

***Generation Interconnection
Feasibility Study Report***

For

***PJM Generation Interconnection Request
Queue Position AC1-215***

***Chase City – Twittys Creek 115kV
68.8 MW Capacity / 100 MW Energy***

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 solar generating facility located in Mecklenburg County, VA. The installed facilities will have a total capability of 100 MW with 68.8 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is 6/30/2018. **This study does not imply an ITO commitment to this in-service date.**

Point of Interconnection

AC1-215 will interconnect with the ITO transmission system via a new three breaker ring bus switching station that connects on the Chase City – Central – Twittys Creek 115kV line # 154.

Cost Summary

The AC1-215 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	\$1,500,000
Direct Connection Network Upgrades	\$5,500,000
Non Direct Connection Network Upgrades	\$1,000,000
Total Costs	\$8,000,000

In addition, the AC1-215 project may be responsible for a contribution to the following costs:

Description	Total Cost
New System Upgrades	\$35,000,000
Previously Identified Upgrades	\$5,650,000
Total Costs	\$40,650,000

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: Build approximately 0.5 miles of 115 kV Line. Estimated Cost \$1,000,000

The estimated total cost of the Attachment Facilities is \$1,500,000. It is estimated to take 24-30 months to complete this work. 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. These costs do not include CIAC Tax Gross-up. The single line is shown below in Attachment 1.

Direct Connection Cost Estimate

Substation: Add three breakers at Clubhouse Substation to interconnect the proposed AC1-215 Project and associated equipment. Estimated Cost \$5,500,000 and it is estimated to take 36-48 months to complete this work.

Non-Direct Connection Cost Estimate

Transmission: Re-arrange existing lines to accommodate new 115 kV Line. Estimated Cost \$1,000,000.

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.

New System Reinforcements

Reinforcement: Twitty Creek – Madisonville – Switch 115 kV line: Wreck and rebuild 17.5 miles of Twitty Creek-Madisonville-Switch 115 kV line which is conductor limited. Estimated cost \$35,000,000 and it is estimated to take 30 - 36 months.

Contribution to Previously Identified System Reinforcements

Reinforcement: Clubhouse 230/115 kV Transformer #1: Add a second transformer and three 115 kV breakers. Estimated cost \$5,500,000 and it is estimated to take 24 months to engineer and construct.

Reinforcement: Clubhouse – Sapony 230kV line: Replace wave trap at Clubhouse Substation. This will increase emergency rating 722 MVA. Estimated cost \$150,000 and it is estimated to take 12-16 months.

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.

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.

