Generation Interconnection

Feasibility Study Report

for

Queue Project AF1-267

UNION CITY TAP 138 KV

37 MW Capacity / 54 MW Energy

January, 2020

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1 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. Cost allocation rules for network upgrades can be found in PJM Manual 14A, Attachment B. 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 Interconnection Customer seeking to interconnect a wind or solar generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per Schedule H to the Interconnection Service Agreement and Section 8 of Manual 14D.

PJM utilizes manufacturer models to ensure the performance of turbines is properly captured during the simulations performed for stability verification and, where applicable, for compliance with low voltage ride through requirements. Turbine manufacturers provide such models to their customers. The list of manufacturer models PJM has already validated is contained in Attachment B of Manual 14G. Manufacturer models may be updated from time to time, for various reasons such as to reflect changes to the control systems or to more accurately represent the capabilities turbines and controls which are currently available in the field. Additionally, as new turbine models are developed, turbine manufacturers provide such new models which must be used in the conduct of these studies. PJM needs adequate time to evaluate the new models in order to reduce delays to the System Impact Study process timeline for the Interconnection Customer as well as other Interconnection Customers in the study group. Therefore, PJM will require that any Interconnection Customer with a new manufacturer model must supply that model to PJM, along with a $10,000 fully refundable deposit, no later than three (3) months prior to the starting date of the System Impact Study (See Section 4.3 for starting dates) for the Interconnection Request which shall specify the use of the new model. The Interconnection Customer will be required to submit a completed dynamic model study request form (Attachment B-1 of Manual 14G) in order to document the request for the study.

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.

2 General

The Interconnection Customer (IC), has proposed a Solar generating facility located in Madison County, KY. The installed facilities will have a total capability of 54 MW with 37 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is 1/31/2022. This study does not imply a TO commitment to this in-service date.

Queue Number	**AF1-267**
Project Name	UNION CITY TAP 138 KV
State	Kentucky
County	Madison
Transmission Owner	EKPC
MFO	54
MWE	54
MWC	37
Fuel	Solar
Basecase Study Year	2023

2.1 Point of Interconnection

AF1-267 will interconnect with the EKPC transmission system at the Union City 138 kV substation.

2.2 Cost Summary

This project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$565,000
Direct Connection Network Upgrade	$4,520,000
Non Direct Connection Network Upgrades	$1,400,000
Total Costs	$6,485,000

In addition, this project may be responsible for a contribution to the following costs

Description	Total Cost
System Upgrades	$11,018,701

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

3 Transmission Owner Scope of Work

4 Attachment Facilities

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

Description	Total Cost
Install necessary equipment (a 138 kV isolation switch structure and associated switch, plus interconnection metering, fiber-optic connection and telecommunications equipment, circuit breaker and associated switches, and relay panel) at the new Union City switching station, to accept the IC generator lead line/bus (Estimated time to implement is 24 months)	$565,000
Total Attachment Facility Costs	$565,000

5 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
Construct a new 138 kV switching station near the EKPC Union City distribution substation to facilitate connection of the IC solar generation project (Estimated time to implement is 24 months)	$4,520,000
Total Direct Connection Facility Costs	$4,520,000

6 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
Construct facilities to loop the existing Union City Tap 138 kV line into the new Union City switching station (Estimated time to implement is 24 months)	$1,270,000
Modify relays and/or settings at the J.K. Smith substation for the existing line to the new Union City switching station (Estimated time to implement is 9 months)	$65,000
Modify relays and/or settings at Fawkes substation for the existing line to the new Union City switching station (Estimated time to implement is 9 months)	$65,000

Description	Total Cost
Total Non-Direct Connection Facility Costs	$1,400,000

7 Incremental Capacity Transfer Rights (ICTRs)

Will be determined at a later study phase

8 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.

9 Revenue Metering and SCADA Requirements

9.1 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.

9.2 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

10 Network Impacts

The Queue Project AF1-267 was evaluated as a 54.0 MW (Capacity 37.0 MW) injection at the Union City 138 kV substation in the EKPC area. Project AF1-267 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-267 was studied with a commercial probability of 0.53. Potential network impacts were as follows:

Summer Peak Load Flow

11 Generation Deliverability

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

None

12 Multiple Facility Contingency

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

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
41676176	342688	4UNION CTY T	138.0	EKPC	324276	4LAKE REBA T	138.0	LGEE	1	EKPC_P4-6_JKSM E63-91T	breaker	306.0	93.15	103.28	DC	30.98
41882638	342688	4UNION CTY T	138.0	EKPC	324276	4LAKE REBA T	138.0	LGEE	1	EKPC_P2-4_JKSM E63-91T-A	bus	306.0	98.09	108.21	DC	30.98
41882639	342688	4UNION CTY T	138.0	EKPC	324276	4LAKE REBA T	138.0	LGEE	1	EKPC_P2-4_JKSM E63-91T-B	bus	306.0	93.15	103.28	DC	30.98

13 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)

