

***Generation Interconnection  
Feasibility Study Report***

***For***

***PJM Generation Interconnection Request  
Queue Position AD1-042***

***Stuarts Draft – Waynesboro 115kV  
12.5 MW Capacity / 0 MW Energy***

**March / 2018**

## 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 Virginia Electric and Power Company (VEPCO).

## Preface

The intent of the Feasibility Study is to determine a plan, with high level estimated 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 an Energy Storage generating facility located east of Stuarts Draft, VA (Augusta County). The installed facilities will have a total capability of 150 MW with 115.6 MW of this output being recognized by PJM as capacity. This queue request is for an addition to a solar generator of 0 MW with 12.5 MW being recognized by PJM as capacity. The proposed in-service date for this project is 10/31/2018. **This study does not imply an ITO commitment to this in-service date.**

## Point of Interconnection

AC2-042 will interconnect with the ITO transmission system at one of the following points of interconnection:

Option 1 will connect via a new three breaker ring bus switching station that connects on the Stuarts Draft – Stuarts Draft DP 115kV line #117.

Option 2 will connect via a new three breaker ring bus switching station that connects at the Stuarts Draft DP – Waynesboro 115kV.

Note: only one set of analysis will be run for both points of interconnection as this is a looped line out of Dooms substation with no expected difference in results.

### **Cost Summary**

The AD1-042 project will be responsible for the following costs:

<b>Description</b>	<b>Total Cost</b>
Attachment Facilities	\$300,000
Direct Connection Network Upgrades	\$0
Non Direct Connection Network Upgrades	\$0
<b>Total Costs</b>	<b>\$300,000</b>

## **Attachment Facilities**

The existing AC2-112 scope of work is sufficient to accommodate this queue request from an Attachment Facilities and substation expansion perspective.

Generation Substation: Install metering and associated Protection Equipment. Estimated Cost \$300,000.

It is estimated to take 12 months to complete this work upon. These preliminary cost estimates are based on typical engineering costs. A more detailed engineering cost estimates are normally done when the developer 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.

## **Non-Direct Connection Cost Estimate**

Remote Terminal Work: During the Facilities Study, ITO's System Protection Engineering Department will review transmission line protection as well as anti-islanding required to accommodate the new generation and interconnection substation. System Protection Engineering will determine the minimal acceptable protection requirements to reliably interconnect the proposed generating facility with the transmission system. The review is based on maintaining system reliability by reviewing ITO's protection requirements with the known transmission system configuration which includes generating facilities in the area. This review may determine that transmission line protection and communication upgrades are required at remote substations.

## **Interconnection Customer Requirements**

ITO's Facility Connection Requirements as posted on PJM's website

<http://www.pjm.com/~media/planning/plan-standards/private-dominion/facility-connection-requirements1.ashx>

An Interconnection Customer entering the New Services Queue on or after October 1, 2012 with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

**Voltage Ride Through Requirements** - The Customer Facility shall be designed to remain in service (not trip) for voltages and times as specified for the Eastern Interconnection in Attachment 1 of NERC Reliability Standard PRC-024-1, and successor Reliability Standards, for both high and low voltage conditions, irrespective of generator size, subject to the permissive trip exceptions established in PRC-024-1 (and successor Reliability Standards).

**Frequency Ride Through Requirements** - The Customer Facility shall be designed to remain in service (not trip) for frequencies and times as specified in Attachment 2 of NERC Reliability Standard PRC-024-1, and successor Reliability Standards, for both high and low frequency condition, irrespective of generator size, subject to the permissive trip exceptions established in PRC-024-1 (and successor Reliability Standards).

Reactive Power - The Generation Interconnection Customer shall design its non-synchronous Customer Facility with the ability to maintain a power factor of at least 0.95 leading to 0.95 lagging measured at the generator's terminals.

## **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 AD1-042 was evaluated as a 0 MW (Capacity 12.5 MW) injection at the Stuarts Draft substation in the ITO area. Project AD1-042 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD1-042 was studied with a commercial probability of 53%.

Potential network impacts were as follows:

PJM assessed the impact of the proposed Queue Project as an injection into the ITO, for compliance with NERC Reliability Criteria. The system was assessed using the summer 2021 RTEP case. When performing analysis, ITO Criteria considers a transmission facility overloaded if it exceeds 94% of its emergency rating under single contingency (normal and stressed system conditions). A full listing of the 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 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. The results of these studies are discussed in more detail below.

### **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)*

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)*

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

### **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 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 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**

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

## **Affected System Analysis & Mitigation**

### **Duke, Progress & TVA Impacts:**

Duke Carolina, Progress, & TVA Impacts to be determined during later study phases (as applicable).