Generation Interconnection
System Impact Study Report

For

PJM Generation Interconnection Request
Queue Position AC1-164

Chickahominy 230kV
220.8 MW Capacity / 320 MW Energy

December / 2017

Revised December / 2019

Introduction

This System Impact Study (SIS) has been prepared in accordance with the PJM Open Access Transmission Tariff, Section 205, as well as the System Impact Study Agreement between sPower Development Company, LLC, 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 System Impact Study is to determine a plan, with approximate cost and construction time estimates, to connect the subject generation interconnection project to the PJM network at a location specified by the IC. As a requirement for interconnection, the IC may be responsible for the cost of constructing Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system. All facilities required for interconnection of a generation interconnection project must be designed to meet the technical specifications (on PJM web site) for the appropriate transmission owner.

In some instances an IC may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection or merchant transmission upgrade, 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 System Impact Study is performed.

The System Impact 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 Transmission Owners, the costs may be included in the study.

General

The IC has proposed a solar generating facility located in Charles City County, VA. The installed facilities will have a total capability of 320 MW with 220.8 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is 10/01/2019. **This study does not imply an ITO commitment to this in-service date.**

Point of Interconnection

AC1-164 will interconnect with the ITO transmission system via a new breaker bay into the Chickahominy 230kV substation.

© PJM Interconnection 2019. All rights reserved.

Cost Summary

The AC1-164 interconnection request will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 7,200,000
Direct Connection Network Upgrades	$ 0
Non Direct Connection Network Upgrades	$ 2,700,000
Allocation for New System Upgrades	$ 58,351
Contribution for Previously Identified Upgrades	$ 109,022
Total Costs	**$ 10,067,373**

© PJM Interconnection 2019. All rights reserved.

Attachment Facilities

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

Transmission: Build approximately 3.0 miles of 230 kV Line. Estimated Cost $6,600,000

The estimated total cost of the Attachment Facilities is $7,200,000. It is estimated to take 30-32 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.

Non-Direct Connection Cost Estimate

Chickahominy 230kV:

- Substation: Add one 230 kV breaker to use the open bay in a breaker and a half bus arrangement. Estimated Cost $1,200,000.
- Transmission: Re-arrange existing lines to accommodate new 230 kV Line. Estimated Cost $1,500,000.

The estimated total cost of the interconnection is $2,700,000. It is estimated to take 14-20 months to complete this work. These preliminary cost estimates are based on typical engineering costs. A more detailed engineering cost estimates are normally done during the Facility Study phase.

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

PJM OATT 217.3 outlines cost responsibility for Network Upgrades and as the minimum amount of Network Upgrades required to resolve a single reliability criteria violation will not meet or exceed $5,000,000 such costs shall be allocated to those Interconnection Requests in the New Services Queue that contribute to the need for such upgrades. Such allocations shall be made in proportion to each Interconnection Request's megawatt contribution to the need for these upgrades subject to the rules for minimum cost allocation thresholds in the PJM Manuals. For the purpose of applying the $5,000,000 threshold, each reliability criteria violation shall be considered separately.

© PJM Interconnection 2019. All rights reserved.

Violation #	Ruling Violation #	Loading	Upgrade Description	Upgrade Cost	Allocated Cost
# 1	1	From 97.94% to 100.27%	Replace wave trap at Chickahominy Substation. This will increase emergency rating to 3424 MVA (normal and emergency) and 3937 MVA load dump. Estimated to take 14-16 months	$500,000	**$31,194**
# 3	3	From 99.66% to 100.51%	Wreck and rebuild a 2 mile segment of the Loudon – Morrisville 500kV line #569. This will increase normal and emergency rating to 3424 MVA. Estimated to take 36-48 months to engineer, permit and construct a VA CPCN is required. Baseline upgrade b3211. Target in-service date: 12/31/24	$6,000,000	**$0**
# 4	4	From 97.83% to 99.98%	Replace wave trap at North Anna Substation for Midlothian – North Anna 500 kV line #576. This will increase emergency rating by 31% to 3424 MVA. Estimated to 12-16 months to engineer and construct. Ratings after the upgrade: 3424/3424/3938 Time: 12-16 Months	$250,000	**$27,157**
# 5	5	From 110.28% to 112.9%	Replace the 2000A wave trap at Four Rivers and the 230kV line switches at St. Johns Substation for the 256 line. The facility is to be upgraded to a new emergency rating of 1195 MVA. Project was put into service in 2017	$150,000	**$0**
# 6, 7	6	From 106.14% to 107.91%	Replace a wave trap on the Bristers – Chance 500kV line Ratings after the upgrade: 2914/2914/3351 Time: 12-16 Months	$300,000	**$0**
# 2, 8, 9, 10, 11	8	From 126.84% to 129.95%	Replacing wavetrap will increase the line's rating up to 2913 MVA (normal), 2913 MVA (emergency), and 3351 MVA (load dump). Time: 12-16 Months	$700,000	**$66,764**
# 12	12	From 101.25% to 102.79%	Replace wave trap at both Ladysmith and Possum Point Substations for the Ladysmith – Possum Pt 500kV line #552. Ratings after the upgrade: 2598/2857/3637. Time: 14-16 Months	$500,000	**$42,258**
			Total Estimate Allocated Cost of Network Upgrades		**$167,373**

© PJM Interconnection 2019. All rights reserved.

Interconnection Customer Requirements

ITO's Facility Interconnection 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.

Meteorological Data Reporting Requirement - The solar generation facility shall, at a minimum, be required to provide the Transmission Provider with site-specific meteorological data including:

- Temperature (degrees Fahrenheit)
- Atmospheric pressure (hectopascals)
- Irradiance
- Forced outage data

Revenue Metering and SCADA Requirements

PJM Requirements

The Interconnection Customer 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.

© PJM Interconnection 2019. All rights reserved.

Interconnected Transmission Owner Requirements

Metering and SCADA/Communication equipment must meet the requirements outlined in section 3.1.6 Metering and Telecommunications of ITO's Facility Connection Requirement NERC Standard FAC-001 which is publically available at www.dom.com.

© PJM Interconnection 2019. All rights reserved.

Network Impacts

The Queue Project AC1-164 was evaluated as a 320.0 MW (Capacity 220.8 MW) injection at the Chickahominy 230kV substation in the ITO area. Project AC1-164 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC1-164 was studied with a commercial probability of 100%. Potential network impacts were as follows:

Contingency Descriptions

The following contingencies resulted in overloads:

Contingency Name	Description
57602	CONTINGENCY '57602' /*NORTH ANNA OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /*MIDLOTHIAN TO NORTH ANNA (LINE 576) OPEN BRANCH FROM BUS 314914 TO BUS 314322 CKT 1 /*MIDLOTHIAN 500-230 (TX#2) OPEN BRANCH FROM BUS 314918 TO BUS 314232 CKT 1 /*NORTH ANNA 500-230 (TX#5) END
557T574	CONTINGENCY '557T574' /* ELMONT OPEN BRANCH FROM BUS 314908 TO BUS 314903 CKT 1 /*ELMONT TO CHICKAHOMINY (LINE 557) OPEN BRANCH FROM BUS 314903 TO BUS 314214 CKT 1 /*CHICKAHOMINY 500-230 (TX#1) OPEN BRANCH FROM BUS 314911 TO BUS 314908 CKT 1 /*ELMONT TO LADYSMITH (LINE 574) END

© PJM Interconnection 2019. All rights reserved.

