Generation Interconnection System Impact Study Report

For

PJM Generation Interconnection Request Queue Position AA1-111

Moshannon-East Towanda 230kV

April 2016

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 Interconnection Customer. As a requirement for interconnection, the Interconnection Customer 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 Interconnection Customer 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 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

Renovo Energy Center, LLC 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	Cost
Attachment Facilities	$ 0
Direct Connection Network Upgrades	$ 8,352,400
Non Direct Connection Network Upgrades	$ 173,900
Allocation for New System Upgrades	$ 113,712,900
Contribution for Previously Identified Upgrades	$ 12,306,500
Total Costs	**$ 134,545,700**

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Attachment Facilities

There are no Attachment Facilities are required to support this interconnection.

Direct Connection Cost Estimate

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	Activity Cost	Tax (if applicable)	Total Cost
AA1-111 Interconnection SS. New 230kV three breaker ring bus substation. (n4956)	$ 7,828,500	$ 2,431,400	$ 10,259,900
Marshall-Moshannon 230kV, Loop to Proposed 3-Breaker Ring Bus. Install a loop, approx. 200' in length, by removing an h-frame structure and installing two new 3-way deadend structures. (n4957)	$ 523,900	$ 161,600	$ 685,500
Total Direct Connection Facility Costs	**$ 8,352,400**	**$ 2,593,000**	**$ 10,945,400**

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	Activity Cost	Tax (if applicable)	Total Cost
AA1-144 Interconnect SS. Revise anti-islanding scheme for AA1-111 Interconnect line. (n4967)	$ 82,300	$ 25,400	$ 107,700
Marshall SS. Revise anti-islanding scheme for AA1-111 Interconnect line. (n4958)	$ 78,600	$ 24,300	$ 102,900
Moshannon 230 kV SS. Adjust Remote Relay Settings at Moshannon 230 kV substation. (n4959)	$ 13,000	$ 4,100	$ 17,100
Total Non-Direct Connection Facility Costs	**$ 173,900**	**$ 53,800**	**$ 227,700**

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Transmission Owner Scope of Work

The interconnection of the Project will require direct connection upgrades consisting of a new 230 kV three breaker ring bus interconnection switching station and a one span loop of the Marshall - Moshannon 230 kV line. The new switching station will be adjacent to Chapman substation. The IC will be responsible for acquiring all easements, properties and permits that may be required to construct both the new interconnection switching station and the associated attachment facilities. The IC will also be responsible for the rough grade of the property and an access road to the proposed three breaker ring bus site. The project will also require non-direct connection upgrades at the remote end substations. A summary of the Project connection facilities that will be required for the Project are shown in Attachment 2.

Schedule

Based on the scope of the direct connection for the Primary POI, it is expected to take a minimum of 20 months from the signing of an Interconnection Connection Service Agreement to complete the installation required for the Project. This includes a preliminary payment that compensates FE for the first three months of the engineering design work that is related to the construction of the AA1-111 230 kV interconnection substation. It also assumes that the IC will provide the property for the AA1-111 230 kV interconnection substation and all right-of-way, permits, easements, etc. that will be needed. A further assumption is that there will be no environmental issues with any of the new properties associated with this project, that there will be no delays in acquiring the necessary permits for implementing the defined direct connection and network upgrades, and that PJM will allow all transmission system outages when requested.

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 purchase and installation of a fully rated circuit breaker on the high side of the AA1-111 230-23 kV step-up transformer.

5. 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.

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6. 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.

7. The purchase and installation of a revenue class meter for each unit to measure the power delivered in compliance with the FE standards.

8. 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.

9. The establishment of dedicated communication circuits for SCADA report to the FE Transmission System Control Center.

10. A compliance with the FE and PJM generator power factor and voltage control requirements.

11. The execution of a back-up retail service agreement with Penelec to serve the customer load supplied from the IC's interconnection point.

12. 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

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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-230 kV line in PENELEC. 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 100% using a Summer Peak 2019 case. Potential network impacts were as follows:

Contingency Descriptions

The following contingencies resulted in overloads:

Contingency Name	Description
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
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

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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-#8D	CONTINGENCY 'B_PN345-SX-#8D' /* FUTURE MAINESBRG - WATERCURE ROAD 345 KV DISCONNECT BRANCH FROM BUS 920750 TO BUS 130757 CKT 1 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-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

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Contingency Name	Description
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
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

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Contingency Name	Description
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
PL100352	CONTINGENCY 'PL100352' /* LACK-OXBO-N.MES 230KV & OXBO TR DISCONNECT BRANCH FROM BUS 200706 TO BUS 200825 CKT 3 DISCONNECT BUS 200708 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

