Generation Interconnection Feasibility Study Report Web Version

For

PJM Generation Interconnection Request Queue Position X3-039

Geneva 115kV Project

February 2012

Feasibility Study Report

Geneva 115kV Generation Project

Introduction

This Feasibility Study report provides the documentation of an assessment that has been performed by PJM Interconnection (PJM), PPL Energy (PPL), and FirstEnergy (FE) in response to a request made by Interconnection Customer (IC) for the connection of the 96 MW (96 MW Capacity) Geneva 115kV (X3-039) Generation Project to the Penelec Transmission System. Interconnection Customer has proposed commercial operation date of December 2014 for the proposed Geneva 115kV (X3-039) facility. As per the PJM study process, the Geneva 115kV Project assessment was accomplished by: 1. Evaluating the reliability impact of the proposed facilities and connection on the interconnected transmission system by the performance of a power flow study; 2. Ensuring compliance with the NERC, ReliabilityFirst, PJM and FE Reliability Standards by identifying the system reinforcements that will need to be installed for an interconnection of the proposed project; 3. Coordinating and cooperating with the PJM staff and Interconnection Customer by participating in project meetings and issuing this report as a part of the PJM study process; 4. Performing a Steady State, Short-Circuit and Dynamics Study as necessary; 5. Conducting all studies in accordance with the PJM Manuals, the "FE Requirements for Transmission Connected Facilities", and the "FE Study Guide".

Connection Facilities

In compliance with the PJM Interconnection Planning protocol, 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 96 MW Generation Project with a net generation capability of 96 MW (96 MW Capacity) on a property near Geneva Substation. For purposes of this report, it has therefore been designated as the Geneva 115kV (X3-039) Project to reflect its interconnection voltage and its proximity to the Geneva Substation.

The interconnection of this project will be accomplished by converting Geneva substation into a 6 breaker ring bus station by installing 3 new 115kV breakers. A summary of the Geneva 115kV (X3-039) Project direct connection facilities that will be required and their estimated costs are shown on Attachment 3. The one-line diagram is shown in Attachment 2.

PJM Interconnection Study Results

The following is the report describing the results of the analysis performed by PJM engineers with respect to the transmission system impacts.

Network Impacts

Queue project X3-039 was studied as a 96.0 MW (96.0 MW of which was Capacity) injection into PENELEC's system at the GENEVA 115.0 kV substation. Project X3-039 was evaluated for compliance with reliability criteria for summer peak conditions in 2015.

Potential transmission network impacts are as follows:

Generator Deliverability

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

No. 1: (PENELEC) The Homer City-Homer City 345/230 kV transformer (from bus 200769 to bus 200767 ckt 1) loads from 86.28% to 88.94% (DC power flow) of its emergency rating (807 MVA) for the single contingency 'B_PN345-XF-#114'. This project contributes approximately 21.47 MW to the thermal violation.

```
CONTINGENCY 'B_PN345-XF-#114'     /* HOMER CITY 345/230 KV SOUTH AUTO-
TRANSFORMER - (PJM-PN31)
  DISCONNECT BRANCH FROM BUS 200769 TO BUS 200767 CKT 2
END
```

No. 2: (PENELEC/PL) The Lewistown 2-Juniata Fake Bus 2 230 kV line (from bus 200513 to bus 208005 ckt 1) loads from 93.84% to 94.03% (DC power flow) of its normal rating (488 MVA) for non contingency condition. This project contributes approximately 5.69 MW to the thermal violation.

Multiple Facility Contingency

(Double Circuit Tower Line contingencies only with full energy output. Stuck Breaker and Bus Fault contingencies will be applied during the Impact Study)

No violations identified.

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.)

