

***Generation Interconnection
Feasibility Study Report***

For

***PJM Generation Interconnection Request
Queue Position AA1-111***

Moshannon-East Towanda 230kV

September 2015

Preface

The intent of the feasibility study is to determine a plan, with ballpark cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the Interconnection Customer. The Interconnection Customer may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system.

In some instances a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection, may also contribute to the need for the same network reinforcement. The possibility of sharing the reinforcement costs with other projects may be identified in the feasibility study, but the actual allocation will be deferred until the impact study is performed.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer 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 Interconnection Customer (IC), has proposed a natural gas generating facility located in Clinton County, PA. The installed facilities will have a total capability of 463 MW with 463 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is October 2019. **This study does not imply a Pennsylvania Electric Company (Penelec) commitment to this in-service date.**

Point of Interconnection

AA1-111 will interconnect with the Penelec transmission system along the Moshannon-East Towanda 230kV line.

Cost Summary

The AA1-111 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	\$ 0
Direct Connection Network Upgrades	\$ 8,146,500
Non Direct Connection Network Upgrades	\$ 368,300
Total Costs	\$ 8,514,800

In addition, the AA1-111 project may be responsible for a contribution to the following costs:

Description	Total Cost
New System Upgrades	\$ 156,854,300
Previously Identified Upgrades	\$ 48,911,700
Total Costs	\$ 205,766,000

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

Attachment Facilities

There are no Attachment Facilities required to be constructed by the Transmission Owner.

Direct Connection Cost Estimate

The interconnection of the Project at the primary POI will be accomplished by constructing a new 230 kV three breaker ring bus and looping the Marshall – Moshannon 230 kV line into the new station between Chapman and Lobo substations. The new 230 kV three breaker ring bus will be adjacent to Chapman substation.

The total preliminary cost estimate for the Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Total Cost
AA1-111 Interconnection SS: New 230kV three breaker ring bus substation.	\$ 7,502,100
Marshall-Moshannon 230kV, Loop to Proposed 3-Breaker Ring Bus: Install a loop, approx. 200' in length, consisting of two 3-way deadend structures and rebuild the adjacent H-frame structures (rebuild outside suspension assemblies by installing 230kV horizontal post insulators).	\$ 6,44,400
Total Direct Connection Facility Costs	\$ 8,146,500

Non-Direct Connection Cost Estimate

The total preliminary cost estimate for the Non-Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Total Cost
AA1-111 Interconnect SS: Install DTT for anti-islanding scheme on AA1-111 Interconnect line.	\$ 98,600
Marshall SS: Install DTT for anti-islanding scheme on AA1-111 Interconnect line	\$ 269,700
Total Non-Direct Connection Facility Costs	\$ 368,300

Interconnection Customer Requirements

1. 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.

2. The Interconnection Customer may be required to install and/or pay for metering as necessary to properly track real time output of the facility as well as installing metering which shall be used for billing purposes. See Section 8 of Appendix 2 to the Interconnection Service Agreement as well as Section 4 of PJM Manual 14D for additional information.
3. The Interconnection Customer seeking to interconnect a wind generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per item 5.iv. of Schedule H to the Interconnection Service Agreement.
4. The Interconnection Customer will be responsible for acquiring all easements, properties and permits that may be required to construct both the new 230 kV three breaker ring bus interconnection substation and the associated attachment facilities. The Interconnection Customer will also be responsible for the rough grade of the property and an access road to the proposed three breaker ring bus site.
5. The purchase and installation of a fully rated circuit breaker on the high side of the (AA1-111) GSU transformer.
6. The purchase and installation of the minimum required FE generation interconnection relaying and control facilities. This includes over/under voltage protection, over/under frequency protection, and zero sequence voltage protection relays.
7. The purchase and installation of a 230 kV interconnection metering instrument transformer. FE will provide the ratio and accuracy specifications based on the customer load and generation levels.
8. The purchase and installation of a revenue class meter for each unit to measure the power delivered in compliance with the FE standards.
9. The purchase and installation of supervisory control and data acquisition (SCADA) equipment to provide information in a compatible format to the FE Transmission System Control Center.
10. The establishment of dedicated communication circuits for SCADA report to the FE Transmission System Control Center.
11. A compliance with the FE and PJM generator power factor and voltage control requirements.
12. The execution of a back-up service agreement to serve the customer load supplied from the (AA1-111) 230 kV interconnection substation when the units are out-of-service. This assumes the intent of the Interconnection Customer is to net the generation with the load.
13. The rough grade of the property for the (AA1-111) 230 kV interconnection substation and an access road for the delivery of equipment to this site.

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.

Penelec Requirements

The Interconnection Customer will be required to comply with all FE Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the "FirstEnergy Requirements for Transmission Connected Facilities" document located at the following links:

<http://www.firstenergycorp.com/feconnect>

<http://www.pjm.com/planning/design-engineering/to-tech-standards.aspx>

Network Impacts

The Queue Project AA1-111 was studied as a 463.0 MW (Capacity 463.0 MW) injection as a tap of the Chapman-Lobo-230kV line in the Penelec area. Project AA1-111 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AA1-111 was studied with a commercial probability of 53% using a Summer Peak 2019 case. Potential network impacts were as follows:

Contingency Descriptions

The following contingencies resulted in overloads:

Contingency Name	Description
01MILESB-01MOSHAN 230_A	CONTINGENCY '01MILESB-01MOSHAN 230_A' OPEN BRANCH FROM BUS 235219 TO BUS 918700 CKT 1 /235219 01MILESB 230 918700 AA1-085_TAP 230 END
AP_SB_449AA_A	CONTINGENCY 'AP_SB_449AA_A' / MOSHANNON230 FUTURE 4 BREAKER RING BUS - SB #A OPEN BRANCH FROM BUS 235220 TO BUS 918700 CKT 1 /*MOSHANNON-AA1-085 TAP (MILESBERG) OPEN BRANCH FROM BUS 235220 TO BUS 235236 CKT 1 /*MOSHANNON-QUEHANNA OPEN BRANCH FROM BUS 235236 TO BUS 235175 CKT 1 /*QUEHANNA-ELKO END
AP_SB_450A_A	CONTINGENCY 'AP_SB_450A_A' / MOSHANNON230 FUTURE 4 BREAKER RING BUS - SB #B OPEN BRANCH FROM BUS 235220 TO BUS 235236 CKT 1 /*MOSHANNON-QUEHANNA OPEN BRANCH FROM BUS 235236 TO BUS 235175 CKT 1 /*QUEHANNA-ELKO OPEN BRANCH FROM BUS 235220 TO BUS 200908 CKT 1F /*MOSHANNON-CHAPMAN OPEN BRANCH FROM BUS 200908 TO BUS 919490 CKT 1 /*CHAPMAN-AA1-111 TAP END
AP_SB_451A_A	CONTINGENCY 'AP_SB_451A_A' / MOSHANNON230 FUTURE 4 BREAKER RING BUS - SB #C OPEN BRANCH FROM BUS 235220 TO BUS 200908 CKT 1F /*MOSHANNON-CHAPMAN OPEN BRANCH FROM BUS 200908 TO BUS 919490 CKT 1 /*CHAPMAN-AA1-111 TAP OPEN BRANCH FROM BUS 235220 TO BUS 200710 CKT 1 /*MOSHANNON-SHAWVILLE END

Contingency Name	Description
B_LINE_SY_017	CONTINGENCY 'B_LINE_SY_017' /* LINE 02AT TO ERIE W 345 CK 1 DISCONNECT BRANCH FROM BUS 238547 TO BUS 200599 CKT 1 /* 02AT 345.00 ERIE W 345.00 END
B_LINE_SY_018	CONTINGENCY 'B_LINE_SY_018' /* 3-TERMINAL LINE PERRY-AT-ERIE W 345 CK 1 DISCONNECT BRANCH FROM BUS 239036 TO BUS 238547 CKT 1 /* 02PERRY 345.00 02AT 345.00 DISCONNECT BRANCH FROM BUS 238547 TO BUS 239082 CKT 1 /* 02AT 345.00 02S8-ATT 345.00 DISCONNECT BRANCH FROM BUS 239082 TO BUS 238544 CKT 8 /* 02S8-ATT 345.00 02ASH_3 138.00 DISCONNECT BRANCH FROM BUS 238547 TO BUS 200599 CKT 1 /* 02AT 345.00 ERIE W 345.00 END
B_PN230-LS-#21A	CONTINGENCY 'B_PN230-LS-#21A' /* ERIE SOUTH 230/115 KV BANK 1 FAULT DISCONNECT BRANCH FROM BUS 200819 TO BUS 200820 CKT 1 /* ERIE SE 230.00 ERIE SE 115.00 DISCONNECT BRANCH FROM BUS 200819 TO BUS 200928 CKT 1F /* ERIE SE 230.00 FOURMILE 230.00 DISCONNECT BRANCH FROM BUS 200819 TO BUS 200625 CKT 4 /* ERIE SE 230.00 ERIE S E 34.50 DISCONNECT BRANCH FROM BUS 200819 TO BUS 200600 CKT 8 /* ERIE SE 230.00 ERIE SO 345.00 DISCONNECT BRANCH FROM BUS 200819 TO BUS 200918 CKT ZB /* ERIE SE 230.00 26ERIE S TIE 230 REDUCE BUS 200819 SHUNT BY 100 PERCENT /* ERIE SE 230.00 END
B_PN230-SX-#11B	CONTINGENCY 'B_PN230-SX-#11B' /* EASTTOWANDA - N MESHOPPEN (ETP) 230 KV & N MESHOPPEN BK 4 DISCONNECT BRANCH FROM BUS 200675 TO BUS 200924 CKT 1F /* 200675 26E.TWANDA 200924 26CANYON DISCONNECT BRANCH FROM BUS 200924 TO BUS 200706 CKT 1F /* 200924 26CANYON 200706 26N.MESHPN DISCONNECT BRANCH FROM BUS 200706 TO BUS 200677 CKT 4 /* 200706 26N.MESHPN 200677 26NO MESHO END
B_PN230-SX-#17C	CONTINGENCY 'B_PN230-SX-#17C' /* ERIE SOUTH - FOURMILE 230 KV DISCONNECT BRANCH FROM BUS 200819 TO BUS 200928 CKT 1F /* ERIE SE 230.00 FOURMILE 230.00 END
B_PN230-SX-#19	CONTINGENCY 'B_PN230-SX-#19' /* ERIE SOUTH - WARREN (GES) 230 KV - (PJM-PN28) DISCONNECT BRANCH FROM BUS 200918 TO BUS 200811 CKT 1 END

Contingency Name	Description
B_PN230-SX-#47	CONTINGENCY 'B_PN230-SX-#47' /* LACKAWANNA-OXBOW-NORTH MESHOPPEN 230 KV DISCONNECT BRANCH FROM BUS 200706 TO BUS 200708 CKT 1 DISCONNECT BRANCH FROM BUS 200708 TO BUS 208009 CKT 1 DISCONNECT BRANCH FROM BUS 200706 TO BUS 200825 CKT 3 DISCONNECT BRANCH FROM BUS 200825 TO BUS 200677 CKT 3 DISCONNECT BRANCH FROM BUS 200708 TO BUS 200709 CKT 1 DISCONNECT BUS 200708 DISCONNECT BUS 200825 END
B_PN345-SX-#6	CONTINGENCY 'B_PN345-SX-#6' /* HANDSOME LAKE - WAYNE (WHL) 345 KV - (PJM-PN33A) DISCONNECT BRANCH FROM BUS 200826 TO BUS 200595 CKT 1 END
B_PN345-XF-#113B	CONTINGENCY 'B_PN345-XF-#113B' /* HOMER CITY 345/230 KV NORTH 3WINDING AUTO-TRANSFORMER - (PJM-PN30) DISCONNECT BRANCH FROM BUS 200769 TO BUS 200767 TO BUS 202640 CKT N END
B_PN345-XF-#113C	CONTINGENCY 'B_PN345-XF-#113C' /* HOMER CITY 345/230 KV NORTH 3WINDING AUTO-TRANSFORMER WITH FAST TRANSFER OF SCRUBBER LOAD DISCONNECT BRANCH FROM BUS 200769 TO BUS 200767 TO BUS 202640 CKT N CLOSE BRANCH FROM BUS 202640 TO BUS 202642 CKT ZB END
B_PN345-XF-#114B	CONTINGENCY 'B_PN345-XF-#114B' /* HOMER CITY 345/230 KV SOUTH 3WINDING AUTO-TRANSFORMER - (PJM-PN31) DISCONNECT BRANCH FROM BUS 200769 TO BUS 200767 TO BUS 202641 CKT S END
B_PN345-XF-#114C	CONTINGENCY 'B_PN345-XF-#114C' /* HOMER CITY 345/230 KV SOUTH 3WINDING AUTO-TRANSFORMER WITH FAST TRANSFER OF SCRUBBER LOAD DISCONNECT BRANCH FROM BUS 200769 TO BUS 200767 TO BUS 202641 CKT S CLOSE BRANCH FROM BUS 202641 TO BUS 202642 CKT ZB END
C1_PN115-BS-76B	CONTINGENCY 'C1_PN115-BS-76B' /* NORTH MESHOPPEN 115 KV MAIN BUS FAULT 2 DISCONNECT BRANCH FROM BUS 200677 TO BUS 200698 CKT 2 DISCONNECT BRANCH FROM BUS 200677 TO BUS 200674 CKT 1 DISCONNECT BRANCH FROM BUS 200677 TO BUS 200687 CKT 2 DISCONNECT BRANCH FROM BUS 200677 TO BUS 200706 CKT 4 END