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Generator Deliverability

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

	Contingency		Affected		Bus			Power	Loading %		Rating		MW	
#	Type	Name	Area	Facility Description	From	To	Circuit	Flow	Initial	Final	Type	MVA	Contribution	Ref
1	N-1	B_PN230-SX-#11B	PENELEC	26TOWANDA-26NO MESHO 115 kV line	200674	200677	1	AC	94.9	110.21	ER	172	32.24	1
2	N-1	B_PN345-SX-#8D	PENELEC - NYISO	26E.TWANDA-HILSD230 230 kV line	200675	130763	1	AC	57.61	63.88	ER	531	31.7	2
3	Non	Non	PENELEC	26E.TWANDA-26CANYON 230 kV line	200675	200924	1F	AC	99.66	114.43	NR	546	88.22	
4	N-1	X4-048 COLL-X4-048	PENELEC	26E.TWANDA-26CANYON 230 kV line	200675	200924	1F	AC	95.11	107.19	ER	666	87.97	
5	N-1	X4-048 COLL-LACK	PENELEC	26E.TWANDA-26CANYON 230 kV line	200675	200924	1F	AC	95.11	107.19	ER	666	87.97	
6	N-1	B_PN230-SX-#11B	PENELEC	26NO MESHO-26MESH2REA 115 kV line	200677	200825	3	DC	86.14	100.03	ER	197	32.83	3
7	N-1	B_PN230-SX-#11B	PENELEC	26N.MESHPN 230/115 kV transformer	200825	200706	3	DC	90.26	104.82	ER	188	32.83	4
8	Non	Non	PENELEC	26CANYON-26N.MESHPN 230 kV line	200924	200706	1F	AC	94.46	109.23	NR	546	88.22	
9	N-1	X4-048 COLL-X4-048	PENELEC	26CANYON-26N.MESHPN 230 kV line	200924	200706	1F	AC	90.85	102.93	ER	666	87.97	
10	N-1	X4-048 COLL-LACK	PENELEC	26CANYON-26N.MESHPN 230 kV line	200924	200706	1F	AC	90.85	102.93	ER	666	87.97	
11	N-1	B_PN230-SX-#47	PENELEC	AA1-111 TAP-26CHAPMAN+ 230 kV line	919490	200908	1	DC	45.49	93.65	ER	666	321.51	

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#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution	Ref
12	N-1	PL100352	PENELEC	AA1-111 TAP-26CHAPMAN+ 230 kV line	919490	200908	1	DC	45.49	93.65	ER	666	321.51	

Note: Please see Attachment 4 for projects providing impacts to flowgate violations. The values in the Reference column correspond to the proper table in the Attachment.

Light Load Analysis

Light Load Studies to be conducted during later study phases (applicable to wind, coal, nuclear, and pumped storage projects).

Multiple Facility Contingency

(Double Circuit Tower Line contingencies were studied for the full energy output. The contingencies of Line with Failed Breaker and Bus Fault will be performed for the Impact Study.)

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution	Ref
13	LFFB	AP_SB_450 A_A	PENELEC	26E.TWANDA-26CANYON 230 kV line	200675	200924	1F	AC	93.82	124.32	ER	666	203.12	5
14	LFFB	AP_SB_451 A_A	PENELEC	26E.TWANDA-26CANYON 230 kV line	200675	200924	1F	AC	93.64	124.14	ER	666	203.09	
15	LFFB	C2_PN230-SB-17A	PENELEC - AP	26CHAPMAN+-01MOSHAN 230 kV line	200908	235220	1F	AC	57.5	105.86	ER	666	322.06	
16	LFFB	C2_PN230-SB-17A	PENELEC - AP	26CHAPMAN+-01MOSHAN 230 kV line	200908	235220	1F	AC	57.5	105.86	ER	666	322.06	
17	LFFB	AP_SB_450 A_A	PENELEC	26CANYON-26N.MESHPN 230 kV line	200924	200706	1F	AC	89.55	120.05	ER	666	203.12	6

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#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution	Ref
18	LFFB	AP_SB_451 A_A	PENELEC	26CANYON-26N.MESHPN 230 kV line	200924	200706	1F	AC	89.38	119.87	ER	666	203.09	
19	LFFB	C2_PN115-SB-#19F	PENELEC	26CANYON-26N.MESHPN 230 kV line	200924	200706	1F	DC	98.51	111.52	ER	666	101.93	
20	LFFB	AP_SB_450 A_A	PENELEC	26SCOTCHHLLW-26E.TWANDA 230 kV line	200940	200675	1	AC	43.46	123.55	ER	554	443.7	7
21	LFFB	AP_SB_451 A_A	PENELEC	26SCOTCHHLLW-26E.TWANDA 230 kV line	200940	200675	1	AC	43.45	123.54	ER	554	443.7	
22	LFFB	C2_PN115-SB-46F	PENELEC	AA1-111 TAP-26CHAPMAN+ 230 kV line	919490	200908	1	AC	58.1	105.48	ER	666	323.33	8
23	LFFB	C2_PN230-SB-17A	PENELEC	AA1-111 TAP-26CHAPMAN+ 230 kV line	919490	200908	1	AC	57.51	105.87	ER	666	322.06	
24	LFFB	C2_PN230-SB-9E2	PENELEC	26HOMER CY 345/1 kV transformer	200769	999442	N	AC	99.6	104.2	ER	807	37.12	9
25	LFFB	C2_PN230-SB-9E2	PENELEC	26HOMER CT 230/1 kV transformer	999442	200767	N	AC	95.9	100.4	ER	807	53.89	10
26	LFFB	C2_PN345-SB-7A	PENELEC	W3-099 TAP-26FOURMILE 230 kV line	903645	200928	1	AC	98.8	102.2	ER	592	24.23	11
27	LFFB	C2_PN345-SB-7C	PENELEC	W3-099 TAP-26FOURMILE 230 kV line	903645	200928	1	AC	98.8	102.2	ER	592	24.23	
28	LFFB	C2_PN345-SB-7B	PENELEC	W3-099 TAP-26FOURMILE 230 kV line	903645	200928	1	AC	98.8	102.2	ER	592	24.23	

Note: Please see Attachment 4 for projects providing impacts to flowgate violations. The values in the Reference column correspond to the proper table in the Attachment.

