

# ***Generation Interconnection Feasibility Study Report Queue Position AB2-032***

The Interconnection Customer (IC) has proposed a 20 MW (13.6 MWC) solar generating facility to be located in Sudlersville, Maryland. PJM studied AB2-032 as a 20 MW injection into the Delmarva Power and Light Company (DPL) system at a tap (AB1-141) of the Church-Wye Mills 138 kV circuit and evaluated it for compliance with reliability criteria for summer peak conditions in 2020. The planned in-service date, as stated during the project kick-off call, is November 1, 2017.

## **Point of Interconnection**

The Interconnection Customer requested a transmission level interconnection. As a result, AB2-032 will interconnect with the DPL system at a new breaker position in the new 138 kV substation constructed by the IC's prior queue project AB1-141. The new substation is adjacent to the Church-Wye Mills 138 kV circuit.

## **Transmission Owner Scope of Work**

### **Substation Interconnection Estimate**

**Scope:** Build a new 138 kV terminal off of the new 138 kV substation created for PJM Queue Project AB1-141. This project will create a fourth position in the 138 kV ring bus at the new substation along Circuit 13723 between Church Substation and Wye Mills Substation.

**Estimate:** \$1,000,000

**Construction Time:** 24 months

### **Major Equipment Included in Estimate:**

• Power Circuit Breaker, 138 kV, 2000A, 40kA, 3 cycle	Qty. 1
• Disconnect Switch, 138 kV, 2000A, Manual Wormgear, Arcing Horns	Qty. 3
• CT/VT Combination Units, 138 kV	Qty. 3
• Disconnect Switch Stand, High, 138 kV, Steel	Qty. 1
• Disconnect Switch Stand, Low, 138 kV, Steel	Qty. 2
• CT/VT Stand, Single Phase, Low, 138 kV, Steel	Qty. 3
• Relay Panel, Transmission Line, FL/BU (20")	Qty. 1
• Control Panel, 138 kV Circuit Breaker (10")	Qty. 1
• Bus Support Structure, 3 phase, 138 kV, Steel	Qty. 3

### **Estimate Assumptions:**

The estimate for AB2-032 assumes that the Transmission Owner Scope of Direct Connection Work for PJM Queue Project AB1-141 is completed.

- All siting work performed by AB1-141 project.
- PJM Queue Project AB1-141 included provisions for a 4<sup>th</sup> position on the 138 kV ring bus.

### **Interconnection Customer Scope of Work**

The Interconnection Customer 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.

### **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).

### **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.

### **Required Relaying and Communications**

New protection relays are required for the new terminal. An SEL-487 will be required for primary protection and an SEL-387 will be required for back-up protection. One 20" relay panel will be required for front line and back-up protection.

An SEL-451 relay on a 20" breaker control panel will be required for the control and operation of the new 138 kV circuit breaker.

The project will require re-wiring of the proposed relay schemes installed during PJM Queue AB1-141 to accommodate the new 138 kV terminal position.

The cost of the required relay and communications is included in the Substation Interconnection Estimate.

### **Metering**

Three phase 138 kV revenue metering points will need to be established. DPL will purchase and install all metering instrument transformers as well as construct a metering structure. The secondary wiring connections at the instrument transformers will be completed by DPL's metering technicians. The metering control cable and meter cabinets will be supplied and installed by DPL. DPL will install conduit for the control cable between the instrument transformers and the metering enclosure. The location of the metering enclosure will be determined in the construction phase. DPL will

provide both the Primary and the Backup meters. DPL's meter technicians will program and install the Primary & Backup solid state multi-function meters for each new metering position. Each meter will be equipped with load profile, telemetry, and DNP outputs. The IC will be provided with one meter DNP output for each meter. DPL will own the metering equipment for the interconnection point, unless the IC asserts its right to install, own, and operate the metering system.

The Interconnection Customer will be required to make provisions for a voice quality phone line within approximately 3 feet of each Company metering position to facilitate remote interrogation and data collection.

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. The estimate for DPL to design, purchase, and install metering as specified in the aforementioned scope for metering is included in the Substation Interconnection Estimate.

## **Summer Peak Analysis - 2020**

### **Transmission Network Impacts**

Potential transmission network impacts are as follows:

#### **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)*

1. (DP&L - DP&L) The TOWNSEND-MIDLTNTP 138 kV line (from bus 232107 to bus 232106 ckt 1) loads from 25.3% to 27.55% (DC power flow) of its emergency rating (348 MVA) for the tower line contingency outage of 'DBL\_4NC'. This project contributes approximately 7.85 MW to the thermal violation.

