918	OH NUG7	2.04
232921	TASLEY2G	1.43
904210	V4-022C	0.09
904212	V4-022E	0.75
901003	W1-003 C	0.14
901004	W1-003 E	1.07
901013	W1-004 C	0.14
901014	W1-004 E	1.07
901023	W1-005 C	0.14
901024	W1-005 E	1.07
901033	W1-006 C	< 0.01
901034	W1-006 E	1.07
907052	X1-032 E	0.82
907323	X1-096 C	0.7
907324	X1-096 E	17.31
920582	Z1-076 C	1.54
920583	Z1-076 E	2.52
920592	Z1-077 C	1.1
920593	Z1-077 E	1.8
916441	Z1-100	0.19
916451	Z1-101	0.19
916461	Z1-102	0.19
920602	Z1-103	0.19
917081	Z2-012 C	0.35

Bus Number	Bus Name	Full Contribution
917082	Z2-012 E	2.99
920952	AA1-025	0.17
920962	AA1-026	0.17
920972	AA1-027	0.17
920982	AA1-028	0.17
921122	AA1-059 C	0.8
921123	AA1-059 E	0.32
918831	AA1-102	1.34
921602	AA1-141 C	1.86
921603	AA1-141 E	3.04
922213	AA2-129 E	4.76
922222	AA2-130	0.37
923902	AB2-030 E	0.97
923931	AB2-033 C	1.73
923932	AB2-033 E	0.68
924361	AB2-084 C	0.78
924362	AB2-084 E	1.27
924681	AB2-120 C OP	9.17
924682	AB2-120 E OP	14.96
925101	AB2-167 C	1.54
925102	AB2-167 E	2.53
925231	AB2-177 C	0.82
925232	AB2-177 E	1.34
925381	AC1-009 C	1.83
925382	AC1-009 E	2.99
925651	AC1-041 C	0.68
925652	AC1-041 E	1.1
925761	AC1-052 C	2.41
925762	AC1-052 E	0.97