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Short Circuit

(Summary of impacted circuit breakers)

None.

Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution	Ref
29	LFFB	C2_PN345-SB-4A2	PENELEC	26HOMER CY 345/1 kV transformer	200769	999443	S	DC	113.99	119.99	ER	824	60.36	12
30	LFFB	C2_PN345-SB-4A2	PENELEC	26HOMER CT 230/1 kV transformer	999443	200767	S	DC	111.43	117.43	ER	824	60.36	13

Note: Please see Attachment 4 for projects providing impacts to flowgate violations. The values in the Reference column correspond to the proper table in the Attachment.

Steady-State Voltage Requirements

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

To be provided in the Facilities Study.

Stability and Reactive Power Requirement for Low Voltage Ride Through

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

To be provided in the Facilities Study.

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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	AA1-111 Allocation
1	East Towanda – N. Meshoppen 115 kV line	In order to mitigate the overloads of facilities above, the following reinforcements are required: • Replacing the existing breaker and wave trap at East Towanda 115 kV bus, and replacing the wave trap at the North Meshoppen. The estimated cost is $242,800, and it will take 31 months to complete. Note: Due to the agreed coordination effort between PJM and NYISO, two NYISO queue projects (Q496 and Q498) were included at the end of PJM's AA2 queue. Once these two projects move into NYISO's impact study phase, PJM will publish impact study reports in order to address the incremental impacts on PJM's transmission system.	n4921	**$ 242,800**	**$ 127,000**
2	E. Towanda (PENELEC) – Hillside (NYISO) 230 kV line	In order to mitigate the overloads of facilities above, the following reinforcements are required: • PENELEC: Replacing the wave trap on the E. Towanda with an emergency rating of 615 MVA is required. The estimate cost is $84,600, and it will take 9 months to complete. • NYSEG: Replacing the wave trap on the Hillside with an emergency rating of 615 MVA is required. The estimated cost is $65,569, and it will take 6-8 month to complete.	n4922 n4923	**$ 150,169**	**$ 18,800**
3, 4, 5, 13, 14	E Towanda– Canyon 230 kV line	In order to mitigate the overloads of facilities above, the following reinforcements are required: • Rebuilding the line with 1590 ACSS and upgrading the associated terminal equipment are required. The estimated cost is $30,476,800, and it will take 39 months to complete.	n4924	**$ 30,476,800**	**$ 30,476,800**

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Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost	AA1-111 Allocation
6, 7	N Meshoppen - North Meshoppen 2 Reactor 115 kV line and N Meshoppen #3 230/115 kV transformer	In order to mitigate the overloads of facilities above, the following reinforcements are required: • Replacing North Meshoppen #3 230/115 KV transformer with an emergency rating of 300 MVA, removing the 115 kV current limiting reactor, replacing the transformer relay, and updating the existing RTU are required. The estimated cost is $4,880,000, and it will take 14 months to complete.	n4925	**$ 4,880,000**	**$ 2,755,100**
19, 20	Chapman tap – Moshannon 230 kV line	In order to mitigate the overloads of facilities above, the following reinforcements are required: • Reconductoring line with 1033 ACSS conductor and replacing the line drops at the Moshannon 230 kV substation are required. The estimated cost is $30,765,200, and it will take 31 months to complete.	n4926	**$ 30,765,200**	**$ 30,765,200**
8, 9, 10, 21, 22, 23	Canyon– N. Meshoppen 230 kV line	In order to mitigate the overloads of facilities above, the following reinforcements are required: • Rebuilding the line with 1590 ACSS, replacing the disconnect switch at the Canyon 230 kV substation, and replacing the wave trap at the N. Meshhoppen 230 kV substation The estimated cost is $24,153,300, and it will take 39 months to complete.	n4927	**$ 24,153,300**	**$ 24,153,300**
11, 12, 26, 27	AA1-111 Tap – Chapman 230 kV line	In order to mitigate the overloads of facilities above, the following reinforcements are required: • Reconductoring 0.1 miles of existing 1033 ACSR conductor with new 1033 ACSS conductor from Chapman Sub to new AA1-111 interconnect on the Marshall-Moshannon 230kV circuit, and adjusting remote settings at the Moshannon substation The estimated cost is $467,400, and it will take 12 months to complete.	n4928	**$ 467,400**	**$ 428,100**

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Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost	AA1-111 Allocation
24, 25	Homer City North 345/230 kV Transformer	In order to mitigate the overloads of facilities above, the following reinforcements are required: • Replacing the Homer City North Transformer and relocating transformer termination The estimated cost is $21,469,500, and it will take 15 months to complete.	n4929	**$ 21,469,500**	**$ 21,469,500**
20, 21	Scotch Hollow – E Towanda 230 kV line	In order to mitigate the overloads of facilities above, the following reinforcements are required: • Replacing the existing wave trap and line drops at East Towanda The estimated cost is $120,100, and it will take 7 months to complete.	n4930	**$ 120,100**	**$ 120,100**
27, 28, 29	W3-099 Tap - Four Mile Jct. 230 kV line	In order to mitigate the overloads of facilities above, the following reinforcements are required: • Reconductoring 230 kV line from Four Mile Junction to the W3-099 Tap point with 1033 ACSS high temperature conductor approximately 9.04 miles, and replacing the line drops at the Four Mile Junction substation. The estimated cost is $10,458,400, and it will take 25 months to complete.	n4931	**$ 10,458,400**	**$ 3,399,000**
				Total New Network Upgrades	**$ 113,712,900**

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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	AA1-111 Allocation
29, 30	Homer City South 345/230 kV Transformer	In order to mitigate the overloads of facilities above, the following reinforcements are required: • Replacing the Homer City North Transformer and relocating transformer termination The estimated cost is $16,170,100, and it will take 15 months to complete.	n4932	**$ 16,170,100**	**$ 12,306,500**
			Total New Network Upgrades		**$ 12,306,500**

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.

