Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position Y1-028

Lewis Run 115 kV

September 2012

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 wind generating facility located in McKean County, Pennsylvania. The installed facilities will have a total capability of 125.0 MW with 16.25 MW of this output being recognized by PJM as capacity. This means that the remaining 108.75 MW will be curtailable should a system reliability constraint occur. The proposed in-service date for this project is December 1, 2014. **This study does not imply a First Energy commitment to this in-service date.**

Point of Interconnection

Y1-028 will interconnect with the Penelec transmission system at one of two options:

Option 1 will interconnect directly to the 115 kV side of Lewis Run substation.

Option 2 will interconnect directly to the 230 kV side of Lewis Run substation.

Cost Summary

Option 1

The Y1-028 project that connects with **Option 1** will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 0
Direct Connection Network Upgrades	$ 7,234,400
Non Direct Connection Network Upgrades	$ 722,600
Total Costs	**$ 7,957,000**

In addition, the Y1-028 project may be responsible for a contribution to the following costs:

Description	Total Cost
New System Upgrades	$ 3,544,800
Previously Identified Upgrades	$ 6,921,300
Total Costs	**$ 10,466,100**

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

Option 2

The Y1-028 project that connects with **Option 2** will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 0
Direct Connection Network Upgrades	$ 1,731,500
Non Direct Connection Network Upgrades	$ 746,800
Total Costs	**$ 2,478,300**

In addition, the Y1-028 project may be responsible for a contribution to the following costs:

Description	Total Cost
New System Upgrades	$ 3,544,800
Previously Identified Upgrades	$ 0
Total Costs	**$ 3,544,800**

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

In compliance with the Regional Transmission Expansion Planning (RTEP) protocol, the Interconnection Customer has submitted a "Form of Generation Interconnection Feasibility Study Agreement" to PJM and a proposed single line diagram that identifies its plan to construct a 125 MW Wind Generation Project with a total capability of 125 MW (16.25 MW Capacity) (see Attachment 1). For purposes of this report, it has therefore been designated as the Lewis Run (Y1-028) Project to reflect its proximity to Lewis Run substation. The IC has requested the study of both a Primary and Secondary Point of Interconnection (POI) for the Project.

Primary Point of Interconnection: Lewis Run 115kV Substation

Direct Connection Cost Estimate – Option 1

The interconnection of the Project at the primary POI for Y1-028 will be accomplished by constructing a new 115kV 5 breaker ring bus at Lewis Run substation. The IC will be responsible for acquiring all easements, properties and permits that may be required to expand Lewis Run substation. A summary of the Project direct connection facilities that will be required for the Primary POI and their estimated costs are shown below. The one-line for the Primary POI is shown in Attachment 1.

Please note that subsequent to the project kick-off meeting, FE and PJM identified the need for baseline system reinforcements in the Lewis Run area. As a result of these reinforcements (PJM baseline RTEP upgrades b1991 and b1994), all 115kV facilities at Lewis Run will be removed and the station will be converted to 230kV operation. Therefore, after the in-service date for the baseline upgrades (6/1/2015), the IC must upgrade its facilities to 230kV operation in order to remain connected to the Penelec transmission system.

The total preliminary cost estimate for Direct Connection work is given in the table below:

Description	Total Cost
Lewis Run: Install a 115kV five position ring bus at the existing Lewis Run substation, utilizing existing transformers.	$ 5,454,600
Engineering, Oversight, & Commissioning	$ 129,600
Tax	$ 1,650,200
Total	**$ 7,234,400**

Non-Direct Connection Cost Estimate – Option 1

In addition to the direct connection upgrades, the Interconnection Customer will also be responsible for the following transmission upgrades to support the installation of Y1-028.

The total preliminary cost estimate for Non-Direct Connection work is given in the table below:

Description	Total Cost
Farmers Valley: Install transfer trip equipment and upgrade relaying on the 115kV line to Lewis Run.	$ 268,000

Description	Total Cost
Glade: Install transfer trip equipment and upgrade relaying on the 230kV line to Lewis Run.	$ 289,700
Tax	$ 164,900
Total	**$ 722,600**

Secondary Point of Interconnection: Lewis Run 230kV Substation

Direct Connection Cost Estimate - Option 2

The interconnection of the project at the secondary POI will be construction of a 5 breaker 230kV ring bus at Lewis Run. Because the system reinforcements mentioned above involve FE constructing a 4 breaker 230kV ring bus at Lewis Run, the IC will be responsible for the difference in cost between a 4 and 5 breaker ring bus. The estimated cost of direct attachment facilities for the Y1-028 project is shown below. The full cost estimate of both the 4 breaker ring bus and 5 breaker ring bus are listed in Attachment 4. The one-line for the Secondary POI is shown in Attachment 2. The IC will be responsible for acquiring all easements, properties and permits that may be required to expand Lewis Run substation.

