Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AB2-150

Clubhouse – Freeman 115kV
19MW Capacity / 40MW 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 solar generating facility located in Greensville County, VA. The installed facilities will have a total capability of 40 MW with 15.2 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is 10/30/2017. **This study does not imply an ITO commitment to this in-service date.**

Point of Interconnection

AB2-150 will interconnect with the ITO transmission system at one of the following points of interconnection:

Option 1 will connect via a new three breaker ring bus switching station that connects on the Clubhouse – Freeman 115kV line #71.

Option 2 will connect at Clubhouse 230kV substation.

Cost Summary

The AB2-150 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$1,500,000
Direct Connection Network Upgrades	$4,500,000
Non Direct Connection Network Upgrades	$700,000
Total Costs	**$6,700,000**

In addition, the AB2-150 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 $500,000.

Transmission: Construct approximately one span of 115 kV Attachment line between the generation substation and a new AB2-150 115 kV Switching Substation. The estimated cost for this work is $1,000,000.

The estimated total cost of the Attachment Facilities is $1,500,000. It is estimated to take 18-24 months to complete this work. These costs do not include CIAC Tax Gross-up. The single line is shown below in Attachment 1.

Direct Connection Cost Estimate

Substation: Establish the new 115 kV AB2-150 Switching Substation (interconnection substation). The estimated cost of this work scope is $4,500,000. It is estimated to take 24-36 months to complete this work.

Non-Direct Connection Cost Estimate

Transmission: Install transmission structure in-line with transmission line to allow the proposed interconnection switching station to be interconnected with the transmission system. Estimated cost is $700,000 dollars and is estimated to take 24-30 months to complete.

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 Clubhouse 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

Voltage Ride Through Requirements - The Customer Facility shall be designed to remain in service (not trip) for voltages and times as specified for the Eastern Interconnection in Attachment 1 of NERC Reliability Standard PRC-024-1, and successor Reliability Standards, for both high and low voltage conditions, irrespective of generator size, subject to the permissive trip exceptions established in PRC-024-1 (and successor Reliability Standards).

Frequency Ride Through Requirements - The Customer Facility shall be designed to remain in service (not trip) for frequencies and times as specified in Attachment 2 of NERC Reliability Standard PRC-024-1, and successor Reliability Standards, for both high and low frequency condition, irrespective of generator size, subject to the permissive trip exceptions established in PRC-024-1 (and successor Reliability Standards).

Reactive Power - The Generation Interconnection Customer shall design its non-synchronous Customer Facility with the ability to maintain a power factor of at least 0.95 leading to 0.95 lagging measured at the generator's terminals.

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.

Option One

Network Impacts

The Queue Project AB2-150 was evaluated as a 40.0 MW (Capacity 15.2 MW) injection tapping the Clubhouse-Freeman 115kV line in the ITO area. Project AB2-150 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AB2-150 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 2058-2181	CONTINGENCY 'LN 2058-2181' OPEN BUS 304226 /* ISLAND: 6PA-RMOUNT#4115.00 OPEN BRANCH FROM BUS 304226 TO BUS 314591 CKT 1 /* 6PA-RMOUNT#4230.00 - 6NASH 230.00 OPEN BRANCH FROM BUS 313845 TO BUS 314591 CKT 1 /* 6HATHAWAY 230.00 - 6NASH 230.00 OPEN BUS 314591 /* ISLAND: 6NASH 230.00 OPEN BRANCH FROM BUS 304222 TO BUS 313845 CKT 1 /* 6ROCKYMT230T230.00 - 6HATHAWAY 230.00 END

Contingency Name	Description
2202_A	CONTINGENCY '2202_A' /* CAROLINA OPEN BRANCH FROM BUS 314559 TO BUS 314571 CKT 1 /* LINE 22 OPEN BRANCH FROM BUS 314571 TO BUS 314702 CKT 1 /* LINE 22 OPEN BRANCH FROM BUS 314559 TO BUS 314259 CKT Z1 /* LINE 56 OPEN BRANCH FROM BUS 314559 TO BUS 921751 CKT 1 /* LINE 54 AA2-053 TAP OPEN BRANCH FROM BUS 314559 TO BUS 314600 CKT 1 /* LINE 130 OPEN BRANCH FROM BUS 314559 TO BUS 314561 CKT 1 /* TX. #4 DECREASE BUS 314559 LOAD BY 100 PERCENT /* REMOVE ALL LOAD AT CAROLINA END
T132_A	CONTINGENCY 'T132_A' /* CAROLINA OPEN BRANCH FROM BUS 314559 TO BUS 314259 CKT Z1 /* LINE 56 OPEN BRANCH FROM BUS 314559 TO BUS 921751 CKT 1 /* LINE 54 AA2-053 TAP OPEN BRANCH FROM BUS 314559 TO BUS 314571 CKT 1 /* LINE 22 OPEN BRANCH FROM BUS 314559 TO BUS 314600 CKT 1 /* LINE 130 OPEN BRANCH FROM BUS 314559 TO BUS 314561 CKT 1 /* TX. #4 DECREASE BUS 314559 LOAD BY 100 PERCENT /* REMOVE ALL LOAD AT CAROLINA END