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Attachment 1. Project Location

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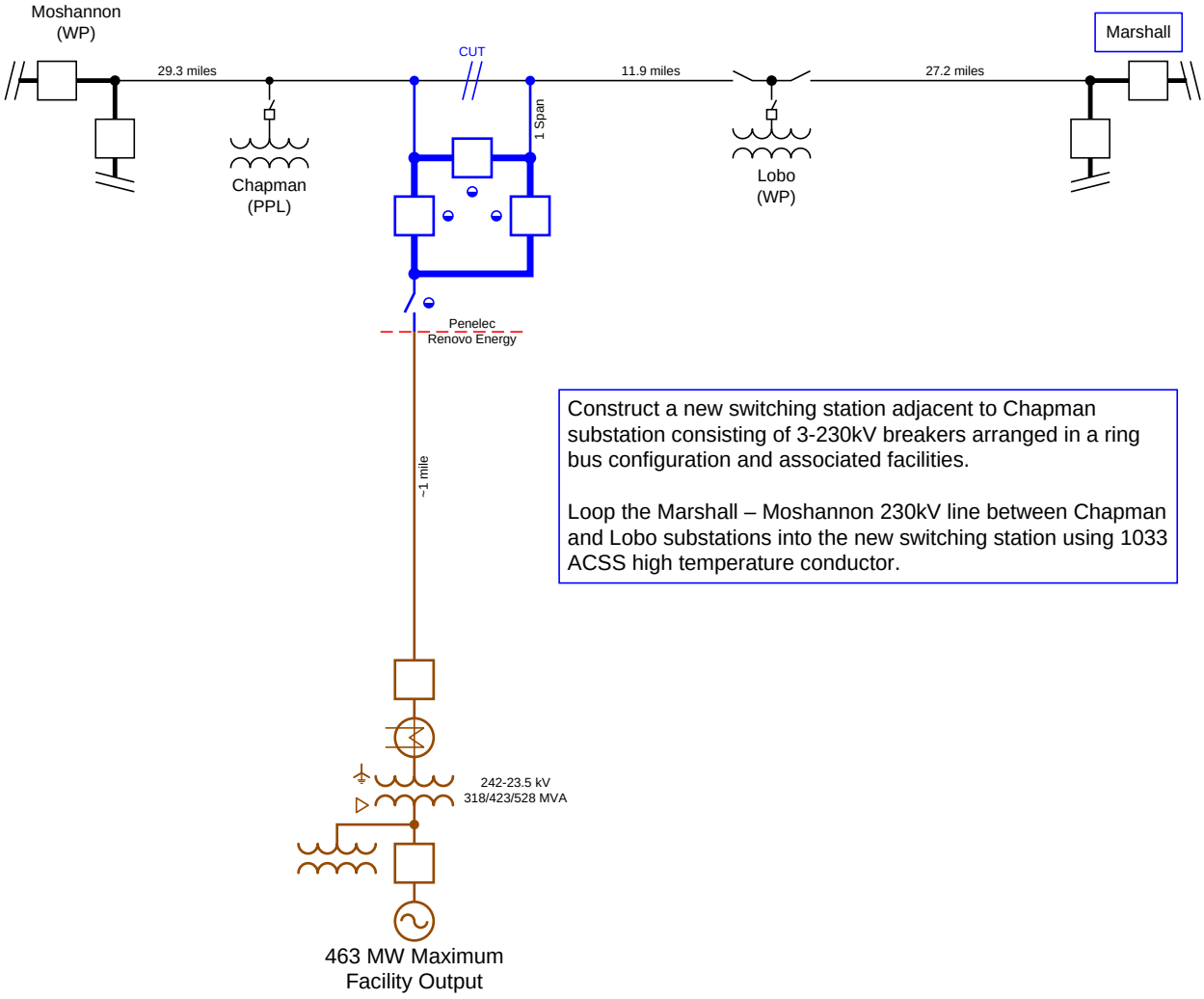
Attachment 2. Single Line Diagram



Construct a new switching station adjacent to Chapman substation consisting of 3-230kV breakers arranged in a ring bus configuration and associated facilities.

Loop the Marshall – Moshannon 230kV line between Chapman and Lobo substations into the new switching station using 1033 ACSS high temperature conductor.

Customer facilities are shown for informational purposes only. The Customer is responsible for designing its facilities to comply with applicable FirstEnergy connection standards, including FE's "Requirements for Transmission Connected Facilities" document.