CONTINGENCY 'DBL\_4NC'

/\* RED LION-CEDAR CREEK

230;RED LION-CARTANZA 230

OPEN LINE FROM BUS 231004 TO BUS 232002 CKT 1

OPEN LINE FROM BUS 231004 TO BUS 232003 CKT 1

END

Please refer to Appendix 1 for a table containing the generators having contribution to this flow gate.

### **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

### **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.*

1. (DP&L - DP&L) The OIL\_CITY-STEEL138 138 kV line (from bus 232801 to bus 232103 ckt 1) loads from .53% to 4.44% (DC power flow) of its emergency rating (159 MVA) for the single line contingency outage of 'CKT 13808'. This project contributes approximately 6.22 MW to the thermal violation.

CONTINGENCY 'CKT 13808'

DISCONNECT BUS 232106

/MOUNT PLEASANT -

MIDDLETOWN - TOWNSEND 138

DISCONNECT BUS 232804

/MIDDLETOWN 138

END

2. (DP&L - DP&L) The AB2-036 TAP-OIL\_CITY 138 kV line (from bus 923950 to bus 232801 ckt 1) loads from 2.41% to 6.33% (DC power flow) of its emergency rating (159 MVA) for the single line contingency outage of 'CKT 13808'. This project contributes approximately 6.22 MW to the thermal violation.

CONTINGENCY 'CKT 13808'

DISCONNECT BUS 232106

/MOUNT PLEASANT -

MIDDLETOWN - TOWNSEND 138

DISCONNECT BUS 232804

/MIDDLETOWN 138

END

### **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)*

1. To mitigate the (DP&L) TOWNSEND-MIDLTNTP 138 kV line (from bus 232107 to bus 232106 ckt 1) overload will require reinforcements to increase the emergency rating of the Townsend to Middletown Tap 138 kV line. Those reinforcements include rebuilding a small section of the circuit and installing new poles and the re-mounting of 138 kV disconnect switches. The estimated cost to perform this work is **\$800,000** and will take **18 months** to complete following a fully executed Interconnection Services Agreement (ISA) and Interconnection Construction Services Agreement (CSA).

#### **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)*

*(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)*

None

#### **Short Circuit**

*(Summary of impacted circuit breakers)*

No issues identified.

#### **Stability and Reactive Power Requirement**

*(Results of the dynamic studies should be inserted here)*

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).

#### **Facilities Study Estimate**

- 7 months to complete following return of Facilities Study Agreement
- Study Deposit will be \$50,000

#### **Delmarva Power and Light Costs**

Cost estimates will further be refined as a part of the Impact Study and Facilities Study for this project. The Interconnection Customer will be responsible for all costs incurred by DPL in connection with the AB2-032 project. Such costs may include, but are not limited to, any transmission system assets currently in DPL's rate base that are prematurely retired due to the AB2-032 project. PJM shall work with DPL to identify these retirement costs and any additional expenses. DPL reserves the right to reassess issues presented in this document and, upon appropriate justification, submit additional costs related to the AB2-032 project.

## Appendices

The following appendices contain additional information about each flow gate presented in the body of the report. For each appendix, a description of the flow gate 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 flow gate 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 TOWNSEND-MIDLTNTP 138 kV line (from bus 232107 to bus 232106 ckt 1) loads from 25.3% to 27.55% (DC power flow) of its emergency rating (348 MVA) for the tower line contingency outage of 'DBL\_4NC'. This project contributes approximately 7.85 MW to the thermal violation.

CONTINGENCY 'DBL\_4NC'

/\* RED LION-CEDAR CREEK

230;RED LION-CARTANZA 230

OPEN LINE FROM BUS 231004 TO BUS 232002 CKT 1

OPEN LINE FROM BUS 231004 TO BUS 232003 CKT 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
232900	DEMECSMY	2.15
232851	DUP-SFR1	0.41
232902	EASTMUNI	3.4
232923	MR1	3.36
232924	MR2	3.36
232910	NRG_G1	2.43
232911	NRG_G2	2.43
292089	T-011	0.17
297076	V2-028 C	0.09
297077	V2-028 E	0.75
904212	V4-022E	0.61
232813	VAUGHN	0.15
232919	VN10	0.57
901004	W1-003 E	0.89
901014	W1-004 E	0.89
901024	W1-005 E	0.89
901034	W1-006 E	0.89
901411	W1-062	2.28
907052	X1-032 E	0.79
907324	X1-096 E	18.27
910571	X3-008 C	0.32