Contingency Name	Description
C1_PN230-BS-22B	CONTINGENCY 'C1_PN230-BS-22B' /* LEWISTOWN 2 230 KV BUS FAULT DISCONNECT BRANCH FROM BUS 200513 TO BUS 200512 TO BUS 200548 CKT 2 DISCONNECT BRANCH FROM BUS 200513 TO BUS 200512 CKT 3 DISCONNECT BRANCH FROM BUS 200513 TO BUS 200517 CKT 1F DISCONNECT BRANCH FROM BUS 200513 TO BUS 235248 CKT 1 DISCONNECT BRANCH FROM BUS 200513 TO BUS 200531 CKT 2 END
C2_PN115-SB-#19F	CONTINGENCY 'C2_PN115-SB-#19F' /* EAST TOWANDA 115 KV STUCK CB - CBE (EAST TOWANDA BUS TIE CB) DISCONNECT BRANCH FROM BUS 200674 TO BUS 200677 CKT 1 REDUCE BUS 200674 SHUNT BY 100 PERCENT DISCONNECT BRANCH FROM BUS 200674 TO BUS 200689 CKT 1 DISCONNECT BRANCH FROM BUS 200674 TO BUS 200689 CKT 2 DISCONNECT BRANCH FROM BUS 200676 TO BUS 200674 CKT 1 DISCONNECT BRANCH FROM BUS 200674 TO BUS 200866 CKT ZB DISCONNECT BRANCH FROM BUS 200674 TO BUS 200675 CKT 3 DISCONNECT BRANCH FROM BUS 200674 TO BUS 200675 CKT 4 END
C2_PN115-SB-#46E	CONTINGENCY 'C2_PN115-SB-#46E' /* NORTH MESHOPPEN 115 KV STUCK CB - (N MESHOPPEN – MEHOOPANY #3,#4&#5) DISCONNECT BRANCH FROM BUS 200677 TO BUS 200698 CKT 2 DISCONNECT BUS 200698 DISCONNECT BRANCH FROM BUS 200677 TO BUS 200674 CKT 1 DISCONNECT BRANCH FROM BUS 200677 TO BUS 200687 CKT 2 DISCONNECT BRANCH FROM BUS 200677 TO BUS 200706 CKT 4 END
C2_PN115-SB-46F	CONTINGENCY 'C2_PN115-SB-46F' /* NORTH MESHOPPEN 115 KV STUCK CB14 - (N MESHOPPEN XFMR 3) /* MARCH 17, 2010 DISCONNECT BRANCH FROM BUS 200677 TO BUS 200699 CKT 1 DISCONNECT BRANCH FROM BUS 200677 TO BUS 200678 CKT 1 REDUCE BUS 200677 SHUNT BY 100 PERCENT DISCONNECT BRANCH FROM BUS 200677 TO BUS 200684 CKT 1 DISCONNECT BRANCH FROM BUS 200706 TO BUS 200708 CKT 1 DISCONNECT BRANCH FROM BUS 200708 TO BUS 208009 CKT 1 DISCONNECT BRANCH FROM BUS 200706 TO BUS 200825 CKT 3 DISCONNECT BRANCH FROM BUS 200825 TO BUS 200677 CKT 3 DISCONNECT BRANCH FROM BUS 200708 TO BUS 200709 CKT 1 DISCONNECT BUS 200708 / ISOLATE OXBOW 230.00 DISCONNECT BUS 200825 / ISOLATE MESH2REA 115.00 DISCONNECT BUS 200684 / ISOLATE N MESH 34.50 DISCONNECT BUS 200709 / ISOLATE OXBOW 34.50 END

Contingency Name	Description
C2_PN115-SB-46G1	CONTINGENCY 'C2_PN115-SB-46G1' /* NORTH MESHOPPEN 115 KV STUCK CB20 - (N MESHOPPEN XFMR 4) DISCONNECT BRANCH FROM BUS 200677 TO BUS 200698 CKT 2 DISCONNECT BRANCH FROM BUS 200677 TO BUS 200674 CKT 1 DISCONNECT BRANCH FROM BUS 200677 TO BUS 200687 CKT 2 DISCONNECT BRANCH FROM BUS 200706 TO BUS 200677 CKT 4 DISCONNECT BRANCH FROM BUS 200706 TO BUS 200924 CKT 1F /* NMESHOPPEN-CANYON DISCONNECT BRANCH FROM BUS 200924 TO BUS 200675 CKT 1F /* CANYON- ETOWANDA END
C2_PN115-SB-83D1	CONTINGENCY 'C2_PN115-SB-83D1' /* FUTURE FOUR MILE 115KV SB OPEN BRANCH FROM BUS 200927 TO BUS 200928 CKT 6F /* FOUR MILE 230/115KV XFMR OPEN BRANCH FROM BUS 200927 TO BUS 200570 CKT 1F /* FOUR MILE - CORRY EAST 115KV END
C2_PN230-SB-14B	CONTINGENCY 'C2_PN230-SB-14B' /* LEWISTOWN 230 KV STUCK CB - CB (LEWISTOWN - RAYSTOWN) DISCONNECT BRANCH FROM BUS 200513 TO BUS 200517 CKT 1F DISCONNECT BRANCH FROM BUS 200517 TO BUS 200539 CKT 1 DISCONNECT BRANCH FROM BUS 200513 TO BUS 235248 CKT 1 DISCONNECT BRANCH FROM BUS 200513 TO BUS 200531 CKT 2 DISCONNECT BRANCH FROM BUS 200513 TO BUS 200512 CKT 3 DISCONNECT BRANCH FROM BUS 200513 TO BUS 200512 TO BUS 200548 CKT 2 END
C2_PN230-SB-17A	CONTINGENCY 'C2_PN230-SB-17A' /* NORTH MESHOPPEN 230 KV STUCK CB - CB19 (BETWEEN TRANSFORMERS 3&4) DISCONNECT BRANCH FROM BUS 200706 TO BUS 200825 CKT 3 DISCONNECT BRANCH FROM BUS 200825 TO BUS 200677 CKT 3 DISCONNECT BUS 200825 DISCONNECT BRANCH FROM BUS 200706 TO BUS 200677 CKT 4 DISCONNECT BRANCH FROM BUS 200706 TO BUS 200708 CKT 1 DISCONNECT BUS 200706 DISCONNECT BRANCH FROM BUS 200708 TO BUS 200709 CKT 1 DISCONNECT BRANCH FROM BUS 200708 TO BUS 208009 CKT 1 DISCONNECT BUS 200708 DISCONNECT BRANCH FROM BUS 200675 TO BUS 200924 CKT 1F DISCONNECT BRANCH FROM BUS 200706 TO BUS 200924 CKT 1F END
C2_PN230-SB-9E2	CONTINGENCY 'C2_PN230-SB-9E2' /* HOMER CITY 230 KV STUCK CB - CB206 DISCONNECT BRANCH FROM BUS 200769 TO BUS 200767 TO BUS 202641 CKT S DISCONNECT BRANCH FROM BUS 200767 TO BUS 200837 CKT 1 REMOVE MACHINE 1 FROM BUS 200837 END

Contingency Name	Description
C2_PN230-SB-9I2	CONTINGENCY 'C2_PN230-SB-9I2' /* HOMER CITY 230 KV STUCK CB - CB210 DISCONNECT BRANCH FROM BUS 200767 TO BUS 200807 CKT 1 DISCONNECT BRANCH FROM BUS 200807 TO BUS 200808 CKT 1 DISCONNECT BRANCH FROM BUS 200808 TO BUS 200809 CKT 1 REMOVE MACHINE 1 FROM BUS 200809 DISCONNECT BUS 200807 DISCONNECT BUS 200808 DISCONNECT BUS 200809 DISCONNECT BRANCH FROM BUS 200767 TO BUS 200769 TO BUS 202640 CKT N END
C2_PN345-SB-4A2	CONTINGENCY 'C2_PN345-SB-4A2' /* HOMER CITY 345 KV STUCK CB - CB301 DISCONNECT BRANCH FROM BUS 200769 TO BUS 235129 CKT 1F /* HOMER CITY-ARMSTRONG DISCONNECT BRANCH FROM BUS 200767 TO BUS 200769 TO BUS 202640 CKT N END
C2_PN345-SB-7A	CONTINGENCY 'C2_PN345-SB-7A' /* WAYNE 345 KV STUCK CB - CB30 DISCONNECT BRANCH FROM BUS 200595 TO BUS 200599 CKT 1 DISCONNECT BRANCH FROM BUS 200595 TO BUS 200598 CKT 2 END
C2_PN345-SB-7B	CONTINGENCY 'C2_PN345-SB-7B' /* WAYNE 345 KV STUCK CB - CB45 DISCONNECT BRANCH FROM BUS 200595 TO BUS 200826 CKT 1 DISCONNECT BRANCH FROM BUS 200595 TO BUS 200599 CKT 1 DISCONNECT BRANCH FROM BUS 200595 TO BUS 200598 CKT 2 DISCONNECT BUS 200595 END
C2_PN345-SB-7C	CONTINGENCY 'C2_PN345-SB-7C' /* WAYNE 345 KV STUCK CB - CB10 DISCONNECT BRANCH FROM BUS 200595 TO BUS 200826 CKT 1 DISCONNECT BRANCH FROM BUS 200595 TO BUS 200598 CKT 2 END
C5-TWL-NR057A	CONTINGENCY 'C5-TWL-NR057A' /* PERRY-LRCR AND PERRY-NRFD 345KV LINE OUTAGES OPEN BRANCH FROM BUS 239334 TO BUS 239036 CKT 1 / 239334 02L.CENTER 345 239036 02PERRY 345 1 OPEN BRANCH FROM BUS 239358 TO BUS 239036 CKT 1 / 239358 02NFIELD 345.00 239036 02PERRY 345 END
C5-TWL-NR63A	CONTINGENCY 'C5-TWL-NR63A' /* PERRY-EASTLAKE AND PERRY-NORTHFIELD 345KV LINE OUTAGES DISCONNECT BRANCH FROM BUS 238684 TO BUS 239036 CKT 1 /* 02EASTLK 345.00 02PERRY 345.00 DISCONNECT BRANCH FROM BUS 239358 TO BUS 239036 CKT 1 /* 02NFIELD 345.00 02PERRY 345.00 END

Contingency Name	Description
DQE_163	CONTINGENCY 'DQE_163' /* LINE ERIE W TO 02PERRY 345 CK 1 DISCONNECT BRANCH FROM BUS 238547 TO BUS 239036 CKT 1 DISCONNECT BRANCH FROM BUS 200599 TO BUS 238547 CKT 1 END
PL100328	CONTINGENCY 'PL100328' /* LACK 230KV EAST BUS & LACK T2 DISCONNECT BRANCH FROM BUS 200074 TO BUS 208009 CKT 4 DISCONNECT BRANCH FROM BUS 200706 TO BUS 200825 CKT 3 DISCONNECT BRANCH FROM BUS 211681 TO BUS 208009 CKT 2 DISCONNECT BRANCH FROM BUS 200708 TO BUS 208009 CKT 1 /* END
PL100329	CONTINGENCY 'PL100329' /* LACK 230KV WEST BUS & LACK T1 DISCONNECT BRANCH FROM BUS 200074 TO BUS 208009 CKT 3 DISCONNECT BRANCH FROM BUS 211681 TO BUS 208009 CKT 1 END
PL100352	CONTINGENCY 'PL100352' /* LACK-OXBO-N.MES 230KV & OXBO TR DISCONNECT BRANCH FROM BUS 200706 TO BUS 200825 CKT 3 DISCONNECT BUS 200708 END
PL100855	CONTINGENCY 'PL100855' /* STAN-LACK 230KV - STUCK CB AT LACK 4W DISCONNECT BRANCH FROM BUS 208009 TO BUS 211681 CKT 1 DISCONNECT BRANCH FROM BUS 200074 TO BUS 208009 CKT 3 /* LACK T3 DISCONNECT BRANCH FROM BUS 208009 TO BUS 208094 CKT 1 /* STAN-LACK END
PL100858	CONTINGENCY 'PL100858' /* MOUN-LACK 230KV - STUCK CB AT LACK 3W DISCONNECT BRANCH FROM BUS 208009 TO BUS 211681 CKT 1 /* LACK T1 230-69 KV DISCONNECT BUS 234253 /* MOUN-LACK DISCONNECT BRANCH FROM BUS 200074 TO BUS 208009 CKT 3 /* LACK T3 500-230 KV END
X4-048 COLL-LACK	CONTINGENCY 'X4-048 COLL-LACK' DISCONNECT BRANCH FROM BUS 912250 TO BUS 208009 CKT 1 END
X4-048 COLL-X4-048	CONTINGENCY 'X4-048 COLL-X4-048' DISCONNECT BRANCH FROM BUS 912250 TO BUS 912251 CKT 2 END

Generator Deliverability

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

#	Contingency		Affected Area	Facility Description	Bus		Circuit	Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To			Initial	Final	Type	MVA		
1	N-1	B_PN345-SX-#6	NYISO - PENELEC	S RIPLEY-26ERIE E 230 kV line	135251	200654	1	DC	82.04	85.99	ER	607	23.95	
2	N-1	B_PN230-SX-#19	NYISO - PENELEC	S RIPLEY-26ERIE E 230 kV line	135251	200654	1	DC	77.98	83.06	ER	607	30.85	
3	N-1	B_PN345-SX-#6	PENELEC	26ERIE E-W3-099 TAP 230 kV line	200654	903645	1	DC	79.9	83.94	ER	592	23.95	
4	N-1	B_PN230-SX-#19	PENELEC	26ERIE E-W3-099 TAP 230 kV line	200654	903645	1	DC	75.75	80.96	ER	592	30.85	
5	Non	Non	PENELEC	26E.TWANDA-26CANYON 230 kV line	200675	200924	1F	DC	98.97	115.13	NR	546	88.22	
6	N-1	X4-048 COLL-LACK	PENELEC	26E.TWANDA-26CANYON 230 kV line	200675	200924	1F	DC	95	108.21	ER	666	87.97	
7	N-1	X4-048 COLL-X4-048	PENELEC	26E.TWANDA-26CANYON 230 kV line	200675	200924	1F	DC	95	108.21	ER	666	87.97	
8	N-1	B_PN230-SX-#11B	PENELEC	26NO MESHO-26MESH2REA 115 kV line	200677	200842	3	DC	85.08	101.74	ER	197	32.82	1
9	Non	Non	PENELEC	26N.MESHPN-26OXBOW 230 kV line	200706	200708	1	DC	63.04	74.81	NR	855	100.68	
10	N-1	X4-048 COLL-X4-048	PENELEC	26N.MESHPN-26OXBOW 230 kV line	200706	200708	1	DC	66.93	77.13	ER	984	100.35	
11	N-1	X4-048 COLL-LACK	PENELEC	26N.MESHPN-26OXBOW 230 kV line	200706	200708	1	DC	66.93	77.13	ER	984	100.35	
12	Non	Non	PENELEC - PL	26OXBOW-LACK 230 kV line	200708	208009	1	DC	61.67	73.6	NR	855	101.95	
13	N-1	X4-048 COLL-X4-048	PENELEC - PL	26OXBOW-LACK 230 kV line	200708	208009	1	DC	65.96	76.28	ER	984	101.61	

