Generation Interconnection

Combined Feasibility / Impact Study Report

for

Queue Project AE2-006

TWITTYS CREEK 34.5 KV

2.9 MW Capacity / 0 MW Energy

July, 2019

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1 Introduction

This combined Feasibility / Impact Study has been prepared in accordance with the PJM Open Access Transmission Tariff, 36.2, as well as the Feasibility Study Agreement between Twittys Creek Solar, 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).

2 Preface

The intent of the combined Feasibility / Impact Study is to determine a plan, with approximate 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.

The Interconnection Customer seeking to interconnect a wind or solar generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per Schedule H to the Interconnection Service Agreement and Section 8 of Manual 14D.

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.

3 General

The Interconnection Customer (IC), has proposed an uprate to an existing Solar generating facility located in Charlotte County, Virginia. This project is a Capacity-only request for an additional of 2.9 MW. The installed facilities will have a total capability of 13.75 MW with 8.6 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is 12/31/2019. This study does not imply a TO commitment to this in-service date.

Queue Number	**AE2-006**
Project Name	TWITTYS CREEK 34.5 KV
Interconnection Customer	Twittys Creek Solar, LLC
State	Virginia
County	Charlotte
Transmission Owner	Dominion

Queue Number	AE2-006
MFO	13.75
MWE	0
MWC	2.9
Fuel	Solar
Basecase Study Year	2022

3.1 Point of Interconnection

AE2-006 will interconnect with the Dominion transmission system as an uprate to AC2-036 which is direct connection to the Twittys Creek 34.5 kV substation.

3.2 Cost Summary

The AE2-006 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ N/A
Direct Connection Network Upgrade	$ N/A
Non Direct Connection Network Upgrades	$ N/A
Total Costs	$ 0

In addition, the AE2-006 project may be responsible for a contribution to the following costs

Description	Total Cost
System Upgrades	$ 0

4 Transmission Owner Analysis

4.1 Power Flow Analysis

PJM performed a power flow analysis of the transmission system using a 2022 summer peak load flow model and the results were verified by Dominion. Additionally, Dominion performed an analysis of its transmission system.

4.2 Short Circuit Analysis

PJM performed a short circuit analysis and the results were verified by Dominion. The connection of AE2-006 project to the system does not result in any newly overdutied circuit breakers on the Dominion transmission system and does not have a significant fault current contribution to existing overdutied circuit breakers

5 Interconnection Customer Requirements

5.1 System Protection

The IC must design its Customer Facilities in accordance with all applicable standards, including the standards in Dominion's "Dominion Energy Electric Transmission Generator Interconnection Requirements" documented in Dominion's Facility Interconnection Requirements "Exhibit C" located at: https://www.dominionenergy.com/company/moving-energy/electric-transmission-access. 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.

5.2 Compliance Issues and Interconnection Customer Requirements

The proposed Customer Facilities must be designed in accordance with Dominion's "Dominion's Facility Interconnection Requirements" document located at: https://www.dominionenergy.com/company/moving-energy/electric-transmission-access. In particular, the IC is responsible for the following:

1. The purchase and installation of a fully rated protection device (circuit breaker, circuit switcher, fuse) to protect the IC's GSU transformer(s).

2. The purchase and installation of the minimum required Dominion generation interconnection relaying and control facilities as described in the System Protection noted above. 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 Dominion Transmission System Control Center.

4. Compliance with the Dominion and PJM generator power factor and voltage control requirements.

   The GSU(s) associated with the IC queue request shall meet the grounding requirements as noted in Dominion's "Dominion's Facility Interconnection Requirements" document located at: https://www.dominionenergy.com/company/moving-energy/electric-transmission-access.

The IC will also be required to meet all PJM, SERC, 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 SERC 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 Dominion system.

5.3 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 Dominion transmission system.

6 Revenue Metering and SCADA Requirements

6.1 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 Section 8 of Attachment O.

6.1.1 Meteorological Data Reporting Requirement

The solar generation facility shall provide the Transmission Provider with site-specific meteorological data including:

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

6.2 Dominion Requirements

See Section 3.4.6 “Metering and telecommunications” of Dominion’s “Dominion’s Facility Interconnection Requirements” document located at: https://www.dominionenergy.com/company/moving-energy/electric-transmission-access.

7 Network Impacts

The Queue Project AE2-006 was evaluated as a 2.9 MW Capacity -only uprate to AC2-036 which is direct connection to the Twittys Creek 115 kV substation in the Dominion area. Project AE2-006 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE2-006 was studied with a commercial probability of 100%. Potential network impacts were as follows:

Summer Peak Load Flow

7.1 Generation Deliverability

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

None

7.2 Multiple Facility Contingency

(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)

None

7.3 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

7.4 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.

