Generation Interconnection Feasibility Study Report Queue Position AD1-018

Interconnection Customer has proposed a new solar generation facility located on the south side of highway 68, New Gorge Creak Road in Allegany County, Maryland. The requested Maximum Facility Output is 20 MWs with 7.6 MW being recognized by PJM as Capacity Interconnection Rights (CIR). The proposed in-service date for this project is October 31, 2019. **This study does not imply a Potomac Edison ("Transmission Owner") commitment to this in-service date.**

Attachment facilities and local upgrades (if required) along with terms and conditions to interconnect AD1-018 will be specified in a separate two party Interconnection Agreement (IA) between Potomac Edison and the Interconnection Customer as this project is considered FERC non-jurisdictional per the PJM Open Access Transmission Tariff (OATT). From the transmission system perspective, no network impacts were identified as detailed below.

Point of Interconnection ("POI")

This project will interconnect with the Potomac Edison distribution system by tapping the Carlos Jct.-Plaza 34.5 kV line. The POI will exist on the line approximately 2 miles from Carlos Junction substation. The generation site is located on a property on the south side of highway I-68, New Gorge Creak Road, 1 mile from the POI. Please refer to Appendix 2 for one-line diagram of system configuration.

Network Impacts

The Queue Project AD1-018 was evaluated as a 20.0 MW (Capacity 7.6 MW) injection tapping Carlos Junction to Plaza 34.5kV line in the APS area. Project AD1-018 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD1-018 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis - 2021

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. (AP - AP) The 01DANSMTN-01RIDGLY 138 kV line (from bus 237310 to bus 235504 ckt 1) loads from 92.21% to 93.9% (**DC power flow**) of its emergency rating (182 MVA) for the line fault with failed breaker contingency outage of 'AP-P2-4-MP-138-200'. This project contributes approximately 3.07 MW to the thermal violation.

```
CONTINGENCY 'AP-P2-4-MP-138-200'                    /* ALBRIGHT BREAKER FAILURE - TIE BREAKER
  DISCONNECT BRANCH FROM BUS 235120 TO BUS 235304 CKT 1      /* 01ALBRIG 138 01BRANDN 138
  DISCONNECT BRANCH FROM BUS 235120 TO BUS 235305 CKT 1      /* 01ALBRIG 138 01 106 J 138
  DISCONNECT BRANCH FROM BUS 235120 TO BUS 235320 CKT 1      /* 01ALBRIG 138 01DENVER 138
  DISCONNECT BRANCH FROM BUS 235120 TO BUS 235356 CKT 1      /* 01ALBRIG 138 01KINGWD 138
  DISCONNECT BRANCH FROM BUS 235120 TO BUS 235398 CKT 1      /* 01ALBRIG 138 01RUTHBL 138
  DISCONNECT BRANCH FROM BUS 235120 TO BUS 235402 CKT 1      /* 01ALBRIG 138 01SNOW T 138
  DISCONNECT BRANCH FROM BUS 235120 TO BUS 934440 CKT 1      /* 01ALBRIG 138 AD1-068 TAP 138
  DISCONNECT BRANCH FROM BUS 235120 TO BUS 235485 CKT 1      /* 01ALBRIG 138 01METTIK 138
  DISCONNECT BRANCH FROM BUS 235120 TO BUS 235492 CKT 1      /* 01ALBRIG 138 01MTZION 138
  END
```

Please refer to Appendix 3 for a table containing the generators having contribution to this flowgate.

2. (AP - AP) The 01DANSMTN-01RIDGLY 138 kV line (from bus 237310 to bus 235504 ckt 1) loads from 91.8% to 93.55% (**DC power flow**) of its emergency rating (182 MVA) for the bus fault outage of 'AP-P2-2-MP-138-101'. This project contributes approximately 3.18 MW to the thermal violation.

```
CONTINGENCY 'AP-P2-2-MP-138-101'                    /* ALBRIGHT-138-SOUTH
  DISCONNECT BRANCH FROM BUS 235120 TO BUS 235320 CKT 1      /* 01ALBRIG 138 01DENVER 138
  DISCONNECT BRANCH FROM BUS 235120 TO BUS 235402 CKT 1      /* 01ALBRIG 138 01SNOW T 138
  DISCONNECT BRANCH FROM BUS 235120 TO BUS 934440 CKT 1      /* 01ALBRIG 138 AD1-068 TAP 138
  DISCONNECT BRANCH FROM BUS 235120 TO BUS 235485 CKT 1      /* 01ALBRIG 138 01METTIK 138
  DISCONNECT BRANCH FROM BUS 235120 TO BUS 235305 CKT 1      /* 01ALBRIG 138 01 106 J 138
  END
```