#	Contingency		Affected Area	Facility Description	Bus		Circuit	Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To			Initial	Final	Type	MVA		
14	N-1	X4-048 COLL-LACK	PENELEC - PL	26OXBOW-LACK 230 kV line	200708	208009	1	DC	65.96	76.28	ER	984	101.61	
15	N-1	01MILESB-01MOSHAN 230_A	PENELEC - AP	26SHAWVL 2-01SHINGL 230 kV line	200726	235248	1	DC	75.81	91.95	ER	554	89.37	
16	N-1	01MILESB-01MOSHAN 230_A	PENELEC - AP	26SHAWVL 2-01SHINGL 230 kV line	200726	235248	1	DC	75.81	91.95	ER	554	89.37	
17	N-1	DQE_163	PENELEC	26HOMER CT-26SHELOCTA 230 kV line	200767	200795	1	DC	78.98	82.35	ER	917	68.58	2
18	N-1	B_LINE_SY_017	PENELEC	26HOMER CT-26SHELOCTA 230 kV line	200767	200795	1	DC	78.98	82.35	ER	917	68.58	
19	N-1	B_PN345-XF-#114C	PENELEC	26HOMER CY 345/1 kV transformer	200769	999442	N	DC	78.99	82.02	ER	807	54.28	
20	N-1	B_PN345-XF-#114B	PENELEC	26HOMER CY 345/1 kV transformer	200769	999442	N	DC	78.27	81.3	ER	807	54.28	
21	N-1	B_PN345-XF-#113C	PENELEC	26HOMER CY 345/1 kV transformer	200769	999443	S	DC	78.16	81.11	ER	824	53.98	
22	N-1	B_PN345-XF-#113B	PENELEC	26HOMER CY 345/1 kV transformer	200769	999443	S	DC	77.31	80.26	ER	824	53.98	
23	N-1	B_PN230-SX-#11B	PENELEC	26N.MESHPN 230/115 kV transformer	200842	200706	3	DC	89.15	106.61	ER	188	32.82	3
24	N-1	PL100352	PENELEC - AP	26CHAPMAN+-01MOSHAN 230 kV line	200908	235220	1F	DC	45.29	93.57	ER	666	321.51	
25	N-1	B_PN230-SX-#47	PENELEC - AP	26CHAPMAN+-01MOSHAN 230 kV line	200908	235220	1F	DC	45.29	93.57	ER	666	321.51	
26	Non	Non	PENELEC - AP	26CHAPMAN+-01MOSHAN 230 kV line	200908	235220	1F	DC	36.95	92.21	NR	546	301.72	
27	Non	Non	PENELEC - AP	26CHAPMAN+-01MOSHAN 230 kV line	200908	235220	1F	DC	36.95	92.21	NR	546	301.72	

Contingency			Affected Area	Facility Description	Bus			Power Flow	Loading %		Rating		MW Contribution	Ref
#	Type	Name			From	To	Circuit		Initial	Final	Type	MVA		
28	N-1	X4-048 COLL-LACK	PENELEC	26CANYON-26N.MESHPN 230 kV line	200924	200706	1F	DC	97.95	112.2	ER	617	87.97	
29	N-1	X4-048 COLL-X4-048	PENELEC	26CANYON-26N.MESHPN 230 kV line	200924	200706	1F	DC	97.95	112.2	ER	617	87.97	
30	N-1	B_PN230-SX-#17C	PENELEC	26FOURMILE-26ERIE SE 115 kV line	200927	200820	1F	DC	75.75	78.87	ER	228	15.78	4
31	N-1	B_PN230-LS-#21A	PENELEC	26FOURMILE-26ERIE SE 115 kV line	200927	200820	1F	DC	70.08	72.95	ER	228	14.54	
32	N-1	B_LINE_SY_017	AP - AP	01KARNSC-01BUTLER 138 kV line	235197	235152	1	DC	74.33	80.99	ER	179	26.45	5
33	N-1	B_LINE_SY_018	AP - AP	01KARNSC-01BUTLER 138 kV line	235197	235152	1	DC	74.33	80.99	ER	179	26.45	
34	N-1	B_PN345-SX-#6	PENELEC	W3-099 TAP-26FOURMILE 230 kV line	903645	200928	1	DC	82.03	86.07	ER	592	23.92	6
35	N-1	B_PN230-SX-#19	PENELEC	W3-099 TAP-26FOURMILE 230 kV line	903645	200928	1	DC	77.86	83.07	ER	592	30.82	
36	N-1	B_PN230-SX-#47	PENELEC	AA2-000 TAP-26CHAPMAN+ 230 kV line	919490	200908	1	DC	45.31	93.58	ER	666	321.51	
37	N-1	PL100352	PENELEC	AA2-000 TAP-26CHAPMAN+ 230 kV line	919490	200908	1	DC	45.31	93.58	ER	666	321.51	
38	Non	Non	PENELEC	AA2-000 TAP-26CHAPMAN+ 230 kV line	919490	200908	1	DC	36.97	92.23	NR	546	301.72	
39	N-1	B_PN345-XF-#114C	PENELEC	26HOMER CT 230/1 kV transformer	999442	200767	N	DC	75.83	78.86	ER	807	54.28	
40	N-1	B_PN345-XF-#114B	PENELEC	26HOMER CT 230/1 kV transformer	999442	200767	N	DC	75.11	78.14	ER	807	54.28	
41	N-1	B_PN345-XF-#113C	PENELEC	26HOMER CT 230/1 kV transformer	999443	200767	S	DC	75.61	78.56	ER	824	53.98	
42	N-1	B_PN345-XF-#113B	PENELEC	26HOMER CT 230/1 kV transformer	999443	200767	S	DC	74.76	77.71	ER	824	53.98	

Note: Please see Attachment 3 for projects providing impacts to flowgate violations. The values in the Reference column correspond to the proper table in the Attachment.

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		Circuit	Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To			Initial	Final	Type	MVA		
43	LFFB	C2_PN345-SB-7B	NYISO - PENELEC	S RIPLEY-26ERIE E 230 kV line	135251	200654	1	DC	90.15	91.94	ER	607	24.23	7
44	LFFB	C2_PN345-SB-7A	NYISO - PENELEC	S RIPLEY-26ERIE E 230 kV line	135251	200654	1	DC	90.15	91.94	ER	607	24.23	
45	LFFB	C2_PN345-SB-7C	PENELEC	S RIPLEY-26ERIE E 230 kV line	135251	200654	1	DC	90.15	91.94	ER	607	24.23	
46	LFFB	C2_PN345-SB-7A	PENELEC	26ERIE E-W3-099 TAP 230 kV line	200654	903645	1	DC	88.21	90.05	ER	592	24.23	8
47	LFFB	C2_PN345-SB-7B	PENELEC	26ERIE E-W3-099 TAP 230 kV line	200654	903645	1	DC	88.21	90.05	ER	592	24.23	
48	LFFB	C2_PN345-SB-7C	PENELEC	26ERIE E-W3-099 TAP 230 kV line	200654	903645	1	DC	88.21	90.05	ER	592	24.23	
49	LFFB	AP_SB_451A_A	PENELEC - NYISO	26E.TWANDA-HILSD230 230 kV line	200675	130763	1	DC	82.44	110.55	ER	531	149.26	
50	LFFB	AP_SB_450A_A	PENELEC - NYISO	26E.TWANDA-HILSD230 230 kV line	200675	130763	1	DC	82.35	110.46	ER	531	149.24	
51	LFFB	C2_PN230-SB-17A	PENELEC - NYISO	26E.TWANDA-HILSD230 230 kV line	200675	130763	1	DC	97.11	104.42	ER	531	86.17	
52	BUS	PL100328	PENELEC - NYISO	26E.TWANDA-HILSD230 230 kV line	200675	130763	1	DC	94.07	101.19	ER	531	83.88	
53	LFFB	AP_SB_450A_A	PENELEC	26N.MESHPN-26OXBOW 230 kV line	200706	200708	1	DC	84.97	107.45	ER	984	221.16	9

#	Contingency		Affected Area	Facility Description	Bus			Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To	Circuit		Initial	Final	Type	MVA		
54	LFFB	AP_SB_451A_A	PENELEC	26N.MESHPN-26OXBOW 230 kV line	200706	200708	1	DC	84.82	107.29	ER	984	221.11	
55	LFFB	C2_PN230-SB-14B	PENELEC	26N.MESHPN-26OXBOW 230 kV line	200706	200708	1	DC	84.76	90.09	ER	984	116.34	
56	BUS	C1_PN230-BS-22B	PENELEC	26N.MESHPN-26OXBOW 230 kV line	200706	200708	1	DC	84.66	89.99	ER	984	116.34	
57	LFFB	AP_SB_450A_A	PENELEC - PL	26OXBOW-LACK 230 kV line	200708	208009	1	DC	85.6	95.84	ER	984	223.71	10
58	LFFB	AP_SB_451A_A	PENELEC - PL	26OXBOW-LACK 230 kV line	200708	208009	1	DC	85.44	95.68	ER	984	223.67	
59	BUS	C1_PN230-BS-22B	PENELEC - PL	26OXBOW-LACK 230 kV line	200708	208009	1	DC	85.82	91.22	ER	984	117.81	
60	LFFB	AP_SB_449AA_A	PENELEC - AP	26SHAWVL 2-01SHINGL 230 kV line	200726	235248	1	DC	82.32	100.42	ER	554	100.26	11
61	LFFB	AP_SB_449AA_A	PENELEC - AP	26SHAWVL 2-01SHINGL 230 kV line	200726	235248	1	DC	82.32	100.42	ER	554	100.26	
62	LFFB	C2_PN230-SB-9I2	PENELEC	26HOMER CY 345/1 kV transformer	200769	999443	S	DC	91.41	94.36	ER	824	53.95	
63	LFFB	C2_PN115-SB-46F	PENELEC - AP	26CHAPMAN+-01MOSHAN 230 kV line	200908	235220	1F	DC	65.37	113.92	ER	666	323.33	12
64	LFFB	C2_PN115-SB-46F	PENELEC - AP	26CHAPMAN+-01MOSHAN 230 kV line	200908	235220	1F	DC	65.37	113.92	ER	666	323.33	
65	LFFB	C2_PN230-SB-17A	PENELEC - AP	26CHAPMAN+-01MOSHAN 230 kV line	200908	235220	1F	DC	64.19	112.54	ER	666	322.06	
66	LFFB	C2_PN230-SB-17A	PENELEC - AP	26CHAPMAN+-01MOSHAN 230 kV line	200908	235220	1F	DC	64.19	112.54	ER	666	322.06	
67	LFFB	C2_PN115-SB-83D1	PENELEC	26FOURMILE-26ERIE SE 230 kV line	200928	200819	1F	DC	85.85	87.69	ER	584	23.78	13
68	LFFB	AP_SB_450A_A	PENELEC	26SCOTCHHLLW-26E.TWANDA 230 kV line	200940	200675	1	DC	43.45	123.54	ER	554	443.73	14

#	Contingency		Affected Area	Facility Description	Bus			Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To	Circuit		Initial	Final	Type	MVA		
69	LFFB	AP_SB_451A_A	PENELEC	26SCOTCHHLLW-26E.TWANDA 230 kV line	200940	200675	1	DC	43.45	123.54	ER	554	443.73	
70	LFFB	PL100858	PL - PJM500	LACKAW 500/230 kV transformer	208009	200074	4	DC	92.15	94.15	ER	1165	51.76	
71	BUS	PL100329	PL - PJM500	LACKAW 500/230 kV transformer	208009	200074	4	DC	93.27	95.07	ER	1165	46.62	
72	LFFB	AP_SB_449AA_A	AP - PENELEC	01MOSHAN-26SHAWVL 1 230 kV line	235220	200710	1	DC	45.61	95.51	ER	554	276.46	15
73	LFFB	AP_SB_449AA_A	AP - PENELEC	01MOSHAN-26SHAWVL 1 230 kV line	235220	200710	1	DC	45.61	95.51	ER	554	276.46	
74	LFFB	C2_PN115-SB-46F	AP - PENELEC	01SHINGL-26LEWISTWN 230 kV line	235248	200513	1	DC	67.44	90.91	ER	554	130.02	16
75	LFFB	C2_PN230-SB-17A	AP - PENELEC	01SHINGL-26LEWISTWN 230 kV line	235248	200513	1	DC	67.31	90.68	ER	554	129.51	
76	DCTL	C5-TWL-NR057A	FE - FE	02PERRY-02EASTLK 345 kV line	239036	238684	1	DC	97.75	99.09	ER	1793	53.53	17
77	LFFB	AP_SB_450A_A	PENELEC	AA1-144 TAP-26SCOTCHHLLW 230 kV line	919200	200940	1	DC	40.84	112.29	ER	621	443.73	18
78	LFFB	AP_SB_451A_A	PENELEC	AA1-144 TAP-26SCOTCHHLLW 230 kV line	919200	200940	1	DC	40.82	112.28	ER	621	443.73	
79	LFFB	C2_PN115-SB-46F	PENELEC	AA2-000 TAP-26CHAPMAN+ 230 kV line	919490	200908	1	DC	65.39	113.94	ER	666	323.33	19
80	LFFB	C2_PN230-SB-17A	PENELEC	AA2-000 TAP-26CHAPMAN+ 230 kV line	919490	200908	1	DC	64.19	112.54	ER	666	322.06	
81	LFFB	C2_PN230-SB-9I2	PENELEC	26HOMER CT 230/1 kV transformer	999443	200767	S	DC	88.86	91.81	ER	824	53.95	

Note: Please see Attachment 3 for projects providing impacts to flowgate violations. The values in the Reference column correspond to the proper table in the Attachment.