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
7761371	314726	3WILLIS	DVP	314691	3FARMVIL	DVP	1	DVP_P1-2: LN 1012-B	operation	287.0	68.54	69.51	AC	2.9

7.5 System Reinforcements

None

7.6 Flow Gate Details

The following appendices contain additional information about each flowgate presented in the body of the report. For each appendix, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact. It should be noted the generator contributions presented in the appendices sections are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.

7.6.1 Contingency Descriptions

Contingency Name	Contingency Definition
DVP_P4-2: 15832	CONTINGENCY 'DVP_P4-2: 15832' /* FARMVILLE 115 KV OPEN BRANCH FROM BUS 314519 TO BUS 314701 CKT 1 /* 3LONEPINE_1 115.00 - 3LONEPN 115.00 OPEN BRANCH FROM BUS 314691 TO BUS 314707 CKT 1 /* 3FARMVIL 115.00 - 3MORAN 115.00 OPEN BRANCH FROM BUS 314701 TO BUS 314707 CKT 1 /* 3LONEPN 115.00 - 3MORAN 115.00 OPEN BUS 314519 /* ISLAND: 3LONEPINE_1 115.00 OPEN BUS 314707 /* ISLAND: 3MORAN 115.00 OPEN BUS 314691 /* 3FARMVIL 115.00 KV END
DVP_P1-2: LN 1012-B	CONTINGENCY 'DVP_P1-2: LN 1012-B' OPEN BRANCH FROM BUS 936480 TO BUS 314681 CKT 1 /* AD2-063 TAP 115.00 - 3CHASCTY 115.00 END
DVP_P4-2: 235T298-A	CONTINGENCY 'DVP_P4-2: 235T298-A' /* FARMVILLE 230 KV OPEN BRANCH FROM BUS 313802 TO BUS 314268 CKT 1 /* 6PRINCE EDW 230.00 - 6BRIERY 230.00 OPEN BRANCH FROM BUS 313802 TO BUS 314692 CKT 1 /* 6PRINCE EDW 230.00 - 6FARMVIL 230.00 OPEN BRANCH FROM BUS 314268 TO BUS 943050 CKT 1 /* 6BRIERY 230.00 - AE2-328 TAP 230.00 OPEN BRANCH FROM BUS 314691 TO BUS 314692 CKT 1 /* 3FARMVIL 115.00 - 6FARMVIL 230.00 OPEN BUS 313802 /* ISLAND: 6PRINCE EDW 230.00 OPEN BUS 314268 /* ISLAND: 6BRIERY 230.00 OPEN BRANCH FROM BUS 314677 TO BUS 314692 CKT 1 /* 6BUCKING 230.00 - 6FARMVIL 230.00 OPEN BRANCH FROM BUS 314677 TO BUS 314747 CKT 1 /* 6BUCKING 230.00 - 6BREMO 230.00 OPEN BRANCH FROM BUS 314691 TO BUS 314692 CKT 2 /* 3FARMVIL 115.00 - 6FARMVIL 230.00 OPEN BUS 314677 /* ISLAND: 6BUCKING 230.00 END

Contingency Name	Contingency Definition
DVP_P4-5: FARMVIL L432-A	CONTINGENCY 'DVP_P4-5: FARMVIL L432-A' /* FARMVILLE 115 KV OPEN BRANCH FROM BUS 313802 TO BUS 314268 CKT 1 /* 6PRINCE EDW 230.00 - 6BRIERY 230.00 OPEN BRANCH FROM BUS 313802 TO BUS 314692 CKT 1 /* 6PRINCE EDW 230.00 - 6FARMVIL 230.00 OPEN BRANCH FROM BUS 314268 TO BUS 943050 CKT 1 /* 6BRIERY 230.00 - AE2-328 TAP 230.00 OPEN BRANCH FROM BUS 314691 TO BUS 314692 CKT 1 /* 3FARMVIL 115.00 - 6FARMVIL 230.00 OPEN BUS 313802 /* ISLAND: 6PRINCE EDW 230.00 OPEN BUS 314268 /* ISLAND: 6BRIERY 230.00 OPEN BUS 314691 /* 3FARMVIL 115.00 KV END

Affected Systems

7.7 Affected Systems

7.7.1 TVA

None

7.7.2 Duke Energy Progress

None

Short Circuit

7.8 Short Circuit

The following Breakers are overduty: None

Attachment 1

System Configuration