



**Generation Interconnection
Feasibility Study Report
for
Queue Project AG1-031
ELK RUN D.P.-GAINESVILLE 230 KV
8.4 MW Capacity / 20 MW Energy**

January 2021

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1 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 Dominion.

2 Preface

The intent of the feasibility study is to determine a plan, with ballpark 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.

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. Cost allocation rules for network upgrades can be found in PJM Manual 14A, Attachment B. 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 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 a planned/existing Solar generating facility located in Fauquier, Virginia. This project is an increase to the Interconnection Customer's AE2-190 project, which will share the same point of interconnection. The AG1-031 queue position is a 20 MW uprate (8.4 MW Capacity uprate) to the previous project. The total installed facilities will have a capability of 90 MW with 35.42 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this uprate project is November 30, 2021. This study does not imply a TO commitment to this in-service date.

Queue Number	AG1-031
Project Name	ELK RUN D.P.-GAINESVILLE 230 KV
State	Virginia
County	Fauquier
Transmission Owner	Dominion
MFO	90
MWE	20
MWC	8.4
Fuel	Solar
Basecase Study Year	2024

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

1.1 Primary Point of Interconnection

AG1-031 "Elk Run D.P.-Gainesville 230 kV" will interconnect with the Dominion transmission system as an uprate to AE2-190, sharing the POI and Attachment Facilities.

The IC is responsible for securing right-of-way, permits, and constructing the proposed attachment line from the generating facility site to the Point of Interconnection. The IC may not install any facilities on Dominion's right-of-way without first obtaining the necessary approval from Dominion Energy.

Costs provided are contingent on the AE2-190 project being built. Should the AE2-190 project withdraw from the Interconnection Queue, the AG1-031 project will assume the Attachment, Direct Connection, and Non-Direct Connection costs identified in the AE2-190 study report for connection to the Dominion system.

Attachment 1 shows a one-line diagram of the proposed interconnection facilities.

1.2 Secondary Point of Interconnection

There is no secondary point of interconnection specified for AG1-031.

5 Cost Summary

The AG1-031 project will be responsible for the following costs:

Description	Total Cost
Total Physical Interconnection Costs	\$0
Total System Network Upgrade Costs	\$16,320,000 ¹
Total Costs	\$16,320,000

This cost excludes a Federal Income Tax Gross Up charges. This tax may or may not be charged based on whether this project meets the eligibility requirements of IRS Notice 2016-36, 2016-25 I.R.B. (6/20/2016). If at a future date it is determined that the Federal Income Tax Gross charge is required, the Transmission Owner shall be reimbursed by the Interconnection Customer for such taxes.

Cost allocations for any System Upgrades will be provided in the System Impact Study Report.

¹ This project currently causes and/or contributes to overloads of the Transmission System (see Summer Peak Load Flow Analysis section below) and therefore has potential to have cost allocation for the system reinforcements listed in the report. This will be re-evaluated in the System Impact phase. The results may vary with queue customers withdrawing from the queue and other generators deactivating over time. If a customer is the first to cause the need for a project (causes loading to exceed 100% of rating), then the customer is responsible. If a customer contributes to a facility that is already overloaded by a prior queue, then they may receive cost allocation.

6 Transmission Owner Scope of Work

The required Attachment Facilities, Direct Connection and Non-Direct Connection work for the interconnection of AG1-031 to the Dominion Transmission System is detailed in the following sections. The associated one-line showing the generation project attachment facilities and primary direct and non-direct connection is 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 phase. 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.

The total physical interconnection costs is given in the table below:

Description	Total Cost
Total Physical Interconnection Costs	\$0

AG1-031 "Elk Run D.P.-Gainesville 230 kV" will interconnect with the Dominion transmission system as an uprate to AE2-190, sharing the POI and Attachment Facilities.

As AG1-031 is sharing the POI and Attachment Facilities with AE2-190, there are no associated interconnection costs for this project. Should the AE2-190 project withdraw from the Interconnection Queue, the AG1-031 project will assume the Attachment, Direct Connection, and Non-Direct Connection costs identified in the AE2-190 study report for connection to the Dominion system.

It is estimated to take 18-30 months to complete this work upon execution of an Interconnection Construction Service Agreement (ICSA). These preliminary cost estimates are based on typical engineering costs. A more detailed engineering cost estimates are normally done when the IC provides an exact site plan location for the generation substation during the Facility Study phase.

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.

7 Schedule

The estimated schedule for the Attachment Facilities, Direct Connection and Non-Direct Connection work is identified in the “Transmission Owner Scope of Work” section of this report.

The estimated schedule for the required Network Impact Reinforcements is identified in the “System Reinforcements” section of this report.

These schedules will be more clearly identified in future study phases.

8 Transmission Owner Analysis

Dominion assessed the impact of the proposed project for compliance with NERC Reliability Criteria on the Dominion Transmission System. The system was assessed using the summer 2024 AG1 case provided to Dominion by PJM.

When performing a generation analysis, Dominion’s main analysis includes load flow study results following a single contingency event for 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.