563T576	CONTINGENCY '563T576' /*MIDLOTHIAN OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /*MIDLOTHIAN TO NORTH ANNA (LINE 576) OPEN BRANCH FROM BUS 314914 TO BUS 314322 CKT 1 /*MIDLOTHIAN 500-230 (TX#2) OPEN BRANCH FROM BUS 314914 TO BUS 314902 CKT 1 /*MIDLOTHIAN TO CARSON (LINE 563) END	
LN 539	CONTINGENCY 'LN 539' OPEN BRANCH FROM BUS 314900 TO BUS 314919 CKT 1 /* 8BRISTER 500.00 - 8OX 500.00 END	
LN 552	CONTINGENCY 'LN 552' OPEN BRANCH FROM BUS 314135 TO BUS 314905 CKT 1 /* 3CHANCE 115.00 - 8CHANCE 500.00 OPEN BRANCH FROM BUS 314900 TO BUS 314905 CKT 1 /* 8BRISTER 500.00 - 8CHANCE 500.00 END	
LN 563	CONTINGENCY 'LN 563' OPEN BRANCH FROM BUS 314902 TO BUS 314914 CKT 1 /* 8CARSON 500.00 - 8MDLTHAN 500.00 END	
LN 573	CONTINGENCY 'LN 573' OPEN BRANCH FROM BUS 314918 TO BUS 314934 CKT 1 /* 8NO ANNA 500.00 - 8SPOTSYL 500.00 END	
LN 574	CONTINGENCY 'LN 574' OPEN BRANCH FROM BUS 314908 TO BUS 314911 CKT 1 /* 8ELMONT 500.00 - 8LDYSMTH 500.00 END	

© PJM Interconnection 2019. All rights reserved.

LN 576	CONTINGENCY 'LN 576' OPEN BRANCH FROM BUS 314322 TO BUS 314914 CKT 1 /* 6MDLTHAN 230.00 - 8MDLTHAN 500.00 OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /* 8MDLTHAN 500.00 - 8NO ANNA 500.00 END
LN 594	CONTINGENCY 'LN 594' OPEN BRANCH FROM BUS 314916 TO BUS 314934 CKT 1 /* 8MORRSVL 500.00 - 8SPOTSYL 500.00 END
WT576	CONTINGENCY 'WT576' /*NORTH ANNA OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /*MIDLOTHIAN TO NORTH ANNA (LINE 576) OPEN BRANCH FROM BUS 314914 TO BUS 314322 CKT 1 /*MIDLOTHIAN 500-230 (TX#2) OPEN BRANCH FROM BUS 314918 TO BUS 314232 CKT 2 /*NORTH ANNA 500-230 (TX#6) END
LN 581	CONTINGENCY 'LN 581' OPEN BRANCH FROM BUS 314135 TO BUS 314905 CKT 2 /* 3CHANCE 115.00 - 8CHANCE 500.00 OPEN BRANCH FROM BUS 314905 TO BUS 314911 CKT 1 /* 8CHANCE 500.00 - 8LDYSMTH 500.00 END

© PJM Interconnection 2019. All rights reserved.

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	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution	Ref
1	N-1	LN 576	DVP - DVP	8CHCKAHM-8ELMONT 500 kV line	314903	314908	1	AC	97.94	100.27	ER	2442	68.05	1
2	N-1	LN 581	DVP - DVP	8LDYSMTH-8POSSUM 500 kV line	314911	314922	1	AC	99.12	100.73	ER	2442	39.19	
3	N-1	LN 539	DVP - DVP	8MORRSVL-8LOUDOUN 500 kV line	314916	314913	1	AC	99.66	100.51	ER	2738	26.2	3

Multiple Facility Contingency

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

#	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
4	LFFB	557T574	DVP-DVP	8MDLTHAN-8NO ANNA 500 kV line	314914	314918	1	AC	97.83	99.98	LD	3144	77.54	4

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

None

© PJM Interconnection 2019. All rights reserved.

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
5	N-1	LN 574	DVP - DVP	6FRRIVER-6STJOHN 230 kV line	314212	314150	1	AC	110.28	112.9	ER	749	23.04	5
6	N-1	LN 594	DVP - DVP	8CHANCE-8BRISTER 500 kV line	314905	314900	1	AC	106.14	107.91	ER	2442	43.26	6
7	N-1	LN 573	DVP - DVP	8CHANCE-8BRISTER 500 kV line	314905	314900	1	AC	101.28	103.0	ER	2442	42.47	
8	N-1	LN 576	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	AC	126.84	129.95	ER	2442	75.3	7
9	N-1	LN 563	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	AC	114.17	116.8	ER	2442	64.01	
10	LFFB	57602	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	AC	103.95	107.22	LD	3351	109.04	
11	LFFB	563T576	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	AC	103.86	107.14	LD	3351	109.1	
12	LFFB	WT576	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	AC	103.95	107.22	LD	3351	109.04	
13	N-1	LN 594	DVP - DVP	8LDYSMTH-8POSSUM 500 kV line	314911	314922	1	AC	101.25	102.79	ER	2442	37.23	8

© PJM Interconnection 2019. All rights reserved.

Steady-State Voltage Requirements

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

None

Stability and Reactive Power Requirement for Low Voltage Ride Through

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

No deficiency found or mitigation required.

New System Reinforcements

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

<table>
<tr><th>Violation #</th><th>Overloaded Facility</th><th>Upgrade Description</th><th>Network Upgrade Number</th><th>Upgrade Cost</th><th>AC1-164 Allocation</th></tr>
<tr><td># 1</td><td>8CHCKAHM-8ELMONT 500 kV</td><td>Replace wave trap at Chickahominy Substation. This will increase emergency rating to 3424 MVA (normal and emergency) and 3937 MVA load dump.
Time: 14-16 months

<table>
<tr><th>Queue</th><th>Impact (MW)</th><th>Cost</th></tr>
<tr><td>Queue</td><td>MW contribution</td><td>Cost $500,000</td></tr>
<tr><td>AC1-086</td><td>27.98</td><td>$12,829.90</td></tr>
<tr><td>AC1-107</td><td>934.51</td><td>$428,509.33</td></tr>
<tr><td>AC1-161</td><td>59.9</td><td>$27,466.43</td></tr>
<tr><td>AC1-164</td><td>68.03</td><td>$31,194.34</td></tr>
</table>
</td><td>n5464</td><td>$500,000</td><td>$31,194</td></tr>
</table>

© PJM Interconnection 2019. All rights reserved.

<table>
<tr><th>Violation #</th><th>Overloaded Facility</th><th>Upgrade Description</th><th>Network Upgrade Number</th><th>Upgrade Cost</th><th>AC1-164 Allocation</th></tr>
<tr><td># 3</td><td>8MORRSVL-8LOUDOUN 500 kV</td><td>Wreck and rebuild a 2 mile segment of the Loudon – Morrisville 500kV line #569. This will increase normal and emergency rating to 3424 MVA. Estimated to take 36-48 months to engineer, permit and construct a VA CPCN is required.

