



Ross County Solar

Exhibit J

Transmission Interconnection Studies

Case No. 20-1380-EL-BGN

***Generation Interconnection
Feasibility Study Report***

For

***PJM Generation Interconnection Request
Queue Position AC2-060***

Buckskin 69kV

September 2017

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. 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 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.

General

The Interconnection Customer (IC) proposes to install PJM Project #AC2-060, a 100.0 MW (64.0 MW Capacity) solar generating facility in Ross County, Ohio (see Figure 1). The point of interconnection is a direct connection to AEP's Buckskin 69 kV substation.

The requested in service date is December 31, 2019.

Attachment Facilities

Primary Point of Interconnection (Buckskin 69kV substation)

To accommodate the interconnection at the Buckskin 69 kV substation, the substation will have to be expanded requiring the installation of two (2) 69 kV circuit breakers (see Figure 1). Installation of associated protection and control equipment, 69 kV line risers, SCADA, and 69 kV revenue metering will also be required.

Direct Connection at the Buckskin 69 kV Substation Work and Cost:

- Expand the substation requiring the installation of two (2) new 69 kV circuit breakers (see Figure 1). Installation of associated protection and control equipment, 69 kV line risers, SCADA, and 69 kV revenue metering will also be required.
- **Estimated Station Cost: \$1,000,000**
- **Note:** The Interconnection Customer may be required to go offline for routine circuit breaker maintenance.

Non-Direct Connection Cost Estimate

The total preliminary cost estimate for Non-Direct Connection work is given in the following table below:

For AEP building Non-Direct Connection cost estimates:

Description	Estimated Cost
69 kV Revenue Metering	\$200,000
Upgrade line protection and controls at the Buckskin 69 kV substation.	\$200,000
Total	\$400,000

Table 1

Interconnection Customer Requirements

It is understood that the IC is responsible for all costs associated with this interconnection. The cost of The IC's generating plant and the costs for the line connecting the generating plant to the Buckskin 69 kV substation are not included in this report; these are assumed to be the IC's responsibility.

The Generation Interconnection Agreement does not in or by itself establish a requirement for American Electric Power to provide power for consumption at the developer's facilities. A separate agreement may be reached with the local utility that provides service in the area to ensure that infrastructure is in place to meet this demand and proper metering equipment is installed. It is the responsibility of the developer to contact the local service provider to determine if a local service agreement is required.

Requirement from the PJM Open Access Transmission Tariff:

1. An Interconnection Customer entering the New Services Queue on or after October 1, 2012 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.
2. The Interconnection Customer may be required to install and/or pay for metering as necessary to properly track real time output of the facility as well as installing metering which shall be used for billing purposes. See Section 8 of Appendix 2 to the Interconnection Service Agreement as well as Section 4 of PJM Manual 14D for additional information.

Revenue Metering and SCADA Requirements

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 the IC's generating Resource. See PJM Manuals M-01 and M-14D, and PJM Tariff Sections 24.1 and 24.2.

AEP Requirements

The Interconnection Customer will be required to comply with all AEP Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the "Requirements for Connection of New Facilities or Changes to Existing Facilities Connected to the AEP Transmission System" document located at the following link:

<http://www.pjm.com/~media/planning/plan-standards/private-aep/aep-interconnection-requirements.ashx>

Network Impacts

The Queue Project AC2-060 was evaluated as a 100.0 MW (Capacity 64.0 MW) injection at the Buckskin 69 kV substation in the AEP area. Project AC2-060 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC2-060 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis – 2020

Contingency Descriptions

The following contingencies resulted in overloads:

Contingency Name	Description
8123	CONTINGENCY '8123' OPEN BRANCH FROM BUS 243453 TO BUS 253110 CKT 1 / 243453 05BEATTY 345 253110 09ADKINS 345 1 OPEN BRANCH FROM BUS 243453 TO BUS 253248 CKT 1 / 243453 05BEATTY 345 253248 09SCHARL 345 1 OPEN BRANCH FROM BUS 243453 TO BUS 243469 CKT 3 / 243453 05BEATTY 345 243469 05BEATTY 138 3 END
160_B3	CONTINGENCY '160_B3' OPEN BRANCH FROM BUS 253110 TO BUS 253100 CKT 1 / 253110 09ADKINS 345 253100 09ATLNTA 345 1 OPEN BRANCH FROM BUS 253100 TO BUS 253099 CKT 1 / 253100 09ATLNTA 345 253099 09ATLNTA 69.0 1 END
2085_C2_05BEATTY 345-304C	CONTINGENCY '2085_C2_05BEATTY 345-304C' OPEN BRANCH FROM BUS 243453 TO BUS 243454 CKT 1 / 243453 05BEATTY 345 243454 05BIXBY 345 1 OPEN BRANCH FROM BUS 243453 TO BUS 253110 CKT 1 / 243453 05BEATTY 345 253110 09ADKINS 345 1 END
5891_B2_TOR607	CONTINGENCY '5891_B2_TOR607' OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1 OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111 09MIDDLE 138 253057 09OHH 138 1 END
6764_B2_TOR5300548	CONTINGENCY '6764_B2_TOR5300548' OPEN BRANCH FROM BUS 246888 TO BUS 242938 CKT 1 / 246888 05BIERSR 345 242938 05MARQUI 345 1 END

Contingency Name	Description
6774_C2_05MARQUI 345-D	<p>CONTINGENCY '6774_C2_05MARQUI 345-D'</p> <p>OPEN BRANCH FROM BUS 246888 TO BUS 242938 CKT 1 / 246888 05BIERSR 345 242938 05MARQUI 345 1</p> <p>OPEN BRANCH FROM BUS 242938 TO BUS 253038 CKT 1 / 242938 05MARQUI 345 253038 09KILLEN 345 1</p> <p>END</p>
6779_C2_05BIERSR 345-D	<p>CONTINGENCY '6779_C2_05BIERSR 345-D'</p> <p>OPEN BRANCH FROM BUS 246888 TO BUS 243454 CKT 1 / 246888 05BIERSR 345 243454 05BIXBY 345 1</p> <p>OPEN BRANCH FROM BUS 246888 TO BUS 246889 CKT 1 / 246888 05BIERSR 345 246889 05BIERSR 138 1</p> <p>END</p>
6781_B3_05BIERSR 345-1	<p>CONTINGENCY '6781_B3_05BIERSR 345-1'</p> <p>OPEN BRANCH FROM BUS 246888 TO BUS 246889 CKT 1 / 246888 05BIERSR 345 246889 05BIERSR 138 1</p> <p>END</p>
7353_B2_TOR12737	<p>CONTINGENCY '7353_B2_TOR12737'</p> <p>OPEN BRANCH FROM BUS 931430 TO BUS 249995 CKT 1 / 243019 05HILLSB 138 249995 08CLINCO 138 1</p> <p>OPEN BRANCH FROM BUS 249995 TO BUS 250122 CKT 1 / 249995 08CLINCO 138 250122 08WARRN1 138 1</p> <p>END</p>
762_B2_TOR8072	<p>CONTINGENCY '762_B2_TOR8072'</p> <p>OPEN BRANCH FROM BUS 243453 TO BUS 253110 CKT 1 / 243453 05BEATTY 345 253110 09ADKINS 345 1</p> <p>END</p>
7954_C1_05MILLBR 138-2_A	<p>CONTINGENCY '7954_C1_05MILLBR 138-2_A'</p> <p>OPEN BRANCH FROM BUS 243042 TO BUS 243088 CKT 1 / 243042 05MILLBR 138 243088 05S POIN 138 1</p> <p>OPEN BRANCH FROM BUS 243042 TO BUS 931350 CKT 1 / 243042 05MILLBR 138 931350 AC2-049 TAP 138 1</p> <p>END</p>
7981_A	<p>CONTINGENCY '7981_A'</p> <p>OPEN BRANCH FROM BUS 243019 TO BUS 931430 CKT 1 / 243019 05HILLSB 138 931430 AC2-061 TAP 138 1</p> <p>OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1</p> <p>OPEN BRANCH FROM BUS 249995 TO BUS 250122 CKT 1 / 249995 08CLINCO 138 250122 08WARRN1 138 1</p> <p>OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111 09MIDDLE 138 253057 09OHH 138 1</p> <p>END</p>

Contingency Name	Description
7981_B	<p>CONTINGENCY '7981_B'</p> <p>OPEN BRANCH FROM BUS 931430 TO BUS 249995 CKT 1 / 931430 AC2-061 TAP 138 249995 08CLINCO 138 1</p> <p>OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1</p> <p>OPEN BRANCH FROM BUS 249995 TO BUS 250122 CKT 1 / 249995 08CLINCO 138 250122 08WARRN1 138 1</p> <p>OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111 09MIDDLE 138 253057 09OHH 138 1</p> <p>END</p>
8108_C2_05HILLSB 138-D_A	<p>CONTINGENCY '8108_C2_05HILLSB 138-D_A'</p> <p>OPEN BRANCH FROM BUS 243019 TO BUS 931430 CKT 1 / 243019 05HILLSB 138 931430 AC2-061 TAP 138 1</p> <p>OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1</p> <p>OPEN BRANCH FROM BUS 249995 TO BUS 250122 CKT 1 / 249995 08CLINCO 138 250122 08WARRN1 138 1</p> <p>OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111 09MIDDLE 138 253057 09OHH 138 1</p> <p>END</p>
8109_C2_05HILLSB 138-A_A	<p>CONTINGENCY '8109_C2_05HILLSB 138-A_A'</p> <p>OPEN BRANCH FROM BUS 243019 TO BUS 243102 CKT 1 / 243019 05HILLSB 138 243102 05SINKG8 138 1</p> <p>OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1</p> <p>OPEN BRANCH FROM BUS 931350 TO BUS 243102 CKT 1 / 931350 AC2-049 TAP 138 243102 05SINKG8 138 1</p> <p>OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111 09MIDDLE 138 253057 09OHH 138 1</p> <p>END</p>
8111_C2_05HILLSB 138-A	<p>CONTINGENCY '8111_C2_05HILLSB 138-A'</p> <p>OPEN BRANCH FROM BUS 243019 TO BUS 926100 CKT 1 / 243019 05HILLSB 138 926100 AC1-089 TAP 138 1</p> <p>OPEN BRANCH FROM BUS 243019 TO BUS 931430 CKT 1 / 243019 05HILLSB 138 931430 AC2-060 TAP 138 1</p> <p>END</p>
8126_A	<p>CONTINGENCY '8126_A'</p> <p>OPEN BRANCH FROM BUS 246889 TO BUS 931410 CKT 1 / 246889 05BIERSR 138 931410 AC2-059 TAP 138 1</p> <p>OPEN BRANCH FROM BUS 246889 TO BUS 246890 CKT 1 / 246889 05BIERSR 138 246890 05HOPETN 138 1</p> <p>END</p>
8126_B	<p>CONTINGENCY '8126_B'</p> <p>OPEN BRANCH FROM BUS 931410 TO BUS 243483 CKT 1 / 931410 AC2-059 TAP 138 243483 05CRCLVS 138 1</p>

Contingency Name	Description
	OPEN BRANCH FROM BUS 246889 TO BUS 246890 CKT 1 / 246889 05BIERSR 138 246890 05HOPETN 138 1 END
889_B2	CONTINGENCY '889_B2' OPEN BRANCH FROM BUS 253100 TO BUS 253077 CKT 1 / 253100 09ATLNTA 345 253077 09STUART 345 1 END
DAY_L34552-2	CONTINGENCY 'DAY_L34552-2' OPEN LINE FROM BUS 253077 TO BUS 253100 CKT 1 /* 09STUART 345 - 09ATLNTA 345 REMOVE UNIT 2 FROM BUS 253077 /* 09STUART 345 END
OUTAGE_02AB	CONTINGENCY 'OUTAGE_02AB' DISCONNECT BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 END
P1-#..B2 WARREN-CLINTONCO-HILLSBORO 2381	CONTINGENCY 'P1-#..B2 WARREN-CLINTONCO-HILLSBORO 2381' OPEN BUS 249995 END
P2-1..LOE BRKR OPEN AT HILLSBORO AEP 2381	CONTINGENCY 'P2-1..LOE BRKR OPEN AT HILLSBORO AEP 2381' OPEN BRANCH FROM BUS 249995 TO BUS 931430 CKT 1 END

Table 2

Generator Deliverability

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

AC2-060 Generator Deliverability														
Contingency			Affected Area	Facility Description	Bus		Cir.	PF	Loading		Rating		MW Con.	FG App.
#	Type	Name			From	To			Initial	Final	Type	MVA		
1	Non	Non	AEP - DEO&K	05HILLSB-AC2-061 TAP 138 kV line	243019	931430	1	DC	91.15	93.29	NR	159	3.41	
2	N-1	6781_B3_05BIERSR 345-1	AEP - AEP	05LATTAVL8-05BIERSRUN 69 kV line	243608	246893	1	DC	40.7	82.34	ER	50	20.82	
3	N-1	6764_B2_TOR5300548	AEP - AEP	05LATTAVL8-05BIERSRUN 69 kV line	243608	246893	1	DC	31.21	74.71	ER	50	21.75	
4	N-1	5891_B2_TOR607	DEO&K - DEO&K	08CLINCO-08WARRN1 138 kV line	249995	250122	1	DC	79.18	81.19	ER	198	3.97	
5	N-1	OUTAGE_02AB	DEO&K - DEO&K	08CLINCO-08WARRN1 138 kV line	249995	250122	1	DC	78.58	80.58	ER	198	3.97	
6	N-1	7353_B2_TOR12737	AEP - AEP	AC2-049 TAP-05MILLBR 138 kV line	931350	243042	1	DC	83.71	86.19	ER	179	4.44	
7	N-1	P1-#..B2 WARREN-CLINTONCO-HILLSBORO 2381	AEP - AEP	AC2-049 TAP-05MILLBR 138 kV line	931350	243042	1	DC	83.71	86.19	ER	179	4.44	
8	Non	Non	DEO&K - DEO&K	AC2-061 TAP-08CLINCO 138 kV line	931430	249995	1	DC	91.08	93.22	NR	159	3.41	

Table 3**Multiple Facility Contingency**

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

AC2-060 Multiple Facility Contingency														
#	Type	Contingency Name	Affected Area	Facility Description	Bus			PF	Loading		Rating	MW	FG	
					From	To	Cir.		Initial	Final	Type	Con.	App.	
1	DCTL	8123	AEP - AEP	05BCKSKI-05LATTAVL8 69 kV line	243598	243608	1	DC	47.51	82.09	ER	100	34.58	1
2	LFFB	6774_C2_05MARQUI 345-D	AEP - AEP	05BCKSKI-05LATTAVL8 69 kV line	243598	243608	1	DC	42.5	76.51	ER	100	34.01	
3	LFFB	6779_C2_05BIERSR 345-D	AEP - AEP	05BCKSKI-05LATTAVL8 69 kV line	243598	243608	1	DC	44.17	76.7	ER	100	32.53	
4	LFFB	DAY L34552-2	AEP - AEP	05BCKSKI-AC2-020 TAP 69 kV line	243598	931130	1	DC	61.62	108.24	ER	72	33.57	2
5	LFFB	2085_C2_05BEATTY 345-304C	AEP - AEP	05BCKSKI-AC2-055 TAP 69 kV line	243598	931380	1	DC	27.7	92.07	ER	50	32.19	3
6	DCTL	8123	AEP - AEP	05LATTAVL8-05BIERSRUN 69 kV line	243608	246893	1	DC	85.82	154.98	ER	50	34.58	4
7	LFFB	6774_C2_05MARQUI 345-D	AEP - AEP	05LATTAVL8-05BIERSRUN 69 kV line	243608	246893	1	DC	75.6	143.61	ER	50	34.01	
8	LFFB	6779_C2_05BIERSR 345-D	AEP - AEP	05LATTAVL8-05BIERSRUN 69 kV line	243608	246893	1	DC	79.15	144.21	ER	50	32.53	
9	LFFB	2085_C2_05BEATTY 345-304C	AEP - AEP	05PETERSB8-05HIGHLA 69 kV line	243612	243606	1	DC	59.18	114.46	ER	50	32.19	5
10	DCTL	7981_B	AEP - AEP	05HIGHLA-05NMARSS 138 kV line	246911	247035	1	DC	88.31	89.43	ER	310	7.72	6
11	DCTL	7981_B	AEP - AEP	05NMARSS-05SEAMAN 138 kV line	247035	243571	1	DC	84.92	86.04	ER	310	7.72	7
12	LFFB	DAY L34552-2	AEP - DAY	AC2-020 TAP-09GRNFLD 69 kV line	931130	253030	1	DC	59.91	106.53	ER	72	33.57	8
13	LFFB	2085_C2_05BEATTY 345-304C	AEP - AEP	AC2-055 TAP-05PETERSB8 69 kV line	931380	243612	1	DC	66.15	130.52	ER	50	32.19	9

Table 4**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)

AC2-060 Contribution to Previously Identified Overloads														
#	Type	Contingency Name	Affected Area	Facility Description	Bus			PF	Loading		Rating	MW	FG	
					From	To	Cir.		Initial	Final	Type	Con.	App.	
1	DCTL	7981_B	AEP - AEP	05HILLSB-05SINKG8 138 kV line	243019	243102	1	DC	213.55	215.59	ER	185	8.38	10
2	LFFB	8108_C2_05HILLSB	AEP - AEP	05HILLSB-05SINKG8	243019	243102	1	DC	213.55	215.59	ER	185	8.38	