No. 3: (PENELEC) The X1-109 TAP-North Meshoppen 230 kV line (from bus 907910 to bus 200706 ckt 1) loads from 139.01% to 140.17% (DC power flow) of its emergency

rating (549 MVA) for the single contingency 'B_PN230-XF-#133A_X1_018_A'. This project contributes approximately 6.39 MW to the thermal violation.

```
CONTINGENCY 'B_PN230-XF-#133A_X1_018_A'    /* LEWISTOWN 230/115KV BANK #3 FAULT
  DISCONNECT BRANCH FROM BUS 200513 TO BUS 200512 CKT 3
  DISCONNECT BRANCH FROM BUS 200513 TO BUS 200517 CKT 1
  DISCONNECT BRANCH FROM BUS 200513 TO BUS 907140 CKT 1
  DISCONNECT BRANCH FROM BUS 200513 TO BUS 200531 CKT 2
  DISCONNECT BRANCH FROM BUS 200513 TO BUS 200512 TO BUS 200548 CKT 2
END
```

No. 4: (PENELEC) The X1-109 TAP-North Meshoppen 230 kV line (from bus 907910 to bus 200706 ckt 1) loads from 140.90% to 142.05% (DC power flow) of its normal rating (488 MVA) for non contingency condition. This project contributes approximately 5.59 MW to the thermal violation.

No. 5: (PENELEC) The North Meshoppen-Oxbow 230 kV line (from bus 200706 to bus 200708 ckt 1) loads from 140.97% to 142.29% (DC power flow) of its emergency rating (608 MVA) for the single contingency 'B_PN230-XF-#133A_X1_018_A'. This project contributes approximately 8.01 MW to the thermal violation.

```
CONTINGENCY 'B_PN230-XF-#133A_X1_018_A'    /* LEWISTOWN 230/115KV BANK #3 FAULT
  DISCONNECT BRANCH FROM BUS 200513 TO BUS 200512 CKT 3
  DISCONNECT BRANCH FROM BUS 200513 TO BUS 200517 CKT 1
  DISCONNECT BRANCH FROM BUS 200513 TO BUS 907140 CKT 1
  DISCONNECT BRANCH FROM BUS 200513 TO BUS 200531 CKT 2
  DISCONNECT BRANCH FROM BUS 200513 TO BUS 200512 TO BUS 200548 CKT 2
END
```

No. 6: (PENELEC) The North Meshoppen-Oxbow 230 kV line (from bus 200706 to bus 200708 ckt 1) loads from 157.97% to 159.46% (DC power flow) of its normal rating (478 MVA) for non contingency condition. This project contributes approximately 7.11 MW to the thermal violation.

No. 7: (PENELEC/PL) The Oxbow-Lackawanna Bus 230 kV line (from bus 200708 to bus 208009 ckt 1) loads from 138.12% to 139.44% (DC power flow) of its emergency rating (617 MVA) for the single contingency 'B_PN230-XF-#133A_X1_018_A'. This project contributes approximately 8.14 MW to the thermal violation.

```
CONTINGENCY 'B_PN230-XF-#133A_X1_018_A'    /* LEWISTOWN 230/115KV BANK #3 FAULT
  DISCONNECT BRANCH FROM BUS 200513 TO BUS 200512 CKT 3
  DISCONNECT BRANCH FROM BUS 200513 TO BUS 200517 CKT 1
  DISCONNECT BRANCH FROM BUS 200513 TO BUS 907140 CKT 1
  DISCONNECT BRANCH FROM BUS 200513 TO BUS 200531 CKT 2
  DISCONNECT BRANCH FROM BUS 200513 TO BUS 200512 TO BUS 200548 CKT 2
END
```

No. 8: (PENELEC/PL) The Oxbow-Lackawanna Bus 230 kV line (from bus 200708 to bus 208009 ckt 1) loads from 153.42% to 154.9% (DC power flow) of its normal rating (488 MVA) for non contingency condition. This project contributes approximately 7.24 MW to the thermal violation.