Contingency Name	Description
5602_A	CONTINGENCY '5602_A' /* CAROLINA OPEN BRANCH FROM BUS 314559 TO BUS 314259 CKT Z1 /* LINE 56 OPEN BRANCH FROM BUS 314259 TO BUS 921161 CKT 1 /* LINE 56 AA1-063A TAP OPEN BRANCH FROM BUS 314604 TO BUS 314587 CKT 1 /* LINE 56 OPEN BRANCH FROM BUS 314587 TO BUS 314558 CKT 1 /* LINE 56 OPEN BRANCH FROM BUS 314559 TO BUS 921751 CKT 1 /* LINE 54 AA2-053 TAP OPEN BRANCH FROM BUS 314559 TO BUS 314571 CKT 1 /* LINE 22 OPEN BRANCH FROM BUS 314559 TO BUS 314600 CKT 1 /* LINE 130 OPEN BRANCH FROM BUS 314559 TO BUS 314561 CKT 1 /* TX. #4 DECREASE BUS 314559 LOAD BY 100 PERCENT /* REMOVE ALL LOAD AT CAROLINA END

Contingency Name	Description
5402_A	CONTINGENCY '5402_A' /* CAROLINA OPEN BRANCH FROM BUS 314559 TO BUS 921751 CKT 1 /* LINE 54 AA2-053 TAP OPEN BRANCH FROM BUS 314581 TO BUS 314626 CKT 1 /* LINE 54 OPEN BRANCH FROM BUS 314626 TO BUS 314625 CKT 1 /* LINE 54 OPEN BRANCH FROM BUS 314625 TO BUS 314568 CKT 1 /* LINE 54 OPEN BRANCH FROM BUS 314559 TO BUS 314571 CKT 1 /* LINE 22 OPEN BRANCH FROM BUS 314559 TO BUS 314259 CKT Z1 /* LINE 56 OPEN BRANCH FROM BUS 314559 TO BUS 314600 CKT 1 /* LINE 130 OPEN BRANCH FROM BUS 314559 TO BUS 314561 CKT 1 /* TX. #4 DECREASE BUS 314559 LOAD BY 100 PERCENT /* REMOVE ALL LOAD AT CAROLINA END

Summer Peak Analysis - 2020

System Reinforcement responsible by ITO

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution
1	DCTL	LN 2058-2181	DVP - CPLE	3BTLEBRO-3ROCKYMT115T 115 kV line	314554	304223	1	DC	115.26	116.06	ER	164	2.91

PJM baseline project (b1794) will eliminate the identified overloads. The scheduled in service date b1794 is 06/01/2016.

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.)

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution
2	LFFB	2202_A	DVP - DVP	6CLUBHSE 230/115 kV transformer	314562	314563	1	DC	83.96	99.35	ER	194	29.91
3	LFFB	T132_A	DVP - DVP	6CLUBHSE 230/115 kV transformer	314562	314563	1	DC	82.93	98.32	ER	194	29.91
4	LFFB	5602_A	DVP - DVP	6CLUBHSE 230/115 kV transformer	314562	314563	1	DC	82.88	98.27	ER	194	29.91
5	LFFB	5402_A	DVP - DVP	6CLUBHSE 230/115 kV transformer	314562	314563	1	DC	82.72	98.12	ER	194	29.91

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
6	DCTL	LN 2058-2181	DVP - CPLE	3BTLEBRO-3ROCKYMT115T 115 kV line	314554	304223	1	DC	115.26	116.06	ER	164	2.91	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)

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
# 1	3BTLEBRO-3ROCKYMT115T 115 kV line	Build a new Hathaway 230/115kV substation	b1794	**$**
# 2 - 5	6CLUBHSE 230/115 kV transformer	Upgrade the Clubhouse 230/115kV transformer	Pending	**$5,500,000**
			Total New Network Upgrades	**$5,500,000**

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)

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
# 6	3BTLEBRO-3ROCKYMT115T 115 kV line	Build a new Hathaway 230/115kV substation	b1794	**$**
			Total New Network Upgrades	**$**

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.

