

***Generation Interconnection
Feasibility Study Report
(Revised)***

For

***PJM Generation Interconnection Request
Queue Position V3-018***

Towanda 115kV

WEB POSTING VERSION

**February, 2010
DOCS 581870v1**

General

In compliance with the PJM Generation Interconnection protocol, the Developer has submitted a "Form of Generation Interconnection Feasibility Study Agreement" to PJM that identifies its plan to construct either a 50 x 1.5 MW Wind Turbine or a 25 x 3 MW Wind Turbine Generation Project with a total capability of 75 MW (9.75 MW Capacity) on a property that is approximately 9 miles south west of the existing East Towanda 115 / 230 kV substation. The planned Commercial Operation Date is December, 2012.

PJM Analysis

Network Impacts

The queue V3-018 project was studied as a 75MW (9.75MW of which was capacity) injection into PENELEC's transmission system. There were two options studied as potential points of interconnection: The primary point of interconnection is a tap of the South Troy – Towanda 115kV line, while the secondary point is a tap of the East Towanda – Grover 230kV line. Project V3-018 was evaluated for compliance with reliability criteria for summer peak conditions in 2014. Potential network impacts were as follows:

Option 1: South Troy – Towanda 115kV

Generator Deliverability

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

No problems identified.

Multiple Facility Contingency

(Double Circuit Tower Line contingencies only for the full energy output. Stuck breaker and bus fault contingencies will be performed for the Impact Study)

No problems 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 problems identified.

New System Reinforcements

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

None.

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.

Short Circuit

PJM has completed the short circuit analysis of the V3-018 queue project Towanda 115kV. Two options were considered during this study: the first option was a tap of the E.Towanda-S.Troy 115kV line, while the second option was a tap of the E.Towanda-Grover 230kV line. Our analysis found no new breakers to be over-duty in the Penelec transmission area.

The study also showed no significant fault current contribution to the breakers which have already been identified as over-duty. This study was performed on the 100kV and above system.

The results of a short circuit analysis by the Transmission Owner are forthcoming.

Potential Congestion due to Local Energy Deliverability

(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 below. There is no guarantee of full deliverability 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 identified overloaded element(s). As a result of the aggregate energy resources in the area, the following violations were identified:

1. The V3-018 TAP – TOWANDA 115kV line (from bus 293419 to bus 200674 ckt 1) loads from 179.61% to 225.89% (DC power flow) of its emergency rating (119MVA) for the operational contingency (MANSFIELD_TWANDA) as a result of V3-018. This project contributes approximately 55.1MW to cause this thermal violation.

2. The P47_OPT1 – MANSFIEL 115kV line (from bus 290058 to bus 200672 ckt 1) loads from 100.82% to 154.61% (DC power flow) of its emergency rating (127MVA) for the operational contingency (B_PN115-SX-#58_P47A_V3-018B) as a result of V3-018. This project contributes approximately 68.3MW to cause this thermal violation.

3. The NO MESHO – MESH2REA 115kV line (from bus 200677 to bus 200825 ckt 3) loads from 107.04% to 114.09% (DC power flow) of its emergency rating (157MVA) for the operational contingency (B_PN230-SX-#11) as a result of V3-018. This project contributes approximately 11.0MW to cause this thermal violation.
4. The TOWANDA – NO MESHO 115kV line (from bus 200674 to bus 200677 ckt 1) loads from 117.28% to 126.16% (DC power flow) of its emergency rating (157MVA) for the operational contingency (B_PN230-SX-#11) as a result of V3-018. This project contributes approximately 13.9MW to cause this thermal violation.
5. The N.MESH PN – OXBOW 230kV line (from bus 200706 to bus 200708 ckt 1) loads from 112.55% to 118.26% (DC power flow) of its normal rating (478MVA) for non-contingency conditions as a result of V3-018. This project contributes approximately 28.3MW to cause this thermal violation.
6. The N.MESH PN – OXBOW 230kV line (from bus 200706 to bus 200708 ckt 1) loads from 108.28% to 112.68% (DC power flow) of its emergency rating (608MVA) for the operational contingency (PJM SUSQ-LACK 500_U4-05A) as a result of V3-018. This project contributes approximately 27.7MW to cause this thermal violation.
7. The OXBOW – LACKAWANA 230kV line (from bus 200708 to bus 208009 ckt 1) loads from 108.97% to 114.67% (DC power flow) of its normal rating (488MVA) for non-contingency conditions as a result of V3-018. This project contributes approximately 28.9MW to cause this thermal violation.
8. The OXBOW – LACKAWANA 230kV line (from bus 200708 to bus 208009 ckt 1) loads from 106.01% to 110.44% (DC power flow) of its emergency rating (617MVA) for the operational contingency (PJM SUSQ-LACK 500_U4-05A) as a result of V3-018. This project contributes approximately 28.3MW to cause this thermal violation.
9. The E.TWANDA – N.MESH PN 230kV line (from bus 200675 to bus 200706 ckt 1) loads from 101.23% to 105.44% (DC power flow) of its emergency rating (549MVA) for the operational contingency (B_PN230-XF-#133A) as a result of V3-018. This project contributes approximately 23.1MW to cause this thermal violation.