Target in-service date: 12/31/24

Queue Project AC1-164 presently does not receive cost allocation for the Network Upgrade.

Although Queue Project AC1-164 may not have cost responsibility for this upgrade, Queue Project AC1-164 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AC1-164 comes into service prior to completion of the upgrade, an interim study will be required.</td><td>b3211</td><td>$6,000,000</td><td>$0</td></tr>
<tr><td># 4</td><td>8MDLTHAN-8NO ANNA 500 kV</td><td>Replace wave trap at North Anna Substation for Midlothian – North Anna 500 kV line #576. This will increase emergency rating by 31% to 3424 MVA. Estimated to 12-16 months to engineer and construct.
Ratings after the upgrade: 3424/3424/3938
Time: 12-16 Months

<table>
<tr><th>Queue</th><th>MW Contribution</th><th>Cost $250,000</th></tr>
<tr><td>AC1-086</td><td>33.04</td><td>$11,571.54</td></tr>
<tr><td>AC1-107</td><td>505.6</td><td>$177,075.45</td></tr>
<tr><td>AC1-161</td><td>77.47</td><td>$27,132.19</td></tr>
<tr><td>AC1-164</td><td>77.54</td><td>$27,156.71</td></tr>
<tr><td>AC1-189</td><td>20.17</td><td>$7,064.11</td></tr>
</table>
</td><td>n6055</td><td>$250,000</td><td>$27,157</td></tr>
<tr><td colspan="5">Total New Network Upgrades</td><td>$58,351</td></tr>
</table>

© PJM Interconnection 2019. All rights reserved.

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 is calculated and reported for in the Impact Study)

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost	AC1-164 Allocation
# 5	6FRRIVER-6STJOHN 230 kV line	Replace the 2000A wave trap at Four Rivers and the 230kV line switches at St. Johns Substation for line #256. The facility is to be upgraded to a new emergency rating of 1195 MVA. Project was put into service in 2017	n4692	$150,000	**$0**
# 6, 7	8CHANCE-8BRISTER 500 kV line	Replace a wave trap on the Bristers – Chancellor 500kV line which is part of the baseline Network Upgrade b3019 to rebuild a 22 mile segment of the Bristers - Chancellor 500kV line #552. Ratings after the upgrade: 2914/2914/3351 Time: 12-16 months Queue Project AC1-164 presently does not receive cost allocation for the Network Upgrade. Although Queue Project AC1-164 may not have cost responsibility for this upgrade, Queue Project AC1-164 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AC1-164 comes into service prior to completion of the upgrade, an interim study will be required.	n6217 / b3019	$300,000	**$0**

© PJM Interconnection 2019. All rights reserved.

<table>
<tr><th>Violation #</th><th>Overloaded Facility</th><th>Upgrade Description</th><th>Network Upgrade Number</th><th>Upgrade Cost</th><th>AC1-164 Allocation</th></tr>
<tr><td># 2, 8, 9, 10, 11</td><td>8ELMONT-8LDYSMTH 500 kV line</td><td>Replace the wavetraps on the Elmont – Ladysmith line #574 will increase the line's rating up to 2913 MVA (normal), 2913 MVA (emergency), and 3351 MVA (load dump).
Time: 12-16 months

<table><tr><th>Queue</th><th>MW Contribution</th><th>Cost $700,000</th></tr><tr><td>AC1-086</td><td>32.32</td><td>$28,667.73</td></tr><tr><td>AC1-107</td><td>627.76</td><td>$556,821.00</td></tr><tr><td>AC1-161</td><td>53.83</td><td>$47,747.03</td></tr><tr><td>AC1-164</td><td>75.27</td><td>$66,764.24</td></tr></table></td><td>n5483</td><td>$700,000</td><td>$66,764</td></tr>
<tr><td># 12</td><td>8LDYSMTH-8POSSUM 500 kV line</td><td>Replace wave trap at both Ladysmith and Possum Point Substations for the Ladysmith – Possum Pt 500kV line #552.

Ratings after the upgrade: 2598/2857/3637
Time: 14-16 months

<table><tr><th>Queue</th><th>MW contribution</th><th>Cost $500,000</th></tr><tr><td>AC1-107</td><td>301.14</td><td>$341,900.06</td></tr><tr><td>AC1-158</td><td>74.26</td><td>$84,312.40</td></tr><tr><td>AC1-161</td><td>27.77</td><td>$31,529.16</td></tr><tr><td>AC1-164</td><td>37.22</td><td>$42,258.38</td></tr></table></td><td>n6063</td><td>$500,000</td><td>$42,258</td></tr>
<tr><td colspan="5">Total New Network Upgrades</td><td>$109,022</td></tr>
</table>

© PJM Interconnection 2019. All rights reserved.

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 interconnection request by addressing 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
13	N-1	LN 574	DVP - DVP	6FRRIVER-6STJOHN 230 kV line	314212	314150	1	AC	109.91	113.7	ER	749	33.38
14	N-1	LN 576	DVP - DVP	8CHCKAHM-8ELMONT 500 kV line	314903	314908	1	AC	115.83	119.22	ER	2442	98.63
15	N-1	LN 594	DVP - DVP	8CHANCE-8BRISTER 500 kV line	314905	314900	1	AC	118.55	120.77	ER	2442	62.69
16	N-1	LN 576	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	AC	142.52	147.02	ER	2442	109.1
17	Non	Non	DVP - DVP	8ELMONT-8LDYSMTH 500 kV line	314908	314911	1	AC	101.93	105.43	NR	2442	86.24
18	N-1	LN 573	DVP - DVP	8LDYSMTH-8CHANCE 500 kV line	314911	314905	1	AC	106.03	108.04	ER	2738	63.77
19	N-1	LN 594	DVP - DVP	8LDYSMTH-8POSSUM 500 kV line	314911	314922	1	AC	110.2	112.11	ER	2442	53.96
20	N-1	LN 574	DVP - DVP	8MDLTHAN-8NO ANNA 500 kV line	314914	314918	1	AC	107.25	109.84	ER	2442	74.32
21	N-1	LN 539	DVP - DVP	8MORRSVL-8LOUDOUN 500 kV line	314916	314913	1	AC	100.62	101.8	ER	2738	37.97

© PJM Interconnection 2019. All rights reserved.

#	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
22	N-1	LN 552	DVP - DVP	8SPOTSYL-8MORRSVL 500 kV line	314934	314916	1	AC	100.4	102.08	ER	3219	64.22

Light Load Analysis in 2020

Not required

ITO Analysis

ITO assessed the impact of the proposed Queue Project #AC1-164 interconnection of 320 MW of energy (Capacity 220.8 MW) for compliance with 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 and multiple facility 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 interconnection request 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 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 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):

- System Normal – No deficiencies identified
- Critical System Condition (No Surry 230 kV Unit) OR (Possum Point Unit #6 (230kV Unit) – No deficiencies identified.

