Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AC1-089

Wildcat 138 kV

March 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 to install PJM Project #AC1-089, a 150.0 MW (57.0 MW Capacity) solar generating facility in Highland County, Ohio (see Figure 2). The primary point of interconnection will be a direct connection to AEP's Wildcat 138 kV substation (see Figure 1). The secondary point of interconnection will be to AEP's Hillsboro – Wildcat 138 kV circuit (see Figure 1).

The requested backfeed date is September 1, 2019.

The requested in service date is October 1, 2019.

Attachment Facilities

Primary Point of Interconnection (Wildcat 138 kV)

To accommodate the interconnection at the Wildcat 138 kV substation, the Wildcat substation will have to be expanded requiring two (2) additional 138 kV circuit breakers to physically configure the substation in a breaker and half bus arrangement (see Figure 2). Installation of associated protection and control equipment, 138 kV line risers, SCADA, and 138 kV revenue metering will also be required.

<u>New Switching Station Work:</u>

- Expand the Wildcat 138 kV substation; the Wildcat substation will have to be expanded requiring two (2) additional 138 kV circuit breakers to physically configure the substation in a breaker and half bus arrangement (see Figure 2). Installation of associated protection and control equipment, 138 kV line risers, SCADA, and 138 kV revenue metering will also be required.
    - **Estimated Station Cost: $3,000,000**

Non-Direct Connection Cost Estimate

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

For AEP building Direct Connection cost estimates:

Description	Estimated Cost
138 kV Revenue Metering	**$300,000**
Upgrade line protection and controls at the expanded Wildcat 138 kV substation.	**$300,000**
Total	**$600,000**

Table 1

Secondary Point of Interconnection (Hillsboro - Wildcat 138 kV Substation)

To accommodate the interconnection on the Hillsboro – Wildcat 138 kV section of line, a new three (3) circuit breaker 138 kV switching station physically configured in a breaker and half bus arrangement but operated as a ring-bus will be constructed (see Figure 1). Installation of associated protection and control equipment, 138 kV line risers, SCADA, and 138 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.

It is understood that The Interconnection Customeris responsible for all costs associated with this interconnection. The costs above are reimbursable to AEP. The cost of Willowbrook Solar's generating plant and the costs for the line connecting the generating plant to Willowbrook Solar's switching station are not included in this report; these are assumed to be Willowbrook 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.

Interconnection Customer Requirements

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 AC1-089 was evaluated as a 150.0 MW (Capacity 57.0 MW) injection at the Wildcat 138kV substation in the AEP area. Project AC1-089 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC1-089 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Base Case Used

Summer Peak Analysis – 2020 Case

Contingency Descriptions

The following contingencies resulted in overloads:

Option 1	
Contingency Name	**Description**
DAY_L34508-2	CONTINGENCY 'DAY_L34508-2' OPEN LINE FROM BUS 253014 TO BUS 253027 CKT 1 /* 09CLINTO 345 - 09GREENE 345 OPEN LINE FROM BUS 253014 TO BUS 253077 CKT 1 /* 09CLINTO 345 - 09STUART 345 END
DAY_L34509	CONTINGENCY 'DAY_L34509' OPEN LINE FROM BUS 253077 TO BUS 253014 CKT 1 /* 09STUART 345 - 09CLINTO 345 OPEN LINE FROM BUS 253077 TO BUS 253076 CKT 1 /* 09STUART 345 - 09STUART 138 END
892_B2	CONTINGENCY '892_B2' OPEN BRANCH FROM BUS 253014 TO BUS 253077 CKT 1 / 253014 09CLINTO 345 253077 09STUART 345 1 END
P7-1..C5 4541MELDAHLSPRLCKSTUARTSPURLOCKDPLEK	CONTINGENCY 'P7-1..C5 4541MELDAHLSPRLCKSTUARTSPURLOCKDPLEK' OPEN BRANCH FROM BUS 342838 TO BUS 249581 CKT 1 OPEN BRANCH FROM BUS 253077 TO BUS 342838 CKT 1 END

Table 2

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)

	Contingency				Bus				Loading		Rating		
#	Type	Name	Affected Area	Facility Description	From	To	Cir.	PF	Initial	Final	Type	MVA	MW Con.
8	DCTL	P7-1..C5 4541MELDAHLSPRLCKSTUART	AEP - AEP	05WLDCAT-05HILLSB 138 kV line	246946	243019	1	DC	85.48	139.78	ER	185	100.44
9	LFFB	DAY_L34509_A	AEP - AEP	05WLDCAT-05HILLSB 138 kV line	246946	243019	1	DC	56.81	109.9	ER	185	98.22
10	LFFB	DAY_L34508_2_A	AEP - AEP	05WLDCAT-05HILLSB 138 kV line	246946	243019	1	DC	55.56	108.57	ER	185	98.07

Table 3

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

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

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.

Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which shall study all overload conditions associated with the overloaded element(s) identified.

	Contingency				Bus				Loading		Rating		
#	Type	Name	Affected Area	Facility Description	From	To	Cir.	PF	Initial	Final	Type	MVA	MW Con.
1	N-1	8468_B2	OVEC - AEP	06KYGER-05SPORN 345 kV line	248005	242528	1	DC	108.41	108.98	NR	1017	12.98
2	N-1	349_B2_TOR21	OVEC - AEP	06KYGER-05SPORN 345 kV line	248005	242528	2	DC	113.55	114.15	NR	971	12.98
3	N-1	892_B2	AEP - AEP	05WLDCAT-05HILLSB 138 kV line	246946	243019	1	DC	53.13	106.28	ER	185	98.33

Table 4

New System Reinforcements

#	Overloaded Facility	Upgrade Description	Schedule	Estimated Cost
#1	05WLDCAT-05HILLSB 138 kV line	A sag check will be required for the ACSR ~ 477 ~ 26/7 ~ HAWK - Conductor Section 1 to determine if the line section can be operated above its emergency rating of 185 MVA. The result could prove that no additional upgrades are necessary, that some upgrades on the circuit are necessary, or that the entire 10.0 mile section of line would need to be rebuilt.	An approximate time for the sag study is 6 to 12 months after signing an interconnection agreement.	**$40,000**
			Total New Network Upgrades	**$40,000**

Table 5

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 Backfeed Date is shorter than usual and may be difficult to achieve.

Conclusion

Based upon the results of this Feasibility Study, the construction of the 150.0 MW (57.0 MW Capacity) solar generating facility of The Interconnection Customer(PJM Project #AC1-089) will require the following additional interconnection charges. This plan of service will interconnect the proposed solar generating facility in a manner that will provide operational reliability and flexibility to both the AEP system and the The Interconnection Customergenerating facility.

Cost Breakdown for Primary Point of Interconnection (Wildcat 138 kV Substation)		
Attachment Cost	Expand the Wildcat 138 kV Substation	**$3,000,000**
Non-Direct Connection Cost Estimate	138 kV Revenue Metering	**$300,000**
	Upgrade line protection and controls at the expanded Wildcat 138 kV substation.	**$300,000**
	A sag check will be required for the ACSR ~ 477 ~ 26/7 ~ HAWK - Conductor Section 1 to determine if the line section can be operated above its emergency rating of 185 MVA. The result could prove that no additional upgrades are necessary, that some upgrades on the circuit are necessary, or that the entire 10.0 mile section of line would need to be rebuilt.	**$40,000**
	Total Estimated Cost for Project AC1-089	**$3,640,000**

Table 6

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.

Option 2

Network Impacts

The Queue Project AC1-089 was evaluated as a 150.0 MW (Capacity 57.0 MW) injection tapping the Hillsboro-Wildcat 138kV line in the AEP area. Project AC1-089 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC1-089 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Base Case Used

Summer Peak Analysis – 2020 Case

Contingency Descriptions

The following contingencies resulted in overloads:

Option 2	
Contingency Name	**Description**
7981	CONTINGENCY '7981' OPEN BRANCH FROM BUS 243019 TO BUS 249995 CKT 1 / 243019 05HILLSB 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
349_B2_TOR21	CONTINGENCY '349_B2_TOR21' OPEN BRANCH FROM BUS 242528 TO BUS 248005 CKT 1 / 242528 05SPORN 345 248005 06KYGER 345 1 END
363_B2_TOR1682	CONTINGENCY '363_B2_TOR1682' OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO 765 243209 05ROCKPT 765 1 END
4812_B2_TOR8931	CONTINGENCY '4812_B2_TOR8931' OPEN BRANCH FROM BUS 242921 TO BUS 242924 CKT 1 / 242921 05CORNU 765 242924 05HANG R 765 1 END
4839_B1_05ROCKPT 765-1	CONTINGENCY '4839_B1_05ROCKPT 765-1' OPEN BRANCH FROM BUS 243209 TO BUS 243442 CKT 1 / 243209 05ROCKPT 765 243442 05RKG1 26.0 1 REMOVE UNIT 1H FROM BUS 243442 / 243442 05RKG1 26.0

