U2-073 Frostburg 138kV II
Generation Interconnection

General

The Interconnection Customer (IC) has proposed a 200 MWE wind power generating facility to be located in the Big Savage and Little Savage Mountain areas of Somerset County, Pennsylvania. The project was evaluated for compliance with reliability criteria for summer peak conditions in 2012. The planned in service date of the project is October 31, 2010.

U2-073 will interconnect with the Allegheny Power (AP) transmission system at either the Frostburg #1 138kV substation (Option 1) or the future Midlothian 138kV substation (Option 2).

Option 1

Point of Interconnection

U2-073 option 1 will interconnect with the AP transmission system at the Frostburg #1 138kV substation. Option 1 was studied as a 200 MW injection into the AP system at the Frostburg 138kV substation.

Direct Connection Requirements

Transmission Owner Scope of Direct Connection Work

The Transmission Owner's (Allegheny Power) scope of work for the direct connection facility includes:

- Frostburg #1 138kV substation expansion. Obtain property and permitting for substation expansion at no cost to AP. Grade the site, install fence, ground grid, and yard stone. Extend the 138kV bus, install one (1) 138kV breaker, 138kV metering, three (3) 138kV disconnect switches, two (2) 138kV deadend structures, 138kV power VT for station service, control cables, panels and equipment, SCADA, telephone service, and associated facilities.

  Estimated Cost: $1,650,000 in 2010 dollars

- Install facilities for transfer trip at the Hazelton 138kVsubstation. Install 138kV line trap, CVT, transfer trip panel and associated equipment.

  Estimated Cost: $150,000 in 2010 dollars

- Install facilities for transfer trip at Ridgeley 138kV substation. Install 138kV line trap, CVT, transfer trip panel and associated equipment.

  Estimated Cost: $150,000 in 2010 dollars

Interconnection Customer Scope of Direct Connection Work

The Interconnection Customer (IC) has assumed full responsibility for the design and construction of all facilities associated with the U2-073 generating facility and the 138kV direct connection line on the IC side of the Point of Interconnection (POI). The IC will interconnect U2-073 with the AP transmission system by constructing a customer-owned 138kV line from the generating facility site to AP's Frostburg #1 138kV substation. Route selection, line design, right-of-way acquisition and construction of such lines will be entirely the responsibility of the IC. Cost estimates do not include construction of that line. It is assumed that the ICs step up transformer will conform to the AP standard of delta on the low side and grounded wye on the high side. It is further assumed that a fiber optic interface will be used for the protection channel between the AP and developer's stations.

The IC will be required to install metering and telemetry equipment to provide revenue metering and real-time telemetry data to PJM. The requirements for this equipment are listed in Appendix 2, Section 8 of Attachment O to the PJM Tariff, as well as PJM Manuals 01 and 14D. Protective relaying and metering design and installation must comply with the Allegheny Power Applicable Standards.

Cost and Timing Summary

While the information in this transmittal is reasonable for the scope of work defined, it should be noted that the cost figures are conceptual in nature at this stage and that an engineering team has not yet been assigned to the project. Obviously, any change to the scope of work will require that the estimates be revisited. The costs are a best estimate, but the developer will be charged for actual costs. Any under-runs or over-runs will be reconciled at the conclusion of the project.

The cost estimates in this report do not include tax gross-up, land acquisition, or any network upgrades which may have been identified and required by this project.

The estimated time to provide for the interconnection of this project is **18 months** after the receipt of a signed Interconnection Service Agreement and Construction Service Agreement.

Network Impacts

Potential network impacts are as follows:

Generator Deliverability

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

None

Multiple Facility Contingency

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

1. The 01BLACKO-01BLACKO 138/500 kV (APS) transformer loads from 84.43% (DC power flow) to 108.77% of its emergency rating (437 MVA) for the tower line outage (37). This project contributes approximately 106.4 MW to cause this thermal violation.

2. The 01ALBRIG-01KINGWD 138kV (APS) line loads from 89.56% to 103.21% (DC power flow) of its emergency rating (176 MVA) for the tower line outage (37). This project contributes approximately 24.0 MW to cause this thermal violation.