FE
Renovo Energy

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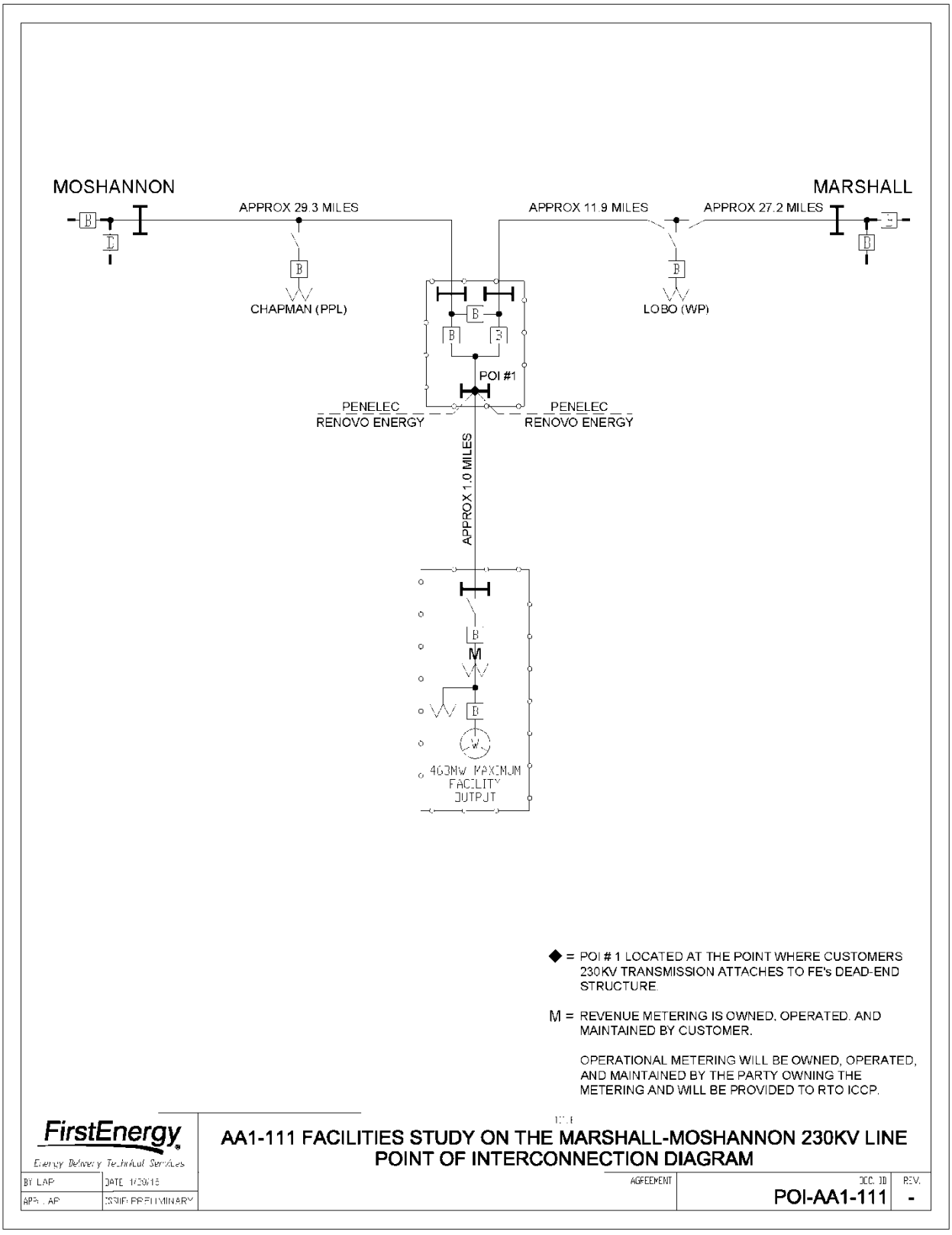
Attachment 3. Engineering Single Line Diagram



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Attachment 4. 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 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

(PENELEC - PENELEC) The 26TOWANDA-26NO MESHO 115 kV line (from bus 200674 to bus 200677 ckt 1) loads from 94.9% to 110.21% (AC power flow) of its emergency rating (172 MVA) for the single line contingency outage of 'B_PN230-SX-#11B'. This project contributes approximately 32.24 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
200887	26ARMNA MT	0.25
203261	26BLOSSBCT	0.22
203283	26MANOR	0.03
907461	X1-109 C	13.29
LTF	Y2-044	4.65
LTF	Z1-019	33.62
916201	Z1-069 C	0.86
916361	Z1-092	0.28
916541	Z1-110	0.29
917072	Z2-011	2.55

Bus Number	Bus Name	Full Contribution
918871	AA1-106	2.55
919201	AA1-144 OP	24.32
919491	AA1-111	32.24
919971	AA2-081	1.47
919991	AA2-083 OP	2.85
920241	AA2-120 OP	20.07
920371	AA2-135	3.41
920611	AA2-167	2.45
LTF	NYISO-Q498	9.23

Appendix 2

(PENELEC - NYISO) The 26E.TWANDA-HILSD230 230 kV line (from bus 200675 to bus 130763 ckt 1) loads from 57.61% to 63.88% (AC power flow) of its emergency rating (531 MVA) for the single line contingency outage of 'B_PN345-SX-#8D'. This project contributes approximately 31.7 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
203283	26MANOR	0.02
200851	26MEHOOP3	< 0.01
294572	P-028 C	0.29

Bus Number	Bus Name	Full Contribution
917621	Z2-103	0.08
917631	Z2-104	0.15
LTF	Z2-117	14.51