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
41055759	250054	08LONGBR	138.0	DEO&K	250077	08MTZION	138.0	DEO&K	1	DAY_P734541 34553	tower	284.0	119.55	120.15	DC	3.83
41055810	250077	08MTZION	138.0	DEO&K	249991	08BUFTN1	138.0	DEO&K	1	DAY_P734541 34553	tower	298.0	109.6	110.18	DC	3.83
41675932	342541	4AVON	138.0	EKPC	342631	4PARIS T	138.0	EKPC	1	EKPC_P4-6_NCLK E114-151T	breaker	220.0	115.51	116.29	DC	3.82
41882555	342541	4AVON	138.0	EKPC	342631	4PARIS T	138.0	EKPC	1	EKPC_P2-4_NCLK E114-151T-B	bus	220.0	115.51	116.29	DC	3.82
41055735	342559	4BOONECO	138.0	EKPC	250054	08LONGBR	138.0	DEO&K	1	DAY_P734541 34553	tower	284.0	126.87	127.48	DC	3.83

14 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.

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.

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
4136468 5	342541	4AVON	138.0	EKPC	342631	4PARIS T	138.0	EKPC	1	EKPC_P1-2_AVON-NCLA345-C	operation	220.0	101.38	101.95	DC	2.76

15 System Reinforcements

ID	Index	Facility	Upgrade Description	Cost
41676176,41882638, 41882639	1	4UNION CTY T 138.0 kV - 4LAKE REBA T 138.0 kV Ckt 1	r0072 (1582) : LGEE violation (non PJM area). EKPC emergency rating is 409 MVA. The external (i.e. Non-PJM) Transmission Owner, LGEE, will not evaluate this violation until the impact study phase. Project Type : FAC Cost : $0 Time Estimate : 0.0 Months	$0
41055759	2	08LONGBR 138.0 kV - 08MTZION 138.0 kV Ckt 1	n30581 (1690) : Rebuild the line and Substation Bus Conductor on the Longbranch terminal at Mt. Zion Project Type : FAC Cost : $2,660,676 Time Estimate : 30.0 Months	$2,660,676
41882555,41675932	4	4AVON 138.0 kV - 4PARIS T 138.0 kV Ckt 1	r0030 (1540) : Increase the maximum operating temperature of the 636 MCM ACSR conductor in the Avon-Paris Tap 138 kV line section to 293 degrees F (6.9 miles) Project Type : FAC Cost : $625,000 Time Estimate : 8.0 Months	$625,000
41055810	3	08MTZION 138.0 kV - 08BUFTN1 138.0 kV Ckt 1	n6785 (1691) : Rebuild the line and Substation Bus Conductor on the Buffington terminal at Mt. Zion, Replace equipment at Buffington Project Type : FAC Cost : $4,973,025 Time Estimate : 30.0 Months	$4,973,025
41055735	5	4BOONE CO 138.0 kV - 08LONGBR 138.0 kV Ckt 1	r0010 (1519) : Upgrade bus and jumpers associated with Boone 138 kV bus using 2-500 MCM 37 CU conductor or equivalent Project Type : FAC Cost : $170,000 Time Estimate : 6.0 Months r0052 (1562) : Replace the 954 MCM ACSR line conductor in the Boone County-Longbranch 138 kV line with 954 MCM ACSS conductor (2.3 miles) Project Type : FAC Cost : $2,590,000 Time Estimate : 14.0 Months	$2,760,000
			TOTAL COST	**$11,018,701**

16 Flow Gate Details

The following indices contain additional information about each flowgate presented in the body of the report. For each index, 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.

16.1 Index 1

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
41882638	342688	4UNION CTY T	EKPC	324276	4LAKE REBA T	LGEE	1	EKPC_P2-4_JKSM E63-91T-A	bus	306.0	98.09	108.21	DC	30.98

Bus #	Bus	MW Impact
342918	1JKCT 1G	2.6457
342921	1JKCT 2G	1.9484
342924	1JKCT 3G	2.6457
342927	1JKCT 4G	1.7558
342930	1JKCT 5G	1.7461
342933	1JKCT 6G	1.7558
342936	1JKCT 7G	1.7558
942591	AE2-275 C O1	11.2691
942592	AE2-275 E O1	4.2388
942893	AE2-308 BAT	9.3705
946021	AF1-267 C O1	21.2262
946022	AF1-267 E O1	9.7526
DUCKCREEK	DUCKCREEK	0.1301
NEWTON	NEWTON	0.1590
FARMERCITY	FARMERCITY	0.0102
NY	NY	0.0393
PRAIRIE	PRAIRIE	0.5424
O-066	O-066	0.5174
COFFEEN	COFFEEN	0.0782
EDWARDS	EDWARDS	0.0361
CHEOAH	CHEOAH	0.2082
TILTON	TILTON	0.0605
G-007	G-007	0.0801
GIBSON	GIBSON	0.0808
CALDERWOOD	CALDERWOOD	0.2097
BLUEG	BLUEG	0.3646
TRIMBLE	TRIMBLE	0.1107
CATAWBA	CATAWBA	0.0917