AC2-060 Contribution to Previously Identified Overloads														
#	Type	Contingency Name	Affected Area	Facility Description	Bus			PF	Loading		Rating		MW Con.	FG App.
					From	To	Cir.		Initial	Final	Type	MVA		
		138-D_A		138 kV line										
3	DCTL	7981_A	AEP - AEP	05HILLSB-05SINKG8 138 kV line	243019	243102	1	DC	213.55	215.59	ER	185	8.38	
4	LFFB	8111_C2_05HILLSB 138-A_A	AEP - DAY	05HILLSB-09MIDDLE 138 kV line	243019	253111	1	DC	160.39	161.76	ER	185	5.65	11
5	DCTL	7981_B	AEP - AEP	05HILLSB-AC1-089 TAP 138 kV line	243019	926100	1	DC	124.92	126.55	ER	185	6.67	12
6	LFFB	8108_C2_05HILLSB 138-D_A	AEP - AEP	05HILLSB-AC1-089 TAP 138 kV line	243019	926100	1	DC	124.92	126.55	ER	185	6.67	
7	DCTL	7981_A	AEP - AEP	05HILLSB-AC1-089 TAP 138 kV line	243019	926100	1	DC	124.92	126.55	ER	185	6.67	
8	LFFB	8109_C2_05HILLSB 138-A_A	AEP - DEO&K	05HILLSB-AC2-061 TAP 138 kV line	243019	931430	1	DC	236.98	239.04	ER	184	8.4	13
9	BUS	7954_C1_05MILLBR 138-2_A	AEP - DEO&K	05HILLSB-AC2-061 TAP 138 kV line	243019	931430	1	DC	190.31	191.99	ER	184	6.87	
10	N-1	5891_B2_TOR607	AEP - DEO&K	05HILLSB-AC2-061 TAP 138 kV line	243019	931430	1	DC	100.64	102.8	ER	184	3.97	
11	N-1	OUTAGE_02AB	AEP - DEO&K	05HILLSB-AC2-061 TAP 138 kV line	243019	931430	1	DC	100.04	102.2	ER	184	3.97	
12	DCTL	7981_B	AEP - AEP	05SINKG8-AC2-049 TAP 138 kV line	243102	931350	1	DC	218.75	220.86	ER	179	8.38	14
13	LFFB	8108_C2_05HILLSB 138-D_A	AEP - AEP	05SINKG8-AC2-049 TAP 138 kV line	243102	931350	1	DC	218.75	220.86	ER	179	8.38	
14	DCTL	7981_A	AEP - AEP	05SINKG8-AC2-049 TAP 138 kV line	243102	931350	1	DC	218.75	220.86	ER	179	8.38	
15	DCTL	7981_B	AEP - AEP	05ADAMS- 05WARERD 138 kV line	243464	246942	1	DC	154.53	156.26	ER	150	5.79	15
16	LFFB	8109_C2_05HILLSB 138-A_A	AEP - AEP	05ADAMS- 05WARERD 138 kV line	243464	246942	1	DC	152.33	154.12	ER	150	5.95	
17	LFFB	8108_C2_05HILLSB 138-D_A	AEP - AEP	05ADAMS- 05WARERD 138 kV line	243464	246942	1	DC	154.59	156.33	ER	150	5.79	
18	DCTL	7981_A	AEP - AEP	05ADAMS- 05WARERD 138 kV line	243464	246942	1	DC	154.59	156.33	ER	150	5.79	
19	BUS	7954_C1_05MILLBR 138-2_A	AEP - AEP	05ADAMS- 05WARERD 138 kV line	243464	246942	1	DC	127.17	128.75	ER	150	5.25	
20	DCTL	7981_B	AEP - AEP	05SEAMAN- 05ADAMS 138 kV line	243571	243464	1	DC	141.13	142.85	ER	150	5.74	16
21	LFFB	8109_C2_05HILLSB 138-A_A	AEP - AEP	05SEAMAN- 05ADAMS 138 kV line	243571	243464	1	DC	138.01	139.77	ER	150	5.87	
22	LFFB	8108_C2_05HILLSB 138-D_A	AEP - AEP	05SEAMAN- 05ADAMS 138 kV line	243571	243464	1	DC	141.13	142.85	ER	150	5.74	
23	DCTL	7981_A	AEP - AEP	05SEAMAN- 05ADAMS 138 kV line	243571	243464	1	DC	141.13	142.85	ER	150	5.74	
24	BUS	7954_C1_05MILLBR 138-2_A	AEP - AEP	05SEAMAN- 05ADAMS 138 kV line	243571	243464	1	DC	113.99	115.55	ER	150	5.18	
25	DCTL	7981_B	AEP - DAY	05HIGHLA- 09MRTNSV 69 kV line	243606	253043	1	DC	114.9	120.48	ER	71	8.79	17
26	LFFB	8108_C2_05HILLSB 138-D_A	AEP - DAY	05HIGHLA- 09MRTNSV 69 kV line	243606	253043	1	DC	114.9	120.48	ER	71	8.79	
27	DCTL	7981_A	AEP - DAY	05HIGHLA- 09MRTNSV 69 kV line	243606	253043	1	DC	114.9	120.48	ER	71	8.79	
28	DCTL	8126_B	AEP - AEP	05BIERSRUN- 05SLATE 69 kV line	246893	243617	1	DC	125.28	133.07	ER	50	8.65	18

AC2-060 Contribution to Previously Identified Overloads														
	Contingency		Affected Area	Facility Description	Bus				Loading		Rating		MW Con.	FG App.
#	Type	Name			From	To	Cir.	PF	Initial	Final	Type	MVA		
29	DCTL	8126_A	AEP - AEP	05BIERSRUN-05SLATE 69 kV line	246893	243617	1	DC	117.81	125.6	ER	50	8.65	
30	DCTL	7981_B	AEP - AEP	05WARERD-05WAVERL 138 kV line	246942	243585	1	DC	144.33	146.06	ER	150	5.79	19
31	LFFB	8109_C2_05HILLSB 138-A_A	AEP - AEP	05WARERD-05WAVERL 138 kV line	246942	243585	1	DC	142.13	143.92	ER	150	5.95	
32	LFFB	8108_C2_05HILLSB 138-D_A	AEP - AEP	05WARERD-05WAVERL 138 kV line	246942	243585	1	DC	144.39	146.13	ER	150	5.79	
33	DCTL	7981_A	AEP - AEP	05WARERD-05WAVERL 138 kV line	246942	243585	1	DC	144.39	146.13	ER	150	5.79	
34	BUS	7954_C1_05MILLBR 138-2_A	AEP - AEP	05WARERD-05WAVERL 138 kV line	246942	243585	1	DC	116.97	118.55	ER	150	5.25	
35	DCTL	7981_B	AEP - AEP	05WLDCAT-05EMERSS 138 kV line	246946	247034	1	DC	152.54	154.17	ER	185	6.67	20
36	LFFB	8108_C2_05HILLSB 138-D_A	AEP - AEP	05WLDCAT-05EMERSS 138 kV line	246946	247034	1	DC	152.54	154.17	ER	185	6.67	
37	DCTL	7981_A	AEP - AEP	05WLDCAT-05EMERSS 138 kV line	246946	247034	1	DC	152.54	154.17	ER	185	6.67	
38	DCTL	7981_B	AEP - AEP	05EMERSS-AC2-062 TAP 138 kV line	247034	931440	1	DC	150.54	152.17	ER	185	6.67	21
39	LFFB	8108_C2_05HILLSB 138-D_A	AEP - AEP	05EMERSS-AC2-062 TAP 138 kV line	247034	931440	1	DC	150.54	152.17	ER	185	6.67	
40	DCTL	7981_A	AEP - AEP	05EMERSS-AC2-062 TAP 138 kV line	247034	931440	1	DC	150.54	152.17	ER	185	6.67	
41	LFFB	8109_C2_05HILLSB 138-A_A	DEO&K - DEO&K	08CLINCO-08WARRN1 138 kV line	249995	250122	1	DC	206.71	208.62	ER	198	8.4	22
42	BUS	7954_C1_05MILLBR 138-2_A	DEO&K - DEO&K	08CLINCO-08WARRN1 138 kV line	249995	250122	1	DC	163.05	164.61	ER	198	6.87	
43	LFFB	8111_C2_05HILLSB 138- A	DAY - DAY	09MIDDLE-09OHH 138 kV line	253111	253057	1	DC	158.12	159.49	ER	185	5.65	23
44	DCTL	7981_B	AEP - AEP	AC1-089 TAP-05WLDCAT 138 kV line	926100	246946	1	DC	153.63	155.25	ER	185	6.67	24
45	LFFB	8108_C2_05HILLSB 138-D_A	AEP - AEP	AC1-089 TAP-05WLDCAT 138 kV line	926100	246946	1	DC	153.63	155.25	ER	185	6.67	
46	DCTL	7981_A	AEP - AEP	AC1-089 TAP-05WLDCAT 138 kV line	926100	246946	1	DC	153.63	155.25	ER	185	6.67	
47	DCTL	7981_B	AEP - AEP	AC2-049 TAP-05MILLBR 138 kV line	931350	243042	1	DC	237.4	239.51	ER	179	8.38	25
48	LFFB	8108_C2_05HILLSB 138-D_A	AEP - AEP	AC2-049 TAP-05MILLBR 138 kV line	931350	243042	1	DC	237.4	239.51	ER	179	8.38	
49	DCTL	7981_A	AEP - AEP	AC2-049 TAP-05MILLBR 138 kV line	931350	243042	1	DC	237.4	239.51	ER	179	8.38	
50	LFFB	8109_C2_05HILLSB 138-A_A	DEO&K - DEO&K	AC2-061 TAP-08CLINCO 138 kV line	931430	249995	1	DC	236.98	239.04	ER	184	8.4	26
51	BUS	7954_C1_05MILLBR 138-2_A	DEO&K - DEO&K	AC2-061 TAP-08CLINCO 138 kV line	931430	249995	1	DC	190.31	191.99	ER	184	6.87	
52	N-1	5891_B2 TOR607	DEO&K - DEO&K	AC2-061 TAP-08CLINCO 138 kV line	931430	249995	1	DC	100.64	102.8	ER	184	3.97	
53	N-1	OUTAGE_02AB	DEO&K - DEO&K	AC2-061 TAP-08CLINCO 138 kV line	931430	249995	1	DC	100.04	102.2	ER	184	3.97	

AC2-060 Contribution to Previously Identified Overloads														
#	Contingency		Affected Area	Facility Description	Bus		Cir.	PF	Loading		Rating Type	MVA	MW Con.	FG App.
	Type	Name			From	To			Initial	Final				
54	DCTL	7981_B	AEP - LGEE	AC2-062 TAP-4KENTON 138 kV line	931440	324267	1	DC	149.84	151.46	ER	185	6.67	27
55	LFFB	8108_C2_05HILLSB 138-D_A	AEP - LGEE	AC2-062 TAP-4KENTON 138 kV line	931440	324267	1	DC	149.84	151.46	ER	185	6.67	
56	DCTL	7981_A	AEP - LGEE	AC2-062 TAP-4KENTON 138 kV line	931440	324267	1	DC	149.84	151.46	ER	185	6.67	

Table 5

Steady-State Voltage Requirements

None

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

None

Affected System Analysis & Mitigation

LGEE Impacts:

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

MISO Impacts:

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

Duke, Progress & TVA Impacts:

Duke Carolina, Progress, & TVA Impacts to be determined during later study phases (as applicable).

OVEC Impacts:

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

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.

AC2-060 Delivery of Energy Portion of Interconnection Request														
Contingency			Affected Area	Facility Description	Bus		Loading		Rating		MW Con.	FG App.		
#	Type	Name			From	To	Cir.	PF	Initial	Final			Type	MVA
1	N-1	7353_B2_TOR12737	AEP - AEP	05HILLSB-05SINKG8 138 kV line	243019	243102	1	DC	160.77	162.46	ER	185	6.93	
2	N-1	5891_B2_TOR607	AEP - DEO&K	05HILLSB-AC2-061 TAP 138 kV line	243019	931430	1	DC	186.14	187.66	ER	184	6.2	
3	Non	Non	AEP - DEO&K	05HILLSB-AC2-061 TAP 138 kV line	243019	931430	1	DC	175.59	177.1	NR	159	5.32	
4	N-1	7353_B2_TOR12737	AEP - AEP	05SINKG8-AC2-049 TAP 138 kV line	243102	931350	1	DC	164.15	165.89	ER	179	6.93	
5	N-1	P1-#..B2 WARREN-CLINTONCO-HILLSBORO 2381	AEP - AEP	05ADAMS-05WARERD 138 kV line	243464	246942	1	DC	123.64	125.17	ER	150	5.09	
6	N-1	7353_B2_TOR12737	AEP - AEP	05SEAMAN-05ADAMS 138 kV line	243571	243464	1	DC	111.32	112.84	ER	150	5.05	
7	N-1	6781_B3_05BIERSR 345-1	AEP - AEP	05BCKSKI-05LATTAVL8 69 kV line	243598	243608	1	DC	43.67	76.2	ER	100	32.53	
8	N-1	889_B2	AEP - AEP	05BCKSKI-AC2-020 TAP 69 kV line	243598	931130	1	DC	61.34	107.96	ER	72	33.57	
9	N-1	762_B2_TOR8072	AEP - AEP	05BCKSKI-AC2-055 TAP 69 kV line	243598	931380	1	DC	27.3	91.68	ER	50	32.19	
10	N-1	7353_B2_TOR12737	AEP - DAY	05HIGHLA-09MRTNSV 69 kV line	243606	253043	1	DC	87.45	92.77	ER	71	8.4	
11	N-1	6781_B3_05BIERSR 345-1	AEP - AEP	05LATTAVL8-05BIERSRUN 69 kV line	243608	246893	1	DC	78.15	143.21	ER	50	32.53	
12	N-1	762_B2_TOR8072	AEP - AEP	05PETERSB8-05HIGHLA 69 kV line	243612	243606	1	DC	59.33	114.32	ER	50	32.19	
13	N-1	P1-#..B2 WARREN-CLINTONCO-HILLSBORO 2381	AEP - AEP	05WARERD-05WAVERL 138 kV line	246942	243585	1	DC	113.44	114.97	ER	150	5.09	
14	N-1	7353_B2_TOR12737	AEP - AEP	05WLDCAT-05EMERSS 138 kV line	246946	247034	1	DC	108.68	110	ER	185	5.45	
15	N-1	7353_B2_TOR12737	AEP - AEP	05EMERSS-AC2-062 TAP 138 kV line	247034	931440	1	DC	106.68	108	ER	185	5.45	
16	N-1	5891_B2_TOR607	DEO&K - DEO&K	08CLINCO-08WARRN1 138 kV line	249995	250122	1	DC	159.14	160.55	ER	198	6.2	
17	Non	Non	DAY - DAY	09GRNFLD-09WASHCH 69 kV line	253030	253091	1	DC	32.09	74.06	NR	80	33.62	
18	N-1	160_B3	DAY - DAY	09TEXTAP-09JFFRTP 69 kV line	253081	253163	1	DC	87.35	104.72	ER	96	16.68	
19	N-1	160_B3	DAY - DAY	09WASHCH-09TEXTAP 69 kV line	253091	253081	1	DC	85.56	102.58	ER	98	16.68	
20	N-1	P2-1..LOE BRKR OPEN AT HILLSBORO AEP 2381	AEP - AEP	AC1-089 TAP-05WLDCAT 138 kV line	926100	246946	1	DC	110	111.32	ER	185	5.45	
21	N-1	889_B2	AEP - DAY	AC2-020 TAP-09GRNFLD 69 kV line	931130	253030	1	DC	59.63	106.25	ER	72	33.57	
22	N-1	7353_B2_TOR12737	AEP - AEP	AC2-049 TAP-05MILLBR 138 kV line	931350	243042	1	DC	181.38	183.13	ER	179	6.93	

AC2-060 Delivery of Energy Portion of Interconnection Request														
#	Type	Contingency	Affected Area	Facility Description	Bus		Cir.	PF	Loading		Type	Rating MVA	MW Con.	FG App.
		Name			From	To			Initial	Final				
23	N-1	762 B2 TOR8072	AEP - AEP	AC2-055 TAP-05PETERSB8 69 kV line	931380	243612	1	DC	65.75	130.13	ER	50	32.19	
24	N-1	5891 B2 TOR607	DEO&K - DEO&K	AC2-061 TAP-08CLINCO 138 kV line	931430	249995	1	DC	186.14	187.66	ER	184	6.2	
25	Non	Non	DEO&K - DEO&K	AC2-061 TAP-08CLINCO 138 kV line	931430	249995	1	DC	175.53	177.04	NR	159	5.32	
26	N-1	P1-#..B2 WARREN-CLINTONCO-HILLSBORO 2381	AEP - LGEE	AC2-062 TAP-4KENTON 138 kV line	931440	324267	1	DC	105.59	106.92	ER	185	5.45	

Table 6

New System Reinforcements

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

Violation #	Overloaded Facility	Upgrade Description	Schedule	Estimated Cost
#1	05HIGHLA-05NMARSS 138 kV line	Rebuild/reconductor 3.10 miles of the ACSR 636 26/7 conductor section 2. Note: This facility is not overloaded by the AC2-060 project as is shown in table 4 above but the AC2 Queue overloads this facility and the AC2-060 project contributes to the overload.	An approximate construction time would be 24 to 36 months after signing an interconnection agreement.	\$4,700,000
#2	05NMARSS-05SEAMAN 138 kV line	Rebuild/reconductor 13.20 miles of the ACSR 636 26/7 conductor section 1. Note: This facility is not overloaded by the AC2-060 project as is shown in table 4 above but the AC2 Queue overloads this facility and the AC2-060 project contributes to the overload.	An approximate construction time would be 24 to 36 months after signing an interconnection agreement.	\$19,800,000
Total New Network Upgrades				\$24,500,000

Table 7

The System Reinforcements listed below are not part of the Bulk Electric System (BES), but were identified by AEP and will be required for the interconnection of AC2-060.

