Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AB2-050

Four Rivers 230kV 20MW Capacity / 0MW Energy

August / 2016

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 a natural gas combined cycle generating facility located in Hanover County, VA. The installed facilities will have a total capability of 746 MW with 646 MW of this output being recognized by PJM as capacity. This queue request is for an additional 0 MW with 20 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is 8/1/2017. **This study does not imply an ITO commitment to this in-service date.**

Point of Interconnection

AB2-050 will interconnect with the ITO transmission at the Fours Rivers 230kV substation.

Cost Summary

The AB2-050 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$0
Direct Connection Network Upgrades	$0
Non Direct Connection Network Upgrades	$0

Description	Total Cost
Total Costs	**$0**

In addition, the AB2-050 project may be responsible for a contribution to the following costs:

Description	Total Cost
New System Upgrades	$0
Previously Identified Upgrades	$150,000
Total Costs	**$150,000**

Cost allocations for these upgrades will be provided in the System Impact Study Report.

Attachment Facilities

None

Non-Direct Connection Cost Estimate

Reinforcement: - Upgrade the existing 230kV, Line #256 between Four Rivers and St. Johns by replacing the 2000a wave trap at Four Rivers and the 230kV line switches at St. Johns Substation to increase the Short Term Emergency Rating of this line to 1195 MVA. N4692
The cost of this upgrade is estimated to be $150,000 and is expected to take 12-18 months to complete.

Note: As queue AA1-145 had not executed its ISA when this case was established the reinforcement was not in the case. If this network upgrade is needed for this queue if it's not built and this customer would cause the upgrade to be needed then PJM couldn't eliminate the need for the upgrade until this queue executed its ISA.

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

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.

Network Impacts

The Queue Project AB2-050 was evaluated as a 20.0 MW (Capacity 20.0 MW) injection at the Four Rivers 230kV substation in the ITO area. Project AB2-050 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AB2-050 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Contingency Descriptions

The following contingencies resulted in overloads:

Contingency Name	Description
LN 2032	CONTINGENCY 'LN 2032' OPEN BRANCH FROM BUS 314212 TO BUS 314222 CKT 1 /* 6FRRIVER 230.00 - 6HANOVER 230.00 OPEN BRANCH FROM BUS 314218 TO BUS 314222 CKT 1 /* 6ELMONT 230.00 - 6HANOVER 230.00 OPEN BUS 314222 /* ISLAND END

Summer Peak Analysis - 2020

Generator Deliverability

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

None

Multiple Facility Contingency

(Double Circuit Tower Line contingencies were studied for the full energy output. The contingencies of Line with Failed Breaker and Bus Fault will be performed for the Impact Study.)

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)

	Contingency		Affected		Bus			Power	Loading %		Rating		MW
#	Type	Name	Area	Facility Description	From	To	Circuit	Flow	Initial	Final	Type	MVA	Contribution
1	N-1	LN 2032	DVP - DVP	6FRRIVER-6STJOHN 230 kV line	314212	314510	1	DC	119.86	122.36	ER	797	19.94

Note:

- For item #1 please refer to Appendix 1 for a table containing the generators having contribution to this flowgate.

Steady-State Voltage Requirements

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

Not required

Stability and Reactive Power Requirement for Low Voltage Ride Through

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

Not required

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)

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
# 1	6FRRIVER-6STJOHN 230 kV line	Upgrade the existing 230kV, Line #256 between Four Rivers and St. Johns by replacing the 2000a wave trap at Four Rivers and the 230kV line switches at St. Johns Substation	n4692	**$150,000**
			Total New Network Upgrades	**$**

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.

Not applicable

Light Load Analysis

Not applicable

ITO Analysis

ITO assessed the impact of the proposed Queue Project #AB2-050 interconnection of a 0 MW Energy (20.0 MW Capacity) injection into the ITO's Transmission System, for compliance with NERC Reliability Criteria on ITO's Transmission System. The system was assessed using the summer 2019 RTEP case provided to ITO by PJM. When performing a generation analysis, ITO's main analysis will be load flow study results under single contingency (both normal and stressed system conditions). ITO Criteria considers a transmission facility overloaded if it exceeds 94% of its emergency rating under normal and stressed system conditions. A full listing of 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's 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.

As part of its generation impact analysis, the ITO routinely evaluates the impact that a proposed new generation resource will have under maximum generation conditions, stress system conditions and import/export system conditions (greater than 20 MW). The results of these studies are discussed in more detail below.

Category B Analysis (Single Contingency):

1. System Normal – No deficiencies identified
2. Critical System Condition (No Surry 230 kV Unit) – No deficiencies identified.

Category C Analysis: (Multiple Facility Analysis)

1. Bus Fault - No deficiencies identified
2. Line Stuck Breaker - No deficiencies identified
3. Tower Line – No deficiencies identified

The import and export conditions into and out of the ITO System are evaluated with any new interconnection greater than 20 MW, any new facility that is interconnected with the ITO System should not significantly decrement FCITC between utilities. These studies will be performed during the System Impact Study.

Attachment 1.

Flowgate Appendices – Option 1

Appendices

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. When a flowgate is identified in multiple analysis the appendix is presented for only the analysis with the greatest overload.

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.

Appendix 1

(DVP - DVP) The 6FRRIVER-6STJOHN 230 kV line (from bus 314212 to bus 314150 ckt 1) loads from 119.86% to 122.36% (**DC power flow**) of its emergency rating (797 MVA) for the single line contingency outage of 'LN 2032'. This project contributes approximately 19.94 MW to the thermal violation.

CONTINGENCY 'LN 2032'
OPEN BRANCH FROM BUS 314212 TO BUS 314222 CKT 1 /* 6FRRIVER 230.00 - 6HANOVER 230.00
OPEN BRANCH FROM BUS 314218 TO BUS 314222 CKT 1 /* 6ELMONT 230.00 - 6HANOVER 230.00
OPEN BUS 314222 /* ISLAND
END

Bus Number	*Bus Name*	*Full Contribution*
315043	*1FRIVERA*	*22.25*
315044	*1FRIVERB*	*17.21*
315045	*1FRIVERC*	*22.25*
315046	*1FRIVERD*	*17.21*
315047	*1FRIVERE*	*17.21*
315048	*1FRIVERF*	*22.25*
921292	*AA1-083*	*19.94*
921622	*AA1-145*	*338.95*
924061	*AB2-050*	*19.94*