

***PJM Generator Interconnection Request  
Queue #U2-026  
Antwerp (Antwerp Windpower) 69kV  
Feasibility Study***

509260

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## **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,

## U2-026 Antwerp (Antwerp Windpower) 69kV Feasibility Study Report

### General

The Interconnection Customer (IC) proposes to install PJM Project #U2-026, a 30 MW generating facility comprised of 20 - 1.5 MW General Electric wind turbine generators with Option #1 connecting to the American Electric Power (AEP) Antwerp 69kV substation via a radial transmission line and Option #2 connecting to the American Electric Power (AEP) Haviland-South Hicksville 69kV circuit via a new 3-breaker ring bus. The proposed project will be located at 1337 State Route 111, Antwerp, Paulding County, Ohio. The projected in-service date is scheduled for December 2010.

### Attachment Facilities

#### Option #1

A new 69 kV circuit breaker will be needed at Antwerp Station to connect the proposed generation for option 1 (see Exhibit 2). Circuit breakers will need to be added to the 69 kV South Hicksville and 69 kV Payne lines. These two existing 69 kV lines will need to be rerouted in and near the station to accommodate the new line. A control house will be added to house the new 69 kV metering, relay panels, and RTU.

It is understood that the IC will be responsible for the all costs associated with this construction as well as facilities associated with connecting their 30 MW generation to the in-line facilities. Line routings were not evaluated as part of this study. Note that the IC station facilities and any facilities outside the new station were not included in the cost estimates. These are assumed to be IC's responsibility.

The AEP construction scope:

- Construction of a new 69 kV circuit breaker and associated equipment at Antwerp station, including 69 kV metering, SCADA, and relaying. Addition of control house. Addition of new 69 kV circuit breakers on the South Hicksville and Payne lines and associated equipment. The estimated cost (2008 Dollars) is **\$2,045,000**

#### Option #2

The new in-line switching station needed for option 2 (see Exhibit 3) is to consist of three (3) 69 kV circuit breakers configured in a ring-bus arrangement with 69 kV metering. AEP will retain ownership of the proposed in-line station facilities. It is expected that any right-of-way for line extensions, as well as a 250' x 200' (minimum) station site will be provided to AEP by the IC.

It is understood that the IC will be responsible for the all costs associated with this construction as well as facilities associated with connecting their 30 MW generation to the

in-line facilities. Line routings were not evaluated as part of this study. Note that the IC station facilities and any facilities outside the new station were not included in the cost estimates. These are assumed to be IC's responsibility.

The AEP construction scope:

- Construction of a new switching station connecting to the South Hicksville – Payne 69 kV circuit, including three (3) 69 kV circuit breakers, relays, 69 kV metering, SCADA, and associated equipment. The estimated Cost (2008 Dollars) is **\$3,042,000**

## **Local AEP Impacts**

### Option #1

The impact of the proposed generating facility on the AEP System was assessed for adherence with applicable reliability criteria. AEP planning criteria require that the transmission system meet performance criteria in accordance with the AEP FERC Form 715. Therefore, this criterion was used to assess the impact of the proposed facility on the AEP System. The project was studied as a 30 MW net capacity consistent with the interconnection application. The results are summarized below.

### Normal System (2012 Summer Conditions)

- No problems identified

### Single Contingency (2012 Summer Conditions)

1. The Antwerp – North Antwerp Sw. 69 kV line is overloaded to more than 100% of its summer emergency rating of 73 MVA for numerous 69 kV single contingencies including an outage on Haviland – Van Wert Co-op 69 kV line.
  2. The Payne – IPP R48 69 kV line is overloaded to 103% of its summer emergency rating of 73 MVA for an outage on the Antwerp – North Antwerp Sw. 69 kV line.
  3. The Cavett – West Van Wert 69 kV line is overloaded to more than 100% of its summer emergency rating of 50 MVA for single contingency outages on the Van Wert – Van Wert Co-op 69 kV line and the Haviland – Van Wert Co-op 69 kV line.
- It should be noted that several 69 kV lines in the area, including the North Antwerp Sw. – Antwerp Co-op line, the Antwerp Co-op – South Hicksville line, and the Haviland – Paulding line load to 97% or more of their summer emergency ratings for various single contingency outages.

