



**Generation Interconnection**  
**Combined Feasibility / System Impact Study Report**  
**for**  
**Queue Project AF2-400**  
**FRANKLIN 13.2 KV**  
**2.71 MW Capacity / 7.13 MW Energy**

July 2020

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## 1 Introduction

This System Impact Study has been prepared in accordance with the PJM Open Access Transmission Tariff, 205, as well as the System Impact Study Agreement between the Interconnection Customer (IC), and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is Dominion.

## 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.

## 3 General

The Interconnection Customer (IC), has proposed a Solar generating facility located in Southampton County, Virginia. The installed facilities will have a total capability of 7.13 MW with 2.71 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is October 29, 2021. This study does not imply a TO commitment to this in-service date.

<b>Queue Number</b>	<b>AF2-400</b>
<b>Project Name</b>	FRANKLIN 13.2 KV
<b>State</b>	Virginia
<b>County</b>	Southampton
<b>Transmission Owner</b>	Dominion
<b>MFO</b>	7.13
<b>MWE</b>	7.13
<b>MWC</b>	2.71
<b>Fuel</b>	Solar
<b>Basecase Study Year</b>	2023

Any new service customers who can feasibly be commercially operable prior to June 1st of the basecase study year are required to request interim deliverability analysis.

#### 4 Point of Interconnection

AF2-400 will interconnect with the Dominion distribution system. The POI is a single line tap on the distribution circuit 497 approximately 2.1 miles from its termination at the Franklin substation. This is the primary Point of Interconnection (POI) chosen by the IC with the ITO’s transmission system. The IC is responsible for securing right-of-way, permits and constructing the proposed attachment line from the solar facility site to the proposed new substation. Attachment 1 shows a one-line diagram of the proposed interconnection facilities. The IC may not install any facilities on Dominion’s right-of-way without first obtaining the necessary approval from Dominion Energy.

#### 5 Cost Summary

Final attachment facilities and local upgrades (if required) along with terms and conditions to interconnect the AF2-400 project will be specified in a separate two party Interconnection Agreement (IA) between the ITO and the Interconnection Customer as this project is considered FERC non-jurisdictional per the PJM Open Access Transmission Tariff (OATT).

The AF2-400 project will be responsible for the following costs:

<b>Description</b>	<b>Total Cost</b>
<b>Total Physical Interconnection Costs</b>	\$ To be provided in IA
<b>Allocation towards System Network Upgrade Costs</b>	\$ 0
<b>Total Costs</b>	\$ To be provided in IA

From the transmission perspective, no network impacts were identified as detailed in the “Network Impacts” section below.

## 6 Transmission Owner Scope of Work

Dominion assessed the impact of the proposed Queue Project AF2-400 was evaluated as a 2.71 MW Capacity (7.13 MW Energy) injection at the AF2-400 13.2 kV substation in the Dominion Distribution System, for compliance with NERC Reliability Criteria on Dominion Transmission System. The system was assessed using the summer 2023 AF2 case provided to Dominion by PJM. When performing a generation analysis, Dominion's main analysis will be load flow study results under single contingency (both normal and stressed system conditions). Dominion Criteria considers a transmission facility overloaded if it exceeds 94% of its emergency rating under normal and stressed system conditions. A full listing of Dominion's Planning Criteria and interconnection requirements can be found in the Company's Facility Connection Requirements which are publicly available at: <http://www.dominionenergy.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, in Planning Studies, NERC Planning Event 3 and 6 Contingency Conditions (Loss of generator, transmission circuit, transformer, shunt device, or Single Pole of a DC line followed by the loss of a generator, transmission circuit, transformer, shunt device or single pole of a DC line) allow for re-dispatch of generating units to resolve potential reliability deficiencies. For Dominion 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 required Attachment Facilities, Direct Connection and Non-Direct Connection work for the interconnection of the AF2-400 generation project to the Dominion Transmission System is detailed in the following sections. The associated one-line with the generation project attachment facilities and primary direct and non-direct connection are shown in Attachment 1.

