

## **T16 Gorman – Snowy Creek 69kV** **Generation Interconnection**

### **General**

The developer has proposed a 30 MW wind generating facility to be located in Garrett County, Maryland. The project will connect with Allegheny Power (AP) at the new Route 560 69kV substation adjacent to the Snowy Creek – William 69kV line (Option 1), or to the existing Kelso Gap 138kV substation (Option 2).

### **Option 1**

**Point of Interconnection:** A new Route 560 switching station to be constructed on the Allegheny Power Snowy Creek – William 69kV line approximately 5 circuit miles east of Oakland substation.

### **Direct Connection Requirements**

#### **Transmission Owner Scope of Direct Connection Work**

Construct a new 69 kV switching station consisting of three 69 kV breakers configured as a ring bus, a 69 kV meter, and associated facilities. The new Route 560 substation will be connected to the AP system by cutting the #116 circuit and looping it into the switching station via two short spans of 336 ACSR. Major equipment in the new station will include three 69kV bay structures, three 69 kV circuit breakers, one 69 kV VB air switch, 18 69kV HS switches, 69kV potential transformer and metering current transformers. A redundant channel transfer trip scheme requiring the addition of CVT's and line traps is included. The station will also include a control building, which will house all protective relaying, metering and SCADA RTU communications equipment required to accommodate the electrical facilities. Revenue metering will be located on the feed to the generator.

**Estimated Cost: \$1,638,000 in 2009 dollars.** This estimate does not include the cost of the developer's facilities.

#### **Interconnection Customer Scope of Direct Connection Work**

The developer's station is assumed to be adjacent to the AP SS. Site preparation including grading and an access road is assumed to be by the developer. The new switching station, to be referred to as Route 560 substation, will be located on property provided by the developer adjacent to the AP Snowy Creek – William 69 kV circuit # 116 approximately 5 circuit miles east of Oakland SS. The developer will interconnect to the AP system via a rigid bus over-the-fence circuit from a 69-34.5 kV substation adjacent to the AP switching station. The Interconnection Customer will also 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.

While we can't mandate that our personnel install protective relaying and communications equipment at the generator site, Allegheny Power has 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 switching station. 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.

**Estimated Cost of engineering and field testing: \$5,000 in 2009 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 Controls Engineering to complete a coordination review of the area, develop new relay settings, and implement the required changes is **\$5,000 in 2009 dollars**.

## **Network Impacts**

### **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 System Impact Study)*

No problems identified.

### **Short Circuit**

No existing breakers were identified as requiring replacement.

Listed below are the positive and zero sequence source equivalent impedance at the proposed Route 560 69 kV site with the GSU and generators OPEN.

Positive:  $(0.02572 + j0.14777)$

Zero:  $(0.02004 + j0.15353)$

### **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)*

1. The 01WILLIM-01PARSNS 138kV line loads from 167.23% to 175.09% (DC power flow) of its emergency rating (126MVA) for the tower line outage (30). The tower contingency results in the following lines being disconnected: all lines connected to the 01DENVER 138kV bus and all lines connected to the 01METTIK 138kV bus. This project contributes approximately 9.9MW to the thermal violation. *Note: This line has been slated for a baseline upgrade which is to be completed in 2011.*

2. The 01PARSNS-01LOUGHL 138kV line loads from 159.81% to 167.67% (DC power flow) of its emergency rating (126MVA) for the tower line outage (30). The tower contingency results in the following lines being disconnected: all lines connected to the 01DENVER 138kV bus and all lines connected to the 01METTIK 138kV bus. This project contributes approximately 9.9MW to the thermal violation. *Note: This line has been slated for a baseline upgrade which is to be completed in 2011.*

3. The P52C-01ALBRIG 138kV line loads from 107.39% to 111.03% (DC power flow) of its emergency rating (202MVA) for the tower line outage (122). The tower contingency results in the following lines being disconnected: 01BUCKHN – 01E BUCK 138kV, and all lines connected to the 01TALLMN 138kV bus. This project contributes approximately 7.4MW to the thermal violation. *Note: This line has been slated for a baseline upgrade which is to be completed in 2011.*

4. The 01ALBRIG-01RUTHBL 138kV line loads from 120.64% to 123.58% (DC power flow) of its emergency rating (176MVA) for the tower line outage (31). The tower contingency results in all lines being disconnected from the following buses: 01BRANDN 138kV, 01 106 J 138kV, 01NEC T 138kV, 01NECEST 138kV, 01TEX E5 138kV, 01NU TP1 138kV, and 01NU 61 138kV. This project contributes approximately 5.2MW to the thermal violation.