3. (AP - AP) The 01DANSMTN-01RIDGLY 138 kV line (from bus 237310 to bus 235504 ckt 1) loads from 91.73% to 93.43% (**DC power flow**) of its emergency rating (182 MVA) for the line fault with failed breaker contingency outage of 'AP-P2-3-MP-138-159'. This project contributes approximately 3.1 MW to the thermal violation.

```
CONTINGENCY 'AP-P2-3-MP-138-159'                    /* ALBRIGHT-DENVER STK BKR AT ALBRIGHT
  DISCONNECT BRANCH FROM BUS 235120 TO BUS 235320 CKT 1      /* 01ALBRIG 138 01DENVER 138
  DISCONNECT BRANCH FROM BUS 235320 TO BUS 235810 CKT 1      /* 01DENVER 138 01INT COAL 138
  DISCONNECT BRANCH FROM BUS 235338 TO BUS 235810 CKT 1      /* 01GRAFTN 138 01INT COAL 138
  DISCONNECT BRANCH FROM BUS 235120 TO BUS 934440 CKT 1      /* 01ALBRIG 138 AD1-068 TAP 138
  DISCONNECT BRANCH FROM BUS 235120 TO BUS 235402 CKT 1      /* 01ALBRIG 138 01SNOW T 138
  DISCONNECT BRANCH FROM BUS 235120 TO BUS 235492 CKT 1      /* 01ALBRIG 138 01MTZION 138
  DISCONNECT BRANCH FROM BUS 235120 TO BUS 235305 CKT 1      /* 01ALBRIG 138 01 106 J 138
  END
```

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)

1. (PENELEC - PENELEC) The 26ROCKWOOD-26SOMERST 115 kV line (from bus 200746 to bus 200744 ckt 1) loads from 146.81% to 148.5% (**DC power flow**) of its emergency rating (179 MVA) for the bus fault outage of 'AP-P2-2-MP-138-101'. This project contributes approximately 3.01 MW to the thermal violation.

```
CONTINGENCY 'AP-P2-2-MP-138-101'                    /* ALBRIGHT-138-SOUTH
  DISCONNECT BRANCH FROM BUS 235120 TO BUS 235320 CKT 1      /* 01ALBRIG 138 01DENVER 138
  DISCONNECT BRANCH FROM BUS 235120 TO BUS 235402 CKT 1      /* 01ALBRIG 138 01SNOW T 138
  DISCONNECT BRANCH FROM BUS 235120 TO BUS 934440 CKT 1      /* 01ALBRIG 138 AD1-068 TAP 138
  DISCONNECT BRANCH FROM BUS 235120 TO BUS 235485 CKT 1      /* 01ALBRIG 138 01METTIK 138
  DISCONNECT BRANCH FROM BUS 235120 TO BUS 235305 CKT 1      /* 01ALBRIG 138 01 106 J 138
  END
```

Please refer to Appendix 4 for a table containing the generators having contribution to this flowgate.

Please refer to Appendix 5 for a table containing FirstEnergy Contingency Analysis Results.

2. (PENELEC - PENELEC) The 26ROCKWOOD-26SOMERST 115 kV line (from bus 200746 to bus 200744 ckt 1) loads from 136.4% to 137.58% (**DC power flow**) of its emergency rating (179 MVA) for the tower line contingency outage of 'AP-P7-1-PE-138-014'. This project contributes approximately 2.07 MW to the thermal violation.

```
CONTINGENCY 'AP-P7-1-PE-138-014'                    /* 111
  DISCONNECT BRANCH FROM BUS 235454 TO BUS 235558 CKT 1        /* 01CUMBRL 138 01SHORTG 138
  DISCONNECT BRANCH FROM BUS 235484 TO BUS 235504 CKT 1        /* 01MESSCK 138 01RIDGLY 138
  END
```

Steady-State Voltage Requirements

To be determined during later study phases

Short Circuit

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. (AP - AP) The 01GARRET-AD1-068 TAP 138 kV line (from bus 235469 to bus 934440 ckt 1) loads from 134.65% to 136.88% (**DC power flow**) of its emergency rating (191 MVA) for the single line contingency outage of 'PN-P1-2-PN-115-068'. This project contributes approximately 4.29 MW to the thermal violation.

```
CONTINGENCY 'PN-P1-2-PN-115-068'                    /* ROCKWOOD - SOMERSET 115KV
  DISCONNECT BRANCH FROM BUS 200744 TO BUS 200746 CKT 1        /* 26SOMERST 115 26ROCKWOOD 115
  DISCONNECT BRANCH FROM BUS 200746 TO BUS 200773 CKT 1        /* 26ROCKWOOD 115 26ROCKWOOD 23
  END
```