© PJM Interconnection 2019. All rights reserved.

Category C Analysis: (Multiple Facility Contingency)

- Bus Fault - No deficiencies identified
- Line Stuck Breaker - No deficiencies identified
- Tower Line – No deficiencies identified

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

Table A: Import Study Results

Import Study Results			
Area	Summer 2020	Summer 2020 with AC1-164	Limiting Element
AEP	2000+	2000+	None
APS	2000+	2000+	None
CPL	2000+	2000+	None
PJM	2000+	2000+	None

Table B: Export Study Results

Export Study Results			
Area	Summer 2020	Summer 2020 with AC1-164	Limiting Element
AEP	2000+	2000+	None

© PJM Interconnection 2019. All rights reserved.

APS	2000+	2000+	None
CPL	2000+	2000+	None
PJM	2000+	2000+	None

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 AC1-164 (Transfer) will not impact ITO's import or export capability

Affected System Analysis & Mitigation

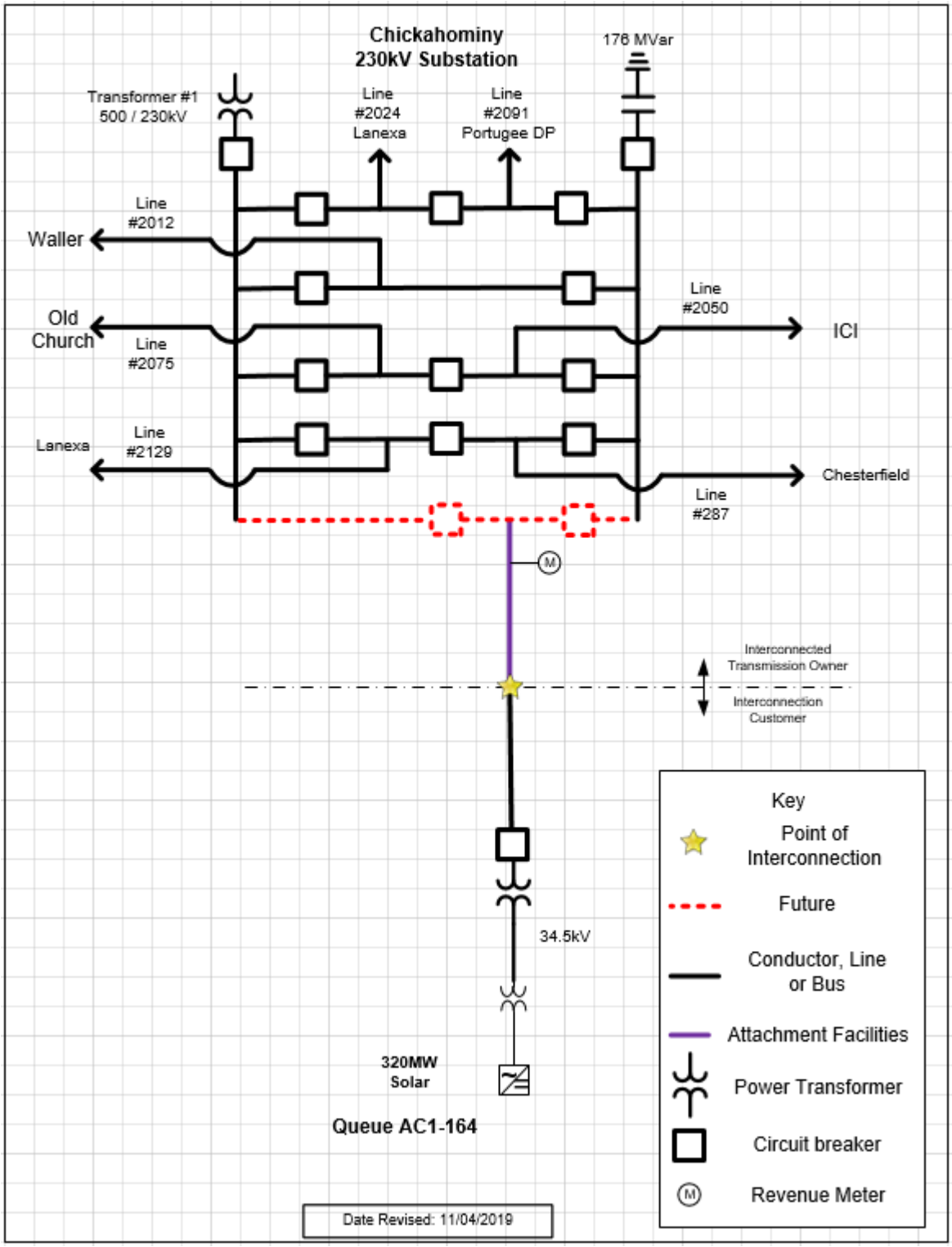
Duke Energy:

None

© PJM Interconnection 2019. All rights reserved.

Attachment 1.

System Configuration



© PJM Interconnection 2019. All rights reserved.

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.

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.

© PJM Interconnection 2019. All rights reserved.

Appendix 1

(DVP - DVP) The 8CHCKAHM-8ELMONT 500 kV line (from bus 314903 to bus 314908 ckt 1) loads from 97.94% to 100.27% (AC power flow) of its emergency rating (2442 MVA) for the single line contingency outage of 'LN 576'. This project contributes approximately 68.05 MW to the thermal violation.

CONTINGENCY 'LN 576'
OPEN BRANCH FROM BUS 314322 TO BUS 314914 CKT 1 /* 6MDLTHAN 230.00 - 8MDLTHAN 500.00
OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /* 8MDLTHAN 500.00 - 8NO ANNA 500.00
END

Bus Number	*Bus Name*	*Full Contribution*
315099	*1CHESPKB*	*2.2*
315108	*1ELIZAR1*	*6.46*
315109	*1ELIZAR2*	*6.35*
315110	*1ELIZAR3*	*6.54*
315233	*1SURRY 2*	*58.85*
315091	*1YORKTN2*	*55.82*
315092	*1YORKTN3*	*47.96*
314421	*6WINCHST*	*0.27*
315074	*CIR_AB2-152*	*12.6*
916191	*Z1-068 C*	*0.09*
921162	*AA1-063AC*	*11.34*
921752	*AA2-053 C*	*11.82*
921762	*AA2-057 C*	*9.27*
921982	*AA2-088 C*	*8.67*
922442	*AA2-165 C*	*1.26*
922512	*AA2-174 C*	*0.54*
922532	*AA2-178 C*	*15.74*

© PJM Interconnection 2019. All rights reserved.