8.1 Power Flow Analysis

PJM performed a power flow analysis of the transmission system using a 2024 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.

9 Interconnection Customer Requirements

9.1 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.

9.2 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 section 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.

9.3 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.

10 Revenue Metering and SCADA Requirements

10.1 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.

10.2 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/meter²)
- Ambient air temperature (Fahrenheit) - (Accepted, not required)
- Wind speed (meters/second) - (Accepted, not required)
- Wind direction (decimal degrees from true north) - (Accepted, not required)

10.3 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/>

11 Summer Peak - Load Flow Analysis

The Queue Project AG1-031 was evaluated as a 20.0 MW (Capacity 8.4 MW) injection as an uprate to AE2-190 which is tapping the Elk Run to Gainesville 230 kV line in the Dominion area. Project AG1-031 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AG1-031 was studied with a commercial probability of 53.0 %. Potential network impacts were as follows:

11.1 Generation Deliverability

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

None

11.2 Multiple Facility Contingency

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

None

11.3 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)

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 LOADIN G %	POST PROJECT LOADIN G %	AC/D C	MW IMPACT
163079076	941850	AE2-190 TAP	230.0	DVP	314037	6GAINSVL	230.0	DVP	1	DVP_P7-1: LN 2039-2040	tower	1204.0	108.15	109.09	DC	13.15

11.4 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.

None

11.5 System Reinforcements - Summer Peak Load Flow - Primary POI

ID	Idx	Facility	Upgrade Description	Cost
163079076	1	AE2-190 TAP 230.0 kV - 6GAINSVL 230.0 kV Ckt 1	<u>DVP</u> n6322 (1370) : Reconductor 20.4 miles of 230 kV Line 2114 from AE2-190 Tap to Gainesville with 795 ACSR. Project Type : FAC Cost : \$16,320,000 Time Estimate : 36-42 Months	\$16,320,000
			TOTAL COST	\$16,320,000 ¹

11.6 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".

11.6.1 Index 1

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
163079076	941850	AE2-190 TAP	DVP	314037	6GAINSVL	DVP	1	DVP_P7-1: LN 2039-2040	tower	1204.0	108.15	109.09	DC	13.15

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
315021	1REMNGT1	14.3126	50/50	14.3126
315022	1REMNGT2	14.5038	50/50	14.5038
315023	1REMNGT3	14.5611	50/50	14.5611
315024	1REMNGT4	14.5038	50/50	14.5038
315030	1M RUN C	15.3939	50/50	15.3939
923892	AB2-029 E	5.6944	Adder	6.7
925022	AB2-158 E	3.2641	Adder	3.84
925671	AC1-043 C (Suspended)	10.6810	Adder	12.57
925672	AC1-043 E (Suspended)	17.4268	Adder	20.5
926001	AC1-076 C	3.2473	Adder	3.82
926002	AC1-076 E	5.2803	Adder	6.21
926481	AC1-120 C O1	8.1824	Adder	9.63
926482	AC1-120 E O1	4.2152	Adder	4.96
926501	AC1-121 C O1	2.8101	Adder	3.31
926502	AC1-121 E O1	1.3224	Adder	1.56
926611	AC1-143 C O1	17.6459	Adder	20.76
926612	AC1-143 E O1	8.0520	Adder	9.47
934861	AD1-115 C	5.3405	Adder	6.28
934862	AD1-115 E	8.7134	Adder	10.25
939225	AE1-153 C	34.6560	Adder	40.77
939226	AE1-153 E	23.3636	Adder	27.49
939231	AE1-154 C	1.2000	Adder	1.41
939232	AE1-154 E	0.8400	Adder	0.99
941361	AE2-132	1.6925	50/50	1.6925
941381	AE2-134 (Suspended)	2.2376	Adder	2.63
941851	AE2-190 C	17.7721	50/50	17.7721
941852	AE2-190 E	28.2697	50/50	28.2697
944111	AF1-079 C	2.2801	Adder	2.68
944112	AF1-079 E	3.0961	Adder	3.64
946371	AF1-301 C	8.8786	Adder	10.45
946372	AF1-301 E	5.9580	Adder	7.01
957431	AF2-037 C	4.8947	Adder	5.76
957432	AF2-037 E	3.2631	Adder	3.84
957461	AF2-040	49.3305	50/50	49.3305
957691	AF2-063 C	7.8106	Adder	9.19
957692	AF2-063 E	5.2071	Adder	6.13
961101	AF2-401 C	1.1522	Adder	1.36
961102	AF2-401 E	1.9094	Adder	2.25
961901	AG1-031 C	5.5250	50/50	5.5250
961902	AG1-031 E	7.6298	50/50	7.6298
963031	AG1-152 C	24.2400	50/50	24.2400