2. (AP - AP) The 01DANSMTN-01RIDGLY 138 kV line (from bus 237310 to bus 235504 ckt 1) loads from 91.02% to 92.83% (**DC power flow**) of its emergency rating (182 MVA) for the single line contingency outage of 'AP-P1-2-MP-138-160-A'. This project contributes approximately 3.3 MW to the thermal violation.

```
CONTINGENCY 'AP-P1-2-MP-138-160-A'                  /* 1518
  DISCONNECT BRANCH FROM BUS 235120 TO BUS 934440 CKT 1        /* 01ALBRIG 138 AD1-068 TAP 138
  END
```

3. (AP - AP) The AD1-068 TAP-01ALBRIG 138 kV line (from bus 934440 to bus 235120 ckt 1) loads from 134.65% to 136.9% (**DC power flow**) of its emergency rating (191 MVA) for the single line contingency outage of 'PN-P1-2-PN-115-068'. This project contributes approximately 4.29 MW to the thermal violation.

```
CONTINGENCY 'PN-P1-2-PN-115-068'                    /* ROCKWOOD - SOMERSET 115KV
 DISCONNECT BRANCH FROM BUS 200744 TO BUS 200746 CKT 1      /* 26SOMERST 115 26ROCKWOOD 115
 DISCONNECT BRANCH FROM BUS 200746 TO BUS 200773 CKT 1      /* 26ROCKWOOD 115 26ROCKWOOD 23
 END
```

4. (AP - AP) The AD1-068 TAP-01ALBRIG 138 kV line (from bus 934440 to bus 235120 ckt 1) loads from 97.41% to 99.3% (**DC power flow**) of its normal rating (164 MVA) for non-contingency condition. This project contributes approximately 3.11 MW to the thermal violation.

Light Load Analysis - 2021

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

System Reinforcements

Short Circuit

None

Stability and Reactive Power Requirement

To be determined during later study phases

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)

Multiple Facility Contingency

1. (AP - AP) The 01DANSMTN-01RIDGLY 138 kV line (from bus 237310 to bus 235504 ckt 1) loads from 92.21% to 93.9% (**DC power flow**) of its emergency rating (182 MVA) for the line fault with failed breaker contingency outage of 'AP-P2-4-MP-138-200'. This project contributes approximately 3.07 MW to the thermal violation.

APS:

In conjunction with AD1-125 generation project, the reconfiguration of the Albright substation eliminates the P2 contingency at Albright. The estimated cost of the reconfiguration is less than the combined estimated cost of the reconductors and line upgrades for both projects. Again, this fixes the contingencies identified. Cost estimate and timeframe will be provided in the feasibility report, and PJM will be responsible for allocating costs. Furthermore, the affected line overload is also represented in the Delivery of Energy Portion of this report, for the single contingency loss of the Albright – AD1-068 Tap line. This contingency is the equivalent to the Albright stuck breaker or bus contingencies with very similar

results. Therefore, PJM will allow the Generator the option to fix the overload or redispatch.

2. (AP - AP) The 01DANSMTN-01RIDGLY 138 kV line (from bus 237310 to bus 235504 ckt 1) loads from 91.8% to 93.55% (**DC power flow**) of its emergency rating (182 MVA) for the bus fault outage of 'AP-P2-2-MP-138-101'. This project contributes approximately 3.18 MW to the thermal violation.

Same as Multiple Facility #1

3. (AP - AP) The 01DANSMTN-01RIDGLY 138 kV line (from bus 237310 to bus 235504 ckt 1) loads from 91.73% to 93.43% (**DC power flow**) of its emergency rating (182 MVA) for the line fault with failed breaker contingency outage of 'AP-P2-3-MP-138-159'. This project contributes approximately 3.1 MW to the thermal violation.

Same as Multiple Facility #1

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)

1. (PENELEC - PENELEC) The 26ROCKWOOD-26SOMERST 115 kV line (from bus 200746 to bus 200744 ckt 1) loads from 146.81% to 148.5% (**DC power flow**) of its emergency rating (179 MVA) for the bus fault outage of 'AP-P2-2-MP-138-101'. This project contributes approximately 3.01 MW to the thermal violation.

APS:
The upgrade is to rebuild the Rockwood-Somerset 115kV Line, approximately 8.12 miles of 795 ACSS high temperature conductor ($14,320,700); replace the Rockwood 115kV breaker, line trap, terminal conductor, and line relaying at Somerset Substation ($599,100); replace Somerset 115kV Wave trap, line conductor, and line relaying at Rockwood Substation ($296,000). The total cost to perform this upgrade is $15,215,800 ($21,528,900 w. Tax included). Estimated construction time is 21 months.