### Multiple Contingency (2012 Summer Conditions)

- No problems identified

### Short Circuit Analysis

- No problems identified.

### Stability Analysis

- Stability studies were not performed as part of this Feasibility Study and are not normally performed as part of a Facility Study effort. The stability assessments are part of the System Impact Study. Based upon the results of this future System Impact Study, the extent of system upgrades could change and the associated costs could be significantly different.

### Local Upgrades

1. The overload on the Antwerp-North Antwerp Sw. 69kV circuit can be alleviated by reconductoring the 1 mile long circuit. The estimated cost (2008 Dollars) is **\$1,000,000.**
2. The overload of the Payne-Project R48 69kV line can be alleviated by reconductoring the 3.1 mile long line. The estimated cost (2008 Dollars) is **\$3,100,000.**
3. The overload of the Cavert-West Van Wert 69kV circuit can be alleviated by reconductoring the 2.76 mile long line. The estimated cost (2008 Dollars) is **\$2,760,000.**

### Option #2

#### Normal System (2012 Summer Conditions)

- No problems identified.

#### Single Contingency (2012 Summer Conditions)

1. The Antwerp – North Antwerp Sw. 69 kV line is overloaded to more than 100% of its summer emergency rating of 73 MVA for numerous 69 kV single contingencies including an outage on Payne – IPP R48 69 kV line.
2. The Antwerp – U2-026 69 kV line is overloaded to more than 100% of its summer emergency rating of 73 MVA for numerous 69 kV single contingencies including an outage on Payne – IPP R48 69 kV line.
3. The Haviland - Paulding 69 kV line is overloaded to 100% of its summer emergency rating of 50 MVA for an outage on Antwerp – U2-026 69 kV line.

4. The Payne – Latty 69 kV line is overloaded to 102% of its summer emergency rating of 73 MVA for an outage on Antwerp – U2-026 69 kV line.
5. The Payne – IPP R48 69 kV line is overloaded to more than 100% of its summer emergency rating of 73 MVA for single contingency outages on the Antwerp – U2-026 69 kV line and the Antwerp – North Antwerp Sw. 69 kV line.
6. The Cavett – West Van Wert 69 kV line is overloaded to 101% of its summer emergency rating of 50 MVA for an outage on the Haviland – Van Wert Co-op 69 kV line.
  - It should be noted that the 69 kV 400A wavetrapp at Haviland station on the Paulding line is loaded to 98% of its summer emergency rating of 51 MVA for an outage on Antwerp – U2-026 69 kV line.

#### Short Circuit Analysis

- No problems identified.

#### Stability Analysis

- Stability studies were not performed as part of this Feasibility Study and are not normally performed as part of a Facility Study effort. The stability assessments are part of the System Impact Study. Based upon the results of this future System Impact Study, the extent of system upgrades could change and the associated costs could be significantly different.

#### Local Upgrades

1. The overload on the Antwerp-North Antwerp Sw. 69kV circuit can be alleviated by reconductoring the 1 mile long circuit. The estimated cost (2008 Dollars) is **\$1,000,000.**
2. The overload on the Antwerp-Payne 69kV circuit can be alleviated by reconductoring the 7.16 mile long circuit. The estimated cost (2008 Dollars) is **\$7,160,000.**
3. The overload on the Haviland-Paulding 69kV circuit can be alleviated by reconductoring the 10.71 mile long circuit. The estimated cost (2008 Dollars) is **\$10,710,000.**
4. The overload on the Payne-Latty 69kV circuit can be alleviated by reconductoring the 7.79 mile long circuit. The estimated cost (2008 Dollars) is **\$7,790,000.**

5. The overload of the Cavert-West Van Wert 69kV circuit can be alleviated by reconductoring the 2.76 mile long line. The estimated cost (2008 Dollars) is **\$2,760,000.**

### **Reactive Requirements**

PJM requires a power factor correction to 95% lead/lag at the point of interconnection for wind generating facilities. It is expected that Great Lakes will adhere to this standard.