#	Overloaded Facility	Upgrade Description	Schedule	Estimated Cost
#1	05BCKSKI-05LATTAVL8 69 kV line	Rebuild/reconductor 12.0 miles of the ACSR 556.5 18/1 conductor section 1. Note: This facility is not overloaded by the AC2-060 project as is shown in table 4 above but the AC2 Queue overloads this facility and the AC2-060 project contributes to the overload.	An approximate construction time would be 24 to 36 months after signing an interconnection agreement.	\$14,400,000
#2	05BCKSKI-AC2-020 TAP 69 kV line	Non AEP conductor is the limiting this line. This is an AEP- Dayton Power & Light tie line therefore; PJM is going to have to coordinate this upgrade with DP&L.	To be provided by DP&L	To be provided by DP&L
#3	05BCKSKI-AC2-055 69 kV line	3.0 miles of ACSR 211.6.4 6/1 conductor section 4 will need to be rebuilt/reconductored.	An approximate construction time would be 24 to 36 months after signing an interconnection agreement	\$3,600,000
#3	05LATTAVL8-05BIERSRUN 69 kV line	Rebuild/reconductor 12.3 miles of the ACSR 211.6 6/1 Penguin (4/0) conductor section 1. Conduct an engineering study will to determine if the Relay Compliance Trip limits settings can be adjusted.	An approximate construction time would be 24 to 36 months after signing an interconnection agreement.	\$14,800,000
#4	05HIGHLA-05PETERSB8 69 kV line	10.0 miles of ACSR 336.4 30/7 conductor section 1 will need to be rebuilt/reconductored.	An approximate construction time would be 24 to 36 months after signing an interconnection agreement	\$12,000,000
#5	05PETERSB8-AC2-055 69 kV line	16.4 miles of ACSR 211.6.4 6/1 conductor section 1 will need to be rebuilt/reconductored.	An approximate construction time would be 24 to 36 months after signing an interconnection agreement	\$7,680,000
#6	AC2-020 TAP-09GRNFLD 69 kV line	Non AEP conductor is the limiting this line. This is an AEP- Dayton Power & Light tie line therefore; PJM is going to have to coordinate this upgrade with DP&L.	To be provided by DP&L	To be provided by DP&L
			Total Network Upgrades	\$48,880,000

Table 8

Previous System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, identified for earlier generation or transmission interconnection projects in the PJM Queue)

Violation #	Overloaded Facility	Upgrade Description	Schedule	Estimated Cost
#1	05HILLSB-05SINKG8 138 kV line	<p>Rebuild/Reconductor 4.36 miles of ACSR 477 26/7 conductor section 1.</p> <p>An engineering study will need to be conducted to determine if the Relay Compliance Trip limits settings can be adjusted to mitigate the overload.</p> <p>Replace the Sinking Springs jumpers.</p> <p>Replace the Sinking Spring Switch (1200A)</p> <p>Rebuild/Reconductor 8.93 miles of ACSR 477 26/7 conductor section 2.</p>	An approximate construction time would be 24 to 36 months after signing an interconnection agreement.	\$20,500,000
#2	05HILLSB-09MIDDLE 138 kV line	<p>22.3 miles of the ACSR 477 26/7 conductor section 1 will need to be rebuilt/reconducted.</p> <p>An engineering study will need to be conducted to determine if the Relay Compliance Trip limits settings at Hillsboro can be adjusted to mitigate the overload.</p>	An approximate construction time would be 24 to 36 months after signing an interconnection agreement	\$33,450,000
#3	05HILLSB-AC1-089 TAP 138 kV line	Rebuild/reconductor 8.0 miles of the ACSR 477 26/7 conductor section 1.	An approximate construction time would be 24 to 36 months after signing an interconnection agreement.	\$12,000,000
#4	05HILLSB-AC2-061 TAP 138 kV line	<p>Rebuild/reconductor 5.0 miles of the ACSR 477 26/7 conductor section 1.</p> <p>Conduct an engineering study will to determine if the Relay Compliance Trip limits settings at Hillsboro can be adjusted.</p>	An approximate construction time would be 24 to 36 months after signing an interconnection agreement.	\$7,500,000
#5	05SINKG8-AC2-049 TAP 138 kV line	<p>Conduct an engineering study will to determine if the Relay Compliance Trip limits settings at Millbrook Park can be adjusted.</p> <p>Rebuild/reconductor 20.37 miles of the ACSR 477 26/7 conductor section 3.</p> <p>Replace the Millbrook Park line riser.</p> <p>Replace the Millbrook Park Bus and Risers.</p> <p>Replace the Millbrook Park Trap Riser.</p> <p>Replace the Sinking Spring switch (1200A).</p>	An approximate construction time would be 24 to 36 months after signing an interconnection agreement.	\$31,800,000

Violation #	Overloaded Facility	Upgrade Description	Schedule	Estimated Cost
		<p>A Sag Study will be required on the 20.37 mile ACSR 477 26/7 conduction section 2.</p> <p>A Sag Study will be required on the 20.37 mile ACSR 477 26/7 conduction section 1.</p> <p>Conduct an engineering study will to determine if the Thermal limit settings at Millbrook Park can be adjusted.</p>		
#6	05ADAMS-05WARERD 138 kV line	Rebuild/reconductor 20.50 miles of the ACSR 336.4 30/7 conductor section 1.	An approximate construction time would be 24 to 36 months after signing an interconnection agreement.	\$30,780,000
#7	05SEAMAN-05ADAMS 138 kV line	Rebuild/reconductor 20.50 miles of the ACSR 336.4 30/7 conductor section 1.	An approximate construction time would be 24 to 36 months after signing an interconnection agreement.	\$12,000,000
#8	05WARERD-05WAVERL 138 kV line	<p>Rebuild/reconductor 3.12 miles of the ACSR 336.4 30/7 conductor section 1.</p> <p>Rebuild/reconductor 4.37 miles of the ACSR 336.4 30/7 conductor section 2.</p>	An approximate construction time would be 24 to 36 months after signing an interconnection agreement.	\$11,240,000
#9	05WLDCAT-05EMERSS 138 kV line	<p>Rebuild/reconductor 1.3 miles of the ACSR 477 26/7 conductor section 1.</p> <p>Conduct an engineering study will to determine if the Relay Compliance Trip limits settings at Hillsboro can be adjusted.</p>	An approximate construction time would be 24 to 36 months after signing an interconnection agreement.	\$2,025,000
#10	05EMERSS-AC2-062 TAP 138 kV line	Rebuild/reconductor 6.4 miles of the ACSR 477 26/7 conductor section 1.	An approximate construction time would be 24 to 36 months after signing an interconnection agreement.	\$9,600,000
#11	AC1-089 TAP-05WLDCAT 138 kV line	Rebuild/reconductor 10.0 miles of the ACSR 477 26/7 conductor section 1.	An approximate construction time would be 24 to 36 months after signing an interconnection agreement.	\$15,000,000
#12	05AC2-049 Tap-05MILLBR 138 kV line	<p>An engineering study will need to be conducted to determine if the Relay Compliance Trip limit settings can be adjusted at Millbrook Park to mitigate the overload.</p> <p>8.50 miles of ACSR 477 26/7 conductor section 3 will need to be rebuilt/reconducted.</p> <p>Replace the Millbrook Park line risers</p> <p>Replace the Millbrook Park bus and risers</p> <p>Replace the Millbrook Park trap riser</p>	An approximate construction time would be 24 to 36 months after signing an interconnection agreement	\$59,100,000

Violation #	Overloaded Facility	Upgrade Description	Schedule	Estimated Cost
		<p>Replace the Sinking Spring switch (1200A)</p> <p>20.4 miles of ACSR 477 26/7 conductor section 2 will need to be rebuilt/reconductored.</p> <p>9.8 miles of ACSR 477 26/7 conductor section 1 will need to be rebuilt/reconductored.</p> <p>An engineering study will need to be conducted to determine if the Relay Thermal limits settings can be adjusted at Millbrook Park to mitigate the overload.</p> <p>Replace the Hillsboro Wavetrap (2000A)</p>		
#13	AC2-061 TAP-08CLINCO 138 kV line	<p>Rebuild/reconductor 5.0 miles of the ACSR 477 26/7 conductor section 1.</p> <p>Conduct an engineering study will to determine if the Relay Compliance Trip limits settings at Hillsboro can be adjusted.</p>	An approximate construction time would be 24 to 36 months after signing an interconnection agreement.	\$7,525,000
#14	AC2-062 TAP-4KENTON 138 kV line	<p>Rebuild/reconductor 18.0 miles of the ACSR 477 26/7 conductor section 1.</p> <p>Replace the Emerald SS Jumpers</p>	An approximate construction time would be 24 to 36 months after signing an interconnection agreement.	\$27,050,000
			Total Previous Network Upgrades	\$279,570,000

Table 9

The System Reinforcements listed below are not part of the Bulk Electric System (BES), but were identified by AEP and will be required for the interconnection of AC2-060.

#	Overloaded Facility	Upgrade Description	Schedule	Estimated Cost
#1	05HIGHLA-09MRTNSV 69 kV line	Conduct an engineering study will to determine if the Thermal limit settings at Highland can be adjusted. Replace the Highland switch (1200A). Conduct an engineering study will to determine if the Relay Compliance Trip limits settings at Highland can be adjusted.	An approximate construction time would be 24 to 36 months after signing an interconnection agreement.	\$250,000
#2	05BIERSRUN-05SLATE 69 kV line	Rebuild/reconductor 5.0 miles of the ACSR 211.6 6/1 Penguin (4/0) conductor section 1.	An approximate construction time would be 24 to 36 months after signing an interconnection agreement.	\$6,000,000
			Total Network Upgrades	\$6,250,000

Table 10

Schedule

It is anticipated that the time between receipt of executed agreements and Commercial Operation may range from 12 to 18 months if no line work is required. If line work is required, construction time would be between 24 to 36 months after signing an interconnection agreement.

Note: The time provided between anticipated normal completion of System Impact, Facilities Studies, subsequent execution of ISA and ICSA documents, and the proposed In-Service Date is shorter than usual and may be difficult to achieve.

Conclusion

Based upon the results of this Feasibility Study, the construction of the 100.0 MW (64.0 MW Capacity) the IC's solar generating facility of (PJM Project #AC2-060) will require the following additional interconnection charges. This plan of service will interconnect the proposed generating facility in a manner that will provide operational reliability and flexibility to both the AEP system and the IC's generating facility.

Cost Breakdown for Point of Interconnection (Buckskin 69 kV)		
Attachment Cost	Expand Buckskin 69 kV Substation	\$1,000,000
Non-Direct Connection Cost Estimate	69 kV Revenue Metering	\$200,000
	Upgrade line protection and controls at the Buckskin 69 kV substation.	\$200,000
	New System Reinforcements <i>(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, initially caused by the addition of this project generation)</i>	\$24,500,000
	Previous System Reinforcements <i>(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, identified for earlier generation or transmission interconnection projects in the PJM Queue)</i>	\$279,570,000
	New System Reinforcements – Not part of BES <i>(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, initially caused by the addition of this project generation)</i>	\$48,880,000
	Previous System Reinforcements-Not part of BES <i>(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, identified for earlier generation or transmission interconnection projects in the PJM Queue)</i>	\$6,250,000
Total Estimated Cost for Project AC2-060		\$359,600,000

Table 11

The estimates are preliminary in nature, as they were determined without the benefit of detailed engineering studies. The cost of remediation for sag limited conductors is not included in this estimate. Final estimates will require an on-site review and coordination to determine final construction requirements.

Figure 1: Point of Interconnection (Buckskin 69 kV Substation)

Single Line Diagram

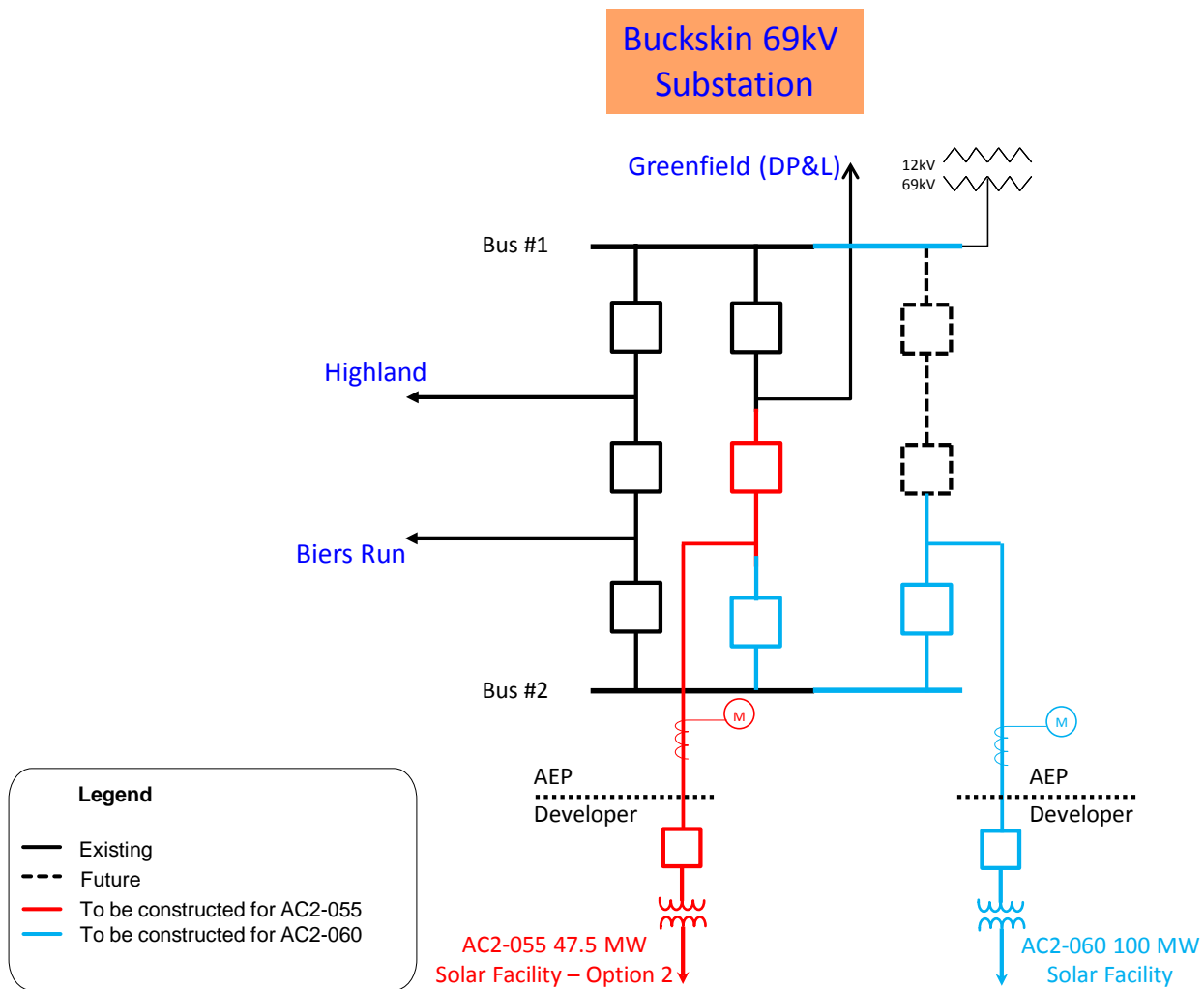


Figure 2: Customer Project Site and Point of Interconnection (Buckskin 69 kV Substation)



Appendices – Primary POI

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

(AEP - AEP) The 05BCKSKI-05LATTAVL8 69 kV line (from bus 243598 to bus 243608 ckt 1) loads from 47.51% to 82.09% (**DC power flow**) of its emergency rating (100 MVA) for the tower line contingency outage of '8123'. This project contributes approximately 34.58 MW to the thermal violation.

CONTINGENCY '8123'

OPEN BRANCH FROM BUS 243453 TO BUS 253110 CKT 1 / 243453
 05BEATTY 345 253110 09ADKINS 345 1
 OPEN BRANCH FROM BUS 243453 TO BUS 253248 CKT 1 / 243453
 05BEATTY 345 253248 09SCHARL 345 1
 OPEN BRANCH FROM BUS 243453 TO BUS 243469 CKT 3 / 243453
 05BEATTY 345 243469 05BEATTY 138 3
 END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
931121	AC2-019 C	0.36
931122	AC2-019 E	0.59
931131	AC2-020 C OP	2.4
931132	AC2-020 E OP	6.33
931192	AC2-027 E	0.96
931381	AC2-055 C OP	5.5
931382	AC2-055 E OP	8.97
931421	AC2-060 C	22.13
931422	AC2-060 E	12.45
931651	AC2-087 C OP	16.39
931652	AC2-087 E OP	13.
247592	W4-036	4.15

Appendix 2

(AEP - AEP) The 05BCKSKI-AC2-020 TAP 69 kV line (from bus 243598 to bus 931130 ckt 1) loads from 61.62% to 108.24% (**DC power flow**) of its emergency rating (72 MVA) for the line fault with failed breaker contingency outage of 'DAY_L34552-2'. This project contributes approximately 33.57 MW to the thermal violation.

CONTINGENCY 'DAY_L34552-2'

OPEN LINE FROM BUS 253077 TO BUS 253100 CKT 1 /* 09STUART 345 -
09ATLNTA 345

REMOVE UNIT 2 FROM BUS 253077 /* 09STUART 345

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
931121	AC2-019 C	0.32
931122	AC2-019 E	0.52
931132	AC2-020 E OP	12.11
931192	AC2-027 E	0.84
931381	AC2-055 C OP	5.31
931382	AC2-055 E OP	8.66
931421	AC2-060 C	21.48
931422	AC2-060 E	12.08
931651	AC2-087 C OP	15.91
931652	AC2-087 E OP	12.62
247592	W4-036	4.03

Appendix 3

(AEP - AEP) The 05BCKSKI-AC2-055 TAP 69 kV line (from bus 243598 to bus 931380 ckt 1) loads from 27.7% to 92.07% (**DC power flow**) of its emergency rating (50 MVA) for the line fault with failed breaker contingency outage of '2085_C2_05BEATTY 345-304C'. This project contributes approximately 32.19 MW to the thermal violation.

CONTINGENCY '2085_C2_05BEATTY 345-304C'

OPEN BRANCH FROM BUS 243453 TO BUS 243454 CKT 1 / 243453

05BEATTY 345 243454 05BIXBY 345 1

OPEN BRANCH FROM BUS 243453 TO BUS 253110 CKT 1 / 243453

05BEATTY 345 253110 09ADKINS 345 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
931131	AC2-020 C OP	2.23
931132	AC2-020 E OP	5.86
931421	AC2-060 C	20.6
931422	AC2-060 E	11.59
931651	AC2-087 C OP	15.26
931652	AC2-087 E OP	12.1
247592	W4-036	3.86

Appendix 4

(AEP - AEP) The 05LATTAVL8-05BIERSRUN 69 kV line (from bus 243608 to bus 246893 ckt 1) loads from 85.82% to 154.98% (**DC power flow**) of its emergency rating (50 MVA) for the tower line contingency outage of '8123'. This project contributes approximately 34.58 MW to the thermal violation.