None

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 #AB2-150 interconnection of a 40.0 MW Energy (15.2 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

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).

Overload #1: 3BTLEBRO-3ROCKYMT115T 115 kV line overload was identified on PJM Queue projects in the AA2 queue with current rating of 94MVA. Duke Progress requires a project to enter into an Affected System Study with Duke Progress so that Duke Progress can determine if a network upgrade is required. In the AA2 queue, Duke Progress preliminary analysis has identified a network upgrade to increase the rating of the line rating from 94MVA to 164MVA. The network upgrade cost responsibility will be governed by the Duke Progress FERC tariff.

Option Two

Network Impacts

The Queue Project AB2-150 was evaluated as a 40.0 MW (Capacity 15.2 MW) injection at the Clubhouse 230kV substation in the ITO area. Project AB2-150 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AB2-150 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 238	CONTINGENCY 'LN 238' OPEN BRANCH FROM BUS 314282 TO BUS 314435 CKT 1 /* 6CARSON 230.00 - 6SAPONY 230.00 OPEN BRANCH FROM BUS 314435 TO BUS 314563 CKT 1 /* 6SAPONY 230.00 - 6CLUBHSE 230.00 OPEN BRANCH FROM BUS 314562 TO BUS 314563 CKT 1 /* 3CLUBHSE 115.00 - 6CLUBHSE 230.00 OPEN BUS 314435 /* ISLAND END
239T2141	CONTINGENCY '239T2141' /* LAKEVIEW OPEN BRANCH FROM BUS 314583 TO BUS 314579 CKT 1 /* 239 OPEN BRANCH FROM BUS 314579 TO BUS 314605 CKT 1 /* 2057 OPEN BRANCH FROM BUS 314583 TO BUS 314561 CKT 1 /* 2141 END

Contingency Name	Description
LN 2058-2181	CONTINGENCY 'LN 2058-2181' OPEN BUS 304226 /* ISLAND: 6PA-RMOUNT#4115.00 OPEN BRANCH FROM BUS 304226 TO BUS 314591 CKT 1 /* 6PA-RMOUNT#4230.00 - 6NASH 230.00 OPEN BRANCH FROM BUS 313845 TO BUS 314591 CKT 1 /* 6HATHAWAY 230.00 - 6NASH 230.00 OPEN BUS 314591 /* ISLAND: 6NASH 230.00 OPEN BRANCH FROM BUS 304222 TO BUS 313845 CKT 1 /* 6ROCKYMT230T230.00 - 6HATHAWAY 230.00 END
23872	CONTINGENCY '23872' /*_ CARSON OPEN BRANCH FROM BUS 314282 TO BUS 314435 CKT 1 /*L238 CARSON SAPONY OPEN BRANCH FROM BUS 314435 TO BUS 314563 CKT 1 /*L238 SAPONY CLUBHOUSE OPEN BRANCH FROM BUS 314563 TO BUS 314562 CKT 1 /*CLUBHOUSE TX1 230-115 OPEN BRANCH FROM BUS 314282 TO BUS 314902 CKT 1 /*CARSON TX2 500-230 OPEN BRANCH FROM BUS 314282 TO BUS 314455 CKT 1 /*CARSON SC172 END
238T2002	CONTINGENCY '238T2002' /*_ CARSON OPEN BRANCH FROM BUS 314331 TO BUS 314288 CKT 1 /*L2002 POE COGENTRIX OPEN BRANCH FROM BUS 314288 TO BUS 314282 CKT 1 /*L2002 COGENTRIX CARSON OPEN BRANCH FROM BUS 314331 TO BUS 314329 CKT 1 /*POE TX5 230-115 OPEN BRANCH FROM BUS 314282 TO BUS 314435 CKT 1 /*L238 CARSON SAPONY OPEN BRANCH FROM BUS 314435 TO BUS 314563 CKT 1 /*L238 SAPONY CLUBHOUSE OPEN BRANCH FROM BUS 314563 TO BUS 314562 CKT 1 /*CLUBHOUSE TX1 230-115 END

Summer Peak Analysis - 2020

Generator Deliverability

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

	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 238	DVP – DVP	6LAKEVEW-6CAROLNA 230 kV line	314583	314561	1	DC	99.82	102.15	ER	399	9.29

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.)