910572	X3-008 E	2.68
910591	X3-015 C	0.3
910592	X3-015 E	2.51
910821	X3-066 C	0.17
910822	X3-066 E	1.41
913361	Y1-079 C	0.24
913362	Y1-079 E	1.96
913411	Y1-080 C	0.05
913412	Y1-080 E	0.43
915751	Y3-033	1.46
915752	Y3-033	9.76
920543	Y3-054 E	2.48
915541	Y3-058 C	0.22
915542	Y3-058 E	1.86
920582	Z1-076 C	1.05
920583	Z1-076 E	1.71
920592	Z1-077 C	0.75
920593	Z1-077 E	1.22
916281	Z1-081 C	0.2
916282	Z1-081 E	1.65
917082	Z2-012 E	2.44
920763	Z2-076 E	0.4
920773	Z2-077 E	0.4
920812	Z2-097 C	1.57
920813	Z2-097 E	0.65
921122	AA1-059 C	0.84
921123	AA1-059 E	0.33
921142	AA1-061 C	2.87
921143	AA1-061 E	1.41
921442	AA1-110 C	1.78
921443	AA1-110 E	0.89
921592	AA1-140 C	1.51
921593	AA1-140 E	2.47
921602	AA1-141 C	1.13
921603	AA1-141 E	1.84
921872	AA2-069	104.81
922213	AA2-129 E	3.94
922222	AA2-130	0.39
922752	AB1-056 C OP	12.79
922753	AB1-056 E OP	36.43
922762	AB1-057 C	12.99
922763	AB1-057 E	37.03
923282	AB1-137 C	2.79
923283	AB1-137 E	1.2
923322	AB1-141 C OP	5.3

923323	<i>AB1-141 E OP</i>	2.47
923332	<i>AB1-142 C OP</i>	5.3
923333	<i>AB1-142 E OP</i>	2.47
923452	<i>AB1-162 C OP</i>	2.4
923453	<i>AB1-162 E OP</i>	3.92
923602	<i>AB1-176 C</i>	1.29
923603	<i>AB1-176 E</i>	2.12
923902	<i>AB2-030 E</i>	0.79
923921	<i>AB2-032 C</i>	5.34
923922	<i>AB2-032 E</i>	2.51
923931	<i>AB2-033 C</i>	1.41
923932	<i>AB2-033 E</i>	0.56
923951	<i>AB2-036 C</i>	13.81
923952	<i>AB2-036 E</i>	22.54
923961	<i>AB2-037 C</i>	14.99
923962	<i>AB2-037 E</i>	24.45
924191	<i>AB2-063 C</i>	2.87
924192	<i>AB2-063 E</i>	4.69
924361	<i>AB2-084 C</i>	0.75
924362	<i>AB2-084 E</i>	1.22
924461	<i>AB2-095 C</i>	2.27
924462	<i>AB2-095 E</i>	3.7
924681	<i>AB2-120 C OP</i>	7.49
924682	<i>AB2-120 E OP</i>	12.21
924781	<i>AB2-130 C OP</i>	7.73
924782	<i>AB2-130 E OP</i>	12.62
924801	<i>AB2-133 C OP</i>	14.2
924802	<i>AB2-133 E OP</i>	19.08
924821	<i>AB2-135 C</i>	12.06
924822	<i>AB2-135 E</i>	18.18
924831	<i>AB2-136 C OP</i>	5.19
924832	<i>AB2-136 E OP</i>	7.37
924881	<i>AB2-142 C</i>	1.14
924882	<i>AB2-142 E</i>	1.85
924891	<i>AB2-143 C OP</i>	3.37
924892	<i>AB2-143 E OP</i>	5.5
924971	<i>AB2-153 C</i>	2.98
924972	<i>AB2-153 E</i>	4.87
925071	<i>AB2-164 C OP</i>	1.5
925072	<i>AB2-164 E OP</i>	2.44
925081	<i>AB2-165 C OP</i>	1.5
925082	<i>AB2-165 E OP</i>	2.44
925091	<i>AB2-166 C</i>	0.4
925092	<i>AB2-166 E</i>	0.7
925101	<i>AB2-167 C</i>	1.05



925102	AB2-167 E	1.72
925151	AB2-172 C OP	4.11
925152	AB2-172 E OP	6.7
925231	AB2-177 C	0.49
925232	AB2-177 E	0.81
925251	AB2-179 C OP	26.29
925252	AB2-179 E OP	8.67
925261	AB2-180 C	2.8
925262	AB2-180 E	1.2
925271	AB2-185 C OP	4.42
925272	AB2-185 E OP	1.89
925311	AB2-192 C OP	1.5
925312	AB2-192 E OP	2.44