Option 2 Contingency Name	Description
	REMOVE UNIT 1L FROM BUS 243442 / 243442 05RKG1 26.0 END
7342_B2_TOR7202268	CONTINGENCY '7342_B2_TOR7202268' OPEN BRANCH FROM BUS 246911 TO BUS 243019 CKT 1 / 246911 05HIGHLA 138 243019 05HILLSB 138 1 END
7350_C2_05HIGHLA 138-_WOMOAB	CONTINGENCY '7350_C2_05HIGHLA 138-_WOMOAB' OPEN BRANCH FROM BUS 246911 TO BUS 243019 CKT 1 / 246911 05HIGHLA 138 243019 05HILLSB 138 1 OPEN BRANCH FROM BUS 246911 TO BUS 247035 CKT 1 / 246911 05HIGHLA 138 247035 05NMARSS 138 1 OPEN BRANCH FROM BUS 246912 TO BUS 247035 CKT 1 / 246912 05N MKT8 138 247035 05NMARSS 138 1 OPEN BRANCH FROM BUS 247035 TO BUS 243571 CKT 1 / 247035 05NMARSS 138 243571 05SEAMAN 138 1 OPEN BRANCH FROM BUS 246911 TO BUS 243606 CKT 3 / 246911 05HIGHLA 138 243606 05HIGHLA 69.0 3 END
8107_C2_05HILLSB 138-C_A	CONTINGENCY '8107_C2_05HILLSB 138-C_A' OPEN BRANCH FROM BUS 246911 TO BUS 243019 CKT 1 / 246911 05HIGHLA 138 243019 05HILLSB 138 1 OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1 END
8107_C2_05HILLSB 138-C_B	CONTINGENCY '8107_C2_05HILLSB 138-C_B' OPEN BRANCH FROM BUS 246911 TO BUS 243019 CKT 1 / 246911 05HIGHLA 138 243019 05HILLSB 138 1 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
8108_C2_05HILLSB 138-D	CONTINGENCY '8108_C2_05HILLSB 138-D' OPEN BRANCH FROM BUS 243019 TO BUS 249995 CKT 1 / 243019 05HILLSB 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

Option 2	
Contingency Name	**Description**
	END
8109_C2_05HILLSB 138-A	CONTINGENCY '8109_C2_05HILLSB 138-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 243042 TO BUS 243102 CKT 1 / 243042 05MILLBR 138 243102 05SINKG8 138 1 OPEN BRANCH FROM BUS 253111 TO BUS 253057 CKT 1 / 253111 09MIDDLE 138 253057 09OHH 138 1 END
8115_C2_05HIGHLA 138-_MOAB	CONTINGENCY '8115_C2_05HIGHLA 138-_MOAB' OPEN BRANCH FROM BUS 246911 TO BUS 243019 CKT 1 / 246911 05HIGHLA 138 243019 05HILLSB 138 1 OPEN BRANCH FROM BUS 246911 TO BUS 247035 CKT 1 / 246911 05HIGHLA 138 247035 05NMARSS 138 1 OPEN BRANCH FROM BUS 246911 TO BUS 243606 CKT 3 / 246911 05HIGHLA 138 243606 05HIGHLA 69.0 3 END
8468_B2	CONTINGENCY '8468_B2' OPEN BRANCH FROM BUS 242528 TO BUS 248005 CKT 2 / 242528 05SPORN 345 248005 06KYGER 345 2 END
892_B2	CONTINGENCY '892_B2' OPEN BRANCH FROM BUS 253014 TO BUS 253077 CKT 1 / 253014 09CLINTO 345 253077 09STUART 345 1 END
DAY_L34508-2	CONTINGENCY 'DAY_L34508-2' OPEN LINE FROM BUS 253014 TO BUS 253027 CKT 1 /* 09CLINTO 345 - 09GREENE 345 OPEN LINE FROM BUS 253014 TO BUS 253077 CKT 1 /* 09CLINTO 345 - 09STUART 345 END
DAY_L34509	CONTINGENCY 'DAY_L34509' OPEN LINE FROM BUS 253077 TO BUS 253014 CKT 1 /* 09STUART 345 - 09CLINTO 345 OPEN LINE FROM BUS 253077 TO BUS 253076 CKT 1 /* 09STUART 345 - 09STUART 138

