Generation Interconnection
System Impact Study Report

For

PJM Generation Interconnection Request
Queue Position AB2-022

Elizabeth City 34.5kV
13 MW Capacity / 20 MW Energy

February / 2018

Introduction

This System Impact Study (SIS) has been prepared in accordance with the PJM Open Access Transmission Tariff, Section 205, as well as the System Impact Study Agreement between Solar Access Development Group, LLC, the 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 System Impact Study is to determine a plan, with approximate cost and construction time estimates, to connect the subject generation interconnection project to the PJM network at a location specified by the IC. As a requirement for interconnection, the IC may be responsible for the cost of constructing Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system. All facilities required for interconnection of a generation interconnection project must be designed to meet the technical specifications (on PJM web site) for the appropriate transmission owner.

In some instances an IC may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection or merchant transmission upgrade, 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 System Impact Study is performed.

The System Impact 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 Transmission Owners, the costs may be included in the study.

General

The IC has proposed a solar generating facility located on Route 343 in Camden County, NC. The installed facilities will have a total capability of 20 MW with 13 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is 12/31/2020. **This study does not imply an ITO commitment to this in-service date.**

Attachment Facilities and local upgrades along with terms and conditions to interconnect AB2-022 will be specified in a separate two party Interconnection Agreement (IA) between VEPCO and the Interconnection Customer as this project is considered FERC non-jurisdictional per the PJM Open Access Transmission Tariff (OATT). From the transmission system perspective, no network impacts were identified as detailed below.

Point of Interconnection

AB2-022 will interconnect with the ITO distribution system on Elizabeth City 34.5kV circuit #410.

Interconnected Transmission Owner Scope of Work

The ITO work described in this section of the report will be part of a separate two party Interconnection Agreement (IA) between VEPCO and the Interconnection Customer and is provided here for informational purposes.

Attachment Facilities

The new Attachment Facilities are:

- Install 5 new poles
- Install 400 feet of 477 Al. line to a new poles
- All metering needed for interconnection of generation and auxiliary load
- G&W Viper ST w/SEL 651R-2 Control Recloser
- Install SEL 735 Power Quality Monitoring Relay and associated control wiring
- Install one single phase pole mounted transformers to supply power to the Recloser controls and to the Power Quality monitoring relay
- One Disconnect Switch to serve as an isolation point
- Transfer trip equipment at the IC's site

The estimated cost of the Engineering, Material, and Construction for installation of the new attachment facilities to provide the interconnection is $264,433. The single line is shown below in Attachment 1.

Local Upgrades

Elizabeth City Substation:

Add one (1) transfer trip relay panel, SEL – 451-5 & SEL – 735 DG Support Panel (w/ Telco TT)

Total estimated cost of the Engineering, Material, and Construction for all substation upgrades equals $27,049. The estimated time for engineering, material acquisition and construction of this interconnection is 12 months.

Distribution:

Reconductor to 477Al approximately 9,000 feet of the existing circuit to the Customer site. Replace approximately 10 line fuses to allow proper coordination on circuit 410 and 412. Remove existing capacitor bank Q0838PL5400 from service. Total estimated cost of the Engineering, Material, and Construction for all distribution upgrades equals $548,000.00. The estimated time for engineering, material acquisition and construction of this interconnection is 12 months.

Interconnection Customer Requirements

AB2-022 interconnection requirements will be specified in a separate two party Interconnection Agreement (IA) between VEPCO and the Interconnection Customer

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.

Meteorological Data Reporting Requirement - The solar generation facility shall, at a minimum, be required to provide the Transmission Provider with site-specific meteorological data including:

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

Network Impacts

The Queue Project AB2-022 was evaluated as a 20.0 MW (Capacity 13.0 MW) injection at Elizabeth City 230 kV substation in the ITO area. Project AB2-022 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AB2-022 was studied with a commercial probability of 100%. Potential network impacts were as follows:

Contingency Descriptions

The following contingencies resulted in overloads:

Contingency Name	Description
LN 2021	CONTINGENCY 'LN 2021' OPEN BRANCH FROM BUS 314638 TO BUS 314647 CKT 1 /* 6ELIZ CT 230.00 - 6SHAWBRO 230.00 OPEN BRANCH FROM BUS 314647 TO BUS 314833 CKT 1 /* 6SHAWBRO 230.00 - 6SHAWB_1 230.00 OPEN BUS 314833 /* ISLAND END

Summer Peak Analysis – 2020

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).

None

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)

Not required

Stability and Reactive Power Requirement for Low Voltage Ride Through

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

Not required

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, initially caused by the addition of this interconnection request)

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 is calculated and reported for in 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 IC 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 interconnection request by addressing 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.

	Contingency		Affected		Bus			Power	Loading %		Rating		MW
#	Type	Name	Area	Facility Description	From	To	Circuit	Flow	Initial	Final	Type	MVA	Contribution
1	N-1	LN 2021	DVP – DVP	6SUNBURY-6SUFFOLK 230 kV line	314648	314537	1	AC	99.34	102.13	ER	449	12.41
2	N-1	LN 2021	DVP-DVP	W1-029-6SUNBURY 230 kV line	901080	314648	1	AC	103.9	106.69	ER	449	12.41

Light Load Analysis in 2020

Not required

ITO Analysis

ITO assessed the impact of the proposed Queue Project #AB2-022 interconnection of 20 MW of energy (Capacity 13 MW) for compliance with reliability criteria on ITO's Transmission System. The system was assessed using the summer 2020 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 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 interconnection request 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 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 (greater than 20 MW). The results of these studies are discussed in more detail below.

Category B Analysis (Single Contingency):

- System Normal – No deficiencies identified
- Critical System Condition No Surry 230 kV Unit OR Possum Point Unit #5 (230kV Unit) – No deficiencies identified.

Category C Analysis: (Multiple Facility Contingency)

- Bus Fault - No deficiencies identified
- Line Stuck Breaker - No deficiencies identified
- Tower Line – No deficiencies identified

Affected System Analysis & Mitigation

Duke Energy:

None identified

Attachment 1.

System Configuration