

***Generation Interconnection
Feasibility Study Report***

for

***PJM Generation Interconnection Request
Queue Position Z2-099***

***Boykins 115kV
13.9MW Capacity / 20MW Energy***

August / 2014

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 Interconnection Customer (IC), and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is Virginia Electric and Power Company (VEPCO).

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 IC. The IC may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the IC may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system.

In some instances a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection, may also contribute to the need for the same network reinforcement. The possibility of sharing the reinforcement costs with other projects may be identified in the Feasibility Study, but the actual allocation will be deferred until the Impact Study is performed.

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

General

The IC, has proposed a solar generating facility located in Boykins, VA. The installed facilities will have a total capability of 20 MW with 13.9 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is 5/01/2016. **This study does not imply an ITO commitment to this in-service date.**

Point of Interconnection

Z2-099 will interconnect with the ITO transmission or distribution system at one of the two following points of interconnection:

Option 1 will connect via a tap onto the Boykins 115kV substation bus

Option 2 will connect via a tap onto the existing 34.5kV circuit which is fed out of Boykins substation.

Option 1

Cost Summary

The Z2-099 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	\$2,500,000
Direct Connection Network Upgrades	\$
Non Direct Connection Network Upgrades	\$
Total Costs	\$2,500,000

Attachment Facilities

Generation Substation: Install metering and associated protection equipment. Estimated Cost \$1,500,000.

Transmission Line: Construct approximately one span of 115 kV Attachment line between the generation substation and the Boykins 115 kV Substation. The estimated cost for this work is \$1,000,000.

The estimated total cost of the Attachment Facilities is \$2,500,000. It is estimated to take 18-24 months to complete this work after execution of ISA and IC SA. These preliminary cost estimates are based on typical engineering costs. A more detailed engineering cost estimate is normally done when the IC provides an exact site plan location for the generation substation during the Facility Study phase. These costs do not include CIAC Tax Gross-up. The single line is shown below in Attachment 1.

Direct Connection Cost Estimate

Substation: The arrangement in the substation will be as shown below on Attachment 1 and all scope of work is classified as Attachment Facilities.

Interconnection Customer Requirements

VEPCO Facility Connection Requirements as posted on PJM's website
<http://www.pjm.com/~media/planning/plan-standards/private-dominion/facility-connection-requirements1.ashx>

Revenue Metering and SCADA Requirements

PJM Requirements

The IC 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.

Option One

Network Impacts

The Queue Project Z2-099 was studied as a 20.0 MW (Capacity 13.9 MW) injection at the Boykins 115 kV substation in the ITO area. Project Z2-099 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners) for summer peak conditions 2018. Project Z2-099 was studied with a commercial probability of 100%. Potential network impacts were as follows:

Contingency Descriptions

The following contingencies resulted in overloads:

None

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, further analysis performed during the Impact Study

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty: None

Contributions to previously identified circuit breakers found to be over-duty: 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 during Impact Study

Stability and Reactive Power Requirement for Low Voltage Ride Through

(Summary of the VAR requirements based upon the results of the dynamic studies)

To be determined if required during Impact Study

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)

None

Potential Congestion due to Local Energy Deliverability

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

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

ITO Analysis

ITO assessed the impact of the proposed Queue Project #Z2-099 interconnection of 20.0 MW of energy (Capacity 13.9 MW) for compliance with reliability criteria on ITO's Transmission System. The system was assessed using the summer 2018 RTEP case provided to ITO by PJM. When performing a generation analysis, ITO's main analysis will be load flow study results under single contingency and multiple facility contingency (both normal and stressed system conditions). ITO's criteria considers a transmission facility overloaded if it exceeds 94% of its emergency rating under normal and stressed system conditions. A full listing of ITO's Planning Criteria and interconnection requirements can be found in the ITO's Facility Connection Requirements which are publicly available at: <http://www.dom.com>.

The results of these studies evaluate the system under a limited set of operating conditions and do not guarantee the full delivery of the capacity and associated energy of this proposed generation facility under all operating conditions. NERC Planning and Operating Reliability Criteria allow for the re-dispatch of generating units to resolve projected and actual deficiencies

in real time and planning studies. Specifically NERC Category C Contingency Conditions (Bus Fault, Tower Line, N-1-1, and Stuck Breaker scenarios) allow for re-dispatch of generating units to resolve potential reliability deficiencies. For ITO's Planning Criteria the re-dispatch of generating units for these contingency conditions is allowed as long as the projected loading does not exceed 100% of a facility Load Dump Rating.

As part of its generation impact analysis ITO routinely evaluates the impact that a proposed new generation resource will have under maximum generation conditions, stress system conditions and import/export system conditions. The results of these studies are discussed in more detail below.

Category B Analysis (Single Contingency):

1. System Normal – No deficiencies identified
2. Critical System Condition (No Surry 230 kV Unit) – No deficiencies identified.

Category C Analysis: (Multiple Facility Contingency)

1. Bus Fault - No deficiencies identified
2. Line Stuck Breaker - No deficiencies identified
3. Tower Line – No deficiencies identified

Option Two

Network Impacts

In Option One the Queue Project Z2-099 was studied as a 20.0 MW (Capacity 13.9 MW) injection at the Boykins 115 kV substation in the ITO area. As Option Two is also an injection at the Boykins substation the transmission impact would be the same as identified in Option One. The Queue Project Z2-099 was studied as a 20.0 MW (Capacity 13.9 MW) injection onto ITO's 34.5kV Distribution System. The IC's request was for a determination of a capacity level that would not require significant, costly, modifications to the Distribution System was requested.

The existing 34.5 kV distribution line on the IC's site consists of #2 copper primary voltage conductor served from a 12.5 MVA, 115/34.5 kV transformer in Boykins substation. As it exists, the capacity in the 34.5 kV distribution line is limited by the capacity of the Substation Transformer to approximately 8.5 MW. Any request for capacity in excess of 8.5 MW would require, at a minimum, reconductoring of the distribution line and replacement of the substation transformer at considerable cost to the IC.

Cost Summary

The Z2-099 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	\$250,000
Direct Connection Network Upgrades	\$
Non Direct Connection Network Upgrades	\$
Total Costs	\$250,000

Attachment Facilities Required:

To provide the interconnection, regardless of capacity, the ITO will at a minimum install overhead primary voltage conductors interconnected to the existing primary voltage conductors, a pole mounted electronic recloser, pole mounted primary bi-directional metering equipment, a power quality monitoring relay and a set of disconnects to provide an isolation point. The estimated cost of these Attachment Facilities is \$250,000.

Upgrades Required:

At this time ITO does not expect that there will be any circuit modifications required to provide the capacity of 8.5 MW.

Additional studies (Impact and Facilities) may identify Distribution and Transmission system protection requirements that would be provided as Upgrades at the IC's expense.