	Contingency		Affected		Bus			Power	Loading %		Rating		MW	
#	Type	Name	Area	Facility Description	From	To	Cir.	Flow	Initial	Final	Type	MVA	Contribution	Ref
2	LFFB	239T2141	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	DC	87.7	92.63	ER	637	31.41	2

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 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
3	DCTL	LN 2058-2181	DVP - CPLE	3BTLEBRO-3ROCKYMT115T 115 kV line	314554	304223	1	DC	110.29	111.11	ER	164	3.01	3
4	LFFB	23872	DVP – DVP	6LAKEVEW-6CAROLNA 230 kV line	314583	314561	1	DC	123.34	129.47	ER	399	24.46	4
5	LFFB	238T2002	DVP – DVP	6LAKEVEW-6CAROLNA 230 kV line	314583	314561	1	DC	123.04	129.17	ER	399	24.45	

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.

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.

Contingency			Affected		Bus			Power	Loading %		Rating		MW
#	Type	Name	Area	Facility Description	From	To	Circuit	Flow	Initial	Final	Type	MVA	Contribution
6	N-1	LN 238	DVP – DVP	6LAKEVEW-6CAROLNA 230 kV line	314583	314561	1	DC	122.84	128.97	ER	399	24.45

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 #AB2-150 interconnection of a 40.0 MW Energy (15.2 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.

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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):

3. System Normal – No deficiencies identified

4. Critical System Condition (No Surry 230 kV Unit) – No deficiencies identified.

Category C Analysis: (Multiple Facility Analysis)

4. Bus Fault - No deficiencies identified
5. Line Stuck Breaker - No deficiencies identified
6. 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.

