

***Revised Generation Interconnection
Feasibility Study Report***

For

***PJM Generation Interconnection Request
Queue Position AD1-134***

JK Smith – Powell County 138kV

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.

The conduct of light load analysis as required under the PJM planning process is not performed during the Generation Interconnection Feasibility Study phase of the PJM study process. Additional reinforcement requirements for this Interconnection Request may be defined during the conduct of the light load analysis which shall be performed following execution of the System Impact Study agreement.

General

The Interconnection Customer (IC), has proposed a Natural Gas generating facility located in Powell County, Kentucky. The installed facilities will have a total capability of 75 MW with 75 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is July 1, 2020. **This study does not imply a EKPC commitment to this in-service date.**

Point of Interconnection

AD1-134 will interconnect with the EKPC transmission system along the JK Smith – Powell County 138kV line.

Cost Summary

The AD1-134 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	\$ 0
Direct Connection Network Upgrades	\$ 3,300,000
Non Direct Connection Network Upgrades	\$ 700,000
Total Costs	\$ 4,000,000

In addition, the AD1-134 project may be responsible for a contribution to the following costs:

Description	Total Cost
New System Upgrades	\$ 0
Previously Identified Upgrades	\$ 0*
Total Costs	\$ 0*

Cost allocations for these upgrades will be provided in the System Impact Study Report.

*Note: The external (i.e. Non-PJM) Transmission Owner, OVEC, will not evaluate violations identified on their system until the Impact Study phase.

Attachment Facilities

No Attachment Facilities are required to support this interconnection request.

Direct Connection Cost Estimate

The total preliminary cost estimate for the Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Total Cost
Build 138kv switching station along the JK Smith – Powell County 138kV line. Estimated Time: 18 months.	\$ 3,300,000
Total Direct Connection Facility Costs	\$ 3,300,000

Non-Direct Connection Cost Estimate

The total preliminary cost estimate for the Non-Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Total Cost
Adjust remote, relaying, and metering settings at JK Smith 138kV Sub.	\$ 100,000
Adjust remote, relaying, and metering settings at Powell County 138kV Sub.	\$ 100,000
Loop the JK Smith – Powell County 138kV circuit into the AD1-134 switching station.	\$ 500,000
Total Non-Direct Connection Facility Costs	\$ 700,000

Interconnection Customer Requirements

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.

EKPC Requirements

The Interconnection Customer will be required to comply with all EKPC Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the "EKPC Facility Connection Requirements" document located at the following link:

<http://www.pjm.com/planning/design-engineering/to-tech-standards/ekpc.aspx>

Network Impacts

The Queue Project AD1-134 was evaluated as a 75.0 MW (Capacity 75.0 MW) injection tapping the JK Smith to Powell Co. 138kV line in the EKPC area. Project AD1-134 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD1-134 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:

Contingency Name	Description
AEP_P1-2_#363	CONTINGENCY 'AEP_P1-2_#363' OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO 765 243209 05ROCKPT 765 1 END
AEP_P1-3_#8818	CONTINGENCY 'AEP_P1-3_#8818' OPEN BRANCH FROM BUS 242921 TO BUS 242924 CKT 1 / 242921 05CORNU 765 242924 05HANG R 765 1 OPEN BRANCH FROM BUS 242921 TO BUS 242934 CKT 1 / 242921 05CORNU 765 242934 05CORNU 345 1 REMOVE UNIT 1A FROM BUS 247245 / 247245 05HRKG1A 18.0 REMOVE UNIT 1B FROM BUS 247246 / 247246 05HRKG1B 18.0 REMOVE UNIT 1S FROM BUS 247247 / 247247 05HRKG1S 18.0 REMOVE UNIT 2A FROM BUS 247248 / 247248 05HRKG2A 18.0 REMOVE UNIT 2B FROM BUS 247249 / 247249 05HRKG2B 18.0 REMOVE UNIT 2S FROM BUS 247250 / 247250 05HRKG2S 18.0 END

Contingency Name	Description
DEO&K P1-* P2-1 PORT UNION- ZIMMER 4544	CONTINGENCY 'DEO&K P1-* P2-1 PORT UNION-ZIMMER 4544' OPEN BRANCH FROM BUS 249570 TO BUS 249577 CKT 1 END
DEO&K P1-* P2-1 RED BANK-SG- ZIMMER 4545	CONTINGENCY 'DEO&K P1-* P2-1 RED BANK-SG-ZIMMER 4545' OPEN BRANCH FROM BUS 249573 TO BUS 249577 CKT 1 OPEN BRANCH FROM BUS 249573 TO BUS 250097 CKT 1 OPEN BRANCH FROM BUS 249571 TO BUS 249573 CKT 1 END
DEO&K P2-3/4 P4-* 1493_RED BANK	CONTINGENCY 'DEO&K P2-3/4 P4-* 1493_RED BANK' OPEN BRANCH FROM BUS 249571 TO BUS 249573 CKT 1 OPEN BRANCH FROM BUS 249573 TO BUS 250097 CKT 1 OPEN BRANCH FROM BUS 249573 TO BUS 249577 CKT 1 OPEN BRANCH FROM BUS 249571 TO BUS 250092 CKT 1 END
DEO&K P2-3/4 P4-* 816_SILVERGROV E	CONTINGENCY 'DEO&K P2-3/4 P4-* 816_SILVERGROVE' OPEN BRANCH FROM BUS 249573 TO BUS 250097 CKT 1 OPEN BRANCH FROM BUS 249988 TO BUS 250097 CKT 1 OPEN BRANCH FROM BUS 250042 TO BUS 250097 CKT 1 OPEN BRANCH FROM BUS 250052 TO BUS 250097 CKT 1 OPEN BRANCH FROM BUS 250053 TO BUS 250097 CKT 1 OPEN BRANCH FROM BUS 249571 TO BUS 249573 CKT 1 OPEN BRANCH FROM BUS 249573 TO BUS 249577 CKT 1 END