No. 9: (AP/PENELEC) The X1-018 TAP-Lewistown 2 230 kV line (from bus 907140 to bus 200513 ckt 1) loads from 102.07% to 103.17% (DC power flow) of its emergency rating (505 MVA) for the single contingency 'B_PN230-LS-#50'. This project contributes approximately 5.58 MW to the thermal violation.

```
CONTINGENCY 'B_PN230-LS-#50'    /* LEWISTOWN - RAYSTOWN (RL) 230 KV + RAYSTOWN
230/46 XF 1
  DISCONNECT BRANCH FROM BUS 200513 TO BUS 200517 CKT 1
  DISCONNECT BRANCH FROM BUS 200517 TO BUS 200539 CKT 1
END
```

No. 10: (AP) The Shingletown-X1-018 TAP 230 kV line (from bus 235248 to bus 907140 ckt 1) loads from 102.00% to 103.17% (DC power flow) of its emergency rating (505 MVA) for the single contingency 'PL100328'. This project contributes approximately 5.93 MW to the thermal violation.

```
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
```

New System Reinforcements

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

No. 1: Refer to the "Interconnected Transmission Owner's Analysis Results" portion of this report.

No. 2: This violation resulted in reinforcements in both the FirstEnergy (Penelec) transmission system and the PPL transmission system. The FirstEnergy (Penelec) reinforcement is described in to the "Interconnected Transmission Owner's Analysis Results" portion of this report. The reinforcement on the PPL transmission system is described below:

> The Lewistown-Juniata transmission line rebuild project and the work at the Juniata substation to accommodate the interconnection of X3-039 is estimated to cost **$2,184,960**, (taxes not included) broken down as follows:
>
> PPL portion of Lewistown-Juniata Transmission Line Upgrade (**$2,064,960**)
> The proposed upgrade will consist of rebuilding approximately 0.9 miles of 1033 kcmil ACSR, (current ratings 494/624 MVA Summer Normal/Emergency based

on conductor temperature at 125C) with new 1590 kcmil ACSR (new ratings 648/802MVA Summer Normal/Emergency conductor temperature at 125C). The existing structures will be removed and new steel monopoles will be installed for the upgraded 230kV circuit.

Juniata Substation Upgrade (**$120,000**)
In addition, there are some minor substation modifications required in the Juniata 230kV yard to accommodate the higher amperage rating of the line. The scope of the work at Juniata is to replace the existing Lewistown disconnect switches. The existing switches are 1200A switches and will be replaced with 2000A switches to match the ratings of the new line.

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.)

No.3 through No. 10: Refer to the "Interconnected Transmission Owner's Analysis Results" portion of this report.

Short Circuit
(Report over-dutied breakers.)

None required.

Energy Portion of Interconnection Request
PJM also studied the delivery of the energy portion of the surrounding generation. Any potential 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 Transmission Interconnection request.
Note: *Only the most severely overloaded conditions are listed. 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 analyzes all overload conditions associated with the overloaded element(s) identified. As a result of the aggregate energy resources in the area, the following violations were identified*.

No violations identified.

Interconnected Transmission Owner's Analysis Results

The following was generated by FirstEnergy (Penelec), the Interconnected Transmission Owner, based upon its analysis, as well as that of PJM, for mitigation of the project's impacts on the transmission and lower voltage system as applicable. It includes the costs and schedules for any system upgrades.

Power Flow Analysis

A Power Flow study was conducted to determine the reliability impact of the proposed Geneva 115kV (X3-039) Project on the FE Transmission System. This included the performance of a contingency analysis to identify any facility overload or voltage condition that violates the FE Planning Criteria. Any such violation that is either directly attributable to this project or for which it will have a shared responsibility is included in this report with a least cost plan identified to mitigate them.

The Geneva 115kV (X3-039) Project Power Flow Analysis was performed using a 2015 summer peak load base case provided by the PJM staff. This base case included a detailed representation of the Penelec transmission system in the area of the Geneva substation. A simulation of all possible contingencies within the NERC and FE Planning Standards that are impacted by the Geneva 115kV (X3-039) Project was conducted to test for criteria compliance.