922682	*AB1-027 C*	*2.42*
922922	*AB1-081 C OP*	*11.29*
923262	*AB1-132 C OP*	*19.*
923572	*AB1-173 C OP*	*2.96*
923582	*AB1-173AC OP*	*2.96*
923801	*AB2-015 C OP*	*15.64*
923831	*AB2-022 C*	*4.11*
923841	*AB2-024 C*	*4.1*
923851	*AB2-025 C*	*3.24*
923911	*AB2-031 C OP*	*2.94*
923991	*AB2-040 C OP*	*9.66*
924021	*AB2-043 C OP*	*3.28*
924151	*AB2-059 C*	*13.3*
924161	*AB2-060 C*	*9.39*
924241	*AB2-068 OP*	*619.11*
924321	*AB2-079 C OP*	*6.25*
924491	*AB2-098 C*	*0.78*
924501	*AB2-099 C*	*0.85*
924511	*AB2-100 C*	*15.34*
924811	*AB2-134 C OP*	*19.08*
925051	*AB2-160 C OP*	*6.37*
925061	*AB2-161 C OP*	*5.24*
925171	*AB2-174 C O1*	*9.22*
925281	*AB2-186 C*	*1.02*
925331	*AB2-190 C*	*30.32*
926261	*AC1-027 C*	*3.68*

© PJM Interconnection 2019. All rights reserved.

926331	*AC1-034 C*	*8.62*
926531	*AC1-054 C OP*	*8.51*
926591	*AC1-060*	*0.1*
926601	*AC1-061*	*0.04*
926621	*AC1-063*	*0.62*
926641	*AC1-065 C*	*5.37*
926851	*AC1-086 C*	*27.98*
926981	*AC1-099 C*	*11.11*
927041	*AC1-105 C OP*	*5.85*
927061	*AC1-107 OP*	*934.51*
927181	*AC1-112 C*	*1.89*
927561	*AC1-147 C*	*4.14*
927711	*AC1-161 C OP*	*59.82*
927741	*AC1-164 C OP*	*68.05*
927991	*AC1-189 C*	*11.76*
928191	*AC1-208 C O1*	*11.97*
928271	*AC1-216 C OP*	*14.56*

© PJM Interconnection 2019. All rights reserved.

Appendix 3

(DVP - DVP) The 8MORRSVL-8LOUDOUN 500 kV line (from bus 314916 to bus 314913 ckt 1) loads from 99.66% to 100.51% (AC power flow) of its emergency rating (2738 MVA) for the single line contingency outage of 'LN 539'. This project contributes approximately 26.2 MW to the thermal violation.

CONTINGENCY 'LN 539'
OPEN BRANCH FROM BUS 314900 TO BUS 314919 CKT 1 /* 8BRISTER 500.00 - 8OX 500.00
END

Bus Number	*Bus Name*	*Full Contribution*
315053	*1BELMED1*	*2.07*
315054	*1BELMED2*	*2.07*
315055	*1BELMED3*	*1.72*
315172	*1LOISA A*	*2.37*
315173	*1LOISA B*	*2.38*
315174	*1LOISA C*	*2.38*
315175	*1LOISA D*	*2.38*
315176	*1LOISA E*	*4.85*
315028	*1M RUN A*	*6.49*
315029	*1M RUN B*	*6.43*
315030	*1M RUN C*	*6.49*
315225	*1N ANNA1*	*33.31*
315226	*1N ANNA2*	*32.79*
315021	*1REMNGT1*	*5.94*
315022	*1REMNGT2*	*5.82*
315023	*1REMNGT3*	*5.85*
315024	*1REMNGT4*	*5.91*
315177	*1SANNAG1*	*1.25*

© PJM Interconnection 2019. All rights reserved.

315179	*1SANNAG2*	*1.25*
315178	*1SANNAS1*	*0.64*
315180	*1SANNAS2*	*0.64*
315083	*1SPRUNCA*	*1.28*
315084	*1SPRUNCB*	*1.28*
315085	*1SPRUNCC*	*0.95*
315086	*1SPRUNCD*	*0.95*
315233	*1SURRY 2*	*18.62*
315091	*1YORKTN2*	*19.67*
314251	*6S PUMP*	*0.65*
314093	*6WARRNTN*	*0.08*
315074	*CIR_AB2-152*	*6.48*
922682	*AB1-027 C*	*1.67*
923801	*AB2-015 C OP*	*5.95*
923831	*AB2-022 C*	*1.53*
923861	*AB2-026 C*	*1.67*
923891	*AB2-029 C*	*1.65*
924241	*AB2-068 OP*	*128.66*
924811	*AB2-134 C OP*	*8.6*
925021	*AB2-158 C*	*10.76*
925051	*AB2-160 C OP*	*3.64*
925061	*AB2-161 C OP*	*2.27*
925331	*AB2-190 C*	*13.42*
926261	*AC1-027 C*	*1.34*
926421	*AC1-043 C*	*7.87*
926601	*AC1-061*	*0.02*

© PJM Interconnection 2019. All rights reserved.

926751	*AC1-076 C*	*4.97*
927061	*AC1-107 OP*	*194.21*
927181	*AC1-112 C*	*1.3*
927281	*AC1-121 C OP*	*10.89*
927521	*AC1-143 C OP*	*8.72*
927561	*AC1-147 C*	*1.51*
927681	*AC1-158 C*	*81.75*
927711	*AC1-161 C OP*	*20.4*
927741	*AC1-164 C OP*	*26.2*
928271	*AC1-216 C OP*	*6.57*

© PJM Interconnection 2019. All rights reserved.

Appendix 4

(DVP - DVP) The 8MDLTHAN-8NO ANNA 500 kV line (from bus 314914 to bus 314918 ckt 1) loads from 97.83% to 99.98% (AC power flow) of its load dump rating (3144 MVA) for the line fault with failed breaker contingency outage of '557T574'. This project contributes approximately 77.54 MW to the thermal violation.

CONTINGENCY '557T574' /* ELMONT
OPEN BRANCH FROM BUS 314908 TO BUS 314903 CKT 1 /*ELMONT TO CHICKAHOMINY (LINE 557)
OPEN BRANCH FROM BUS 314903 TO BUS 314214 CKT 1 /*CHICKAHOMINY 500-230 (TX#1)
OPEN BRANCH FROM BUS 314911 TO BUS 314908 CKT 1 /*ELMONT TO LADYSMITH (LINE 574)
END

Bus Number	*Bus Name*	*Full Contribution*
315102	*1BRUNSWICKG1*	*15.79*
315103	*1BRUNSWICKG2*	*15.79*
315104	*1BRUNSWICKG3*	*15.79*
315105	*1BRUNSWICKS1*	*32.81*
315108	*1ELIZAR1*	*6.15*
315109	*1ELIZAR2*	*6.04*
315110	*1ELIZAR3*	*6.22*
315073	*1STONECA*	*10.31*
315233	*1SURRY 2*	*48.71*
314784	*1WEYRHSB*	*3.45*
315091	*1YORKTN2*	*48.04*
314539	*3UNCAMP*	*4.3*
314541	*3WATKINS*	*1.23*
314189	*6PAPERMILL*	*8.87*
315074	*CIR_AB2-152*	*14.5*

© PJM Interconnection 2019. All rights reserved.