Network Impacts

The Queue Project AC1-215 was evaluated as a 100.0 MW (Capacity 68.8 MW) injection tapping the Chase City-Central City 115kV line in the ITO area. Project AC1-215 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC1-215 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
3312	CONTINGENCY '3312' /* CHASE CITY OPEN BUS 314267 /*CHASE CITY 115KV BUS 3 OPEN BUS 314669 /*LINE 33 BARNS J OPEN BUS 314684 /*LINE 33 MT LAUREL OPEN BUS 314696 /*LINE 33 HALIFAX OPEN BUS 314518 /*SC312 END
3612	CONTINGENCY '3612' /* CHASE CITY OPEN BUS 314681 /*CHASE CITY 115KV BUS 4 OPEN BUS 314781 /*LINE 36 BLACKBRANCH OPEN BUS 314788 /*LINE 36 JONES STORE OPEN BUS 314683 /*LINE 36 CLARKSVILLE OPEN BUS 314869 /*LINE 36 BURLINGTON END
4012	CONTINGENCY '4012' /* CHASE CITY OPEN BUS 314681 /*CHASE CITY 115KV BUS 4 OPEN BUS 314708 /*LINE 40 NORVIEW OPEN BUS 314721 /*LINE 40 S HILL END
17112	CONTINGENCY '17112' /* CHASE CITY OPEN BUS 314681 /*CHASE CITY 115KV BUS 4 END
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 925780 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 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
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
246T2034_A	CONTINGENCY '246T2034_A' /* EARLEYS OPEN BRANCH FROM BUS 314569 TO BUS 314575 CKT 1 /* 246 OPEN BRANCH FROM BUS 314575 TO BUS 921571 CKT 1 /* 246 AA1-138 TAP OPEN BRANCH FROM BUS 314575 TO BUS 314590 CKT 1 /* 246 - NUCOR OPEN BRANCH FROM BUS 314569 TO BUS 314620 CKT 1 /* 2034 OPEN BRANCH FROM BUS 314620 TO BUS 314616 CKT 1 /* 2034 OPEN BRANCH FROM BUS 314616 TO BUS 314613 CKT 1 /* TROWBRIDGE TX #1&2 END
3CAROLNA-6CAROLNA	CONTINGENCY '3CAROLNA-6CAROLNA' OPEN BRANCH FROM BUS 314559 TO BUS 314561 CKT 1 END
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
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
LN 158-235	CONTINGENCY 'LN 158-235' OPEN BRANCH FROM BUS 314691 TO BUS 314707 CKT 1 /* 3FARMVIL 115.00 - 3MORAN 115.00 OPEN BRANCH FROM BUS 314701 TO BUS 314707 CKT 1 /* 3LONE PN 115.00 - 3MORAN 115.00 OPEN BRANCH FROM BUS 314701 TO BUS 314519 CKT 1 /* 3LONE PN 115.00 - 3CREWE_1 115.0 OPEN BUS 314519 /* ISLAND OPEN BUS 314707 /* ISLAND OPEN BRANCH FROM BUS 313802 TO BUS 314268 CKT 1 /* 6PRINCE EDW 230.00 - 6BRIERY 230.00 OPEN BRANCH FROM BUS 313802 TO BUS 314692 CKT 1 /* 6PRINCE EDW 230.00 - 6FARMVIL 230.00 OPEN BRANCH FROM BUS 314268 TO BUS 314686 CKT 1 /* 6BRIERY 230.00 - 6CLOVER 230.00 OPEN BRANCH FROM BUS 314691 TO BUS 314692 CKT 1 /* 3FARMVIL 115.00 - 6FARMVIL 230.00 OPEN BUS 313802 /* ISLAND OPEN BUS 314268 /* ISLAND END
LN 2012	CONTINGENCY 'LN 2012' OPEN BRANCH FROM BUS 314266 TO BUS 314569 CKT 1 /* 6NORTHAMPTON230.00 - 6EARLEYS 230.00 OPEN BRANCH FROM BUS 314266 TO BUS 314599 CKT 1 /* 6NORTHAMPTON230.00 - 6ROA VAL 230.00 OPEN BUS 314266 /* ISLAND END

Contingency Name	Description
LN 54-2012_B	CONTINGENCY 'LN 54-2012_B' OPEN BRANCH FROM BUS 921751 TO BUS 314581 CKT 1 /* AA2-053 TAP 115.00 - 3JACKSON 115.00 OPEN BRANCH FROM BUS 314568 TO BUS 314625 CKT 1 /* 3EARLEYS 115.00 - 3AULANDR 115.00 OPEN BRANCH FROM BUS 314581 TO BUS 314626 CKT 1 /* 3JACKSON 115.00 - 3WOODLND 115.00 OPEN BRANCH FROM BUS 314625 TO BUS 314626 CKT 1 /* 3AULANDR 115.00 - 3WOODLND 115.00 OPEN BUS 314581 /* ISLAND OPEN BUS 314625 /* ISLAND OPEN BUS 314626 /* ISLAND OPEN BRANCH FROM BUS 314266 TO BUS 314569 CKT 1 /* 6NORTHAMPTON230.00 - 6EARLEYS 230.00 OPEN BRANCH FROM BUS 314266 TO BUS 314599 CKT 1 /* 6NORTHAMPTON230.00 - 6ROA VAL 230.00 OPEN BUS 314266 /* ISLAND END
LN 56-2012_A	CONTINGENCY 'LN 56-2012_A' OPEN BRANCH FROM BUS 314259 TO BUS 314559 CKT Z1 /* 3CAR56_1 115.00 - 3CAROLNA 115.00 OPEN BRANCH FROM BUS 314259 TO BUS 921161 CKT 1 /* 3CAR56_1 115.00 - AA1-063A TAP 115.00 OPEN BRANCH FROM BUS 314558 TO BUS 314587 CKT 1 /* 3BOYKINS 115.00 - 3MARGTSV 115.00 OPEN BRANCH FROM BUS 314587 TO BUS 314604 CKT 1 /* 3MARGTSV 115.00 - 3SEABORD 115.00 OPEN BUS 314259 /* ISLAND OPEN BUS 314587 /* ISLAND OPEN BUS 314604 /* ISLAND OPEN BRANCH FROM BUS 314266 TO BUS 314569 CKT 1 /* 6NORTHAMPTON230.00 - 6EARLEYS 230.00 OPEN BRANCH FROM BUS 314266 TO BUS 314599 CKT 1 /* 6NORTHAMPTON230.00 - 6ROA VAL 230.00 OPEN BUS 314266 /* ISLAND END