Option 2 Contingency Name	Description
	END
H1TH3	CONTINGENCY 'H1TH3' /* BATH CO. REMOVE MACHINE 5 FROM BUS 315205 /*BATH UNIT #5 REMOVE MACHINE 6 FROM BUS 315206 /*BATH UNIT #6 REMOVE MACHINE 1 FROM BUS 315201 /*BATH UNIT #1 REMOVE MACHINE 2 FROM BUS 315202 /*BATH UNIT #2 END
P04	CONTINGENCY 'P04' DISCONNECT BUS 200122 /* DISCONNECT BUS 200192 /* DISCONNECT BUS 200193 /* DISCONNECT BUS 200194 /* DISCONNECT BUS 200195 /* 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 243019 CKT 1 END
P7-1..C5 4524FOSTRSUGRCRK34598FOSTERBATH	CONTINGENCY 'P7-1..C5 4524FOSTRSUGRCRK34598FOSTERBATH' OPEN BRANCH FROM BUS 253079 TO BUS 249566 CKT 1 OPEN BRANCH FROM BUS 253006 TO BUS 249566 CKT 1 END
P7-1..C5 4541MELDAHLSPRLCKSTUARTSPURLOCKDPLEK	CONTINGENCY 'P7-1..C5 4541MELDAHLSPRLCKSTUARTSPURLOCKDPLEK' OPEN BRANCH FROM BUS 342838 TO BUS 249581 CKT 1 OPEN BRANCH FROM BUS 253077 TO BUS 342838 CKT 1 END

Table 7

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)

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Cir.	PF	Loading Initial	Loading Final	Rating Type	Rating MVA	MW Con.
1	LFFB	8107_C2_05HILLSB 138-C_A	AEP - AEP	05HILLSB-05SINKG8 138 kV line	243019	243102	1	DC	76.58	102.35	ER	185	47.8
2	LFFB	8107_C2_05HILLSB 138-C_B	AEP - AEP	05HILLSB-05SINKG8 138 kV line	243019	243102	1	DC	76.58	102.35	ER	185	47.8
3	LFFB	8108_C2_05HILLSB 138-D	AEP - AEP	05HILLSB-05SINKG8 138 kV line	243019	243102	1	DC	76.17	101.6	ER	185	47.04
4	DCTL	7981	AEP - AEP	05HILLSB-05SINKG8 138 kV line	243019	243102	1	DC	76.17	101.6	ER	185	47.04
5	LFFB	8109_C2_05HILLSB 138-A	AEP - DEO&K	05HILLSB-08CLINCO 138 kV line	243019	249995	1	DC	98.59	124.65	ER	184	47.95
6	LFFB	8115_C2_05HIGHLA 138-_MOAB	AEP - DEO&K	05HILLSB-08CLINCO 138 kV line	243019	249995	1	DC	80.07	101.3	ER	184	39.06
7	LFFB	7350_C2_05HIGHLA 138-_WOMOAB	AEP - DEO&K	05HILLSB-08CLINCO 138 kV line	243019	249995	1	DC	80.07	101.3	ER	184	39.06
8	DCTL	P7-1..C5 4524FOSTRSUGRCRK34598FOSTERBATH	AEP - DAY	05HILLSB-09MIDDLE 138 kV line	243019	253111	1	DC	86.69	97.61	ER	185	20.2
9	LFFB	8107_C2_05HILLSB 138-C_B	AEP - AEP	05SINKG8-05MILLBR 138 kV line	243102	243042	1	DC	78.63	104.44	ER	179	47.8
10	LFFB	8107_C2_05HILLSB 138-C_A	AEP - AEP	05SINKG8-05MILLBR 138 kV line	243102	243042	1	DC	78.62	104.41	ER	179	47.8
11	LFFB	8108_C2_05HILLSB 138-D	AEP - AEP	05SINKG8-05MILLBR 138 kV line	243102	243042	1	DC	77.65	103.42	ER	179	47.04
12	DCTL	7981	AEP - AEP	05SINKG8-05MILLBR 138 kV line	243102	243042	1	DC	77.65	103.42	ER	179	47.04
13	LFFB	8107_C2_05HILLSB 138-C_B	DEO&K - DEO&K	08CLINCO-08WARRN1 138 kV line	249995	250122	1	DC	86.97	111.65	ER	198	48.86

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Cir.	PF	Loading Initial	Loading Final	Rating Type	Rating MVA	MW Con.
14	LFFB	8107_C2_05HILLSB 138-C_A	DEO&K - DEO&K	08CLINCO-08WARRN1 138 kV line	249995	250122	1	DC	86.97	111.65	ER	198	48.86
15	LFFB	8109_C2_05HILLSB 138-A	DEO&K - DEO&K	08CLINCO-08WARRN1 138 kV line	249995	250122	1	DC	78.05	102.27	ER	198	47.95
16	DCTL	P7-1..C5 4524FOSTRSUGRCRK34598FOSTERBATH	DAY - DAY	09MIDDLE-09OHH 138 kV line	253111	253057	1	DC	84.42	95.34	ER	185	20.2
17	DCTL	P7-1..C5 4541MELDAHLSPRLCKSTUARTSPURLOCKDPLEK	AEP - AEP	AC1-089 TAP-05HILLSB 138 kV line	926100	243019	1	DC	85.54	146.32	ER	185	112.44
18	LFFB	DAY_L34509	AEP - AEP	AC1-089 TAP-05HILLSB 138 kV line	926100	243019	1	DC	56.75	116.67	ER	185	110.85
19	LFFB	DAY_L34508-2	AEP - AEP	AC1-089 TAP-05HILLSB 138 kV line	926100	243019	1	DC	55.62	115.45	ER	185	110.69

Table 8

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)

Note: Please see Appendices for projects providing impacts to flowgate violations. The values in the Reference column correspond to the proper table in the Appendix.

