



**Generation Interconnection  
Feasibility Study Report  
for  
Queue Project AF1-320  
MERRILL CREEK 115 KV  
42 MW Capacity / 70 MW Energy**

January, 2020

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## 1 Introduction

This Feasibility Study has been prepared in accordance with the PJM Open Access Transmission Tariff, 36.2, as well as the Feasibility Study Agreement between the Interconnection Customer (IC), and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is Jersey Central Power and Light (JCPL).

## 2 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.

### 3 General

The Interconnection Customer (IC), has proposed a Solar; Storage generating facility located in Warren County, New Jersey. The installed facilities will have a total capability of 70 MW with 42 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is December 1, 2022. This study does not imply a TO commitment to this in-service date.

<b>Queue Number</b>	<b>AF1-320</b>
<b>Project Name</b>	MERRILL CREEK 115 KV
<b>State</b>	New Jersey
<b>County</b>	Warren
<b>Transmission Owner</b>	JCPL
<b>MFO</b>	70
<b>MWE</b>	70
<b>MWC</b>	42
<b>Fuel</b>	Solar; Storage
<b>Basecase Study Year</b>	2023

## 4 Point of Interconnection

### 4.1 Primary POI

The interconnection of the project to the JCPL system will be accomplished by constructing a new direct connection to the Merrill Creek 115 kV substation. The IC will be responsible for acquiring all easements, properties, and permits that may be required to construct the associated Attachment facilities.

Attachment 1 shows a one-line diagram of the proposed primary direct connection facilities for the AF1-320 generation project to connect to the FirstEnergy (“FE”) transmission system. IC will be responsible for constructing all of the facilities on its side of the POI, including the attachment facilities which connect the generator to the FE transmission system’s direct connection facilities.

### 4.2 Secondary POI

The interconnection of the project at a Secondary POI can be accomplished by tapping the Martins Creek – Morris Park 230 kV line. A full scope of work or estimated cost is not provided for the proposed Secondary POI.

## 5 Cost Summary

The AF1-320 project will be responsible for the following costs:

Description	Total Cost
<b>Attachment Facilities</b>	\$360,800
<b>Direct Connection Network Upgrade</b>	\$0
<b>Non Direct Connection Network Upgrades</b>	\$10,075,600
<b>Total Costs</b>	<b>\$10,436,400</b>

In addition, the AF1-320 project may be responsible for a contribution to the following costs

Description	Total Cost
<b>System Upgrades</b>	<b>\$20,904,000</b>

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

The Feasibility Study is used to make a preliminary determination of the type and scope of Attachment Facilities, Local Upgrades, and Network Upgrades that will be necessary to accommodate the Interconnection Request and to provide the Interconnection Customer a preliminary estimate of the time that will be required to construct any necessary facilities and upgrades and the Interconnection Customer's cost responsibility. The System Impact Study provides refined and comprehensive estimates of cost responsibility and construction lead times for new facilities and system upgrades. Facilities Studies will include, commensurate with the degree of engineering specificity as provided in the Facilities Study Agreement, good faith estimates of the cost, determined in accordance with Section 217 of the Tariff,

- (a) to be charged to each affected New Service Customer for the Facilities and System Upgrades that are necessary to accommodate this queue project;
- (b) the time required to complete detailed design and construction of the facilities and upgrades; and
- (c) a description of any site-specific environmental issues or requirements that could reasonably be anticipated to affect the cost or time required to complete construction of such facilities and upgrades.

The costs provided above exclude the Contribution in Aid of Construction ("CIAC") Federal Income Tax Gross Up charge. If, at a future date, it is determined that the CIAC Federal Income Tax Gross charge is required, the Transmission Owner shall be reimbursed by the Interconnection Customer for such taxes.