Contingency Name	Description
LN 68	CONTINGENCY 'LN 68' OPEN BRANCH FROM BUS 314527 TO BUS 314536 CKT 1 /* 3HOLLAND 115.00 - 3SUFFOLK 115.00 OPEN BRANCH FROM BUS 314527 TO BUS 314539 CKT 1 /* 3HOLLAND 115.00 - 3UNCAMP 115.00 OPEN BUS 314527 /* ISLAND END
LN 98	CONTINGENCY 'LN 98' OPEN BRANCH FROM BUS 314701 TO BUS 314687 CKT 1 /* 3LONEPN 115.00 - 3CREWE 115.00 OPEN BRANCH FROM BUS 314687 TO BUS 314706 CKT 1 /* 3CREWE 115.00 - 3MARTNTP 115.00 OPEN BRANCH FROM BUS 314432 TO BUS 314706 CKT 1 /* 3MATN DP 115.00 - 3MATN TP 115.00 OPEN BRANCH FROM BUS 314706 TO BUS 314725 CKT 1 /* 3MATN TP 115.00 - 3VICT DP 115.00 OPEN BRANCH FROM BUS 314723 TO BUS 314725 CKT 1 /* 3VICTRIA 115.00 - 3VICT DP 115.00 OPEN BRANCH FROM BUS 314427 TO BUS 314723 CKT 1 /* 3GARY TP 115.00 - 3VICTRIA 115.00 OPEN BUS 314723 OPEN BUS 314725 OPEN BUS 314706 OPEN BUS 314432 OPEN BUS 314687 END
T122C	CONTINGENCY 'T122C' /* CAROLINA OPEN BUS 314559 /* CAROLINA 115KV BUS OPEN BUS 315126 /* ROANOKE RAPIDS GEN 1 AND 2 OPEN BUS 315128 /* ROANOKE RAPIDS GEN 3 AND 4 OPEN BRANCH FROM BUS 314559 TO BUS 314561 CKT 1 /* TX. #4 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
T342	CONTINGENCY 'T342' /* CHASE CITY OPEN BUS 314267 /*CHASE CITY 115KV BUS 3 OPEN BUS 314681 /*CHASE CITY 115KV BUS 4 OPEN BUS 314518 /*SC312 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, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)

#	Contingency		Affected Area	Facility Description	Bus			Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To	Cir.		Initial	Final	Type	MVA		
1	LFFB	3312	DVP - DVP	3MADSONV-3S84T154 115 kV line	314715	314434	1	DC	94.38	130.28	LD	86	30.87	1
2	LFFB	3612	DVP - DVP	3MADSONV-3S84T154 115 kV line	314715	314434	1	DC	30.94	115.47	LD	86	100	
3	LFFB	4012	DVP - DVP	3MADSONV-3S84T154 115 kV line	314715	314434	1	DC	30.94	115.47	LD	86	100	
4	LFFB	17112	DVP - DVP	3MADSONV-3S84T154 115 kV line	314715	314434	1	DC	31.02	115.35	LD	86	100	
5	LFFB	T342	DVP - DVP	3MADSONV-3S84T154 115 kV line	314715	314434	1	DC	31.11	115.23	LD	86	100	
6	LFFB	3312	DVP - DVP	3TWITTYS-3MADSONV 115 kV line	314722	314715	1	DC	99.15	135.05	LD	86	30.87	2
7	LFFB	3612	DVP - DVP	3TWITTYS-3MADSONV 115 kV line	314722	314715	1	DC	27.41	120.23	LD	86	100	
8	LFFB	4012	DVP - DVP	3TWITTYS-3MADSONV 115 kV line	314722	314715	1	DC	27.41	120.23	LD	86	100	