16.2 Index 2

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
41055759	250054	08LONGBR	DEO&K	250077	08MTZION	DEO&K	1	DAY_P734541 34553	tower	284.0	119.55	120.15	DC	3.83

Bus #	Bus	MW Impact
342957	1SPURLK1G	5.1535
342960	1SPURLK2G	8.0926
342963	1SPURLK3G	4.2526
342966	1SPURLK4G	4.2526
925981	AC1-074 C O1	9.2562
925982	AC1-074 E O1	3.9670
932551	AC2-075 C	2.1984
932552	AC2-075 E	1.1074
936381	AD2-048 C	6.0729
936382	AD2-048 E	3.0299
936571	AD2-072 C O1	2.9465
936572	AD2-072 E O1	1.4447
939141	AE1-144 C O1	8.7899
939142	AE1-144 E O1	4.3621
940531	AE2-038 C O1	5.8636
940532	AE2-038 E O1	2.9044
941411	AE2-138 C	14.2325
941412	AE2-138 E	5.2641
941981	AE2-210 C O1	4.9041
941982	AE2-210 E O1	1.8447
942411	AE2-254 C O1	1.4096
942412	AE2-254 E O1	0.9398
942591	AE2-275 C O1	4.0264
942592	AE2-275 E O1	1.5145
942891	AE2-308 C O1	6.9274
942892	AE2-308 E O1	2.5191
943111	AE2-339 C	2.0999
943112	AE2-339 E	1.0343
944211	AF1-089 C O1	1.5157
944212	AF1-089 E O1	0.4638
944621	AF1-127 C O1	2.1479
944622	AF1-127 E O1	1.0579
945541	AF1-219 C O1	0.6926
945542	AF1-219 E O1	0.2248
945681	AF1-233 C O1	16.4726
945682	AF1-233 E O1	8.1379
945861	AF1-251 C	5.2663
945862	AF1-251 E	3.5109
945911	AF1-256 C	5.3174
945912	AF1-256 E	3.5450
946021	AF1-267 C O1	1.1808
946022	AF1-267 E O1	0.5425

Bus #	Bus	MW Impact
LGEE	LGEE	1.7069
CPLE	CPLE	0.2792
WEC	WEC	0.0350
CBM-W2	CBM-W2	6.2080
NY	NY	0.0735
CBM-W1	CBM-W1	0.6755
TVA	TVA	1.6156
O-066	O-066	0.7325
CBM-S2	CBM-S2	3.3062
CBM-S1	CBM-S1	12.7459
G-007	G-007	0.1123
MADISON	MADISON	3.7740
MEC	MEC	0.5673

16.3 Index 3

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
41055810	250077	08MTZION	DEO&K	249991	08BUFTN1	DEO&K	1	DAY_P734541 34553	tower	298.0	109.6	110.18	DC	3.83

Bus #	Bus	MW Impact
342957	1SPURLK1G	5.1535
342960	1SPURLK2G	8.0926
342963	1SPURLK3G	4.2526
342966	1SPURLK4G	4.2526
925981	AC1-074 C O1	9.2562
925982	AC1-074 E O1	3.9670
932551	AC2-075 C	2.1984
932552	AC2-075 E	1.1074
936381	AD2-048 C	6.0729
936382	AD2-048 E	3.0299
936571	AD2-072 C O1	2.9465
936572	AD2-072 E O1	1.4447
939141	AE1-144 C O1	8.7899
939142	AE1-144 E O1	4.3621
940531	AE2-038 C O1	5.8636
940532	AE2-038 E O1	2.9044
941411	AE2-138 C	14.2325
941412	AE2-138 E	5.2641
941981	AE2-210 C O1	4.9041
941982	AE2-210 E O1	1.8447
942411	AE2-254 C O1	1.4096
942412	AE2-254 E O1	0.9398
942591	AE2-275 C O1	4.0264
942592	AE2-275 E O1	1.5145
942891	AE2-308 C O1	6.9274
942892	AE2-308 E O1	2.5191
943111	AE2-339 C	2.0999
943112	AE2-339 E	1.0343
944211	AF1-089 C O1	1.5157
944212	AF1-089 E O1	0.4638
944621	AF1-127 C O1	2.1479
944622	AF1-127 E O1	1.0579
945541	AF1-219 C O1	0.6926
945542	AF1-219 E O1	0.2248
945681	AF1-233 C O1	16.4726
945682	AF1-233 E O1	8.1379
945861	AF1-251 C	5.2663
945862	AF1-251 E	3.5109
945911	AF1-256 C	5.3174
945912	AF1-256 E	3.5450
946021	AF1-267 C O1	1.1808
946022	AF1-267 E O1	0.5425

Bus #	Bus	MW Impact
LGEE	LGEE	1.7069
CPLE	CPLE	0.2792
WEC	WEC	0.0350
CBM-W2	CBM-W2	6.2080
NY	NY	0.0735
CBM-W1	CBM-W1	0.6755
TVA	TVA	1.6156
O-066	O-066	0.7325
CBM-S2	CBM-S2	3.3062
CBM-S1	CBM-S1	12.7459
G-007	G-007	0.1123
MADISON	MADISON	3.7740
MEC	MEC	0.5673