The results from the study Power Flow Analysis showing a comparison of the FE and PJM contingency study results are detailed on Attachment 4. As shown, the conclusion from this analysis is that there are upgrades required for the Geneva 115kV (X3-039) Project. Additionally, the PJM and FE findings show that there are criteria violations which will have an impact on network congestion and local energy deliverability. Interconnection Customer will therefore be subject to generation curtailment in order to mitigate these violations.

Short Circuit and Dynamics Analysis

A short circuit analysis has been performed by PJM and the findings were confirmed by FE. The findings show that the Union City 115kV breaker at Erie South substation is newly over dutied with the addition of this project. Therefore, the Geneva 115kV (X3-039) Project will be responsible for the cost of upgrading this breaker.

Metering

Interconnection Customer will be required to comply with all FE Revenue Metering Requirements for Generation Interconnection Customers. These FE requirements are detailed on Attachment 7 of this report.

Compliance Issues

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.

Interconnection Customer must also meet all PJM, ReliabilityFirst and NERC reliability criteria and operating procedures required for standards compliance. For example, the Interconnection Customer 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.

FE Facility Upgrades and Costs

The results from the PJM and FE Power Flow Analysis (Attachment 4) show that there are FE criteria violations that are directly attributable to the capacity of the Geneva 115kV (X3-039) Project. Therefore in accordance with the RTEP procedures defined in the PJM Open Access Transmission Tariff and PJM Manuals, Interconnection Customer is responsible for network upgrades. Additionally, the PJM and FE findings show that there are criteria violations which will have an impact on network congestion and local energy deliverability. Interconnection Customer will therefore be subject to generation curtailment in order to mitigate these violations. Note that the FE and PJM study results differ due to the differences in the study process and power flow programs utilized.

Note that all cost estimates contained in this document were produced without a detailed engineering review and are therefore subject to error. More accurate estimates will be determined as a part of the System Impact Study. Interconnection Customer will be responsible for the actual cost of the direct connection that is implemented. FE herein reserves the right to return to any issues in this document and, upon appropriate justification, request additional monies to complete any reinforcements to the transmission system.

Interconnection Customer Requirements

In addition to the FE facilities, 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 X3-039 115/13.2kV 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 an 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 the X3-039 115kV interconnection substation when the units are out-of-service. This assumes the intent of Interconnection Customer is to net the generation with the load.

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

Summary – Overall Project

The cost for the FirstEnergy Attachment Facilities and Network Reinforcements is $87,171,100, not including taxes. The cost for the PPL portion of the reinforcement No. 2 is $2,184,960, not including taxes, bringing the overall project cost to $89,356,960, without tax. Specific information on each Transmission Owner's portion is summarized below.

Summary – Interconnected Transmission Owner, FirstEnergy (Penelec)

The Geneva 115kV (X3-039) Project direct connection for the Primary POI will require the facility upgrades defined in Attachment 3. As shown, the total estimated cost of the expanding Geneva substation is $6,892,000. This cost includes a CIAC (Contribution in Aid of Construction) Federal Income Tax Gross Up charge of $1,612,400. This tax may or may not be charged based on whether or not this project meets the eligibility requirements of IRS Notice 88-129. Power flows from the Geneva 115kV (X3-039) Project will require facility upgrades in the FirstEnergy territory defined in Attachment 5. As shown, the total estimated cost of these reinforcements is $106,832,200. This cost includes a CIAC (Contribution in Aid of Construction) Federal Income Tax Gross Up charge of $24,940,700. 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 the direct connection for, it is expected to take a minimum of two (2) years from the signing of a Connection Service Agreement to complete the installation required for the Geneva 115kV (X3-039) 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 X3-039 115kV interconnection substation. It also 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.

Summary – Affected Transmission Owner, PPL

The Lewistown-Juniata transmission line rebuild project and the work at the Juniata substation to accommodate the interconnection of X3-039 is estimated to cost **$2,184,960**, (taxes not included).