#	Contingency		Affected Area	Facility Description	Bus			Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To	Cir.		Initial	Final	Type	MVA		
9	LFFB	17112	DVP - DVP	3TWITTYS-3MADSONV 115 kV line	314722	314715	1	DC	27.58	120	LD	86	100	
10	LFFB	T342	DVP - DVP	3TWITTYS-3MADSONV 115 kV line	314722	314715	1	DC	27.58	120	LD	86	100	
11	DCTL	LN 158-235	DVP - DVP	3TWITTYS-3MADSONV 115 kV line	314722	314715	1	DC	79.94	104.32	LD	86	20.96	

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 Area	Facility Description	Bus			Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To	Cir.		Initial	Final	Type	MVA		
12	LFFB	T122C	DVP - DVP	6CLUBHSE 230/115 kV transformer	314562	314563	1	DC	129.25	136.52	LD	209	15.16	3
13	LFFB	2202_A	DVP - DVP	6CLUBHSE 230/115 kV transformer	314562	314563	1	DC	123.94	130.8	LD	209	14.32	

#	Contingency		Affected Area	Facility Description	Bus			Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To	Cir.		Initial	Final	Type	MVA		
14	LFFB	T132_A	DVP - DVP	6CLUBHSE 230/115 kV transformer	314562	314563	1	DC	122.98	129.85	LD	209	14.32	
15	LFFB	5602_A	DVP - DVP	6CLUBHSE 230/115 kV transformer	314562	314563	1	DC	122.93	129.8	LD	209	14.32	
16	LFFB	5402_A	DVP - DVP	6CLUBHSE 230/115 kV transformer	314562	314563	1	DC	122.79	129.65	LD	209	14.32	
17	LFFB	239T2141	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	DC	123.58	125.45	LD	637	11.92	4
18	LFFB	246T2034_A	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	DC	121.1	122.04	LD	637	13.33	
19	DCTL	LN 54-2012_B	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	DC	117.9	118.85	LD	637	13.52	
20	DCTL	LN 56-2012_A	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	DC	117.3	118.29	LD	637	13.94	

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 - 5	3MADSONV-3S84T154 115 kV line	Wreck and rebuild 17.5 miles of Twitty Creek-Madisonville-Switch 115 kV line which is conductor limited. Estimated time 30 – 36 months	Pending	\$35,000,000
# 6 - 11	3TWITTYS-3MADSONV 115 kV line			
Total New Network Upgrades				\$35,000,000

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)

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
# 12 – 16	6CLUBHSE 230/115 kV transformer	Add a second Clubhouse 230/115kV transformer and three 115kV breakers. Estimated time 14 – 16 months	Pending	\$5,500,000
# 17 - 20	6CLUBHSE-6SAPONY 230 kV line	Replace wave trap at Clubhouse Substation. This will increase emergency rating 722 MVA. Estimated time: 12-16 months.	Pending	\$150,000
Total New Network Upgrades				\$5,650,000

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.