CONTINGENCY '8123'

OPEN BRANCH FROM BUS 243453 TO BUS 253110 CKT 1 / 243453

05BEATTY 345 253110 09ADKINS 345 1

OPEN BRANCH FROM BUS 243453 TO BUS 253248 CKT 1 / 243453

05BEATTY 345 253248 09SCHARL 345 1

OPEN BRANCH FROM BUS 243453 TO BUS 243469 CKT 3 / 243453

05BEATTY 345 243469 05BEATTY 138 3

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
931121	AC2-019 C	0.36
931122	AC2-019 E	0.59
931131	AC2-020 C OP	2.4
931132	AC2-020 E OP	6.33
931192	AC2-027 E	0.96
931381	AC2-055 C OP	5.5
931382	AC2-055 E OP	8.97
931421	AC2-060 C	22.13
931422	AC2-060 E	12.45
931651	AC2-087 C OP	16.39
931652	AC2-087 E OP	13.
247592	W4-036	4.15

Appendix 5

(AEP - AEP) The 05PETERSB8-05HIGHLA 69 kV line (from bus 243612 to bus 243606 ckt 1) loads from 59.18% to 114.46% (**DC power flow**) of its emergency rating (50 MVA) for the line fault with failed breaker contingency outage of '2085_C2_05BEATTY 345-304C'. This project contributes approximately 32.19 MW to the thermal violation.

CONTINGENCY '2085_C2_05BEATTY 345-304C'

OPEN BRANCH FROM BUS 243453 TO BUS 243454 CKT 1 / 243453

05BEATTY 345 243454 05BIXBY 345 1

OPEN BRANCH FROM BUS 243453 TO BUS 253110 CKT 1 / 243453

05BEATTY 345 253110 09ADKINS 345 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
931131	AC2-020 C OP	2.23
931132	AC2-020 E OP	5.86
931381	AC2-055 C OP	7.31
931382	AC2-055 E OP	11.92
931421	AC2-060 C	20.6
931422	AC2-060 E	11.59
931651	AC2-087 C OP	15.26
931652	AC2-087 E OP	12.1
247592	W4-036	3.86

Appendix 6

(AEP - AEP) The 05HIGHLA-05NMARSS 138 kV line (from bus 246911 to bus 247035 ckt 1) loads from 88.31% to 89.43% (**DC power flow**) of its emergency rating (310 MVA) for the tower line contingency outage of '7981_B'. This project contributes approximately 7.72 MW to the thermal violation.

CONTINGENCY '7981_B'

OPEN BRANCH FROM BUS 931430 TO BUS 249995 CKT 1 / 931430 AC2-061
TAP 138 249995 08CLINCO 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB
138 253111 09MIDDLE 138 1
OPEN BRANCH FROM BUS 249995 TO BUS 250122 CKT 1 / 249995
08CLINCO 138 250122 08WARRN1 138 1
OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111
09MIDDLE 138 253057 09OHH 138 1
END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
931022	AC2-008 E	1.73
931121	AC2-019 C	0.77
931122	AC2-019 E	1.25
931131	AC2-020 C OP	0.54
931132	AC2-020 E OP	1.42
931192	AC2-027 E	2.02
931221	AC2-031 C	14.63
931222	AC2-031 E	7.2
931281	AC2-042 C	45.72
931282	AC2-042 E	30.48
931351	AC2-049 C	2.96
931352	AC2-049 E	1.97
931381	AC2-055 C OP	1.77
931382	AC2-055 E OP	2.88
931421	AC2-060 C	4.94
931422	AC2-060 E	2.78
931431	AC2-061 C	12.68
931432	AC2-061 E	12.86
931441	AC2-062 C OP	2.24
931442	AC2-062 E OP	3.65
931451	AC2-064 C	6.95
931452	AC2-064 E	4.63
931651	AC2-087 C OP	3.66
931652	AC2-087 E OP	2.9
247592	W4-036	0.93
926061	AC1-085 C	33.18
926062	AC1-085 E	54.14

<i>926101</i>	<i>ACI-089 C</i>	<i>11.16</i>
<i>926102</i>	<i>ACI-089 E</i>	<i>18.22</i>
<i>926631</i>	<i>ACI-144 C</i>	<i>14.69</i>
<i>926632</i>	<i>ACI-144 E</i>	<i>7.14</i>

Appendix 7

(AEP - AEP) The 05NMARSS-05SEAMAN 138 kV line (from bus 247035 to bus 243571 ckt 1) loads from 84.92% to 86.04% (**DC power flow**) of its emergency rating (310 MVA) for the tower line contingency outage of '7981_B'. This project contributes approximately 7.72 MW to the thermal violation.

CONTINGENCY '7981_B'

OPEN BRANCH FROM BUS 931430 TO BUS 249995 CKT 1 / 931430 AC2-061
TAP 138 249995 08CLINCO 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB
138 253111 09MIDDLE 138 1
OPEN BRANCH FROM BUS 249995 TO BUS 250122 CKT 1 / 249995
08CLINCO 138 250122 08WARRN1 138 1
OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111
09MIDDLE 138 253057 09OHH 138 1
END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
931022	AC2-008 E	1.73
931121	AC2-019 C	0.77
931122	AC2-019 E	1.25
931131	AC2-020 C OP	0.54
931132	AC2-020 E OP	1.42
931192	AC2-027 E	2.02
931221	AC2-031 C	14.63
931222	AC2-031 E	7.2
931281	AC2-042 C	45.72
931282	AC2-042 E	30.48
931351	AC2-049 C	2.96
931352	AC2-049 E	1.97
931381	AC2-055 C OP	1.77
931382	AC2-055 E OP	2.88
931421	AC2-060 C	4.94
931422	AC2-060 E	2.78
931431	AC2-061 C	12.68
931432	AC2-061 E	12.86
931441	AC2-062 C OP	2.24
931442	AC2-062 E OP	3.65
931451	AC2-064 C	6.95
931452	AC2-064 E	4.63
931651	AC2-087 C OP	3.66
931652	AC2-087 E OP	2.9
247592	W4-036	0.93
926061	AC1-085 C	33.18
926062	AC1-085 E	54.14

<i>926101</i>	<i>ACI-089 C</i>	<i>11.16</i>
<i>926102</i>	<i>ACI-089 E</i>	<i>18.22</i>
<i>926631</i>	<i>ACI-144 C</i>	<i>14.69</i>
<i>926632</i>	<i>ACI-144 E</i>	<i>7.14</i>

Appendix 8

(AEP - DAY) The AC2-020 TAP-09GRNFLD 69 kV line (from bus 931130 to bus 253030 ckt 1) loads from 59.91% to 106.53% (**DC power flow**) of its emergency rating (72 MVA) for the line fault with failed breaker contingency outage of 'DAY_L34552-2'. This project contributes approximately 33.57 MW to the thermal violation.

CONTINGENCY 'DAY_L34552-2'

OPEN LINE FROM BUS 253077 TO BUS 253100 CKT 1 /* 09STUART 345 -
09ATLNTA 345

REMOVE UNIT 2 FROM BUS 253077 /* 09STUART 345

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
931121	AC2-019 C	0.32
931122	AC2-019 E	0.52
931131	AC2-020 C OP	3.
931132	AC2-020 E OP	7.89
931192	AC2-027 E	0.84
931381	AC2-055 C OP	5.31
931382	AC2-055 E OP	8.66
931421	AC2-060 C	21.48
931422	AC2-060 E	12.08
931651	AC2-087 C OP	15.91
931652	AC2-087 E OP	12.62
247592	W4-036	4.03

Appendix 9

(AEP - AEP) The AC2-055 TAP-05PETERSB8 69 kV line (from bus 931380 to bus 243612 ckt 1) loads from 66.15% to 130.52% (**DC power flow**) of its emergency rating (50 MVA) for the line fault with failed breaker contingency outage of '2085_C2_05BEATTY 345-304C'. This project contributes approximately 32.19 MW to the thermal violation.

CONTINGENCY '2085_C2_05BEATTY 345-304C'

OPEN BRANCH FROM BUS 243453 TO BUS 243454 CKT 1 / 243453

05BEATTY 345 243454 05BIXBY 345 1

OPEN BRANCH FROM BUS 243453 TO BUS 253110 CKT 1 / 243453

05BEATTY 345 253110 09ADKINS 345 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
931131	AC2-020 C OP	2.23
931132	AC2-020 E OP	5.86
931381	AC2-055 C OP	7.31
931382	AC2-055 E OP	11.92
931421	AC2-060 C	20.6
931422	AC2-060 E	11.59
931651	AC2-087 C OP	15.26
931652	AC2-087 E OP	12.1
247592	W4-036	3.86

Appendix 10

(AEP - AEP) The 05HILLSB-05SINKG8 138 kV line (from bus 243019 to bus 243102 ckt 1) loads from 213.55% to 215.59% (**DC power flow**) of its emergency rating (185 MVA) for the tower line contingency outage of '7981_B'. This project contributes approximately 8.38 MW to the thermal violation.

CONTINGENCY '7981_B'

OPEN BRANCH FROM BUS 931430 TO BUS 249995 CKT 1 / 931430 AC2-061
TAP 138 249995 08CLINCO 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB
138 253111 09MIDDLE 138 1
OPEN BRANCH FROM BUS 249995 TO BUS 250122 CKT 1 / 249995
08CLINCO 138 250122 08WARRN1 138 1
OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111
09MIDDLE 138 253057 09OHH 138 1
END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
931022	AC2-008 E	2.78
931121	AC2-019 C	0.76
931122	AC2-019 E	1.25
931131	AC2-020 C OP	0.59
931132	AC2-020 E OP	1.55
931192	AC2-027 E	2.01
931221	AC2-031 C	23.37
931222	AC2-031 E	11.51
931281	AC2-042 C	73.05
931282	AC2-042 E	48.7
931381	AC2-055 C OP	1.86
931382	AC2-055 E OP	3.04
931421	AC2-060 C	5.36
931422	AC2-060 E	3.02
931431	AC2-061 C	20.27
931432	AC2-061 E	20.55
931441	AC2-062 C OP	3.64
931442	AC2-062 E OP	5.94
931651	AC2-087 C OP	3.97
931652	AC2-087 E OP	3.15
247592	W4-036	1.01
924371	AB2-085 C OP	8.23
924372	AB2-085 E OP	3.87
924541	AB2-103 C OP	5.1
924542	AB2-103 E OP	2.4
926061	AC1-085 C	53.03
926062	AC1-085 E	86.52

<i>926101</i>	<i>ACI-089 C</i>	<i>17.87</i>
<i>926102</i>	<i>ACI-089 E</i>	<i>29.16</i>
<i>926631</i>	<i>ACI-144 C</i>	<i>23.48</i>
<i>926632</i>	<i>ACI-144 E</i>	<i>11.41</i>

Appendix 11

(AEP - DAY) The 05HILLSB-09MIDDLE 138 kV line (from bus 243019 to bus 253111 ckt 1) loads from 160.39% to 161.76% (**DC power flow**) of its emergency rating (185 MVA) for the line fault with failed breaker contingency outage of '8111_C2_05HILLSB 138-_A'. This project contributes approximately 5.65 MW to the thermal violation.

CONTINGENCY '8111_C2_05HILLSB 138-_A'

OPEN BRANCH FROM BUS 243019 TO BUS 926100 CKT 1 / 243019 05HILLSB
138 926100 AC1-089 TAP 138 1

OPEN BRANCH FROM BUS 243019 TO BUS 931430 CKT 1 / 243019 05HILLSB
138 931430 AC2-060 TAP 138 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
931121	AC2-019 C	0.54
931122	AC2-019 E	0.88
931131	AC2-020 C OP	0.39
931132	AC2-020 E OP	1.02
931192	AC2-027 E	1.42
931221	AC2-031 C	16.99
931222	AC2-031 E	8.37
931281	AC2-042 C	53.11
931282	AC2-042 E	35.41
931351	AC2-049 C	3.7
931352	AC2-049 E	2.47
931381	AC2-055 C OP	1.28
931382	AC2-055 E OP	2.08
931421	AC2-060 C	3.62
931422	AC2-060 E	2.04
931451	AC2-064 C	8.69
931452	AC2-064 E	5.8
931651	AC2-087 C OP	2.68
931652	AC2-087 E OP	2.13
247592	W4-036	0.68
924371	AB2-085 C OP	6.32
924372	AB2-085 E OP	2.97
924541	AB2-103 C OP	3.81
924542	AB2-103 E OP	1.79
926061	AC1-085 C	38.55
926062	AC1-085 E	62.9
926631	AC1-144 C	17.07
926632	AC1-144 E	8.29

Appendix 12

(AEP - AEP) The 05HILLSB-AC1-089 TAP 138 kV line (from bus 243019 to bus 926100 ckt 1) loads from 124.92% to 126.55% (**DC power flow**) of its emergency rating (185 MVA) for the tower line contingency outage of '7981_B'. This project contributes approximately 6.67 MW to the thermal violation.

CONTINGENCY '7981_B'

OPEN BRANCH FROM BUS 931430 TO BUS 249995 CKT 1 / 931430 AC2-061
TAP 138 249995 08CLINCO 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB
138 253111 09MIDDLE 138 1
OPEN BRANCH FROM BUS 249995 TO BUS 250122 CKT 1 / 249995
08CLINCO 138 250122 08WARRN1 138 1
OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111
09MIDDLE 138 253057 09OHH 138 1
END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
931121	AC2-019 C	0.61
931122	AC2-019 E	1.
931131	AC2-020 C OP	0.46
931132	AC2-020 E OP	1.22
931192	AC2-027 E	1.62
931221	AC2-031 C	18.99
931222	AC2-031 E	9.35
931281	AC2-042 C	59.34
931282	AC2-042 E	39.56
931351	AC2-049 C	4.11
931352	AC2-049 E	2.74
931381	AC2-055 C OP	1.49
931382	AC2-055 E OP	2.42
931421	AC2-060 C	4.27
931422	AC2-060 E	2.4
931431	AC2-061 C	16.47
931432	AC2-061 E	16.69
931451	AC2-064 C	9.64
931452	AC2-064 E	6.43
931651	AC2-087 C OP	3.16
931652	AC2-087 E OP	2.51
247592	W4-036	0.8
924371	AB2-085 C OP	7.03
924372	AB2-085 E OP	3.31
924541	AB2-103 C OP	4.25
924542	AB2-103 E OP	2.
926061	AC1-085 C	43.08

<i>926062</i>	<i>ACI-085 E</i>	<i>70.28</i>
<i>926631</i>	<i>ACI-144 C</i>	<i>19.07</i>
<i>926632</i>	<i>ACI-144 E</i>	<i>9.27</i>

Appendix 13

(AEP - DEO&K) The 05HILLSB-AC2-061 TAP 138 kV line (from bus 243019 to bus 931430 ckt 1) loads from 236.98% to 239.04% (**DC power flow**) of its emergency rating (184 MVA) for the line fault with failed breaker contingency outage of '8109_C2_05HILLSB 138-A_A'. This project contributes approximately 8.4 MW to the thermal violation.

CONTINGENCY '8109_C2_05HILLSB 138-A_A'

OPEN BRANCH FROM BUS 243019 TO BUS 243102 CKT 1 / 243019 05HILLSB
138 243102 05SINKG8 138 1

OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB
138 253111 09MIDDLE 138 1

OPEN BRANCH FROM BUS 931350 TO BUS 243102 CKT 1 / 931350 AC2-049
TAP 138 243102 05SINKG8 138 1

OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111
09MIDDLE 138 253057 09OHH 138 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
931022	AC2-008 E	2.83
931121	AC2-019 C	0.77
931122	AC2-019 E	1.26
931131	AC2-020 C OP	0.59
931132	AC2-020 E OP	1.54
931192	AC2-027 E	2.04
931221	AC2-031 C	23.89
931222	AC2-031 E	11.77
931281	AC2-042 C	74.67
931282	AC2-042 E	49.78
931381	AC2-055 C OP	1.87
931382	AC2-055 E OP	3.06
931421	AC2-060 C	5.37
931422	AC2-060 E	3.02
931441	AC2-062 C OP	3.63
931442	AC2-062 E OP	5.93
931651	AC2-087 C OP	3.98
931652	AC2-087 E OP	3.16
247592	W4-036	1.01
916272	Z1-080 E	2.18
924371	AB2-085 C OP	8.72
924372	AB2-085 E OP	4.1
924541	AB2-103 C OP	5.31
924542	AB2-103 E OP	2.5
926061	AC1-085 C	54.2
926062	AC1-085 E	88.44
926101	AC1-089 C	18.22

<i>926102</i>	<i>ACI-089 E</i>	<i>29.73</i>
<i>926631</i>	<i>ACI-144 C</i>	<i>24.</i>
<i>926632</i>	<i>ACI-144 E</i>	<i>11.66</i>

Appendix 14

(AEP - AEP) The 05SINKG8-AC2-049 TAP 138 kV line (from bus 243102 to bus 931350 ckt 1) loads from 218.75% to 220.86% (**DC power flow**) of its emergency rating (179 MVA) for the tower line contingency outage of '7981_B'. This project contributes approximately 8.38 MW to the thermal violation.

