

***Generation Interconnection
Feasibility Study Report***

For

***PJM Generation Interconnection Request
Queue Position AD2-213***

“East Flemington-Lebanon 34.5 kV”

0 MW Capacity / 20 MW Energy

July 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 users, e.g. another generation interconnection, may also contribute to the need for the same network reinforcement. The possibility of sharing the reinforcement costs with other projects may be identified in the feasibility study, but the actual allocation will be deferred until the impact study is performed.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

General

The Interconnection Customer (IC), has proposed a new battery storage generating facility to be located at 79 Junction Road, Flemington, New Jersey, 08822. The installed facilities will have a total capability of **20 MW** with **0 MW** of this output being recognized by PJM as Capacity. The proposed in-service date for this project is **March 29, 2019**. **This study does not imply a Jersey Central Power & Light (JCP&L) commitment to this in-service date.**

Primary Point of Interconnection

The **AD2-213 “East Flemington-Lebanon 34.5 kV”** generation project will interconnect with the East Flemington-Lebanon 34.5 kV line. The primary direct connection of this project will be accomplished by tapping the East Flemington-Lebanon (F734) 34.5 kV line, and installing one span of overhead 34.5 kV line to the point of interconnection (“POI”) including 2-34.5 kV gang-operated SCADA controlled switches at the tap location, and 34.5 kV interconnection metering. This is the primary Point of Interconnection (POI) chosen by the IC. The IC will also be responsible for the rough grade of the property and an access road to the proposed site. The project will require non-direct connection relay upgrades at East Flemington and Lebanon substations.

Attachment 1 shows a one-line diagram of the proposed primary direct connection (Option 1) of the (AD2-213) generation project to the Jersey Central Power & Light transmission systems. **Attachment 2** provides the proposed location for the point of interconnection. IC will be responsible for constructing all of the facilities on its side of the POI including the attachment line. IC may not install above ground equipment within any JCP&L right-of-way unless permission to do so is expressly granted by JCP&L. The JCP&L facilities required to be

upgraded for the interconnection of the generation project and the associated cost estimate are shown in the Cost Summary section.

Secondary Point of Interconnection

The IC requested that a secondary POI be reviewed for network impacts (Option 2). The secondary interconnection chosen was a direct line into the East Flemington-Glen Gardner No. 2 (T748) 34.5 kV line.

This report does not provide costs for the physical interconnection of Option 2. It was just analyzed for network impacts to the system. Results are shown in the “Network Impacts – Option 2” section of this report.

Cost Summary

The AD2-213 “East Flemington-Lebanon 34.5 kV” project will be responsible for the following costs. These costs do not include CIAC Tax Gross-up:

Description	Total Cost
Attachment Facilities	\$ 258,000
Direct Connection Network Upgrades	\$ 0
Non Direct Connection Network Upgrades	\$ 237,600
Total Costs	\$ 495,600

In addition, the AD2-213 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

The transmission and substation costs given above exclude any applicable state or federal taxes. If at a future date Federal CIAC (contribution in aid of construction) taxes are deemed necessary by the IRS for this project, JPCL shall be reimbursed by the Interconnection Customer for such taxes. JPCL estimates the tax, if applicable, would be approximately **\$75,800**.

The required Attachment Facilities, Direct Connection, and Non-Direct Connection work for the interconnection of the AD2-213 generation project to the JCPL Transmission System is detailed in the following sections. The associated one-line with the generation project attachment facilities and primary direct and non-direct connection are shown in Attachment 1.

Note that the FE findings were made from a conceptual review of this project. A more detailed review of the connection facilities and their cost will be identified in the Facilities Study. Further note that the cost estimate data contained in this document should be considered high level estimates since it was produced without a detailed engineering review. The applicant will be responsible for the actual cost of construction. FE herein reserves the right to return to any

issues in this document and, upon appropriate justification, request additional monies to complete any reinforcements to the transmission systems.

Attachment Facilities

To accommodate the proposed AD2-213 Project, JCP&L will tap the East Flemington-Lebanon (F734) 34.5 kV line, and install one span of overhead 34.5 kV line to the point of interconnection (“POI”) including 2-34.5 kV gang-operated SCADA controlled switches at the tap location, and 34.5 kV interconnection metering. The IC will be responsible for acquiring all easements, properties and permits that may be required to construct the associated facilities.