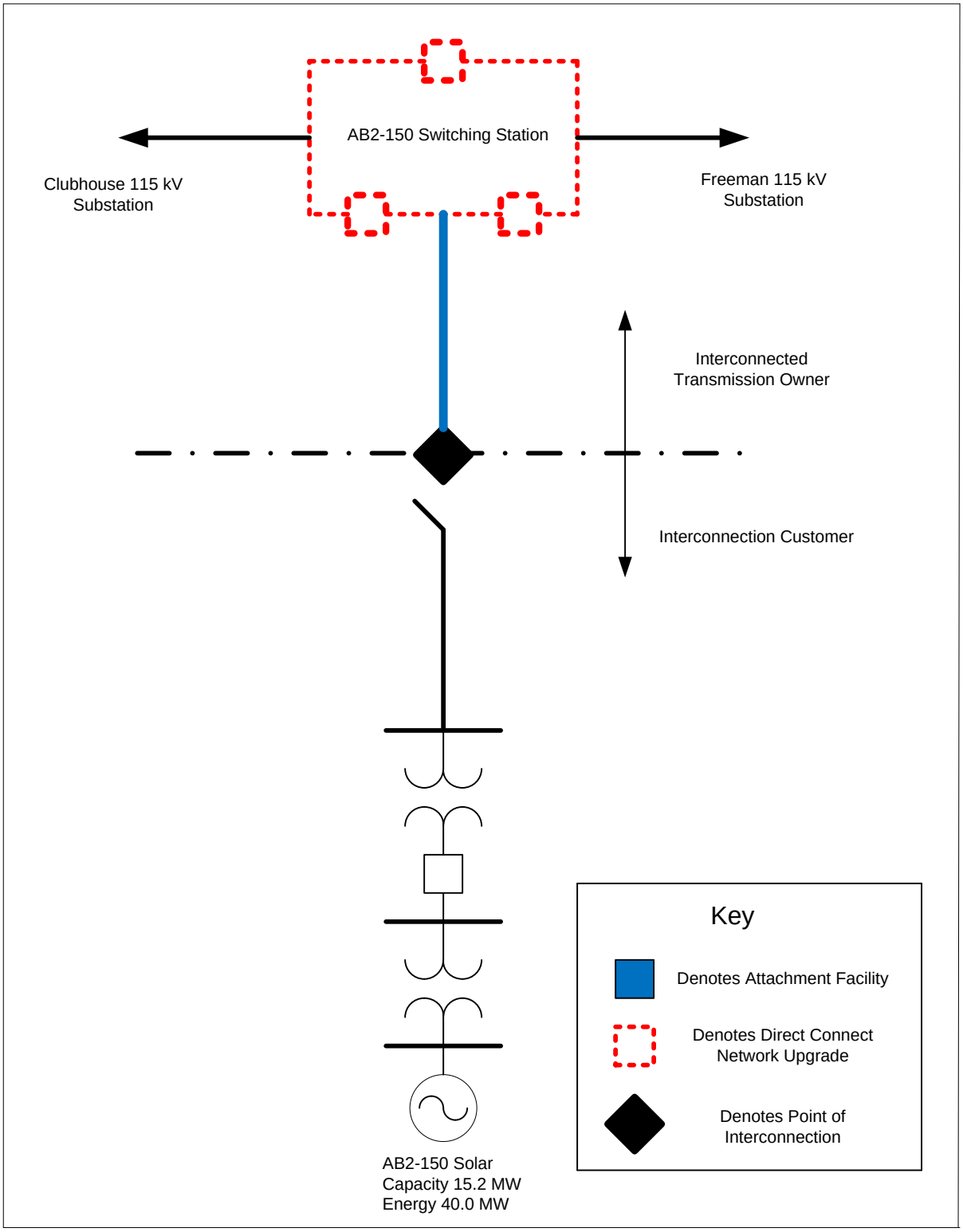
Affected System Analysis & Mitigation

Duke, Progress & TVA Impacts:

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

Attachment 1.

System Configuration



Attachment 2.

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 - CPLE) The 3BTLEBRO-3ROCKYMT115T 115 kV line (from bus 314554 to bus 304223 ckt 1) loads from 115.26% to 116.06% (**DC power flow**) of its emergency rating (164 MVA) for the tower line contingency outage of 'LN 2058-2181'. This project contributes approximately 2.91 MW to the thermal violation.

CONTINGENCY 'LN 2058-2181'
OPEN BUS 304226 /* ISLAND: 6PA-RMOUNT#4115.00
OPEN BRANCH FROM BUS 304226 TO BUS 314591 CKT 1 /* 6PA-RMOUNT#4230.00 - 6NASH 230.00
OPEN BRANCH FROM BUS 313845 TO BUS 314591 CKT 1 /* 6HATHAWAY 230.00 - 6NASH 230.00
OPEN BUS 314591 /* ISLAND: 6NASH 230.00
OPEN BRANCH FROM BUS 304222 TO BUS 313845 CKT 1 /* 6ROCKYMT230T230.00 - 6HATHAWAY 230.00
END

Bus Number	Bus Name	Full Contribution
315131	1EDGECMA	2.63
315132	1EDGECMB	2.63
315139	1GASTONA	2.5
315141	1GASTONB	2.5
315126	1ROARAP2	1.04
315128	1ROARAP4	1.
315134	1ROAVALA	3.54
315135	1ROAVALB	0.94
315136	1ROSEMG1	2.03
315138	1ROSEMG2	0.95
315137	1ROSEMS1	1.26
314541	3WATKINS	0.26
900672	V4-068 E	0.15
902241	W2-022 C OP1	0.61
902242	W2-022 E OP1	4.07
917331	Z2-043 C	0.38
917332	Z2-043 E	0.83
917341	Z2-044 C	0.57
917342	Z2-044 E	1.25
917511	Z2-088 C OP1	0.73
917512	Z2-088 E OP1	6.09
917592	Z2-099 E	0.2
918411	AA1-050	0.62
LTF	AA1-053	6.16
LTF	AA1-054	5.36

LTF	AA1-055	9.54
921162	AA1-063AC	4.88
921163	AA1-063AE	2.3
918512	AA1-065 E OP	1.96
921182	AA1-067 C	0.73
921183	AA1-067 E	0.31
918561	AA1-072 C	0.06
918562	AA1-072 E	0.14
921562	AA1-135 C	4.03
921563	AA1-135 E	1.73
921752	AA2-053 C	5.42
921753	AA2-053 E	2.33
921762	AA2-057 C	12.88
921763	AA2-057 E	6.44
921862	AA2-068 C	3.3
921863	AA2-068 E	1.52
920022	AA2-086 E	0.11
921982	AA2-088 C	2.94
921983	AA2-088 E	4.8
922032	AA2-105 C	1.71
922033	AA2-105 E	0.8
922072	AA2-113 C	1.71
922073	AA2-113 E	0.8
922442	AA2-165 C	1.76
922443	AA2-165 E	0.85
922512	AA2-174 C	0.25
922513	AA2-174 E	0.27
922722	AB1-053 C	0.84
922723	AB1-053 E	0.47
922732	AB1-054 C	3.16
922733	AB1-054 E	1.55
922922	AB1-081 C OP	20.07
922923	AB1-081 E OP	8.6
923262	AB1-132 C OP	9.76
923263	AB1-132 E OP	4.18
923572	AB1-173 C OP	1.21
923573	AB1-173 E OP	0.57
923582	AB1-173AC OP	1.21
923583	AB1-173AE OP	0.57
923911	AB2-031 C OP	1.2
923912	AB2-031 E OP	0.59
923941	AB2-035 C	0.37
923942	AB2-035 E	0.16
923991	AB2-040 C OP	4.09
923992	AB2-040 E OP	3.09