Description	Total Cost
Lewis Run: Construct 5 breaker 230kV ring bus. (Difference between 4 breaker ring bus and 5 breaker ring bus)*	$ 1,236,500
Engineering, Oversight, & Commissioning	$ 129,600
Tax	$ 365,400
Total	**$ 1,731,500**

* If PJM baseline RTEP upgrades b1991 and b1994 are cancelled, Y1-028 will be responsible for the cost of the 4 breaker 230 kV ring bus at Lewis Run.

Non-Direct Connection Cost Estimate – Option 2

In addition to the direct connection upgrades, the Interconnection Customer will also be responsible for the following transmission upgrades to support the installation of Y1-028.

The total preliminary cost estimate for Non-Direct Connection work is given in the table below:

Description	Total Cost
Farmers Valley: Install transfer trip equipment and upgrade relaying.	$ 288,200
Glade: Install transfer trip equipment and upgrade relaying.	$ 288,200
Tax	$ 170,400
Total	**$ 746,800**

Interconnection Customer Requirements

Compliance Issues

The Interconnection Customer will be responsible for meeting all FE criteria as defined in the FE Requirements for Transmission Connected Facilities document. While the voltage analysis is not performed for the feasibility study, any voltage criteria violations that would require the plant to provide reactive power, that determination of reactive power requirements will be determined in the system impact study, which will include the low voltage ride through analysis.

The IC must also meet all PJM, ReliabilityFirst and NERC reliability criteria and operating procedures required for standards compliance. For example, the IC will need to properly locate and report the over and under-voltage and over and under-frequency system protection elements for its units as well as the submission of the generator model and protection data required to satisfy the PJM and ReliabilityFirst audits. Failure to comply with these requirements may result in a disconnection of service if the violation is found to compromise the reliability of the FE system.

The IC has proposed a non-standard winding configuration for the main GSU transformer. This configuration is in violation of FE's Requirements for Transmission Facilities document and will not be accepted. As discussed in section 14.2.7 of the document, the transformer shall have a grounded wye winding on the high (utility) side and a delta winding on the low (generator) side.

Other Requirements

In addition to the FE facilities, the Interconnection Customer will also be responsible for meeting all criteria as specified in the applicable sections of the "FE Requirements for Transmission Connected Facilities" document including:

1. The purchase and installation of a fully rated circuit breaker on the high side of the Y1-028 step-up transformer.

2. 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.

3. The purchase and installation of a 115kV interconnection metering instrument transformer. FE will provide the ratio and accuracy specifications based on the customer load and generation levels.

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

5. 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.

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

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

8. The execution of a back-up service agreement to serve the customer load supplied from Lewis Run substation when the units are out-of-service. This assumes the intent of the IC is to net the generation with the load.

The above requirements are in addition to any metering required by PJM.

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.

First Energy 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

Summary

The Lewis Run 115kV (Y1-028) Project direct connection for the Primary POI will require the facility upgrades defined above. As shown, the total estimated cost of the 115kV five breaker ring bus substation is $7,957,000. This cost includes a CIAC (Contribution in Aid of Construction) Federal Income Tax Gross Up charge of $1,815,100. This tax may or may not be charged based on whether or not this project meets the eligibility requirements of IRS Notice 88-129.The Project will require network upgrades to the FE system as defined below. As shown, the total estimated cost of the upgrades is $10,466,100. This cost includes a CIAC (Contribution in Aid of Construction) Federal Income Tax Gross Up charge of $2,386,600. Please note that PJM is responsible for determining the cost responsibility for the network upgrade required to mitigate these violations.

The Lewis Run 115kV (Y1-028) Project direct connection for the Secondary POI will require the facility upgrades defined above. As shown, the total estimated cost difference between the 4 and 5 breaker 230kV ring bus stations is $2,478,300. This cost includes a CIAC (Contribution in Aid of Construction) Federal Income Tax Gross Up charge of $535,800. The Project will require

network upgrades to the FE system as defined below. As shown, the total estimated cost of the upgrades is $3,544,800. This cost includes a CIAC (Contribution in Aid of Construction) Federal Income Tax Gross Up charge of $808,600. Please note that PJM is responsible for determining the cost responsibility for the network upgrade required to mitigate these violations.

Based on the scope of each direct connection, it is expected to take a minimum of two (2) years from the signing of a Construction 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 expansion of Lewis Run substation. It assumes 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.