The required Attachment Facilities and Direct and/or Non-Direct Connection work for the interconnection of the AF1-320 generation project to the FE Transmission System is detailed in the following sections. The associated one-line with the generation project Attachment Facilities and the Primary Direct and Non-Direct Connection facilities are shown in Attachment 1

## 6 Transmission Owner Scope of Work

The interconnection of the project to the JCPL system will be accomplished by constructing a new direct connection to the Merrill Creek 115 kV substation. The IC will be responsible for acquiring all easements, properties, and permits that may be required to construct the associated Attachment facilities.

## 7 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
Line terminal work associated with AF1-320 at the new four breaker ring bus @ Merrill Creek	\$281,600
Install metering in customer facilities @ AF1-320	\$79,200
<b>Total Attachment Facility Costs</b>	<b>\$360,800</b>

## 8 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
<b>Total Direct Connection Facility Costs</b>	<b>\$0</b>

## 9 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
Replace existing substation configuration with a four breaker ring bus expandable to future breaker-and-a-half operation. @ Merrill Creek	\$9,436,700
Re-terminate the S919(Flanders-Gilbert-Pequest River) 115kV Line into the new 4 breaker ring bus.	\$638,900
<b>Total Non-Direct Connection Facility Costs</b>	<b>\$10,075,600</b>

## 10 Schedule

Based on the scope of work for the Attachment Facilities and the Direct and/or Non-Direct Connection facilities, it is expected to take a minimum of **24 months** after the signing of an Interconnection Construction Service Agreement to complete the installation. This assumes that there will be no environmental issues with any of the new properties associated with this project, that there will be no delays in acquiring the necessary permits for implementing the defined interconnection work and network upgrades, and that all transmission system outages will be allowed when requested.

The schedule for the required Network Impact Reinforcements will be more clearly identified in future study phases. The estimate elapsed time to complete each of the required reinforcements is identified in the “System Reinforcements” section of the report.

## 11 Transmission Owner Analysis

### 11.1 Power Flow Analysis

FE performed an analysis of its underlying transmission <100 kV system. The AF1-320 project did not contribute to any overloads on the FE transmission <100 kV system.

## 12 Interconnection Customer Requirements

### 12.1 System Protection

The IC must design its Customer Facilities in accordance with all applicable standards, including the standards in FE's "Requirements for Transmission Connected Facilities" document located at: <http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx>. Preliminary Protection requirements will be provided as part of the Facilities Study. Detailed Protection Requirements will be provided once the project enters the construction phase.

### 12.2 Compliance Issues and Interconnection Customer Requirements

The proposed Customer Facilities must be designed in accordance with FE's "Requirements for Transmission Connected Facilities" document located at: <http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx>. In particular, the IC is responsible for the following:

1. The purchase and installation of a fully rated 115 kV circuit breaker to protect the AF1-320 generator lead line. A single circuit breaker must be used to protect this line; if the project has several GSU transformers, the individual GSU transformer breakers cannot be used to protect this line.
2. The purchase and installation of the minimum required FE generation interconnection relaying and control facilities. This includes over/under voltage protection, over/under frequency protection, and zero sequence voltage protection relays.
3. The purchase and installation of supervisory control and data acquisition ("SCADA") equipment to provide information in a compatible format to the FE Transmission System Control Center.
4. Compliance with the FE and PJM generator power factor and voltage control requirements.
5. The execution of a back-up service agreement to serve the customer load supplied from the AF1-320 generation project metering point when the units are out-of-service. This assumes the intent of the IC is to net the generation with the load.

The IC will also be required to meet all PJM, ReliabilityFirst, and NERC reliability criteria and operating procedures for standards compliance. For example, the IC will need to properly locate and report the over and under voltage and over and under frequency system protection elements for its units as well as the submission of the generator model and protection data required to satisfy the PJM and ReliabilityFirst audits. Failure to comply with these requirements may result in a disconnection of service if the violation is found to compromise the reliability of the FE system.

### **12.3 Power Factor Requirements**

The IC shall design its non-synchronous Customer Facility with the ability to maintain a power factor of at least 0.95 leading (absorbing VARs) to 0.95 lagging (supplying VARs) measured at the high-side of the facility substation transformer(s) connected to the FE transmission system.