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

Short Circuit

No breakers were identified as being over their maximum interrupting rating.

Listed below are the positive and zero sequence source equivalent impedance at the new Frostburg #1 138kV substation with the GSU and generators OPEN.

Positive: (0.00602+j0.05255)
Zero: (0.02478+j0.09943)

While Allegheny Power can't mandate that their personnel install protective relaying and communications equipment at the generator site, they have the responsibility for designing the protection scheme and providing specifications for all relays to be employed on the interconnection breaker terminal at the generation site to assure that the protective relaying equipment will be compatible with that installed on the interconnection breaker terminal at the new substation. The relaying package will likely include both primary and backup protection. Allegheny Power is also responsible for testing and calibrating all relays and performing all tests to assure that relaying at the generator site is properly installed and functional.

The estimated total cost of this engineering and field test effort is **$5,000 in 2010 dollars**.

Note: Purchase and installation of protective relaying and associated equipment at the generation site is not included in this scope of work. This phase of work is the responsibility of the customer.

The estimated cost for Allegheny Power Controls Engineering to complete a coordination review of the area, develop new relay settings, and implement the required changes is approximately **$5,000 in 2010 dollars**.

Stability and Reactive Power Requirements

Will be performed during the Queue U2-073 System Impact Study.

New System Reinforcements

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

1. To mitigate the 01BLACKO-01BLACKO 138/500kV (APS) transformer overload would require the installation of a second 500/138kV- 210/280/350 MVA- LTC transformer, a new 500kV breaker, 138kV metering, and two (2) new 138kV breakers. It would also require the upgrade of all bus work, connectors, and disconnect switches as necessary. The estimated cost to perform this work is **$9,600,000** and will require **27 months** to complete after receipt of a signed Interconnection Service Agreement and Construction Service Agreement.

2. To mitigate the 01ALBRIG-01KINGWD 138kV (APS) line overload would require the reconductor of 4.0 miles of line from the Albright 138kV substation to the Kingwood 138kV substation with 954 ACSR (currently 556 ACSR). The estimated cost to perform this work is **$1,540,000** and will take **24 months** to complete after receipt of a signed Interconnection Service Agreement and Construction Service Agreement.

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 System Impact Study)

None

Delivery of Energy Portion of Interconnection Request

PJM also studied the delivery of the energy portion of this interconnection request with all earlier queues at their energy output and the system at peak load with all transmission facilities in service. Any problems identified below may result in operational restrictions to the project under study or other PJM generation. There may also be other conditions causing congestion which were not studied. The developer can proceed with network upgrades to eliminate the potential congestion at their discretion by submitting a Merchant Transmission Interconnection request now or in the future.

These are not required reliability upgrades.

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

1. The Q34-SOMERST 115kV (PENELEC) line loads from 142.6% to 151.0% (DC power flow) of its normal rating (129 MVA) for non-contingency condition. This project contributes approximately 10.7 MW to the thermal congestion.

2. The ROCKWOOD-Q34 115kV (PENELEC) line loads from 92.9% to 100.0% (DC power flow) of its emergency rating (159 MVA) for the single line contingency outage (APS-SB-1). This project contributes approximately 11.4 MW to the thermal congestion.

   To mitigate the overloads in items 1 and 2 would require the replacement of a 115kV disconnect switch and two (2) 115kV CT circuits at the Somerset substation as well as the replacement of a 115kV disconnect switch at the Rockwood substation. Additionally, approximately 8.12 miles of 115kV conductor must be upgraded / replaced. The estimated cost to perform this work is **$2,643,000**.

Option 2

Point of Interconnection

U2-073 option 2 will interconnect with the Allegheny Power transmission system at the future Midlothian 138kV substation adjacent to the existing Hazelton-Ridgeley 138kV line. Option 2 was studied as a 200 MW injection into the AP system at the Frostburg-Jennings 138kV line.

Direct Connection Requirements

Transmission Owner Scope of Direct Connection Work

The Transmission Owner's (Allegheny Power) scope of work for the direct connection facility includes:

- Obtain property at no cost to AP and cut the existing Hazelton-Ridgeley 138kV line. Construct a one (1) span (0.1 mile) 954 ACSR 138kV line loop into the proposed Midlothian 138kV substation.

