

***Generation Interconnection
System Impact Study Report***

For

***PJM Generation Interconnection Request
Queue Position AC1-098/AC1-099***

***Dawson – South Justice 115kV
50.2 MW Capacity / 80 MW Energy***

January 2020

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 American Beech Solar 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 two solar generating facilities located in Halifax County, North Carolina. Queue project AC1-098 will have an installed capability of 60 MW (37.6 MW Capacity) and AC1-099 will have an installed capability of 20 MW (12.6 MW Capacity). The AC1-098 and AC1-099 projects will share the same point of interconnection and were evaluated as a single combined project. The installed AC1-098_099 facilities will have a total capability of 80 MW, with 50.2 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is 11/1/2022. **This study does not imply an ITO commitment to this in-service date.**

Point of Interconnection

AC1-098_099 will interconnect with the ITO transmission system via a new three breaker ring bus switching station that connects at the Dawson – South Justice Branch 115kV line.

Cost Summary

The AC1-098_099interconnection request will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	\$ 600,000
Direct Connection Network Upgrades	\$ 5,600,000
Non Direct Connection Network Upgrades	\$ 600,000
Allocation for New System Upgrades	\$ 14,802
Contribution for Previously Identified Upgrades	\$ 18,832
Total Costs	\$ 6,833,634

Attachment Facilities

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

Direct Connection Cost Estimate

Substation: Build a three breaker and install associated equipment at the 115 kV Switching Station located between Scotland Neck and South Justice Substations. Estimated cost \$5,600,000 and it is estimated to take 24-30 months to permit and construct.

Non-Direct Connection Cost Estimate

Transmission: Install necessary transmission structures to split line # 1015 into the proposed new AC1-099 Switching Station. Estimated cost \$600,000.

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.

System Reinforcement

Violation #	Upgrade Description	Upgrade Cost Allocation
1,2	Baseline b2745 (Rebuild 21.32 miles of existing line between Chesterfield - Lakeside 230 kV) resolves this violation.	\$0
3,4	<u>Clubhouse-Sapony 230kV</u> Replace wave trap at Clubhouse Substation. This will increase emergency rating to 722 MVA. Estimated time 12-16 months to engineer and construct. Cost: \$150,000	\$14,802
5,6,7,8	Baseline b3121 (Rebuild Clubhouse-Lakeview 230 kV Line #254 with single-circuit wood pole equivalent structures at the current 230 kV standard with a minimum rating of 1047 MVA) resolves this violation	\$0
9	Baseline b2990 (Chesterfield to Basin 230 kV line - Replace 0.14 miles of 1109 ACAR with a conductor which will increase the line rating to approximately 706 MVA) resolves this violation	\$0
10	<u>Rocky Mountain – Battleboro 115kV:</u> Reconductoring the circuit to 1590 ACSR will bring the rating to 185/205/214 MVA (Limited by Breaker Leads at Battleboro). In addition, Upgrading the terminal equipment at Rocky Mountain will bring the rating to 311/311/311 MVA (Limited by 1590 ACSR conductor) The estimated cost is approximately \$15 Million Note: Although the project may not have cost responsibility for this upgrade, Queue project AC1-098/099 may need this upgrade in-service to be deliverable to the PJM system. If Queue project AC1-098/099 comes into service prior to completion of the upgrade, the project will need an interim study.	\$0
10	<u>Rocky Mountain – Battleboro 115kV:</u> Upgrading the breaker leads at DVP's terminal will bring the rating to 239/239/239 MVA (Limited by terminal equipment at Rocky Mount) – Approximately \$0.1 Million	\$18,832
11-15	Baseline b3121 (Rebuild Clubhouse-Lakeview 230 kV Line #254 with single-circuit wood pole equivalent structures at the current 230 kV standard with a minimum rating of 1047 MVA) resolves this violation	\$0
Total Network Upgrades		\$33,634

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>

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.

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.

Network Impacts

The Queue Project AC1-098_099 was evaluated as an 80.0 MW (Capacity 50.2 MW) injection tapping the Dawson - South Justice 115kV substation in the ITO area. Project AC1-098_099 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC1-098_099 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
2012TH4	CONTINGENCY '2012TH4' /* EARLEYS OPEN BRANCH FROM BUS 314569 TO BUS 314266 CKT 1 /* 2012 OPEN BRANCH FROM BUS 314266 TO BUS 314599 CKT 1 /* 2012 OPEN BRANCH FROM BUS 314569 TO BUS 314568 CKT 2 /* TX. #4 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
562T563	CONTINGENCY '562T563' /*CARSON OPEN BRANCH FROM BUS 314902 TO BUS 314923 CKT 1 /*CARSON TO MIDLOTHIAN OPEN BRANCH FROM BUS 314914 TO BUS 314902 CKT 1 /*CARSON 500.00 - 8SEPTA 500.00 END
DVP_P1- 2:2056_AC1-208	CONTINGENCY 'DVP_P1-2:2056_AC1-208' OPEN BRANCH FROM BUS 313845 TO BUS 314579 CKT 1 /* 6HATHAWAY 230.00 - 6HORNRTN 230.00 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
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 /*

Contingency Name	Description
	6ROCKYMT230T230.00 - 6HATHAWAY 230.00 END
LN 2131A	CONTINGENCY 'LN 2131A' OPEN BRANCH FROM BUS 314662 TO BUS 916040 CKT 1 /* 6S HERTFORD 230.00 - Z1-036 TAP 230.00 OPEN BRANCH FROM BUS 314651 TO BUS 314662 CKT 1 /* 6WINFALL 230.00 - 6S HERTFORD 230.00 OPEN BUS 314662 /* ISLAND END
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
LN 254_A	CONTINGENCY 'LN 254_A' OPEN BRANCH FROM BUS 314563 TO BUS 924510 CKT 1 /* 6CLUBHSE 230.00 - AB2-100 TAP 230.00 END
LN 259	CONTINGENCY 'LN 259' OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /* 6BASIN 230.00 - 6CHSTF B 230.00 END
LN 54-2012_A	CONTINGENCY 'LN 54-2012_A' OPEN BRANCH FROM BUS 314559 TO BUS 921751 CKT 1 /* 3CAROLNA 115.00 - AA2-053 TAP 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

