Generation Interconnection

Feasibility Study Report

for

Queue Project AF1-219

PERRYVILLE 69 KV

30.2 MW Capacity / 40 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 Boyle County, KY. The installed facilities will have a total capability of 40 MW with 30.2 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is 6/1/2022. This study does not imply a TO commitment to this in-service date.

Queue Number	**AF1-219**
Project Name	PERRYVILLE 69 KV
State	Kentucky
County	Boyle
Transmission Owner	EKPC
MFO	40
MWE	40
MWC	30.2
Fuel	Solar
Basecase Study Year	2023

2.1 Point of Interconnection

AF1-219 will interconnect with the EKPC transmission system at the Perryville 69 kV substation.

2.2 Cost Summary

The AF1-219 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$400,000
Direct Connection Network Upgrade	$3,165,000
Non Direct Connection Network Upgrades	$685,000
Total Costs	$4,250,000

In addition, the AF1-219 project may be responsible for a contribution to the following costs

Description	Total Cost
System Upgrades	$0

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.

	Total Cost
Install necessary equipment (a 69 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 Perryville switching station, to accept the IC generator lead line/bus (Estimated time to implement is 24 months)	$400,000
Total Attachment Facility Costs	$400,000

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 69 kV switching station near the EKPC Perryville distribution substation to facilitate connection of the IC solar generation project (Estimated time to implement is 24 months)	$3,165,000
Total Direct Connection Facility Costs	$3,165,000

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 Hunt Farm Junction-Perryville-KU Mackville 69 kV line into the new Perryville switching station (Estimated time to implement is 24 months)	$130,000
Modify relays and/or settings at the Hunt Farm Junction substation for the existing line to the new Perryville switching station (Estimated time to implement is 9 months)	$45,000
Modify relays and/or settings at North Springfield substation for the existing line to the new Perryville switching station (Estimated time to implement is 9 months)	$45,000
Install OPGW on the Perryville-Hunt Farm Junction 69 kV line (5.3 miles) (Estimated time to implement is 14 months)	$450,000
Total Non-Direct Connection Facility Costs	$685,000

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 Revenue Metering and SCADA Requirements

10.1 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 Section 8 of Attachment O.

10.2 EKPC Requirements

[Please enter any TO revenue metering and SCADA Requirements]

11 Network Impacts

The Queue Project AF1-219 was evaluated as a 40.0 MW (Capacity 30.2 MW) injection at the Perryville 69 kV substation in the EKPC area. Project AF1-219 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-219 was studied with a commercial probability of 0.53. Potential network impacts were as follows:

Summer Peak Load Flow

12 Generation Deliverability

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

None

13 Multiple Facility Contingency

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

None

14 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

15 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
51047868	341794	2MACKVILK U T	69.0	EKPC	341935	2N SPRINGFLD	69.0	EKPC	1	3424062VAN ARSDELL 69.0 936570 AD2-072 TAP 69.0 1	operation	63.0	71.51	114.75	DC	27.24

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
51047867	342061	2PERRYVILLE	69.0	EKPC	341794	2MACKVILK U T	69.0	EKPC	1	3424062VAN ARSDELL 69.0 936570 AD2-072 TAP 69.0 1	operation	63.0	72.63	115.86	DC	27.24

16 System Reinforcements

ID	Index	Facility	Upgrade Description	Cost
			TOTAL COST	$0

17 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.

Affected Systems

18 Affected Systems

18.1 LG&E

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

18.2 MISO

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

18.3 TVA

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

18.4 Duke Energy Progress

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

18.5 NYISO

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

19 Contingency Descriptions

Contingency Name	Contingency Definition
342406 2VAN ARSDELL 69.0 936570 AD2-072 TAP 69.0 1	CONTINGENCY '342406 2VAN ARSDELL 69.0 936570 AD2-072 TAP 69.0 1' OPEN BRANCH FROM BUS 342406 TO BUS 936570 CKT 1 END

Short Circuit

20 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

21 Network Impacts – Secondary POI

The Queue Project AF1-219 was evaluated as a 40.0 MW (Capacity 30.2 MW) injection at the Hunt Farm 69 kV substation in the EKPC area. Project AF1-219 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-219 was studied with a commercial probability of 0.53. Potential network impacts were as follows:

Summer Peak Load Flow

22 Generation Deliverability

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

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
59551050	341671	2HUNT FARM J	69.0	EKPC	342061	2PERRYVILLE	69.0	EKPC	1	342406 2VAN ARSDELL 69.0 936570 AD2-072 TAP 69.0 1	single	46.0	70.11	110.03	DC	18.36

23 Multiple Facility Contingency

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

None

24 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

25 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.

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51047969	341671	2HUNT FARM J	69.0	EKPC	341044	2BALLARD	69.0	EKPC	1	3424062VAN ARSDELL 69.0 936570 AD2-072 TAP 69.0 1	operation	46.0	66.12	100.2	DC	15.68
59551049	341671	2HUNT FARM J	69.0	EKPC	342061	2PERRYVILLE	69.0	EKPC	1	3424062VAN ARSDELL 69.0 936570 AD2-072 TAP 69.0 1	operation	46.0	111.42	164.3	DC	24.32
51047868	341794	2MACKVILKUT	69.0	EKPC	341935	2N SPRINGFLD	69.0	EKPC	1	3424062VAN ARSDELL 69.0 936570 AD2-072 TAP 69.0 1	operation	63.0	71.51	110.12	DC	24.32
51047867	342061	2PERRYVILLE	69.0	EKPC	341794	2MACKVILKUT	69.0	EKPC	1	3424062VAN ARSDELL 69.0 936570 AD2-072 TAP 69.0 1	operation	63.0	72.63	111.23	DC	24.32

26 Flow Gate Details

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26.1 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
59551050	341671	2HUNT FARM J	EKPC	342061	2PERRYVILLE	EKPC	1	342406 2VAN ARSDELL 69.0 936570 AD2-072 TAP 69.0 1	single	46.0	70.11	110.03	DC	18.36

Bus #	Bus	MW Impact
936571	AD2-072 C O1	38.7614
945541	AF1-219 C O2	18.3637
DUCKCREEK	DUCKCREEK	0.0645
NEWTON	NEWTON	0.0849
FARMERCITY	FARMERCITY	0.0041
G-007A	G-007A	0.0048
VFT	VFT	0.0129
PRAIRIE	PRAIRIE	0.2325
COFFEEN	COFFEEN	0.0391
EDWARDS	EDWARDS	0.0186
CHEOAH	CHEOAH	0.0305
TILTON	TILTON	0.0391
GIBSON	GIBSON	0.0688
CALDERWOOD	CALDERWOOD	0.0308
BLUEG	BLUEG	0.2726
TRIMBLE	TRIMBLE	0.0735
CATAWBA	CATAWBA	0.0109

Affected Systems

27 Affected Systems

27.1 LG&E

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

27.2 MISO

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

27.3 TVA

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

27.4 Duke Energy Progress

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

27.5 NYISO

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

28 Contingency Descriptions

Contingency Name	Contingency Definition
342406 2VAN ARSDELL 69.0 936570 AD2-072 TAP 69.0 1	CONTINGENCY '342406 2VAN ARSDELL 69.0 936570 AD2-072 TAP 69.0 1' OPEN BRANCH FROM BUS 342406 TO BUS 936570 CKT 1 END

Short Circuit

29 Short Circuit

The following Breakers are overduty

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