Option 2: East Towanda – Grover 230kV

Generator Deliverability

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

No problems identified.

Multiple Facility Contingency

(Double Circuit Tower Line contingencies only for the full energy output. Stuck breaker and bus fault contingencies will be performed for the Impact Study)

No problems 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)

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all overload conditions associated with the identified overloaded element(s). As a result of the aggregate energy resources in the area, the following violations were identified:

1. The NO MESH0 – MESH2REA 115kV line (from bus 200677 to bus 200825 ckt 3) loads from 106.95% to 112.30% (DC power flow) of its emergency rating (157MVA) for the operational contingency (B_PN230-SX-#11) as a result of V3-018. This project contributes approximately 8.4MW to cause this thermal violation.
2. The N.MESH0PN – OXBOW 230kV line (from bus 200706 to bus 200708 ckt 1) loads from 108.26% to 112.32% (DC power flow) of its emergency rating (608MVA) for the operational contingency (PJM SUSQ-LACK 500_U4-05A) as a result of V3-018. This project contributes approximately 25.6MW to cause this thermal violation.
3. The TOWANDA – NO MESH0 115kV line (from bus 200674 to bus 200677 ckt 1) loads from 117.21% to 123.44% (DC power flow) of its emergency rating (157MVA) for the operational contingency (B_PN230-SX-#11) as a result of V3-018. This project contributes approximately 9.8MW to cause this thermal violation.
4. The OXBOW – LACKAWANA 230kV line (from bus 200708 to bus 208009 ckt 1) loads from 105.99% to 110.04% (DC power flow) of its emergency rating (617MVA) for the operational contingency (PJM SUSQ-LACK 500_U4-05A) as a result of V3-018. This project contributes approximately 26.0MW to cause this thermal violation.
5. The E.TWANDA – N.MESH0PN 230kV line (from bus 200675 to bus 200706 ckt 1) loads from 102.99% to 105.84% (DC power flow) of its emergency rating (549MVA) for the operational contingency (B_PN230-XF-#133A) as a result of V3-018. This project contributes approximately 25.5MW to cause this thermal violation.

FirstEnergy Analysis

Introduction

This Feasibility Study report provides the documentation of an assessment that has been performed by FirstEnergy (FE) in response to a request made by the Developer for the connection of an 75 MW (9.75 MW Capacity) Towanda (V3-018) Wind Farm Generation Project to the Penelec Transmission System. As per the PJM RTEP study process, the Towanda (V3-018) 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 the Developer by participating in project meetings and issuing this report as a part of the RTEP 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

For purposes of this report, this project been designated as the Towanda (V3-018) 115kV Project to reflect its interconnection voltage and its proximity to the East Towanda substation. The direct connection of this project will be accomplished by the construction of a new 115 kV 3 breaker ring bus and the looping of the East Towanda - Mansfield (MET) 115 kV line to it. The 115 kV direct connection is considered Option #1. Procurement and construction of the 115 kV transmission line connecting the 3 breaker ring bus to the Wind Farm 115 kV export bus is the responsibility of the Developer as this facility is not owned by FirstEnergy Corp. The Developer will be responsible for acquiring all easements, properties and permits that may be required to construct both the project connection 3 breaker ring bus and the attachment facilities. The Developer will also be responsible for the rough grade of the property and an access road to the proposed 3 breaker ring bus site. A 230 kV direct connection to the East Towanda – Grover (SET) 230 kV line is also studied. No estimated costs are provided for the 230 kV direct connection, option #2.