Network Impacts

Option 1

The Queue Project #Y1-028 was studied as a 125.0MW (Capacity16.3MW) injection at the LEWIS RN 115 kV substation in the PENELEC area. Project #Y1-028 was evaluated for compliance with reliability criteria for summer peak conditions in 2015. Potential network impacts were as follows:

Contingency Descriptions

The following contingencies resulted in overloads:

Contingency Name	Description
APS_B_G297_U2-055A	CONTINGENCY 'APS_B_G297_U2-055A' / 235219 01MILESB 230 235853 01KARTHS 230 1 OPEN BRANCH FROM BUS 235219 TO BUS 889060 CKT 1 END
B_PN230-SX-#11_X1_109B	CONTINGENCY 'B_PN230-SX-#11_X1_109B' /* EAST TOWANDA - N MESHOPPEN (ETP) 230 KV & N MESHOPPEN BK 4 DISCONNECT BRANCH FROM BUS 907910 TO BUS 200706 CKT 1 DISCONNECT BRANCH FROM BUS 200706 TO BUS 200677 CKT 4 END
B_PN230-SX-#15	CONTINGENCY 'B_PN230-SX-#15' /* ELKO - FOREST (FE) 230 KV - (PJM-PN09) DISCONNECT BRANCH FROM BUS 200581 TO BUS 235175 CKT 1 END
B_PN230-SX-#25	CONTINGENCY 'B_PN230-SX-#25' /* FOREST - GLADE 230 KV DISCONNECT BRANCH FROM BUS 200581 TO BUS 200593 CKT 1 END
B_PN230-SX-#28	CONTINGENCY 'B_PN230-SX-#28' /* GLADE - WARREN 230 KV & WARREN 230/115 BK 4 - (PJM-PN28) DISCONNECT BRANCH FROM BUS 200811 TO BUS 200593 CKT 1 DISCONNECT BRANCH FROM BUS 200818 TO BUS 200811 CKT 4 END
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_PN230-SX-#61	CONTINGENCY 'B_PN230-SX-#61' /* SHAWVILLE - SHINGLETOWN (SHS) 230 KV - (PJM-PN26) DISCONNECT BRANCH FROM BUS 200726 TO BUS 235248 CKT 1 END

Contingency Name	Description
'C5_PN230-TW-#2'	CONTINGENCY 'C5_PN230-TW-#2' /* GLADE-FOREST & GLADE-LEWIS RUN 230 KV DISCONNECT BRANCH FROM BUS 200581 TO BUS 200593 CKT 1 DISCONNECT BRANCH FROM BUS 200593 TO BUS 200704 CKT 1 DISCONNECT BRANCH FROM BUS 200704 TO BUS 200667 CKT 1 DISCONNECT BRANCH FROM BUS 200704 TO BUS 200705 CKT 2 DISCONNECT BUS 200704 END
DQE_161	CONTINGENCY 'DQE_161' /* LINE 02AT TO 02PERRY 345 CK 1 DISCONNECT BRANCH FROM BUS 238547 TO BUS 239036 CKT 1 END
KEYSTONE_JACK MTN1_1	CONTINGENCY 'KEYSTONE_JACKMTN1_1' /* 500/500KV, AREA 225/225. DISCONNECT BRANCH FROM BUS 200011 TO BUS 200071 CKT 1 END
PL100352	CONTINGENCY 'PL100352' /* LACKAWANNA-OXBOW-N.MESHOPPEN 230KV & OXBOW TR DISCONNECT BRANCH FROM BUS 200706 TO BUS 200825 CKT 3 DISCONNECT BUS 200708 END
PL100328	CONTINGENCY 'PL100328' /* LACKAWANNA 230KV EAST BUS & LACK T2 DISCONNECT BRANCH FROM BUS 211681 TO BUS 208009 CKT 2 DISCONNECT BRANCH FROM BUS 200706 TO BUS 200825 CKT 3 DISCONNECT BUS 200708 END
PL100841	CONTINGENCY 'PL100841' /*230KV BRANCH FROM SUSQUEHANNA BUS TO SUSQ G1 OUT DISCONNECT BRANCH FROM BUS 208113 TO BUS 208114 CKT 1 END
PL100903	CONTINGENCY 'PL100903' /* SUSQUEHANNA-SUSQ GEN 1 230KV DISCONNECT BUS 208114 END

Generator Deliverability

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

None.

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		Affected		Bus			Power	Loading %		Rating		MW
#	Type	Name	Area	Facility Description	From	To	Circuit	Flow	Initial	Final	Type	MVA	Contribution
1	DCTL	C5_PN230-TW-#2	PJM	FARM VLY-RIDGWAY 115 kV line	200668	200582	1	DC	2.97	63.73	ER	149	90.53

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

None.

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

None.