  Estimated Cost: $210,000 in 2010 dollars

- Midlothian 138kV substation. Substation property and permitting to be obtained by the developer at no cost to AP. Grade the site, install fence, ground grid, yard stone, and access roads. Construct a 138kV breaker station in a ring bus configuration consisting of three (3) 138kV breakers, 138kV metering, seven (7) 138kV disconnect switches, three (3) 138kV deadend structures, 138kV power VT for station service, metal control building, control cables, panels and equipment, SCADA, telephone service, and associated facilities.

  Estimated Cost: $2,942,000 in 2010 dollars

- Install facilities for transfer trip at the Hazelton 138kVsubstation. Install 138kV line trap, CVT, transfer trip panel and associated equipment.

  Estimated Cost: $150,000 in 2010 dollars

- Install facilities for transfer trip at Ridgeley 138kV substation. Install 138kV line trap, CVT, transfer trip panel and associated equipment.

Estimated Cost: $150,000 in 2010 dollars

Interconnection Customer Scope of Direct Connection Work

The Interconnection Customer (IC) has assumed full responsibility for the design and construction of all facilities associated with the U2-073 generating facility and the 138kV direct connection line on the IC side of the POI. The IC will interconnect U2-073 with the AP system by constructing a customer-owned 138kV line from the generating facility site to AP's new Midlothian 138kV substation. Route selection, line design, right-of-way acquisition and construction of such lines will be entirely the responsibility of the IC. Cost estimates do not include construction of that line. It is assumed that the ICs step up transformer will conform to the AP standard of delta on the low side and grounded wye on the high side. It is further assumed that a fiber optic interface will be used for the protection channel between the AP and developer's stations.

The IC will be required to install metering and telemetry equipment to provide revenue metering and real-time telemetry data to PJM. The requirements for this equipment are listed in Appendix 2, Section 8 of Attachment O to the PJM Tariff, as well as PJM Manuals 01 and 14D. Protective relaying and metering design and installation must comply with the Allegheny Power Applicable Standards.

Cost and Timing Summary

While the information in this transmittal is reasonable for the scope of work defined it should be noted that the cost figures are conceptual in nature at this stage and that an engineering team has not yet been assigned to the project. Obviously, any change to the scope of work will require that the estimates be revisited. The costs are a best estimate, but the developer will be charged for actual costs. Any under-runs or over-runs will be reconciled at the conclusion of the project.

The cost estimates in this report do not include tax gross-up or any network upgrades which may have been identified and required by this project.

The estimated time to provide for the interconnection of this project is **24 months** after the receipt of a signed Interconnection Service Agreement and Construction Service Agreement.

Network Impacts

Potential network impacts are as follows:

Generator Deliverability

*(Single or N-1 contingencies for the **full energy** output of the interconnection request)*

None

Multiple Facility Contingency

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

1. The ROCKWOOD-Q34 115kV (PENELEC) line loads from 95.42% to 103.91% (DC power flow) of its emergency rating (159 MVA) for the tower line outage (31). This project contributes approximately 13.5 MW to cause this thermal violation.

2. The 01BLACKO-01BLACKO 138/500kV (APS) transformer loads from 84.53% (DC power flow) to 108.86% of its emergency rating (437 MVA) for the tower line outage (37). This project contributes approximately 106.4 MW to cause this thermal violation.

3. The 01ALBRIG-01KINGWD 138kV (APS) line loads from 89.78% to 103.43% (DC power flow) of its emergency rating (176 MVA) for the tower line outage (37). This project contributes approximately 24.0 MW to cause this thermal violation.

4. The 01GARRET 138-01GARRET 115kV (PENELEC) transformer loading 10% (DC power flow) of its emergency rating (90 MVA) for the tower line outage (2PN_WITH_S11A). This project contributes approximately 8.8 MW to cause this thermal violation.

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

Short Circuit

No breakers were identified as being over their maximum interrupting rating.

Listed below are the positive and zero sequence source equivalent impedance at the new Midlothian 138kV substation with the GSU and generators OPEN.