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	Circuit		Initial	Final	Type	MVA		
82	N-1	B_PN230-SX-#11B	PENELEC	26TOWANDA-26NO MESHO 115 kV line	200674	200677	1	DC	101.2	119.95	ER	172	32.25	20
83	LFFB	C2_PN115-SB-46F	PENELEC - NYISO	26E.TWANDA-HILSD230 230 kV line	200675	130763	1	DC	108.31	125.43	ER	531	90.89	21
84	LFFB	C2_PN115-SB-46G1	PENELEC - NYISO	26E.TWANDA-HILSD230 230 kV line	200675	130763	1	DC	104.29	121.17	ER	531	89.65	
85	LFFB	AP_SB_450A_A	PENELEC	26E.TWANDA-26CANYON 230 kV line	200675	200924	1F	DC	106.1	136.59	ER	666	203.12	22
86	LFFB	AP_SB_451A_A	PENELEC	26E.TWANDA-26CANYON 230 kV line	200675	200924	1F	DC	105.92	136.41	ER	666	203.09	
87	LFFB	C2_PN115-SB-#46E	PENELEC	26E.TWANDA-26CANYON 230 kV line	200675	200924	1F	DC	110.4	124.9	ER	666	96.56	
88	LFFB	C2_PN115-SB-#19F	PENELEC	26E.TWANDA-26CANYON 230 kV line	200675	200924	1F	DC	116.35	131.65	ER	666	101.93	
89	BUS	C1_PN115-SB-76B	PENELEC	26E.TWANDA-26CANYON 230 kV line	200675	200924	1F	DC	109.57	124.08	ER	666	96.58	
90	LFFB	C2_PN230-SB-9E2	PENELEC	26HOMER CY 345/1 kV transformer	200769	999442	N	DC	110.66	113.67	ER	807	53.86	23
91	LFFB	C2_PN345-SB-4A2	PENELEC	26HOMER CY 345/1 kV transformer	200769	999443	S	DC	119.68	122.97	ER	824	60.32	24
92	LFFB	AP_SB_450A_A	PENELEC	26CANYON-26N.MESHPN 230 kV line	200924	200706	1F	DC	109.93	142.85	ER	617	203.12	25
93	LFFB	AP_SB_451A_A	PENELEC	26CANYON-26N.MESHPN 230 kV line	200924	200706	1F	DC	109.72	142.64	ER	617	203.09	
94	LFFB	C2_PN115-SB-#46E	PENELEC	26CANYON-26N.MESHPN 230 kV line	200924	200706	1F	DC	114.59	130.24	ER	617	96.56	

#	Contingency		Affected Area	Facility Description	Bus		Circuit	Power Flow	Loading %		Rating		MW Contribution	Ref
	Type	Name			From	To			Initial	Final	Type	MVA		
95	LFFB	C2_PN115-SB-#19F	PENELEC	26CANYON-26N.MESHPN 230 kV line	200924	200706	1F	DC	120.99	137.51	ER	617	101.93	
96	BUS	C1_PN115-SB-76B	PENELEC	26CANYON-26N.MESHPN 230 kV line	200924	200706	1F	DC	113.67	129.33	ER	617	96.58	
97	Non	Non	PENELEC	26CANYON-26N.MESHPN 230 kV line	200924	200706	1F	DC	104.94	123.01	NR	488	88.22	
98	LFFB	PL100855	PL - PJM500	LACKAW 500/230 kV transformer	208009	200074	4	DC	101.64	103.71	ER	1165	53.57	26
99	DCTL	C5-TWL-NR63A	FE - FE	02PERRY-02L.CENTER 345 kV line	239036	239334	1	DC	107.15	108.61	ER	1673	54.01	27
100	LFFB	C2_PN230-SB-9E2	PENELEC	26HOMER CT 230/1 kV transformer	999442	200767	N	DC	107.5	110.51	ER	807	53.86	28
101	LFFB	C2_PN345-SB-4A2	PENELEC	26HOMER CT 230/1 kV transformer	999443	200767	S	DC	117.13	120.43	ER	824	60.32	29

Note: Please see Attachment 3 for projects providing impacts to flowgate violations. The values in the Reference column correspond to the proper table in the Attachment.

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

#	Area	Bus No.	Bus	Breaker	Rating Type	Duty Percent Without AA1-111	Duty Percent With AA1-111	Duty Percent Difference
102	PPL	208009	LACK 230.kV	MOUNTAIN PMG	S	98.97%	103.46%	4.49%
103	PPL	208009	LACK 230.kV	STANTON WEST	S	98.97%	103.46%	4.49%
104	PPL	208009	LACK 230.kV	PECK 3-MOUNT	S	95.81%	100.30%	4.49%

#	Area	Bus No.	Bus	Breaker	Rating Type	Duty Percent Without AA1-111	Duty Percent With AA1-111	Duty Percent Difference
105	PENELEC	11	KEYSTONE 500.kV	#1	S	98.64%	106.49%	7.85%
106	PENELEC	11	KEYSTONE 500.kV	JUNIATA	S	98.64%	106.49%	7.85%
107	PENELEC	11	KEYSTONE 500.kV	NO.3 TRANSFO	S	98.64%	106.49%	7.85%
108	PENELEC	200674	ETOWANDA 115 115.kV	MANSFIELD	S	97.94%	104.59%	6.65%
109	PENELEC	200743	HOOVRSVL 115 115.kV	C CITY W	S	99.92%	100.65%	0.73%

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

#	Area	Bus No.	Bus	Breaker	Rating Type	Duty Percent Without AA1-111	Duty Percent With AA1-111	Duty Percent Difference
110	PENELEC	11	KEYSTONE 500.kV	NO.14 CABOT	S	100.36%	108.35%	7.99%
111	PENELEC	11	KEYSTONE 500.kV	NO.16 CABOT	S	100.36%	108.35%	7.99%

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 developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.

Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which shall study all overload conditions associated with the overloaded element(s) identified.

None.

New System Reinforcements

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

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
1, 2, 43, 44, 45	S RIPLEY-26ERIE E 230 kV line	Erie East SS: Replace line drops on South Ripley line exit. (\$42,600) Re-conductor 4.6 miles of the Erie East-South Ripley 230 kV line replacing the existing 1033 ACSR conductor with 1033 ACSS conductor. (\$4,858,300) Estimated Time: 29 months; National Grid will need to review the load ability of its equipment on this line and provide the costs for any upgrades to National Grid owned equipment. This overload is caused by a later AA2 queue project. PJM's cost allocation rules state that upgrades caused within the AA2 queue costing less than \$5,000,000 will be allocated amongst all projects that contribute to the loading and overloading of the facility. Cost allocations will be confirmed in the System Impact Study phase.	Pending	\$ 4,900,900
3, 4, 46, 47, 48	26ERIE E-W3-099 TAP 230 kV line	Erie East SS: Replace line drops on W3-099 exit. (\$42,600) Re-conductor 0.3 miles of Erie East-Four Mile Junction 230 kV circuit, from W3-099 to Erie East, with 1033 ACSS conductor. (\$544,800) Estimated Time: 22 months This overload is caused by a later AA2 queue project. PJM's cost allocation rules state that upgrades caused within the AA2 queue costing less than \$5,000,000 will be allocated amongst all projects that contribute to the loading and overloading of the facility. Cost allocations will be confirmed in the System Impact Study phase.	Pending	\$ 587,400

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
9, 10, 11, 53, 54, 55, 56 12, 13, 14, 57, 58, 59	26N.MESHPN-26OXBOW 230 kV line 26OXBOW-LACK 230 kV line	North Meshoppen SS: Replace the existing 1200A wave trap on the Oxbow line exit with 2000A or better. (\$85,500) Increment to rebuild and re-conductor the 10.6 mile North Meshoppen – Oxbow section of the Lackawanna – North Meshoppen 230 kV line with 1590 kcmil ACSS conductor, replacing the existing 1033 kcmil ACSR conductor. The new structures shall be designed as single, future double – circuit. (\$15,550,000) Oxbow SS: Replace the existing 2000A disconnect switches with 3000A disconnect switches. (\$180,700) Increment to rebuild and re-conductor the 16.3 mile Lackawanna – Oxbow section of the Lackawanna – North Meshoppen 230 kV line with 1590 kcmil ACSS conductor, replacing the existing 1033 kcmil ACSR conductor. The new structures shall be designed as single, future double – circuit. (\$23,970,000) Estimated Time: 42 months	Pending	\$ 39,786,200
15, 16, 60, 61	26SHAWVL 2-01SHINGL 230 kV line	Shawville SS: Replace the existing 1200A wave trap on the Shingletown line exit with 2000A or better. (\$85,500) Shingletown SS: Replace the existing 1200A wave trap on the Shawville line exit with 2000A or better. (\$85,500) Estimated Time: 9 months This overload is caused by a later AA2 queue project. PJM’s cost allocation rules state that upgrades caused within the AA2 queue costing less than \$5,000,000 will be allocated amongst all projects that contribute to the loading and overloading of the facility. Cost allocations will be confirmed in the System Impact Study phase.	Pending	\$ 171,000
23	26N.MESHPN 230/115 kV transformer	North Meshoppen SS: Replace No. 3 TR to support the PJM interconnection project. (\$6,471,400); Estimated Time: 21 months North Meshoppen SS - Replace existing 230/115kV Transformer No. 4. (\$4,561,400); Estimated Time: 12 months	Pending	\$ 11,032,800
26	26CHAPMAN+-01MOSHAN 230 kV line	Moshannon SS: Replace line drops on the Chapman line exit due to new line rating. (\$74,100) Re-conductor existing 1033 ACSR conductor with new 1033 ACSS conductor from Moshannon sub to Chapman sub, 29.3 miles, on the existing Marshall - Moshannon 230 kV circuit. (\$26,783,800) Estimated Time: 31 months	Pending	\$ 26,857,900

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
31	26FOURMILE-26ERIE SE 115 kV line	Erie South SS: Upgrade line drops on Four Mile line exit for new line rating. (\$40,100) Four Mile Junction SS: Upgrade line drops on Erie South line exit for new line rating. (\$67,100) Rebuild the existing 115 kV circuit from Erie South Sub to Four Mile Junction, 4.6 miles, with 795 kcmil ACSS conductor.(\$5,899,300) Estimated Time: 39 months This overload is caused by a later AA2 queue project. PJM's cost allocation rules state that upgrades caused within the AA2 queue costing less than \$5,000,000 will be allocated amongst all projects that contribute to the loading and overloading of the facility. Cost allocations will be confirmed in the System Impact Study phase.	Pending	\$ 6,006,500
32, 33	01KARNSC-01BUTLER 138 kV line	Butler SS: Re-conductor the Karns City 138kV line terminal including wave trap, risers, wave trap and disconnects. (\$92,300) Karns City SS: On the Butler line terminal, replace line side disconnect risers and connectors, and revise relay settings. (\$18,100) Re-conductor the 15.6 mile Butler-Karns City 138kV line with 336 kcmil ACSS conductor, replacing the existing 336 kcmil ACSR. Numerous structures will need to be replaced as part of the scope. (\$17,425,900) Estimated Time: 26 months This overload is caused by a later AA2 queue project. PJM's cost allocation rules state that upgrades caused within the AA2 queue costing less than \$5,000,000 will be allocated amongst all projects that contribute to the loading and overloading of the facility. Cost allocations will be confirmed in the System Impact Study phase.	Pending	\$ 17,536,300
34, 35	W3-099 TAP-26FOURMILE 230 kV line	Four Mile Jct SS: Replace line drops on W3-099 exit. (\$42,600) Re-conductor 9.1 miles of Erie East-Four Mile 230 kV circuit, from W3-099 to Four Mile Junction, with 1033 ACSS conductor. (\$8,894,900) Estimated Time: 30 months	Pending	\$ 8,937,500

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
38	AA2-000 TAP-26CHAPMAN+ 230 kV line	Re-conductor 0.1 miles of existing 1033 ACSR conductor with new 1033 ACSS conductor from Chapman sub to new AA1-111 interconnect on the East Towanda - Moshannon 230 kV circuit. (\$383,100); Estimated Time: 12 months	Pending	\$ 383,100
67	26FOURMILE-26ERIE SE 230 kV line	Erie South SS: Replace line drops on Four Mile Junction exit. (\$42,600) Four Mile Jct SS: Replace line drops on Erie South exit. (\$42,600) Re-conductor existing 1033 ACSR conductor with new 1033 ACSS conductor between Four Mile Sub and Erie South Sub, approximately 4.5 miles. (\$4,393,400) Estimated Time: 30 months This overload is caused by a later AA2 queue project. PJM's cost allocation rules state that upgrades caused within the AA2 queue costing less than \$5,000,000 will be allocated amongst all projects that contribute to the loading and overloading of the facility. Cost allocations will be confirmed in the System Impact Study phase.	Pending	\$ 4,478,600
68, 69 77, 78	26SCOTCHHLLW-26E.TWANDA 230 kV line AA1-144 TAP-26SCOTCHHLLW 230 kV line	East Towanda SS: Replace Scotch Hollow 230 kV line exit wave trap, line drop, and bus conductor for increased line capacity. (\$128,200) Scotch Hollow SS: Replace two motor operated load break switches for increased line capacity. (\$283,100) Re-conductor 2.7 miles of the AA1-144 - Scotch Hollow - East Towanda 230 kV line with 1033 ACSS conductor. (\$2,324,100) Estimated Time: 29 months	Pending	\$ 2,735,400
72, 73	01MOSHAN-26SHAWVL 1 230 kV line	Shawville SS: Replace wave trap and line relaying for new line rating. (\$297,100) Moshannon SS. Replace the line risers on the East Towanda (Marshall) 230 kV line. (\$11,100) Estimated Time: 13 months This overload is caused by a later AA2 queue project. PJM's cost allocation rules state that upgrades caused within the AA2 queue costing less than \$5,000,000 will be allocated amongst all projects that contribute to the loading and overloading of the facility. Cost allocations will be confirmed in the System Impact Study phase.	Pending	\$ 308,200

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
76	02PERRY-02EASTLK 345 kV line	Replace the 345 kV meter on Eastlake 345 kV line with at least 1891 MVA. (\$180,300); Estimated Time: 6 months This overload is caused by a later AA2 queue project. PJM's cost allocation rules state that upgrades caused within the AA2 queue costing less than \$5,000,000 will be allocated amongst all projects that contribute to the loading and overloading of the facility. Cost allocations will be confirmed in the System Impact Study phase.	Pending	\$ 180,300
102	LACK 230.kV MOUNTAIN PMG circuit breaker	Replace three circuit breakers.	Pending	\$ 1,050,000
103	LACK 230.kV STANTON WEST circuit breaker			
104	LACK 230.kV PECK 3-MOUNT circuit breaker			
105	KEYSTONE 500.kV #1 circuit breaker	Replace three circuit breakers.	Pending	\$ 3,063,600
106	KEYSTONE 500.kV JUNIATA circuit breaker			
107	KEYSTONE 500.kV NO.3 TRANSFO circuit breaker			
108	ETOWANDA 115 115.kV MANSFIELD circuit breaker	Replace circuit breaker	Pending	\$ 228,300
109	HOOVERSVL 115 115.kV C CITY W circuit breaker	Replace circuit breaker	Pending	\$ 228,300
Total New Network Upgrades				\$ 156,854,300