CONTINGENCY '7981_B'

OPEN BRANCH FROM BUS 931430 TO BUS 249995 CKT 1 / 931430 AC2-061
TAP 138 249995 08CLINCO 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB
138 253111 09MIDDLE 138 1
OPEN BRANCH FROM BUS 249995 TO BUS 250122 CKT 1 / 249995
08CLINCO 138 250122 08WARRN1 138 1
OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111
09MIDDLE 138 253057 09OHH 138 1
END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
931022	AC2-008 E	2.78
931121	AC2-019 C	0.76
931122	AC2-019 E	1.25
931131	AC2-020 C OP	0.59
931132	AC2-020 E OP	1.55
931192	AC2-027 E	2.01
931221	AC2-031 C	23.37
931222	AC2-031 E	11.51
931281	AC2-042 C	73.05
931282	AC2-042 E	48.7
931381	AC2-055 C OP	1.86
931382	AC2-055 E OP	3.04
931421	AC2-060 C	5.36
931422	AC2-060 E	3.02
931431	AC2-061 C	20.27
931432	AC2-061 E	20.55
931441	AC2-062 C OP	3.64
931442	AC2-062 E OP	5.94
931651	AC2-087 C OP	3.97
931652	AC2-087 E OP	3.15
247592	W4-036	1.01
924371	AB2-085 C OP	8.23
924372	AB2-085 E OP	3.87
924541	AB2-103 C OP	5.1
924542	AB2-103 E OP	2.4
926061	AC1-085 C	53.03
926062	AC1-085 E	86.52

<i>926101</i>	<i>ACI-089 C</i>	<i>17.87</i>
<i>926102</i>	<i>ACI-089 E</i>	<i>29.16</i>
<i>926631</i>	<i>ACI-144 C</i>	<i>23.48</i>
<i>926632</i>	<i>ACI-144 E</i>	<i>11.41</i>

Appendix 15

(AEP - AEP) The 05ADAMS-05WARERD 138 kV line (from bus 243464 to bus 246942 ckt 1) loads from 154.53% to 156.26% (**DC power flow**) of its emergency rating (150 MVA) for the tower line contingency outage of '7981_B'. This project contributes approximately 5.79 MW to the thermal violation.

CONTINGENCY '7981_B'

OPEN BRANCH FROM BUS 931430 TO BUS 249995 CKT 1 / 931430 AC2-061
TAP 138 249995 08CLINCO 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB
138 253111 09MIDDLE 138 1
OPEN BRANCH FROM BUS 249995 TO BUS 250122 CKT 1 / 249995
08CLINCO 138 250122 08WARRN1 138 1
OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111
09MIDDLE 138 253057 09OHH 138 1
END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
931022	AC2-008 E	1.34
931121	AC2-019 C	0.59
931122	AC2-019 E	0.96
931131	AC2-020 C OP	0.41
931132	AC2-020 E OP	1.07
931192	AC2-027 E	1.55
931221	AC2-031 C	11.2
931222	AC2-031 E	5.51
931281	AC2-042 C	34.99
931282	AC2-042 E	23.33
931351	AC2-049 C	2.18
931352	AC2-049 E	1.45
931381	AC2-055 C OP	1.33
931382	AC2-055 E OP	2.18
931421	AC2-060 C	3.7
931422	AC2-060 E	2.08
931431	AC2-061 C	9.71
931432	AC2-061 E	9.84
931441	AC2-062 C OP	1.77
931442	AC2-062 E OP	2.88
931451	AC2-064 C	5.11
931452	AC2-064 E	3.41
931651	AC2-087 C OP	2.74
931652	AC2-087 E OP	2.18
247592	W4-036	0.69
924371	AB2-085 C OP	27.11
924372	AB2-085 E OP	12.76

<i>924541</i>	<i>AB2-103 C OP</i>	<i>10.95</i>
<i>924542</i>	<i>AB2-103 E OP</i>	<i>5.15</i>
<i>926061</i>	<i>AC1-085 C</i>	<i>25.4</i>
<i>926062</i>	<i>AC1-085 E</i>	<i>41.44</i>
<i>926101</i>	<i>AC1-089 C</i>	<i>8.57</i>
<i>926102</i>	<i>AC1-089 E</i>	<i>13.99</i>
<i>926631</i>	<i>AC1-144 C</i>	<i>11.25</i>
<i>926632</i>	<i>AC1-144 E</i>	<i>5.46</i>

Appendix 16

(AEP - AEP) The 05SEAMAN-05ADAMS 138 kV line (from bus 243571 to bus 243464 ckt 1) loads from 141.13% to 142.85% (**DC power flow**) of its emergency rating (150 MVA) for the tower line contingency outage of '7981_B'. This project contributes approximately 5.74 MW to the thermal violation.

CONTINGENCY '7981_B'

OPEN BRANCH FROM BUS 931430 TO BUS 249995 CKT 1 / 931430 AC2-061
TAP 138 249995 08CLINCO 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB
138 253111 09MIDDLE 138 1
OPEN BRANCH FROM BUS 249995 TO BUS 250122 CKT 1 / 249995
08CLINCO 138 250122 08WARRN1 138 1
OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111
09MIDDLE 138 253057 09OHH 138 1
END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
931022	AC2-008 E	1.31
931121	AC2-019 C	0.58
931122	AC2-019 E	0.95
931131	AC2-020 C OP	0.4
931132	AC2-020 E OP	1.06
931192	AC2-027 E	1.53
931221	AC2-031 C	11.02
931222	AC2-031 E	5.43
931281	AC2-042 C	34.44
931282	AC2-042 E	22.96
931351	AC2-049 C	2.17
931352	AC2-049 E	1.45
931381	AC2-055 C OP	1.32
931382	AC2-055 E OP	2.15
931421	AC2-060 C	3.67
931422	AC2-060 E	2.07
931431	AC2-061 C	9.56
931432	AC2-061 E	9.69
931441	AC2-062 C OP	1.72
931442	AC2-062 E OP	2.81
931451	AC2-064 C	5.1
931452	AC2-064 E	3.4
931651	AC2-087 C OP	2.72
931652	AC2-087 E OP	2.16
247592	W4-036	0.69
924541	AB2-103 C OP	10.77
924542	AB2-103 E OP	5.07

<i>926061</i>	<i>ACI-085 C</i>	<i>25.</i>
<i>926062</i>	<i>ACI-085 E</i>	<i>40.79</i>
<i>926101</i>	<i>ACI-089 C</i>	<i>8.43</i>
<i>926102</i>	<i>ACI-089 E</i>	<i>13.75</i>
<i>926631</i>	<i>ACI-144 C</i>	<i>11.07</i>
<i>926632</i>	<i>ACI-144 E</i>	<i>5.38</i>

Appendix 17

(AEP - DAY) The 05HIGHLA-09MRTNSV 69 kV line (from bus 243606 to bus 253043 ckt 1) loads from 114.9% to 120.48% (**DC power flow**) of its emergency rating (71 MVA) for the tower line contingency outage of '7981_B'. This project contributes approximately 8.79 MW to the thermal violation.

CONTINGENCY '7981_B'

OPEN BRANCH FROM BUS 931430 TO BUS 249995 CKT 1 / 931430 AC2-061
TAP 138 249995 08CLINCO 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB
138 253111 09MIDDLE 138 1
OPEN BRANCH FROM BUS 249995 TO BUS 250122 CKT 1 / 249995
08CLINCO 138 250122 08WARRN1 138 1
OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111
09MIDDLE 138 253057 09OHH 138 1
END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
931022	AC2-008 E	0.66
931121	AC2-019 C	0.93
931122	AC2-019 E	1.52
931131	AC2-020 C OP	0.59
931132	AC2-020 E OP	1.55
931192	AC2-027 E	2.45
931221	AC2-031 C	5.64
931222	AC2-031 E	2.78
931281	AC2-042 C	17.62
931282	AC2-042 E	11.74
931381	AC2-055 C OP	2.05
931382	AC2-055 E OP	3.35
931421	AC2-060 C	5.63
931422	AC2-060 E	3.17
931431	AC2-061 C	4.89
931432	AC2-061 E	4.96
931651	AC2-087 C OP	4.17
931652	AC2-087 E OP	3.31
247592	W4-036	1.06
924371	AB2-085 C OP	3.36
924372	AB2-085 E OP	1.58
924541	AB2-103 C OP	2.03
924542	AB2-103 E OP	0.96
926061	AC1-085 C	12.79
926062	AC1-085 E	20.86
926101	AC1-089 C	4.29
926102	AC1-089 E	7.

<i>926631</i>	<i>ACI-144 C</i>	<i>5.66</i>
<i>926632</i>	<i>ACI-144 E</i>	<i>2.75</i>

Appendix 18

(AEP - AEP) The 05BIERSRUN-05SLATE 69 kV line (from bus 246893 to bus 243617 ckt 1) loads from 125.28% to 133.07% (**DC power flow**) of its emergency rating (50 MVA) for the tower line contingency outage of '8126_B'. This project contributes approximately 8.65 MW to the thermal violation.

CONTINGENCY '8126_B'

OPEN BRANCH FROM BUS 931410 TO BUS 243483 CKT 1 / 931410 AC2-059

TAP 138 243483 05CRCLVS 138 1

OPEN BRANCH FROM BUS 246889 TO BUS 246890 CKT 1 / 246889 05BIERSR

138 246890 05HOPETN 138 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
931131	AC2-020 C OP	0.6
931132	AC2-020 E OP	1.58
931381	AC2-055 C OP	1.36
931382	AC2-055 E OP	2.22
931411	AC2-059 C	4.08
931412	AC2-059 E	4.21
931421	AC2-060 C	5.53
931422	AC2-060 E	3.11
931651	AC2-087 C OP	4.1
931652	AC2-087 E OP	3.25
247592	W4-036	1.04

Appendix 19

(AEP - AEP) The 05WARERD-05WAVERL 138 kV line (from bus 246942 to bus 243585 ckt 1) loads from 144.33% to 146.06% (**DC power flow**) of its emergency rating (150 MVA) for the tower line contingency outage of '7981_B'. This project contributes approximately 5.79 MW to the thermal violation.

CONTINGENCY '7981_B'

OPEN BRANCH FROM BUS 931430 TO BUS 249995 CKT 1 / 931430 AC2-061
TAP 138 249995 08CLINCO 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB
138 253111 09MIDDLE 138 1
OPEN BRANCH FROM BUS 249995 TO BUS 250122 CKT 1 / 249995
08CLINCO 138 250122 08WARRN1 138 1
OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111
09MIDDLE 138 253057 09OHH 138 1
END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
931022	AC2-008 E	1.34
931121	AC2-019 C	0.59
931122	AC2-019 E	0.96
931131	AC2-020 C OP	0.41
931132	AC2-020 E OP	1.07
931192	AC2-027 E	1.55
931221	AC2-031 C	11.2
931222	AC2-031 E	5.51
931281	AC2-042 C	34.99
931282	AC2-042 E	23.33
931351	AC2-049 C	2.18
931352	AC2-049 E	1.45
931381	AC2-055 C OP	1.33
931382	AC2-055 E OP	2.18
931421	AC2-060 C	3.7
931422	AC2-060 E	2.08
931431	AC2-061 C	9.71
931432	AC2-061 E	9.84
931441	AC2-062 C OP	1.77
931442	AC2-062 E OP	2.88
931451	AC2-064 C	5.11
931452	AC2-064 E	3.41
931651	AC2-087 C OP	2.74
931652	AC2-087 E OP	2.18
247592	W4-036	0.69
924371	AB2-085 C OP	27.11
924372	AB2-085 E OP	12.76

<i>924541</i>	<i>AB2-103 C OP</i>	<i>10.95</i>
<i>924542</i>	<i>AB2-103 E OP</i>	<i>5.15</i>
<i>926061</i>	<i>AC1-085 C</i>	<i>25.4</i>
<i>926062</i>	<i>AC1-085 E</i>	<i>41.44</i>
<i>926101</i>	<i>AC1-089 C</i>	<i>8.57</i>
<i>926102</i>	<i>AC1-089 E</i>	<i>13.99</i>
<i>926631</i>	<i>AC1-144 C</i>	<i>11.25</i>
<i>926632</i>	<i>AC1-144 E</i>	<i>5.46</i>

Appendix 20

(AEP - AEP) The 05WLDCAT-05EMERSS 138 kV line (from bus 246946 to bus 247034 ckt 1) loads from 152.54% to 154.17% (**DC power flow**) of its emergency rating (185 MVA) for the tower line contingency outage of '7981_B'. This project contributes approximately 6.67 MW to the thermal violation.

CONTINGENCY '7981_B'

OPEN BRANCH FROM BUS 931430 TO BUS 249995 CKT 1 / 931430 AC2-061
TAP 138 249995 08CLINCO 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB
138 253111 09MIDDLE 138 1
OPEN BRANCH FROM BUS 249995 TO BUS 250122 CKT 1 / 249995
08CLINCO 138 250122 08WARRN1 138 1
OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111
09MIDDLE 138 253057 09OHH 138 1
END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
931022	AC2-008 E	4.3
931121	AC2-019 C	0.61
931122	AC2-019 E	1.
931131	AC2-020 C OP	0.46
931132	AC2-020 E OP	1.22
931192	AC2-027 E	1.62
931221	AC2-031 C	18.99
931222	AC2-031 E	9.35
931281	AC2-042 C	59.34
931282	AC2-042 E	39.56
931351	AC2-049 C	4.11
931352	AC2-049 E	2.74
931381	AC2-055 C OP	1.49
931382	AC2-055 E OP	2.42
931421	AC2-060 C	4.27
931422	AC2-060 E	2.4
931431	AC2-061 C	16.47
931432	AC2-061 E	16.69
931451	AC2-064 C	9.64
931452	AC2-064 E	6.43
931651	AC2-087 C OP	3.16
931652	AC2-087 E OP	2.51
247592	W4-036	0.8
924371	AB2-085 C OP	7.03
924372	AB2-085 E OP	3.31
924541	AB2-103 C OP	4.25
924542	AB2-103 E OP	2.

<i>926061</i>	<i>ACI-085 C</i>	<i>43.08</i>
<i>926062</i>	<i>ACI-085 E</i>	<i>70.28</i>
<i>926101</i>	<i>ACI-089 C</i>	<i>20.33</i>
<i>926102</i>	<i>ACI-089 E</i>	<i>33.17</i>
<i>926631</i>	<i>ACI-144 C</i>	<i>19.07</i>
<i>926632</i>	<i>ACI-144 E</i>	<i>9.27</i>

Appendix 21

(AEP - AEP) The 05EMERSS-AC2-062 TAP 138 kV line (from bus 247034 to bus 931440 ckt 1) loads from 150.54% to 152.17% (**DC power flow**) of its emergency rating (185 MVA) for the tower line contingency outage of '7981_B'. This project contributes approximately 6.67 MW to the thermal violation.

CONTINGENCY '7981_B'

OPEN BRANCH FROM BUS 931430 TO BUS 249995 CKT 1 / 931430 AC2-061
TAP 138 249995 08CLINCO 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB
138 253111 09MIDDLE 138 1
OPEN BRANCH FROM BUS 249995 TO BUS 250122 CKT 1 / 249995
08CLINCO 138 250122 08WARRN1 138 1
OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111
09MIDDLE 138 253057 09OHH 138 1
END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
931022	AC2-008 E	4.3
931121	AC2-019 C	0.61
931122	AC2-019 E	1.
931131	AC2-020 C OP	0.46
931132	AC2-020 E OP	1.22
931192	AC2-027 E	1.62
931221	AC2-031 C	18.99
931222	AC2-031 E	9.35
931281	AC2-042 C	59.34
931282	AC2-042 E	39.56
931351	AC2-049 C	4.11
931352	AC2-049 E	2.74
931381	AC2-055 C OP	1.49
931382	AC2-055 E OP	2.42
931421	AC2-060 C	4.27
931422	AC2-060 E	2.4
931431	AC2-061 C	16.47
931432	AC2-061 E	16.69
931451	AC2-064 C	9.64
931452	AC2-064 E	6.43
931651	AC2-087 C OP	3.16
931652	AC2-087 E OP	2.51
247592	W4-036	0.8
924371	AB2-085 C OP	7.03
924372	AB2-085 E OP	3.31
924541	AB2-103 C OP	4.25
924542	AB2-103 E OP	2.

<i>926061</i>	<i>ACI-085 C</i>	<i>43.08</i>
<i>926062</i>	<i>ACI-085 E</i>	<i>70.28</i>
<i>926101</i>	<i>ACI-089 C</i>	<i>20.33</i>
<i>926102</i>	<i>ACI-089 E</i>	<i>33.17</i>
<i>926631</i>	<i>ACI-144 C</i>	<i>19.07</i>
<i>926632</i>	<i>ACI-144 E</i>	<i>9.27</i>

Appendix 22

(DEO&K - DEO&K) The 08CLINCO-08WARRN1 138 kV line (from bus 249995 to bus 250122 ckt 1) loads from 206.71% to 208.62% (**DC power flow**) of its emergency rating (198 MVA) for the line fault with failed breaker contingency outage of '8109_C2_05HILLSB 138-A_A'. This project contributes approximately 8.4 MW to the thermal violation.

CONTINGENCY '8109_C2_05HILLSB 138-A_A'

OPEN BRANCH FROM BUS 243019 TO BUS 243102 CKT 1 / 243019 05HILLSB
138 243102 05SINKG8 138 1

OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB
138 253111 09MIDDLE 138 1

OPEN BRANCH FROM BUS 931350 TO BUS 243102 CKT 1 / 931350 AC2-049
TAP 138 243102 05SINKG8 138 1

OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111
09MIDDLE 138 253057 09OHH 138 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
931022	AC2-008 E	2.83
931121	AC2-019 C	0.77
931122	AC2-019 E	1.26
931131	AC2-020 C OP	0.59
931132	AC2-020 E OP	1.54
931192	AC2-027 E	2.04
931221	AC2-031 C	23.89
931222	AC2-031 E	11.77
931281	AC2-042 C	74.67
931282	AC2-042 E	49.78
931381	AC2-055 C OP	1.87
931382	AC2-055 E OP	3.06
931421	AC2-060 C	5.37
931422	AC2-060 E	3.02
931431	AC2-061 C	28.84
931432	AC2-061 E	29.24
931441	AC2-062 C OP	3.63
931442	AC2-062 E OP	5.93
931651	AC2-087 C OP	3.98
931652	AC2-087 E OP	3.16
247592	W4-036	1.01
916272	Z1-080 E	3.82
924371	AB2-085 C OP	8.72
924372	AB2-085 E OP	4.1
924541	AB2-103 C OP	5.31
924542	AB2-103 E OP	2.5
926061	AC1-085 C	54.2

<i>926062</i>	<i>ACI-085 E</i>	<i>88.44</i>
<i>926101</i>	<i>ACI-089 C</i>	<i>18.22</i>
<i>926102</i>	<i>ACI-089 E</i>	<i>29.73</i>
<i>926631</i>	<i>ACI-144 C</i>	<i>24.</i>
<i>926632</i>	<i>ACI-144 E</i>	<i>11.66</i>

Appendix 23

(DAY - DAY) The 09MIDDLE-09OHH 138 kV line (from bus 253111 to bus 253057 ckt 1) loads from 158.12% to 159.49% (**DC power flow**) of its emergency rating (185 MVA) for the line fault with failed breaker contingency outage of '8111_C2_05HILLSB 138-_A'. This project contributes approximately 5.65 MW to the thermal violation.