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Bus Number	Bus Name	Full Contribution
907461	X1-109 C	18.92
913191	Y1-047 OP1	0.15
914041	Y2-042	1.68
914151	Y2-060	0.03
915951	Y3-092	39.62
916051	Z1-038	1.83
916541	Z1-110	0.31
917072	Z2-011	2.66

Bus Number	Bus Name	Full Contribution
918871	AA1-106	2.66
919201	AA1-144 OP	34.45
919491	AA1-111	31.7
919991	AA2-083 OP	1.64
920351	AA2-133	2.28
920371	AA2-135	2.64
LTF	NYISO-Q496	109.79
LTF	NYISO-Q498	111.21

Appendix 3

(PENELEC - PENELEC) The 26NO MESHO-26MESH2REA 115 kV line (from bus 200677 to bus 200825 ckt 3) loads from 86.14% to 100.03% (**DC power flow**) of its emergency rating (197 MVA) for the single line contingency outage of 'B_PN230-SX-#11B'. This project contributes approximately 32.83 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
203283	26MANOR	0.03
200851	26MEHOOP3	< 0.01
294572	P-028 C	1.37
907461	X1-109 C	12.69
913191	Y1-047 OP1	0.7
LTF	Y2-044	9.59
914151	Y2-060	0.16
LTF	Z1-019	69.55
916051	Z1-038	5.93
916201	Z1-069 C	1.11
916351	Z1-091	0.67
916361	Z1-092	0.33
916541	Z1-110	0.29

Bus Number	Bus Name	Full Contribution
917072	Z2-011	2.51
917621	Z2-103	0.4
918871	AA1-106	2.51
919201	AA1-144 OP	23.24
919491	AA1-111	32.83
919971	AA2-081	1.87
919991	AA2-083 OP	2.78
920171	AA2-112	4.99
920241	AA2-120 OP	25.32
920341	AA2-132	4.8
920351	AA2-133	4.62
920371	AA2-135	3.59
20611	AA2-167	2.88

Appendix 4

(PENELEC - PENELEC) The 26N.MESHPN 230/115 kV transformer (from bus 200825 to bus 200706 ckt 3) loads from 90.26% to 104.82% (**DC power flow**) of its emergency rating (188 MVA) for the single line contingency outage of 'B_PN230-SX-#11B'. This project contributes approximately 32.83 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
203283	26MANOR	0.03
200851	26MEHOOP3	< 0.01
294572	P-028 C	1.37
907461	X1-109 C	12.69

Bus Number	Bus Name	Full Contribution
917072	Z2-011	2.51
917621	Z2-103	0.4
918871	AA1-106	2.51
919201	AA1-144 OP	23.24

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Bus Number	Bus Name	Full Contribution
913191	Y1-047 OP1	0.7
LTF	Y2-044	9.59
914151	Y2-060	0.16
LTF	Z1-019	69.55
916051	Z1-038	5.93
916201	Z1-069 C	1.11
916351	Z1-091	0.67
916361	Z1-092	0.33
916541	Z1-110	0.29

Bus Number	Bus Name	Full Contribution
919491	AA1-111	32.83
919971	AA2-081	1.87
919991	AA2-083 OP	2.78
920171	AA2-112	4.99
920241	AA2-120 OP	25.32
920341	AA2-132	4.8
920351	AA2-133	4.62
920371	AA2-135	3.59
920611	AA2-167	2.88

Appendix 5

(PENELEC - PENELEC) The 26E.TWANDA-26CANYON 230 kV line (from bus 200675 to bus 200924 ckt 1F) loads from 93.82% to 124.32% (AC 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
203283	26MANOR	0.06
200857	26MARSHALL	31.25
200888	P-047 E	21.25
292392	T-121 E	8.09
297050	V2-019 E	0.13
903643	W3-099 C OP1	1.04
903644	W3-099 E OP1	6.94
907461	X1-109 C	41.39
LTF	Y2-044	18.68

Bus Number	Bus Name	Full Contribution
LTF	Z1-019	135.43
916201	Z1-069 C	2.39
916202	Z1-069 E	10.17
916541	Z1-110	0.93
917072	Z2-011	8.14
917662	Z2-107 E	1.61
918871	AA1-106	8.14
919201	AA1-144 OP	76.59
919491	AA1-111	203.12

Appendix 6

(PENELEC - PENELEC) The 26CANYON-26N.MESHPN 230 kV line (from bus 200924 to bus 200706 ckt 1F) loads from 89.55% to 120.05% (AC 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.

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Bus Number	Bus Name	Full Contribution
203283	26MANOR	0.06
200857	26MARSHALL	31.25
200888	P-047 E	21.25
292392	T-121 E	8.09
297050	V2-019 E	0.13
903643	W3-099 C OP1	1.04
903644	W3-099 E OP1	6.94
907461	X1-109 C	41.39
LTF	Y2-044	18.68
LTF	Z1-019	135.43
916201	Z1-069 C	2.39
916202	Z1-069 E	10.17
916541	Z1-110	0.93

Bus Number	Bus Name	Full Contribution
917072	Z2-011	8.14
917662	Z2-107 E	1.61
918871	AA1-106	8.14
919201	AA1-144 OP	76.59
919491	AA1-111	203.12
919971	AA2-081	4.09
919991	AA2-083 OP	6.71
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 7