Contribution to Previously Identified Overloads

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

	Contingency		Affected		Bus			Power	Loading %		Rating		MW
#	Type	Name	Area	Facility Description	From	To	Circuit	Flow	Initial	Final	Type	MVA	Contribution

#	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
2	N-1	B_PN230-SX-#25	PJM	LEWIS RN-FARM VLY 115 kV line	200667	200668	1	DC	104.79	108.89	ER	149	6.11

Steady-State Voltage Requirements

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

To be determined.

Stability and Reactive Power Requirement for Low Voltage Ride Through

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

To be determined.

New System Reinforcements

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

Overload #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
#1	FARM VLY-RIDGWAY 115 kV line	**Farmers Valley-Ridgeway 115kV:** Reconductor 5.6 Miles	Pending	**$ 2,736,200**
			Tax	**$ 808,600**
			Total New Network Upgrades	**$ 3,544,800**

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)

Overload #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
#2	LEWIS RN-FARM VLY 115 kV line	**Farmers Valley-Lewis Run 115kV:** Reconductor 5.6 Miles with 336 ACSS	Pending	**$ 5,342,500**
			Tax	**$ 1,578,800**
			Total New Network Upgrades	**$ 6,921,300**

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.

	Contingency		Affected		Bus			Power	Loading %		Rating		MW
#	Type	Name	Area	Facility Description	From	To	Circuit	Flow	Initial	Final	Type	MVA	Contribution
3	N-1	B_PN230-SX-#61	PJM	U2-055 TAP-01MILESB 230 kV line	889060	235219	1	DC	97.2	100.4	ER	593	18.95
4	N-1	B_PN230-SX-#28	PJM	FOREST-01ELKO 230 kV line	200581	235175	1	DC	73.37	91.69	ER	505	92.55
5	N-1	B_PN230-SX-#15	PJM	ROCKTON-SHAWVL 1 115 kV line	200713	200714	1	DC	66.06	86.35	ER	119	24.15
6	N-1	B_PN230-SX-#15	PJM	R-092 TAP-ROCKTON 115 kV line	883550	200713	1	DC	66.32	86.61	ER	119	24.15
7	N-1	B_PN230-SX-#15	PJM	RIDGWAY-WHETSTON 115 kV line	200582	200711	1	DC	77.3	92.68	ER	157	24.15
8	N-1	B_PN230-SX-#47	PJM	E.TWANDA-HILSD230 230 kV line	200675	130763	1	DC	101.63	101.9	ER	531	8.66

#	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
9	N-1	PL100352	PJM	E.TWANDA-HILSD230 230 kV line	200675	130763	1	DC	101.63	101.9	ER	531	8.66
10	N-1	PL100328	PJM	E.TWANDA-HILSD230 230 kV line	200675	130763	1	DC	101.63	101.89	ER	531	8.66
11	N-1	APS_B_G297_U2-055A	PJM	SHAWVL 2-01SHINGL 230 kV line	200726	235248	1	DC	102.49	106.21	ER	505	18.77
12	N-1	APS_B_G297_U2-055A	PJM	SHAWVL 2-01SHINGL 230 kV line	200726	235248	1	DC	102.49	106.2	ER	505	18.77
13	Non	Non	PJM	GOLD-N-036 C 115 kV line	200669	293270	1	DC	76.68	78.09	NR	135	11.81
14	N-1	KEYSTONE_JACKMTN1_1	PJM	LEWISTWN-JUNI BU2 230 kV line	200513	208005	1	DC	106.15	108.76	ER	617	17.26
15	N-1	B_PN230-SX-#28	PJM	01SHINGL-LEWISTWN 230 kV line	235248	200513	1	DC	100.26	108.31	ER	505	40.67
16	N-1	B_PN230-SX-#28	PJM	01SHINGL-LEWISTWN 230 kV line	235248	200513	1	DC	100.26	108.31	ER	505	40.67
17	Non	Non	PJM	01SHINGL-LEWISTWN 230 kV line	235248	200513	1	DC	104.27	109.69	NR	426	23.1
18	Non	Non	PJM	01SHINGL-LEWISTWN 230 kV line	235248	200513	1	DC	104.27	109.69	NR	426	23.1
19	Non	Non	PJM	LEWISTWN-JUNI BU2 230 kV line	200513	208005	1	DC	109.6	112.91	NR	488	17.15
20	Non	Non	PJM	SOUTH TR-TOWANDA 115 kV line	200673	200674	1	DC	82.78	84.28	NR	111	10.3
21	Non	Non	PJM	LEWIS RN-FARM VLY 115 kV line	200667	200668	1	DC	86.48	120.92	NR	111	38.23
22	Non	Non	PJM	N-036 C-SABINSVI 115 kV line	293270	200670	1	DC	92.76	94.17	NR	135	11.81