16.4 Index 4

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
41882555	342541	4AVON	EKPC	342631	4PARIS T	EKPC	1	EKPC_P2-4_NCLK E114-151T-B	bus	220.0	115.51	116.29	DC	3.82

Bus #	Bus	MW Impact
941411	AE2-138 C	48.8242
941412	AE2-138 E	18.0582
941981	AE2-210 C O1	16.8235
941982	AE2-210 E O1	6.3281
942411	AE2-254 C O1	1.2908
942412	AE2-254 E O1	0.8605
942591	AE2-275 C O1	4.1365
942592	AE2-275 E O1	1.5559
942891	AE2-308 C O1	8.9246
942892	AE2-308 E O1	3.2453
943111	AE2-339 C	6.8940
943112	AE2-339 E	3.3956
944621	AF1-127 C O1	13.7881
944622	AF1-127 E O1	6.7911
945861	AF1-251 C	33.9557
945862	AF1-251 E	22.6371
946021	AF1-267 C O1	1.1795
946022	AF1-267 E O1	0.5419
LGEE	LGEE	0.6641
CPLE	CPLE	0.2216
WEC	WEC	0.0403
CBM-W2	CBM-W2	4.2097
NY	NY	0.0160
CBM-W1	CBM-W1	1.1885
TVA	TVA	1.1312
O-066	O-066	0.1142
CBM-S2	CBM-S2	2.5143
CBM-S1	CBM-S1	7.4465
G-007	G-007	0.0166
MADISON	MADISON	2.0019
MEC	MEC	0.4449

16.5 Index 5

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
41055735	342559	4BOONE CO	EKPC	250054	08LONGBR	DEO&K	1	DAY_P734541 34553	tower	284.0	126.87	127.48	DC	3.83

Bus #	Bus	MW Impact
342957	1SPURLK1G	5.1535
342960	1SPURLK2G	8.0926
342963	1SPURLK3G	4.2526
342966	1SPURLK4G	4.2526
925981	AC1-074 C O1	9.2562
925982	AC1-074 E O1	3.9670
932551	AC2-075 C	2.1984
932552	AC2-075 E	1.1074
936381	AD2-048 C	6.0729
936382	AD2-048 E	3.0299
936571	AD2-072 C O1	2.9465
936572	AD2-072 E O1	1.4447
939141	AE1-144 C O1	8.7899
939142	AE1-144 E O1	4.3621
940531	AE2-038 C O1	5.8636
940532	AE2-038 E O1	2.9044
941411	AE2-138 C	14.2325
941412	AE2-138 E	5.2641
941981	AE2-210 C O1	4.9041
941982	AE2-210 E O1	1.8447
942411	AE2-254 C O1	1.4096
942412	AE2-254 E O1	0.9398
942591	AE2-275 C O1	4.0264
942592	AE2-275 E O1	1.5145
942891	AE2-308 C O1	6.9274
942892	AE2-308 E O1	2.5191
943111	AE2-339 C	2.0999
943112	AE2-339 E	1.0343
944211	AF1-089 C O1	1.5157
944212	AF1-089 E O1	0.4638
944621	AF1-127 C O1	2.1479
944622	AF1-127 E O1	1.0579
945541	AF1-219 C O1	0.6926
945542	AF1-219 E O1	0.2248
945681	AF1-233 C O1	16.4726
945682	AF1-233 E O1	8.1379
945861	AF1-251 C	5.2663
945862	AF1-251 E	3.5109
945911	AF1-256 C	5.3174
945912	AF1-256 E	3.5450
946021	AF1-267 C O1	1.1808
946022	AF1-267 E O1	0.5425

Bus #	Bus	MW Impact
LGEE	LGEE	1.7069
CPLE	CPLE	0.2792
WEC	WEC	0.0350
CBM-W2	CBM-W2	6.2080
NY	NY	0.0735
CBM-W1	CBM-W1	0.6755
TVA	TVA	1.6156
O-066	O-066	0.7325
CBM-S2	CBM-S2	3.3062
CBM-S1	CBM-S1	12.7459
G-007	G-007	0.1123
MADISON	MADISON	3.7740
MEC	MEC	0.5673

Affected Systems

17 Affected Systems

17.1 LG&E

LG&E Impacts to be determined during later study phases (as applicable).

17.2 MISO

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

17.3 TVA

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

17.4 Duke Energy Progress

Duke Energy Progress Impacts to be determined during later study phases (as applicable).