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 563	CONTINGENCY 'LN 563' OPEN BRANCH FROM BUS 314902 TO BUS 314914 CKT 1 /* 8CARSON 500.00 - 8MDLTHAN 500.00 END
T672B	CONTINGENCY 'T672B' /* _ BASIN OPEN BRANCH FROM BUS 314276 TO BUS 314260 CKT 1 /*L284 BASIN VARINA OPEN BRANCH FROM BUS 314275 TO BUS 314276 CKT 1 /*L2055 BASIN BELLMEADE REMOVE MACHINE 1 FROM BUS 315053 /*BELMEADE GEN CT-1 REMOVE MACHINE 2 FROM BUS 315054 /*BELMEADE GEN CT-2 REMOVE MACHINE 3 FROM BUS 315055 /*BELMEADE GEN ST OPEN BRANCH FROM BUS 314274 TO BUS 314276 CKT 1 /*BASIN TX5 OPEN BRANCH FROM BUS 314274 TO BUS 314276 CKT 2 /*BASIN TX6 OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1 /*L259 BASIN CHESTERFIELD OPEN BRANCH FROM BUS 314276 TO BUS 314339 CKT 1 /*L2065 BASIN SPRUANCE NUG 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	T672B	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	AC	99.76	100.55		459	4.26	1
2	LFFB	T672B	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	AC	99.79	100.58		459	4.26	2
3	LFFB	246T2034_A	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	AC	93.84	97.25		637	21.76	3
4	DCTL	LN 54-2012_B	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	AC	94.76	97.18		637	15.28	
5	LFFB	246T2034_A	DVP - DVP	6LAKEVEW-AB2-100 TAP 230 kV line	314583	924510	1	AC	94.9	98.52		459	17.24	4
6	DCTL	LN 54-2012_B	DVP - DVP	6LAKEVEW-AB2-100 TAP 230 kV line	314583	924510	1	AC	97.04	99.46		459	11.48	
7	LFFB	2012TH4	DVP - DVP	6LAKEVEW-AB2-100 TAP 230 kV line	314583	924510	1	AC	94.53	97.12		459	12.23	
8	DCTL	LN 54-2012_A	DVP - DVP	6LAKEVEW-AB2-100 TAP 230 kV line	314583	924510	1	AC	93.69	96.11		459	11.48	

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		
9	LFFB	562T563	DVP - DVP	6CHSTF B-6BASIN 230 kV line	314287	314276	1	AC	102.27	103.15		549	5.65	5
10	DCTL	LN 2058-2181	DVP - CPLE	3BTLEBRO-3ROCKYMT115T 115 kV line	314554	304223	1	AC	149.69	159.91	ER	164	17.45	6
11	LFFB	246T2034_A	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	AC	108.34	112.01		459	17.24	7
12	DCTL	LN 54-2012_B	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	AC	110.98	113.43		459	11.48	
13	LFFB	2012TH4	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	AC	108.33	110.94		459	12.23	
14	DCTL	LN 54-2012_A	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	AC	107.54	110		459	11.48	

#	Contingency		Affected Area	Facility Description	Bus			Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To	Cir.		Initial	Final	Type	MVA		
15	N-1	LN 2012	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	AC	103.98	105.86	ER	375	7.27	

Steady-State Voltage Requirements

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

Not required.

Stability and Reactive Power Requirement for Low Voltage Ride Through

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

No mitigations required

New System Reinforcements

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

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost	AC1-098/AC1-099 Allocation
1, 2	Chesterfield-Basin 230kV	See PJM Baseline b2990 for resolution Chesterfield to Basin 230 kV line - Replace 0.14 miles of 1109 ACAR with a conductor Ratings after the upgrade: 706/706/812 While the project AC1-098/AC1-099 does not have a cost allocation for this upgrade, project AC1-098/AC1-099 may require the upgrade to be in-service to be deliverable to the PJM system. If project AC1-098/AC1-099 comes into service prior to completion of the upgrade, an interim deliverability study for a particular Delivery Year will be required.	b2990		

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost	AC1-098/AC1-099Allocation																					
3, 4	Line #238 Clubhouse to Sapony 230 kV	<div>Replace wave trap at both Substations. This will increase emergency rating to 722 MVA. Estimated cost \$150,000 and it is estimated to 12-16 months to engineer and construct.</div> <table><tr><th>Queue</th><th>Impact (MW)</th><th>Cost</th></tr><tr><td>AC1-034</td><td>13.17</td><td>\$12,758.33</td></tr><tr><td>AC1-054</td><td>13.92</td><td>\$13,484.89</td></tr><tr><td>AC1-086</td><td>74.33</td><td>\$72,006.59</td></tr><tr><td>AC1-099</td><td>15.28</td><td>\$14,802.38</td></tr><tr><td>AC1-189</td><td>16.14</td><td>\$15,635.49</td></tr><tr><td>AC1-208</td><td>22</td><td>\$21,312.32</td></tr></table>	Queue	Impact (MW)	Cost	AC1-034	13.17	\$12,758.33	AC1-054	13.92	\$13,484.89	AC1-086	74.33	\$72,006.59	AC1-099	15.28	\$14,802.38	AC1-189	16.14	\$15,635.49	AC1-208	22	\$21,312.32	n6051	\$ 150,000	\$14,802.38
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AC1-208	22	\$21,312.32																								
5,6,7,8	Clubhouse-Lakeview 230kV	<div>See PJM Baseline b3121 for resolution</div> <div>Rebuild Clubhouse-Lakeview 230 kV Line #254 with single-circuit wood pole equivalent structures at the current 230 kV standard with a minimum rating of 1047 MVA</div> <div>While the project AC1-098/AC1-099 does not have a cost allocation for this upgrade, project AC1-098/AC1-099 may require the upgrade to be in-service to be deliverable to the PJM system. If project AC1-098/AC1-099 comes into service prior to completion of the upgrade, an interim deliverability study for a particular Delivery Year will be required.</div>	b3121																							
Total New Network Upgrades					\$14,802.38																					

