# Generation Interconnection

# System Impact Study Report

# for

# Queue Project AE1-035

# EARLEYS 230 KV

# 13.4 MW Capacity / 20 MW Energy

Revised January, 2020

August, 2019

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# 1 Introduction

This System Impact Study (SIS) has been prepared in accordance with the PJM Open Access Transmission Tariff, 205, as well as the Feasibility Study Agreement between Aulander Holloman 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 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 Interconnection Customer. As a requirement for interconnection, the Interconnection Customer 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 Interconnection Customer 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 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.

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.

An Interconnection Customer 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.

# 3 General

The IC has proposed a solar generating facility located at NC 42 and Joe Holloman Road in Aulander, NC in Hertford County. The installed facilities will have a total capability of 100 MW with 67 MW of this output

being recognized by PJM as capacity. This queue request is for an additional 20 MW with 13.4MW's being recognized by PJM as capacity. The proposed in-service date for this project is 5/31/2019. **This study does not imply an ITO commitment to this in-service date.**

| Queue Number | AE1-035 |
|---|---|
| Project Name | EARLEYS 230 KV |
| Interconnection Customer | Aulander Holloman Solar, LLC |
| State | North Carolina |
| County | Hertford |
| Transmission Owner | Dominion |
| MFO | 100 |
| MWE | 20 |
| MWC | 13.4 |
| Fuel | Solar |
| Basecase Study Year | 2022 |

### 3.1 Point of Interconnection

AE1-035 is an uprate to the AA1-065 queue position which is a tap onto the Earleys 230kV substation bus.

### 3.2 Cost Summary

The AE1-035 project will be responsible for the following costs:

| Description | Total Cost |
|---|---|
| Attachment Facilities | $ NA |
| Direct Connection Network Upgrade | $ NA |
| Non Direct Connection Network Upgrades | $ NA |
| Total Costs | $ 0 |

In addition, the AE1-035 project may be responsible for a contribution to the following costs

| Description | Total Cost |
|---|---|
| System Upgrades | $ 0 |

## 4 Transmission Owner Scope of Work

### 4.1 Attachment Facilities

The existing AA1-065 scope of work is sufficient to accommodate this queue request from an Attachment Facilities and substation expansion perspective. The single line is shown below in Attachment 1.

# 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 AE1-035 was evaluated as a 20.0 MW (Capacity 13.4 MW) injection at the Earleys 230kV substation in the Dominion area. Project AE1-035 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE1-035 was studied with a commercial probability of 100%. Potential network impacts were as follows:

# Summer Peak Load Flow

## 8 Generation Deliverability

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

None

## 9 Multiple Facility Contingency

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

None

## 10 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

## 11 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **3318746** | 314569 | 6EARLEYS | DVP | 314575 | 6NUCO TP | DVP | 1 | DVP_P1-2: LN 2092 | operation | 571.52 | 169.18 | 170.28 | AC | 7.28 |
| **3318754** | 314569 | 6EARLEYS | DVP | 314575 | 6NUCO TP | DVP | 1 | Base Case | operation | 571.52 | 105.9 | 106.79 | AC | 6.08 |
| **3318893** | 314574 | 6EVERETS | DVP | 936530 | AD2-068 TAP | DVP | 1 | DVP_P1-2: LN 246 | operation | 449.32 | 151.07 | 152.03 | AC | 4.8 |
| **3318796** | 314575 | 6NUCO TP | DVP | 919140 | AA1-138 TAP | DVP | 1 | DVP_P1-2: LN 2092 | operation | 571.52 | 162.67 | 163.76 | AC | 7.28 |
| **3318804** | 314575 | 6NUCO TP | DVP | 919140 | AA1-138 TAP | DVP | 1 | Base Case | operation | 571.52 | 99.64 | 100.53 | AC | 6.08 |
| **3318936** | 314583 | 6LAKEVEW | DVP | 924510 | AB2-100 TAP | DVP | 1 | DVP_P1-2: LN 246 | operation | 375.06 | 145.38 | 146.39 | AC | 3.79 |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **3318806** | 919140 | AA1-138 TAP | DVP | 314537 | 6SUFFOLK | DVP | 1 | DVP_P1-2: LN 2092 | operation | 571.52 | 162.47 | 163.57 | AC | 7.28 |
| **3318814** | 919140 | AA1-138 TAP | DVP | 314537 | 6SUFFOLK | DVP | 1 | Base Case | operation | 571.52 | 99.54 | 100.43 | AC | 6.08 |
| **3318816** | 924510 | AB2-100 TAP | DVP | 314563 | 6CLUBHSE | DVP | 1 | DVP_P1-2: LN 246 | operation | 375.06 | 164.61 | 165.62 | AC | 3.79 |
| **3318919** | 936530 | AD2-068 TAP | DVP | 304451 | 6GREENVILE T | CPLE | 1 | DVP_P1-2: LN 246 | operation | 478.0 | 148.34 | 149.23 | AC | 4.8 |

## 12 System Reinforcements

None

## 13 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.

### 13.1 Contingency Descriptions

| Contingency Name | Contingency Definition |
|---|---|
| **Base Case** | |
| **DVP_P1-2: LN 246** | CONTINGENCY 'DVP_P1-2: LN 246'<br>OPEN BRANCH FROM BUS 314537 TO BUS 919140 CKT 1 /* 6SUFFOLK 230.00 - AA1-138 TAP 230.00<br>OPEN BRANCH FROM BUS 314569 TO BUS 314575 CKT 1 /* 6EARLEYS 230.00 - 6NUCO TP 230.00<br>OPEN BRANCH FROM BUS 314575 TO BUS 314590 CKT 1 /* 6NUCO TP 230.00 - 6NUCOR 230.00<br>OPEN BRANCH FROM BUS 314575 TO BUS 919140 CKT 1 /* 6NUCO TP 230.00 - AA1-138 TAP 230.00<br>OPEN BUS 314575 /* ISLAND: 6NUCO TP 230.00<br>OPEN BUS 314590 /* ISLAND: 6NUCOR 230.00<br>OPEN BUS 919140 /* ISLAND: AA1-138 TAP 230.00<br>END |

| Contingency Name | Contingency Definition |
|---|---|
| **DVP_P1-2: LN 2092** | CONTINGENCY 'DVP_P1-2: LN 2092'<br>OPEN BRANCH FROM BUS 313714 TO BUS 314662 CKT 1 /* 6PERQUIMANS 230.00 - 6S HERTFORD 230.00<br>OPEN BRANCH FROM BUS 314651 TO BUS 314662 CKT 1 /* 6WINFALL 230.00 - 6S HERTFORD 230.00<br>OPEN BUS 314662 /* ISLAND: 6S HERTFORD 230.00<br>END |

# Affected Systems

## 14 Affected Systems

None

# Short Circuit

## 15 Short Circuit

The following Breakers are overduty

None

# Stability

# 16 Stability

## 16.1 Steady-State Voltage Requirements

*(Summary of the VAR requirements based upon the results of the steady-state voltage studies)*

None

## 16.2 Stability and Reactive Power Requirement for Low Voltage Ride Through

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

No mitigations were found to be required.

## Attachment 1

System Configuration