Positive: (0.00696+j0.06005)
Zero: (0.02044+j0.10002)

While Allegheny Power can't mandate that their personnel install protective relaying and communications equipment at the generator site, they have the responsibility for designing the protection scheme and providing specifications for all relays to be employed on the interconnection breaker terminal at the generation site to assure that the protective relaying equipment will be compatible with that installed on the interconnection breaker terminal at the new substation. The relaying package will likely include both primary and backup protection. Allegheny Power is also responsible for testing and calibrating all relays and performing all tests to assure that relaying at the generator site is properly installed and functional.

The estimated total cost of this engineering and field test effort is **$5,000 in 2010 dollars**.

Note: Purchase and installation of protective relaying and associated equipment at the generation site is not included in this scope of work. This phase of work is the responsibility of the customer.

The estimated cost for Allegheny Power Controls Engineering to complete a coordination review of the area, develop new relay settings, and implement the required changes is approximately **$5,000 in 2010 dollars**.

Stability and Reactive Power Requirements

Will be performed during the Queue U2-073 System Impact Study.

New System Reinforcements

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

1. To mitigate the ROCKWOOD-Q34 115kV (PENELEC) line overload would require the replacement of a 115kV disconnect switch and two (2) 115kV CT circuits at the Somerset substation as well as the replacement of a 115kV disconnect switch at the Rockwood substation. Additionally, approximately 8.12 miles of 115kV conductor must be upgraded / replaced. The total cost of this upgrade is estimated to be **$2,643,000**.

2. To mitigate the 01BLACKO-01BLACKO 138/500kV (APS) transformer overload would require the installation of a second 500/138kV- 210/280/350 MVA- LTC transformer, a new 500kV breaker, 138kV metering, and two (2) new 138kV breakers. It would also require the upgrade of all bus work, connectors, and disconnect switches as necessary. The estimated cost to perform this work is **$9,600,000** and will require **27 months** to complete after receipt of a signed Interconnection Service Agreement and Construction Service Agreement.

3. To mitigate the 01ALBRIG-01KINGWD 138kV (APS) line overload would require the reconductor of 4.0 miles of line from the Albright 138kV substation to Kingwood 138kV substation with 954 ACSR (currently 556 ACSR). The estimated cost to perform this work is **$1,540,000** and will take **24 months** to complete after receipt of a signed Interconnection Service Agreement and Construction Service Agreement.

4. The 01GARRET 138-01GARRET 115kV (PENELEC) transformer loading 10% (DC power flow) of its emergency rating (90MVA) for the tower line outage (2PN_WITH_S11A). This project contributes approximately 8.8MW to cause this thermal violation.

   No reinforcement is required for this transformer. The Garret transformer does not exceed 100% loading. However, because U2-073 increases the loading of the transformer by at least 10%, it is included in this report for information. Based on the current ratings, the transformer is loaded to 62.34%.

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 System Impact Study)

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 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.

1. The Q34-SOMERST 115kV (PENELEC) line loads from 146.5% to 154.4% (DC power flow) of its normal rating (129 MVA) for non-contingency condition. This project contributes approximately 10.1 MW to the thermal congestion. It must be noted that the same thermal violation (DC power flow: 146.5%) already exists in the 2012 base case.

2. The ROCKWOOD-Q34 115kV (PENELEC) line loads from 92.5% to 100.3% (DC power flow) of its normal rating (129 MVA) for non-contingency condition. This project contributes approximately 10.1 MW to the thermal congestion.

   To mitigate the overloads in items 1 and 2 would require the replacement of a 115kV disconnect switch and two (2) 115kV CT circuits at the Somerset substation as well as the replacement of a 115kV disconnect switch at the Rockwood substation. Additionally, approximately 8.12 miles of 115kV conductor must be upgraded / replaced. The estimated cost to perform this work is **$2,643,000**.

3. The 01GARRET 138kV – 01GARRET 115kV (PENELEC) transformer loading increases 16% (DC power flow) of its normal rating (63 MVA) for non-contingency condition. This project contributes approximately 10.2 MW to the thermal congestion. No reinforcement required.