AC1-089 Contribution to Previously Identified Overloads

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Cir.	PF	Loading Initial	Loading Final	Rating Type	Rating MVA	MW Con.	FG App.
1	LFFB	8107_C2_05HILLSB 138-C_A	AEP - DEO&K	05HILLSB-08CLINCO 138 kV line	243019	249995	1	DC	108.17	134.73	ER	184	48.86	7
2	LFFB	8107_C2_05HILLSB 138-C_B	AEP - DEO&K	05HILLSB-08CLINCO 138 kV line	243019	249995	1	DC	108.17	134.73	ER	184	48.86	
3	LFFB	8108_C2_05HILLSB 138-D	AEP - AEP	05HIGHLA 138/69 kV transformer	246911	243606	3	DC	110.19	126.65	ER	122	20.08	8
4	DCTL	7981	AEP - AEP	05HIGHLA 138/69 kV transformer	246911	243606	3	DC	110.19	126.65	ER	122	20.08	
5	LFFB	8109_C2_05HILLSB 138-A	AEP - AEP	05HIGHLA 138/69 kV	246911	243606	3	DC	102.97	119.07	ER	122	19.65	

AC1-089 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		
				transformer										
6	N-1	363_B2_TOR1682	LGEE - OVEC	7TRIMBLE-06CLIFTY 345 kV line	324114	248000	1	DC	174.06	174.06	ER	1370	0	9
7	Non	Non	LGEE - OVEC	7TRIMBLE-06CLIFTY 345 kV line	324114	248000	1	DC	120.55	120.55	NR	1134	0	
8	N-1	4812_B2_TOR8931	LGEE - OVEC	7TRIMBLE-06CLIFTY 345 kV line	324114	248000	1	DC	106.48	106.48	ER	1370	0	
9	Non	Non	MISO AMIL - MISO AMIL	7NEWTON-7CASEY 345 kV line	347830	346809	1	DC	110.79	110.79	NR	1200	0	10
10	LFFB	H1TH3	MISO AMIL - MISO AMIL	7NEWTON-7CASEY 345 kV line	347830	346809	1	DC	106.49	106.49	ER	1319	0	
11	N-1	P04	MISO AMIL - MISO AMIL	7NEWTON-7CASEY 345 kV line	347830	346809	1	DC	106.32	106.32	ER	1319	0	
12	N-1	4839_B1_05ROCKPT 765-1	MISO AMIL - MISO AMIL	7NEWTON-7CASEY 345 kV line	347830	346809	1	DC	106.13	106.13	ER	1319	0	

Table 9

Steady-State Voltage Requirements

None

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

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.

Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which shall study all overload conditions associated with the overloaded element(s) identified.

AC1-089 Delivery of Energy Portion of Interconnection Request

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Cir.	PF	Loading Initial	Loading Final	Rating Type	Rating MVA	MW Con.
1	N-1	7342_B2_TOR7202268	AEP - DEO&K	05HILLSB-08CLINCO 138 kV line	243019	249995	1	DC	80.02	101.25	ER	184	39.06
2	Non	Non	AEP - DEO&K	05HILLSB-08CLINCO 138 kV line	243019	249995	1	DC	73.82	92.8	NR	159	30.17
3	N-1	P2-1..LOE BRKR OPEN AT HILLSBORO AEP 2381	AEP - DAY	05HILLSB-09MIDDLE 138 kV line	243019	253111	1	DC	76.5	90.71	ER	185	26.28
4	N-1	P2-1..LOE BRKR OPEN AT HILLSBORO AEP 2381	AEP - AEP	05HIGHLA 138/69 kV transformer	246911	243606	3	DC	91.11	104.17	ER	122	15.93
5	N-1	8468_B2	OVEC - AEP	06KYGER-05SPORN 345 kV line	248005	242528	1	DC	107.71	108.28	NR	1017	12.83
6	N-1	349_B2_TOR21	OVEC - AEP	06KYGER-05SPORN 345 kV line	248005	242528	2	DC	112.81	113.41	NR	971	12.83
7	N-1	363_B2_TOR1682	LGEE - OVEC	7TRIMBLE-06CLIFTY 345 kV line	324114	248000	1	DC	185.09	185.09	ER	1370	0
8	Non	Non	LGEE - OVEC	7TRIMBLE-06CLIFTY 345 kV line	324114	248000	1	DC	117.28	117.28	NR	1134	0
9	Non	Non	MISO AMIL - MISO AMIL	7NEWTON-7CASEY 345 kV line	347830	346809	1	DC	110.79	110.79	NR	1200	0
10	N-1	4839_B1_05ROCKPT 765-1	MISO AMIL - MISO AMIL	7NEWTON-7CASEY 345 kV line	347830	346809	1	DC	106.13	106.13	ER	1319	0
11	N-1	892_B2	AEP - AEP	AC1-089 TAP-05HILLSB 138 kV line	926100	243019	1	DC	53.07	113.06	ER	185	110.98