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
963032	AG1-152 E	36.3600	50/50	36.3600
964421	AG1-305 C O1	3.2565	Adder	7.23
964422	AG1-305 E O1	2.1710	Adder	4.82
964811	AG1-344 C	2.0938	Adder	4.65
964812	AG1-344 E	1.3959	Adder	3.1
965971	AG1-466 C	0.8651	Adder	1.92
965972	AG1-466 E	0.5768	Adder	1.28
965981	AG1-467 C	0.9640	Adder	2.14
965982	AG1-467 E	0.6427	Adder	1.43
966001	AG1-469 C	0.9594	Adder	2.13
966002	AG1-469 E	0.6396	Adder	1.42
966331	AG1-502 C	5.0929	Adder	11.3
966332	AG1-502 E	3.3953	Adder	7.54
966341	AG1-503 C	1.2732	Adder	2.83
966342	AG1-503 E	0.8488	Adder	1.88
966501	AG1-519 C	1.1486	Adder	2.55
966502	AG1-519 E	0.7657	Adder	1.7
966681	AG1-538 C	6.6041	Adder	14.66
966682	AG1-538 E	8.8743	Adder	19.7
WEC	WEC	0.0765	Confirmed LTF	0.0765
LGEE	LGEE	0.1810	Confirmed LTF	0.1810
CPL	CPL	0.7275	Confirmed LTF	0.7275
CBM-W2	CBM-W2	3.7453	Confirmed LTF	3.7453
NY	NY	0.7482	Confirmed LTF	0.7482
TVA	TVA	0.7434	Confirmed LTF	0.7434
O-066	O-066	10.2161	Confirmed LTF	10.2161
SIGE	SIGE	0.1908	Confirmed LTF	0.1908
CBM-S2	CBM-S2	9.5839	Confirmed LTF	9.5839
CBM-S1	CBM-S1	0.1851	Confirmed LTF	0.1851
G-007	G-007	1.6044	Confirmed LTF	1.6044
MEC	MEC	0.4846	Confirmed LTF	0.4846
LAGN	LAGN	0.8890	Confirmed LTF	0.8890
CBM-W1	CBM-W1	2.8881	Confirmed LTF	2.8881

11.7 Queue Dependencies

The Queue Projects below are listed in one or more indices for the overloads identified in your report. These projects contribute to the loading of the overloaded facilities identified in your report. The percent overload of a facility and cost allocation you may have towards a particular reinforcement could vary depending on the action of these earlier projects. The status of each project at the time of the analysis is presented in the table. This list may change as earlier projects withdraw or modify their requests.

Queue Number	Project Name	Status
AB2-029	Remington 34.5kV	In Service
AB2-158	Louisa-South Anna 230kV	Under Construction
AC1-043	Mountain Run-Mitchell 115 kV	Suspended
AC1-076	Locust Grove-Paytes 115kV	Engineering and Procurement
AC1-120	Mitchell-Mountain Run 115kV	Engineering and Procurement
AC1-121	Mitchell-Mountain Run 115kV	Engineering and Procurement
AC1-143	Brandy-Remington 115kV	Engineering and Procurement
AD1-115	Mountain Run-Mitchell 115 kV	Active
AE1-153	Remington-Gordonsville 230 kV	Active
AE1-154	Louisa-South Anna 230 kV	Engineering and Procurement
AE2-132	Remington CT 230 kV	In Service
AE2-134	Locust Grove-Paytes 115 kV	Suspended
AE2-190	Elk Run D.P.-Gainesville 230 kV	Active
AF1-079	Louisa-South Anna 230 kV	Active
AF1-301	Louisa-South Anna 230 kV	Active
AF2-037	Louisa-North Anna 230 kV	Active
AF2-040	Elk Run-Gainesville 230 kV	Active
AF2-063	Louisa-North Anna 230 kV	Active
AF2-401	Culpeper 34.5 kV	Engineering and Procurement
AG1-031	Elk Run D.P.-Gainesville 230 kV	Active
AG1-152	Remington CT 230 kV	Active
AG1-305	Louisa-North Anna 230 kV	Active
AG1-344	Culpeper 34.5 kV	Active
AG1-466	Orange 34.5 kV	Active
AG1-467	Somerset 34.5 kV	Active
AG1-469	Gordonsville 34.5 kV	Active
AG1-502	Oak Green 115 kV	Active
AG1-503	Oak Green 115 kV	Active
AG1-519	Cash's Corner 230 kV	Active
AG1-538	Remington-Gordonsville 230 kV	Active

11.8 Contingency Descriptions

Contingency Name	Contingency Definition
DVP_P7-1: LN 2039-2040	CONTINGENCY 'DVP_P7-1: LN 2039-2040' /*. OPEN BRANCH FROM BUS 314063 TO BUS 314099 CKT 1 /* 6MORRSVL 230.00 - 6GI1MRUN 230.00 OPEN BRANCH FROM BUS 314063 TO BUS 314099 CKT 2 /* 6MORRSVL 230.00 - 6GI1MRUN 230.00 END

12 Short Circuit Analysis

The following Breakers are overdutied:

None

13 Affected Systems

13.1 TVA

TVA Impacts to be determined during later study phases (as applicable).

13.2 Duke Energy Progress

Duke Energy Progress Impacts to be determined during later study phases (as applicable).

14 Attachment 1: One Line Diagram