### **Network Impacts**

#### **Option #1**

The queue project U2-026 was studied as a 30MW (3.9MW capacity) injection into the AEP system at the Haviland 138kV substation, as a proxy for the Antwerp 69kV bus. U2-026 was evaluated for compliance with reliability criteria for summer peak conditions in 2012. Potential network impacts were as follows:

#### **Generator Deliverability**

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

None

#### **Multiple Facility Contingency**

*(Double Circuit Tower Line, Line with Failed Breaker and Bus Fault contingencies for the full energy output)*

None

#### **Short Circuit**

(Summary form of Cost allocation for breakers will be inserted here if any)

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)*

None

#### **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)*

*(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)*

None

## **Delivery of Energy Portion of Interconnection Request**

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. **These are not required reliability upgrades.**

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 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.

*As a result of the aggregate energy resources in the area, the following potential congestion was identified*

1. **(AEP)** The S73C-Lincoln 138kV line loads from 114.7% to 118.9% (DC power flow) of its emergency rating (250MVA) for the single line contingency outage (AEP\_S73C). This project contributes approximately 10.6MW to the thermal congestion.
2. **(AEP)** The S73C-Lincoln 138kV line loads from 109.0% to 113.2% (DC power flow) of its normal rating (191MVA) for non-contingency condition. This project contributes approximately 8.0MW to the thermal congestion.

To eliminate overloads on items 1 & 2 above requires replacing the risers at Lincoln (\$100,000) and reconductoring the 17.1 mile circuit between Lincoln and project S73 (\$25,650,000). Total estimated cost (2008 Dollars) is \$25,750,000.

3. **(AEP)** The Milan-Sharper 138kV line loads from 108.4% to 112.5% (DC power flow) of its emergency rating (192MVA) for the single line contingency outage (AEP\_S73A). This project contributes approximately 8.0MW to the thermal congestion.

To eliminate the overload on item 3 above requires replacing the 600 ampere switch and risers at Milan Station. Total estimated cost is \$100,000.

## **MISO Impacts**

Any impacts on the MISO transmission system will be identified in the Impact Study.

### **Option #2**

The queue project U2-026 was studied as a 30MW (3.9MW capacity) injection into the AEP system at the Haviland – S. Hicksville 69kV lines. U2-026 Option #2 was evaluated for compliance with reliability criteria for summer peak conditions in 2012. Potential network impacts were as follows:

### **Generator Deliverability**

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

None

### **Multiple Facility Contingency**

*(Double Circuit Tower Line, Line with Failed Breaker and Bus Fault contingencies for the full energy output)*

None

### **Short Circuit**

*(Summary form of Cost allocation for breakers will be inserted here if any)*

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)*

None

### **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)*

*(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)*

None

## **Delivery of Energy Portion of Interconnection Request**

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. **These are not required reliability upgrades.**

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 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.

*As a result of the aggregate energy resources in the area, the following potential congestion was identified*

1. **(AEP)** The S73C-Lincoln 138kV line loads from 114.7% to 116.8% (DC power flow) of its emergency rating (250MVA) for the single line contingency outage (AEP\_S73C). This project contributes approximately 5.3MW to the thermal congestion.

To eliminate overloads on items 1 above requires replacing the risers at Lincoln (\$100,000) and reconductoring the 17.1 mile circuit between Lincoln and project S73 (\$25,650,000). Total estimated cost (2008 Dollars) is \$25,750,000.

## **MISO Impacts**

Any impacts on the MISO transmission system will be identified in the Impact Study.

**Exhibit 1: Approximate interconnection location of the proposed facilities**

**Exhibit 2: Simplified diagram of proposed 69 kV connection to Antwerp Station –  
Option 1**

**Exhibit 3: Simplified diagram of proposed 69 kV in-line switching substation –  
Option 2**