292791	*U1-032 E*	*5.37*
900672	*V4-068 E*	*0.47*
901082	*W1-029E*	*79.25*
907092	*X1-038 E*	*10.75*
913392	*Y1-086 E*	*3.78*
916042	*Z1-036 E*	*77.7*
916191	*Z1-068 C*	*0.08*
916192	*Z1-068 E*	*3.29*
916301	*Z1-086 C*	*96.09*
916302	*Z1-086 E*	*16.77*
917122	*Z2-027 E*	*1.83*
917332	*Z2-043 E*	*1.59*
917342	*Z2-044 E*	*0.88*
917512	*Z2-088 E OP1*	*12.41*
921162	*AA1-063AC*	*13.36*
921163	*AA1-063AE*	*6.3*
918512	*AA1-065 E OP*	*7.27*
921183	*AA1-067 E*	*1.14*
918562	*AA1-072 E*	*0.27*
921583	*AA1-139 E*	*11.2*
921752	*AA2-053 C*	*13.81*
921753	*AA2-053 E*	*5.93*
921762	*AA2-057 C*	*10.99*
921763	*AA2-057 E*	*5.5*
921982	*AA2-088 C*	*10.05*
921983	*AA2-088 E*	*16.4*

© PJM Interconnection 2019. All rights reserved.

922442	*AA2-165 C*	*1.5*
922443	*AA2-165 E*	*0.72*
922512	*AA2-174 C*	*0.63*
922513	*AA2-174 E*	*0.69*
922532	*AA2-178 C*	*16.14*
922533	*AA2-178 E*	*6.92*
922682	*AB1-027 C*	*3.05*
922683	*AB1-027 E*	*1.31*
922922	*AB1-081 C OP*	*13.56*
922923	*AB1-081 E OP*	*5.81*
923262	*AB1-132 C OP*	*22.44*
923263	*AB1-132 E OP*	*9.62*
923572	*AB1-173 C OP*	*3.59*
923573	*AB1-173 E OP*	*1.68*
923582	*AB1-173AC OP*	*3.59*
923583	*AB1-173AE OP*	*1.68*
923801	*AB2-015 C OP*	*15.36*
923802	*AB2-015 E OP*	*12.6*
923831	*AB2-022 C*	*3.99*
923832	*AB2-022 E*	*2.15*
923841	*AB2-024 C*	*3.31*
923842	*AB2-024 E*	*1.49*
923851	*AB2-025 C*	*4.06*
923852	*AB2-025 E*	*1.82*
923861	*AB2-026 C*	*3.72*
923862	*AB2-026 E*	*1.67*

© PJM Interconnection 2019. All rights reserved.

923911	*AB2-031 C OP*	*3.57*
923912	*AB2-031 E OP*	*1.76*
923991	*AB2-040 C OP*	*11.71*
923992	*AB2-040 E OP*	*9.58*
924021	*AB2-043 C OP*	*4.44*
924022	*AB2-043 E OP*	*7.28*
924151	*AB2-059 C*	*15.98*
924152	*AB2-059 E*	*8.23*
924161	*AB2-060 C*	*12.75*
924162	*AB2-060 E*	*6.*
924241	*AB2-068 OP*	*334.96*
924321	*AB2-079 C OP*	*8.45*
924322	*AB2-079 E OP*	*5.63*
924491	*AB2-098 C*	*0.89*
924492	*AB2-098 E*	*0.38*
924501	*AB2-099 C*	*0.94*
924502	*AB2-099 E*	*0.4*
924511	*AB2-100 C*	*18.7*
924512	*AB2-100 E*	*9.21*
924811	*AB2-134 C OP*	*20.17*
924812	*AB2-134 E OP*	*19.83*
925051	*AB2-160 C OP*	*8.33*
925052	*AB2-160 E OP*	*13.59*
925061	*AB2-161 C OP*	*5.65*
925062	*AB2-161 E OP*	*9.21*
925122	*AB2-169 E*	*9.41*

© PJM Interconnection 2019. All rights reserved.

925171	*AB2-174 C O1*	*11.22*
925172	*AB2-174 E O1*	*10.15*
925281	*AB2-186 C*	*1.03*
925282	*AB2-186 E*	*0.44*
925331	*AB2-190 C*	*31.67*
925332	*AB2-190 E*	*13.57*
926261	*AC1-027 C*	*3.51*
926262	*AC1-027 E*	*2.*
926331	*AC1-034 C*	*10.35*
926332	*AC1-034 E*	*7.81*
926351	*AC1-036 C*	*1.31*
926352	*AC1-036 E*	*2.13*
926531	*AC1-054 C OP*	*10.79*
926532	*AC1-054 E OP*	*4.97*
926591	*AC1-060*	*0.1*
926601	*AC1-061*	*0.05*
926611	*AC1-062*	*0.42*
926621	*AC1-063*	*0.52*
926641	*AC1-065 C*	*4.5*
926642	*AC1-065 E*	*7.34*
926851	*AC1-086 C*	*33.04*
926852	*AC1-086 E*	*15.04*
926981	*AC1-099 C*	*12.91*
926982	*AC1-099 E*	*7.66*
927041	*AC1-105 C OP*	*7.88*
927042	*AC1-105 E OP*	*3.92*

© PJM Interconnection 2019. All rights reserved.

927061	*AC1-107 OP*	*505.6*
927181	*AC1-112 C*	*2.37*
927182	*AC1-112 E*	*1.33*
927561	*AC1-147 C*	*3.94*
927562	*AC1-147 E*	*2.32*
927711	*AC1-161 C OP*	*54.3*
927712	*AC1-161 E OP*	*23.18*
927741	*AC1-164 C OP*	*53.5*
927742	*AC1-164 E OP*	*24.04*
927991	*AC1-189 C*	*13.47*
927992	*AC1-189 E*	*6.71*
928191	*AC1-208 C O1*	*14.11*
928192	*AC1-208 E O1*	*6.27*
928271	*AC1-216 C OP*	*15.39*
928272	*AC1-216 E OP*	*12.11*
928321	*AC1-221 C*	*3.13*
928322	*AC1-221 E*	*3.13*
928331	*AC1-222 C*	*5.04*
928332	*AC1-222 E*	*4.8*

© PJM Interconnection 2019. All rights reserved.

Appendix 5

(DVP - DVP) The 6FRRIVER-6STJOHN 230 kV line (from bus 314212 to bus 314150 ckt 1) loads from 110.28% to 112.9% (AC power flow) of its emergency rating (749 MVA) for the single line contingency outage of 'LN 574'. This project contributes approximately 23.03 MW to the thermal violation.

CONTINGENCY 'LN 574'
OPEN BRANCH FROM BUS 314908 TO BUS 314911 CKT 1 /* 8ELMONT 500.00 - 8LDYSMTH 500.00
END

Bus Number	*Bus Name*	*Full Contribution*
315053	*1BELMED1*	*1.87*
315054	*1BELMED2*	*1.87*
315055	*1BELMED3*	*1.55*
315058	*1CHESTF3*	*1.96*
315059	*1CHESTF4*	*3.18*
315060	*1CHESTF5*	*6.42*
315061	*1CHESTG7*	*2.52*
315063	*1CHESTG8*	*2.5*
315062	*1CHESTS7*	*1.14*
315064	*1CHESTS8*	*1.28*
315067	*1DARBY 1*	*1.86*
315068	*1DARBY 2*	*1.86*
315069	*1DARBY 3*	*1.89*
315070	*1DARBY 4*	*1.89*
315043	*1FRIVERA*	*6.17*
315044	*1FRIVERB*	*4.78*
315045	*1FRIVERC*	*6.17*
315046	*1FRIVERD*	*4.78*

© PJM Interconnection 2019. All rights reserved.