Power Flow Analysis

A Power Flow study was conducted to determine the reliability impact of the proposed Towanda (V3-018) 115 kV 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 Towanda (V3-018) 115 kV Project Power Flow Analysis that was performed was completed using a 2014 summer peak load base case power flow provided by the PJM staff. This base case included a detailed representation of the Penelec transmission system in the area of the proposed East Towanda 115 kV substation. A simulation of all possible contingencies within the NERC and FE Planning Standards that are impacted by the Towanda (V3-018) 115 kV Project was conducted to test for criteria compliance.

The direct connection of the Towanda (V3-018) 115 kV Project to the Penelec transmission system was studied for two different voltages; Option1 was for an interconnection to the 115 kV line between East Towanda Sub and South Troy Sub, and Option 2 was for an interconnection to the 230 kV line between East Towanda Sub and Grover Sub.

The PJM analysis results were based on the S-049 project modeled at 205 MW, however the FE analysis has the S-049 project generation reduced to 90 MW. At the time of this analysis, the Q72 project had been withdrawn from the PJM Queue. The PJM analysis results were based on the Q72 generation and Q72 reinforcements in service. The FE analysis is shown for two separate scenarios; scenario 1 is with the Q72 Project generator off line, and scenario 2 is with both the Q72 generator off line and the Q72 required reinforcements removed. As shown, the conclusion from this analysis is that there are no new upgrades required for the Towanda (V3-018) 115 kV Project.

However, the findings show that there are criteria violations which will have an impact on network congestion and local energy deliverability.

Energy Delivery Violations	Q72 Gen Removed		Q72 Gen + Reinforcement Removed	
	Option 1	Option 2	Option 1	Option 2
V3-018 Tap - Towanda 115kV line	yes	no	yes	no
P47 Tap – Mansfield 115kV line	yes	no	no	no
North Meshoppen – Meshoppen Reactor 115kV line	yes	yes	yes	yes
Towanda - North Meshoppen 115kV line	no	no	no	no
North Meshoppen – Oxbow 230kV line	yes	yes	yes	yes
East Towanda – Hillside 230kV line	yes	yes	yes	yes
Oxbow – Lackawanna 230kV line	yes	yes	yes	yes
East Towanda – North Meshoppen 230kV line	yes	yes	no	yes
Shelocta – Keystone 230 kV line	yes	yes	yes	yes
Homer City – Shelocta 230 kV line	yes	yes	yes	yes

The Developer will therefore be subject to generation curtailment in order to mitigate these violations.

Short Circuit and Dynamics Analysis

A short circuit analysis was performed by PJM and is reported above in the PJM Analysis section of this report.

System Protection Analysis

An analysis was conducted to assess the impact of the Towanda (V3-018) 115 kV Project (Option 1) on the system protection requirements in the area. The results of this review show that the following relay additions and upgrades will be required:

V3-018 Interconnection Substation 115kV

- Three Line Relay panels and One PLC (Power Line Carrier) panel for Everts Drive 115kV line
- One Fiber Panel for East Towanda line exit
- One Fiber Panel for V3-018 Generation Substation exit
- SEL--352 BF/SC (Breaker Failure / Sync Check) relaying required for each ring bus breaker
- Everts Drive exit
 - primary protection over PLC utilizing SEL321
 - backup using existing SEL311C, DTT receiver to trip V3-018 generation for breaker open at Everts Drive sub or Mansfield sub, DTT transmitter to trip Everts Drive generation for open breakers at V3-018 or East Towanda
- East Towanda exit
 - primary protection over fiber using SEL321 and 311L backup
 - DTT receiver to trip V3-018 and Everts Drive generation
- V3-018 Generation Substation exit
 - primary protection over fiber using primary and backup 311L relays

- DTT transmitter(s) to trip V3-018 generation for open breakers at Everts Drive, Manfield, East Towanda or V3-018

East Towanda Substation

- V3-018 115kV line exit
 - One line exit panel and One Fiber Panel for V3-018 line exit
 - Primary protection over fiber using SEL321 (may need more contacts than what is on existing relay) and SEL311L backup
 - DTT transmitters to trip V3-018 generation

Everts Drive Substation

- V3-018 115kV line exit -- One line exit relay panel –
 - primary protection over PLC utilizing SEL321 (may need more contacts than what is on existing relay)
 - backup using existing SEL311C
 - DTT (Direct transfer Trip) transmitter to V3-018 generation for breaker open at Everts Drive Sub or Mansfield Sub

Note that the V3-018 – East Towanda 115 kV line will have fiber based relaying with dual pilot relaying on this line.