CONTINGENCY '8111_C2_05HILLSB 138-_A'

OPEN BRANCH FROM BUS 243019 TO BUS 926100 CKT 1 / 243019 05HILLSB
138 926100 AC1-089 TAP 138 1

OPEN BRANCH FROM BUS 243019 TO BUS 931430 CKT 1 / 243019 05HILLSB
138 931430 AC2-060 TAP 138 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
931121	AC2-019 C	0.54
931122	AC2-019 E	0.88
931131	AC2-020 C OP	0.39
931132	AC2-020 E OP	1.02
931192	AC2-027 E	1.42
931221	AC2-031 C	16.99
931222	AC2-031 E	8.37
931281	AC2-042 C	53.11
931282	AC2-042 E	35.41
931351	AC2-049 C	3.7
931352	AC2-049 E	2.47
931381	AC2-055 C OP	1.28
931382	AC2-055 E OP	2.08
931421	AC2-060 C	3.62
931422	AC2-060 E	2.04
931451	AC2-064 C	8.69
931452	AC2-064 E	5.8
931651	AC2-087 C OP	2.68
931652	AC2-087 E OP	2.13
247592	W4-036	0.68
924371	AB2-085 C OP	6.32
924372	AB2-085 E OP	2.97
924541	AB2-103 C OP	3.81
924542	AB2-103 E OP	1.79
926061	AC1-085 C	38.55
926062	AC1-085 E	62.9
926631	AC1-144 C	17.07
926632	AC1-144 E	8.29

Appendix 24

(AEP - AEP) The AC1-089 TAP-05WLDCAT 138 kV line (from bus 926100 to bus 246946 ckt 1) loads from 153.63% to 155.25% (**DC power flow**) of its emergency rating (185 MVA) for the tower line contingency outage of '7981_B'. This project contributes approximately 6.67 MW to the thermal violation.

CONTINGENCY '7981_B'

OPEN BRANCH FROM BUS 931430 TO BUS 249995 CKT 1 / 931430 AC2-061
TAP 138 249995 08CLINCO 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB
138 253111 09MIDDLE 138 1
OPEN BRANCH FROM BUS 249995 TO BUS 250122 CKT 1 / 249995
08CLINCO 138 250122 08WARRN1 138 1
OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111
09MIDDLE 138 253057 09OHH 138 1
END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
931121	AC2-019 C	0.61
931122	AC2-019 E	1.
931131	AC2-020 C OP	0.46
931132	AC2-020 E OP	1.22
931192	AC2-027 E	1.62
931221	AC2-031 C	18.99
931222	AC2-031 E	9.35
931281	AC2-042 C	59.34
931282	AC2-042 E	39.56
931351	AC2-049 C	4.11
931352	AC2-049 E	2.74
931381	AC2-055 C OP	1.49
931382	AC2-055 E OP	2.42
931421	AC2-060 C	4.27
931422	AC2-060 E	2.4
931431	AC2-061 C	16.47
931432	AC2-061 E	16.69
931451	AC2-064 C	9.64
931452	AC2-064 E	6.43
931651	AC2-087 C OP	3.16
931652	AC2-087 E OP	2.51
247592	W4-036	0.8
924371	AB2-085 C OP	7.03
924372	AB2-085 E OP	3.31
924541	AB2-103 C OP	4.25
924542	AB2-103 E OP	2.
926061	AC1-085 C	43.08

<i>926062</i>	<i>ACI-085 E</i>	<i>70.28</i>
<i>926101</i>	<i>ACI-089 C</i>	<i>20.33</i>
<i>926102</i>	<i>ACI-089 E</i>	<i>33.17</i>
<i>926631</i>	<i>ACI-144 C</i>	<i>19.07</i>
<i>926632</i>	<i>ACI-144 E</i>	<i>9.27</i>

Appendix 25

(AEP - AEP) The AC2-049 TAP-05MILLBR 138 kV line (from bus 931350 to bus 243042 ckt 1) loads from 237.4% to 239.51% (**DC power flow**) of its emergency rating (179 MVA) for the tower line contingency outage of '7981_B'. This project contributes approximately 8.38 MW to the thermal violation.

CONTINGENCY '7981_B'

OPEN BRANCH FROM BUS 931430 TO BUS 249995 CKT 1 / 931430 AC2-061
TAP 138 249995 08CLINCO 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB
138 253111 09MIDDLE 138 1
OPEN BRANCH FROM BUS 249995 TO BUS 250122 CKT 1 / 249995
08CLINCO 138 250122 08WARRN1 138 1
OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111
09MIDDLE 138 253057 09OHH 138 1
END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
931022	AC2-008 E	2.78
931121	AC2-019 C	0.76
931122	AC2-019 E	1.25
931131	AC2-020 C OP	0.59
931132	AC2-020 E OP	1.55
931192	AC2-027 E	2.01
931221	AC2-031 C	23.37
931222	AC2-031 E	11.51
931281	AC2-042 C	73.05
931282	AC2-042 E	48.7
931351	AC2-049 C	20.15
931352	AC2-049 E	13.43
931381	AC2-055 C OP	1.86
931382	AC2-055 E OP	3.04
931421	AC2-060 C	5.36
931422	AC2-060 E	3.02
931431	AC2-061 C	20.27
931432	AC2-061 E	20.55
931441	AC2-062 C OP	3.64
931442	AC2-062 E OP	5.94
931451	AC2-064 C	47.29
931452	AC2-064 E	31.53
931651	AC2-087 C OP	3.97
931652	AC2-087 E OP	3.15
247592	W4-036	1.01
924371	AB2-085 C OP	8.23
924372	AB2-085 E OP	3.87

<i>924541</i>	<i>AB2-103 C OP</i>	<i>5.1</i>
<i>924542</i>	<i>AB2-103 E OP</i>	<i>2.4</i>
<i>926061</i>	<i>AC1-085 C</i>	<i>53.03</i>
<i>926062</i>	<i>AC1-085 E</i>	<i>86.52</i>
<i>926101</i>	<i>AC1-089 C</i>	<i>17.87</i>
<i>926102</i>	<i>AC1-089 E</i>	<i>29.16</i>
<i>926631</i>	<i>AC1-144 C</i>	<i>23.48</i>
<i>926632</i>	<i>AC1-144 E</i>	<i>11.41</i>

Appendix 26

(DEO&K - DEO&K) The AC2-061 TAP-08CLINCO 138 kV line (from bus 931430 to bus 249995 ckt 1) loads from 236.98% to 239.04% (**DC power flow**) of its emergency rating (184 MVA) for the line fault with failed breaker contingency outage of '8109_C2_05HILLSB 138-A_A'. This project contributes approximately 8.4 MW to the thermal violation.

CONTINGENCY '8109_C2_05HILLSB 138-A_A'

OPEN BRANCH FROM BUS 243019 TO BUS 243102 CKT 1 / 243019 05HILLSB
138 243102 05SINKG8 138 1

OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB
138 253111 09MIDDLE 138 1

OPEN BRANCH FROM BUS 931350 TO BUS 243102 CKT 1 / 931350 AC2-049
TAP 138 243102 05SINKG8 138 1

OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111
09MIDDLE 138 253057 09OHH 138 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
931022	AC2-008 E	2.83
931121	AC2-019 C	0.77
931122	AC2-019 E	1.26
931131	AC2-020 C OP	0.59
931132	AC2-020 E OP	1.54
931192	AC2-027 E	2.04
931221	AC2-031 C	23.89
931222	AC2-031 E	11.77
931281	AC2-042 C	74.67
931282	AC2-042 E	49.78
931381	AC2-055 C OP	1.87
931382	AC2-055 E OP	3.06
931421	AC2-060 C	5.37
931422	AC2-060 E	3.02
931431	AC2-061 C	28.84
931432	AC2-061 E	29.24
931441	AC2-062 C OP	3.63
931442	AC2-062 E OP	5.93
931651	AC2-087 C OP	3.98
931652	AC2-087 E OP	3.16
247592	W4-036	1.01
916272	Z1-080 E	2.18
924371	AB2-085 C OP	8.72
924372	AB2-085 E OP	4.1
924541	AB2-103 C OP	5.31
924542	AB2-103 E OP	2.5
926061	AC1-085 C	54.2

<i>926062</i>	<i>ACI-085 E</i>	<i>88.44</i>
<i>926101</i>	<i>ACI-089 C</i>	<i>18.22</i>
<i>926102</i>	<i>ACI-089 E</i>	<i>29.73</i>
<i>926631</i>	<i>ACI-144 C</i>	<i>24.</i>
<i>926632</i>	<i>ACI-144 E</i>	<i>11.66</i>

Appendix 27

(AEP - LGEE) The AC2-062 TAP-4KENTON 138 kV line (from bus 931440 to bus 324267 ckt 1) loads from 149.84% to 151.46% (**DC power flow**) of its emergency rating (185 MVA) for the tower line contingency outage of '7981_B'. This project contributes approximately 6.67 MW to the thermal violation.

CONTINGENCY '7981_B'

OPEN BRANCH FROM BUS 931430 TO BUS 249995 CKT 1 / 931430 AC2-061
TAP 138 249995 08CLINCO 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB
138 253111 09MIDDLE 138 1
OPEN BRANCH FROM BUS 249995 TO BUS 250122 CKT 1 / 249995
08CLINCO 138 250122 08WARRN1 138 1
OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111
09MIDDLE 138 253057 09OHH 138 1
END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
931022	AC2-008 E	4.3
931121	AC2-019 C	0.61
931122	AC2-019 E	1.
931131	AC2-020 C OP	0.46
931132	AC2-020 E OP	1.22
931192	AC2-027 E	1.62
931221	AC2-031 C	18.99
931222	AC2-031 E	9.35
931281	AC2-042 C	59.34
931282	AC2-042 E	39.56
931351	AC2-049 C	4.11
931352	AC2-049 E	2.74
931381	AC2-055 C OP	1.49
931382	AC2-055 E OP	2.42
931421	AC2-060 C	4.27
931422	AC2-060 E	2.4
931431	AC2-061 C	16.47
931432	AC2-061 E	16.69
931441	AC2-062 C OP	13.5
931442	AC2-062 E OP	22.03
931451	AC2-064 C	9.64
931452	AC2-064 E	6.43
931651	AC2-087 C OP	3.16
931652	AC2-087 E OP	2.51
247592	W4-036	0.8
924371	AB2-085 C OP	7.03
924372	AB2-085 E OP	3.31

<i>924541</i>	<i>AB2-103 C OP</i>	<i>4.25</i>
<i>924542</i>	<i>AB2-103 E OP</i>	<i>2.</i>
<i>926061</i>	<i>AC1-085 C</i>	<i>43.08</i>
<i>926062</i>	<i>AC1-085 E</i>	<i>70.28</i>
<i>926101</i>	<i>AC1-089 C</i>	<i>20.33</i>
<i>926102</i>	<i>AC1-089 E</i>	<i>33.17</i>
<i>926631</i>	<i>AC1-144 C</i>	<i>19.07</i>
<i>926632</i>	<i>AC1-144 E</i>	<i>9.27</i>

***Generation Interconnection
System Impact Study Report***

For

***PJM Generation Interconnection Request
Queue Position AC2-060***

Buckskin 69kV

December 2019

Preface

The intent of the System Impact 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: (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. 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 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 or merchant transmission upgrade, may also contribute to the need for the same network reinforcement.

The System Impact 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.

General

First Solar Development, LLC proposes to install PJM Project #AC2-060, a 100.0 MW (64.0 MW Capacity) solar generating facility in Ross County, Ohio (see Figure 1). The point of interconnection is a direct connection to AEP's Buckskin 69 kV substation.

The requested in service date is December 31, 2019.

Attachment Facilities

Primary Point of Interconnection (Buckskin 69kV substation)

To accommodate the interconnection at the Buckskin 69 kV substation, the substation will have to be expanded requiring the installation of two (2) 69 kV circuit breakers (see Figure 1). Installation of associated protection and control equipment, 69 kV line risers, SCADA, and 69 kV revenue metering will also be required. AEP reserves the right to specify the final acceptable configuration considering design practices, future expansion, and compliance requirements.

Direct Connection at the Buckskin 69 kV Substation Work and Cost:

- Expand the substation requiring the installation of two (2) new 69 kV circuit breakers (see Figure 1). Installation of associated protection and control equipment, 69 kV line risers, SCADA, and 69 kV revenue metering will also be required.
- **Estimated Station Cost: \$1,500,000**
- **Note:** The Interconnection Customer may be required to go offline for routine circuit breaker maintenance.

Non-Direct Connection Cost Estimate

The total preliminary cost estimate for Non-Direct Connection work is given in the following table below:

For AEP building Non-Direct Connection cost estimates:

Description	Estimated Cost
69 kV Revenue Metering	\$200,000
Upgrade line protection and controls at the Buckskin 69 kV substation.	\$200,000
Total	\$400,000

Table 1

Interconnection Customer Requirements

It is understood that First Solar Development is responsible for all costs associated with this interconnection. The cost of First Solar Development's generating plant and the costs for the line connecting the generating plant to the Buckskin 69 kV substation are not included in this report; these are assumed to be First Solar Development's responsibility.

The Generation Interconnection Agreement does not in or by itself establish a requirement for American Electric Power to provide power for consumption at the developer's facilities. A separate agreement may be reached with the local utility that provides service in the area to ensure that infrastructure is in place to meet this demand and proper metering equipment is installed. It is the responsibility of the developer to contact the local service provider to determine if a local service agreement is required.

Requirement from the PJM Open Access Transmission Tariff:

1. An Interconnection Customer entering the New Services Queue on or after October 1, 2012 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.
2. The Interconnection Customer may be required to install and/or pay for metering as necessary to properly track real time output of the facility as well as installing metering which shall be used for billing purposes. See Section 8 of Appendix 2 to the Interconnection Service Agreement as well as Section 4 of PJM Manual 14D for additional information.

Revenue Metering and SCADA Requirements

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 Sections 24.1 and 24.2.

AEP Requirements

The Interconnection Customer will be required to comply with all AEP Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the "Requirements for Connection of New Facilities or Changes to Existing Facilities Connected to the AEP Transmission System" document located at the following link:

<http://www.pjm.com/~media/planning/plan-standards/private-aep/aep-interconnection-requirements.ashx>

Network Impacts

The Queue Project AC2-060 was evaluated as a 100.0 MW (Capacity 64.0 MW) injection into the Buckskin 69 kV substation in the AEP area. Project AC2-060 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC2-060 was studied with a commercial probability of 100%. Potential network impacts were as follows:

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)

None

Steady-State Voltage Requirements

(Results of the steady-state voltage studies should be inserted here)

None

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

None

Stability and Reactive Power Requirement

(Results of the dynamic studies should be inserted here)

No mitigations are required due to instability; however, it was observed that the AC2-060 plant is deficient in lagging power factor requirement by 24.21 MVar. This will need to be addressed through reactive power compensation.

First Solar Development will be responsible for addressing the deficiency in lagging power factor requirements.

Affected System Analysis & Mitigation

LGEE Impacts:

None

MISO Impacts:

None

Duke, Progress & TVA Impacts:

None

OVEC Impacts:

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. (AEP - AEP) The 05BCKSKI-05PETERSB8 69 kV line (from bus 243598 to bus 243612 ckt 1) loads from 72.83% to 163.71% (AC power flow) of its emergency rating (50 MVA) for the single line contingency outage of '412_B2_TOR13998_WOMOAB_B'. This project contributes approximately 48.67 MW to the thermal violation.

CONTINGENCY '412_B2_TOR13998_WOMOAB_B'

OPEN BRANCH FROM BUS 253030 TO BUS 932130 CKT 1 / 932130 AC2-020
TAP 69.0 253030 09GRNFLD 69.0 1
END

2. (AEP - AEP) The 05BCKSKI-05PETERSB8 69 kV line (from bus 243598 to bus 243612 ckt 1) loads from 48.02% to 103.04% (AC power flow) of its normal rating (50 MVA) for non-contingency condition. This project contributes approximately 32.11 MW to the thermal violation.

3. (AEP - AEP) The 05BCKSKI-AC2-020 TAP 69 kV line (from bus 243598 to bus 932130 ckt 1) loads from 44.47% to 113.63% (AC power flow) of its emergency rating (72 MVA) for the single line contingency outage of '413_B2_TOR9317'. This project contributes approximately 49.78 MW to the thermal violation.

CONTINGENCY '413_B2_TOR9317'
OPEN BRANCH FROM BUS 243598 TO BUS 243612 CKT 1 / 243598
05BCKSKI 69.0 243612 05PETERSB8 69.0 1
OPEN BRANCH FROM BUS 243606 TO BUS 243612 CKT 1 / 243606
05HIGHLA 69.0 243612 05PETERSB8 69.0 1
END

4. (AEP - AEP) The 05LATTAVL8-05BIERSRUN 69 kV line (from bus 243608 to bus 246893 ckt 1) loads from 90.92% to 192.26% (AC power flow) of its emergency rating (50 MVA) for the single line contingency outage of '412_B2_TOR13998_WOMOAB_B'. This project contributes approximately 51.33 MW to the thermal violation.

CONTINGENCY '412_B2_TOR13998_WOMOAB_B'
OPEN BRANCH FROM BUS 253030 TO BUS 932130 CKT 1 / 932130 AC2-020
TAP 69.0 253030 09GRNFLD 69.0 1
END

5. (AEP - AEP) The 05LATTAVL8-05BIERSRUN 69 kV line (from bus 243608 to bus 246893 ckt 1) loads from 68.51% to 127.34% (AC power flow) of its normal rating (50 MVA) for non-contingency condition. This project contributes approximately 34.26 MW to the thermal violation.