#	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
23	N-1	DQE_161	PJM	02S8-ATT 345/138 kV transformer	239082	238544	8	DC	112.63	117.12	ER	370	16.64
24	N-1	PL100841	PJM	X1-109 TAP-N.MESHPN 230 kV line	907910	200706	1	DC	136.58	139.06	ER	549	14.39
25	N-1	PL100903	PJM	X1-109 TAP-N.MESHPN 230 kV line	907910	200706	1	DC	136.58	139.06	ER	549	14.39
26	N-1	B_PN230-SX-#25	PJM	LEWIS RN-FARM VLY 115 kV line	200667	200668	1	DC	112.31	143.64	ER	149	47.03
27	Non	Non	PJM	X1-109 TAP-N.MESHPN 230 kV line	907910	200706	1	DC	138.89	141.68	NR	488	14.39
28	N-1	B_PN230-SX-#11_X1_109B	PJM	N.MESHPN 230/115 kV transformer	200825	200706	1	DC	152.81	153.37	ER	188	6.64
29	N-1	B_PN230-SX-#11_X1_109B	PJM	NO MESHO-MESH2REA 115 kV line	200677	200825	3	DC	152.83	153.39	ER	188	6.64
30	N-1	PL100841	PJM	N.MESHPN-OXBOW 230 kV line	200706	200708	1	DC	150.05	152.82	ER	608	17.73
31	N-1	PL100903	PJM	N.MESHPN-OXBOW 230 kV line	200706	200708	1	DC	150.05	152.82	ER	608	17.73
32	N-1	PL100841	PJM	OXBOW-LACK 230 kV line	200708	208009	1	DC	151.17	153.94	ER	617	18.03
33	N-1	PL100903	PJM	OXBOW-LACK 230 kV line	200708	208009	1	DC	151.17	153.94	ER	617	18.03
34	Non	Non	PJM	N.MESHPN-OXBOW 230 kV line	200706	200708	1	DC	172.68	176.2	NR	478	17.73
35	Non	Non	PJM	OXBOW-LACK 230 kV line	200708	208009	1	DC	173.03	176.54	NR	488	18.03

Option 2

The Queue Project #Y1-028 was studied as a 125.0MW (Capacity16.3MW) injection at the LEWIS RN 230 kV substation in the PENELEC area. Project #Y1-028 was evaluated for compliance with reliability criteria for summer peak conditions in 2015. Potential network impacts were as follows:

Contingency Descriptions

The following contingencies resulted in overloads:

Contingency Name	Description
APS_B_G297_U2-055A	CONTINGENCY 'APS_B_G297_U2-055A' / 235219 01MILESB 230 235853 01KARTHS 230 1 OPEN BRANCH FROM BUS 235219 TO BUS 889060 CKT 1 END
B_PN230-SX-#15	CONTINGENCY 'B_PN230-SX-#15' /* ELKO - FOREST (FE) 230 KV - (PJM-PN09) DISCONNECT BRANCH FROM BUS 200581 TO BUS 235175 CKT 1 END
B_PN230-SX-#22	CONTINGENCY 'B_PN230-SX-#22' /* ERIE SOUTH 230/115 KV BANK 6 FAULT DISCONNECT BRANCH FROM BUS 200568 TO BUS 200567 CKT 6 DISCONNECT BRANCH FROM BUS 200568 TO BUS 200600 CKT 5 DISCONNECT BRANCH FROM BUS 200568 TO BUS 200624 CKT 3 DISCONNECT BRANCH FROM BUS 200568 TO BUS 200641 CKT 7 DISCONNECT BRANCH FROM BUS 200568 TO BUS 200811 CKT 1 DISCONNECT BRANCH FROM BUS 200568 TO BUS 200819 CKT 1 REDUCE BUS 200568 SHUNT BY 100 PERCENT DISCONNECT BUS 200568 END
B_PN230-SX-#25	CONTINGENCY 'B_PN230-SX-#25' /* FOREST - GLADE 230 KV DISCONNECT BRANCH FROM BUS 200581 TO BUS 200593 CKT 1 END
B_PN230-SX-#28	CONTINGENCY 'B_PN230-SX-#28' /* GLADE - WARREN 230 KV & WARREN 230/115 BK 4 - (PJM-PN28) DISCONNECT BRANCH FROM BUS 200811 TO BUS 200593 CKT 1 DISCONNECT BRANCH FROM BUS 200818 TO BUS 200811 CKT 4 END
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_PN230-SX-#61	CONTINGENCY 'B_PN230-SX-#61' /* SHAWVILLE - SHINGLETOWN (SHS) 230 KV - (PJM-PN26) DISCONNECT BRANCH FROM BUS 200726 TO BUS 235248 CKT 1 END

