Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AB2-152

Cogentrix 230kV 107.4MW Capacity / 107.4MW Energy

September / 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 combustion turbine generating facility located in Hopewell, VA. The installed facilities will have a total capability of 107.4 MW with 107.4 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is 6/30/2019. **This study does not imply an ITO commitment to this in-service date.**

Note: 92 MW of CIR's from the Cogentrix Hopewell James River Genco are being transferred to this project

Point of Interconnection

AB2-152 will interconnect with the ITO transmission system at Cogentrix 230kV substation.

Cost Summary

The AB2-152 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$1,800,000
Direct Connection Network Upgrades	$0
Non Direct Connection Network Upgrades	$tbd
Total Costs	**$1,800,000**

In addition, the AB2-152 project may be responsible for a contribution to the following costs:

Description	Total Cost
New System Upgrades	$5,500,000
Previously Identified Upgrades	$0
Total Costs	**$5,500,000**

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

Attachment Facilities

Generation Substation: Install metering and associated protection equipment. Estimated Cost $600,000.

Transmission: Construct approximately one span of 230 kV Attachment line between the generation substation and an existing Hopewell 230 kV Substation. The estimated cost for this work is $1,200,000.

The estimated total cost of the Attachment Facilities is $1,800,000. It is estimated to take 18-24 months to complete this work.

Non-Direct Connection Cost Estimate

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.

Reinforcement: Upgrade the Prince George 230/115kV transformer. It is estimated to take 24-28 months to complete and it is estimated to cost $5,500,000 to resolve this deficiency.

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

An Interconnection Customer entering the New Services Queue on or after October 1, 2012 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.

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 AB2-152 was evaluated as a 107.4 MW (Capacity 107.4 MW) injection at the Hopewell 230kV substation in the ITO area. Project AB2-152 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AB2-152 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 211-228	CONTINGENCY 'LN 211-228' OPEN BRANCH FROM BUS 314287 TO BUS 314303 CKT 1 /* 6CHSTF B 230.00 - 6HOPEWLL 230.00 OPEN BRANCH FROM BUS 314278 TO BUS 314286 CKT 1 /* 6BERMUDA 230.00 - 6CHSTF A 230.00 OPEN BRANCH FROM BUS 314278 TO BUS 314303 CKT 1 /* 6BERMUDA 230.00 - 6HOPEWLL 230.00 OPEN BUS 314278 /* ISLAND END

Summer Peak Analysis - 2020

Generator Deliverability

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

No

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.)

No

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	Cir.	Flow	Initial	Final	Type	MVA	Contribution	Ref
1	DCTL	LN 211-228	DVP - DVP	6PRGEORG 230/115 kV transformer	314269	314291	1	DC	112.23	114.31	ER	203	4.22	1

Steady-State Voltage Requirements

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

To be determined during Impact Study.

Stability and Reactive Power Requirement for Low Voltage Ride Through

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

To be determined during Impact Study.

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, initially caused by the addition of this project generation)

No

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	6PRGEORG 230/115 kV transformer	Upgrade of the Prince George 230/115kV transformer.	Pending	**$5,500,000**
			Total New Network Upgrades	**$5,500,000**

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 required

Light Load Analysis

Light Load Studies to be conducted during later study phases (as required by PJM Manual 14B).

ITO Analysis

ITO assessed the impact of the proposed Queue Project #AB2-152 interconnection of a 107.4 MW Energy (107.4 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 2020 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

Import/Export Analysis (Single Contingency) are tabulated in Table A and B below.

Table A: Import Study Results

Import Study Results			
Area	Summer 2020	Summer 2020 with AB2-152	Limiting Element
AEP	2000+	2000+	8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'
APS	2000+	2000+	8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'
CPL	2000+	2000+	8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'
PJM	2000+	2000+	8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'

Table B: Export Study Results

Export Study Results			
Area	Summer 2020	Summer 2020 with AB2-152	Limiting Element
AEP	2000+	2000+	8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'
APS	2000+	2000+	8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'

CPL	2000+	2000+	8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'
PJM	2000+	2000+	8ELMONT-8LDYSMTH 500 kV line for single contingency outage of 'LN 576'

ITO's Planning Criteria indicates a need to have approximately 2000 MW of import and export capability. The results of these import and export studies indicate that the proposed interconnection will impact ITO's import or export capability.

Affected System Analysis & Mitigation

Duke, Progress & TVA Impacts:

Duke Carolina, Progress, & TVA Impacts to be determined during later study phases (as applicable).

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 6PRGEORG 230/115 kV transformer (from bus 314269 to bus 314291 ckt 1) loads from 112.23% to 114.31% (**DC power flow**) of its emergency rating (203 MVA) for the tower line contingency outage of 'LN 211-228'. This project contributes approximately 4.22 MW to the thermal violation.

CONTINGENCY 'LN 211-228'
OPEN BRANCH FROM BUS 314287 TO BUS 314303 CKT 1 /* 6CHSTF B 230.00 - 6HOPEWLL 230.00
OPEN BRANCH FROM BUS 314278 TO BUS 314286 CKT 1 /* 6BERMUDA 230.00 - 6CHSTF A 230.00
OPEN BRANCH FROM BUS 314278 TO BUS 314303 CKT 1 /* 6BERMUDA 230.00 - 6HOPEWLL 230.00
OPEN BUS 314278 /* ISLAND
END

Bus Number	*Bus Name*	*Full Contribution*
315119	*1GRAVEL3*	*1.96*
315120	*1GRAVEL4*	*1.97*
315121	*1GRAVEL5*	*1.94*
315122	*1GRAVEL6*	*1.97*
315077	*1HOPHCF1*	*4.12*
315078	*1HOPHCF2*	*4.12*
315079	*1HOPHCF3*	*4.12*
315080	*1HOPHCF4*	*6.25*
315076	*1HOPPOLC*	*3.52*
315073	*1STONECA*	*10.8*
315116	*1SURRY 1*	*20.47*
315074	*CIR_AB2-152*	*1.69*
315075	*CIR_AB2-152*	*1.66*
292791	*U1-032 E*	*5.63*
914231	*Y2-077*	*1.66*
922522	*AA2-177 C*	*11.1*
922523	*AA2-177 E*	*4.76*
924011	*AB2-042 C OP*	*8.93*
924012	*AB2-042 E OP*	*7.12*
924811	*AB2-134 C OP*	*14.23*
924812	*AB2-134 E OP*	*19.02*
924961	*AB2-152*	*4.22*
925331	*AB2-190 C*	*25.37*
925332	*AB2-190 E*	*6.34*