#	Contingency		Affected Area	Facility Description	Bus			Power Flow	Loading %		Rating		MW Contribution
	Type	Name			From	To	Circuit		Initial	Final	Type	MVA	
21	N-1	LN 68	DVP - DVP	6CAROLNA 230/115 kV transformer	314559	314561	1	DC	103.58	105.2	ER	240	8.61
22	N-1	3CAROLN A-6CAROLN A	DVP - DVP	6CLUBHSE 230/115 kV transformer	314562	314563	1	DC	114.95	122.56	ER	183	13.91
23	N-1	LN 2012	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	DC	120.62	121.59	ER	599	12.99
24	N-1	LN 98	DVP - DVP	3MADSONV-3S84T154 115 kV line	314715	314434	1	DC	81.04	113.54	ER	70	22.61
25	N-1	LN 98	DVP - DVP	3TWITTYS-3MADSONV 115 kV line	314722	314715	1	DC	86.93	119.43	ER	70	22.61

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 #AC1-215 interconnection of a 100 MW Energy (68.8 MW Capacity) injection into the ITO's Transmission System at a new interconnection switching station located between the Chase City – Central 115kV substations on a section of Line # 154, 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).

Flowgate Appendices

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 gauge 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 3MADSONV-3S84T154 115 kV line (from bus 314715 to bus 314434 ckt 1) loads from 94.38% to 130.28% (**DC power flow**) of its load dump rating (86 MVA) for the line fault with failed breaker contingency outage of '3312'. This project contributes approximately 30.87 MW to the thermal violation.

CONTINGENCY '3312'

OPEN BUS 314267

OPEN BUS 314669

OPEN BUS 314684

OPEN BUS 314696

OPEN BUS 314518

END

/* CHASE CITY

/*CHASE CITY 115KV BUS 3

/*LINE 33 BARNES J

/*LINE 33 MT LAUREL

/*LINE 33 HALIFAX

/*SC312

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315150	1BUGGS 1	2.2
315151	1BUGGS 2	2.2
315159	1KERR 2	1.2
315164	1KERR 7	1.18
315266	1PLYWOOD A	1.51
922472	AA2-169 C	1.22
922473	AA2-169 E	0.56
923572	AB1-173 C OP	0.68
923573	AB1-173 E OP	0.32
923582	AB1-173AC OP	0.68
923583	AB1-173AE OP	0.32
923911	AB2-031 C OP	0.68
923912	AB2-031 E OP	0.33
923991	AB2-040 C OP	2.22
923992	AB2-040 E OP	1.82
924021	AB2-043 C OP	4.22
924022	AB2-043 E OP	6.93
924301	AB2-077 C OP	2.61
924302	AB2-077 E OP	1.74
924311	AB2-078 C OP	2.61
924312	AB2-078 E OP	1.74
924321	AB2-079 C OP	2.61
924322	AB2-079 E OP	1.74
924401	AB2-089 C	1.42

924402	AB2-089 E	0.73
924411	AB2-090 C	5.32
924412	AB2-090 E	2.73
924931	AB2-147 C	0.92
924932	AB2-147 E	1.5
924951	AB2-150 C OP	0.92
924952	AB2-150 E OP	1.5
925171	AB2-174 C OP	2.21
925172	AB2-174 E OP	2.
925221	AB2-176 C	2.19
925222	AB2-176 E	0.94
925611	AC1-036 C	2.34
925612	AC1-036 E	3.82
925781	AC1-054 C OP	4.47
925782	AC1-054 E OP	2.06
926281	AC1-106	3.51
927211	AC1-215 C	21.24
927212	AC1-215 E	9.63

Appendix 2

(DVP - DVP) The 3TWITTYS-3MADSONV 115 kV line (from bus 314722 to bus 314715 ckt 1) loads from 99.15% to 135.05% (**DC power flow**) of its load dump rating (86 MVA) for the line fault with failed breaker contingency outage of '3312'. This project contributes approximately 30.87 MW to the thermal violation.