Attachment 3
Geneva 115kV (X3-039) Project
Direct Connection Requirements

Upgrade ID	Description	Total Cost	Tax	Cost
PN-S-525-1	**Geneva SS:** Convert substation to 115kV 6 breaker ring bus and add line terminal to serve as interconnect for the X3-039 interconnect.	$5,108,600	$1,195,200	$3,913,400
PN-S-525-2	**Wayne SS:** Split PR and BU relaying on 115kV Geneva line. Add RFL-9780 for anit-islanding scheme as part of the X3-039 generation interconnection project.	$518,600	$121,300	$397,300
PN-S-525-3	**Morgan Street SS:** Split PR and BU relaying on 115kV Edinboro South (X3-039) line. Add RFL-9780 for anti-islanding scheme as part of the X3-039 generation interconnection project.	$412,900	$96,600	$316,300
PN-S-525-4	**Springboro SS:** Add RFL-9780 for anti-islanding scheme as part of the X3-039 generation interconnection project.	$308,600	$72,200	$236,400
PN-S-525-5	**Edinboro South SS:** Add RFL-9780 for anti-islanding scheme as part of the X3-039 generation interconnection project.	$308,600	$72,200	$236,400
PN-T-146	Relocate the 115kV exits at Geneva Substation as part of PJM X3-039. Scope consists of removing the existing spans and installing new spans.	$64,100	$15,000	$49,100
EOC	Engineering Oversight and Commissioning	$170,600	$39,900	$130,700
Total		$6,892,000	$1,612,400	$5,279,600

Attachment 4
Geneva 115kV (X3-039) Project
FE Contingency Analysis

Generator Deliverability Overloads										
				Rating		FE Results		PJM Results		
Contingency	Type	Contingency Description	Overloaded Facility	N	4 Hr	MVA	% Rating	MVA	% Rating	FE Comments
B_PN345-XF-#114	Single	Homer City South 345-230 XFMR	Homer City North 345-230 XFMR		807			717.7	88.94	FE did not flag this overload
	Base		Lewistown - Juniata 230kV Line	488				458.9	94.03	FE did not flag this overload

Contribution to Previsouly Identified Overloads										
				Rating		FE Results		PJM Results		
Contingency	Type	Contingency Description	Overloaded Facility	N	4 Hr	MVA	% Rating	MVA	% Rating	FE Comments
B_PN230-XF-#133A_X1_018_A	Single	Lewistown 230-115kV Bank Fault	X1-109 TAP - North Meshoppen 230kV Line		549	778	141.7	769.5	140.17	
	Base		X1-109 TAP - North Meshoppen 230kV Line	488		778	147.2	693.2	142.05	
B_PN230-XF-#133A_X1_018_A	Single	Lewistown 230-115kV Bank Fault	North Meshoppen - Oxbow 230kV Line		608	965.2	158.8	865.1	142.29	
	Base		North Meshoppen - Oxbow 230kV Line	478		872.6	182.5	762.2	159.46	
B_PN230-XF-#133A_X1_018_A	Single	Lewistown 230-115kV Bank Fault	Oxbow - Lackawanna 230kV Line		617	963.8	156.2	860.3	139.44	
	Base		Oxbow - Lackawanna 230kV Line	488		870	178.3	755.9	154.90	
B_PN230-LS-#50	Single	Lewistown - Raystown 230kV Line Fault	X1-018 TAP - Lewistown 230kV Line		505	461.5	91.4	521.0	103.17	
PL100328	Single	Lackawanna T2 fault	Shingletown - X1-018 230kV Line		505			521.0	103.17	

Attachment 5
Geneva 115kV (X3-039) Project
FE Network Facility Reinforcement Conceptual Costs Estimates

Erie South: Replace Union City 115kV Breaker

Upgrade ID	Description	Total Cost	Tax	Cost
PN-S-532	**Erie South SS:** Replace 115kV Union City Breaker.	$463,400	$108,400	$355,000
Total		$463,400	$108,400	$355,000