315047	*1FRIVERE*	*4.78*
315048	*1FRIVERF*	*6.17*
315091	*1YORKTN2*	*13.88*
314309	*6IRON208*	*0.26*
314236	*6NRTHEST*	*0.14*
314251	*6S PUMP*	*0.68*
315074	*CIR_AB2-152*	*5.37*
297087	*V2-040*	*0.11*
921292	*AA1-083*	*1.08*
921622	*AA1-145*	*18.41*
922682	*AB1-027 C*	*1.81*
923801	*AB2-015 C OP*	*3.83*
923841	*AB2-024 C*	*1.22*
924061	*AB2-050*	*6.05*
924241	*AB2-068 OP*	*106.83*
924811	*AB2-134 C OP*	*6.63*
925051	*AB2-160 C OP*	*2.92*
925061	*AB2-161 C OP*	*1.57*
925331	*AB2-190 C*	*10.23*
926591	*AC1-060*	*0.04*
926601	*AC1-061*	*0.02*
926621	*AC1-063*	*0.18*
926641	*AC1-065 C*	*1.54*
927061	*AC1-107 OP*	*161.25*
927181	*AC1-112 C*	*1.41*
927411	*AC1-134*	*15.12*

© PJM Interconnection 2019. All rights reserved.

927561	*AC1-147 C*	*0.96*
927741	*AC1-164 C OP*	*23.03*
928011	*AC1-191 C OP*	*6.7*
928271	*AC1-216 C OP*	*5.06*

© PJM Interconnection 2019. All rights reserved.

Appendix 6

(DVP - DVP) The 8CHANCE-8BRISTER 500 kV line (from bus 314905 to bus 314900 ckt 1) loads from 106.14% to 107.91% (AC power flow) of its emergency rating (2442 MVA) for the single line contingency outage of 'LN 594'. This project contributes approximately 43.26 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*	*3.32*
315054	*1BELMED2*	*3.32*
315055	*1BELMED3*	*2.75*
315067	*1DARBY 1*	*3.02*
315068	*1DARBY 2*	*3.03*
315069	*1DARBY 3*	*3.07*
315070	*1DARBY 4*	*3.07*
315043	*1FRIVERA*	*4.07*
315044	*1FRIVERB*	*3.15*
315045	*1FRIVERC*	*4.07*
315046	*1FRIVERD*	*3.15*
315047	*1FRIVERE*	*3.15*
315048	*1FRIVERF*	*4.07*
315225	*1N ANNA1*	*45.91*
315226	*1N ANNA2*	*45.2*
315083	*1SPRUNCA*	*2.03*
315084	*1SPRUNCB*	*2.03*
315085	*1SPRUNCC*	*1.51*

© PJM Interconnection 2019. All rights reserved.

315086	*1SPRUNCD*	*1.51*
315091	*1YORKTN2*	*31.45*
314309	*6IRON208*	*0.46*
314236	*6NRTHEST*	*0.22*
314251	*6S PUMP*	*1.05*
315074	*CIR_AB2-152*	*10.39*
297087	*V2-040*	*0.14*
921162	*AA1-063AC*	*7.91*
921292	*AA1-083*	*0.71*
921622	*AA1-145*	*12.14*
921752	*AA2-053 C*	*8.17*
921762	*AA2-057 C*	*6.43*
921982	*AA2-088 C*	*5.95*
922442	*AA2-165 C*	*0.88*
922512	*AA2-174 C*	*0.37*
922532	*AA2-178 C*	*9.58*
922682	*AB1-027 C*	*2.78*
922922	*AB1-081 C OP*	*7.88*
923262	*AB1-132 C OP*	*13.31*
923572	*AB1-173 C OP*	*2.14*
923582	*AB1-173AC OP*	*2.14*
923801	*AB2-015 C OP*	*9.27*
923831	*AB2-022 C*	*2.38*
923841	*AB2-024 C*	*2.63*
923851	*AB2-025 C*	*2.46*
923861	*AB2-026 C*	*2.32*

© PJM Interconnection 2019. All rights reserved.

923911	*AB2-031 C OP*	*2.12*
923991	*AB2-040 C OP*	*6.97*
924021	*AB2-043 C OP*	*2.64*
924061	*AB2-050*	*3.99*
924151	*AB2-059 C*	*9.29*
924161	*AB2-060 C*	*7.59*
924241	*AB2-068 OP*	*215.35*
924321	*AB2-079 C OP*	*5.02*
924491	*AB2-098 C*	*0.52*
924501	*AB2-099 C*	*0.56*
924511	*AB2-100 C*	*11.22*
924811	*AB2-134 C OP*	*13.71*
925021	*AB2-158 C*	*8.79*
925051	*AB2-160 C OP*	*5.79*
925061	*AB2-161 C OP*	*3.55*
925171	*AB2-174 C O1*	*6.69*
925281	*AB2-186 C*	*0.61*
925331	*AB2-190 C*	*21.36*
926261	*AC1-027 C*	*2.09*
926331	*AC1-034 C*	*6.02*
926351	*AC1-036 C*	*0.79*
926531	*AC1-054 C OP*	*6.36*
926591	*AC1-060*	*0.08*
926601	*AC1-061*	*0.04*
926621	*AC1-063*	*0.41*
926641	*AC1-065 C*	*3.56*

© PJM Interconnection 2019. All rights reserved.

926751	*AC1-076 C*	*4.72*
926851	*AC1-086 C*	*19.6*
926981	*AC1-099 C*	*7.59*
927061	*AC1-107 OP*	*325.06*
927181	*AC1-112 C*	*2.17*
927251	*AC1-118 C*	*1.98*
927411	*AC1-134*	*9.98*
927561	*AC1-147 C*	*2.36*
927681	*AC1-158 C*	*88.25*
927711	*AC1-161 C OP*	*31.89*
927741	*AC1-164 C OP*	*43.26*
927991	*AC1-189 C*	*7.87*
928011	*AC1-191 C OP*	*10.2*
928191	*AC1-208 C O1*	*8.29*
928271	*AC1-216 C OP*	*10.46*

© PJM Interconnection 2019. All rights reserved.

Appendix 7

(DVP - DVP) The 8ELMONT-8LDYSMTH 500 kV line (from bus 314908 to bus 314911 ckt 1) loads from 126.84% to 129.95% (AC power flow) of its emergency rating (2442 MVA) for the single line contingency outage of 'LN 576'. This project contributes approximately 75.28 MW to the thermal violation.