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

Description	Total Cost
Construct a 34.5 line tap/connection and 2-34.5kV switches at tap location, including 1 span of 34.5kV line to the point of interconnection. @ East Flemington-Lebanon (F734) 34.5kV Line Tap. <i>(One of the two switches covering the generator lead line and the one span to the POI are considered Attachment Facilities).</i>	\$ 258,000
Total Attachment Facility Costs	\$ 258,000

The transmission Attachment Facility cost estimate for the AD2-213 “East Flemington-Lebanon 34.5 kV” project is approximately **\$258,000**. JCPL plans to tap the F734 (East Flemington-Lebanon) 34.5 kV line and installing an overhead 34.5 kV line to the point of interconnection (“POI”), 2-34.5 kV gang-operated SCADA controlled switches at the tap location, and 34.5 kV interconnection metering. The SCADA-controlled MOAB switch covering the generator lead line will be considered an Attachment Facility.

Direct Connection Cost Estimate

There is no Direct Connection scope of work required for this project.

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
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Description	Total Cost
Construct a 34.5 line tap/connection and 2-34.5kV switches at tap location, including 1 span of 34.5kV line to the point of interconnection. @ East Flemington-Lebanon (F734) 34.5kV Line Tap (<i>One of the two switches is considered a Non-Direct Connection facility</i>)	\$ 210,000
East Flemington Substation – Adjust remote relay and metering settings	\$ 13,800
Lebanon Substation – Adjust remote relay and metering settings	\$ 13,800
Total Non-Direct Connection Facility Costs	\$ 237,600

The total Non-Direct Connection cost estimate for the AD2-213 project is approximately **237,600**.

Of the total, the transmission Non-Direct Connection cost estimate for the AD2-213 project is approximately **\$210,000**. JCPL plans to tap the F734 (East Flemington-Lebanon) 34.5 kV line and install an overhead 34.5 kV line to the point of interconnection (“POI”), 2-34.5 kV gang-operated SCADA controlled switches at the tap location, and 34.5 kV interconnection metering. The SCADA-controlled MOAB switch adjacent to the tap will be considered a Non-Direct Connection Facility.

Of the total, the substation Non-Direct Connection cost estimate for the AD2-213 project is approximately **\$27,600**. Remote relay and metering setting changes will need to be made at East Flemington and Lebanon Substations to facilitate the interconnection of the new generation.

Schedule

Based on the extent of the JCP&L primary Attachment Facilities and Non-Direct Connection work required to support the AD2-213 generation project, it is expected to take a minimum of **seven (7) months** from the date of a fully executed Interconnection Construction Service Agreement to complete the installation. This includes the requirement for the IC to make a preliminary payment to FE which funds the Non-Direct Connection work and the first three months of engineering design that is related to the construction of the Attachment Facilities. It further assumes that the IC will provide all rights-of-way, permits, easements, etc. that will be needed. A further assumption is 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 Attachment Facilities and Non-Direct Connection work and that all system outages will be allowed when requested.

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.

JPCL 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>.

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 [PRI POI VOLTAGE] kV circuit breaker to protect the AD2-213 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 AD2-213 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.

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.

JCPL Analysis:

Power Flow Analysis

PJM performed a power flow analysis of the transmission system using a 2021 summer peak load flow model and the results were verified by FE. Additionally, FE performed an analysis of its underlying transmission <100 kV system. The AD2-213 project did not contribute to any overloads on the FE transmission system at the Primary POI. At the Secondary POI, the AD2-213 project contributes to overloads on the FE transmission system as shown in the Network Impacts section for Option 2. Cost estimates are not provided for the secondary POI.

Short Circuit Analysis

As the AD2-213 project is less than or equal to 20 MW and is inverter based, PJM did not perform a short circuit analysis. FE performed an analysis of its underlying transmission <100 kV system. The connection of AD2-213 project to the system does not result in any newly overdutied circuit breakers on the FE transmission system and does not have a significant fault current contribution to existing overdutied circuit breakers.

Stability Analysis

PJM will be responsible for completing a dynamic stability analysis, if necessary, as part of the System Impact Study. The results of this analysis will be reviewed by FE. Should stability concerns be identified in PJM's study, FE will develop appropriate system reinforcement(s) and included the estimated cost of any reinforcement(s) in FE's System Impact Study report.