(PENELEC - PENELEC) The 26SCOTCHHLLW-26E.TWANDA 230 kV line (from bus 200940 to bus 200675 ckt 1) loads from 43.46% to 123.55% (AC 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 443.7 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
200857	26MARSHALL	67.09
916541	Z1-110	1.58
917072	Z2-011	13.79
918871	AA1-106	13.79

Bus Number	Bus Name	Full Contribution
919201	AA1-144 OP	160.54
919491	AA1-111	443.7
919991	AA2-083 OP	3.51

Appendix 8

(PENELEC - PENELEC) The AA1-111 TAP-26CHAPMAN+ 230 kV line (from bus 919490 to bus 200908 ckt 1) loads from 58.1% to 105.48% (AC 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
200857	26MARSHALL	39.81
200851	26MEHOOP3	< 0.01
294572	P-028 C	0.83

Bus Number	Bus Name	Full Contribution
916541	Z1-110	0.71
917072	Z2-011	6.19
917621	Z2-103	0.24
918871	AA1-106	6.19

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Bus Number	Bus Name	Full Contribution
294573	P-028 E	28.24
200888	P-047 E	12.24
297050	V2-019 E	0.08
907461	X1-109 C	22.21
910522	X3-003 E	4.79
913191	Y1-047 OP1	0.42
LTF	Y2-044	10
914151	Y2-060	0.1
LTF	Z1-019	72.64
916201	Z1-069 C	1.08
916202	Z1-069 E	4.59

Bus Number	Bus Name	Full Contribution
919201	AA1-144 OP	42.92
919491	AA1-111	323.33
919971	AA2-081	2.06
919991	AA2-083 OP	4.36
920171	AA2-112	2.37
920241	AA2-120 OP	29.98
920341	AA2-132	2.39
920351	AA2-133	4.62
920371	AA2-135	4.68
920611	AA2-167	3.64

Appendix 9

(PENELEC - PENELEC) The 26HOMER CY 345/1 kV transformer (from bus 200769 to bus 999442 ckt N) loads from 99.6% to 104.2% (AC 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 37.12 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
200887	26ARMNA MT	0.59
203261	26BLOSSBCT	0.52
200828	26HNSMLK 1	1.72
200829	26HNSMLK 2	1.72
200830	26HNSMLK 3	1.72
200831	26HNSMLK 4	1.72
200832	26HNSMLK 5	1.72
200838	26HOMER C2	36.76
200839	26HOMER C3	38.91
200857	26MARSHALL	9.04
200642	26SENECA#1	5.68
200715	26SHAWVL 1	10.44
200722	26SHAWVL 2	10.63
200665	26SHAWVL 3	16.02
200666	26SHAWVL 4	15.97
294573	P-028 E	15.89
200888	P-047 E	20.62
292391	T-121 C	< 0.01
292392	T-121 E	17.06
297050	V2-019 E	0.13
903643	W3-099 C OP1	2.41
903644	W3-099 E OP1	16.11

Bus Number	Bus Name	Full Contribution
LTF	Y2-044	19.92
915951	Y3-092	151.19
LTF	Z1-019	143.98
916051	Z1-038	2.6
916201	Z1-069 C	3.77
916202	Z1-069 E	16.07
916311	Z1-087	8.75
917072	Z2-011	3.47
917621	Z2-103	0.13
917631	Z2-104	0.14
917672	Z2-108 E	2.57
918871	AA1-106	3.47
918962	AA1-115 E	2.25
919201	AA1-144 OP	25.64
919491	AA1-111	53.89
919971	AA2-081	5.63
919991	AA2-083 OP	4.12
920082	AA2-104 E	2.57
920171	AA2-112	3.77
920241	AA2-120 OP	70.65
920341	AA2-132	3.84
920351	AA2-133	3

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910522	X3-003 E	2.7	920371	AA2-135	3.31
913311	Y1-071	0.92	920611	AA2-167	4.09
914041	Y2-042	1.64	LTF	NYISO-Q496	82.74

Appendix 10

(PENELEC - PENELEC) The 26HOMER CT 230/1 kV transformer (from bus 999442 to bus 200767 ckt N) loads from 103.13% to 108.62% (**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 53.89 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution	Bus Number	Bus Name	Full Contribution
200887	26ARMNA MT	0.59	LTF	Y2-044	19.92
203261	26BLOSSBCT	0.52	915951	Y3-092	151.19
200828	26HNSMLK 1	1.72	LTF	Z1-019	143.98
200829	26HNSMLK 2	1.72	916051	Z1-038	2.6
200830	26HNSMLK 3	1.72	916201	Z1-069 C	3.77
200831	26HNSMLK 4	1.72	916202	Z1-069 E	16.07
200832	26HNSMLK 5	1.72	916311	Z1-087	8.75
200838	26HOMER C2	36.76	917072	Z2-011	3.47
200839	26HOMER C3	38.91	917621	Z2-103	0.13
200857	26MARSHALL	9.04	917631	Z2-104	0.14
200642	26SENECA#1	5.68	917672	Z2-108 E	2.57
200715	26SHAWVL 1	10.44	918871	AA1-106	3.47
200722	26SHAWVL 2	10.63	918962	AA1-115 E	2.25
200665	26SHAWVL 3	16.02	919201	AA1-144 OP	25.64
200666	26SHAWVL 4	15.97	919491	AA1-111	53.89
294573	P-028 E	15.89	919971	AA2-081	5.63
200888	P-047 E	20.62	919991	AA2-083 OP	4.12
292391	T-121 C	< 0.01	920082	AA2-104 E	2.57
292392	T-121 E	17.06	920171	AA2-112	3.77
297050	V2-019 E	0.13	920241	AA2-120 OP	70.65
903643	W3-099 C OP1	2.41	920341	AA2-132	3.84
903644	W3-099 E OP1	16.11	920351	AA2-133	3
910522	X3-003 E	2.7	920371	AA2-135	3.31
913311	Y1-071	0.92	920611	AA2-167	4.09
914041	Y2-042	1.64	LTF	NYISO-Q496	82.74