Contingency Name	Description
C5_PN230-TW-#2	CONTINGENCY 'C5_PN230-TW-#2' /* GLADE-FOREST & GLADE-LEWIS RUN 230 KV DISCONNECT BRANCH FROM BUS 200581 TO BUS 200593 CKT 1 DISCONNECT BRANCH FROM BUS 200593 TO BUS 200704 CKT 1 DISCONNECT BRANCH FROM BUS 200704 TO BUS 200667 CKT 1 DISCONNECT BRANCH FROM BUS 200704 TO BUS 200705 CKT 2 DISCONNECT BUS 200704 END
DQE_161	CONTINGENCY 'DQE_161' /* LINE 02AT TO 02PERRY 345 CK 1 DISCONNECT BRANCH FROM BUS 238547 TO BUS 239036 CKT 1 END
KEYSTONE_JACK MTN1_1	CONTINGENCY 'KEYSTONE_JACKMTN1_1' /* 500/500KV, AREA 225/225. DISCONNECT BRANCH FROM BUS 200011 TO BUS 200071 CKT 1 END
PL100352	CONTINGENCY 'PL100352' /* LACKAWANNA-OXBOW-N.MESHOPPEN 230KV & OXBOW TR DISCONNECT BRANCH FROM BUS 200706 TO BUS 200825 CKT 3 DISCONNECT BUS 200708 END
PL100328	CONTINGENCY 'PL100328' /* LACKAWANNA 230KV EAST BUS & LACK T2 DISCONNECT BRANCH FROM BUS 211681 TO BUS 208009 CKT 2 DISCONNECT BRANCH FROM BUS 200706 TO BUS 200825 CKT 3 DISCONNECT BUS 200708 END
PL100841	CONTINGENCY 'PL100841' /*230KV BRANCH FROM SUSQUEHANNA BUS TO SUSQ G1 OUT DISCONNECT BRANCH FROM BUS 208113 TO BUS 208114 CKT 1 END
PL100903	CONTINGENCY 'PL100903' /* SUSQUEHANNA-SUSQ GEN 1 230KV DISCONNECT BUS 208114 END

Generator Deliverability

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

None.

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		Affected		Bus			Power	Loading %		Rating		MW
#	Type	Name	Area	Facility Description	From	To	Circuit	Flow	Initial	Final	Type	MVA	Contribution
1	DCTL	C5_PN230-TW-#2	PJM	FARM VLY-RIDGWAY 115 kV line	200668	200582	1	DC	3.01	63.77	ER	149	90.53

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

None.

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

None.

Contribution to Previously Identified Overloads

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

None.

Steady-State Voltage Requirements

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

To be determined.

Stability and Reactive Power Requirement for Low Voltage Ride Through

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

To be determined.

New System Reinforcements

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

Overload #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
#1	FARM VLY-RIDGWAY 115 kV line	**Farmers Valley-Ridgeway 115kV:** Reconductor 5.6 Miles	Pending	**$ 2,736,200**
			Tax	**$ 808,600**
			Total New Network Upgrades	**$ 3,544,800**

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)

None.

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.

	Contingency		Affected		Bus			Power	Loading %		Rating		MW
#	Type	Name	Area	Facility Description	From	To	Circuit	Flow	Initial	Final	Type	MVA	Contribution
2	N-1	B_PN230-SX-#61	PJM	U2-055 TAP-01MILESB 230 kV line	889060	235219	1	DC	97.21	100.3	ER	593	18.34
3	N-1	B_PN230-SX-#15	PJM	ROCKTON-SHAWVL 1 115 kV line	200713	200714	1	DC	66.1	84.81	ER	119	22.27
4	N-1	B_PN230-SX-#15	PJM	R-092 TAP-ROCKTON 115 kV line	883550	200713	1	DC	66.36	85.07	ER	119	22.27
5	N-1	B_PN230-SX-#28	PJM	FOREST-01ELKO 230 kV line	200581	235175	1	DC	73.37	92.68	ER	505	97.56
6	N-1	B_PN230-SX-#15	PJM	RIDGWAY-WHETSTON 115 kV line	200582	200711	1	DC	77.31	91.5	ER	157	22.27
7	Non	Non	PJM	Y1-031 TAP-BUFF. RD 115 kV line	913250	200569	1	DC	29.1	29.8	NR	174	7.59
8	Non	Non	PJM	LEWIS RN-FARM VLY 115 kV line	200667	200668	1	DC	86.5	105.69	NR	111	21.3
9	N-1	B_PN230-SX-#47	PJM	E.TWANDA-HILSD230 230 kV line	200675	130763	1	DC	101.61	101.82	ER	531	6.63
10	N-1	PL100352	PJM	E.TWANDA-HILSD230 230 kV line	200675	130763	1	DC	101.61	101.81	ER	531	6.63
11	N-1	PL100328	PJM	E.TWANDA-HILSD230 230 kV line	200675	130763	1	DC	101.61	101.81	ER	531	6.63
12	N-1	B_PN230-SX-#22	PJM	Y1-031 TAP-BUFF. RD 115 kV line	913250	200569	1	DC	43.06	49.96	ER	227	15.68
13	N-1	APS_B_G297_U2-055A	PJM	SHAWVL 2-01SHINGL 230 kV line	200726	235248	1	DC	102.51	106.1	ER	505	18.14
14	Non	Non	PJM	GOLD-N-036 C 115 kV line	200669	293270	1	DC	76.68	77.6	NR	135	7.66