17.5 NYISO

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

18 Contingency Descriptions

Contingency Name	Contingency Definition
EKPC_P2-4_JKSM E63-91T-A	CONTINGENCY 'EKPC_P2-4_JKSM E63-91T-A' /* JK SMITH OPEN BRANCH FROM BUS 342596 TO BUS 342607 CKT 1 /* 342596 4HUNT 138.00 342607 4JK SMITH 138.00 OPEN BRANCH FROM BUS 342577 TO BUS 942590 CKT 1 /* 342577 4FAWKES EK 138.00 942590 AE2-275 TAP 138.00 END
EKPC_P2-4_JKSM E63-91T-B	CONTINGENCY 'EKPC_P2-4_JKSM E63-91T-B' /* JK SMITH OPEN BRANCH FROM BUS 342596 TO BUS 342607 CKT 1 /* 342596 4HUNT 138.00 342607 4JK SMITH 138.00 OPEN BRANCH FROM BUS 942590 TO BUS 342607 CKT 1 /* 942590 AE2-275 TAP 138.00 342607 4JK SMITH 138.00 END
EKPC_P4-6_JKSM E63-91T	CONTINGENCY 'EKPC_P4-6_JKSM E63-91T' /* JK SMITH OPEN BRANCH FROM BUS 342596 TO BUS 342607 CKT 1 /* 342596 4HUNT 138.00 342607 4JK SMITH 138.00 OPEN BRANCH FROM BUS 942590 TO BUS 342607 CKT 1 /* 942590 AE2-275 TAP 138.00 342607 4JK SMITH 138.00 END
EKPC_P1-2_AVON-NCLA345-C	CONTINGENCY 'EKPC_P1-2_AVON-NCLA345-C' /* AVON - N CLARK OPEN BRANCH FROM BUS 941410 TO BUS 342835 CKT 1 /* 941410 AE2-138 TAP 345.00 342835 7N CLARK 345.00 END
DAY_P734541 34553	CONTINGENCY 'DAY_P734541 34553' OPEN BRANCH FROM BUS 249581 TO BUS 342838 CKT 1 /* 249581 08MELDAL 345.00 342838 7SPURLOCK 345.00 OPEN BRANCH FROM BUS 253077 TO BUS 342838 CKT 1 /* 253077 09STUART 345.00 342838 7SPURLOCK 345.00 END
EKPC_P2-4_NCLK E114-151T-B	CONTINGENCY 'EKPC_P2-4_NCLK E114-151T-B' /* NORTH CLARK OPEN BRANCH FROM BUS 342832 TO BUS 342835 CKT 1 /* 342832 7JK SMITH 345.00 342835 7N CLARK 345.00 OPEN BRANCH FROM BUS 941410 TO BUS 342835 CKT 1 /* 941410 AE2-138 TAP 345.00 342835 7N CLARK 345.00 END
EKPC_P4-6_NCLK E114-151T	CONTINGENCY 'EKPC_P4-6_NCLK E114-151T' OPEN BRANCH FROM BUS 342832 TO BUS 342835 CKT 1 /* 342832 7JK SMITH 345.00 342835 7N CLARK 345.00 OPEN BRANCH FROM BUS 941410 TO BUS 342835 CKT 1 /* 941410 AE2-138 TAP 345.00 342835 7N CLARK 345.00 END

Short Circuit

19 Short Circuit

The following Breakers are overduty

Bus Number	Bus Name	BREAKER	Type	Capacity (Amps)	Duty Percentage Post Queue	Duty Percentage Pre Queue

Secondary Point of Interconnection

20 Network Impacts – Secondary POI

The Queue Project AF1-267 was evaluated as a 54.0 MW (Capacity 37.0 MW) injection tapping the Lake Reba to Union City Tap 138 kV line in the EKPC area. Project AF1-267 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-267 was studied with a commercial probability of 0.53. Potential network impacts were as follows:

Summer Peak Load Flow

21 Generation Deliverability

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

None

22 Multiple Facility Contingency

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

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
53879472	946020	AF1-267 TAP	138.0	EKPC	324276	4LAKE REBAT	138.0	LGEE	1	EKPC_P4-6_JKSM E63-91T	breaker	306.0	93.15	103.92	DC	32.94
53879632	946020	AF1-267 TAP	138.0	EKPC	324276	4LAKE REBAT	138.0	LGEE	1	EKPC_P2-4_JKSM E63-91T-A	bus	306.0	98.09	108.85	DC	32.94
53879633	946020	AF1-267 TAP	138.0	EKPC	324276	4LAKE REBAT	138.0	LGEE	1	EKPC_P2-4_JKSM E63-91T-B	bus	306.0	93.15	103.92	DC	32.94

23 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)

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
41055759	250054	08LONGBR	138.0	DEO&K	250077	08MTZION	138.0	DEO&K	1	DAY_P734541 34553	tower	284.0	119.67	120.28	DC	3.81
41055810	250077	08MTZION	138.0	DEO&K	249991	08BUFTN1	138.0	DEO&K	1	DAY_P734541 34553	tower	298.0	109.75	110.33	DC	3.81
41675932	342541	4AVON	138.0	EKPC	342631	4PARIS T	138.0	EKPC	1	EKPC_P4-6_NCLK E114-151T	breaker	220.0	115.51	116.29	DC	3.84
41882555	342541	4AVON	138.0	EKPC	342631	4PARIS T	138.0	EKPC	1	EKPC_P2-4_NCLK E114-151T-B	bus	220.0	115.51	116.29	DC	3.84
41055735	342559	4BOONECO	138.0	EKPC	250054	08LONGBR	138.0	DEO&K	1	DAY_P734541 34553	tower	284.0	126.99	127.6	DC	3.81

24 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.