924151	AB2-059 C OP	23.66
924152	AB2-059 E OP	12.19
924381	AB2-087 C	0.31
924382	AB2-087 E	0.15
924391	AB2-088 C	0.47
924392	AB2-088 E	0.23
924491	AB2-098 C	0.24
924492	AB2-098 E	0.1
924501	AB2-099 C	0.32
924502	AB2-099 E	0.14
924511	AB2-100 C	6.41
924512	AB2-100 E	3.16
924761	AB2-128 C	5.49
924762	AB2-128 E	2.16
924931	AB2-147 C	1.11
924932	AB2-147 E	1.81
924951	AB2-150 C OP	1.11
924952	AB2-150 E OP	1.81
925121	AB2-169 C OP	2.48
925122	AB2-169 E OP	2.22
925141	AB2-171 C OP	1.88
925142	AB2-171 E OP	3.07
925171	AB2-174 C OP	3.57
925172	AB2-174 E OP	3.23

Appendix 2

(DVP - DVP) The 6CLUBHSE-6SAPONY 230 kV line (from bus 314563 to bus 314435 ckt 1) loads from 87.7% to 92.63% (**DC power flow**) of its emergency rating (637 MVA) for the line fault with failed breaker contingency outage of '239T2141'. This project contributes approximately 31.41 MW to the thermal violation.

```
CONTINGENCY '239T2141'                                  /* LAKEVIEW
  OPEN BRANCH FROM BUS 314583 TO BUS 314579 CKT 1       /* 239
  OPEN BRANCH FROM BUS 314579 TO BUS 314605 CKT 1       /* 2057
  OPEN BRANCH FROM BUS 314583 TO BUS 314561 CKT 1       /* 2141
  END
```

Bus Number	*Bus Name*	*Full Contribution*
315139	*1GASTONA*	*16.92*
315141	*1GASTONB*	*16.92*
315159	*1KERR 2*	*1.19*
315164	*1KERR 7*	*1.17*
315126	*1ROARAP2*	*1.59*
315128	*1ROARAP4*	*1.53*
314704	*3LAWRENC*	*1.*
921162	*AA1-063AC*	*6.84*
921163	*AA1-063AE*	*3.22*
921752	*AA2-053 C*	*7.37*
921753	*AA2-053 E*	*3.16*
922032	*AA2-105 C*	*2.07*
922033	*AA2-105 E*	*0.97*
922072	*AA2-113 C*	*2.07*
922073	*AA2-113 E*	*0.97*
922472	*AA2-169 C*	*1.83*
922473	*AA2-169 E*	*0.84*
922512	*AA2-174 C*	*0.34*
922513	*AA2-174 E*	*0.37*
923262	*AB1-132 C OP*	*65.96*
923263	*AB1-132 E OP*	*28.27*
923572	*AB1-173 C OP*	*5.09*
923573	*AB1-173 E OP*	*2.38*
923582	*AB1-173AC OP*	*5.09*
923583	*AB1-173AE OP*	*2.38*
923911	*AB2-031 C OP*	*10.52*
923912	*AB2-031 E OP*	*5.18*
923991	*AB2-040 C OP*	*35.8*

923992	*AB2-040 E OP*	*27.01*
924161	*AB2-060 C OP*	*13.37*
924162	*AB2-060 E OP*	*6.29*
924251	*AB2-069 C OP*	*2.24*
924252	*AB2-069 E OP*	*3.54*
924401	*AB2-089 C*	*1.61*
924402	*AB2-089 E*	*0.83*
924411	*AB2-090 C*	*3.12*
924412	*AB2-090 E*	*1.6*
924511	*AB2-100 C*	*52.61*
924512	*AB2-100 E*	*25.91*
924761	*AB2-128 C*	*45.07*
924762	*AB2-128 E*	*17.75*
924931	*AB2-147 C*	*7.84*
924932	*AB2-147 E*	*12.79*
924951	*AB2-150 C OP*	*11.93*
924952	*AB2-150 E OP*	*19.47*
925171	*AB2-174 C OP*	*32.98*
925172	*AB2-174 E OP*	*29.84*
925221	*AB2-176 C*	*1.29*
925222	*AB2-176 E*	*0.55*