5. The 01RUTHBL-01CHEATL 138kV line loads from 118.23% to 121.16% (DC power flow) of its emergency rating (176MVA) for the tower line outage (31). The tower contingency results in all lines being disconnected from the following buses: 01BRANDN 138kV, 01 106 J 138kV, 01NEC T 138kV, 01NECEST 138kV, 01TEX E5 138kV, 01NU TP1 138kV, and 01NU 61 138kV. This project contributes approximately 5.2MW to the thermal violation.

6. The 01CHEATL-01LKLYNN 138kV line loads from 112.33% to 115.27% (DC power flow) of its emergency rating (176MVA) for the tower line outage (31). The tower contingency results in all lines being disconnected from the following buses: 01BRANDN 138kV, 01 106 J 138kV, 01NEC T 138kV, 01NECEST 138kV, 01TEX E5 138kV, 01NU TP1 138kV, and 01NU 61 138kV. This project contributes approximately 5.2MW to the thermal violation.

### **New System Reinforcements**

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

AP will install a redundant channel transfer trip scheme between the breakers at Snowy Creek, William, Route 560, and T16.

**Estimated Cost: \$475,000 in 2009 dollars**

**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)*

1. To mitigate the William – Parsons 175% overload would require upgrading the circuit by reconductoring 12.56 miles with 954 ACSR and upgrading terminal equipment at William and Parsons SS including disconnects leads, line trap, line risers, relay circuitry, and RTU units. Due to the age of the line it is assumed that a complete rebuild of the circuit will be required. The estimate to perform this work is **\$5,410,000 in 2009 dollars** with 30 months leadtime. *Note: This line has been slated for a baseline upgrade which is to be completed in 2011.*
2. To mitigate the Parsons – Loughs Lane 168% overload would require upgrading the circuit by reconductoring 20.77 miles with 954 ACSR and upgrading terminal equipment at Loughs Lane and Parsons SS including disconnects leads, line trap, line risers, relay circuitry, and RTU units. Due to the age of the line it is assumed that a complete rebuild of the circuit will be required. The estimate to perform this work is **\$8,871,000 in 2009 dollars** with 30 months leadtime. *Note: This line has been slated for a baseline upgrade which is to be completed in 2011.*
3. To mitigate the P52 – Albright 111% overload would require upgrading the circuit by reconductoring approximately 4.0 miles with 954 ACSR and upgrading terminal equipment at Albright SS including disconnects leads, line trap, line risers, relay circuitry, and RTU units. Due to the age of the line it is assumed that a complete rebuild of the circuit will be required. The estimate to perform this work is **\$1,785,000 in 2009 dollars** with 30 months leadtime. *Note: This line has been slated for a baseline upgrade which is to be completed in 2011.*
4. To mitigate the Albright – Ruthbelle 124% overload would require upgrading the circuit by reconductoring 1.46 miles with 954 ACSR and upgrading terminal equipment at Albright SS including disconnects leads, line trap, line risers, relay circuitry, and RTU units. Due to the age of the line it is assumed that a complete rebuild of the circuit will be required. The estimate to perform this work is **\$486,000 in 2009 dollars** with 30 months leadtime.
5. To mitigate the Ruthbelle – Cheat Lake 121% overload would require upgrading the circuit by reconductoring approximately 18.25 miles with 954 ACSR. Due to the age of the line it is assumed that a complete rebuild of the circuit will be required. The estimate to perform this work is **\$6,069,000 in 2009 dollars** with 30 months leadtime.
6. To mitigate the Cheat Lake – Lake Lynn 115% overload would require upgrading the circuit by reconductoring approximately 2.00 miles with 954 ACSR. Due to the age of the line it is

assumed that a complete rebuild of the circuit will be required. The estimate to perform this work is **\$740,000 in 2009 dollars** with 30 months leadtime.