6. (AEP - AEP) The 05PETERSB8-05HIGHLA 69 kV line (from bus 243612 to bus 243606 ckt 1) loads from 74.43% to 153.53% (AC power flow) of its emergency rating (50 MVA) for the single line contingency outage of '412_B2_TOR13998_WOMOAB_B'. This project contributes approximately 48.67 MW to the thermal violation.

CONTINGENCY '412_B2_TOR13998_WOMOAB_B'
OPEN BRANCH FROM BUS 253030 TO BUS 932130 CKT 1 / 932130 AC2-020
TAP 69.0 253030 09GRNFLD 69.0 1
END

7. (AEP - AEP) The 05BIERSRUN-05SLATE 69 kV line (from bus 246893 to bus 243617 ckt 1) loads from 92.43% to 106.46% (AC power flow) of its emergency rating (50 MVA) for the single line contingency outage of '6786_B2'. This project contributes approximately 8.25 MW to the thermal violation.

CONTINGENCY '6786_B2'

OPEN BRANCH FROM BUS 246889 TO BUS 246890 CKT 1 / 246889 05BIERSR
138 246890 05HOPETN 138 1
END

8. (AEP - DAY) The AC2-020 TAP-09GRNFLD 69 kV line (from bus 932130 to bus 253030 ckt 1) loads from 58.93% to 128.06% (AC power flow) of its emergency rating (72 MVA) for the single line contingency outage of '413_B2_TOR9317'. This project contributes approximately 49.78 MW to the thermal violation.

CONTINGENCY '413_B2_TOR9317'

OPEN BRANCH FROM BUS 243598 TO BUS 243612 CKT 1 / 243598
05BCKSKI 69.0 243612 05PETERSB8 69.0 1
OPEN BRANCH FROM BUS 243606 TO BUS 243612 CKT 1 / 243606
05HIGHLA 69.0 243612 05PETERSB8 69.0 1
END

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)

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

None

Schedule

It is anticipated that the time between receipt of executed agreements and Commercial Operation may range from 12 to 18 months if no line work is required. If line work is required, construction time would be between 24 to 36 months after signing an interconnection agreement.

Note: The time provided between anticipated normal completion of System Impact, Facilities Studies, subsequent execution of ISA and ICSA documents, and the proposed In-Service Date is shorter than usual and may be difficult to achieve.

Conclusion

Based upon the results of this System Impact Study, the construction of the 100.0 MW (64.0 MW Capacity) solar generating facility of First Solar Development (PJM Project #AC2-060) will require the following additional interconnection charges. This plan of service will interconnect the proposed generating facility in a manner that will provide operational reliability and flexibility to both the AEP system and the First Solar Development generating facility.

Cost Breakdown for Point of Interconnection (Buckskin 69 kV)		
Attachment Cost	Expand Buckskin 69 kV substation	\$1,500,000
Non-Direct Connection Cost Estimate	69 kV Revenue Metering	\$200,000
	Upgrade line protection and controls at the Buckskin 69 kV substation.	\$200,000
	First Solar Development will be responsible for addressing the deficiency in lagging power factor requirements.	First Solar Development Responsibility
	Total Estimated Cost for Project AC2-055	\$1,900,000

Table 2

The estimates are preliminary in nature, as they were determined without the benefit of detailed engineering studies. Final estimates will require an on-site review and coordination to determine final construction requirements.

Figure 1: Point of Interconnection (Buckskin 69 kV Substation)
Single Line Diagram

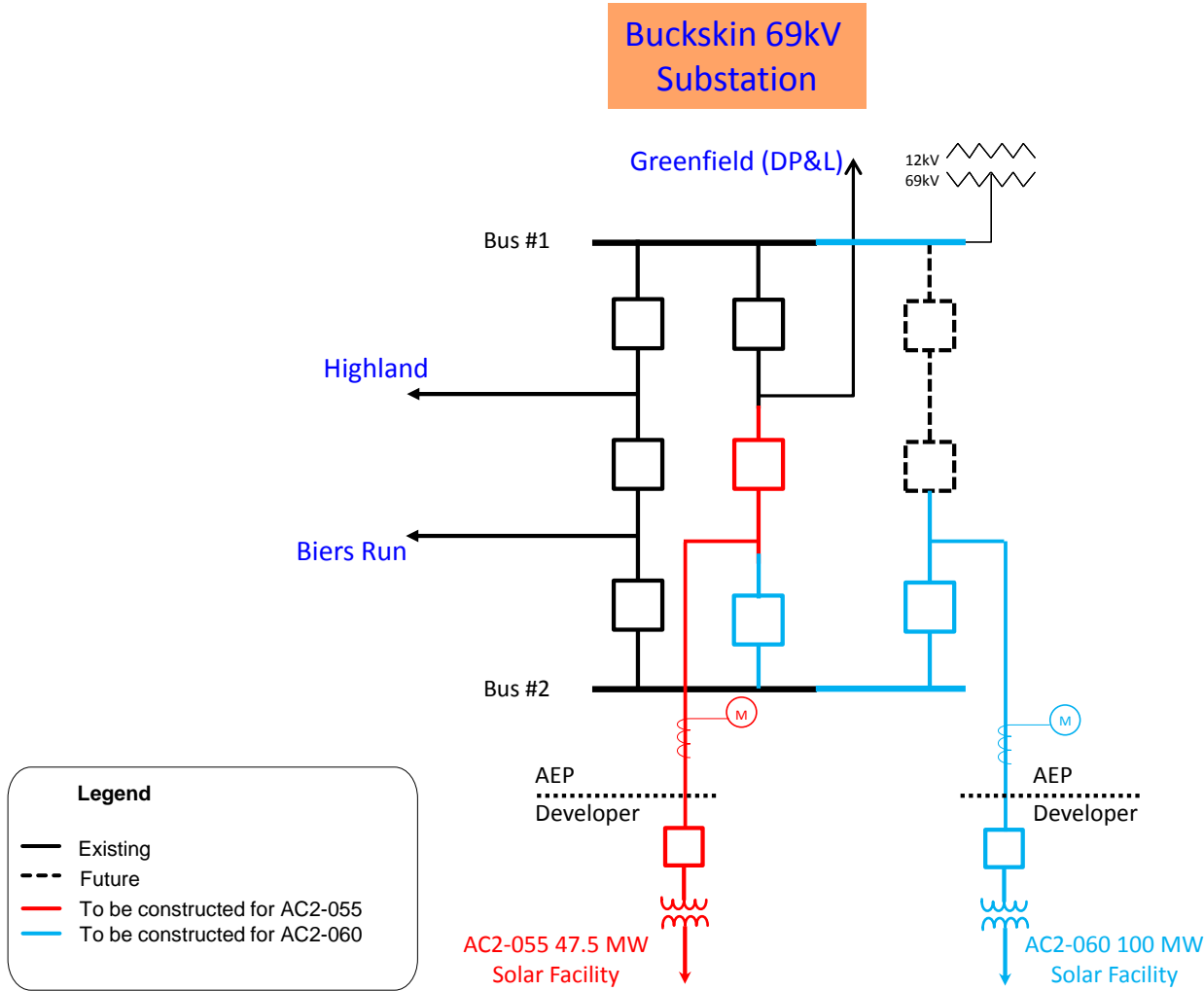


Figure 2: Customer Project Site and Point of Interconnection (Buckskin 69 kV Substation)



***Generation Interconnection
Feasibility Study Report***

For

***PJM Generation Interconnection Request
Queue Position AD1-073***

Buckskin 69kV

April 2018

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. 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 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.

General

The Interconnection Customer (IC) proposes to increase the generation of its previous PJM Project #AC2-060, a 100.0 MW (64.0 MW Capacity) solar generating facility in Ross County, Ohio by 20.0 MW (13.2 MW Capacity) (see Figure 1). The point of interconnection is a direct connection to AEP's Buckskin 69 kV substation.

The requested in service date is June 1, 2020.

Attachment Facilities

To be constructed by PJM Project #AC2-060.

Note: It is assumed that the 69 kV revenue metering and gen lead installed for the #AC2-060 will be adequate for the additional generation.

Interconnection Customer Requirements

The Generation Interconnection Agreement does not in or by itself establish a requirement for American Electric Power to provide power for consumption at the developer's facilities. A separate agreement may be reached with the local utility that provides service in the area to ensure that infrastructure is in place to meet this demand and proper metering equipment is installed. It is the responsibility of the developer to contact the local service provider to determine if a local service agreement is required.

Requirement from the PJM Open Access Transmission Tariff:

1. An Interconnection Customer entering the New Services Queue on or after October 1, 2012 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.
2. The Interconnection Customer may be required to install and/or pay for metering as necessary to properly track real time output of the facility as well as installing metering which shall be used for billing purposes. See Section 8 of Appendix 2 to the Interconnection Service Agreement as well as Section 4 of PJM Manual 14D for additional information.

Revenue Metering and SCADA Requirements

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 Sections 24.1 and 24.2.

AEP Requirements

The Interconnection Customer will be required to comply with all AEP Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the "Requirements for Connection of New Facilities or Changes to Existing Facilities Connected to the AEP Transmission System" document located at the following link:

<http://www.pjm.com/~media/planning/plan-standards/private-aep/aep-interconnection-requirements.ashx>

Network Impacts

The Queue Project AD1-073 was evaluated as a 20.0 MW (Capacity 13.2 MW) uprate to the AC2-060 Queue Project which is a direct connection to the Buckskin substation in the AEP area. Project AD1-073 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD1-073 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis – 2021

Contingency Descriptions

The following contingencies resulted in overloads:

Option 1	
Contingency Name	Description
DAY_P1_1339_B3	OPEN BRANCH FROM BUS 253100 TO BUS 253099 CKT 1 / 253100 09ATLNTA 345 253099 09ATLNTA 69.0 1 END
DAY_P1_160_B3	OPEN BRANCH FROM BUS 253110 TO BUS 253100 CKT 1 / 253110 09ADKINS 345 253100 09ATLNTA 345 1 OPEN BRANCH FROM BUS 253100 TO BUS 253099 CKT 1 / 253100 09ATLNTA 345 253099 09ATLNTA 69.0 1 END

Table 1

Generator Deliverability

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

AD1-073 Generator Deliverability														
#	Contingency		Affected Area	Facility Description	Bus		Cir.	PF	Loading		Rating		MW Con.	FG App.*
	Type	Name			From	To			Initial	Final	Type	MVA		
1	N-1	DAY_P1_1339_B3	AEP-DAY	AC2-020 TAP-09GRNFLD 69 kV line	932130	253030	1	DC	97.07	102.44	ER	72	3.87	1
2	N-1	DAY_P1_160_B3	AEP-DAY	AC2-020 TAP-09GRNFLD 69 kV line	932130	253030	1	DC	96.88	102.25	ER	72	3.87	1

Table 2

*Please refer to Appendix 1 for a table containing the generators having contribution to this flowgate.

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)

None

Steady-State Voltage Requirements

None

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

None

Affected System Analysis & Mitigation

LGEE Impacts:

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

MISO Impacts:

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

Duke, Progress & TVA Impacts:

Duke Carolina, Progress, & TVA Impacts to be determined during later study phases (as applicable).

OVEC Impacts:

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

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.

AD1-073 Generator Deliverability														
#	Contingency		Affected Area	Facility Description	Bus		Cir.	PF	Loading		Rating		MW Con.	FG App.
	Type	Name			From	To			Initial	Final	Type	MVA		
1	N-1	DAY_P1_1339_B3	DAY-DAY	AC2-020 TAP-09GRNFLD 69 kV line	932130	253030	1	DC	149.42	157.56	ER	72	5.86	
2	NON	NON	DEO&K-DEO&K	AC2-061 TAP-08CLINCO 138 kV line	932430	249995	1	DC	99.86	100.16	ER	159	1.04	

Table 3

New System Reinforcements

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

Generator Deliverability:

1. (AEP - DAY) The AC2-020 TAP-09GRNFLD 69 kV line (from bus 932130 to bus 253030 ckt 1) loads from 97.07% to 102.44% (DC power flow) of its emergency rating (72 MVA) for the single line contingency outage of 'DAY_P1_1339_B3'. This project contributes approximately 3.87 MW to the thermal violation.

AEP:

No mitigation is required

DAY:

Replace 600A circuit breaker at Greenfield Substation with a new 1200A circuit breaker.

Cost: \$630,000; Time: 12 months to engineer, procure, construct, and place in service, subject to detailed engineering analysis

2. (AEP - DAY) The AC2-020 TAP-09GRNFLD 69 kV line (from bus 932130 to bus 253030 ckt 1) loads from 96.88% to 102.25% (DC power flow) of its emergency rating (72 MVA) for the single line contingency outage of 'DAY_P1_160_B3'. This project contributes approximately 3.87 MW to the thermal violation.

Same as Generator Deliverability #1

Previous System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, identified for earlier generation or transmission interconnection projects in the PJM Queue)

None

Schedule

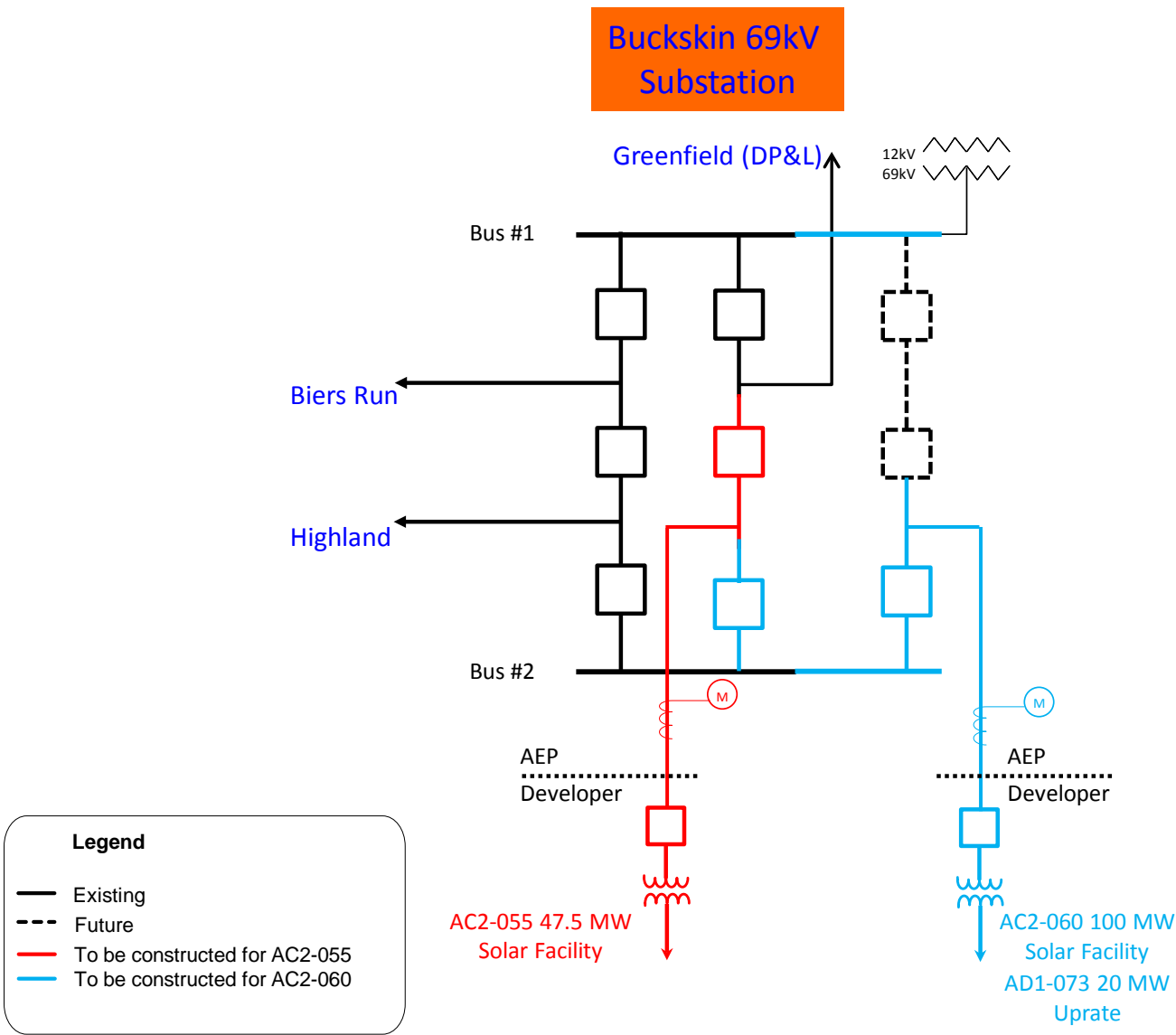
It is anticipated that the time between receipt of executed agreements and Commercial Operation may range from 12 to 18 months if no line work is required. If line work is required, construction time would be between 24 to 36 months after signing an interconnection agreement.

Note: The time provided between anticipated normal completion of System Impact, Facilities Studies, subsequent execution of ISA and ICSA documents, and the proposed In-Service Date is shorter than usual and may be difficult to achieve.

Conclusion

Based upon the results of this Feasibility Study, the increase of 20.0 MW (PJM Project #AD1-073) generation to the IC's previous request of 100.0 MW (64.0 MW Capacity) solar generating facility (PJM Project #AC2-060) will not require additional interconnection charges.

Figure 1: Point of Interconnection (Buckskin 69 kV Substation)
Single Line Diagram



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 gauge 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

(AEP - DAY) The AC2-020 TAP-09GRNFLD 69 kV line (from bus 932130 to bus 253030 ckt 1) loads from 97.07% to 102.44% (**DC power flow**) of its emergency rating (72 MVA) for the single line contingency outage of 'DAY_P1_1339_B3'. This project contributes approximately 3.87 MW to the thermal violation.