2. (PENELEC - PENELEC) The 26ROCKWOOD-26SOMERST 115 kV line (from bus 200746 to bus 200744 ckt 1) loads from 136.4% to 137.58% (**DC power flow**) of its emergency rating (179 MVA) for the tower line contingency outage of 'AP-P7-1-PE-138-014'. This project contributes approximately 2.07 MW to the thermal violation.

Same as Contribution to Previously Identified #1

Light Load 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)

None

Appendix 3

Flowgate Information: Contingency - Albright Breaker Failure (Tie Breaker)
PJM Queue Position: AD1-018

This appendix contains additional information about the flowgate presented in the body of the report. The intent of this 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.

(AP - AP) The 01DANSMTN-01RIDGLY 138 kV line (from bus 237310 to bus 235504 ckt 1) loads from 92.21% to 93.9% (**DC power flow**) of its emergency rating (182 MVA) for the line fault with failed breaker contingency outage of 'AP-P2-4-MP-138-200'. This project contributes approximately 3.07 MW to the thermal violation.

```
CONTINGENCY 'AP-P2-4-MP-138-200'
/* ALBRIGHT BREAKER FAILURE - TIE BREAKER

  DISCONNECT BRANCH FROM BUS 235120 TO BUS
235304 CKT 1          /* 01ALBRIG 138 01BRANDN 138

  DISCONNECT BRANCH FROM BUS 235120 TO BUS
235305 CKT 1          /* 01ALBRIG 138 01 106 J 138

  DISCONNECT BRANCH FROM BUS 235120 TO BUS
235320 CKT 1          /* 01ALBRIG 138 01DENVER 138

  DISCONNECT BRANCH FROM BUS 235120 TO BUS
235356 CKT 1          /* 01ALBRIG 138 01KINGWD 138

  DISCONNECT BRANCH FROM BUS 235120 TO BUS
235398 CKT 1          /* 01ALBRIG 138 01RUTHBL 138

  DISCONNECT BRANCH FROM BUS 235120 TO BUS
235402 CKT 1          /* 01ALBRIG 138 01SNOW T 138

  DISCONNECT BRANCH FROM BUS 235120 TO BUS
934440 CKT 1          /* 01ALBRIG 138 AD1-068 TAP 138

  DISCONNECT BRANCH FROM BUS 235120 TO BUS
235485 CKT 1          /* 01ALBRIG 138 01METTIK 138

  DISCONNECT BRANCH FROM BUS 235120 TO BUS
235492 CKT 1          /* 01ALBRIG 138 01MTZION 138

  END
```

Bus Number	*Bus Name*	*Full Contribution*
237312	*01DANS_S-014*	*10.83*
200890	*26BF_G21_K23*	*9.76*
200891	*26CSLMN_L13*	*0.36*
200840	*26DEEPCRK1*	*0.92*
200841	*26DEEPCRK2*	*0.92*
200835	*26DSGENWIN*	*0.47*
200846	*26FORWARD*	*1.75*
200892	*26LOOKOUT*	*0.35*
202225	*26SCI_S29B*	*0.16*
200889	*26STNY CRK*	*0.23*
200834	*26SW_E13_K22*	*0.28*
200813	*26YOUGH*	*0.37*
932001	*AC2-004 C*	*1.53*
932002	*AC2-004 E*	*10.26*
932981	*AC2-122 C*	*4.41*
932982	*AC2-122 E*	*7.2*
933951	***AD1-018 C***	***1.17***
933952	***AD1-018 E***	***1.91***
934441	*AD1-068 C*	*6.56*
934442	*AD1-068 E*	*38.08*
292340	*K-022*	*0.05*
292350	*K-023*	*0.27*
292542	*L-013 1*	*7.43*
293902	*O-048 E*	*6.69*
294903	*P-060 E*	*4.71*
293432	*R-040 E*	*0.42*
290229	*S-014 E*	*43.32*
291409	*S-029B E*	*0.15*
913141	*Y1-033 C OP1*	*0.27*
913142	*Y1-033 E OP1*	*9.32*
917672	*Z2-108 E*	*4.18*
918331	*AA1-046 C*	*1.35*
918332	*AA1-046 E*	*9.04*
918812	*AA1-100 E*	*1.64*
926991	*AC1-186 C*	*1.36*
926992	*AC1-186 E*	*9.1*

Appendix 4

Flowgate Information: Contingency – Albright-138-South
PJM Queue Position: AD1-018

This appendix contains additional information about the flowgate presented in the body of the report. The intent of this 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.