CONTINGENCY '3312'

OPEN BUS 314267

OPEN BUS 314669

OPEN BUS 314684

OPEN BUS 314696

OPEN BUS 314518

END

/* CHASE CITY

/*CHASE CITY 115KV BUS 3

/*LINE 33 BARNES J

/*LINE 33 MT LAUREL

/*LINE 33 HALIFAX

/*SC312

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315150	1BUGGS 1	2.2
315151	1BUGGS 2	2.2
315159	1KERR 2	1.2
315164	1KERR 7	1.18
315266	1PLYWOOD A	1.51
922472	AA2-169 C	1.22
922473	AA2-169 E	0.56
923572	AB1-173 C OP	0.68
923573	AB1-173 E OP	0.32
923582	AB1-173AC OP	0.68
923583	AB1-173AE OP	0.32
923911	AB2-031 C OP	0.68
923912	AB2-031 E OP	0.33
923991	AB2-040 C OP	2.22
923992	AB2-040 E OP	1.82
924021	AB2-043 C OP	4.22
924022	AB2-043 E OP	6.93
924301	AB2-077 C OP	2.61
924302	AB2-077 E OP	1.74
924311	AB2-078 C OP	2.61
924312	AB2-078 E OP	1.74
924321	AB2-079 C OP	2.61
924322	AB2-079 E OP	1.74
924401	AB2-089 C	1.42

924402	AB2-089 E	0.73
924411	AB2-090 C	5.32
924412	AB2-090 E	2.73
924931	AB2-147 C	0.92
924932	AB2-147 E	1.5
924951	AB2-150 C OP	0.92
924952	AB2-150 E OP	1.5
925171	AB2-174 C OP	2.21
925172	AB2-174 E OP	2.
925221	AB2-176 C	2.19
925222	AB2-176 E	0.94
925611	AC1-036 C	2.34
925612	AC1-036 E	3.82
925781	AC1-054 C OP	4.47
925782	AC1-054 E OP	2.06
926281	AC1-106	3.51
927211	AC1-215 C	21.24
927212	AC1-215 E	9.63

924402	AB2-089 E	0.83
924411	AB2-090 C	3.96
924412	AB2-090 E	2.03
924931	AB2-147 C	11.82
924932	AB2-147 E	19.28
924951	AB2-150 C OP	11.82
924952	AB2-150 E OP	19.28
925171	AB2-174 C OP	33.34
925172	AB2-174 E OP	30.17
925221	AB2-176 C	1.63
925222	AB2-176 E	0.7
925611	AC1-036 C	0.76
925612	AC1-036 E	1.24
925781	AC1-054 C OP	5.44
925782	AC1-054 E OP	2.51
926281	AC1-106	2.61
927211	AC1-215 C	10.43
927212	AC1-215 E	4.73

Appendix 4

(DVP - DVP) The 6CLUBHSE-6SAPONY 230 kV line (from bus 314563 to bus 314435 ckt 1) loads from 123.58% to 125.45% (**DC power flow**) of its load dump rating (637 MVA) for the line fault with failed breaker contingency outage of '239T2141'. This project contributes approximately 11.92 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

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315139	1GASTONA	16.32
315141	1GASTONB	16.32
315159	1KERR 2	1.15
315164	1KERR 7	1.13
315126	1ROARAP2	1.53
315128	1ROARAP4	1.47
314704	3LAWRENC	0.96
921162	AA1-063AC	6.84
921163	AA1-063AE	3.22
921752	AA2-053 C	7.37
921753	AA2-053 E	3.16
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	5.05
923912	AB2-031 E OP	2.49
923991	AB2-040 C OP	16.59
923992	AB2-040 E OP	13.57
924021	AB2-043 C OP	2.48

924022	AB2-043 E OP	4.07
924301	AB2-077 C OP	1.53
924302	AB2-077 E OP	1.02
924311	AB2-078 C OP	1.53
924312	AB2-078 E OP	1.02
924321	AB2-079 C OP	1.53
924322	AB2-079 E OP	1.02
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	8.12
924932	AB2-147 E	13.25
924951	AB2-150 C OP	8.12
924952	AB2-150 E OP	13.25
925171	AB2-174 C OP	18.36
925172	AB2-174 E OP	16.61
925221	AB2-176 C	1.29
925222	AB2-176 E	0.55
925781	AC1-054 C OP	5.63
925782	AC1-054 E OP	2.59
926071	AC1-086 C	97.13
926072	AC1-086 E	44.21
926281	AC1-106	2.06
927111	AC1-206 C OP	53.31
927112	AC1-206 E OP	25.2
927211	AC1-215 C	8.2
927212	AC1-215 E	3.72