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.

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
4136468 5	342541	4AVON	138.0	EKPC	342631	4PARIS T	138.0	EKPC	1	EKPC_P1-2_AVON-NCLA345-C	operation	220.0	101.38	101.95	DC	2.8

25 Flow Gate Details

The following indices contain additional information about each flowgate presented in the body of the report. For each index, 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.

25.1 Index 1

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
53879632	946020	AF1-267 TAP	EKPC	324276	4LAKE REBA T	LGEE	1	EKPC_P2-4_JKSM E63-91T-A	bus	306.0	98.09	108.85	DC	32.94

Bus #	Bus	MW Impact
342918	1JKCT 1G	2.6457
342921	1JKCT 2G	1.9484
342924	1JKCT 3G	2.6457
342927	1JKCT 4G	1.7558
342930	1JKCT 5G	1.7461
342933	1JKCT 6G	1.7558
342936	1JKCT 7G	1.7558
942591	AE2-275 C O1	11.2691
942592	AE2-275 E O1	4.2388
942893	AE2-308 BAT	9.3705
946021	AF1-267 C O2	22.5719
946022	AF1-267 E O2	10.3709
DUCKCREEK	DUCKCREEK	0.1301
NEWTON	NEWTON	0.1590
FARMERCITY	FARMERCITY	0.0102
NY	NY	0.0393
PRAIRIE	PRAIRIE	0.5424
O-066	O-066	0.5174
COFFEEN	COFFEEN	0.0782
EDWARDS	EDWARDS	0.0361
CHEOAH	CHEOAH	0.2082
TILTON	TILTON	0.0605
G-007	G-007	0.0801
GIBSON	GIBSON	0.0808
CALDERWOOD	CALDERWOOD	0.2097
BLUEG	BLUEG	0.3646
TRIMBLE	TRIMBLE	0.1107
CATAWBA	CATAWBA	0.0917

25.2 Index 2

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
41055759	250054	08LONGBR	DEO&K	250077	08MTZION	DEO&K	1	DAY_P734541 34553	tower	284.0	119.67	120.28	DC	3.81

Bus #	Bus	MW Impact
342957	1SPURLK1G	5.1535
342960	1SPURLK2G	8.0926
342963	1SPURLK3G	4.2526
342966	1SPURLK4G	4.2526
925981	AC1-074 C O1	9.2562
925982	AC1-074 E O1	3.9670
932551	AC2-075 C	2.1984
932552	AC2-075 E	1.1074
936381	AD2-048 C	6.0729
936382	AD2-048 E	3.0299
936571	AD2-072 C O1	2.9465
936572	AD2-072 E O1	1.4447
939141	AE1-144 C O1	8.7899
939142	AE1-144 E O1	4.3621
940531	AE2-038 C O1	5.8636
940532	AE2-038 E O1	2.9044
941411	AE2-138 C	14.2325
941412	AE2-138 E	5.2641
941981	AE2-210 C O1	4.9041
941982	AE2-210 E O1	1.8447
942411	AE2-254 C O1	1.4096
942412	AE2-254 E O1	0.9398
942591	AE2-275 C O1	4.0264
942592	AE2-275 E O1	1.5145
942891	AE2-308 C O1	6.9274
942892	AE2-308 E O1	2.5191
943111	AE2-339 C	2.0999
943112	AE2-339 E	1.0343
944211	AF1-089 C O2	1.5123
944212	AF1-089 E O2	0.4627
944621	AF1-127 C O2	2.2259
944622	AF1-127 E O2	1.0963
945541	AF1-219 C O2	0.7318
945542	AF1-219 E O2	0.2375
945681	AF1-233 C O2	16.5976
945682	AF1-233 E O2	8.1996
945861	AF1-251 C	5.2663
945862	AF1-251 E	3.5109
945911	AF1-256 C	5.3174
945912	AF1-256 E	3.5450
946021	AF1-267 C O2	1.1750
946022	AF1-267 E O2	0.5398

Bus #	Bus	MW Impact
LGEE	LGEE	1.7069
CPLE	CPLE	0.2792
WEC	WEC	0.0350
CBM-W2	CBM-W2	6.2080
NY	NY	0.0735
CBM-W1	CBM-W1	0.6755
TVA	TVA	1.6156
O-066	O-066	0.7325
CBM-S2	CBM-S2	3.3062
CBM-S1	CBM-S1	12.7459
G-007	G-007	0.1123
MADISON	MADISON	3.7740
MEC	MEC	0.5673

25.3 Index 3

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
41055810	250077	08MTZION	DEO&K	249991	08BUFTN1	DEO&K	1	DAY_P734541 34553	tower	298.0	109.75	110.33	DC	3.81