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	AC1-098/AC1-099Allocation																		
9	Chesterfield-Basin 230kV	Please see PJM baseline b2990 for resolution. Chesterfield to Basin 230 kV line - Replace 0.14 miles of 1109 ACAR with a conductor Ratings after the upgrade: 706/706/812	b2990																				
10	Rocky Mountain – Battleboro 115kV	Dominion scope: Upgrading the breaker leads at DVP’s terminal will bring the rating to 239/239/239 MVA (Limited by terminal equipment at Rocky Mount) – Approximately \$0.1 Million <table><tr><th>Queue</th><th>Impact (MW)</th><th>Cost</th></tr><tr><td>AC1-034</td><td>27.15</td><td>\$29,316.48</td></tr><tr><td>AC1-086</td><td>21.59</td><td>\$23,312.81</td></tr><tr><td>AC1-099</td><td>17.44</td><td>\$18,831.65</td></tr><tr><td>AC1-189</td><td>7.90</td><td>\$8,530.39</td></tr><tr><td>AC1-208</td><td>18.53</td><td>\$20,008.63</td></tr></table> Duke Energy Progress scope: Reconductoring the Battleboro - Rocky Mount 115kV line. Note: Although the project may not have cost responsibility for this upgrade, Queue project AC1-098/099 may need this upgrade in-service to be deliverable to the PJM system. If Queue project AC1-098/099 comes into service prior to completion of the upgrade, the project will need an interim study.	Queue	Impact (MW)	Cost	AC1-034	27.15	\$29,316.48	AC1-086	21.59	\$23,312.81	AC1-099	17.44	\$18,831.65	AC1-189	7.90	\$8,530.39	AC1-208	18.53	\$20,008.63	n6118	\$100,000	\$18,832
Queue	Impact (MW)	Cost																					
AC1-034	27.15	\$29,316.48																					
AC1-086	21.59	\$23,312.81																					
AC1-099	17.44	\$18,831.65																					
AC1-189	7.90	\$8,530.39																					
AC1-208	18.53	\$20,008.63																					

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost	AC1-098/AC1-099 Allocation
11-15	Clubhouse-Lakeview 230kV	Please see PJM baseline b3121 for resolution Rebuild Clubhouse-Lakeview 230 kV Line #254 with single-circuit wood pole equivalent structures at the current 230 kV standard with a minimum rating of 1047 MVA	b3121		
Total New Network Upgrades					\$18,832

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 Area	Facility Description	Bus			Power Flow	Loading %		Rating		MW Contribution
	Type	Name			From	To	Cir.		Initial	Final	Type	MVA	
16	N-1	LN 259	DVP - DVP	6CHARCTY-6LAKESD 230 kV line	314225	314227	1	AC	106.81	107.77	ER	375	4.23
17	N-1	LN 259	DVP - DVP	6MESSER-6CHARCTY 230 kV line	314228	314225	1	AC	120.44	121.39	ER	375	4.23
18	N-1	LN 259	DVP - DVP	6CHSTF B-6MESSER 230 kV line	314287	314228	1	AC	120.47	121.43	ER	375	4.23
19	N-1	LN 563	DVP - DVP	6CHSTF B-6BASIN 230 kV line	314287	314276	1	AC	112.9	113.93	ER	449	5.45

#	Contingency		Affected Area	Facility Description	Bus			Power Flow	Loading %		Rating		MW Contribution
	Type	Name			From	To	Cir.		Initial	Final	Type	MVA	
20	N-1	LN 254_A	DVP - DVP	6CLUBHSE 230/115 kV transformer	314562	314563	1	AC	111.7	114.74	ER	183	7.37
21	N-1	LN 2012	DVP - DVP	6CLUBHSE-6SAPONY 230 kV line	314563	314435	1	AC	95.12	97.72	ER	599	15.48
22	N-1	LN 2131A	DVP - DVP	6EARLEYS-6NUCO TP 230 kV line	314569	314575	1	AC	90.84	94.13	ER	572	18.71
23	N-1	DVP_P1-2:2056_AC1-208	DVP - DVP	3COX DP-3WITAKRS 115 kV line	314577	314623	1	AC	70.1	93.09	ER	134	30.7
24	Non	Non	DVP - DVP	3COX DP-3WITAKRS 115 kV line	314577	314623	1	AC	47.29	72.63	NR	123	30.84
25	N-1	LN 2012	DVP - DVP	6LAKEVIEW-AB2-100 TAP 230 kV line	314583	924510	1	AC	114.52	117.52	ER	375	11.58
26	N-1	LN 238	DVP - DVP	6ROA VAL-6NORTHAMPTON 230 kV line	314599	314266	1	AC	101.64	102.52	ER	548	5.63
27	N-1	DVP_P1-2:2056_AC1-208	DVP - DVP	3WITAKRS-3BTLEBRO 115 kV line	314623	314554	1	AC	69.81	92.8	ER	134	30.69
28	N-1	LN 2012	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	AC	131.35	134.38	ER	375	11.58
29	Non	Non	DVP - DVP	AB2-100 TAP-6CLUBHSE 230 kV line	924510	314563	1	AC	99.17	102.11	NR	375	11.4

Light Load Analysis in 2020

Not Required

ITO Analysis

ITO assessed the impact of the proposed Queue Project #AC1-098_099 interconnection of 80 MW of energy (Capacity 50.2 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 – No deficiencies identified.
- Critical System Condition – No Possum Point Unit #6 Unit – No deficiencies identified.

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 AC1-098/AC1-099	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 AC1-098/AC1-099	Limiting Element
AEP	2000+	2000+	None

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 AC1-098_099 (Transfer) will not impact ITO's import or export capability