## 13 Revenue Metering and SCADA Requirements

### 13.1 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.

#### 13.1.1 Meteorological Data Reporting Requirement

The solar generation facility shall provide the Transmission Provider with site-specific meteorological data including:

- Temperature (degrees Fahrenheit)
- Atmospheric pressure (hectopascals)
- Irradiance
- Forced outage data

### 13.2 FE Requirements

The IC will be required to comply with all FE revenue metering requirements for generation interconnection customers which can be found in FE's "Requirements for Transmission Connected Facilities" document located at: <http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx>.

## **14 Network Impacts – Primary POI**

The Queue Project AF1-320 was evaluated as a 70.0 MW (Capacity 42.0 MW) injection at the Merrill Creek Pumping Station 115 kV substation in the JCPL area. Project AF1-320 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-320 was studied with a commercial probability of 53%. Potential network impacts were as follows:

# Summer Peak Load Flow

### 14.1 Generation Deliverability

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

None

### 14.2 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
41080231	206227	28BELVIDER	115.0	JCP&L	206713	28DRKTN TP	115.0	JCP&L	1	JC-P7-1-JCN-230-17T	tower	245.0	93.93	100.78	DC	16.77
41080232	206227	28BELVIDER	115.0	JCP&L	206713	28DRKTN TP	115.0	JCP&L	1	JC-P7-1-JCN-230-13	tower	245.0	94.82	101.6	DC	16.61

### 14.3 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

### 14.4 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.

None

## 14.5 System Reinforcements

ID	Index	Facility	Upgrade Description	Cost
41080232,410 80231	1	28BELVIDER 115.0 kV - 28DRKTN TP 115.0 kV Ckt 1	<u>JCPL</u> JCP&L-AF1-F-0035 (195) : Belvidere-Drakestown 115 kV Tap: Reconductor transmission line Project Type : FAC Cost : \$20,904,000 Time Estimate : 24.0 Months	\$20,904,000
			TOTAL COST	\$20,904,000

## 14.6 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.

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## 14.7 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
41080232	206227	28BELVIDER	JCP&L	206713	28DRKTN TP	JCP&L	1	JC-P7-1-JCN-230-13	tower	245.0	94.82	101.6	DC	16.61

Bus #	Bus	MW Impact
204651	27PORT CT	0.5615
206345	28N27_Y2-018	0.3946
206346	28MILF GEN	0.3052
206671	28HOFFMAN	0.1626
206679	28M&M S721	-0.5482
206740	28WCRR (Deactivation : 06/01/19)	2.0771
206747	28DSM_X3-029	2.5985
206757	28RH_W2-091	0.6895
207402	28AA2-082 E	1.1490
207411	AA2-060 BAT	0.4205
207414	AA2-061 BAT	0.5607
290131	U2-059E	0.0820
902062	W1-127E	0.1257
903632	W3-044 E OP1	0.9067
903962	W3-077 E	0.6413
905442	W4-046 E	0.4132
905602	W4-073 E	0.6900
905762	W4-097 E	0.1160
924142	AB2-058 E	0.4039
925461	AC1-018 C	0.0331
925462	AC1-018 E	0.0595
936552	AD2-070 E	0.2690
940012	AE1-243 E	1.2687
940022	AE1-244 E (Withdrawn : 12/19/2019)	1.2084
940441	AE2-028 C	0.0283
940442	AE2-028 E	0.0248
942253	AE2-237 BAT	16.7519
942971	AE2-317 C O1	13.3872
942972	AE2-317 E O1	8.9248
943483	AF1-019 BAT	1.0866
943551	AF1-026	0.0677
944681	AF1-133 C	2.7966
944682	AF1-133 E	1.8644
945221	AF1-187	0.2299
945921	AF1-257	0.0065
946393	AF1-303 BAT	16.5165
946561	AF1-320 C O1	9.9670
946562	AF1-320 E O1	6.6447
946613	AF1-325 BAT	2.2912
LGEE	LGEE	0.0365
CPL	CPL	0.0311