Metering

The Developer will be required to comply with all FE Revenue Metering Requirements for Generation Interconnection Customers.

Compliance Issues

The Developer 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 Developer must also meet all PJM, ReliabilityFirst and NERC reliability criteria and operating procedures required for standards compliance. For example, the Developer 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 FE power flow analysis show that there are no FE criteria violations that are directly attributable to the capacity of the Towanda (V3-018) 115 kV Project. However, there are seven violations for direct connection Option 1, and seven violations for direct connection Option 2 affecting network congestion and local energy delivery that the Towanda (V3-018) 115 kV Project will impact. Note that the FE and PJM study results differ somewhat due to the differences in the study process and power flow programs utilized. However, the overall conclusions reached by the FE and PJM staff are the same. In accordance with the RTEP procedures defined in the PJM Open Access Transmission Tariff and PJM Manuals, the Developer is not responsible for network upgrades.

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. The Developer will be responsible for the actual cost of the direct connection that is implemented. In addition, the Developer is responsible to provide the transmission line between V3-018 interconnecting substation and the V3-018 generating substation, as the Developer will own this transmission line. 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.

Developer Requirements

In addition to the FE facilities, the Developer 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 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.
2. The purchase and installation of a 115 kV interconnection metering instrument transformer. FE will provide the ratio and accuracy specifications based on the customer load and generation levels.
3. The purchase and installation of a revenue class meter for each unit to measure the power delivered in compliance with the FE standards.
4. 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.
5. The establishment of dedicated communication circuits for SCADA report to the FE Transmission System Control Center.
6. A compliance with the FE and PJM generator power factor and voltage control requirements.

7. The execution of a back-up service agreement to serve the customer load supplied from the East Towanda 115kV substation when the units are out-of-service. This assumes the intent of the Developer is to net the generation with the load.
8. The rough grade of the property for the V3-018 Interconnection 115 kV Substation and an access road for the delivery of equipment to this site.

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

Summary

The total estimated cost of the new 115 kV three breaker ring bus substation and attachment lines is \$4,620,700. The Towanda (V3-018) Project does not have any required network upgrades.

Based on the scope of the FE direct connection Option 1, 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 Towanda (V3-018) 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 a new V3-018 Interconnecting substation and the loop of the Penelec 115 kV lines to this site. It also assumes that the Developer will provide the property for the attachment 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.

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1. The NO MESH0 – MESH2REA 115kV line (from bus 200677 to bus 200825 ckt 3) loads from 106.95% to 112.30% (DC power flow) of its emergency rating (157MVA) for the operational contingency (B_PN230-SX-#11) as a result of V3-018. This project contributes approximately 8.4MW to cause this thermal violation.

2. The N.MESH0PN – OXBOW 230kV line (from bus 200706 to bus 200708 ckt 1) loads from 108.26% to 112.32% (DC power flow) of its emergency rating (608MVA) for the operational contingency (PJM SUSQ-LACK 500_U4-05A) as a result of V3-018. This project contributes approximately 25.6MW to cause this thermal violation.

3. The TOWANDA – NO MESH0 115kV line (from bus 200674 to bus 200677 ckt 1) loads from 117.21% to 123.44% (DC power flow) of its emergency rating (157MVA) for the operational contingency (B_PN230-SX-#11) as a result of V3-018. This project contributes approximately 9.8MW to cause this thermal violation.

4. The OXBOW – LACKAWANA 230kV line (from bus 200708 to bus 208009 ckt 1) loads from 105.99% to 110.04% (DC power flow) of its emergency rating (617MVA) for the operational contingency (PJM SUSQ-LACK 500_U4-05A) as a result of V3-018. This project contributes approximately 26.0MW to cause this thermal violation.