Table 10

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 05WLDCAT-05HILLSB 138 kV line (from bus 246946 to bus 243019 ckt 1) loads from 85.48% to 139.78% (**DC power flow**) of its emergency rating (185 MVA) for the tower line contingency outage of 'P7-1..C5 4541MELDAHLSPRLCKSTUARTSPURLOCKDPLEK'. This project contributes approximately 100.44 MW to the thermal violation.

CONTINGENCY 'P7-1..C5 4541MELDAHLSPRLCKSTUARTSPURLOCKDPLEK'
OPEN BRANCH FROM BUS 342838 TO BUS 249581 CKT 1
OPEN BRANCH FROM BUS 253077 TO BUS 342838 CKT 1
END

Bus Number	*Bus Name*	*Full Contribution*
342910	*1DALE 3G*	*3.78*
342911	*1DALE 4G*	*3.88*
342957	*1SPURLK1G*	*5.79*
916272	*Z1-080 E*	*0.58*
924101	*AB2-054*	*26.3*
925981	*AC1-074 C OP*	*3.43*
925982	*AC1-074 E OP*	*1.47*
926101	*AC1-089 C*	*38.17*
926102	*AC1-089 E*	*62.27*

Appendices – Secondary 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 05HILLSB-05SINKG8 138 kV line (from bus 243019 to bus 243102 ckt 1) loads from 76.58% to 102.35% (**DC power flow**) of its emergency rating (185 MVA) for the line fault with failed breaker contingency outage of '8107_C2_05HILLSB 138-C_A'. This project contributes approximately 47.8 MW to the thermal violation.

CONTINGENCY '8107_C2_05HILLSB 138-C_A'
OPEN BRANCH FROM BUS 246911 TO BUS 243019 CKT 1 / 246911 05HIGHLA 138 243019 05HILLSB 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1
END

Bus Number	*Bus Name*	*Full Contribution*
916272	*Z1-080 E*	*1.23*
926061	*AC1-085 C*	*53.86*
926062	*AC1-085 E*	*87.88*
926101	*AC1-089 C*	*18.17*
926102	*AC1-089 E*	*29.64*
926631	*AC1-144 C*	*23.85*
926632	*AC1-144 E*	*11.59*

Appendix 2

(AEP - DAY) The 05HILLSB-09MIDDLE 138 kV line (from bus 243019 to bus 253111 ckt 1) loads from 86.69% to 97.61% (**DC power flow**) of its emergency rating (185 MVA) for the tower line contingency outage of 'P7-1..C5 4524FOSTRSUGRCRK34598FOSTERBATH'. This project contributes approximately 20.2 MW to the thermal violation.

CONTINGENCY 'P7-1..C5 4524FOSTRSUGRCRK34598FOSTERBATH'
OPEN BRANCH FROM BUS 253079 TO BUS 249566 CKT 1
OPEN BRANCH FROM BUS 253006 TO BUS 249566 CKT 1
END

Bus Number	*Bus Name*	*Full Contribution*
914372	*Y2-111 E*	*0.75*
915582	*Y3-080 E*	*0.5*
916272	*Z1-080 E*	*0.51*
924371	*AB2-085 C OP*	*3.74*
924372	*AB2-085 E OP*	*1.76*
924541	*AB2-103 C OP*	*2.26*
924542	*AB2-103 E OP*	*1.06*
926061	*AC1-085 C*	*22.78*
926062	*AC1-085 E*	*37.18*
926101	*AC1-089 C*	*7.68*
926102	*AC1-089 E*	*12.52*
926631	*AC1-144 C*	*10.09*
926632	*AC1-144 E*	*4.9*

Appendix 3

(AEP - AEP) The 05SINKG8-05MILLBR 138 kV line (from bus 243102 to bus 243042 ckt 1) loads from 78.63% to 104.44% (**DC power flow**) of its emergency rating (179 MVA) for the line fault with failed breaker contingency outage of '8107_C2_05HILLSB 138-C_B'. This project contributes approximately 47.8 MW to the thermal violation.