Appendix 11

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(PENELEC - PENELEC) The W3-099 TAP-26FOURMILE 230 kV line (from bus 903645 to bus 200928 ckt 1) loads from 103.94% to 106.88% (**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	0.25
200857	26MARSHALL	4.64
294573	P-028 E	10.88
200888	P-047 E	8.78
292392	T-121 E	5.01
297050	V2-019 E	0.05
903643	W3-099 C OP1	9.77
903644	W3-099 E OP1	65.38
910522	X3-003 E	1.85
914041	Y2-042	1.25
LTF	Y2-044	15.71
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	0.28
916361	Z1-092	0.31
917072	Z2-011	1.86
917621	Z2-103	0.09
917631	Z2-104	0.11
LTF	Z2-117	39.61
918871	AA1-106	1.86
919201	AA1-144 OP	16.21
919491	AA1-111	24.23
919971	AA2-081	2.05
919991	AA2-083 OP	2.08
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 12

(PENELEC - PENELEC) The 26HOMER CY 345/1 kV transformer (from bus 200769 to bus 999443 ckt S) loads from 113.99% to 119.99% (**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 60.36 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
200887	26ARMNA MT	0.75
203261	26BLOSSBCT	0.65
200838	26HOMER C2	49.18
200839	26HOMER C3	52.06
200857	26MARSHALL	10.56
200715	26SHAWVL 1	11.05
200722	26SHAWVL 2	11.25
200665	26SHAWVL 3	16.65
200666	26SHAWVL 4	16.59
294573	P-028 E	20.28
916311	Z1-087	9.25
916361	Z1-092	0.58
917072	Z2-011	4.31
917621	Z2-103	0.17
917631	Z2-104	0.19
917672	Z2-108 E	1.65
918701	AA1-085 C	0.5
918702	AA1-085 E	3.35
918871	AA1-106	4.31
919201	AA1-144 OP	32.09

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Bus Number	Bus Name	Full Contribution
200888	P-047 E	26.17
292391	T-121 C	< 0.01
292392	T-121 E	20.85
297050	V2-019 E	0.16
903643	W3-099 C OP1	1.9
903644	W3-099 E OP1	12.72
910522	X3-003 E	3.44
914041	Y2-042	2.19
LTF	Y2-044	24.06
LTF	Z1-019	174.01
916051	Z1-038	3.33
916201	Z1-069 C	4.69
916202	Z1-069 E	20

Bus Number	Bus Name	Full Contribution
919491	AA1-111	60.36
919971	AA2-081	7.08
919991	AA2-083 OP	5.19
920082	AA2-104 E	1.65
920171	AA2-112	4.68
920241	AA2-120 OP	89.46
920341	AA2-132	4.77
920351	AA2-133	3.79
920371	AA2-135	4.15
920611	AA2-167	5.07
LTF	NYISO-Q496	122.45
LTF	NYISO-Q498	34.24

Appendix 13

(PENELEC - PENELEC) The 26HOMER CT 230/1 kV transformer (from bus 999443 to bus 200767 ckt S) loads from 111.43% to 117.43% (**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 60.36 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
200887	26ARMNA MT	0.75
203261	26BLOSSBCT	0.65
200838	26HOMER C2	49.18
200839	26HOMER C3	52.06
200857	26MARSHALL	10.56
200715	26SHAWVL 1	11.05
200722	26SHAWVL 2	11.25
200665	26SHAWVL 3	16.65
200666	26SHAWVL 4	16.59
294573	P-028 E	20.28
200888	P-047 E	26.17
292391	T-121 C	< 0.01
292392	T-121 E	20.85
297050	V2-019 E	0.16
903643	W3-099 C OP1	1.9
903644	W3-099 E OP1	12.72
910522	X3-003 E	3.44
914041	Y2-042	2.19
LTF	Y2-044	24.06
LTF	Z1-019	174.01

Bus Number	Bus Name	Full Contribution
916311	Z1-087	9.25
916361	Z1-092	0.58
917072	Z2-011	4.31
917621	Z2-103	0.17
917631	Z2-104	0.19
917672	Z2-108 E	1.65
918701	AA1-085 C	0.5
918702	AA1-085 E	3.35
918871	AA1-106	4.31
919201	AA1-144 OP	32.09
919491	AA1-111	60.36
919971	AA2-081	7.08
919991	AA2-083 OP	5.19
920082	AA2-104 E	1.65
920171	AA2-112	4.68
920241	AA2-120 OP	89.46
920341	AA2-132	4.77
920351	AA2-133	3.79
920371	AA2-135	4.15
920611	AA2-167	5.07

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916051	Z1-038	3.33
916201	Z1-069 C	4.69
916202	Z1-069 E	20

LTF	NYISO-Q496	122.45
LTF	NYISO-Q498	34.24

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