5. The E.TWANDA – N.MESH0PN 230kV line (from bus 200675 to bus 200706 ckt 1) loads from 102.99% to 105.84% (DC power flow) of its emergency rating (549MVA) for the operational contingency (B_PN230-XF-#133A) as a result of V3-018. This project contributes approximately 25.5MW to cause this thermal violation.

FirstEnergy Analysis

Introduction

This Feasibility Study report provides the documentation of an assessment that has been performed by FirstEnergy (FE) in response to a request made by the Developer for the connection of an 75 MW (9.75 MW Capacity) Towanda (V3-018) Wind Farm Generation Project to the Penelec Transmission System. As per the PJM RTEP study process, the Towanda (V3-018) 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 the Developer by participating in project meetings and issuing this report as a part of the RTEP 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

For purposes of this report, this project been designated as the Towanda (V3-018) 115kV Project to reflect its interconnection voltage and its proximity to the East Towanda substation. The direct connection of this project will be accomplished by the construction of a new 115 kV 3 breaker ring bus and the looping of the East Towanda - Mansfield (MET) 115 kV line to it. The 115 kV direct connection is considered Option #1. Procurement and construction of the 115 kV transmission line connecting the 3 breaker ring bus to the Wind Farm 115 kV export bus is the responsibility of the Developer as this facility is not owned by FirstEnergy Corp. The Developer will be responsible for acquiring all easements, properties and permits that may be required to construct both the project connection 3 breaker ring bus and the attachment facilities. The Developer will also be responsible for the rough grade of the property and an access road to the proposed 3 breaker ring bus site. A 230 kV direct connection to the East Towanda – Grover (SET) 230 kV line is also studied. No estimated costs are provided for the 230 kV direct connection, option #2.

Power Flow Analysis

A Power Flow study was conducted to determine the reliability impact of the proposed Towanda (V3-018) 115 kV 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 Towanda (V3-018) 115 kV Project Power Flow Analysis that was performed was completed using a 2014 summer peak load base case power flow provided by the PJM staff. This base case included a detailed representation of the Penelec transmission system in the area of the proposed East Towanda 115 kV substation. A simulation of all possible contingencies within the NERC and FE Planning Standards that are impacted by the Towanda (V3-018) 115 kV Project was conducted to test for criteria compliance.

The direct connection of the Towanda (V3-018) 115 kV Project to the Penelec transmission system was studied for two different voltages; Option1 was for an interconnection to the 115 kV line between East Towanda Sub and South Troy Sub, and Option 2 was for an interconnection to the 230 kV line between East Towanda Sub and Grover Sub.

The PJM analysis results were based on the S-049 project modeled at 205 MW, however the FE analysis has the S-049 project generation reduced to 90 MW. At the time of this analysis, the Q72 project had been withdrawn from the PJM Queue. The PJM analysis results were based on the Q72 generation and Q72 reinforcements in service. The FE analysis is shown for two separate scenarios; scenario 1 is with the Q72 Project generator off line, and scenario 2 is with both the Q72 generator off line and the Q72 required reinforcements removed. As shown, the conclusion from this analysis is that there are no new upgrades required for the Towanda (V3-018) 115 kV Project.

However, the findings show that there are criteria violations which will have an impact on network congestion and local energy deliverability.

Energy Delivery Violations	Q72 Gen Removed		Q72 Gen + Reinforcement Removed	
	Option 1	Option 2	Option 1	Option 2
V3-018 Tap - Towanda 115kV line	yes	no	yes	no
P47 Tap – Mansfield 115kV line	yes	no	no	no
North Meshoppen – Meshoppen Reactor 115kV line	yes	yes	yes	yes
Towanda - North Meshoppen 115kV line	no	no	no	no
North Meshoppen – Oxbow 230kV line	yes	yes	yes	yes
East Towanda – Hillside 230kV line	yes	yes	yes	yes
Oxbow – Lackawanna 230kV line	yes	yes	yes	yes
East Towanda – North Meshoppen 230kV line	yes	yes	no	yes
Shelocta – Keystone 230 kV line	yes	yes	yes	yes
Homer City – Shelocta 230 kV line	yes	yes	yes	yes

The Developer will therefore be subject to generation curtailment in order to mitigate these violations.

Short Circuit and Dynamics Analysis

A short circuit analysis was performed by PJM and is reported above in the PJM Analysis section of this report.