### **Wholesale Distribution Charges**

The charges below are the wholesale distribution charges. This charge is a rough estimate based on a rolled-in rate methodology, which assumes subtransmission facilities between AP's transmission system and the interconnection point are integrated network facilities.

**Estimated Cost: \$8,100/month**

### **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.

As a result of the aggregate energy resources in the area, the following violations were identified:

1. The 01WILLIM-01PARSNS 138kV line loads from 194.8% to 202.6% (DC power flow) of its emergency rating (126MVA) for the single line contingency outage of the 01ALBRIG – P52, 138kV line (ALBRIG\_P52). This project contributes approximately 9.8MW to the thermal congestion. To mitigate the William – Parsons 203% overload would require upgrading the circuit by reconductoring 12.56 miles with 954 ACSR and upgrading terminal equipment at William and Parsons SS including disconnect leads, line trap, line risers, relay circuitry, and RTU units. Due to the age of the line it is assumed that a complete rebuild of the circuit will be required. The estimate to perform this work is **\$5,410,000 in 2009 dollars** with 30 months leadtime.
2. The 01PARSNS-01LOUGHL 138kV line loads from 187.4% to 195.1% (DC power flow) of its emergency rating (126MVA) for the single line contingency outage of the 01ALBRIG – P52, 138kV line (ALBRIG\_P52). This project contributes approximately 9.8MW to the thermal congestion. To mitigate the Parsons – Loughs Lane 195% overload would require upgrading the circuit by reconductoring 20.77 miles with 954 ACSR and upgrading terminal equipment at Loughs Lane and Parsons SS including disconnect leads, line trap, line risers, relay circuitry, and RTU units. Due to the age of the line it is assumed that a complete rebuild of the circuit will be required. The estimate to perform this work is **\$8,871,000 in 2009 dollars** with 30 months leadtime.
3. The 01SNOW T-01ALBRIG 138kV line loads from 105.6% to 113.3% (DC power flow) of its emergency rating (196MVA) for the single line contingency outage of the 01JUNCTN – R22COP1, 138kV line (APS-SB-567\_R22A). This project contributes approximately 15.1MW to the thermal congestion. To mitigate the Snowy Creek Tap – Albright 113% overload would require upgrading the circuit by reconductoring 5.97 miles with 954 ACSR and upgrading terminal equipment at Albright SS including bus taps, disconnect leads, line trap, line risers,

relay circuitry, and RTU units. Due to the age of the line it is assumed that a complete rebuild of the circuit will be required. The estimate to perform this work is **\$2,619,000 in 2009 dollars** with 30 months leadtime.

4. The 01WILLIM-01METTIK 138kV line loads from 126.5% to 130.5% (DC power flow) of its emergency rating (202MVA) for the single line contingency outage of the 01NPETER – 01NFRANK, 138kV line (APS-SB-595). This project contributes approximately 8.1MW to the thermal congestion. To mitigate the William – Mettiki Tap 130% overload would require upgrading the circuit by reconductoring 3.42 miles with 954 ACSR and upgrading terminal equipment at William SS including disconnect leads, line trap, line risers, relay circuitry, and RTU units. Due to the age of the line it is assumed that a complete rebuild of the circuit will be required. The estimate to perform this work is **\$1,539,000 in 2009 dollars** with 30 months leadtime.

5. The P52C-01ALBRIG 138kV line loads from 147.9% to 151.9% (DC power flow) of its emergency rating (202MVA) for the single line contingency outage of the 01NPETER – 01NFRANK, 138kV line (APS-SB-595). This project contributes approximately 8.1MW to the thermal congestion. To mitigate the P52 – Albright 151% overload would require upgrading the circuit by reconductoring approximately 4.0 miles with high temperature conductor and upgrading terminal equipment at Albright SS including disconnects leads, line trap, line risers, relay circuitry, and RTU units. Due to the age of the line it is assumed that a complete rebuild of the circuit will be required. The estimate to perform this work is **\$4,064,000 in 2009 dollars** with 30 months leadtime.