Note that the ITO findings were made from a conceptual review of this project. A more detailed review of the connection facilities and their cost will be identified in a future study phases. Further note that the cost estimate data contained in this document should be considered high level estimates since it was produced without a detailed engineering review. The applicant will be responsible for the actual cost of construction. ITO herein reserves the right to return to any issues in this document and, upon appropriate justification, request additional monies to complete any reinforcements to the transmission systems.

## 7 Transmission Owner Analysis

### 7.1 Power Flow Analysis

PJM performed a power flow analysis of the transmission system using a 2023 summer peak load flow model and the results were verified by Dominion. Additionally, Dominion performed an analysis of its transmission system and no further deficiencies were identified.

## 8 Interconnection Customer Requirements

### 8.1 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.

### 8.2 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.

### **8.3 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.

## **9 Revenue Metering and SCADA Requirements**

### **9.1 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.

### **9.2 Meteorological Data Reporting Requirements**

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

- Back Panel temperature (Fahrenheit)
- Irradiance (Watts/meter<sup>2</sup>)
- Ambient air temperature (Fahrenheit) – (Accepted, not required)
- Wind speed (meters/second) – (Accepted, not required)
- Wind direction (decimal degrees from true north) – (Accepted, not required)

### **9.3 Interconnected Transmission Owner Requirements**

The IC will be required to comply with all Interconnected Transmission Owner's revenue metering requirements for generation interconnection customers located at the following link:

<http://www.pjm.com/planning/design-engineering/to-tech-standards/>

## **10 Summer Peak Analysis**

The Queue Project AF2-400 was evaluated as a 7.13 MW (Capacity 2.71 MW) injection at the Franklin 115 kV substation in the Dominion area. Project AF2-400 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF2-400 was studied with a commercial probability of 100%. Potential network impacts were as follows:

### **10.1 Generation Deliverability**

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

None

## 10.2 Multiple Facility Contingency

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

None

## 10.3 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

## 10.4 Steady-State Voltage Requirements

To be determined

## 10.5 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	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADIN G %	POST PROJECT LOADIN G %	AC D C	MW IMPAC T
97585429	313720	3NEWSOMS	115.0	DVP	314558	3BOYKINS	115.0	DVP	1	DVP_P 1-2: LN 68	operation	280.11999517	102.12	104.53	AC	7.13
97585333	313723	3PECAN	115.0	DVP	314259	3CAROL56_1	115.0	DVP	1	DVP_P 1-2: LN 68	operation	224.660003662	125.96	127.94	AC	4.57
97585331	314259	3CAROL56_1	115.0	DVP	314559	3CAROLNA	115.0	DVP	Z1	DVP_P 1-2: LN 68	operation	224.660003662	125.85	127.82	AC	4.57
97585345	314524	3FRNKLN	115.0	DVP	314539	3UNCAMP	115.0	DVP	1	DVP_P 1-2: LN 238-B	operation	224.660003662	123.46	125.28	AC	4.18
97585396	314527	3HOLLAND	115.0	DVP	314536	3SUFFOLK	115.0	DVP	1	DVP_P 1-2: LN 1010	operation	269.779998779	110.71	112.61	AC	5.21
97585282	314539	3UNCAMP	115.0	DVP	314527	3HOLLAND	115.0	DVP	1	DVP_P 1-2: LN 1010	operation	224.660003662	140.29	142.57	AC	5.21
97585287	314539	3UNCAMP	115.0	DVP	314527	3HOLLAND	115.0	DVP	1	Base Case	operation	224.660003662	110.4	112.19	AC	4.13