Appendix 3

(DVP - CPLE) The 3BTLEBRO-3ROCKYMT115T 115 kV line (from bus 314554 to bus 304223 ckt 1) loads from 110.29% to 111.11% (**DC power flow**) of its emergency rating (164 MVA) for the tower line contingency outage of 'LN 2058-2181'. This project contributes approximately 3.01 MW to the thermal violation.

CONTINGENCY 'LN 2058-2181'
OPEN BUS 304226 /* ISLAND: 6PA-RMOUNT#4115.00
OPEN BRANCH FROM BUS 304226 TO BUS 314591 CKT 1 /* 6PA-RMOUNT#4230.00 - 6NASH 230.00
OPEN BRANCH FROM BUS 313845 TO BUS 314591 CKT 1 /* 6HATHAWAY 230.00 - 6NASH 230.00
OPEN BUS 314591 /* ISLAND: 6NASH 230.00
OPEN BRANCH FROM BUS 304222 TO BUS 313845 CKT 1 /* 6ROCKYMT230T230.00 - 6HATHAWAY 230.00
END

Bus Number	*Bus Name*	*Full Contribution*
315131	*1EDGECMA*	*2.63*
315132	*1EDGECMB*	*2.63*
315139	*1GASTONA*	*2.5*
315141	*1GASTONB*	*2.5*
315126	*1ROARAP2*	*1.04*
315128	*1ROARAP4*	*1.*
315134	*1ROAVALA*	*3.54*
315135	*1ROAVALB*	*0.94*
315136	*1ROSEMG1*	*2.03*
315138	*1ROSEMG2*	*0.95*
315137	*1ROSEMS1*	*1.26*
314784	*1WEYRHSB*	*0.77*
314541	*3WATKINS*	*0.26*
900672	*V4-068 E*	*0.15*
902241	*W2-022 C OP1*	*0.61*
902242	*W2-022 E OP1*	*4.07*
917331	*Z2-043 C*	*0.38*
917332	*Z2-043 E*	*0.83*
917341	*Z2-044 C*	*0.57*
917342	*Z2-044 E*	*1.25*
917511	*Z2-088 C OP1*	*0.73*
917512	*Z2-088 E OP1*	*6.09*
917592	*Z2-099 E*	*0.2*

918411	*AA1-050*	*0.62*
LTF	*AA1-053*	*6.16*
LTF	*AA1-054*	*5.36*
LTF	*AA1-055*	*9.54*
921162	*AA1-063AC*	*4.88*
921163	*AA1-063AE*	*2.3*
918512	*AA1-065 E OP*	*1.96*
921182	*AA1-067 C*	*0.73*
921183	*AA1-067 E*	*0.31*
918561	*AA1-072 C*	*0.06*
918562	*AA1-072 E*	*0.14*
921562	*AA1-135 C*	*4.03*
921563	*AA1-135 E*	*1.73*
921752	*AA2-053 C*	*5.42*
921753	*AA2-053 E*	*2.33*
921762	*AA2-057 C*	*12.88*
921763	*AA2-057 E*	*6.44*
921862	*AA2-068 C*	*3.3*
921863	*AA2-068 E*	*1.52*
920022	*AA2-086 E*	*0.11*
921982	*AA2-088 C*	*2.94*
921983	*AA2-088 E*	*4.8*
922032	*AA2-105 C*	*1.71*
922033	*AA2-105 E*	*0.8*
922072	*AA2-113 C*	*1.71*
922073	*AA2-113 E*	*0.8*
922442	*AA2-165 C*	*1.76*
922443	*AA2-165 E*	*0.85*
922472	*AA2-169 C*	*0.85*
922473	*AA2-169 E*	*0.39*
922512	*AA2-174 C*	*0.25*
922513	*AA2-174 E*	*0.27*
922722	*AB1-053 C*	*0.84*
922723	*AB1-053 E*	*0.47*
922732	*AB1-054 C*	*3.16*
922733	*AB1-054 E*	*1.55*
922922	*AB1-081 C OP*	*20.07*
922923	*AB1-081 E OP*	*8.6*
923262	*AB1-132 C OP*	*9.76*
923263	*AB1-132 E OP*	*4.18*
923572	*AB1-173 C OP*	*1.21*
923573	*AB1-173 E OP*	*0.57*
923582	*AB1-173AC OP*	*1.21*
923583	*AB1-173AE OP*	*0.57*
923801	*AB2-015 C OP*	*4.03*