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
5, 6, 7, 8, 84, 86, 87, 88, 89	26E.TWANDA-26CANYON 230 kV line	East Towanda SS: Upgrade line equipment on Canyon line exit. (\$326,200) Canyon SS: Replace line disconnect switch on the East Towanda exit due to new line rating. (\$95,400) Rebuild 12.3 miles of single circuit 230kV between East Towanda and Canyon substations, approximately 12.3 miles, using 1590 ACSS. (\$17,041,300) Estimated Time: 39 months	Pending	\$ 17,462,900
17, 18 19, 20, 21, 22, 62, 90, 91 39, 40, 41, 42, 81, 100, 101	26HOMER CT-26SHELOCTA 230 kV line 26HOMER CY 345/1 kV transformer 26HOMER CT 230/1 kV transformer	At the Homer City SS: Install one 500/345 kV transformer, one 345 kV breaker to fill in existing bay and 3 breaker 500 kV ring bus expansion. (\$26,716,200) At the Keystone SS: Replace 500 kV wave traps and install surge arresters on the Conemaugh line. (\$217,300) At the Conemaugh SS: Replace 500 kV wave traps and install surge arresters on the Keystone line. (\$217,300) Loop the Conemaugh – Keystone 500 kV line to the proposed Homer City 500 kV expanded substation. Install a loop, approx. 1000' in length, to the proposed Homer City 500 kV expanded substation. The new structures shall be steel with concrete foundations. (\$4,298,000) Estimated Time: 26 months	Pending	\$ 31,448,800

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
24, 25, 27, 63, 64, 65, 66 36, 37, 79, 80 74, 75 82	26CHAPMAN+-01MOSHAN 230 kV line AA2-000 TAP-26CHAPMAN+ 230 kV line 01SHINGL-26LEWISTWN 230 kV line 26TOWANDA-26NO MESHO 115 kV line	East Towanda SS: Install two new breakers and add a line exit to Lackawanna substation. (\$2,381,000) Build a new 230 kV circuit between East Towanda substation and Lackawanna substation, approximately 48.2 miles, constructed within existing ROW adjacent to existing 230 kV. (\$71,128,300) Estimated Time: 39 months	Pending	\$ 73,509,300
28, 29, 30, 92, 93, 94, 95, 96, 97	26CANYON-26N.MESHPPN 230 kV line	North Meshoppen SS: Upgrade line equipment on Canyon line exit. (\$326,200) Canyon SS: Replace line disconnect switch on the North Meshoppen exit due to new line rating. (\$95,400) Rebuild 9.8 miles of single circuit Canyon-North Meshoppen 230 kV transmission line using 1590 ACSS conductor. (\$13,747,000) Estimated Time: 27 months	Pending	\$ 14,168,600
49, 50, 51, 52, 83, 84	26E.TWANDA-HILSD230 230 kV line	East Towanda SS: Replace existing 1200A wave trap on the Hillside line exit with 2000A or better. (\$85,500) Estimated Time: 8 months Note: NYSEG will need to review the loadability of their equipment and provide any necessary upgrades	Pending	\$ 85,500
70, 71, 98	LACKAW 500/230 kV transformer	Install 3 rd 500/230 kV transformer at Lackawanna substation. Estimated Cost: \$20 M; Estimated Time: 36 months This overload is caused by a later AA2 queue project. PJM's cost allocation rules state that upgrades caused within the AA2 queue costing less than \$5,000,000 will be allocated amongst all projects that contribute to the loading and overloading of the facility. Cost allocations will be confirmed in the System Impact Study phase.	Pending	\$ 20,000,000

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
99	02PERRY-02L.CENTER 345 kV line	Perry SS: Re-conductor the future Leroy Center Line. (\$35,700) Re-conductor the 9.7 mile Leroy Center-Perry 345 kV line with bundled 954 kcmil ACSS, replacing the existing bundled 954 kcmil ACSR conductor. Note the line is currently Harding-Perry prior to completion of expansion at Leroy Center in 2016. (\$10,391,900) Estimated Time: 23 months	Pending	\$ 10,427,600
Total New Network Upgrades				\$ 48,911,700

Attachment 1. Project Location

Attachment 2. Single Line Diagram

Attachment 3. Flowgate Details

The following appendices contain additional information about each flowgate presented in the body of the report. For each appendix, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gauge other generators impact.

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

(PENELEC - PENELEC) The 26NO MESHO-26MESH2REA 115 kV line (from bus 200677 to bus 200825 ckt 3) loads from 85.08% to 101.74% (DC power flow) of its emergency rating (197 MVA) for the single line contingency outage of 'B_PN230-SX-#11B'. This project contributes approximately 32.82 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
200887	26ARMNA MT	0.2
203261	26BLOSSBCT	0.18
203283	26MANOR	0.02
200851	26MEHOOP3	1.99
294572	P-028 C	1.01
292391	T-121 C	1.58
907461	X1-109 C	9.38
913191	Y1-047 OP1	0.52
LTF	Y2-044	9.58
914151	Y2-060	1.39
LTF	Z1-019	69.54
916051	Z1-038	5.93
916201	Z1-069 C	1.11
916351	Z1-091	5.81
916361	Z1-092	2.88
916541	Z1-110	2.51

Bus Number	Bus Name	Full Contribution
917072	Z2-011	2.51
917621	Z2-103	0.4
918871	AA1-106	2.51
919091	AA1-131 C	0.9
919201	AA1-144 OP	23.23
919491	AA2-000	32.82
LTF	AA2-033	34.77
LTF	AA2-034	34.77
919971	AA2-081	1.87
919991	AA2-083 OP	3.15
920171	AA2-112	4.99
920241	AA2-120 OP	25.32
920341	AA2-132	4.79
920351	AA2-133	4.62
920371	AA2-135	3.59
920611	AA2-167	2.88

Appendix 2

(PENELEC - PENELEC) The 26HOMER CT-26SHELOCTA 230 kV line (from bus 200767 to bus 200795 ckt 1) loads from 78.98% to 82.35% (DC power flow) of its emergency rating (917

MVA) for the single line contingency outage of 'DQE_163'. This project contributes approximately 68.58 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
200812	26ALY HYDR	0.08
200887	26ARMNA MT	0.33
203261	26BLOSSBCT	0.3
200503	26C.SLOPE	2.66
200835	26DSGENWIN	0.24
200828	26HNSMLK 1	1.08
200829	26HNSMLK 2	1.08
200830	26HNSMLK 3	1.08
200831	26HNSMLK 4	1.08
200832	26HNSMLK 5	1.08
200837	26HOMER C1	20.25
200838	26HOMER C2	17.28
200839	26HOMER C3	18.29
200849	26LAKVU GN	0.08
200856	26LICK RUN	0.13
200649	26PENNTech	0.66
200662	26SCRUB GR	1.26
200642	26SENECA#1	3.95
200643	26SENECA#2	3.69
200644	26SENECA#3	0.53
200833	26SEWRDB34	11.45
200913	26SHAW-D	0.95
200715	26SHAWVL 1	18.68
200722	26SHAWVL 2	19.15
200665	26SHAWVL 3	26.58
200666	26SHAWVL 4	26.57
200809	26SITHE	1.18
200834	26SOMERWIN	0.19
200852	26WARR RDG	0.08
200864	K-013	0.14
292340	K-022	0.03
292350	K-023	0.1
293300	N-039 C	0.33
293602	O-018 C	0.26
293801	O-038 C	0.21
293901	O-048 C	0.11
294512	P-022 C	0.08
294902	P-060 C	0.2
200905	Q-036 C	0.16
200882	Q-053 C	0.14

Bus Number	Bus Name	Full Contribution
296322	R-032 C	0.3
293431	R-040 C	< 0.01
291409	S-029B	0.06
291011	S-103	1.
292391	T-121 C	5.4
293392	V3-030 C	0.06
903643	W3-099 C OP1	0.22
909093	X2-031 C	1.54
913311	Y1-071	0.86
LTF	Y2-044	16.1
914101	Y2-055	0.51
914151	Y2-060	0.42
915951	Y3-092	196.19
LTF	Z1-019	116.3
916051	Z1-038	2.32
916201	Z1-069 C	2.91
916311	Z1-087	8.24
916351	Z1-091	2.92
916361	Z1-092	3.36
916541	Z1-110	3.08
917072	Z2-011	3.08
917101	Z2-014	0.02
917621	Z2-103	0.12
918221	AA1-037	0.78
918341	AA1-046 C	2.33
918701	AA1-085 C	1.51
918871	AA1-106	3.08
919091	AA1-131 C	0.71
919201	AA1-144 OP	22.65
919491	AA2-000	68.58
LTF	AA2-033	58.15
LTF	AA2-034	58.15
919971	AA2-081	4.28
919991	AA2-083 OP	3.15
920171	AA2-112	3.12
920241	AA2-120 OP	53.17
920341	AA2-132	3.18
920351	AA2-133	2.61
920371	AA2-135	2.84
920611	AA2-167	3.36

Appendix 3

(PENELEC - PENELEC) The 26N.MESHPN 230/115 kV transformer (from bus 200825 to bus 200706 ckt 3) loads from 89.15% to 106.61% (DC power flow) of its emergency rating (188 MVA) for the single line contingency outage of 'B_PN230-SX-#11B'. This project contributes approximately 32.82 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
200887	26ARMNA MT	0.2
203261	26BLOSSBCT	0.18
203283	26MANOR	0.02
200851	26MEHOOP3	1.99
294572	P-028 C	1.01
292391	T-121 C	1.58
907461	X1-109 C	9.38
913191	Y1-047 OP1	0.52
LTF	Y2-044	9.58
914151	Y2-060	1.39
LTF	Z1-019	69.54
916051	Z1-038	5.93
916201	Z1-069 C	1.11
916351	Z1-091	5.81
916361	Z1-092	2.88
916541	Z1-110	2.51

Bus Number	Bus Name	Full Contribution
917072	Z2-011	2.51
917621	Z2-103	0.4
918871	AA1-106	2.51
919091	AA1-131 C	0.9
919201	AA1-144 OP	23.23
919491	AA2-000	32.82
LTF	AA2-033	34.77
LTF	AA2-034	34.77
919971	AA2-081	1.87
919991	AA2-083 OP	3.15
920171	AA2-112	4.99
920241	AA2-120 OP	25.32
920341	AA2-132	4.79
920351	AA2-133	4.62
920371	AA2-135	3.59
920611	AA2-167	2.88

Appendix 4

(PENELEC - PENELEC) The 26FOURMILE-26ERIE SE 115 kV line (from bus 200927 to bus 200820 ckt 1F) loads from 75.75% to 78.87% (DC power flow) of its emergency rating (228 MVA) for the single line contingency outage of 'B_PN230-SX-#17C'. This project contributes approximately 15.78 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
200887	26ARMNA MT	0.1
203261	26BLOSSBCT	0.09
203283	26MANOR	< 0.01
291011	S-103	0.4
292391	T-121 C	1.31
903643	W3-099 C OP1	0.4
907461	X1-109 C	3.5
LTF	Y2-044	8.27
914101	Y2-055	0.2
915951	Y3-092	48.12

Bus Number	Bus Name	Full Contribution
LTF	Z1-019	59.47
916201	Z1-069 C	0.75
916351	Z1-091	1.27
916361	Z1-092	1.44
916541	Z1-110	1.02
917072	Z2-011	1.02
918871	AA1-106	1.02
919091	AA1-131 C	0.28
919201	AA1-144 OP	8.72
919491	AA2-000	15.78

Bus Number	Bus Name	Full Contribution
LTF	AA2-033	29.74
LTF	AA2-034	29.74
919971	AA2-081	1.15
919991	AA2-083 OP	1.13
920171	AA2-112	1.39

Bus Number	Bus Name	Full Contribution
920241	AA2-120 OP	14.68
920341	AA2-132	1.41
920351	AA2-133	1.04
920371	AA2-135	1.11
920611	AA2-167	1.44

Appendix 5

(AP - AP) The 01KARNSC-01BUTLER 138 kV line (from bus 235197 to bus 235152 ckt 1) loads from 74.33% to 80.99% (DC power flow) of its emergency rating (179 MVA) for the single line contingency outage of 'B_LINE_SY_017'. This project contributes approximately 26.45 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
235134	01AL&D6	0.04
200805	26COLVER13	0.62
200828	26HNSMLK 1	0.46
200829	26HNSMLK 2	0.46
200830	26HNSMLK 3	0.46
200831	26HNSMLK 4	0.46
200832	26HNSMLK 5	0.46
200849	26LAKVU GN	0.03
200649	26PENNTech	0.26
200608	26PINEY #1	0.36
200662	26SCRUB GR	0.91
200642	26SENECA#1	1.38
200643	26SENECA#2	1.29
200644	26SENECA#3	0.18
200913	26SHAW-D	0.37
200715	26SHAWVL 1	7.7
200722	26SHAWVL 2	7.89
200665	26SHAWVL 3	11.09
200666	26SHAWVL 4	11.1
291011	S-103	0.36

Bus Number	Bus Name	Full Contribution
292391	T-121 C	1.47
292548	T-155	0.05
903643	W3-099 C OP1	0.09
913311	Y1-071	1.15
LTF	Y2-044	4.46
914101	Y2-055	0.18
915951	Y3-092	84.4
LTF	Z1-019	32.15
916201	Z1-069 C	0.75
916311	Z1-087	2.89
916321	Z1-088	0.03
916331	Z1-089	0.03
917491	Z2-085	0.01
918221	AA1-037	0.82
918701	AA1-085 C	0.61
919491	AA2-000	26.45
LTF	AA2-033	16.07
LTF	AA2-034	16.07
919971	AA2-081	1.08
920241	AA2-120 OP	13.06

Appendix 6

(PENELEC - PENELEC) The W3-099 TAP-26FOURMILE 230 kV line (from bus 903645 to bus 200928 ckt 1) loads from 82.03% to 86.07% (DC power flow) of its emergency rating (592 MVA) for the single line contingency outage of 'B_PN345-SX-#6'. This project contributes approximately 23.92 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
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Bus Number	Bus Name	Full Contribution
200887	26ARMNA MT	0.19
203261	26BLOSSBCT	0.16
203283	26MANOR	0.01
200851	26MEHOOP3	0.46
294572	P-028 C	0.23
292391	T-121 C	1.99
903643	W3-099 C OP1	0.83
907461	X1-109 C	6.51
913191	Y1-047 OP1	0.12
914041	Y2-042	1.25
LTF	Y2-044	15.69
914151	Y2-060	0.32
915951	Y3-092	105.29
LTF	Z1-019	112.79
916051	Z1-038	1.77
916201	Z1-069 C	1.27
916351	Z1-091	2.39
916361	Z1-092	2.71