No.1: Homer City Transformer Upgrade

Upgrade ID	Description	Total Cost	Tax	Cost
PN-S-533	**Homer City SS:** Replace 345/230kV North Autotransformer	$8,498,300	$1,988,200	$6,510,100
Total		$8,498,300	$1,988,200	$6,510,100

No. 2: (FE Portion only) Lewistown – Juniata 230kV Line Upgrade

Upgrade ID	Description	Total Cost	Tax	Cost
PN-T-145	**Juniata-Lewistown 230kV:** Reconductor the 24.6 mile Juniata-Lewistown 230kV line with 1033 kcmil ACSS, replacing the existing 1033 kcmil ACSR for PJM W3-021a and W3-099.	$17,884,600	$4,184,100	$13,700,500
PN-S-528	**Lewistown SS:** Upgrade conductor and wave trap on 230kV Juniata line exit.	$124,100	$29,000	$95,100
Total		$18,008,700	$4,213,100	$13,795,600

No.'s 3 & 4: X1-109 TAP – North Meshoppen 230kV Line Upgrade

Upgrade ID	Description	Total Cost	Tax	Cost
PN-T-147	**North Meshoppen-(X1-109) 230kV:** Rebuild and reconductor approx. 21 miles for PJM X3-039. Remove existing H-frame structures, install new H-frame structures and reconductor with 1590 kcmil ACSS.	$33,770,300	$7,900,600	$25,869,700
PN-S-534	**North Meshoppen SS:** Upgrade East Towanda (future X1-109) line terminal for summer LTE rating of 867 MVA.	$206,100	$48,200	$157,900
PN-S-542	**Canyon SS:** Replace 230kV line disconnect switches.	$467,500	$109,400	$358,100
Total		$34,443,900	$8,058,200	$26,385,700

No.'s 5 & 6: North Meshoppen – Oxbow 230kV Line Upgrade

Upgrade ID	Description	Total Cost	Tax	Cost
PN-T	**North Meshoppen-Lackawanna 230kV:** Rebuild and reconductor approx. 10 miles for PJM X3-039. Remove existing H-frame structures, install new H-frame structures and reconductor with 1590 kcmil ACSS.	$16,623,000	$3,889,000	$12,734,000
PN-S-535	**North Meshoppen SS:** Upgrade the Oxbow line terminal.	$344,900	$80,700	$264,200
PN-S-541	**Oxbow SS:** Upgrade the North Meshoppen line terminal.	$253,500	$59,300	$194,200
Total		$17,221,400	$4,029,000	$13,192,400

No.'s 7 & 8: Oxbow – Lackawanna 230kV Line Upgrade

Upgrade ID	Description	Total Cost	Tax	Cost
PN-T-149	**North Meshoppen-Lackawanna 230kV:** Rebuild and reconductor approx. 16 miles for PJM X3-039. Remove existing H-frame structures, install new H-frame structures and reconductor with 1590 kcmil ACSS.	$27,106,000	$6,341,500	$20,764,500
PN-S-536	**Oxbow SS:** Upgrade the Lackawanna line terminal.	$177,900	$41,600	$136,300
Total		$27,283,900	$6,383,100	$20,900,800

No. 9: X1-018 TAP – Lewistown 230kV Line Upgrade

Upgrade ID	Description	Total Cost	Tax	Cost
PN-S	**Lewistown SS:** Replace 230kV wave trap on the Shingletown line	$280,800	$65,700	$215,100
Total		$280,800	$65,700	$215,100

No. 10: Shingletown – X1-018 TAP 230kV Line Upgrade

Upgrade ID	Description	Total Cost	Tax	Cost
WP-S	**Shingletown SS:** On the Lewistown 230kV line terminal, replace 230kV line trap with a 2000A line trap, and replace the 230kV OCB with a 3000A, 230kV breaker for 563 MVA emergency rating for PJM Queue X3-039. Replace breaker foundation, risers, and control cables.	$631,800	$95,000	$536,800
Total		$631,800	$95,000	$536,800