Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AC1-134

Four Rivers 230kV
50 MW Capacity / 0 MW Energy

Revised May / 2017

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 Ashland, VA (Hanover County). The installed facilities will have a total capability of 746 MW with 696 MW of this output being recognized by PJM as capacity. This queue request is for an additional 0 MW with 50 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is 6/1/2017. **This study does not imply an ITO commitment to this in-service date.**

Point of Interconnection

AC1-134 will interconnect with the ITO transmission at the Fours Rivers 230kV substation.

Cost Summary

The AC1-134 project is not expected to have additional costs to interconnect than those identified in the AA1-083 ISA.

In addition, the AC1-134 project may be responsible for a contribution to the following costs:

Description	Total Cost

Description	Total Cost
New System Upgrades	$50,000,000
Previously Identified Upgrades	$0
Total Costs	**$50,000,000**

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

Note: PJM Open Access Transmission Tariff (OATT) section 217.3A outline cost allocation rules. The rules are further clarified in PJM Manual 14A Attachment B. For New System Upgrades, the cost allocation rule differ depending on whether the minimum amount of upgrades to resolve a single reliability criteria violation will cost less than $5,000,000. For upgrades estimated to cost less than $5,000,000 the allocation of costs will not occur outside of the Queue in which the need for the Network Upgrade was identified. Cost allocation within the Queue will be contingent each Queue projects Distribution Factor on the overloaded facility. For upgrades estimated to cost $5,000,000 or greater the allocation of costs will start with the first Queue project to cause the need for the upgrade. Later queue projects will receive cost allocation contingent on their contribution to the violation and are allocated to the queues that have not closed less than 5 years following the execution of the first Interconnection Service Agreement which identifies the need for this upgrade

Transmission Owner Scope of Work

Attachment Facilities

The scope identified in queue AA1-083 is sufficient to accommodate this queue request from an Attachment Facilities and Chase City substation expansion perspective. The single line is shown below in Attachment 1.

Non-Direct Connection Cost Estimate

None identified

New System Reinforcement

Reinforcement: Ladysmith – Chancellor 500kV line #581: Wreck and rebuild the existing line since overload exceeds conductor rating of 2913 MVA by 3.1% new line rating 4300 MVA. A Virginia CPCN is required. It is estimated to cost $50,000,000 and it is estimate to take 36-48 months to engineer, permit and construct.

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 AC1-134 was evaluated as a 0 MW (Capacity 50.0 MW) uprate to the Four Rivers substation in the ITO area. Project AC1-134 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC1-134 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 594	CONTINGENCY 'LN 594' OPEN BRANCH FROM BUS 314916 TO BUS 314934 CKT 1 /* 8MORRSVL 500.00 - 8SPOTSYL 500.00 END

Summer Peak Analysis - 2020

Generator Deliverability

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

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Cir.	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution	Ref
1	N-1	LN 594	DVP - DVP	8LDYSMTH-8CHANCE 500 kV line	314911	314905	1	DC	99.66	100.02	ER	2738	9.93	1

Multiple Facility Contingency

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

None

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

Not required

Contributions to previously identified circuit breakers found to be over-duty:

Not required

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

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)

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
# 1	8LDYSMTH-8CHANCE 500 kV line	Wreck and rebuild the existing line since overload exceeds conductor rating of 2913 MVA by 3.1% new line rating 4300 MVA. VA CPCN is required. Estimated time 36 – 48 months.	Pending	$50,000,000
			Total New Network Upgrades	**$50,000,000**

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)

None

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

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 #AC1-134 interconnection of a 0 MW Energy (50 MW Capacity) injection into the ITO's Transmission System at the existing Four Rivers 230 kV Generating Units located at the Four Rivers Substation, 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

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.

Affected System Analysis & Mitigation

Duke, Progress & TVA Impacts:

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

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 8LDYSMTH-8CHANCE 500 kV line (from bus 314911 to bus 314905 ckt 1) loads from 99.66% to 100.02% (**DC power flow**) of its emergency rating (2738 MVA) for the single line contingency outage of 'LN 594'. This project contributes approximately 9.93 MW to the thermal violation.