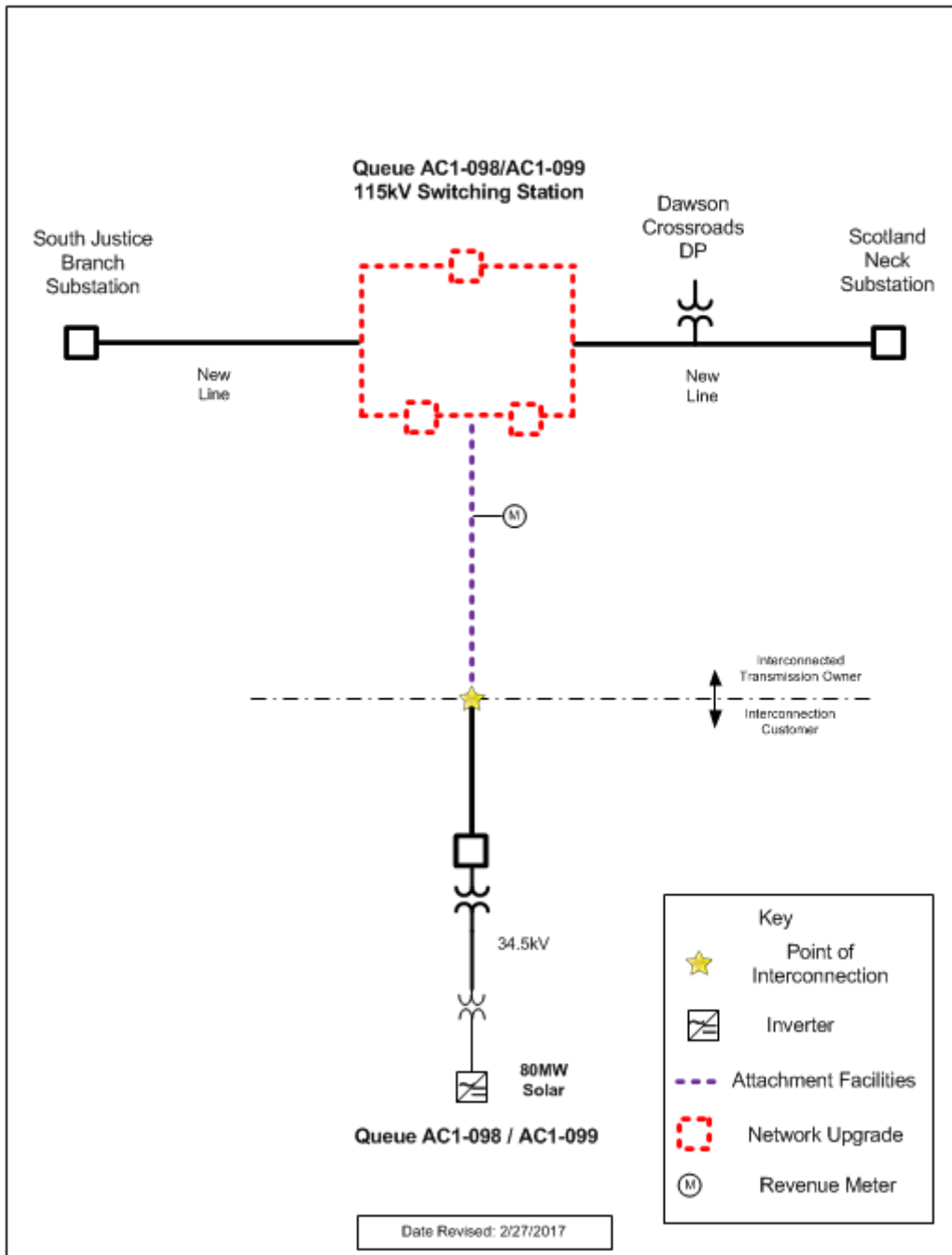
Affected System Analysis & Mitigation

Duke Energy:

Please refer to violation #10 and associated reinforcements.

Attachment 1.

System Configuration



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.

Appendix 1

(DVP - DVP) The 6MESSER-6CHARCTY 230 kV line (from bus 314228 to bus 314225 ckt 1) loads from 99.76% to 100.55% (AC power flow) of its load dump rating (459 MVA) for the line fault with failed breaker contingency outage of 'T672B'. This project contributes approximately 4.26 MW to the thermal violation.

```

CONTINGENCY 'T672B'                                /*_ BASIN
  OPEN BRANCH FROM BUS 314276 TO BUS 314260 CKT 1    /*L284 BASIN
VARINA
  OPEN BRANCH FROM BUS 314275 TO BUS 314276 CKT 1    /*L2055 BASIN
BELLMEADE
  REMOVE MACHINE 1 FROM BUS 315053                    /*BELMEADE GEN CT-1
  REMOVE MACHINE 2 FROM BUS 315054                    /*BELMEADE GEN CT-2
  REMOVE MACHINE 3 FROM BUS 315055                    /*BELMEADE GEN ST
  OPEN BRANCH FROM BUS 314274 TO BUS 314276 CKT 1    /*BASIN TX5
  OPEN BRANCH FROM BUS 314274 TO BUS 314276 CKT 2    /*BASIN TX6
  OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1    /*L259 BASIN
CHESTERFIELD
  OPEN BRANCH FROM BUS 314276 TO BUS 314339 CKT 1    /*L2065 BASIN
SPRUANCE NUG
END
  
```

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315065	1CHESTF6	33.25
315077	1HOPHCF1	1.78
315078	1HOPHCF2	1.78
315079	1HOPHCF3	1.78
315080	1HOPHCF4	2.7
315076	1HOPPOLC	1.52
315073	1STONECA	5.12
314314	3LOCKS	1.
314539	3UNCAMP	0.79
314541	3WATKINS	0.23
314229	6MT R221	-0.3
315074	CIR_AB2-152	7.2

315075	CIR_AB2-152	0.62
292791	U1-032 E	2.67
900672	V4-068 E	0.1
907092	X1-038 E	1.97
914231	Y2-077	0.72
917332	Z2-043 E	0.32
921162	AA1-063AC	3.06
921163	AA1-063AE	1.44
918512	AA1-065 E OP	1.39
918562	AA1-072 E	0.05
921752	AA2-053 C	3.11
921753	AA2-053 E	1.34
921762	AA2-057 C	2.24
921763	AA2-057 E	1.12
921982	AA2-088 C	2.23
921983	AA2-088 E	3.64
922442	AA2-165 C	0.31
922443	AA2-165 E	0.15
922512	AA2-174 C	0.14
922513	AA2-174 E	0.15
923262	AB1-132 C OP	5.72
923263	AB1-132 E OP	2.45
923572	AB1-173 C OP	0.95
923573	AB1-173 E OP	0.44
923582	AB1-173AC OP	0.95
923583	AB1-173AE OP	0.44

923801	AB2-015 C OP	2.81
923802	AB2-015 E OP	2.31
923851	AB2-025 C	1.57
923852	AB2-025 E	0.71
923911	AB2-031 C OP	0.94
923912	AB2-031 E OP	0.46
923991	AB2-040 C OP	3.09
923992	AB2-040 E OP	2.53
924501	AB2-099 C	0.19
924502	AB2-099 E	0.08
924511	AB2-100 C	6.
924512	AB2-100 E	2.95
924811	AB2-134 C OP	7.38
924812	AB2-134 E OP	7.25
925051	AB2-160 C OP	4.06
925052	AB2-160 E OP	6.63
925061	AB2-161 C OP	1.88
925062	AB2-161 E OP	3.07
925171	AB2-174 C OI	3.03
925172	AB2-174 E OI	2.75
925331	AB2-190 C	10.99
925332	AB2-190 E	4.71
926601	AC1-061	0.03
926851	AC1-086 C	8.42
926852	AC1-086 E	3.83
926981	AC1-099 C	2.67

<i>926982</i>	<i>ACI-099 E</i>	<i>1.59</i>
<i>928191</i>	<i>ACI-208 C OI</i>	<i>2.98</i>
<i>928192</i>	<i>ACI-208 E OI</i>	<i>1.33</i>
<i>928271</i>	<i>ACI-216 C OP</i>	<i>5.63</i>
<i>928272</i>	<i>ACI-216 E OP</i>	<i>4.43</i>