<b>Bus #</b>	<b>Bus</b>	<b>MW Impact</b>
WEC	WEC	0.0205
CBM-W2	CBM-W2	0.5078
NY	NY	0.4208
CBM-W1	CBM-W1	0.8382
TVA	TVA	0.0826
O-066	O-066	10.6243
CBM-S2	CBM-S2	0.2948
CBM-S1	CBM-S1	0.5112
G-007	G-007	0.9734
MEC	MEC	0.1017

## Affected Systems

## 14.8 Affected Systems

### 14.8.1 LG&E

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

### 14.8.2 MISO

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

### 14.8.3 TVA

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

### 14.8.4 Duke Energy Progress

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

### 14.8.5 NYISO

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

## 14.9 Contingency Definitions

Contingency Name	Contingency Definition
<b>JC-P7-1-JCN-230-13</b>	CONTINGENCY 'JC-P7-1-JCN-230-13' /* POHATCONG-W.WHARTON & CHESTER- W.WHARTON 230 KV DISCONNECT BRANCH FROM BUS 206374 TO BUS 206377 CKT 1 /* 28ELASTMLD 230 28DOTWHART 230 DISCONNECT BRANCH FROM BUS 206377 TO BUS 206255 CKT ZL /* 28DOTWHART 230 28W WHRTN 230 REMOVE LOAD C FROM BUS 206374 /* 28ELASTMLD 230 REMOVE LOAD C FROM BUS 206377 /* 28DOTWHART 230 DISCONNECT BRANCH FROM BUS 206247 TO BUS 206374 CKT 1 /* 28POHATCNG 230 28ELASTMLD 230 DISCONNECT BRANCH FROM BUS 206228 TO BUS 206255 CKT 1 /* 28CHESTER 230 28W WHRTN 230 DISCONNECT BRANCH FROM BUS 206228 TO BUS 206212 CKT 4 /* 28CHESTER 230 28CHESTER 35 DISCONNECT BRANCH FROM BUS 206203 TO BUS 206255 CKT 2 /* 28W WHRTN 35 28W WHRTN 230 END
<b>JC-P7-1-JCN-230-17T</b>	CONTINGENCY 'JC-P7-1-JCN-230-17T' /* PORTLAND-GREYSTONE & KITTATINNY- POHATCONG 230 KV DISCONNECT BRANCH FROM BUS 204510 TO BUS 206241 CKT 1 /* 27PORTLAND 230 28GRYSTN Q 230 REMOVE LOAD 3 FROM BUS 206241 /* 28GRYSTN Q 230 DISCONNECT BRANCH FROM BUS 206242 TO BUS 206247 CKT 1 /* 28KITATINY 230 28POHATCNG 230 DISCONNECT BRANCH FROM BUS 206247 TO BUS 206219 CKT 1 /* 28POHATCNG 230 28POHATCNG 35 END

# Short Circuit

## 14.10 Short Circuit

The following Breakers are overduty:

None

## **15 Network Impacts – Secondary POI**

The Queue Project AF1-320 was evaluated as a 70.0 MW (Capacity 42.0 MW) injection tapping the Martins Creek to Morris Park 230 kV line in the JCPL area. Project AF1-320 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF1-320 was studied with a commercial probability of 53%. Potential network impacts were as follows:

# Summer Peak Load Flow

### **15.1 Generation Deliverability**

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

None

### **15.2 Multiple Facility Contingency**

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

None

### **15.3 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

### **15.4 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.

None

# Affected Systems

## 15.5 Affected Systems

### 15.5.1 LG&E

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

### 15.5.2 MISO

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

### 15.5.3 TVA

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

### 15.5.4 Duke Energy Progress

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

### 15.5.5 NYISO

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

# Short Circuit

## 15.6 Short Circuit

The following Breakers are overduty:

None

## 16 Attachment One: One Line Diagram