Contingency Name	Description
DEO&K P7-1 CIRCUIT1883&4545 REDBANKSILGRVZ IMMER	CONTINGENCY 'DEO&K P7-1 CIRCUIT1883&4545REDBANKSILGRVZIMMER' OPEN BRANCH FROM BUS 249989 TO BUS 250080 CKT 1 OPEN BRANCH FROM BUS 250079 TO BUS 250080 CKT Z1 OPEN BRANCH FROM BUS 250079 TO BUS 250092 CKT 1 OPEN BRANCH FROM BUS 249573 TO BUS 249577 CKT 1 OPEN BRANCH FROM BUS 249573 TO BUS 250097 CKT 1 OPEN BRANCH FROM BUS 249571 TO BUS 249573 CKT 1 END
EKPC_P1-2_JKS- NCLA345	CONTINGENCY 'EKPC_P1-2_JKS-NCLA345' /* JK SMITH - N CLARK OPEN BRANCH FROM BUS 342832 TO BUS 342835 CKT 1 /* 342832 7JK SMITH 345.00 342835 7N CLARK 345.00 END

Generator Deliverability

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

None.

Multiple Facility Contingency

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

None.

Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

#	Contingency		Affected Area	Facility Description	Bus		Circuit	Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To			Initial	Final	Type	MVA		
1	N-1	AEP_P1-2_#363	LGEE - OVEC	7TRIMBLE-06CLIFTY 345 kV line	324114	248000	1	DC	187.31	187.92	ER	1370	8.35	1
2	Non	Non	LGEE - OVEC	7TRIMBLE-06CLIFTY 345 kV line	324114	248000	1	DC	134.77	135.46	NR	1134	7.86	
3	N-1	AEP_P1-3_#8818	LGEE - OVEC	7TRIMBLE-06CLIFTY 345 kV line	324114	248000	1	DC	112.89	113.47	ER	1370	7.85	
4	N-1	EKPC_P1-2_JKS-NCLA345	EKPC - EKPC	4JK SMITH-4DALE 138 kV line	342607	342574	1	DC	100.81	105.06	ER	284	12.06	2
5	N-1	DEO&K P1- P2-1 RED BANK-SG- ZIMMER 4545	EKPC - DAY	7SPURLOCK-09STUART 345 kV line	342838	253077	1	DC	109.71	110.32	ER	1374	18.23	3

#	Contingency		Affected Area	Facility Description	Bus		Circuit	Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To			Initial	Final	Type	MVA		
6	LFFB	DEO&K P2-3/4 P4-* 816_SILVER GROVE	EKPC - DAY	7SPURLOCK-09STUART 345 kV line	342838	253077	1	DC	105.55	106.47	ER	1374	18.25	
7	LFFB	DEO&K P2-3/4 P4-* 1493_RED BANK	EKPC - DAY	7SPURLOCK-09STUART 345 kV line	342838	253077	1	DC	105.45	106.38	ER	1374	18.23	
8	DCTL	DEO&K P7-1 CIRCUIT188 3&4545RED BANKSILGR VZIMMER	EKPC - DAY	7SPURLOCK-09STUART 345 kV line	342838	253077	1	DC	105.39	106.32	ER	1374	18.23	
9	N-1	DEO&K P1-* P2-1 PORT UNION- ZIMMER 4544	EKPC - DAY	7SPURLOCK-09STUART 345 kV line	342838	253077	1	DC	102.81	103.41	ER	1374	17.87	

Note: Please see Attachment 3 for projects providing impacts to flowgate violations. The values in the Reference column correspond to the proper table in the Attachment.

Short Circuit

(Summary of impacted circuit breakers)

None.

Potential Congestion due to Local Energy Deliverability

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.

None.

Steady-State Voltage Requirements

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

To be determined during the Impact Study

Stability and Reactive Power Requirement

(Results of the dynamic studies should be inserted here)

To be determined during the Impact Study

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).

Light Load Analysis - 2021

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

New System Reinforcements

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

None.