Appendix 2

(DVP - DVP) The 6CHSTF B-6MESSER 230 kV line (from bus 314287 to bus 314228 ckt 1) loads from 99.79% to 100.58% (AC power flow) of its load dump rating (459 MVA) for the line fault with failed breaker contingency outage of 'T672B'. This project contributes approximately 4.26 MW to the thermal violation.

```

CONTINGENCY 'T672B'                                /*_ BASIN
  OPEN BRANCH FROM BUS 314276 TO BUS 314260 CKT 1    /*L284 BASIN
VARINA
  OPEN BRANCH FROM BUS 314275 TO BUS 314276 CKT 1    /*L2055 BASIN
BELLMEADE
  REMOVE MACHINE 1 FROM BUS 315053                  /*BELMEADE GEN CT-1
  REMOVE MACHINE 2 FROM BUS 315054                  /*BELMEADE GEN CT-2
  REMOVE MACHINE 3 FROM BUS 315055                  /*BELMEADE GEN ST
  OPEN BRANCH FROM BUS 314274 TO BUS 314276 CKT 1    /*BASIN TX5
  OPEN BRANCH FROM BUS 314274 TO BUS 314276 CKT 2    /*BASIN TX6
  OPEN BRANCH FROM BUS 314276 TO BUS 314287 CKT 1    /*L259 BASIN
CHESTERFIELD
  OPEN BRANCH FROM BUS 314276 TO BUS 314339 CKT 1    /*L2065 BASIN
SPRUANCE NUG
END
  
```

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315065	1CHESTF6	33.25
315077	1HOPHCF1	1.78
315078	1HOPHCF2	1.78
315079	1HOPHCF3	1.78
315080	1HOPHCF4	2.7
315076	1HOPPOLC	1.52
315073	1STONECA	5.12
314314	3LOCKS	1.
314539	3UNCAMP	0.79
314541	3WATKINS	0.23
314229	6MT R221	-0.3

315074	CIR_AB2-152	7.2
315075	CIR_AB2-152	0.62
292791	U1-032 E	2.67
900672	V4-068 E	0.1
907092	X1-038 E	1.97
914231	Y2-077	0.72
917332	Z2-043 E	0.32
921162	AA1-063AC	3.06
921163	AA1-063AE	1.44
918512	AA1-065 E OP	1.39
918562	AA1-072 E	0.05
921752	AA2-053 C	3.11
921753	AA2-053 E	1.34
921762	AA2-057 C	2.24
921763	AA2-057 E	1.12
921982	AA2-088 C	2.23
921983	AA2-088 E	3.64
922442	AA2-165 C	0.31
922443	AA2-165 E	0.15
922512	AA2-174 C	0.14
922513	AA2-174 E	0.15
923262	AB1-132 C OP	5.72
923263	AB1-132 E OP	2.45
923572	AB1-173 C OP	0.95
923573	AB1-173 E OP	0.44
923582	AB1-173AC OP	0.95

923583	<i>AB1-173AE OP</i>	<i>0.44</i>
923801	<i>AB2-015 C OP</i>	<i>2.81</i>
923802	<i>AB2-015 E OP</i>	<i>2.31</i>
923851	<i>AB2-025 C</i>	<i>1.57</i>
923852	<i>AB2-025 E</i>	<i>0.71</i>
923911	<i>AB2-031 C OP</i>	<i>0.94</i>
923912	<i>AB2-031 E OP</i>	<i>0.46</i>
923991	<i>AB2-040 C OP</i>	<i>3.09</i>
923992	<i>AB2-040 E OP</i>	<i>2.53</i>
924501	<i>AB2-099 C</i>	<i>0.19</i>
924502	<i>AB2-099 E</i>	<i>0.08</i>
924511	<i>AB2-100 C</i>	<i>6.</i>
924512	<i>AB2-100 E</i>	<i>2.95</i>
924811	<i>AB2-134 C OP</i>	<i>7.38</i>
924812	<i>AB2-134 E OP</i>	<i>7.25</i>
925051	<i>AB2-160 C OP</i>	<i>4.06</i>
925052	<i>AB2-160 E OP</i>	<i>6.63</i>
925061	<i>AB2-161 C OP</i>	<i>1.88</i>
925062	<i>AB2-161 E OP</i>	<i>3.07</i>
925171	<i>AB2-174 C OI</i>	<i>3.03</i>
925172	<i>AB2-174 E OI</i>	<i>2.75</i>
925331	<i>AB2-190 C</i>	<i>10.99</i>
925332	<i>AB2-190 E</i>	<i>4.71</i>
926601	<i>AC1-061</i>	<i>0.03</i>
926851	<i>AC1-086 C</i>	<i>8.42</i>
926852	<i>AC1-086 E</i>	<i>3.83</i>

<i>926981</i>	<i>ACI-099 C</i>	<i>2.67</i>
<i>926982</i>	<i>ACI-099 E</i>	<i>1.59</i>
<i>928191</i>	<i>ACI-208 C OI</i>	<i>2.98</i>
<i>928192</i>	<i>ACI-208 E OI</i>	<i>1.33</i>
<i>928271</i>	<i>ACI-216 C OP</i>	<i>5.63</i>
<i>928272</i>	<i>ACI-216 E OP</i>	<i>4.43</i>

Appendix 3

(DVP - DVP) The 6CLUBHSE-6SAPONY 230 kV line (from bus 314563 to bus 314435 ckt 1) loads from 93.84% to 97.25% (AC power flow) of its load dump rating (637 MVA) for the line fault with failed breaker contingency outage of '246T2034_A'. This project contributes approximately 21.76 MW to the thermal violation.