Bus Number	Bus Name	Full Contribution
916541	Z1-110	1.85
917072	Z2-011	1.85
917621	Z2-103	0.09
917631	Z2-104	0.11
918871	AA1-106	1.85
919091	AA1-131 C	0.52
919201	AA1-144 OP	16.14
919491	AA2-000	23.92
LTF	AA2-033	56.4
LTF	AA2-034	56.4
919971	AA2-081	2.04
919991	AA2-083 OP	2.1
920171	AA2-112	2.62
920241	AA2-120 OP	26.94
920341	AA2-132	2.67
920351	AA2-133	1.94
920371	AA2-135	2.06
920611	AA2-167	2.71

Appendix 7

(NYISO - PENELEC) The S RIPLEY-26ERIE E 230 kV line (from bus 135251 to bus 200654 ckt 1) loads from 90.15% to 91.94% (DC power flow) of its emergency rating (607 MVA) for the line fault with failed breaker contingency outage of 'C2_PN345-SB-7B'. This project contributes approximately 24.23 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
200887	26ARMNA MT	0.19
203261	26BLOSSBCT	0.16
203283	26MANOR	0.01
200857	26MARSHALL	4.64
294573	P-028 E	11.08
200888	P-047 E	8.78
292391	T-121 C	2.
292392	T-121 E	8.01
297050	V2-019 E	0.05
907461	X1-109 C	6.53
907462	X1-109 E	8.55
910522	X3-003 E	1.85
914041	Y2-042	1.25
LTF	Y2-044	15.71
914151	Y2-060	0.32
915951	Y3-092	107.85

Bus Number	Bus Name	Full Contribution
LTF	Z1-019	112.94
916051	Z1-038	1.78
916201	Z1-069 C	1.27
916202	Z1-069 E	5.43
916351	Z1-091	2.4
916361	Z1-092	2.71
916541	Z1-110	1.86
917072	Z2-011	1.86
917621	Z2-103	0.09
917631	Z2-104	0.11
918682	AA1-082 E	7.54
918871	AA1-106	1.86
919091	AA1-131 C	0.52
919092	AA1-131 E	0.31
919201	AA1-144 OP	16.21
919491	AA2-000	24.23

Bus Number	Bus Name	Full Contribution
LTF	AA2-033	56.47
LTF	AA2-034	56.47
919971	AA2-081	2.05
919991	AA2-083 OP	2.11
920171	AA2-112	2.62

Bus Number	Bus Name	Full Contribution
920241	AA2-120 OP	27.05
920341	AA2-132	2.68
920351	AA2-133	1.94
920371	AA2-135	2.07
920611	AA2-167	2.71

Appendix 8

(PENELEC - PENELEC) The 26ERIE E-W3-099 TAP 230 kV line (from bus 200654 to bus 903645 ckt 1) loads from 88.21% to 90.05% (DC power flow) of its emergency rating (592 MVA) for the line fault with failed breaker contingency outage of 'C2_PN345-SB-7A'. This project contributes approximately 24.23 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
200887	26ARMNA MT	0.19
203261	26BLOSSBCT	0.16
203283	26MANOR	0.01
200857	26MARSHALL	4.64
294573	P-028 E	11.08
200888	P-047 E	8.78
292391	T-121 C	2.
292392	T-121 E	8.01
297050	V2-019 E	0.05
907461	X1-109 C	6.53
907462	X1-109 E	8.55
910522	X3-003 E	1.85
914041	Y2-042	1.25
LTF	Y2-044	15.71
914151	Y2-060	0.32
915951	Y3-092	107.85
LTF	Z1-019	112.94
916051	Z1-038	1.78
916201	Z1-069 C	1.27
916202	Z1-069 E	5.43
916351	Z1-091	2.4

Bus Number	Bus Name	Full Contribution
916361	Z1-092	2.71
916541	Z1-110	1.86
917072	Z2-011	1.86
917621	Z2-103	0.09
917631	Z2-104	0.11
918682	AA1-082 E	7.54
918871	AA1-106	1.86
919091	AA1-131 C	0.52
919092	AA1-131 E	0.31
919201	AA1-144 OP	16.21
919491	AA2-000	24.23
LTF	AA2-033	56.47
LTF	AA2-034	56.47
919971	AA2-081	2.05
919991	AA2-083 OP	2.11
920171	AA2-112	2.62
920241	AA2-120 OP	27.05
920341	AA2-132	2.68
920351	AA2-133	1.94
920371	AA2-135	2.07
920611	AA2-167	2.71

Appendix 9

(PENELEC - PENELEC) The 26N.MESHPPN-26OXBOW 230 kV line (from bus 200706 to bus 200708 ckt 1) loads from 84.97% to 107.45% (DC power flow) of its emergency rating (984 MVA) for the line fault with failed breaker contingency outage of 'AP_SB_450A_A'. This project contributes approximately 221.16 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
203283	26MANOR	0.06
200857	26MARSHALL	34.19
200851	26MEHOOP3	2.86
294572	P-028 C	1.45
294573	P-028 E	68.45
200888	P-047 E	27.85
292391	T-121 C	4.27
292392	T-121 E	17.07
297050	V2-019 E	0.17
907461	X1-109 C	33.72
907462	X1-109 E	44.11
910522	X3-003 E	11.41
913191	Y1-047 OP1	0.75
LTF	Y2-044	26.05
914151	Y2-060	2.
LTF	Z1-019	188.95
916051	Z1-038	8.96
916201	Z1-069 C	3.13
916202	Z1-069 E	13.33
916311	Z1-087	2.4
916351	Z1-091	9.59

Bus Number	Bus Name	Full Contribution
916361	Z1-092	8.25
916541	Z1-110	9.31
917072	Z2-011	9.31
917621	Z2-103	0.57
917662	Z2-107 E	2.15
918682	AA1-082 E	38.92
918871	AA1-106	9.31
919091	AA1-131 C	2.48
919092	AA1-131 E	1.49
919201	AA1-144 OP	84.39
919491	AA2-000	221.16
LTF	AA2-033	94.48
LTF	AA2-034	94.48
919971	AA2-081	5.35
919991	AA2-083 OP	9.13
920171	AA2-112	8.91
920241	AA2-120 OP	73.18
920341	AA2-132	8.74
920351	AA2-133	9.47
920371	AA2-135	9.87
920611	AA2-167	8.25

Appendix 10

(PENELEC - PL) The 260XBOW-LACK 230 kV line (from bus 200708 to bus 208009 ckt 1) loads from 85.6% to 95.84% (DC power flow) of its emergency rating (984 MVA) for the line fault with failed breaker contingency outage of 'AP_SB_450A_A'. This project contributes approximately 223.71 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
203283	26MANOR	0.07
200857	26MARSHALL	34.58
200851	26MEHOOP3	2.95
294572	P-028 C	1.5
294573	P-028 E	70.64
200888	P-047 E	28.31
292391	T-121 C	4.34
292392	T-121 E	17.34
297050	V2-019 E	0.18
907461	X1-109 C	34.12
907462	X1-109 E	44.63
910522	X3-003 E	11.77
913191	Y1-047 OP1	0.77

Bus Number	Bus Name	Full Contribution
914041	Y2-042	12.8
LTF	Y2-044	26.48
914151	Y2-060	2.06
LTF	Z1-019	192.08
916051	Z1-038	11.92
916201	Z1-069 C	3.18
916202	Z1-069 E	13.54
916311	Z1-087	2.44
916351	Z1-091	9.86
916361	Z1-092	8.39
916541	Z1-110	9.43
917072	Z2-011	9.43
917621	Z2-103	0.59

Bus Number	Bus Name	Full Contribution
917631	Z2-104	1.12
917662	Z2-107 E	2.19
918682	AA1-082 E	39.38
918871	AA1-106	9.43
919091	AA1-131 C	2.56
919092	AA1-131 E	1.54
919201	AA1-144 OP	85.38
919491	AA2-000	223.71
LTF	AA2-033	96.04

Bus Number	Bus Name	Full Contribution
LTF	AA2-034	96.04
919971	AA2-081	5.43
919991	AA2-083 OP	9.29
920171	AA2-112	9.13
920241	AA2-120 OP	74.35
920341	AA2-132	8.96
920351	AA2-133	10.96
920371	AA2-135	10.2
920611	AA2-167	8.39

Appendix 11

(PENELEC - AP) The 26SHAWVL 2-01SHINGL 230 kV line (from bus 200726 to bus 235248 ckt 1) loads from 82.32% to 100.42% (DC power flow) of its emergency rating (554 MVA) for the line fault with failed breaker contingency outage of 'AP_SB_449AA_A'. This project contributes approximately 100.26 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
236828	01GRAYMONT	-1.49
200857	26MARSHALL	12.08
200649	26PENNTech	0.58
200913	26SHAW-D	1.32
200715	26SHAWVL 1	34.4
200722	26SHAWVL 2	35.59
200665	26SHAWVL 3	51.9
200666	26SHAWVL 4	52.57
200888	P-047 E	4.66
200905	Q-036 C	0.11
290086	Q-036 E	5.14
292391	T-121 C	1.89
292392	T-121 E	7.57
297050	V2-019 E	0.03
293393	V3-030 E	1.43
903644	W3-099 E OP1	4.36
907462	X1-109 E	5.48
913311	Y1-071	0.32
LTF	Y2-044	4.78
LTF	Z1-019	34.52
916201	Z1-069 C	0.92
916202	Z1-069 E	3.92

Bus Number	Bus Name	Full Contribution
916311	Z1-087	4.06
916351	Z1-091	1.
916361	Z1-092	1.18
916541	Z1-110	1.83
917072	Z2-011	1.83
918221	AA1-037	0.27
918682	AA1-082 E	4.84
918871	AA1-106	1.83
919091	AA1-131 C	0.3
919092	AA1-131 E	0.18
919201	AA1-144 OP	11.11
919491	AA2-000	100.26
LTF	AA2-033	17.26
LTF	AA2-034	17.26
919971	AA2-081	1.26
919991	AA2-083 OP	1.22
920171	AA2-112	1.04
920241	AA2-120 OP	14.87
920341	AA2-132	1.05
920351	AA2-133	1.07
920371	AA2-135	1.2
920611	AA2-167	1.18

Appendix 12

(PENELEC - AP) The 26CHAPMAN+-01MOSHAN 230 kV line (from bus 200908 to bus 235220 ckt 1F) loads from 65.37% to 113.92% (DC power flow) of its emergency rating (666 MVA) for the line fault with failed breaker contingency outage of 'C2_PN115-SB-46F'. This project contributes approximately 323.33 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
236828	01GRAYMONT	-0.36
203261	26BLOSSBCT	0.32
203283	26MANOR	0.03
200857	26MARSHALL	39.81
200851	26MEHOOP3	1.2
294572	P-028 C	0.61
294573	P-028 E	28.76
200888	P-047 E	12.24
297050	V2-019 E	0.08
907461	X1-109 C	16.42
907462	X1-109 E	21.48
910522	X3-003 E	4.79
913191	Y1-047 OP1	0.31
LTF	Y2-044	10.
914151	Y2-060	0.84
LTF	Z1-019	72.64
916201	Z1-069 C	1.08
916202	Z1-069 E	4.59
916351	Z1-091	2.26
916361	Z1-092	3.64

Bus Number	Bus Name	Full Contribution
916541	Z1-110	6.19
917072	Z2-011	6.19
917621	Z2-103	0.24
918682	AA1-082 E	18.96
918871	AA1-106	6.19
919091	AA1-131 C	1.17
919092	AA1-131 E	0.7
919201	AA1-144 OP	42.92
919491	AA2-000	323.33
LTF	AA2-033	36.32
LTF	AA2-034	36.32
919971	AA2-081	2.06
919991	AA2-083 OP	4.29
920171	AA2-112	2.37
920241	AA2-120 OP	29.97
920341	AA2-132	2.39
920351	AA2-133	4.62
920371	AA2-135	4.68
920611	AA2-167	3.64

Appendix 13

(PENELEC - PENELEC) The 26FOURMILE-26ERIE SE 230 kV line (from bus 200928 to bus 200819 ckt 1F) loads from 85.85% to 87.69% (DC power flow) of its emergency rating (584 MVA) for the line fault with failed breaker contingency outage of 'C2_PN115-SB-83D1'. This project contributes approximately 23.78 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
200887	26ARMNA MT	0.18
203283	26MANOR	0.01
200857	26MARSHALL	4.56
294573	P-028 E	10.84
200888	P-047 E	8.5
292391	T-121 C	2.01
292392	T-121 E	8.02
297050	V2-019 E	0.05

Bus Number	Bus Name	Full Contribution
903643	W3-099 C OP1	0.84
903644	W3-099 E OP1	65.86
907462	X1-109 E	8.38
910522	X3-003 E	1.81
914041	Y2-042	1.22
LTF	Y2-044	15.65
914151	Y2-060	0.32
915951	Y3-092	82.22

Bus Number	Bus Name	Full Contribution
LTF	Z1-019	112.46
916051	Z1-038	1.74
916201	Z1-069 C	1.25
916202	Z1-069 E	5.34
916351	Z1-091	2.37
916361	Z1-092	2.68
916541	Z1-110	1.82
917072	Z2-011	1.82
917621	Z2-103	0.09
917631	Z2-104	0.11
918682	AA1-082 E	7.39
918871	AA1-106	1.82
919091	AA1-131 C	0.51

Bus Number	Bus Name	Full Contribution
919092	AA1-131 E	0.31
919201	AA1-144 OP	15.89
919491	AA2-000	23.78
LTF	AA2-033	56.23
LTF	AA2-034	56.23
919971	AA2-081	2.
919991	AA2-083 OP	2.06
920171	AA2-112	2.59
920241	AA2-120 OP	26.18
920341	AA2-132	2.64
920351	AA2-133	1.9
920371	AA2-135	2.03
920611	AA2-167	2.68

Appendix 14

(PENELEC - PENELEC) The 26SCOTCHHLLW-26E.TWANDA 230 kV line (from bus 200940 to bus 200675 ckt 1) loads from 43.45% to 123.54% (DC power flow) of its emergency rating (554 MVA) for the line fault with failed breaker contingency outage of 'AP_SB_450A_A'. This project contributes approximately 443.73 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
203261	26BLOSSBCT	0.49
200857	26MARSHALL	67.09
916541	Z1-110	13.79
917072	Z2-011	13.79

Bus Number	Bus Name	Full Contribution
918871	AA1-106	13.79
919201	AA1-144 OP	160.55
919491	AA2-000	443.73