CONTINGENCY 'LN 594'
OPEN BRANCH FROM BUS 314916 TO BUS 314934 CKT 1 /* 8MORRSVL 500.00 - 8SPOTSYL 500.00
END

Bus Number	*Bus Name*	*Full Contribution*
315053	*1BELMED1*	*3.45*
315054	*1BELMED2*	*3.45*
315055	*1BELMED3*	*2.86*
315067	*1DARBY 1*	*3.15*
315068	*1DARBY 2*	*3.15*
315069	*1DARBY 3*	*3.19*
315070	*1DARBY 4*	*3.19*
315043	*1FRIVERA*	*4.27*
315044	*1FRIVERB*	*3.3*
315045	*1FRIVERC*	*4.27*
315046	*1FRIVERD*	*3.3*
315047	*1FRIVERE*	*3.3*
315048	*1FRIVERF*	*4.27*
315037	*1LDYSMT1*	*5.56*
315038	*1LDYSMT2*	*5.55*
315039	*1LDYSMT3*	*5.88*
315040	*1LDYSMT4*	*5.89*
315041	*1LDYSMT5*	*5.91*
315225	*1N ANNA1*	*46.02*
315226	*1N ANNA2*	*45.3*
315091	*1YORKTN2*	*30.94*
314309	*6IRON208*	*0.48*
314236	*6NRTHEST*	*0.23*
314251	*6S PUMP*	*1.05*
297087	*V2-040*	*0.15*
921092	*AA1-049 C*	*2.46*
LTF	*AA1-058*	*0.73*
921162	*AA1-063AC*	*8.04*
921172	*AA1-064 C*	*7.98*
921182	*AA1-067 C*	*1.54*

921292	*AA1-083*	*3.97*
921532	*AA1-132 C*	*7.61*
921542	*AA1-133 C*	*10.18*
921552	*AA1-134 C*	*9.94*
921562	*AA1-135 C*	*8.6*
921572	*AA1-138 C*	*9.75*
921582	*AA1-139 C*	*15.27*
921622	*AA1-145*	*67.49*
921752	*AA2-053 C*	*8.14*
921772	*AA2-059 C*	*2.35*
921862	*AA2-068 C*	*2.02*
LTF	*AA2-074*	*4.84*
921982	*AA2-088 C*	*6.24*
922512	*AA2-174 C*	*0.37*
922522	*AA2-177 C*	*10.51*
922532	*AA2-178 C*	*9.41*
922602	*AB1-013 C*	*2.84*
922672	*AB1-026 C*	*2.1*
922682	*AB1-027 C*	*2.75*
922722	*AB1-053 C*	*0.99*
922732	*AB1-054 C*	*6.59*
923262	*AB1-132 C OP*	*13.14*
923272	*AB1-135 C OP*	*2.71*
923572	*AB1-173 C OP*	*2.12*
923582	*AB1-173AC OP*	*2.12*
923801	*AB2-015 C OP*	*8.48*
923831	*AB2-022 C*	*2.33*
923841	*AB2-024 C*	*2.6*
923851	*AB2-025 C*	*2.41*
923861	*AB2-026 C*	*2.25*
923911	*AB2-031 C OP*	*2.1*
923981	*AB2-039 C OP*	*8.58*
923991	*AB2-040 C OP*	*6.91*
924061	*AB2-050*	*3.97*
924071	*AB2-051 C OP*	*140.73*
924241	*AB2-068 OP*	*213.47*
924381	*AB2-087 C*	*0.54*
924491	*AB2-098 C*	*0.51*
924501	*AB2-099 C*	*0.56*
924511	*AB2-100 C*	*10.8*
924761	*AB2-128 C*	*9.25*
924811	*AB2-134 C OP*	*13.48*

924931	*AB2-147 C*	*2.41*
924941	*AB2-149 C OP*	*3.45*
924951	*AB2-150 C OP*	*2.41*
924961	*AB2-152*	*2.84*
925051	*AB2-160 C OP*	*5.69*
925061	*AB2-161 C OP*	*3.47*
925121	*AB2-169 C OP*	*6.12*
925141	*AB2-171 C OP*	*4.78*
925171	*AB2-174 C OP*	*6.63*
925281	*AB2-186 C*	*0.61*
925291	*AB2-188 C OP*	*2.32*
925331	*AB2-190 C*	*24.03*
925361	*AC1-007 C OP*	*0.7*
925521	*AC1-027 C*	*2.05*
925691	*AC1-045 C*	*1.77*
925701	*AC1-046 C*	*1.78*
925711	*AC1-047 C*	*2.36*
925811	*AC1-060*	*2.62*
925821	*AC1-061*	*0.04*
925841	*AC1-063*	*0.41*
925861	*AC1-065 C*	*3.52*
926071	*AC1-086 C*	*19.35*
926201	*AC1-098 C*	*5.64*
926211	*AC1-099 C*	*1.89*
926291	*AC1-107 OP*	*322.22*
926411	*AC1-112 C*	*2.14*
926441	*AC1-115 C*	*1.12*
926471	*AC1-118 C*	*1.98*
926551	*AC1-134*	*9.93*
926591	*AC1-142 C*	*9.8*
926661	*AC1-147 C*	*2.32*
926731	*AC1-158 C*	*78.78*
926741	*AC1-159 C*	*139.64*
926751	*AC1-161 C OP*	*31.28*
926771	*AC1-163 C*	*2.02*
926781	*AC1-164 C OP*	*44.47*
927041	*AC1-191 C*	*10.67*
927051	*AC1-193 C*	*3.5*
927141	*AC1-208 C*	*8.11*
927221	*AC1-216 C OP*	*10.29*