System Protection Analysis

An analysis was conducted to assess the impact of the Towanda (V3-018) 115 kV Project (Option 1) on the system protection requirements in the area. The results of this review show that the following relay additions and upgrades will be required:

V3-018 Interconnection Substation 115kV

- Three Line Relay panels and One PLC (Power Line Carrier) panel for Everts Drive 115kV line
- One Fiber Panel for East Towanda line exit
- One Fiber Panel for V3-018 Generation Substation exit
- SEL--352 BF/SC (Breaker Failure / Sync Check) relaying required for each ring bus breaker
- Everts Drive exit
 - primary protection over PLC utilizing SEL321
 - backup using existing SEL311C, DTT receiver to trip V3-018 generation for breaker open at Everts Drive sub or Mansfield sub, DTT transmitter to trip Everts Drive generation for open breakers at V3-018 or East Towanda
- East Towanda exit
 - primary protection over fiber using SEL321 and 311L backup
 - DTT receiver to trip V3-018 and Everts Drive generation
- V3-018 Generation Substation exit
 - primary protection over fiber using primary and backup 311L relays

- DTT transmitter(s) to trip V3-018 generation for open breakers at Everts Drive, Manfield, East Towanda or V3-018

East Towanda Substation

- V3-018 115kV line exit
 - One line exit panel and One Fiber Panel for V3-018 line exit
 - Primary protection over fiber using SEL321 (may need more contacts than what is on existing relay) and SEL311L backup
 - DTT transmitters to trip V3-018 generation

Everts Drive Substation

- V3-018 115kV line exit -- One line exit relay panel –
 - primary protection over PLC utilizing SEL321 (may need more contacts than what is on existing relay)
 - backup using existing SEL311C
 - DTT (Direct transfer Trip) transmitter to V3-018 generation for breaker open at Everts Drive Sub or Mansfield Sub

Note that the V3-018 – East Towanda 115 kV line will have fiber based relaying with dual pilot relaying on this line.

Metering

The Developer will be required to comply with all FE Revenue Metering Requirements for Generation Interconnection Customers.

Compliance Issues

The Developer 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 Developer must also meet all PJM, ReliabilityFirst and NERC reliability criteria and operating procedures required for standards compliance. For example, the Developer 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 FE power flow analysis show that there are no FE criteria violations that are directly attributable to the capacity of the Towanda (V3-018) 115 kV Project. However, there are seven violations for direct connection Option 1, and seven violations for direct connection Option 2 affecting network congestion and local energy delivery that the Towanda (V3-018) 115 kV Project will impact. Note that the FE and PJM study results differ somewhat due to the differences in the study process and power flow programs utilized. However, the overall conclusions reached by the FE and PJM staff are the same. In accordance with the RTEP procedures defined in the PJM Open Access Transmission Tariff and PJM Manuals, the Developer is not responsible for network upgrades.

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. The Developer will be responsible for the actual cost of the direct connection that is implemented. In addition, the Developer is responsible to provide the transmission line between V3-018 interconnecting substation and the V3-018 generating substation, as the Developer will own this transmission line. 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.

Developer Requirements

In addition to the FE facilities, the Developer 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 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.
2. The purchase and installation of a 115 kV interconnection metering instrument transformer. FE will provide the ratio and accuracy specifications based on the customer load and generation levels.
3. The purchase and installation of a revenue class meter for each unit to measure the power delivered in compliance with the FE standards.
4. 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.
5. The establishment of dedicated communication circuits for SCADA report to the FE Transmission System Control Center.
6. A compliance with the FE and PJM generator power factor and voltage control requirements.

7. The execution of a back-up service agreement to serve the customer load supplied from the East Towanda 115kV substation when the units are out-of-service. This assumes the intent of the Developer is to net the generation with the load.
8. The rough grade of the property for the V3-018 Interconnection 115 kV Substation and an access road for the delivery of equipment to this site.

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

Summary

The total estimated cost of the new 115 kV three breaker ring bus substation and attachment lines is \$4,620,700. The Towanda (V3-018) Project does not have any required network upgrades.

Based on the scope of the FE direct connection Option 1, 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 Towanda (V3-018) 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 a new V3-018 Interconnecting substation and the loop of the Penelec 115 kV lines to this site. It also assumes that the Developer will provide the property for the attachment 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.