CONTINGENCY 'DAY_P1_1339_B3'

OPEN BRANCH FROM BUS 253100 TO BUS 253099 CKT 1 / 253100

09ATLNTA 345 253099 09ATLNTA 69.0 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
932131	AC2-020 C	2.44
932381	AC2-055 C	5.29
932421	AC2-060 C	18.75
932651	AC2-087 C	13.89
934491	AD1-073 C	3.87

***Generation Interconnection
System Impact Study Report***

For

***PJM Generation Interconnection Request
Queue Position AD1-073***

Buckskin 69kV

December 2019

Preface

The intent of the System Impact 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: (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. 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 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 or merchant transmission upgrade, may also contribute to the need for the same network reinforcement.

The System Impact 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.

General

Ross County Solar, LLC proposes to increase the generation of its previous PJM Project #AC2-060, a 100.0 MW (64.0 MW Capacity) solar generating facility in Ross County, Ohio by 20.0 MW (13.2 MW Capacity) (see Figure 1). The point of interconnection is a direct connection to AEP's Buckskin 69 kV substation.

The requested in service date is December 31, 2019.

Attachment Facilities

Point of Interconnection (Buckskin 69kV substation)

To be constructed by PJM Project #AC2-060.

Note: It is assumed that the 69 kV revenue metering and gen lead installed for the #AC2-060 will be adequate for the additional generation.

Non-Direct Connection Cost Estimate

The total preliminary cost estimate for Non-Direct Connection work is given in the following table below:

For AEP building Non-Direct Connection cost estimates:

Description	Estimated Cost
Modify Relay Settings for the Buckskin 69kV substation	\$25,000
Total	\$25,000

Table 1

Interconnection Customer Requirements

It is understood that Ross County Solar is responsible for all costs associated with this interconnection. The cost of Ross County Solar's generating plant and the costs for the line connecting the generating plant to the Buckskin 69 kV substation are not included in this report; these are assumed to be Ross County Solar's responsibility. It is also assumed that any metering or other operational data PJM may require for the new generation/storage facility to participate in the desired PJM Markets can be accommodated by the existing telecommunications equipment. If any modification of metering or telecommunications equipment is required, that would also be Ross County Solar's responsibility.

The Generation Interconnection Agreement does not in or by itself establish a requirement for American Electric Power to provide power for consumption at the developer's facilities. A separate agreement may be reached with the local utility that provides service in the area to ensure that infrastructure is in place to meet this demand and proper metering equipment is installed. It is the responsibility of the developer to contact the local service provider to determine if a local service agreement is required.

Requirement from the PJM Open Access Transmission Tariff:

1. An Interconnection Customer entering the New Services Queue on or after October 1, 2012 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.
2. The Interconnection Customer may be required to install and/or pay for metering as necessary to properly track real time output of the facility as well as installing metering which shall be used for billing purposes. See Section 8 of Appendix 2 to the Interconnection Service Agreement as well as Section 4 of PJM Manual 14D for additional information.

Revenue Metering and SCADA Requirements

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 Sections 24.1 and 24.2.

AEP Requirements

The Interconnection Customer will be required to comply with all AEP Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the "Requirements for Connection of New Facilities or Changes to Existing Facilities Connected to the AEP Transmission System" document located at the following link:

<http://www.pjm.com/~media/planning/plan-standards/private-aep/aep-interconnection-requirements.ashx>

Network Impacts

The Queue Project AD1-073 was evaluated as a 20.0 MW (Capacity 13.2 MW) injection into the Buckskin 69 kV substation in the AEP area. Project AD1-073 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD1-073 was studied with a commercial probability of 100%. 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)

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)

None

Steady-State Voltage Requirements

(Results of the steady-state voltage studies should be inserted here)

None

Stability and Reactive Power Requirement

(Results of the dynamic studies should be inserted here)

Instabilities were identified for the AC2-087 project connected at Buckskin 69 kV station for contingencies P4.05 and P4.07 due to the loss of the Buckskin – Petersburg – Highland and Buckskin – Lattaville – Biers Run 69 kV circuits, following two upgrades were made in the base case.

The proposed upgrade to mitigate the instability is to add a second line (19.25 mile) from Buckskin to Highland 69 kV using 1033 ACSR conductor, AC2-087 is responsible for this upgrade and AD1-073 has some cost allocation (see Table 3). After applying the upgrade to the study case, all criteria were met for the contingencies tested.

Reactive compensation is required to mitigate the reactive deficiency.

Network Upgrade	Description	Cost Estimate
PJM Network Upgrade N6303	At Buckskin Substation install (2) 69kV CBs for a new line position with associated buswork. Construct the line exit for a new 69kV line to Highland.	\$1.3M
PJM Network Upgrade N6304	At Highland Substation remove the existing 69-12 kV transformer #2 to free up space for the new line position. The transformer will be replaced with a new 138-12kV transformer served via the 138kV bus and install new 138kV circuit breaker for high-side protection. The DP&L Willmington line will need to be moved over to where the old 69-12kV Transformer #2 was. The Willmington Line will need a new 69kV breaker for its line termination. The new Buckskin Line #2 can be terminated where the Willmington line was (CB 64). There will be associated Protection & Control work.	\$4.6M
PJM Network Upgrade N6305	Construct new 19.25-mile 69kV Buckskin–Highland #2 Line with steel H-frame construction using 1033 ACSR conductor.	\$39M

Table 2

Queue	MW Impact	Percentage of Impact	Cost Allocation (\$ MW)
AC2-087	85	0.81	36.35
AD1-073	20	0.19	8.55

Table 3

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

None

Dayton Local Planning Analysis

1. (AEP - DAY) The (BUCKSKIN) AC2-020 TAP-09GRNFLD 69 kV line (from bus 932130 to bus 253030 ckt 1) loading exceeds its emergency rating (72 MVA) for the single line contingency outage of 'DAY_P1_160_B3'.

This project contributes approximately 3.87 MW to the thermal violation.

CONTINGENCY 'DAY_P1_160_B3'

OPEN BRANCH FROM BUS 253110 TO BUS 253100 CKT 1 / 253110
09ADKINS 345 253100 09ATLNTA 345 1

OPEN BRANCH FROM BUS 253100 TO BUS 253099 CKT 1 / 253100
09ATLNTA 345 253099 09ATLNTA 69.0 1

END

2. (AEP - DAY) The (BUCKSKIN) AC2-020 TAP-09GRNFLD 69 kV line (from bus 932130 to bus 253030 ckt 1) loading exceeds its emergency rating (72 MVA) for the single line contingency outage of 'DAY_P1_1339_B3'.

This project contributes approximately 3.87 MW to the thermal violation.

CONTINGENCY 'DAY_P1_1339_B3'

OPEN BRANCH FROM BUS 253100 TO BUS 253099 CKT 1 / 253100
09ATLNTA 345 253099 09ATLNTA 69.0 1

END

Affected System Analysis & Mitigation

LGEE Impacts:

None

MISO Impacts:

None

Duke, Progress & TVA Impacts:

None

OVEC Impacts:

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. (AEP - DAY) The (BUCKSKIN) AC2-020 TAP-09GRNFLD 69 kV line (from bus 932130 to bus 253030 ckt 1) loads from 149.47% to 158.77% (AC power flow) of its emergency rating (72 MVA) for the single line contingency outage of 'AEP_P1-2_#6763'. This project contributes approximately 6.59 MW to the thermal violation.

CONTINGENCY 'AEP_P1-2_#6763'

OPEN BRANCH FROM BUS 246888 TO BUS 243454 CKT 1 / 246888 05BIERSR
345 243454 05BIXBY 345 1
END

2. (AEP - DAY) The (BUCKSKIN) AC2-020 TAP-09GRNFLD 69 kV line (from bus 932130 to bus 253030 ckt 1) loads from 140.21% to 149.46% (AC power flow) of its normal rating (72 MVA) for non-contingency condition. This project contributes approximately 6.56 MW to the thermal violation.

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 resolve the (Buckskin) AC2-020 TAP-09GRNFLD 69 kV line overloads:

(Dayton work required):

Replace a 600 A Greenfield 69 kV circuit breaker with a 2000 A circuit breaker.

Estimated cost is \$207K. PJM Network Upgrade N6016.

The AEP portion of the line has an emergency rating of 165 MVA and is sufficient.

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

Schedule

It is anticipated that the time between receipt of executed agreements and Commercial Operation may range from 12 to 18 months if no line work is required. If line work is required, construction time would be between 24 to 36 months after signing an interconnection agreement.

Note: The time provided between anticipated normal completion of System Impact, Facilities Studies, subsequent execution of ISA and ICSA documents, and the proposed In-Service Date is shorter than usual and may be difficult to achieve.

Conclusion

Based upon the results of this System Impact Study, the increase of 20.0 MW (PJM Project #AD1-073) generation to the previous request of 100.0 MW (64.0 MW Capacity) solar generating facility of Ross County Solar will require the following additional interconnection charges shown in table 4 below. This plan of service will interconnect the proposed generating facility in a manner that will provide operational reliability and flexibility to both the AEP system and the Ross County Solar generating facility.

Cost Breakdown for the Point of Interconnection (Buckskin 69 kV Substation)		
	Modify Relay Settings for the Buckskin 69kV substation	\$25,000
	Construct new 19.25-mile 69kV Buckskin–Highland #2 Line with steel H-frame construction using 1033 ACSR conductor. PJM Network Upgrade N6305. At Buckskin Substation install (2) 69kV CBs for a new line position with associated buswork. Construct the line exit for a new 69kV line to Highland. PJM Network Upgrade N6303. At Highland Substation remove the existing 69-12 kV transformer #2 to free up space for the new line position. The transformer will be replaced with a new 138-12kV transformer served via the 138kV bus and install new 138kV circuit breaker for high-side protection. The DP&L Willmington line will need to be moved over to where the old 69-12kV Transformer #2 was. The Willmington Line will need a new 69kV breaker for its line termination. The new Buckskin Line #2 can be terminated where the Willmington line was (CB 64). There will be associated Protection & Control work. PJM Network Upgrade N6304.	\$8,550,000
	Replace a 600 A Greenfield 69 kV circuit breaker with a 2000 A circuit breaker. Estimated cost is \$207K. PJM Network Upgrade N6016	\$207,000
	Total Estimated Cost for Project AD1-073	\$8,782,000

Table 3

The estimates are preliminary in nature, as they were determined without the benefit of detailed engineering studies. Final estimates will require an on-site review and coordination to determine final construction requirements.

Figure 1: Point of Interconnection (Buckskin 69 kV Substation)

Single Line Diagram

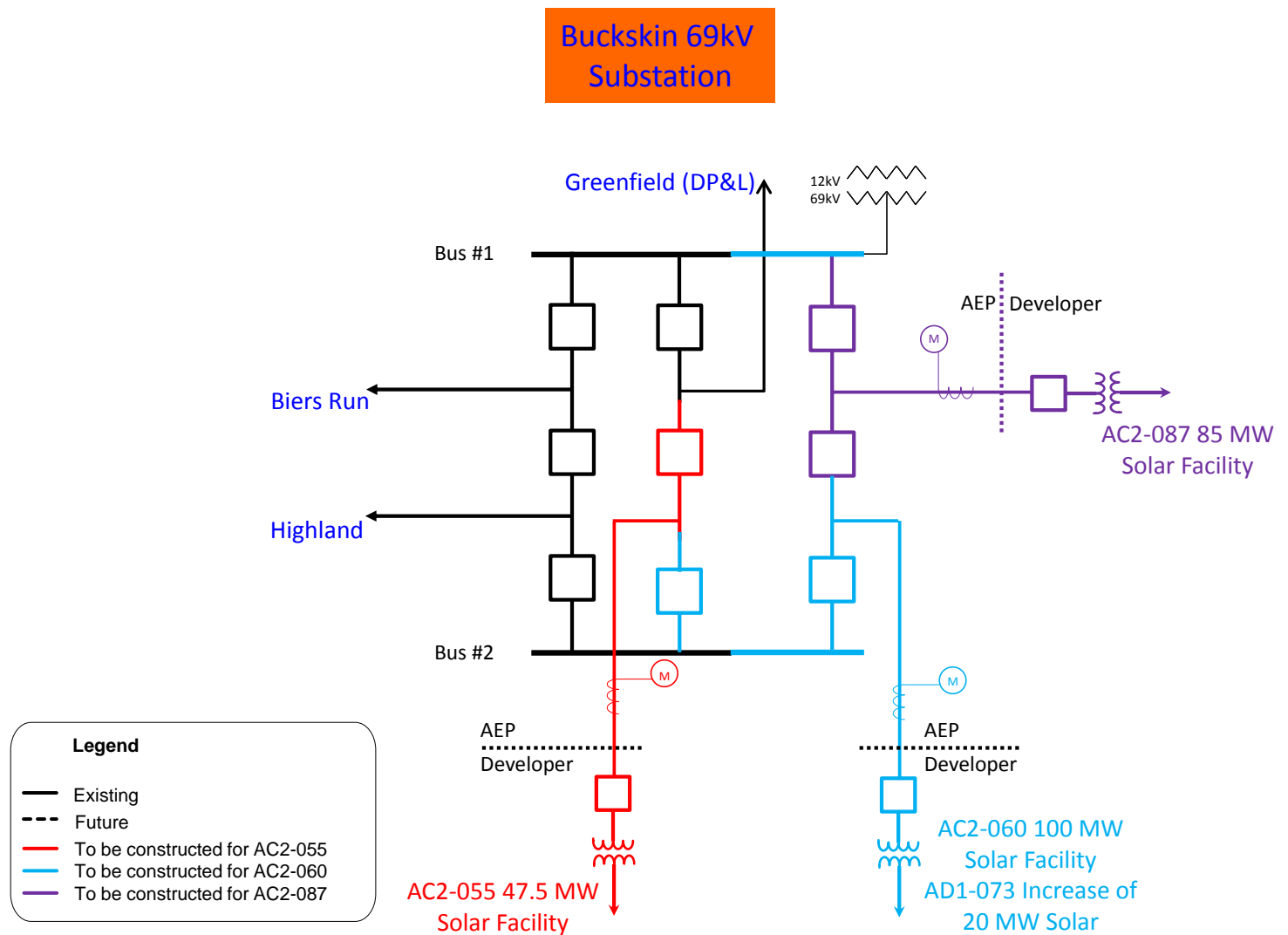
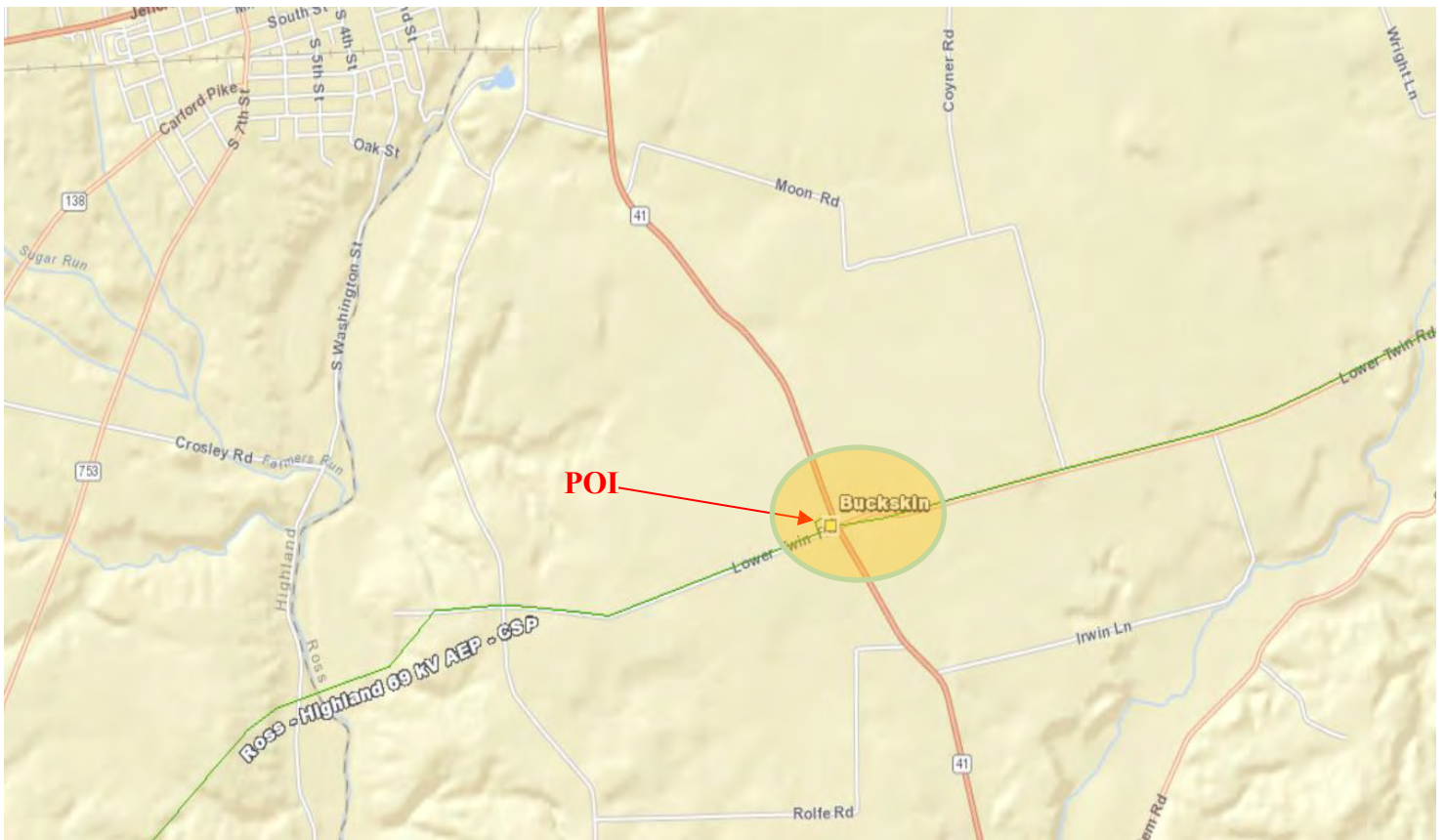


Figure 2: Point of Interconnection (Buckskin 69 kV Substation)



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in

Case No(s). 20-1380-EL-BGN

Summary: Application Application Exhibit J electronically filed by Mr. Michael J. Settineri on behalf of Ross County Solar, LLC