6. The 01METTIK-P52C 138kV line loads from 117.2% to 121.2% (DC power flow) of its emergency rating (202MVA) for the single line contingency outage of the 01NPETER – 01NFRANK, 138kV line (APS-SB-595). This project contributes approximately 8.1MW to the thermal congestion. To mitigate the Mettiki Tap – P52 121% overload would require upgrading the circuit by reconductoring approximately 17.29 miles with 954 ACSR. Due to the age of the line it is assumed that a complete rebuild of the circuit will be required. The estimate to perform this work is **\$7,322,000 in 2009 dollars** with 30 months leadtime.

7. The 01ALBRIG-01KINGWD 138kV line loads from 104.8% to 107.8% (DC power flow) of its emergency rating (176MVA) for the single line contingency outage of the 01BLACKO – 01HATFLD, 500kV line, coupled with the outage of the 01BLACKO 500/138kV transformer (AP128\_OP). This project contributes approximately 5.3MW to the thermal congestion. To mitigate the Albright – Kingwood 108% overload would require upgrading the circuit by reconductoring 4.00 miles with 954 ACSR and upgrading terminal equipment at Albright and Kingwood SS including disconnects leads, line trap, line risers, relay circuitry, and RTU units. Due to the age of the line it is assumed that a complete rebuild of the circuit will be required. The estimate to perform this work is **\$1,785,000 in 2009 dollars** with 30 months leadtime.

## **Option 2**

**Point of Interconnection:** A direct connection to the Kelso Gap 138 kV substation which will be constructed for project H23-W70. It is assumed that project H23-W70 and all associated

system upgrades have been constructed and are in service, establishing the new AP Kelso Gap 138 kV three breaker ring bus switching station.

## **Direct Connection Requirements**

### **Transmission Owner Scope of Direct Connection Work**

For purposes of this study, it is assumed that project H23\_W70 and all associated system upgrades have been constructed and are in service, establishing the new AP Kelso Gap 138 kV three breaker ring bus switching station. For Queue Project T16, AP will install a fourth 138 kV breaker in the ring and establish a new line terminal position with a 138 kV meter. Major equipment will include a 138kV breaker, three 138kV CVTs, three 138kV switches, and three extended range 138kV current transformers.

**Estimated Cost: \$660,000 in 2009 dollars.** This estimate does not include the cost of the customer facilities.

### **Interconnection Customer Scope of Direct Connection Work**

The customer will interconnect to the AP system via a rigid bus over-the-fence circuit from a 138-34.5 kV substation adjacent to the AP switching station. The assumption is made that the developer's facilities will be adjacent to Kelso Gap SS and interconnection will be made by tubular bus.

While we can't mandate that our personnel install protective relaying and communications equipment at the generator site, Allegheny Power has 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 switching station. 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 2009 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 Controls Engineering to complete a coordination review of the area, develop new relay settings, and implement the required changes is approximately **\$5,000 in 2009 dollars.**

## **Network Impacts**

### **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 System Impact Study)*

No problems identified.

### **Short Circuit**

No existing breakers were identified as requiring replacement

Listed below are the positive and zero sequence source equivalent impedance at the proposed Kelso Gap 138 kV site with the GSU and generators OPEN. This calculation assumes that the project H23\_W70 is in-service.

Positive: (0.01153 + j0.06377)

Zero: (0.00748 + j0.05540)

### **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)*

1. The 01ALBRIG-01RUTHBL 138kV line loads from 120.64% to 123.68% (DC power flow) of its emergency rating (176MVA) for the tower line outage (31). The tower contingency results in all lines being disconnected from the following buses: 01BRANDN 138kV, 01 106 J 138kV, 01NEC T 138kV, 01NECEST 138kV, 01TEX E5 138kV, 01NU TP1 138kV, and 01NU 61 138kV. This project contributes approximately 5.4MW to the thermal violation.
2. The 01RUTHBL-01CHEATL 138kV line loads from 118.23% to 121.27% (DC power flow) of its emergency rating (176MVA) for the tower line outage (31). The tower contingency results in all lines being disconnected from the following buses: 01BRANDN 138kV, 01 106 J 138kV, 01NEC T 138kV, 01NECEST 138kV, 01TEX E5 138kV, 01NU TP1 138kV, and 01NU 61 138kV. This project contributes approximately 5.4MW to the thermal violation.
3. The 01CHEATL-01LKLYNN 138kV line loads from 112.33% to 115.37% (DC power flow) of its emergency rating (176MVA) for the tower line outage (31). The tower contingency results in all lines being disconnected from the following buses: 01BRANDN 138kV, 01 106 J 138kV, 01NEC T 138kV, 01NECEST 138kV, 01TEX E5 138kV, 01NU TP1 138kV, and 01NU 61 138kV. This project contributes approximately 5.4MW to the thermal violation.