Appendix 15

(AP - PENELEC) The 01MOSHAN-26SHAWVL 1 230 kV line (from bus 235220 to bus 200710 ckt 1) loads from 45.61% to 95.51% (DC power flow) of its emergency rating (554 MVA) for the line fault with failed breaker contingency outage of 'AP_SB_449AA_A'. This project contributes approximately 276.46 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
236828	01GRAYMONT	-0.33
203261	26BLOSSBCT	0.2
203283	26MANOR	0.02
200857	26MARSHALL	32.51
294573	P-028 E	11.88
200888	P-047 E	6.44
297050	V2-019 E	0.04
907461	X1-109 C	9.1

Bus Number	Bus Name	Full Contribution
907462	X1-109 E	11.91
910522	X3-003 E	1.98
914041	Y2-042	1.41
LTF	Y2-044	5.21
914151	Y2-060	0.35
LTF	Z1-019	37.91
916051	Z1-038	1.96
916351	Z1-091	1.77

Bus Number	Bus Name	Full Contribution
916361	Z1-092	1.95
916541	Z1-110	4.19
917072	Z2-011	4.19
917621	Z2-103	0.1
917631	Z2-104	0.12
918682	AA1-082 E	10.51
918871	AA1-106	4.19
919091	AA1-131 C	0.62
919092	AA1-131 E	0.37
919201	AA1-144 OP	24.62

Bus Number	Bus Name	Full Contribution
919491	AA2-000	276.46
LTF	AA2-033	18.96
LTF	AA2-034	18.96
919991	AA2-083 OP	2.3
920171	AA2-112	1.69
920241	AA2-120 OP	15.15
920341	AA2-132	1.67
920351	AA2-133	2.25
920371	AA2-135	2.47
920611	AA2-167	1.95

Appendix 16

(AP - PENELEC) The 01SHINGL-26LEWISTWN 230 kV line (from bus 235248 to bus 200513 ckt 1) loads from 67.44% to 90.91% (DC power flow) of its emergency rating (554 MVA) for the line fault with failed breaker contingency outage of 'C2_PN115-SB-46F'. This project contributes approximately 130.02 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
236828	01GRAYMONT	1.99
200857	26MARSHALL	16.6
200649	26PENNTech	0.8
200913	26SHAW-D	1.54
200715	26SHAWVL 1	39.53
200722	26SHAWVL 2	40.61
200665	26SHAWVL 3	59.45
200666	26SHAWVL 4	59.72
294573	P-028 E	14.82
200888	P-047 E	8.54
290086	Q-036 E	6.07
292391	T-121 C	2.89
292392	T-121 E	11.57
297050	V2-019 E	0.05
903644	W3-099 E OP1	6.66
907462	X1-109 E	11.09
910522	X3-003 E	2.47
913311	Y1-071	0.46
LTF	Y2-044	8.37
914151	Y2-060	0.43
LTF	Z1-019	60.52
916201	Z1-069 C	1.49
916202	Z1-069 E	6.35
916311	Z1-087	5.89

Bus Number	Bus Name	Full Contribution
916351	Z1-091	1.61
916361	Z1-092	2.26
916541	Z1-110	3.05
917072	Z2-011	3.05
917621	Z2-103	0.12
918221	AA1-037	0.38
918682	AA1-082 E	9.79
918701	AA1-085 C	4.62
918702	AA1-085 E	30.78
918871	AA1-106	3.05
919091	AA1-131 C	0.63
919092	AA1-131 E	0.38
919201	AA1-144 OP	21.85
919491	AA2-000	130.02
LTF	AA2-033	30.26
LTF	AA2-034	30.26
919971	AA2-081	2.13
919991	AA2-083 OP	2.42
920171	AA2-112	1.71
920241	AA2-120 OP	25.82
920341	AA2-132	1.74
920351	AA2-133	2.44
920371	AA2-135	2.5
920611	AA2-167	2.26

Appendix 17

(FE - FE) The 02PERRY-02EASTLK 345 kV line (from bus 239036 to bus 238684 ckt 1) loads from 97.75% to 99.09% (DC power flow) of its emergency rating (1793 MVA) for the tower line contingency outage of 'C5-TWL-NR057A'. This project contributes approximately 53.53 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
236828	01GRAYMONT	0.4
238545	02ASHTG5	37.6
239297	02CPPW41	-3.28
239035	02PERRG1	69.28
200828	26HNSMLK 1	1.2
200829	26HNSMLK 2	1.2
200830	26HNSMLK 3	1.2
200831	26HNSMLK 4	1.2
200832	26HNSMLK 5	1.2
200849	26LAKVU GN	0.14
200857	26MARSHALL	7.93
200662	26SCRUB GR	1.63
200913	26SHAW-D	0.69
200715	26SHAWVL 1	14.31
200722	26SHAWVL 2	14.65
200665	26SHAWVL 3	20.63
200666	26SHAWVL 4	20.62
239276	COLLW 11	-2.92
294573	P-028 E	11.53
200888	P-047 E	10.05
290086	Q-036 E	3.9
291011	S-103	1.13
292391	T-121 C	3.71
292392	T-121 E	14.83
297050	V2-019 E	0.06
903643	W3-099 C OP1	0.35
903644	W3-099 E OP1	27.43
907462	X1-109 E	9.1
910522	X3-003 E	1.92
913311	Y1-071	0.78
LTF	Y2-044	12.88
914101	Y2-055	0.58

Bus Number	Bus Name	Full Contribution
914151	Y2-060	0.34
915951	Y3-092	396.64
LTF	Z1-019	92.8
916051	Z1-038	1.87
916201	Z1-069 C	1.91
916202	Z1-069 E	8.14
916311	Z1-087	8.15
916351	Z1-091	2.28
916361	Z1-092	2.54
916541	Z1-110	2.26
917072	Z2-011	2.26
917621	Z2-103	0.1
918221	AA1-037	0.81
918682	AA1-082 E	8.03
918701	AA1-085 C	1.15
918702	AA1-085 E	7.66
918871	AA1-106	2.26
919091	AA1-131 C	0.54
919092	AA1-131 E	0.33
919201	AA1-144 OP	17.5
919491	AA2-000	53.53
LTF	AA2-033	46.4
LTF	AA2-034	46.4
919971	AA2-081	2.73
919991	AA2-083 OP	2.27
920171	AA2-112	2.43
920241	AA2-120 OP	33.16
920341	AA2-132	2.46
920351	AA2-133	2.04
920371	AA2-135	2.17
920611	AA2-167	2.54

Appendix 18

(PENELEC - PENELEC) The AA1-144 TAP-26SCOTCHHLLW 230 kV line (from bus 919200 to bus 200940 ckt 1) loads from 40.84% to 112.29% (DC power flow) of its emergency rating (621 MVA) for the line fault with failed breaker contingency outage of 'AP_SB_450A_A'. This project contributes approximately 443.73 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
203261	26BLOSSBCT	0.49
200857	26MARSHALL	67.09
916541	Z1-110	13.79
917072	Z2-011	13.79

Bus Number	Bus Name	Full Contribution
918871	AA1-106	13.79
919201	AA1-144 OP	160.55
919491	AA2-000	443.73

Appendix 19

(PENELEC - PENELEC) The AA2-000 TAP-26CHAPMAN+ 230 kV line (from bus 919490 to bus 200908 ckt 1) loads from 65.39% to 113.94% (DC power flow) of its emergency rating (666 MVA) for the line fault with failed breaker contingency outage of 'C2_PN115-SB-46F'. This project contributes approximately 323.33 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
236828	01GRAYMONT	-0.36
203261	26BLOSSBCT	0.32
203283	26MANOR	0.03
200857	26MARSHALL	39.81
200851	26MEHOOP3	1.2
294572	P-028 C	0.61
294573	P-028 E	28.76
200888	P-047 E	12.24
297050	V2-019 E	0.08
907461	X1-109 C	16.42
907462	X1-109 E	21.48
910522	X3-003 E	4.79
913191	Y1-047 OP1	0.31
LTF	Y2-044	10.
914151	Y2-060	0.84
LTF	Z1-019	72.64
916201	Z1-069 C	1.08
916202	Z1-069 E	4.59
916351	Z1-091	2.26
916361	Z1-092	3.64

Bus Number	Bus Name	Full Contribution
916541	Z1-110	6.19
917072	Z2-011	6.19
917621	Z2-103	0.24
918682	AA1-082 E	18.96
918871	AA1-106	6.19
919091	AA1-131 C	1.17
919092	AA1-131 E	0.7
919201	AA1-144 OP	42.92
919491	AA2-000	323.33
LTF	AA2-033	36.32
LTF	AA2-034	36.32
919971	AA2-081	2.06
919991	AA2-083 OP	4.29
920171	AA2-112	2.37
920241	AA2-120 OP	29.97
920341	AA2-132	2.39
920351	AA2-133	4.62
920371	AA2-135	4.68
920611	AA2-167	3.64

Appendix 20

(PENELEC - PENELEC) The 26TOWANDA-26NO MESHO 115 kV line (from bus 200674 to bus 200677 ckt 1) loads from 101.2% to 119.95% (DC power flow) of its emergency rating (172 MVA) for the single line contingency outage of 'B_PN230-SX-#11B'. This project contributes approximately 32.25 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
200887	26ARMNA MT	0.18
203261	26BLOSSBCT	0.16
203283	26MANOR	0.02
907461	X1-109 C	9.83
914041	Y2-042	-2.41
LTF	Y2-044	4.65
LTF	Z1-019	33.64
916201	Z1-069 C	0.86
916361	Z1-092	2.45
916541	Z1-110	2.55
917072	Z2-011	2.55

Bus Number	Bus Name	Full Contribution
918871	AA1-106	2.55
919091	AA1-131 C	0.86
919201	AA1-144 OP	24.32
919491	AA2-000	32.25
LTF	AA2-033	16.82
LTF	AA2-034	16.82
919971	AA2-081	1.47
919991	AA2-083 OP	3.41
920241	AA2-120 OP	20.07
920371	AA2-135	3.41
920611	AA2-167	2.45

Appendix 21

(PENELEC - NYISO) The 26E.TWANDA-HILSD230 230 kV line (from bus 200675 to bus 130763 ckt 1) loads from 108.31% to 125.43% (DC power flow) of its emergency rating (531 MVA) for the line fault with failed breaker contingency outage of 'C2_PN115-SB-46F'. This project contributes approximately 90.89 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
200887	26ARMNA MT	0.17
203261	26BLOSSBCT	0.24
203283	26MANOR	0.05
200857	26MARSHALL	19.7
200851	26MEHOOP3	2.31
294572	P-028 C	1.18
294573	P-028 E	55.38
200888	P-047 E	8.01
297050	V2-019 E	0.05
907461	X1-109 C	32.54
907462	X1-109 E	42.57
910522	X3-003 E	9.23
913191	Y1-047 OP1	0.6
914151	Y2-060	1.62

Bus Number	Bus Name	Full Contribution
916361	Z1-092	1.7
916541	Z1-110	6.82
917072	Z2-011	6.82
917621	Z2-103	0.46
918682	AA1-082 E	37.57
918871	AA1-106	6.82
919091	AA1-131 C	2.06
919092	AA1-131 E	1.24
919201	AA1-144 OP	80.33
919491	AA2-000	90.89
919991	AA2-083 OP	6.55
920351	AA2-133	8.25
920371	AA2-135	8.21
920611	AA2-167	1.7

Appendix 22

(PENELEC - PENELEC) The 26E.TWANDA-26CANYON 230 kV line (from bus 200675 to bus 200924 ckt 1F) loads from 106.1% to 136.59% (DC power flow) of its emergency rating (666 MVA) for the line fault with failed breaker contingency outage of 'AP_SB_450A_A'. This project contributes approximately 203.12 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
200887	26ARMNA MT	0.45
203261	26BLOSSBCT	0.48
203283	26MANOR	0.05
200857	26MARSHALL	31.25
200888	P-047 E	21.25
292391	T-121 C	3.24
292392	T-121 E	12.94
297050	V2-019 E	0.13
903644	W3-099 E OP1	1.88
907461	X1-109 C	30.6
907462	X1-109 E	40.04
914041	Y2-042	-2.21
LTF	Y2-044	18.68
LTF	Z1-019	135.43
916201	Z1-069 C	2.39
916202	Z1-069 E	10.18
916361	Z1-092	6.19
916541	Z1-110	8.14

Bus Number	Bus Name	Full Contribution
917072	Z2-011	8.14
917662	Z2-107 E	1.61
918682	AA1-082 E	35.33
918871	AA1-106	8.14
919091	AA1-131 C	1.77
919092	AA1-131 E	1.06
919201	AA1-144 OP	76.59
919491	AA2-000	203.12
LTF	AA2-033	67.72
LTF	AA2-034	67.72
919971	AA2-081	4.09
919991	AA2-083 OP	6.89
920171	AA2-112	2.39
920241	AA2-120 OP	56.09
920341	AA2-132	2.58
920351	AA2-133	4.02
920371	AA2-135	7.04
920611	AA2-167	6.19

Appendix 23

(PENELEC - PENELEC) The 26HOMER CY 345/1 kV transformer (from bus 200769 to bus 999442 ckt N) loads from 110.66% to 113.67% (DC power flow) of its emergency rating (807 MVA) for the line fault with failed breaker contingency outage of 'C2_PN230-SB-9E2'. This project contributes approximately 53.86 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
200887	26ARMNA MT	0.44
203261	26BLOSSBCT	0.38
200828	26HNSMLK 1	1.27
200829	26HNSMLK 2	1.27
200830	26HNSMLK 3	1.27
200831	26HNSMLK 4	1.27
200832	26HNSMLK 5	1.27
200838	26HOMER C2	27.17
200839	26HOMER C3	28.76
200857	26MARSHALL	9.04

Bus Number	Bus Name	Full Contribution
200642	26SENECA#1	4.2
200643	26SENECA#2	3.92
200644	26SENECA#3	0.56
200715	26SHAWVL 1	10.43
200722	26SHAWVL 2	10.62
200665	26SHAWVL 3	16.
200666	26SHAWVL 4	15.95
294573	P-028 E	16.18
200888	P-047 E	20.61
292391	T-121 C	6.82

Bus Number	Bus Name	Full Contribution
292392	T-121 E	27.29
297050	V2-019 E	0.13
903644	W3-099 E OP1	16.11
907462	X1-109 E	13.44
910522	X3-003 E	2.7
913311	Y1-071	0.92
914041	Y2-042	1.64
LTF	Y2-044	19.91
914151	Y2-060	0.47
915951	Y3-092	151.1
LTF	Z1-019	143.93
916051	Z1-038	2.6
916201	Z1-069 C	3.77
916202	Z1-069 E	16.07
916311	Z1-087	8.75
916351	Z1-091	3.46
916361	Z1-092	4.09
916541	Z1-110	3.47
917072	Z2-011	3.47
917621	Z2-103	0.13