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

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315132	1EDGECEMB	2.2
315139	1GASTONA	7.72
315141	1GASTONB	7.72
315126	1ROARAP2	2.99
315128	1ROARAP4	2.87
315134	1ROAVALA	11.05
315135	1ROAVALB	2.95
315136	1ROSEMG1	5.22
315138	1ROSEMG2	2.44
315137	1ROSEMS1	3.24
314704	3LAWRENC	0.81
900671	V4-068 C	0.18
900672	V4-068 E	0.55
917331	Z2-043 C	0.71

917332	Z2-043 E	1.7
917341	Z2-044 C	0.34
917342	Z2-044 E	0.82
917512	Z2-088 E OP1	10.1
921162	AA1-063AC	16.77
921163	AA1-063AE	7.91
918511	AA1-065 C OP	2.73
918512	AA1-065 E OP	7.51
921183	AA1-067 E	0.9
918561	AA1-072 C	0.11
918562	AA1-072 E	0.28
921752	AA2-053 C	17.03
921753	AA2-053 E	7.31
921762	AA2-057 C	10.91
921763	AA2-057 E	5.45
921982	AA2-088 C	12.17
921983	AA2-088 E	19.86
922442	AA2-165 C	1.49
922443	AA2-165 E	0.72
922512	AA2-174 C	0.78
922513	AA2-174 E	0.85
922922	AB1-081 C OP	11.81
922923	AB1-081 E OP	5.06
923262	AB1-132 C OP	32.88
923263	AB1-132 E OP	14.09
923572	AB1-173 C OP	5.51

923573	<i>AB1-173 E OP</i>	2.57
923582	<i>AB1-173AC OP</i>	5.51
923583	<i>AB1-173AE OP</i>	2.57
923911	<i>AB2-031 C OP</i>	5.47
923912	<i>AB2-031 E OP</i>	2.7
923991	<i>AB2-040 C OP</i>	17.97
923992	<i>AB2-040 E OP</i>	14.7
924021	<i>AB2-043 C OP</i>	3.02
924022	<i>AB2-043 E OP</i>	4.95
924151	<i>AB2-059 C</i>	13.92
924152	<i>AB2-059 E</i>	7.17
924161	<i>AB2-060 C</i>	8.56
924162	<i>AB2-060 E</i>	4.03
924321	<i>AB2-079 C OP</i>	5.68
924322	<i>AB2-079 E OP</i>	3.79
924491	<i>AB2-098 C</i>	0.7
924492	<i>AB2-098 E</i>	0.3
924501	<i>AB2-099 C</i>	1.04
924502	<i>AB2-099 E</i>	0.44
924511	<i>AB2-100 C</i>	37.61
924512	<i>AB2-100 E</i>	18.53
925122	<i>AB2-169 E</i>	4.7
925171	<i>AB2-174 C O1</i>	17.82
925172	<i>AB2-174 E O1</i>	16.12
926331	<i>AC1-034 C</i>	9.02
926332	<i>AC1-034 E</i>	6.8

<i>926351</i>	<i>ACI-036 C</i>	<i>0.72</i>
<i>926352</i>	<i>ACI-036 E</i>	<i>1.17</i>
<i>926531</i>	<i>ACI-054 C OP</i>	<i>9.75</i>
<i>926532</i>	<i>ACI-054 E OP</i>	<i>4.49</i>
<i>926851</i>	<i>ACI-086 C</i>	<i>48.43</i>
<i>926852</i>	<i>ACI-086 E</i>	<i>22.04</i>
<i>926981</i>	<i>ACI-099 C</i>	<i>13.65</i>
<i>926982</i>	<i>ACI-099 E</i>	<i>8.1</i>
<i>927991</i>	<i>ACI-189 C</i>	<i>10.77</i>
<i>927992</i>	<i>ACI-189 E</i>	<i>5.37</i>
<i>928191</i>	<i>ACI-208 C OI</i>	<i>15.23</i>
<i>928192</i>	<i>ACI-208 E OI</i>	<i>6.76</i>

Appendix 4

(DVP - DVP) The 6LAKEVEW-AB2-100 TAP 230 kV line (from bus 314583 to bus 924510 ckt 1) loads from 94.9% to 98.52% (AC power flow) of its load dump rating (459 MVA) for the line fault with failed breaker contingency outage of '246T2034_A'. This project contributes approximately 17.24 MW to the thermal violation.

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

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315131	1EDGECEMA	2.08
315132	1EDGECEMB	2.08
315139	1GASTONA	7.88
315141	1GASTONB	7.88
315126	1ROARAP2	1.87
315128	1ROARAP4	1.8
315134	1ROAVALA	11.01
315135	1ROAVALB	2.94
315136	1ROSEMG1	5.3
315138	1ROSEMG2	2.48
315137	1ROSEMS1	3.29
314784	1WEYRHSB	1.22
900671	V4-068 C	0.13
900672	V4-068 E	0.41

917331	Z2-043 C	0.59
917332	Z2-043 E	1.42
917341	Z2-044 C	0.29
917342	Z2-044 E	0.7
917511	Z2-088 C OP1	1.04
917512	Z2-088 E OP1	9.45
918411	AA1-050	0.87
921162	AA1-063AC	10.95
921163	AA1-063AE	5.16
918511	AA1-065 C OP	2.53
918512	AA1-065 E OP	6.95
921182	AA1-067 C	0.35
921183	AA1-067 E	0.84
918561	AA1-072 C	0.09
918562	AA1-072 E	0.24
921752	AA2-053 C	11.48
921753	AA2-053 E	4.93
921762	AA2-057 C	8.87
921763	AA2-057 E	4.43
921982	AA2-088 C	8.49
921983	AA2-088 E	13.85
922442	AA2-165 C	1.21
922443	AA2-165 E	0.58
922512	AA2-174 C	0.53
922513	AA2-174 E	0.57
922922	AB1-081 C OP	10.75

922923	<i>AB1-081 E OP</i>	<i>4.61</i>
923262	<i>AB1-132 C OP</i>	<i>33.58</i>
923263	<i>AB1-132 E OP</i>	<i>14.39</i>
924151	<i>AB2-059 C</i>	<i>12.67</i>
924152	<i>AB2-059 E</i>	<i>6.53</i>
924491	<i>AB2-098 C</i>	<i>0.65</i>
924492	<i>AB2-098 E</i>	<i>0.28</i>
924501	<i>AB2-099 C</i>	<i>0.86</i>
924502	<i>AB2-099 E</i>	<i>0.37</i>
925121	<i>AB2-169 C</i>	<i>0.89</i>
925122	<i>AB2-169 E</i>	<i>4.43</i>
926331	<i>AC1-034 C</i>	<i>8.21</i>
926332	<i>AC1-034 E</i>	<i>6.19</i>
926531	<i>AC1-054 C OP</i>	<i>4.81</i>
926532	<i>AC1-054 E OP</i>	<i>2.22</i>
926851	<i>AC1-086 C</i>	<i>49.46</i>
926852	<i>AC1-086 E</i>	<i>22.51</i>
926981	<i>AC1-099 C</i>	<i>10.82</i>
926982	<i>AC1-099 E</i>	<i>6.42</i>
927991	<i>AC1-189 C</i>	<i>10.05</i>
927992	<i>AC1-189 E</i>	<i>5.01</i>
928191	<i>AC1-208 C OI</i>	<i>11.51</i>
928192	<i>AC1-208 E OI</i>	<i>5.11</i>

Appendix 5

(DVP - DVP) The 6CHSTF B-6BASIN 230 kV line (from bus 314287 to bus 314276 ckt 1) loads from 102.27% to 103.15% (AC power flow) of its load dump rating (549 MVA) for the line fault with failed breaker contingency outage of '562T563'. This project contributes approximately 5.65 MW to the thermal violation.