### **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 System Impact Study)*

1. To mitigate the Albright – Ruthbelle 124% overload would require upgrading the circuit by reconductoring 1.46 miles with 954 ACSR and upgrading terminal equipment at Albright SS including disconnects leads, line trap, line risers, relay circuitry, and RTU units. Due to the age of the line it is assumed that a complete rebuild of the circuit will be required. The estimate to perform this work is **\$486,000 in 2009 dollars** with 30 months leadtime.

2. To mitigate the Ruthbelle – Cheat Lake 121% overload would require upgrading the circuit by reconductoring approximately 18.25 miles with 954 ACSR. Due to the age of the line it is assumed that a complete rebuild of the circuit will be required. The estimate to perform this work is **\$6,069,000 in 2009 dollars** with 30 months leadtime.

3. To mitigate the Cheat Lake – Lake Lynn 115% overload would require upgrading the circuit by reconductoring approximately 2.00 miles with 954 ACSR. Due to the age of the line it is assumed that a complete rebuild of the circuit will be required. The estimate to perform this work is **\$740,000 in 2009 dollars** with 30 months leadtime.

### **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.

As a result of the aggregate energy resources in the area, the following violations were identified:

1. The 01SNOW T-01ALBRIG 138kV line loads from 105.6% to 120.3% (DC power flow) of its emergency rating (196MVA) for the single line contingency outage of the 01JUNCTN – R22COP1, 138kV line (APS-SB-567\_R22A). This project contributes approximately 28.7MW to the thermal congestion. To mitigate the Snowy Creek Tap – Albright 120% overload would require upgrading the circuit by reconductoring 5.97 miles with 954 ACSR and upgrading terminal equipment at Albright SS including bus taps, disconnect leads, line trap, line risers, relay circuitry, and RTU units. Do to the age of the line it is assumed that a complete rebuild of the circuit will be required. The estimate to perform this work is **\$2,619,000 in 2009 dollars** with 30 months leadtime.

2. The 01ALBRIG-01KINGWD 138kV line loads from 104.8% to 108.2% (DC power flow) of its emergency rating (176MVA) for the single line contingency outage of the 01BLACKO – 01HATFLD, 500kV line, coupled with the outage of the 01BLACKO 500/138kV transformer

(AP128\_OP). This project contributes approximately 6.1MW to the thermal congestion. To mitigate the Albright – Kingwood 108% overload would require upgrading the circuit by reconductoring 4.00 miles with 954 ACSR and upgrading terminal equipment at Albright and Kingwood SS including disconnects leads, line trap, line risers, relay circuitry, and RTU units. Do to the age of the line it is assumed that a complete rebuild of the circuit will be required. The estimate to perform this work is **\$1,785,000 in 2009 dollars** with 30 months leadtime.

3. The R22COP1-01JUNCTN 138kV line loads from 92.5% to 104.4% (DC power flow) of its emergency rating (201MVA) for the single line contingency outage of the 01ALBRIG – 01SNOW T, 138kV line (APS-SB-78). This project contributes approximately 23.8MW to the thermal congestion. To mitigate the R22 – Junction 104% overload would require upgrading the circuit by reconductoring 12.13 miles with 954 ACSR and upgrading terminal equipment at Junction SS including disconnects leads, line trap, line risers, relay circuitry, and RTU units. Do to the age of the line it is assumed that a complete rebuild of the circuit will be required. The estimate to perform this work is **\$5,228,000 in 2009 dollars** with 30 months leadtime.