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.

The IC has requested a non-standard GSU transformer winding configuration. This transformer is in violation of section 14.2.6 of FE's "Requirements for Transmission Connected Facilities" document and will not be accepted. The GSU transformer must have a grounded wye connection on the high (utility) side and a delta connection on the low (generator) side.

Network Impacts – Option 1

The Queue Project AD2-213 was evaluated as a 20.0 MW (Capacity 0.0 MW) injection tapping the Lipton Tap to X2-075 Tap 34.5 kV line in the JCPL area. Project AD2-213 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD2-213 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis - 2021

Generator Deliverability

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

None.

Multiple Facility Contingency

(Double Circuit Tower Line contingencies were studied for the full energy output. The contingencies of Line with Failed Breaker and Bus Fault will be performed for the Impact Study.)

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)

None.

Steady-State Voltage Requirements

(Summary of the VAR requirements based upon the results of the steady-state voltage studies)

To be determined in the Impact Study Phase.

Short Circuit

(Summary of impacted circuit breakers)

None.

Affected System Analysis & Mitigation

(Summary of impacts on systems external to PJM)

NYISO Impacts:

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

Delivery of Energy Portion of Interconnection Request

PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.

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

None

Light Load Analysis - 2021

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

System Reinforcements

Short Circuit

(Summary form of Cost allocation for breakers will be inserted here if any)

To be determined

Stability and Reactive Power Requirement

(Results of the dynamic studies should be inserted here)

To be determined

Summer Peak Load Flow Analysis Reinforcements

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)

(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)

None

Light Load Load Flow Analysis Reinforcements

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)

(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)

None

Network Impacts – Option 2

The Queue Project AD2-213 was evaluated as a 20.0 MW (Capacity 0.0 MW) injection tapping the East Flemington –Glen Gardner 34.5kV line in the JCPL area. Project AD2-213 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD2-213 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis - 2021

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)

FE <100kV System Analysis

Contingency Description	Overloaded Element	Rating (MVA)	% Loading After AD2-213	Final % Loading	AD2-213 MW Contrib.
JC-P7-1-JCN-230-4	50 AD2-213 TAP2 206224 28E FLEM	38	101.92	101.92	16.74
JC-P7-1-JCN-230-5LT	50 AD2-213 TAP2 206224 28E FLEM	38	101.79	101.79	16.74

Note: For Option 2 POI, no system reinforcement cost are provided.

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)

FE <100kV System Analysis

Contingency Description	Overloaded Element	Rating (MVA)	% Loading After AD2-213	Final % Loading	AD2-213 MW Contrib.
JC-P2-4-JCN-230-052T	50 AD2-213 TAP2 206224 28E FLEM	38	115.77	115.77	11.58
JC-P2-3-JCN-230-001T	50 AD2-213 TAP2 206224 28E FLEM	38	115.77	115.77	11.58
I2209+Q2243	50 AD2-213 TAP2 206224 28E FLEM	38	129.26	129.26	13.89

Note: For Option 2 POI, no system reinforcement cost are provided.

Steady-State Voltage Requirements

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

To be determined

Short Circuit

(Summary of impacted circuit breakers)

To be determined

Affected System Analysis & Mitigation

NYISO Impacts:

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

Delivery of Energy Portion of Interconnection Request

PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.

Only the most severely overloaded conditions are listed. 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 will study all overload conditions associated with the overloaded element(s) identified.

Overload Number	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution	Flowgate Appendix
1	Non	Non	JCPL - PL	28GILBERT-SFLD 230 kV line	206236	208091	1	DC	99.9	100	NR	653	1.77	

Note: For Option 2 POI, no system reinforcement cost are provided.

Light Load Analysis - 2021

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

System Reinforcements

Short Circuit

(Summary form of Cost allocation for breakers will be inserted here if any)

To be determined

Stability and Reactive Power Requirement

(Results of the dynamic studies should be inserted here)

To be determined

Summer Peak Load Flow Analysis Reinforcements

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)

(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)

None

Light Load Load Flow Analysis Reinforcements

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)

(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)

None

**Attachment 1. AD2-213 ‘East Flemington-Lebanon 34.5 kV’
One Line Diagram**

Attachment 2. AD2-213 ‘East Flemington-Lebanon 34.5 kV’ Project Location