CONTINGENCY '562T563' /*CARSON
 OPEN BRANCH FROM BUS 314902 TO BUS 314923 CKT 1 /*CARSON TO
 MIDLOTHIAN
 OPEN BRANCH FROM BUS 314914 TO BUS 314902 CKT 1 /*CARSON 500.00
 - 8SEPTA 500.00
 END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315065	1CHESTF6	34.34
315077	1HOPHCF1	1.82
315078	1HOPHCF2	1.82
315079	1HOPHCF3	1.82
315080	1HOPHCF4	2.76
315076	1HOPPOLC	1.56
315073	1STONECA	5.23
314784	1WEYRHSB	0.81
314539	3UNCAMP	0.97
314541	3WATKINS	0.28
315074	CIR_AB2-152	7.35
315075	CIR_AB2-152	0.63
292791	U1-032 E	2.72
900672	V4-068 E	0.13
901082	W1-029E	15.86
907092	X1-038 E	2.43
913392	Y1-086 E	0.74

914231	Y2-077	0.73
916042	Z1-036 E	16.15
916192	Z1-068 E	0.61
916302	Z1-086 E	3.97
917122	Z2-027 E	0.36
917332	Z2-043 E	0.42
917342	Z2-044 E	0.24
917512	Z2-088 E OP1	3.19
921162	AA1-063AC	3.94
921163	AA1-063AE	1.86
918512	AA1-065 E OP	1.82
921183	AA1-067 E	0.29
918562	AA1-072 E	0.07
921583	AA1-139 E	2.08
921752	AA2-053 C	4.01
921753	AA2-053 E	1.72
921762	AA2-057 C	3.02
921763	AA2-057 E	1.51
921982	AA2-088 C	2.88
921983	AA2-088 E	4.7
922442	AA2-165 C	0.41
922443	AA2-165 E	0.2
922512	AA2-174 C	0.18
922513	AA2-174 E	0.2
922532	AA2-178 C	3.57
922533	AA2-178 E	1.53

922922	<i>AB1-081 C OP</i>	3.65
922923	<i>AB1-081 E OP</i>	1.56
923262	<i>AB1-132 C OP</i>	7.24
923263	<i>AB1-132 E OP</i>	3.1
923572	<i>AB1-173 C OP</i>	1.19
923573	<i>AB1-173 E OP</i>	0.56
923582	<i>AB1-173AC OP</i>	1.19
923583	<i>AB1-173AE OP</i>	0.56
923801	<i>AB2-015 C OP</i>	3.47
923802	<i>AB2-015 E OP</i>	2.84
923831	<i>AB2-022 C</i>	0.77
923832	<i>AB2-022 E</i>	0.41
923851	<i>AB2-025 C</i>	1.86
923852	<i>AB2-025 E</i>	0.84
923911	<i>AB2-031 C OP</i>	1.18
923912	<i>AB2-031 E OP</i>	0.58
923991	<i>AB2-040 C OP</i>	3.88
923992	<i>AB2-040 E OP</i>	3.17
924151	<i>AB2-059 C</i>	4.3
924152	<i>AB2-059 E</i>	2.21
924491	<i>AB2-098 C</i>	0.22
924492	<i>AB2-098 E</i>	0.1
924501	<i>AB2-099 C</i>	0.25
924502	<i>AB2-099 E</i>	0.11
924511	<i>AB2-100 C</i>	7.29
924512	<i>AB2-100 E</i>	3.59

924811	AB2-134 C OP	7.75
924812	AB2-134 E OP	7.62
925051	AB2-160 C OP	3.89
925052	AB2-160 E OP	6.35
925061	AB2-161 C OP	2.1
925062	AB2-161 E OP	3.43
925122	AB2-169 E	2.25
925171	AB2-174 C OI	3.79
925172	AB2-174 E OI	3.43
925281	AB2-186 C	0.22
925282	AB2-186 E	0.09
925331	AB2-190 C	11.61
925332	AB2-190 E	4.97
926261	AC1-027 C	0.65
926262	AC1-027 E	0.37
926331	AC1-034 C	2.78
926332	AC1-034 E	2.1
926531	AC1-054 C OP	2.81
926532	AC1-054 E OP	1.29
926601	AC1-061	0.03
926851	AC1-086 C	10.67
926852	AC1-086 E	4.85
926981	AC1-099 C	3.54
926982	AC1-099 E	2.1
927561	AC1-147 C	0.74
927562	AC1-147 E	0.43

<i>927991</i>	<i>ACI-189 C</i>	<i>3.42</i>
<i>927992</i>	<i>ACI-189 E</i>	<i>1.7</i>
<i>928191</i>	<i>ACI-208 C OI</i>	<i>3.96</i>
<i>928192</i>	<i>ACI-208 E OI</i>	<i>1.76</i>
<i>928271</i>	<i>ACI-216 C OP</i>	<i>5.91</i>
<i>928272</i>	<i>ACI-216 E OP</i>	<i>4.65</i>

Appendix 6

(DVP - CPLE) The 3BTLEBRO-3ROCKYMT115T 115 kV line (from bus 314554 to bus 304223 ckt 1) loads from 149.69% to 159.91% (AC power flow) of its emergency rating (164 MVA) for the tower line contingency outage of 'LN 2058-2181'. This project contributes approximately 17.45 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

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315131	1EDGECEMA	2.44
315132	1EDGECEMB	2.44
315139	1GASTONA	2.37
315141	1GASTONB	2.37
315126	1ROARAP2	1.02
315128	1ROARAP4	0.98
315134	1ROAVALA	3.35
315135	1ROAVALB	0.89
315136	1ROSEMG1	1.91
315138	1ROSEMG2	0.89
315137	1ROSEMS1	1.18
900671	V4-068 C	0.06
900672	V4-068 E	0.19
917331	Z2-043 C	0.36