CONTINGENCY '8107_C2_05HILLSB 138-C_B'
OPEN BRANCH FROM BUS 246911 TO BUS 243019 CKT 1 / 246911 05HIGHLA 138 243019 05HILLSB 138 1
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

Bus Number	*Bus Name*	*Full Contribution*
916272	*Z1-080 E*	*1.23*
926061	*AC1-085 C*	*53.86*
926062	*AC1-085 E*	*87.88*
926101	*AC1-089 C*	*18.17*
926102	*AC1-089 E*	*29.64*
926631	*AC1-144 C*	*23.85*
926632	*AC1-144 E*	*11.59*

Appendix 4

(DEO&K - DEO&K) The 08CLINCO-08WARRN1 138 kV line (from bus 249995 to bus 250122 ckt 1) loads from 86.97% to 111.65% (**DC power flow**) of its emergency rating (198 MVA) for the line fault with failed breaker contingency outage of '8107_C2_05HILLSB 138-C_B'. This project contributes approximately 48.86 MW to the thermal violation.

CONTINGENCY '8107_C2_05HILLSB 138-C_B'
OPEN BRANCH FROM BUS 246911 TO BUS 243019 CKT 1 / 246911 05HIGHLA 138 243019 05HILLSB 138 1
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

Bus Number	*Bus Name*	*Full Contribution*
916272	*Z1-080 E*	*3.83*
926061	*AC1-085 C*	*55.28*
926062	*AC1-085 E*	*90.19*
926101	*AC1-089 C*	*18.57*
926102	*AC1-089 E*	*30.29*
926631	*AC1-144 C*	*24.48*
926632	*AC1-144 E*	*11.89*

Appendix 5

(DAY - DAY) The 09MIDDLE-09OHH 138 kV line (from bus 253111 to bus 253057 ckt 1) loads from 84.42% to 95.34% (**DC power flow**) of its emergency rating (185 MVA) for the tower line contingency outage of 'P7-1..C5 4524FOSTRSUGRCRK34598FOSTERBATH'. This project contributes approximately 20.2 MW to the thermal violation.

CONTINGENCY 'P7-1..C5 4524FOSTRSUGRCRK34598FOSTERBATH'
OPEN BRANCH FROM BUS 253079 TO BUS 249566 CKT 1
OPEN BRANCH FROM BUS 253006 TO BUS 249566 CKT 1
END

Bus Number	*Bus Name*	*Full Contribution*
914372	*Y2-111 E*	*0.75*
915582	*Y3-080 E*	*0.5*
916272	*Z1-080 E*	*0.51*
924371	*AB2-085 C OP*	*3.74*
924372	*AB2-085 E OP*	*1.76*
924541	*AB2-103 C OP*	*2.26*
924542	*AB2-103 E OP*	*1.06*
926061	*AC1-085 C*	*22.78*
926062	*AC1-085 E*	*37.18*
926101	*AC1-089 C*	*7.68*
926102	*AC1-089 E*	*12.52*
926631	*AC1-144 C*	*10.09*
926632	*AC1-144 E*	*4.9*

Appendix 6

(AEP - AEP) The AC1-089 TAP-05HILLSB 138 kV line (from bus 926100 to bus 243019 ckt 1) loads from 85.54% to 146.32% (**DC power flow**) of its emergency rating (185 MVA) for the tower line contingency outage of 'P7-1..C5 4541MELDAHLSPRLCKSTUARTSPURLOCKDPLEK'. This project contributes approximately 112.44 MW to the thermal violation.

CONTINGENCY 'P7-1..C5 4541MELDAHLSPRLCKSTUARTSPURLOCKDPLEK'
OPEN BRANCH FROM BUS 342838 TO BUS 249581 CKT 1
OPEN BRANCH FROM BUS 253077 TO BUS 342838 CKT 1
END

Bus Number	*Bus Name*	*Full Contribution*
342910	*1DALE 3G*	*3.78*
342911	*1DALE 4G*	*3.88*
342957	*1SPURLK1G*	*5.79*
916272	*Z1-080 E*	*0.58*
924101	*AB2-054*	*26.3*
925981	*AC1-074 C OP*	*3.44*
925982	*AC1-074 E OP*	*1.47*
926101	*AC1-089 C*	*42.73*
926102	*AC1-089 E*	*69.71*

Appendix 7

(AEP - DEO&K) The 05HILLSB-08CLINCO 138 kV line (from bus 243019 to bus 249995 ckt 1) loads from 108.17% to 134.73% (**DC power flow**) of its emergency rating (184 MVA) for the line fault with failed breaker contingency outage of '8107_C2_05HILLSB 138-C_A'. This project contributes approximately 48.86 MW to the thermal violation.