Bus #	Bus	MW Impact
342957	1SPURLK1G	5.1535
342960	1SPURLK2G	8.0926
342963	1SPURLK3G	4.2526
342966	1SPURLK4G	4.2526
925981	AC1-074 C O1	9.2562
925982	AC1-074 E O1	3.9670
932551	AC2-075 C	2.1984
932552	AC2-075 E	1.1074
936381	AD2-048 C	6.0729
936382	AD2-048 E	3.0299
936571	AD2-072 C O1	2.9465
936572	AD2-072 E O1	1.4447
939141	AE1-144 C O1	8.7899
939142	AE1-144 E O1	4.3621
940531	AE2-038 C O1	5.8636
940532	AE2-038 E O1	2.9044
941411	AE2-138 C	14.2325
941412	AE2-138 E	5.2641
941981	AE2-210 C O1	4.9041
941982	AE2-210 E O1	1.8447
942411	AE2-254 C O1	1.4096
942412	AE2-254 E O1	0.9398
942591	AE2-275 C O1	4.0264
942592	AE2-275 E O1	1.5145
942891	AE2-308 C O1	6.9274
942892	AE2-308 E O1	2.5191
943111	AE2-339 C	2.0999
943112	AE2-339 E	1.0343
944211	AF1-089 C O2	1.5123
944212	AF1-089 E O2	0.4627
944621	AF1-127 C O2	2.2259
944622	AF1-127 E O2	1.0963
945541	AF1-219 C O2	0.7318
945542	AF1-219 E O2	0.2375
945681	AF1-233 C O2	16.5976
945682	AF1-233 E O2	8.1996
945861	AF1-251 C	5.2663
945862	AF1-251 E	3.5109
945911	AF1-256 C	5.3174
945912	AF1-256 E	3.5450
946021	AF1-267 C O2	1.1750
946022	AF1-267 E O2	0.5398

Bus #	Bus	MW Impact
LGEE	LGEE	1.7069
CPLE	CPLE	0.2792
WEC	WEC	0.0350
CBM-W2	CBM-W2	6.2080
NY	NY	0.0735
CBM-W1	CBM-W1	0.6755
TVA	TVA	1.6156
O-066	O-066	0.7325
CBM-S2	CBM-S2	3.3062
CBM-S1	CBM-S1	12.7459
G-007	G-007	0.1123
MADISON	MADISON	3.7740
MEC	MEC	0.5673

25.4 Index 4

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
41882555	342541	4AVON	EKPC	342631	4PARIS T	EKPC	1	EKPC_P2-4_NCLK E114-151T-B	bus	220.0	115.51	116.29	DC	3.84

Bus #	Bus	MW Impact
941411	AE2-138 C	48.8242
941412	AE2-138 E	18.0582
941981	AE2-210 C O1	16.8235
941982	AE2-210 E O1	6.3281
942411	AE2-254 C O1	1.2908
942412	AE2-254 E O1	0.8605
942591	AE2-275 C O1	4.1365
942592	AE2-275 E O1	1.5559
942891	AE2-308 C O1	8.9246
942892	AE2-308 E O1	3.2453
943111	AE2-339 C	6.8940
943112	AE2-339 E	3.3956
944621	AF1-127 C O2	13.7881
944622	AF1-127 E O2	6.7911
945861	AF1-251 C	33.9557
945862	AF1-251 E	22.6371
946021	AF1-267 C O2	1.1840
946022	AF1-267 E O2	0.5440
LGEE	LGEE	0.6641
CPLE	CPLE	0.2216
WEC	WEC	0.0403
CBM-W2	CBM-W2	4.2097
NY	NY	0.0160
CBM-W1	CBM-W1	1.1885
TVA	TVA	1.1312
O-066	O-066	0.1142
CBM-S2	CBM-S2	2.5143
CBM-S1	CBM-S1	7.4465
G-007	G-007	0.0166
MADISON	MADISON	2.0019
MEC	MEC	0.4449

25.5 Index 5

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
41055735	342559	4BOONE CO	EKPC	250054	08LONGBR	DEO&K	1	DAY_P734541 34553	tower	284.0	126.99	127.6	DC	3.81

Bus #	Bus	MW Impact
342957	1SPURLK1G	5.1535
342960	1SPURLK2G	8.0926
342963	1SPURLK3G	4.2526
342966	1SPURLK4G	4.2526
925981	AC1-074 C O1	9.2562
925982	AC1-074 E O1	3.9670
932551	AC2-075 C	2.1984
932552	AC2-075 E	1.1074
936381	AD2-048 C	6.0729
936382	AD2-048 E	3.0299
936571	AD2-072 C O1	2.9465
936572	AD2-072 E O1	1.4447
939141	AE1-144 C O1	8.7899
939142	AE1-144 E O1	4.3621
940531	AE2-038 C O1	5.8636
940532	AE2-038 E O1	2.9044
941411	AE2-138 C	14.2325
941412	AE2-138 E	5.2641
941981	AE2-210 C O1	4.9041
941982	AE2-210 E O1	1.8447
942411	AE2-254 C O1	1.4096
942412	AE2-254 E O1	0.9398
942591	AE2-275 C O1	4.0264
942592	AE2-275 E O1	1.5145
942891	AE2-308 C O1	6.9274
942892	AE2-308 E O1	2.5191
943111	AE2-339 C	2.0999
943112	AE2-339 E	1.0343
944211	AF1-089 C O2	1.5123
944212	AF1-089 E O2	0.4627
944621	AF1-127 C O2	2.2259
944622	AF1-127 E O2	1.0963
945541	AF1-219 C O2	0.7318
945542	AF1-219 E O2	0.2375
945681	AF1-233 C O2	16.5976
945682	AF1-233 E O2	8.1996
945861	AF1-251 C	5.2663
945862	AF1-251 E	3.5109
945911	AF1-256 C	5.3174
945912	AF1-256 E	3.5450
946021	AF1-267 C O2	1.1750
946022	AF1-267 E O2	0.5398