#	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
15	N-1	KEYSTONE_JACKMTN1_1	PJM	LEWISTWN-JUNI BU2 230 kV line	200513	208005	1	DC	106.17	108.72	ER	617	16.85
16	N-1	B_PN230-SX-#28	PJM	01SHINGL-LEWISTWN 230 kV line	235248	200513	1	DC	100.28	108.54	ER	505	41.74
17	N-1	B_PN230-SX-#28	PJM	01SHINGL-LEWISTWN 230 kV line	235248	200513	1	DC	100.28	108.54	ER	505	41.74
18	Non	Non	PJM	01SHINGL-LEWISTWN 230 kV line	235248	200513	1	DC	104.3	109.54	NR	426	22.35
19	Non	Non	PJM	01SHINGL-LEWISTWN 230 kV line	235248	200513	1	DC	104.3	109.54	NR	426	22.35
20	Non	Non	PJM	LEWISTWN-JUNI BU2 230 kV line	200513	208005	1	DC	109.63	112.86	NR	488	16.72
21	Non	Non	PJM	SOUTH TR-TOWANDA 115 kV line	200673	200674	1	DC	82.78	83.76	NR	111	6.74
22	Non	Non	PJM	SABINSVI-NILES VA 115 kV line	200670	200671	1	DC	84.65	85.56	NR	135	7.66
23	Non	Non	PJM	N-036 C-SABINSVI 115 kV line	293270	200670	1	DC	92.75	93.67	NR	135	7.66
24	N-1	DQE_161	PJM	02S8-ATT 345/138 kV transformer	239082	238544	8	DC	112.65	117.41	ER	370	17.62
25	N-1	B_PN230-SX-#25	PJM	LEWIS RN-FARM VLY 115 kV line	200667	200668	1	DC	112.32	134.46	ER	149	33.31
26	N-1	PL100841	PJM	X1-109 TAP-N.MESHPN 230 kV line	907910	200706	1	DC	136.6	138.9	ER	549	13.31
27	N-1	PL100903	PJM	X1-109 TAP-N.MESHPN 230 kV line	907910	200706	1	DC	136.6	138.9	ER	549	13.31
28	Non	Non	PJM	X1-109 TAP-N.MESHPN 230 kV line	907910	200706	1	DC	138.92	141.5	NR	488	13.31

#	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
29	N-1	PL100841	PJM	N.MESHPN-OXBOW 230 kV line	200706	200708	1	DC	150.07	152.63	ER	608	16.37
30	N-1	PL100903	PJM	N.MESHPN-OXBOW 230 kV line	200706	200708	1	DC	150.07	152.63	ER	608	16.37
31	N-1	PL100841	PJM	OXBOW-LACK 230 kV line	200708	208009	1	DC	151.2	153.76	ER	617	16.64
32	N-1	PL100903	PJM	OXBOW-LACK 230 kV line	200708	208009	1	DC	151.2	153.76	ER	617	16.64
33	Non	Non	PJM	N.MESHPN-OXBOW 230 kV line	200706	200708	1	DC	172.72	175.97	NR	478	16.37
34	Non	Non	PJM	OXBOW-LACK 230 kV line	200708	208009	1	DC	173.07	176.31	NR	488	16.64