CONTINGENCY '8107_C2_05HILLSB 138-C_A'
OPEN BRANCH FROM BUS 246911 TO BUS 243019 CKT 1 / 246911 05HIGHLA 138 243019 05HILLSB 138 1
OPEN BRANCH FROM BUS 243019 TO BUS 253111 CKT 1 / 243019 05HILLSB 138 253111 09MIDDLE 138 1
END

Bus Number	*Bus Name*	*Full Contribution*
916272	*Z1-080 E*	*2.17*
926061	*AC1-085 C*	*55.28*
926062	*AC1-085 E*	*90.19*
926101	*AC1-089 C*	*18.57*
926102	*AC1-089 E*	*30.29*
926631	*AC1-144 C*	*24.48*
926632	*AC1-144 E*	*11.89*

Appendix 8

(AEP - AEP) The 05HIGHLA 138/69 kV transformer (from bus 246911 to bus 243606 ckt 3) loads from 110.19% to 126.65% (**DC power flow**) of its emergency rating (122 MVA) for the line fault with failed breaker contingency outage of '8108_C2_05HILLSB 138-D'. This project contributes approximately 20.08 MW to the thermal violation.

CONTINGENCY '8108_C2_05HILLSB 138-D'
OPEN BRANCH FROM BUS 243019 TO BUS 249995 CKT 1 / 243019 05HILLSB 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

Bus Number	*Bus Name*	*Full Contribution*
924371	*AB2-085 C OP*	*5.85*
924372	*AB2-085 E OP*	*2.75*
924541	*AB2-103 C OP*	*3.58*
924542	*AB2-103 E OP*	*1.68*
926061	*AC1-085 C*	*22.71*
926062	*AC1-085 E*	*37.06*
926101	*AC1-089 C*	*7.63*
926102	*AC1-089 E*	*12.45*
926631	*AC1-144 C*	*10.06*
926632	*AC1-144 E*	*4.89*

Appendix 9

(LGEE - OVEC) The 7TRIMBLE-06CLIFTY 345 kV line (from bus 324114 to bus 248000 ckt 1) loads from 174.06% to 174.06% (**DC power flow**) of its emergency rating (1370 MVA) for the single line contingency outage of '363_B2_TOR1682'. This project contributes approximately 0.0 MW to the thermal violation.

CONTINGENCY '363_B2_TOR1682'
OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO 765 243209 05ROCKPT 765 1
END

Bus Number	*Bus Name*	*Full Contribution*
243442	*05RKG1*	*38.66*
243443	*05RKG2*	*38.08*
342900	*1COOPER1 G*	*3.1*
342903	*1COOPER2 G*	*6.02*
342910	*1DALE 3G*	*9.18*
342911	*1DALE 4G*	*8.89*
342918	*1JKCT 1G*	*2.44*
342921	*1JKCT 2G*	*2.44*
342924	*1JKCT 3G*	*2.44*
342927	*1JKCT 4G*	*1.62*
342930	*1JKCT 5G*	*1.62*
342933	*1JKCT 6G*	*1.62*
342936	*1JKCT 7G*	*1.62*
342939	*1JKCT 9G*	*1.66*
342942	*1JKCT 10G*	*1.66*
342945	*1LAUREL 1G*	*1.75*
900405	*X3-028 E*	*217.86*
LTF	*Y2-006*	*16.25*

247629	*Y3-038*	*5.5*
LTF	*Z1-046*	*18.63*
LTF	*AA1-001*	*6.08*
LTF	*AA1-004*	*15.42*
922982	*AB1-087 C OP*	*59.91*
922992	*AB1-088 C OP*	*59.91*
LTF	*AB2-005*	*10.3*
924101	*AB2-054*	*57.43*
924261	*AB2-070 C OP*	*1.33*
LTF	*AB2-075*	*2.42*
LTF	*AB2-076*	*3.07*
LTF	*AC1-002*	*42.48*
927331	*AC1-040 C*	*9.5*
925771	*AC1-053 C*	*1.33*
925981	*AC1-074 C OP*	*4.67*

Appendix 10

(MISO AMIL - MISO AMIL) The 7NEWTON-7CASEY 345 kV line (from bus 347830 to bus 346809 ckt 1) loads from 110.79% to 110.79% (**DC power flow**) of its normal rating (1200 MVA) for non-contingency condition. This project contributes approximately 0.0 MW to the thermal violation.

Bus Number	*Bus Name*	*Full Contribution*
LTF	*Y2-006*	*12.9*
LTF	*Z1-046*	*12.12*
LTF	*AA1-001*	*11.88*
LTF	*AA1-004*	*12.25*
LTF	*AB2-005*	*7.69*
LTF	*AC1-002*	*76.7*