Generation Interconnection Feasibility Study Report

for

PJM Generation Interconnection Request Queue Position Z2-088

Tarboro-Everetts 230kV 30.4MW Capacity / 80MW 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 Conetoe, NC. The installed facilities will have a total capability of 80 MW with 30.4 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is 12/31/2014. This project was evaluated for compliance with reliability criteria for summer peak conditions in 2018. **This study does not imply an ITO commitment to this in-service date.**

Point of Interconnection

Z2-088 will interconnect with the ITO transmission system at one of the two following points of interconnection:

Option 1 will connect via a new three breaker ring bus switching station that connects on the Tarboro – Everetts 230kV line.

Option 2 will connect via a new switching station that connects on the Tarboro – Parmele 115kV line.

Option One

Cost Summary

The Z2-088 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$1,600,000
Direct Connection Network Upgrades	$5,000,000
Non Direct Connection Network Upgrades	$0
Total Costs	**$6,600,000**

Attachment Facilities

Generation Substation: Install metering and associated protection equipment. Estimated Cost $600,000.

Transmission Line: Construct approximately one span of 230 kV Attachment line between the generation substation and a new Z2-088 230 kV Switching Substation. The estimated cost for this work is $1,000,000.

The estimated total cost of the Attachment Facilities is $1,600,000. It is estimated to take 18-24 months to complete this work after execution of ISA and ICSA. These preliminary cost estimates are based on typical engineering costs. A more detailed engineering cost estimates are 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 Network Facilities

Substation: Establish the new 230 kV Z2-088 Switching Substation (interconnection substation). The arrangement in the substation will be as shown below on Attachment A: One–Line Diagram. The estimated cost of this facility is $5,000,000. It is estimated to take 24-36 months to complete this work after execution of ISA and ICSA.

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 1

Network Impacts

The Queue Project Z2-088 was studied as an 80.0 MW (Capacity 30.4 MW) injection as a tap of the Tarboro – Everetts 230 kV substation in the ITO area. Project Z2-088 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and ITO) for summer peak conditions in 2018. Project Z2-088 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 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 during Impact Study

Light Load Analysis

(Study to determine that the Transmission System is capable of delivering the system generating capacity at light load)

Light Load Studies not required for solar generation.

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 #Z2-088 interconnection of 80.0 MW of energy (Capacity 30.4 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 2

Cost Summary

The secondary Point of Interconnection receives a sensitivity analysis which will include definition of the overloads and no estimated costs.

Network Impacts

The Queue Project Z2-088 was studied as an 80.0 MW (Capacity 30.4 MW) injection as a tap of the Tarboro – Parmele 115 kV line in the ITO area. Project Z2-088 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and ITO) for summer peak conditions in 2018. Project Z2-088 was studied with a commercial probability of 100%. Potential network impacts were as follows:

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1. (VEPCO - VEPCO) The 3SHILOH-3TDP 115 kV line (from bus 313823 to bus 314555 ckt 1) loads from 17.91% to 101.49% (**DC power flow**) of its normal rating (67 MVA) for non-contingency condition. This project contributes approximately 80.0 MW to the thermal violation.

2. (VEPCO - VEPCO) The 3CNETO-3SHILOH 115 kV line (from bus 314560 to bus 313823 ckt 1) loads from 17.91% to 101.49% (**DC power flow**) of its normal rating (67 MVA) for non-contingency condition. This project contributes approximately 80.0 MW to the thermal violation.