Attachment 1

System Configuration – Option 1

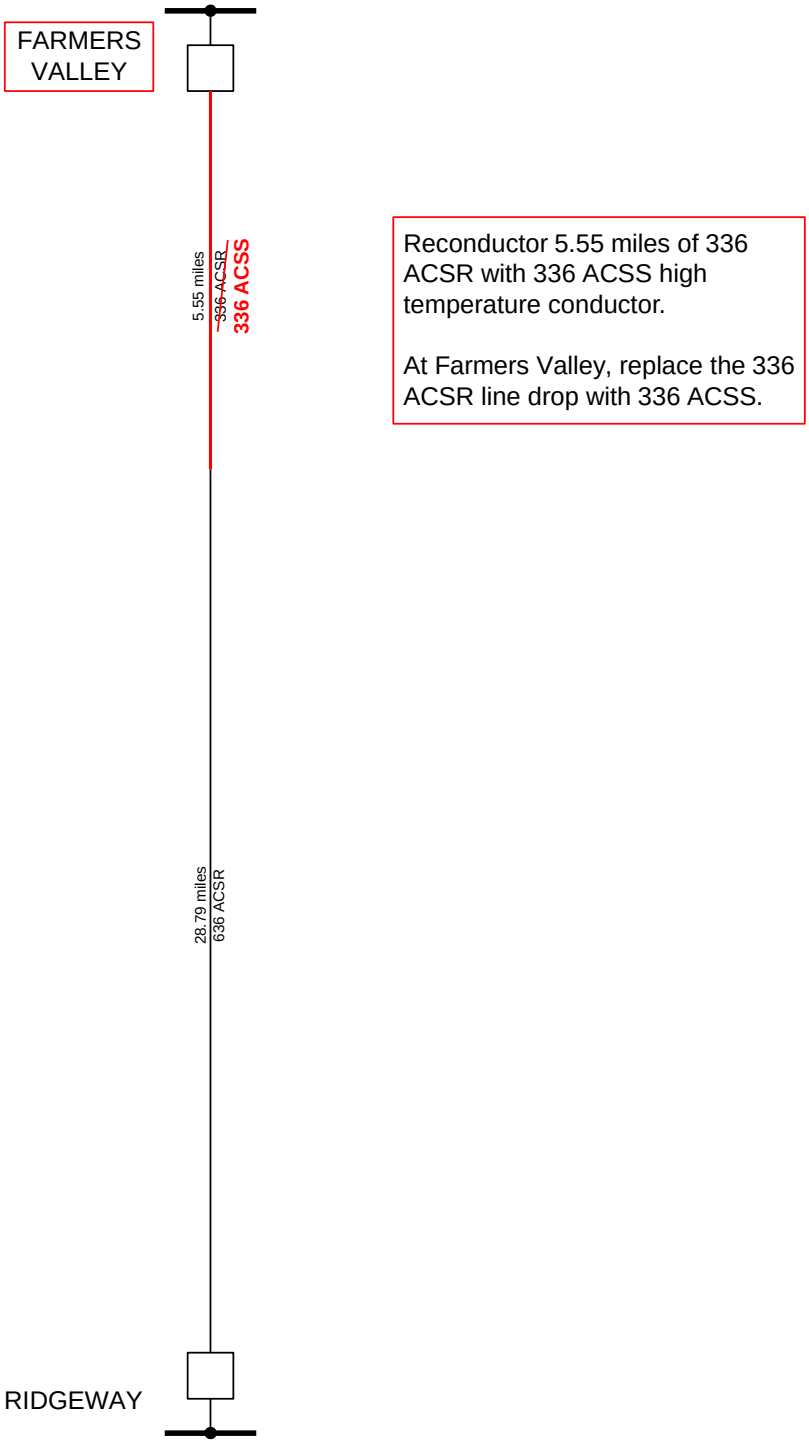
Attachment 2

System Configuration – Option 2

Attachment 3

FE Network Facility Reinforcement Conceptual One Line Diagrams

Farmers Valley – Ridgway 115kV Line



LEWIS RUN - FARMERS VALLEY 115KV LINE UPGRADE

Reconductor 12.46 miles of 336 ACSR conductor with 336 ACSS and upgrade 336 ACSR line drops in Lewis Run and Farmers Valley substations to 336 ACSS to achieve a minimum long term emergency rating of 150 MVA.

Attachment 4

Secondary POI Cost Estimates

4 Breaker 230 kV Ring Bus

Upgrade ID	Description	Total Cost	Tax	Cost
PN-S-580	Lewis Run: Construct 4 breaker 230kV ring bus.	$9,293,700	$2,119,900	$7,173,800
EOC	Engineering, Oversight, & Commissioning	$167,900	$38,300	$129,600
TOTAL		$9,461,600	$2,158,200	$7,303,400

5 Breaker 230 kV Ring Bus

Upgrade ID	Description	Total Cost	Tax	Cost
PN-S-615	Lewis Run: Construct 5 breaker 230kV ring bus.	$10,895,600	$2,485,300	$8,410,300
PN-S-613	Glade: Install transfer trip equipment and upgrade relaying.	$373,400	$85,200	$288,200
PN-S-612	Farmers Valley: Install transfer trip equipment and upgrade relaying.	$373,400	$85,200	$288,200
EOC	Engineering, Oversight, & Commissioning	$167,900	$38,300	$129,600
TOTAL		$11,810,300	$2,694,000	$9,116,300