Bus Number	Bus Name	Full Contribution
917631	Z2-104	0.14
917672	Z2-108 E	2.57
918221	AA1-037	0.68
918682	AA1-082 E	11.85
918871	AA1-106	3.47
918962	AA1-115 E	2.25
919091	AA1-131 C	0.83
919092	AA1-131 E	0.5
919201	AA1-144 OP	25.63
919491	AA2-000	53.86
LTF	AA2-033	71.97
LTF	AA2-034	71.97
919971	AA2-081	5.63
919991	AA2-083 OP	3.81
920171	AA2-112	3.77
920241	AA2-120 OP	70.63
920341	AA2-132	3.84
920351	AA2-133	3.
920371	AA2-135	3.3
920611	AA2-167	4.09

Appendix 24

(PENELEC - PENELEC) The 26HOMER CY 345/1 kV transformer (from bus 200769 to bus 999443 ckt S) loads from 119.68% to 122.97% (DC power flow) of its emergency rating (824 MVA) for the line fault with failed breaker contingency outage of 'C2_PN345-SB-4A2'. This project contributes approximately 60.32 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
200887	26ARMNA MT	0.56
203261	26BLOSSBCT	0.48
200838	26HOMER C2	36.35
200839	26HOMER C3	38.48
200857	26MARSHALL	10.56
200642	26SENECA#1	4.44
200643	26SENECA#2	4.14
200644	26SENECA#3	0.59
200715	26SHAWVL 1	11.03
200722	26SHAWVL 2	11.24
200665	26SHAWVL 3	16.64
200666	26SHAWVL 4	16.57
294573	P-028 E	20.64
200888	P-047 E	26.16

Bus Number	Bus Name	Full Contribution
292391	T-121 C	8.34
292392	T-121 E	33.35
297050	V2-019 E	0.16
903644	W3-099 E OP1	12.71
907462	X1-109 E	16.85
910522	X3-003 E	3.44
914041	Y2-042	2.19
LTF	Y2-044	24.05
914151	Y2-060	0.6
LTF	Z1-019	173.95
916051	Z1-038	3.33
916201	Z1-069 C	4.69
916202	Z1-069 E	19.99
916311	Z1-087	9.25

Bus Number	Bus Name	Full Contribution
916351	Z1-091	4.33
916361	Z1-092	5.07
916541	Z1-110	4.31
917072	Z2-011	4.31
917621	Z2-103	0.17
917631	Z2-104	0.19
917672	Z2-108 E	1.65
918682	AA1-082 E	14.87
918701	AA1-085 C	0.25
918702	AA1-085 E	1.67
918871	AA1-106	4.31
919091	AA1-131 C	1.04
919092	AA1-131 E	0.63

Bus Number	Bus Name	Full Contribution
919201	AA1-144 OP	32.08
919491	AA2-000	60.31
LTF	AA2-033	86.98
LTF	AA2-034	86.98
919971	AA2-081	7.08
919991	AA2-083 OP	4.81
920171	AA2-112	4.68
920241	AA2-120 OP	89.44
920341	AA2-132	4.77
920351	AA2-133	3.79
920371	AA2-135	4.15
920611	AA2-167	5.07

Appendix 25

(PENELEC - PENELEC) The 26CANYON-26N.MESHNP 230 kV line (from bus 200924 to bus 200706 ckt 1F) loads from 109.93% to 142.85% (DC power flow) of its emergency rating (617 MVA) for the line fault with failed breaker contingency outage of 'AP_SB_450A_A'. This project contributes approximately 203.12 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
200887	26ARMNA MT	0.45
203261	26BLOSSBCT	0.48
203283	26MANOR	0.05
200857	26MARSHALL	31.25
200888	P-047 E	21.25
292391	T-121 C	3.24
292392	T-121 E	12.94
297050	V2-019 E	0.13
903644	W3-099 E OP1	1.88
907461	X1-109 C	30.6
907462	X1-109 E	40.04
914041	Y2-042	-2.21
LTF	Y2-044	18.68
LTF	Z1-019	135.43
916201	Z1-069 C	2.39
916202	Z1-069 E	10.18
916361	Z1-092	6.19
916541	Z1-110	8.14

Bus Number	Bus Name	Full Contribution
917072	Z2-011	8.14
917662	Z2-107 E	1.61
918682	AA1-082 E	35.33
918871	AA1-106	8.14
919091	AA1-131 C	1.77
919092	AA1-131 E	1.06
919201	AA1-144 OP	76.59
919491	AA2-000	203.12
LTF	AA2-033	67.72
LTF	AA2-034	67.72
919971	AA2-081	4.09
919991	AA2-083 OP	6.89
920171	AA2-112	2.39
920241	AA2-120 OP	56.09
920341	AA2-132	2.58
920351	AA2-133	4.02
920371	AA2-135	7.04
920611	AA2-167	6.19

Appendix 26

(PL - PJM500) The LACKAW 500/230 kV transformer (from bus 208009 to bus 200074 ckt 4) loads from 101.64% to 103.71% (DC power flow) of its emergency rating (1165 MVA) for the line fault with failed breaker contingency outage of 'PL100855'. This project contributes approximately 53.57 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
200857	26MARSHALL	10.76
209003	KSTN IPP	0.14
292590	L-018 E	2.78
294573	P-028 E	35.24
200888	P-047 E	13.54
209010	PEIP 1	0.75
209009	PEIP 2	1.23
297050	V2-019 E	0.08
209029	WAYM IPP	0.25
209031	WAYMART E	20.18
907462	X1-109 E	21.16
910522	X3-003 E	5.87
912251	X4-048	40.26
914041	Y2-042	6.58
LTF	Y2-044	12.82
914151	Y2-060	1.03
914271	Y2-089	175.42
LTF	Z1-019	93.
916051	Z1-038	5.96
916201	Z1-069 C	1.56
916202	Z1-069 E	6.66
916351	Z1-091	4.88
916361	Z1-092	4.02
916422	Z1-098 E	6.61

Bus Number	Bus Name	Full Contribution
916541	Z1-110	4.06
917072	Z2-011	4.06
917621	Z2-103	0.29
917631	Z2-104	0.58
917662	Z2-107 E	6.61
918211	AA1-036 OP	26.52
918601	AA1-077 C	20.86
918602	AA1-077 E	32.71
918682	AA1-082 E	18.67
918871	AA1-106	4.06
919091	AA1-131 C	1.23
919092	AA1-131 E	0.74
919201	AA1-144 OP	40.02
919491	AA2-000	53.57
LTF	AA2-033	46.5
LTF	AA2-034	46.5
919971	AA2-081	2.64
919991	AA2-083 OP	4.43
920171	AA2-112	4.5
920241	AA2-120 OP	35.78
920341	AA2-132	4.4
920351	AA2-133	5.36
920371	AA2-135	4.89
920611	AA2-167	4.02

Appendix 27

(FE - FE) The 02PERRY-02L.CENTER 345 kV line (from bus 239036 to bus 239334 ckt 1) loads from 107.15% to 108.61% (DC power flow) of its emergency rating (1673 MVA) for the tower line contingency outage of 'C5-TWL-NR63A'. This project contributes approximately 54.01 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
236828	01GRAYMONT	0.4
238545	02ASHTG5	25.95
239297	02CPPW41	-3.36
239035	02PERRG1	71.

Bus Number	Bus Name	Full Contribution
200828	26HNSMLK 1	1.21
200829	26HNSMLK 2	1.21
200830	26HNSMLK 3	1.21
200831	26HNSMLK 4	1.21

Bus Number	Bus Name	Full Contribution
200832	26HNSMLK 5	1.21
200849	26LAKVU GN	0.15
200857	26MARSHALL	8.
200662	26SCRUB GR	1.65
200913	26SHAW-D	0.69
200715	26SHAWVL 1	14.43
200722	26SHAWVL 2	14.78
200665	26SHAWVL 3	20.81
200666	26SHAWVL 4	20.81
239276	COLLW 11	-2.84
294573	P-028 E	11.63
200888	P-047 E	10.14
290086	Q-036 E	3.93
291011	S-103	1.14
292391	T-121 C	3.74
292392	T-121 E	14.96
297050	V2-019 E	0.06
903643	W3-099 C OP1	0.35
903644	W3-099 E OP1	27.67
907462	X1-109 E	9.19
910522	X3-003 E	1.94
913311	Y1-071	0.79
LTF	Y2-044	12.99
914101	Y2-055	0.58
914151	Y2-060	0.34
915951	Y3-092	400.11
LTF	Z1-019	93.62
916051	Z1-038	1.89

Bus Number	Bus Name	Full Contribution
916201	Z1-069 C	1.93
916202	Z1-069 E	8.21
916311	Z1-087	8.22
916351	Z1-091	2.3
916361	Z1-092	2.57
916541	Z1-110	2.28
917072	Z2-011	2.28
917621	Z2-103	0.1
918221	AA1-037	0.82
918682	AA1-082 E	8.1
918701	AA1-085 C	1.16
918702	AA1-085 E	7.72
918871	AA1-106	2.28
919091	AA1-131 C	0.55
919092	AA1-131 E	0.33
919201	AA1-144 OP	17.65
919491	AA2-000	54.01
LTF	AA2-033	46.81
LTF	AA2-034	46.81
919971	AA2-081	2.75
919991	AA2-083 OP	2.29
920171	AA2-112	2.45
920241	AA2-120 OP	33.46
920341	AA2-132	2.48
920351	AA2-133	2.06
920371	AA2-135	2.19
920611	AA2-167	2.57

Appendix 28

(PENELEC - PENELEC) The 26HOMER CT 230/1 kV transformer (from bus 999442 to bus 200767 ckt N) loads from 107.5% to 110.51% (DC power flow) of its emergency rating (807 MVA) for the line fault with failed breaker contingency outage of 'C2_PN230-SB-9E2'. This project contributes approximately 53.86 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
200887	26ARMNA MT	0.44
203261	26BLOSSBCT	0.38
200828	26HNSMLK 1	1.27
200829	26HNSMLK 2	1.27
200830	26HNSMLK 3	1.27
200831	26HNSMLK 4	1.27

Bus Number	Bus Name	Full Contribution
200832	26HNSMLK 5	1.27
200838	26HOMER C2	27.17
200839	26HOMER C3	28.76
200857	26MARSHALL	9.04
200642	26SENECA#1	4.2
200643	26SENECA#2	3.92

Bus Number	Bus Name	Full Contribution
200644	26SENECA#3	0.56
200715	26SHAWVL 1	10.43
200722	26SHAWVL 2	10.62
200665	26SHAWVL 3	16.
200666	26SHAWVL 4	15.95
294573	P-028 E	16.18
200888	P-047 E	20.61
292391	T-121 C	6.82
292392	T-121 E	27.29
297050	V2-019 E	0.13
903644	W3-099 E OP1	16.11
907462	X1-109 E	13.44
910522	X3-003 E	2.7
913311	Y1-071	0.92
914041	Y2-042	1.64
LTF	Y2-044	19.91
914151	Y2-060	0.47
915951	Y3-092	151.1
LTF	Z1-019	143.93
916051	Z1-038	2.6
916201	Z1-069 C	3.77
916202	Z1-069 E	16.07
916311	Z1-087	8.75
916351	Z1-091	3.46

Bus Number	Bus Name	Full Contribution
916361	Z1-092	4.09
916541	Z1-110	3.47
917072	Z2-011	3.47
917621	Z2-103	0.13
917631	Z2-104	0.14
917672	Z2-108 E	2.57
918221	AA1-037	0.68
918682	AA1-082 E	11.85
918871	AA1-106	3.47
918962	AA1-115 E	2.25
919091	AA1-131 C	0.83
919092	AA1-131 E	0.5
919201	AA1-144 OP	25.63
919491	AA2-000	53.86
LTF	AA2-033	71.97
LTF	AA2-034	71.97
919971	AA2-081	5.63
919991	AA2-083 OP	3.81
920171	AA2-112	3.77
920241	AA2-120 OP	70.63
920341	AA2-132	3.84
920351	AA2-133	3.
920371	AA2-135	3.3
920611	AA2-167	4.09

Appendix 29

(PENELEC - PENELEC) The 26HOMER CT 230/1 kV transformer (from bus 999443 to bus 200767 ckt S) loads from 117.13% to 120.43% (DC power flow) of its emergency rating (824 MVA) for the line fault with failed breaker contingency outage of 'C2_PN345-SB-4A2'. This project contributes approximately 60.32 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
200887	26ARMNA MT	0.56
203261	26BLOSSBCT	0.48
200838	26HOMER C2	36.35
200839	26HOMER C3	38.48
200857	26MARSHALL	10.56
200642	26SENECA#1	4.44
200643	26SENECA#2	4.14
200644	26SENECA#3	0.59
200715	26SHAWVL 1	11.03
200722	26SHAWVL 2	11.24

Bus Number	Bus Name	Full Contribution
200665	26SHAWVL 3	16.64
200666	26SHAWVL 4	16.57
294573	P-028 E	20.64
200888	P-047 E	26.16
292391	T-121 C	8.34
292392	T-121 E	33.35
297050	V2-019 E	0.16
903644	W3-099 E OP1	12.71
907462	X1-109 E	16.85
910522	X3-003 E	3.44

Bus Number	Bus Name	Full Contribution
914041	Y2-042	2.19
LTF	Y2-044	24.05
914151	Y2-060	0.6
LTF	Z1-019	173.95
916051	Z1-038	3.33
916201	Z1-069 C	4.69
916202	Z1-069 E	19.99
916311	Z1-087	9.25
916351	Z1-091	4.33
916361	Z1-092	5.07
916541	Z1-110	4.31
917072	Z2-011	4.31
917621	Z2-103	0.17
917631	Z2-104	0.19
917672	Z2-108 E	1.65
918682	AA1-082 E	14.87
918701	AA1-085 C	0.25

Bus Number	Bus Name	Full Contribution
918702	AA1-085 E	1.67
918871	AA1-106	4.31
919091	AA1-131 C	1.04
919092	AA1-131 E	0.63
919201	AA1-144 OP	32.08
919491	AA2-000	60.31
LTF	AA2-033	86.98
LTF	AA2-034	86.98
919971	AA2-081	7.08
919991	AA2-083 OP	4.81
920171	AA2-112	4.68
920241	AA2-120 OP	89.44
920341	AA2-132	4.77
920351	AA2-133	3.79
920371	AA2-135	4.15
920611	AA2-167	5.07