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CK T ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC D C	MW IMPACT
97585189	314551	3AHOSKIE	115.0	DVP	314568	3EARLEYS	115.0	DVP	1	DVP_P1-2: LN68	operation	141.0	156.39	158.11	AC	2.55
97585194	314551	3AHOSKIE	115.0	DVP	314568	3EARLEYS	115.0	DVP	1	Base Case	operation	141.0	99.79	100.52	AC	1.05
97585381	314558	3BOYKINS	115.0	DVP	314589	3MURPHYS	115.0	DVP	1	DVP_P1-2: LN68	operation	116.559997559	113.88	116.05	AC	2.55
97585195	314617	3TUNIS	115.0	DVP	314551	3AHOSKIE	115.0	DVP	1	DVP_P1-2: LN68	operation	142.880004883	154.7	156.38	AC	2.55
97585230	957520	AF2-046 TAP	115.0	DVP	314617	3TUNIS	115.0	DVP	1	DVP_P1-2: LN68	operation	142.880004883	149.63	151.32	AC	2.55

## 10.6 System Reinforcements

None

## 10.7 Flow Gate Details

The following indices contain additional information about each facility presented in the body of the report. For each index, a description of the flowgate and its contingency was included for convenience. The intent of the indices is to provide more details on which projects/generators have contributions to the flowgate in question. All New Service Queue Requests, through the end of the Queue under study, that are contributors to a flowgate will be listed in the indices. Please note that there may be contributors that are subsequently queued after the queue under study that are not listed in the indices. Although this information is not used "as is" for cost allocation purposes, it can be used to gage the impact of other projects/generators. It should be noted the project/generator MW contributions presented in the body of the report are Full MW Impact contributions which are also noted in the indices column named "Full MW Impact", whereas the loading percentages reported in the body of the report, take into consideration the PJM Generator Deliverability Test rules such as commercial probability of each project as well as the ramping impact of "Adder" contributions. The MW Impact found and used in the analysis is shown in the indices column named "Gendeliv MW Impact".

## 10.8 Contingency Descriptions

Contingency Name	Contingency Definition
<b>DVP_P1-2: LN 1010</b>	CONTINGENCY 'DVP_P1-2: LN 1010' OPEN BRANCH FROM BUS 313723 TO BUS 314259 CKT 1 /* 3PECAN 115.00 - 3CAROL56_1 115.00 OPEN BRANCH FROM BUS 314259 TO BUS 314559 CKT Z1 /* 3CAROL56_1 115.00 - 3CAROLNA 115.00 OPEN BRANCH FROM BUS 314259 TO BUS 314835 CKT 1 /* 3CAROL56_1 115.00 - 3CAROL_1 115.00 OPEN BUS 314259 /* ISLAND: 3CAROL56_1 115.00 OPEN BUS 314835 /* ISLAND: 3CAROL_1 115.00 END
<b>Base Case</b>	
<b>DVP_P1-2: LN 68</b>	CONTINGENCY 'DVP_P1-2: LN 68' OPEN BRANCH FROM BUS 314527 TO BUS 314536 CKT 1 /* 3HOLLAND 115.00 - 3SUFFOLK 115.00 OPEN BRANCH FROM BUS 314527 TO BUS 314539 CKT 1 /* 3HOLLAND 115.00 - 3UNCAMP 115.00 OPEN BUS 314527 /* ISLAND: 3HOLLAND 115.00 END
<b>DVP_P1-2: LN 238-B</b>	CONTINGENCY 'DVP_P1-2: LN 238-B' OPEN BRANCH FROM BUS 940480 TO BUS 314563 CKT 1 /* AE2-033 TAP 230.00 - 6CLUBHSE 230.00 OPEN BRANCH FROM BUS 314562 TO BUS 314563 CKT 1 /* 3CLUBHSE 115.00 - 6CLUBHSE 230.00 END

## 11 Short Circuit Analysis

No circuit breakers were identified as overdutied in this study.

## 12 Affected Systems

### 12.1 TVA

None

### 12.2 Duke Energy Progress

None

# Attachment 1: One Line Diagram