Bus #	Bus	MW Impact
LGEE	LGEE	1.7069
CPLE	CPLE	0.2792
WEC	WEC	0.0350
CBM-W2	CBM-W2	6.2080
NY	NY	0.0735
CBM-W1	CBM-W1	0.6755
TVA	TVA	1.6156
O-066	O-066	0.7325
CBM-S2	CBM-S2	3.3062
CBM-S1	CBM-S1	12.7459
G-007	G-007	0.1123
MADISON	MADISON	3.7740
MEC	MEC	0.5673

Affected Systems

26 Affected Systems

26.1 LG&E

LG&E Impacts to be determined during later study phases (as applicable).

26.2 MISO

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

26.3 TVA

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

26.4 Duke Energy Progress

Duke Energy Progress Impacts to be determined during later study phases (as applicable).

26.5 NYISO

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

27 Contingency Descriptions

Contingency Name	Contingency Definition
EKPC_P2-4_JKSM E63-91T-A	CONTINGENCY 'EKPC_P2-4_JKSM E63-91T-A' /* JK SMITH OPEN BRANCH FROM BUS 342596 TO BUS 342607 CKT 1 /* 342596 4HUNT 138.00 342607 4JK SMITH 138.00 OPEN BRANCH FROM BUS 342577 TO BUS 942590 CKT 1 /* 342577 4FAWKES EK 138.00 942590 AE2-275 TAP 138.00 END
EKPC_P2-4_JKSM E63-91T-B	CONTINGENCY 'EKPC_P2-4_JKSM E63-91T-B' /* JK SMITH OPEN BRANCH FROM BUS 342596 TO BUS 342607 CKT 1 /* 342596 4HUNT 138.00 342607 4JK SMITH 138.00 OPEN BRANCH FROM BUS 942590 TO BUS 342607 CKT 1 /* 942590 AE2-275 TAP 138.00 342607 4JK SMITH 138.00 END
EKPC_P4-6_JKSM E63-91T	CONTINGENCY 'EKPC_P4-6_JKSM E63-91T' /* JK SMITH OPEN BRANCH FROM BUS 342596 TO BUS 342607 CKT 1 /* 342596 4HUNT 138.00 342607 4JK SMITH 138.00 OPEN BRANCH FROM BUS 942590 TO BUS 342607 CKT 1 /* 942590 AE2-275 TAP 138.00 342607 4JK SMITH 138.00 END
EKPC_P1-2_AVON-NCLA345-C	CONTINGENCY 'EKPC_P1-2_AVON-NCLA345-C' /* AVON - N CLARK OPEN BRANCH FROM BUS 941410 TO BUS 342835 CKT 1 /* 941410 AE2-138 TAP 345.00 342835 7N CLARK 345.00 END
DAY_P734541 34553	CONTINGENCY 'DAY_P734541 34553' OPEN BRANCH FROM BUS 249581 TO BUS 342838 CKT 1 /* 249581 08MELDAL 345.00 342838 7SPURLOCK 345.00 OPEN BRANCH FROM BUS 253077 TO BUS 342838 CKT 1 /* 253077 09STUART 345.00 342838 7SPURLOCK 345.00 END
EKPC_P2-4_NCLK E114-151T-B	CONTINGENCY 'EKPC_P2-4_NCLK E114-151T-B' /* NORTH CLARK OPEN BRANCH FROM BUS 342832 TO BUS 342835 CKT 1 /* 342832 7JK SMITH 345.00 342835 7N CLARK 345.00 OPEN BRANCH FROM BUS 941410 TO BUS 342835 CKT 1 /* 941410 AE2-138 TAP 345.00 342835 7N CLARK 345.00 END
EKPC_P4-6_NCLK E114-151T	CONTINGENCY 'EKPC_P4-6_NCLK E114-151T' OPEN BRANCH FROM BUS 342832 TO BUS 342835 CKT 1 /* 342832 7JK SMITH 345.00 342835 7N CLARK 345.00 OPEN BRANCH FROM BUS 941410 TO BUS 342835 CKT 1 /* 941410 AE2-138 TAP 345.00 342835 7N CLARK 345.00 END

Short Circuit

28 Short Circuit

The following Breakers are overduty

Bus Number	Bus Name	BREAKER	Type	Capacity (Amps)	Duty Percentage Post Queue	Duty Percentage Pre Queue