(PENELEC - PENELEC) The 26ROCKWOOD-26SOMERST 115 kV line (from bus 200746 to bus 200744 ckt 1) loads from 146.81% to 148.5% (**DC power flow**) of its emergency rating (179 MVA) for the bus fault outage of 'AP-P2-2-MP-138-101'. This project contributes approximately 3.01 MW to the thermal violation.

```
CONTINGENCY 'AP-P2-2-MP-138-101'
/* ALBRIGHT-138-SOUTH

  DISCONNECT BRANCH FROM BUS 235120 TO BUS
235320 CKT 1          /* 01ALBRIG 138 01DENVER 138

  DISCONNECT BRANCH FROM BUS 235120 TO BUS
235402 CKT 1          /* 01ALBRIG 138 01SNOW T 138

  DISCONNECT BRANCH FROM BUS 235120 TO BUS
934440 CKT 1          /* 01ALBRIG 138 AD1-068 TAP 138

  DISCONNECT BRANCH FROM BUS 235120 TO BUS
235485 CKT 1          /* 01ALBRIG 138 01METTIK 138

  DISCONNECT BRANCH FROM BUS 235120 TO BUS
235305 CKT 1          /* 01ALBRIG 138 01 106 J 138

  END
```

Bus Number	***Bus Name***	***Full Contribution***
237312	*01DANS_S-014*	*2.69*
237319	*01FMR_U2-030*	*0.17*
235530	*01TR_U2-073A*	*0.43*
235531	*01TR_U2-073A*	*0.19*
236001	*01WARRIOR RN*	*4.95*
200890	*26BF_G21_K23*	*31.64*
200891	*26CSLMN_L13*	*1.18*
200840	*26DEEPCRK1*	*0.96*
200841	*26DEEPCRK2*	*0.96*
200835	*26DSGENWIN*	*1.54*
200892	*26LOOKOUT*	*1.12*
200813	*26YOUGH*	*0.78*
932001	*AC2-004 C*	*4.97*
932002	*AC2-004 E*	*33.26*
932981	*AC2-122 C*	*14.31*
932982	*AC2-122 E*	*23.35*
933951	***AD1-018 C***	***1.14***
933952	***AD1-018 E***	***1.86***
934441	*AD1-068 C*	*4.8*
934442	*AD1-068 E*	*27.84*
292350	*K-023*	*0.89*
292542	*L-013 1*	*24.11*
293902	*O-048 E*	*21.7*
293432	*R-040 E*	*1.36*
290229	*S-014 E*	*10.77*
291409	*S-029B E*	*-0.16*
929522	*U2-030 E*	*5.83*
235098	*U2-073A E*	*14.83*
235099	*U2-073B E*	*6.49*
913141	*Y1-033 C OP1*	*0.71*
913142	*Y1-033 E OP1*	*24.11*
917091	*Z2-013*	*0.17*
917231	*Z2-038 C*	*1.*
917232	*Z2-038 E*	*1.61*
917672	*Z2-108 E*	*13.56*
918812	*AA1-100 E*	*1.54*
923971	*AB2-038*	*0.1*
924001	*AB2-041 C*	*0.45*
924002	*AB2-041 E*	*2.*

Appendix 5

FirstEnergy Contingency Analysis Results
PJM Queue Position: AD1-018

Overloaded Element	Contingency Label	Contingency Description	Rating (MVA)	% Loading	FE Comments/Reinforcements
Rockwood to Somerset 115 kV	'AP-P2-2-MP-138-101'	ALBRIGHT-138-SOUTH	179	157.16	**Proposed Upgrade:** Rebuild the Rockwood-Somerset 115kV Line. Approximately 8.12 miles of 795 ACSS high temperature conductor and substation upgrades at Rockwood substation and Somerset substation
Rockwood to Somerset 115 kV	'AP-P7-1-PE-138-014'	01CUMBRL 138 01SHORTG 138 & 01MESSCK 138 01RIDGLY 138	179	151.00	**Proposed Upgrade:** Rebuild the Rockwood-Somerset 115kV Line. Approximately 8.12 miles of 795 ACSS high temperature conductor and substation upgrades at Rockwood substation and Somerset substation
Carlos Junction to Garret 138 kV	'AP-P2-3-MP-138-150'	ALBRIGHT-BRANDONVILLE 106 JCT. STK BKR AT ALBRIGHT	172*	102.05*	**Proposed Upgrade:** N/A since actual line rating is 206 MVA STE

*Actual line rating 206MVA STE