923802	*AB2-015 E OP*	*2.92*
923911	*AB2-031 C OP*	*1.28*
923912	*AB2-031 E OP*	*0.63*
923941	*AB2-035 C*	*0.37*
923942	*AB2-035 E*	*0.16*
923991	*AB2-040 C OP*	*4.36*
923992	*AB2-040 E OP*	*3.29*
924151	*AB2-059 C OP*	*15.3*
924152	*AB2-059 E OP*	*7.88*
924381	*AB2-087 C*	*0.31*
924382	*AB2-087 E*	*0.15*
924391	*AB2-088 C*	*0.47*
924392	*AB2-088 E*	*0.23*
924491	*AB2-098 C*	*0.24*
924492	*AB2-098 E*	*0.1*
924501	*AB2-099 C*	*0.32*
924502	*AB2-099 E*	*0.14*
924511	*AB2-100 C*	*6.41*
924512	*AB2-100 E*	*3.16*
924761	*AB2-128 C*	*5.49*
924762	*AB2-128 E*	*2.16*
924931	*AB2-147 C*	*1.11*
924932	*AB2-147 E*	*1.81*
924951	*AB2-150 C OP*	*1.14*
924952	*AB2-150 E OP*	*1.87*
925121	*AB2-169 C OP*	*2.51*
925122	*AB2-169 E OP*	*2.25*
925141	*AB2-171 C OP*	*1.93*
925142	*AB2-171 E OP*	*3.16*
925171	*AB2-174 C OP*	*4.02*
925172	*AB2-174 E OP*	*3.64*

Appendix 4

(DVP - DVP) The 6LAKEVEW-6CAROLNA 230 kV line (from bus 314583 to bus 314561 ckt 1) loads from 123.34% to 129.47% (**DC power flow**) of its emergency rating (399 MVA) for the line fault with failed breaker contingency outage of '23872'. This project contributes approximately 24.46 MW to the thermal violation.

CONTINGENCY '23872' /*_ CARSON
OPEN BRANCH FROM BUS 314282 TO BUS 314435 CKT 1 /*L238 CARSON SAPONY
OPEN BRANCH FROM BUS 314435 TO BUS 314563 CKT 1 /*L238 SAPONY CLUBHOUSE
OPEN BRANCH FROM BUS 314563 TO BUS 314562 CKT 1 /*CLUBHOUSE TX1 230-115
OPEN BRANCH FROM BUS 314282 TO BUS 314902 CKT 1 /*CARSON TX2 500-230
OPEN BRANCH FROM BUS 314282 TO BUS 314455 CKT 1 /*CARSON SC172
END

Bus Number	*Bus Name*	*Full Contribution*
315131	*1EDGECMA*	*2.04*
315132	*1EDGECMB*	*2.04*
315139	*1GASTONA*	*13.18*
315141	*1GASTONB*	*13.18*
315136	*1ROSEMG1*	*8.61*
315138	*1ROSEMG2*	*4.03*
315137	*1ROSEMS1*	*5.34*
922722	*AB1-053 C*	*3.56*
922723	*AB1-053 E*	*2.*
922922	*AB1-081 C OP*	*7.68*
922923	*AB1-081 E OP*	*3.29*
923262	*AB1-132 C OP*	*51.36*
923263	*AB1-132 E OP*	*22.01*
923911	*AB2-031 C OP*	*8.19*
923912	*AB2-031 E OP*	*4.04*
923941	*AB2-035 C*	*0.25*
923942	*AB2-035 E*	*0.11*
923991	*AB2-040 C OP*	*27.88*
923992	*AB2-040 E OP*	*21.03*
924151	*AB2-059 C OP*	*11.85*
924152	*AB2-059 E OP*	*6.11*
924391	*AB2-088 C*	*0.33*

924392	*AB2-088 E*	*0.16*
924511	*AB2-100 C*	*40.96*
924512	*AB2-100 E*	*20.18*
924761	*AB2-128 C*	*35.09*
924762	*AB2-128 E*	*13.82*
924951	*AB2-150 C OP*	*9.29*
924952	*AB2-150 E OP*	*15.16*
925171	*AB2-174 C OP*	*25.68*
925172	*AB2-174 E OP*	*23.23*