Contribution to Previously Identified System Reinforcements

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

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
#1, 2, 3	7TRIMBLE-06CLIFTY 345 kV line	<p>OVEC: The external (i.e. Non-PJM) Transmission Owner, OVEC, will not evaluate this violation until the impact study phase.</p> <p>LGEE: The external (i.e. Non-PJM) Transmission Owner, LGEE, will not evaluate this violation until the impact study phase.</p>		\$ TBD*
#4	4JK SMITH-4DALE 138 kV line	<p>EKPC: Increase MOT JK Smith-Dale 138kV line to 275°F (PJM Upgrade Id: b2939). New ratings will be S/N: 229 MVA, S/E: 296 MVA. The scheduled in-service date is 12/1/2019.</p>		\$ 0
#5, 6, 7, 8, 9	7SPURLOCK-09STUART 345 kV line	<p>EKPC: Reconductor EKPC's portion of the Spurlock-Stuart 345kV line with 954 ACSS (PJM Upgrade Id: b2879.2). New EKPC ratings will be S/N: 1466 MVA, S/E: 1710 MVA. The scheduled in-service date is 12/31/2018.</p> <p>DAY: Replace wavetrap at the Stuart 345 kV substation – Already proposed as part of generation retirement project (PJM Upgrade Id: b2879.1). The scheduled in-service date is 06/01/2018.</p>		\$ 0
Total New Network Upgrades				\$ 0*

*Note: The external (i.e. Non-PJM) Transmission Owner, OVEC, will not evaluate violations identified on their system until the Impact Study phase.

Attachment 1. Flowgate Details

Appendices

The following appendices contain additional information about each flowgate presented in the body of the report. For each appendix, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact.

It should be noted the generator contributions presented in the appendices sections are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.

Appendix 1

(LGEE - OVEC) The 7TRIMBLE-06CLIFTY 345 kV line (from bus 324114 to bus 248000 ckt 1) loads from 187.31% to 187.92% (**DC power flow**) of its emergency rating (1370 MVA) for the single line contingency outage of 'AEP_P1-2_#363'. This project contributes approximately 8.35 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
247287	05AND G3	0.81
243442	05RKG1	39.3
243443	05RKG2	38.7
342900	1COOPER1 G	3.15
342903	1COOPER2 G	6.11
342918	1JKCT 1G	2.47
342921	1JKCT 2G	2.47
342924	1JKCT 3G	2.47
342927	1JKCT 4G	1.64
342930	1JKCT 5G	1.63
342933	1JKCT 6G	1.64
342936	1JKCT 7G	1.64
342939	1JKCT 9G	1.68
342942	1JKCT 10G	1.68
342945	1LAUREL 1G	1.78
932551	AC2-075 C	1.09

Bus Number	Bus Name	Full Contribution
933441	AC2-157 C	8.17
935011	AD1-134	8.35
935141	AD1-148	2.48
983071	J332	9.59
981181	J708	40.76
981521	J759	9.34
981531	J762	29.4
981571	J783	9.24
274650	KINCAID ;1U	6.26
274651	KINCAID ;2U	6.23
900404	X3-028 C	161.28
930461	AB1-087	59.14
930471	AB1-088	59.14
927331	AC1-040 C	9.43
925981	AC1-074 C	4.54

Appendix 2

(EKPC - EKPC) The 4JK SMITH-4DALE 138 kV line (from bus 342607 to bus 342574 ckt 1) loads from 100.81% to 105.06% (**DC power flow**) of its emergency rating (284 MVA) for the single line contingency outage of 'EKPC_P1-2_JKS-NCLA345'. This project contributes approximately 12.06 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
342918	1JKCT 1G	4.38
342921	1JKCT 2G	4.38
342924	1JKCT 3G	4.38
342927	1JKCT 4G	2.91
342930	1JKCT 5G	2.89

Bus Number	Bus Name	Full Contribution
342933	1JKCT 6G	2.91
342936	1JKCT 7G	2.91
342939	1JKCT 9G	2.27
342942	1JKCT 10G	2.27
935011	AD1-134	12.06

Appendix 3

(EKPC - DAY) The 7SPURLOCK-09STUART 345 kV line (from bus 342838 to bus 253077 ckt 1) loads from 109.71% to 110.32% (**DC power flow**) of its emergency rating (1374 MVA) for the single line contingency outage of 'DEO&K P1-* P2-1 RED BANK-SG-ZIMMER 4545'. This project contributes approximately 18.23 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
251970	08MELDL1	2.76
251971	08MELDL2	2.76
251972	08MELDL3	2.77
251968	08ZIMRHP	54.45
251969	08ZIMRLP	29.82
342918	1JKCT 1G	5.52
342921	1JKCT 2G	5.52
342924	1JKCT 3G	5.52
342927	1JKCT 4G	3.67
342930	1JKCT 5G	3.65
342933	1JKCT 6G	3.67
342936	1JKCT 7G	3.67

Bus Number	Bus Name	Full Contribution
342939	1JKCT 9G	4.06
342942	1JKCT 10G	4.06
342957	1SPURLK1G	28.31
342960	1SPURLK2G	53.96
342963	1SPURLK3G	28.36
342966	1SPURLK4G	28.36
932551	AC2-075 C	3.72
935011	AD1-134	18.23
925981	AC1-074 C	15.53
926101	AC1-089 C	5.6
926951	AC1-182	6.6