917332	Z2-043 E	0.86
917341	Z2-044 C	0.53
917342	Z2-044 E	1.26
917511	Z2-088 C OP1	0.68
917512	Z2-088 E OP1	6.22
918411	AA1-050	0.58
921162	AA1-063AC	5.73
921163	AA1-063AE	2.7
918512	AA1-065 E OP	2.03
921183	AA1-067 E	0.32
918561	AA1-072 C	0.05
918562	AA1-072 E	0.14
921752	AA2-053 C	5.82
921753	AA2-053 E	2.5
921762	AA2-057 C	13.08
921763	AA2-057 E	6.54
921982	AA2-088 C	4.15
921983	AA2-088 E	6.78
922442	AA2-165 C	1.78
922443	AA2-165 E	0.86
922512	AA2-174 C	0.27
922513	AA2-174 E	0.29
922922	AB1-081 C OP	20.25
922923	AB1-081 E OP	8.68
923262	AB1-132 C OP	10.08
923263	AB1-132 E OP	4.32

923572	<i>AB1-173 C OP</i>	<i>1.29</i>
923573	<i>AB1-173 E OP</i>	<i>0.6</i>
923582	<i>AB1-173AC OP</i>	<i>1.29</i>
923583	<i>AB1-173AE OP</i>	<i>0.6</i>
923911	<i>AB2-031 C OP</i>	<i>1.28</i>
923912	<i>AB2-031 E OP</i>	<i>0.63</i>
923991	<i>AB2-040 C OP</i>	<i>4.2</i>
923992	<i>AB2-040 E OP</i>	<i>3.44</i>
924151	<i>AB2-059 C</i>	<i>23.86</i>
924152	<i>AB2-059 E</i>	<i>12.29</i>
924491	<i>AB2-098 C</i>	<i>0.25</i>
924492	<i>AB2-098 E</i>	<i>0.11</i>
924501	<i>AB2-099 C</i>	<i>0.35</i>
924502	<i>AB2-099 E</i>	<i>0.15</i>
924511	<i>AB2-100 C</i>	<i>5.52</i>
924512	<i>AB2-100 E</i>	<i>2.72</i>
925122	<i>AB2-169 E</i>	<i>2.31</i>
925171	<i>AB2-174 C OI</i>	<i>3.84</i>
925172	<i>AB2-174 E OI</i>	<i>3.47</i>
926331	<i>AC1-034 C</i>	<i>15.46</i>
926332	<i>AC1-034 E</i>	<i>11.66</i>
926851	<i>AC1-086 C</i>	<i>14.84</i>
926852	<i>AC1-086 E</i>	<i>6.75</i>
926981	<i>AC1-099 C</i>	<i>10.95</i>
926982	<i>AC1-099 E</i>	<i>6.5</i>
927991	<i>AC1-189 C</i>	<i>5.28</i>

<i>927992</i>	<i>ACI-189 E</i>	<i>2.63</i>
<i>928191</i>	<i>ACI-208 C OI</i>	<i>12.83</i>
<i>928192</i>	<i>ACI-208 E OI</i>	<i>5.7</i>

Appendix 7

(DVP - DVP) The AB2-100 TAP-6CLUBHSE 230 kV line (from bus 924510 to bus 314563 ckt 1) loads from 108.34% to 112.01% (AC power flow) of its load dump rating (459 MVA) for the line fault with failed breaker contingency outage of '246T2034_A'. This project contributes approximately 17.24 MW to the thermal violation.

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

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
315131	1EDGECEMA	2.08
315132	1EDGECEMB	2.08
315139	1GASTONA	7.88
315141	1GASTONB	7.88
315126	1ROARAP2	1.87
315128	1ROARAP4	1.8
315134	1ROAVALA	11.01
315135	1ROAVALB	2.94
315136	1ROSEMG1	5.3
315138	1ROSEMG2	2.48
315137	1ROSEMS1	3.29
314784	1WEYRHSB	1.22
900671	V4-068 C	0.13
900672	V4-068 E	0.41

917331	Z2-043 C	0.59
917332	Z2-043 E	1.42
917341	Z2-044 C	0.29
917342	Z2-044 E	0.7
917511	Z2-088 C OP1	1.04
917512	Z2-088 E OP1	9.45
918411	AA1-050	0.87
921162	AA1-063AC	10.95
921163	AA1-063AE	5.16
918511	AA1-065 C OP	2.53
918512	AA1-065 E OP	6.95
921182	AA1-067 C	0.35
921183	AA1-067 E	0.84
918561	AA1-072 C	0.09
918562	AA1-072 E	0.24
921752	AA2-053 C	11.48
921753	AA2-053 E	4.93
921762	AA2-057 C	8.87
921763	AA2-057 E	4.43
921982	AA2-088 C	8.49
921983	AA2-088 E	13.85
922442	AA2-165 C	1.21
922443	AA2-165 E	0.58
922512	AA2-174 C	0.53
922513	AA2-174 E	0.57
922922	AB1-081 C OP	10.75

922923	<i>AB1-081 E OP</i>	<i>4.61</i>
923262	<i>AB1-132 C OP</i>	<i>33.58</i>
923263	<i>AB1-132 E OP</i>	<i>14.39</i>
924151	<i>AB2-059 C</i>	<i>12.67</i>
924152	<i>AB2-059 E</i>	<i>6.53</i>
924491	<i>AB2-098 C</i>	<i>0.65</i>
924492	<i>AB2-098 E</i>	<i>0.28</i>
924501	<i>AB2-099 C</i>	<i>0.86</i>
924502	<i>AB2-099 E</i>	<i>0.37</i>
924511	<i>AB2-100 C</i>	<i>44.05</i>
924512	<i>AB2-100 E</i>	<i>21.7</i>
925121	<i>AB2-169 C</i>	<i>0.89</i>
925122	<i>AB2-169 E</i>	<i>4.43</i>
926331	<i>AC1-034 C</i>	<i>8.21</i>
926332	<i>AC1-034 E</i>	<i>6.19</i>
926531	<i>AC1-054 C OP</i>	<i>4.81</i>
926532	<i>AC1-054 E OP</i>	<i>2.22</i>
926851	<i>AC1-086 C</i>	<i>49.46</i>
926852	<i>AC1-086 E</i>	<i>22.51</i>
926981	<i>AC1-099 C</i>	<i>10.82</i>
926982	<i>AC1-099 E</i>	<i>6.42</i>
927991	<i>AC1-189 C</i>	<i>10.05</i>
927992	<i>AC1-189 E</i>	<i>5.01</i>
928191	<i>AC1-208 C OI</i>	<i>11.51</i>
928192	<i>AC1-208 E OI</i>	<i>5.11</i>