CONTINGENCY 'LN 576'
OPEN BRANCH FROM BUS 314322 TO BUS 314914 CKT 1 /* 6MDLTHAN 230.00 - 8MDLTHAN 500.00
OPEN BRANCH FROM BUS 314914 TO BUS 314918 CKT 1 /* 8MDLTHAN 500.00 - 8NO ANNA 500.00
END

Bus Number	*Bus Name*	*Full Contribution*
315058	*1CHESTF3*	*5.82*
315059	*1CHESTF4*	*9.43*
315060	*1CHESTF5*	*20.*
315061	*1CHESTG7*	*7.84*
315063	*1CHESTG8*	*7.77*
315062	*1CHESTS7*	*3.56*
315064	*1CHESTS8*	*3.98*
315067	*1DARBY 1*	*5.11*
315068	*1DARBY 2*	*5.11*
315069	*1DARBY 3*	*5.18*
315070	*1DARBY 4*	*5.18*
315233	*1SURRY 2*	*50.84*
315091	*1YORKTN2*	*53.56*
315092	*1YORKTN3*	*45.92*
314309	*6IRON208*	*0.77*
314236	*6NRTHEST*	*0.37*
314251	*6S PUMP*	*1.73*

© PJM Interconnection 2019. All rights reserved.

315074	*CIR_AB2-152*	*17.43*
297087	*V2-040*	*0.24*
921162	*AA1-063AC*	*13.05*
921752	*AA2-053 C*	*13.5*
921762	*AA2-057 C*	*10.67*
921982	*AA2-088 C*	*9.83*
922442	*AA2-165 C*	*1.45*
922512	*AA2-174 C*	*0.62*
922532	*AA2-178 C*	*16.*
922682	*AB1-027 C*	*4.78*
922922	*AB1-081 C OP*	*13.1*
923262	*AB1-132 C OP*	*21.95*
923572	*AB1-173 C OP*	*3.51*
923582	*AB1-173AC OP*	*3.51*
923801	*AB2-015 C OP*	*15.52*
923831	*AB2-022 C*	*3.98*
923841	*AB2-024 C*	*4.39*
923851	*AB2-025 C*	*4.*
923861	*AB2-026 C*	*3.53*
923911	*AB2-031 C OP*	*3.48*
923991	*AB2-040 C OP*	*11.44*
924061	*AB2-050*	*4.81*
924151	*AB2-059 C*	*15.43*
924241	*AB2-068 OP*	*415.53*
924491	*AB2-098 C*	*0.87*
924501	*AB2-099 C*	*0.93*

© PJM Interconnection 2019. All rights reserved.

924511	*AB2-100 C*	*18.36*
924811	*AB2-134 C OP*	*23.03*
925051	*AB2-160 C OP*	*9.56*
925061	*AB2-161 C OP*	*5.91*
925171	*AB2-174 C O1*	*10.96*
925281	*AB2-186 C*	*1.02*
925331	*AB2-190 C*	*35.9*
926261	*AC1-027 C*	*3.51*
926331	*AC1-034 C*	*10.*
926531	*AC1-054 C OP*	*10.42*
926591	*AC1-060*	*0.13*
926601	*AC1-061*	*0.06*
926621	*AC1-063*	*0.67*
926641	*AC1-065 C*	*5.81*
926851	*AC1-086 C*	*32.32*
926981	*AC1-099 C*	*12.58*
927061	*AC1-107 OP*	*627.22*
927181	*AC1-112 C*	*3.72*
927411	*AC1-134*	*12.03*
927561	*AC1-147 C*	*3.96*
927711	*AC1-161 C OP*	*53.83*
927741	*AC1-164 C OP*	*75.28*
927991	*AC1-189 C*	*13.11*
928011	*AC1-191 C OP*	*16.39*
928191	*AC1-208 C O1*	*13.73*
928271	*AC1-216 C OP*	*17.58*

© PJM Interconnection 2019. All rights reserved.

Appendix 8

(DVP - DVP) The 8LDYSMTH-8POSSUM 500 kV line (from bus 314911 to bus 314922 ckt 1) loads from 101.25% to 102.79% (AC power flow) of its emergency rating (2442 MVA) for the single line contingency outage of 'LN 594'. This project contributes approximately 37.23 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*	*2.87*
315054	*1BELMED2*	*2.87*
315055	*1BELMED3*	*2.38*
315060	*1CHESTF5*	*10.15*
315061	*1CHESTG7*	*3.98*
315063	*1CHESTG8*	*3.95*
315062	*1CHESTS7*	*1.81*
315064	*1CHESTS8*	*2.02*
315067	*1DARBY 1*	*2.6*
315068	*1DARBY 2*	*2.61*
315069	*1DARBY 3*	*2.64*
315070	*1DARBY 4*	*2.64*
315225	*1N ANNA1*	*39.21*
315226	*1N ANNA2*	*38.6*
315083	*1SPRUNCA*	*1.76*
315084	*1SPRUNCB*	*1.76*
315085	*1SPRUNCC*	*1.3*
315086	*1SPRUNCD*	*1.3*

© PJM Interconnection 2019. All rights reserved.

315091	*1YORKTN2*	*27.23*
314309	*6IRON208*	*0.39*
314236	*6NRTHEST*	*0.19*
314251	*6S PUMP*	*0.9*
315074	*CIR_AB2-152*	*8.99*
297087	*V2-040*	*0.12*
921162	*AA1-063AC*	*7.07*
921622	*AA1-145*	*10.22*
921752	*AA2-053 C*	*7.3*
921982	*AA2-088 C*	*5.31*
922512	*AA2-174 C*	*0.33*
922532	*AA2-178 C*	*8.44*
922682	*AB1-027 C*	*2.39*
923262	*AB1-132 C OP*	*11.86*
923572	*AB1-173 C OP*	*1.91*
923582	*AB1-173AC OP*	*1.91*
923801	*AB2-015 C OP*	*8.09*
923831	*AB2-022 C*	*2.08*
923841	*AB2-024 C*	*2.25*
923851	*AB2-025 C*	*2.16*
923861	*AB2-026 C*	*2.09*
923911	*AB2-031 C OP*	*1.89*
923991	*AB2-040 C OP*	*6.22*
924061	*AB2-050*	*3.36*
924241	*AB2-068 OP*	*186.57*
924501	*AB2-099 C*	*0.5*

© PJM Interconnection 2019. All rights reserved.

924511	*AB2-100 C*	*9.92*
924811	*AB2-134 C OP*	*11.88*
925021	*AB2-158 C*	*8.99*
925051	*AB2-160 C OP*	*5.02*
925061	*AB2-161 C OP*	*3.09*
925171	*AB2-174 C O1*	*5.96*
925281	*AB2-186 C*	*0.54*
925331	*AB2-190 C*	*18.52*
926261	*AC1-027 C*	*1.83*
926591	*AC1-060*	*0.07*
926601	*AC1-061*	*0.03*
926621	*AC1-063*	*0.35*
926641	*AC1-065 C*	*3.03*
926751	*AC1-076 C*	*3.24*
926851	*AC1-086 C*	*17.46*
926981	*AC1-099 C*	*6.81*
927061	*AC1-107 OP*	*281.62*
927181	*AC1-112 C*	*1.86*
927411	*AC1-134*	*8.39*
927561	*AC1-147 C*	*2.06*
927681	*AC1-158 C*	*74.26*
927711	*AC1-161 C OP*	*27.77*
927741	*AC1-164 C OP*	*37.23*
928011	*AC1-191 C OP*	*8.61*
928271	*AC1-216 C OP*	*9.07*

© PJM Interconnection 2019. All rights reserved.