

**PJM Generator Interconnection Request
Queue #N07
Monterey 69 KV (38 MW)
Impact Study Report**

January 2006
DMS# 353688v1

Monterey 69 KV Impact Study

General

Highland New Wind Development, LLC (Highland) has proposed a 38 MW wind turbine generating facility to be installed in Highland County, Virginia near the community of Monterey. The Interconnection Customer will interconnect with Allegheny Power (AP) at a new Red Oak Knob 69 kV interconnection switching-station. The generating facilities will consist of 24-1.65 MW wind turbines. The project will inject 38 MW with 20% (7.6 MW) capacity. The requested commercial in-service date for the project was December 1, 2005. PJM is expecting a schedule update from the Interconnection Customer.

The intent of the impact study is to determine cost and construction time estimates of system reinforcements required to facilitate the addition of the new generating plant to the PJM system. The reinforcements include the direct connection of the generator to the system and any network upgrades necessary to maintain the reliability of the PJM system

The estimated total cost to prepare a suitable site, provided by the developer at a location approximately 5.43 circuit miles northwest of Monterey Substation, and to complete all work required to install the facilities required for this interconnection is \$1,004,000 in 2005 dollars. This estimate does not include any tax gross up. Completion of the work herein described will enable the developer (Highland) to install and operate a new generating facility in Allegheny Power's Monterey Service Center. The project will be connected to the Allegheny Power Durbin-Monterey 69 kV line as depicted in Figure No. 1. The scope of work and estimated cost for individual project segments is as follows:

Direct Connection

The generation project will be interconnected to the transmission system at a new Allegheny Power Red Oak Knob 138 kV switching Station on the Durbin – Monterey 69 kV circuit approximately 5.43 circuit miles from the Monterey 69 kV Substation as depicted on Figure No. 1.

The Interconnection Customer (#N07) is responsible for construction of all facilities located at the generator site, including a line terminal with a 3 phase gang operated switch, circuit breaker and 34.5 kV - 69 kV transformer adjacent to Allegheny Power's facilities at the Red Oak Knob switching station. The Interconnection Customer is also responsible for all ROW acquisition, permitting and approval issues for facilities to interconnect to this site. The estimates do not include the impact that delays in obtaining ROW, permits or other approvals may have on the time or cost estimates.

The Transmission Owner's construction scope includes:

Interconnection Point: Construct a new AP Red Oak Knob 69 kV Substation on the Durbin – Monterey 69 kV circuit approximately 5.43 circuit miles from the Mettiki Tap including:

- One 69 kV line terminal.
- Two 69 kV steel bay structures,
- Three group operated 69 kV air-break switches (one load break),
- One 69 kV circuit breaker,
- A control building to house protective relaying, metering and communications equipment, including SCADA RTU facilities.
- A 69 kV Meter and facilities for metering.
- Relaying including dual channel transfer trip scheme.

Estimated cost: **\$655,000 in 2005 dollars**

- Prepare the right of way and construct new facilities required to loop the Durbin-Monterey 69 kV line into the proposed new Roth Rock switching station

Estimated cost: **\$120,000 in 2005 dollars.**

- Protection: Provide design for the protection scheme for primary and backup protection to the Interconnection Customer's breaker terminal. Provide specifications for all relays to be employed on the Interconnection Customer's breaker terminal to assure that the protective relaying equipment will be compatible with that installed on the interconnection breaker terminal at the new switching station. Test and calibrate all relays at the generator interconnection for proper installation and functionality.

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.

Estimated cost: **\$5,000 in 2005 dollars.**

Total Direction Connection costs: **\$780,000 in 2005 dollars.**

Network Upgrades:

- Install dual channel transfer trip between Durbin SS and Red Oak Knob Substation.

Estimated cost: **\$219,000 in 2005 dollars.**

- Perform a relay coordination review of the area facilities, develop and implement new settings.

Estimated cost: **\$5,000 in 2005 dollars.**

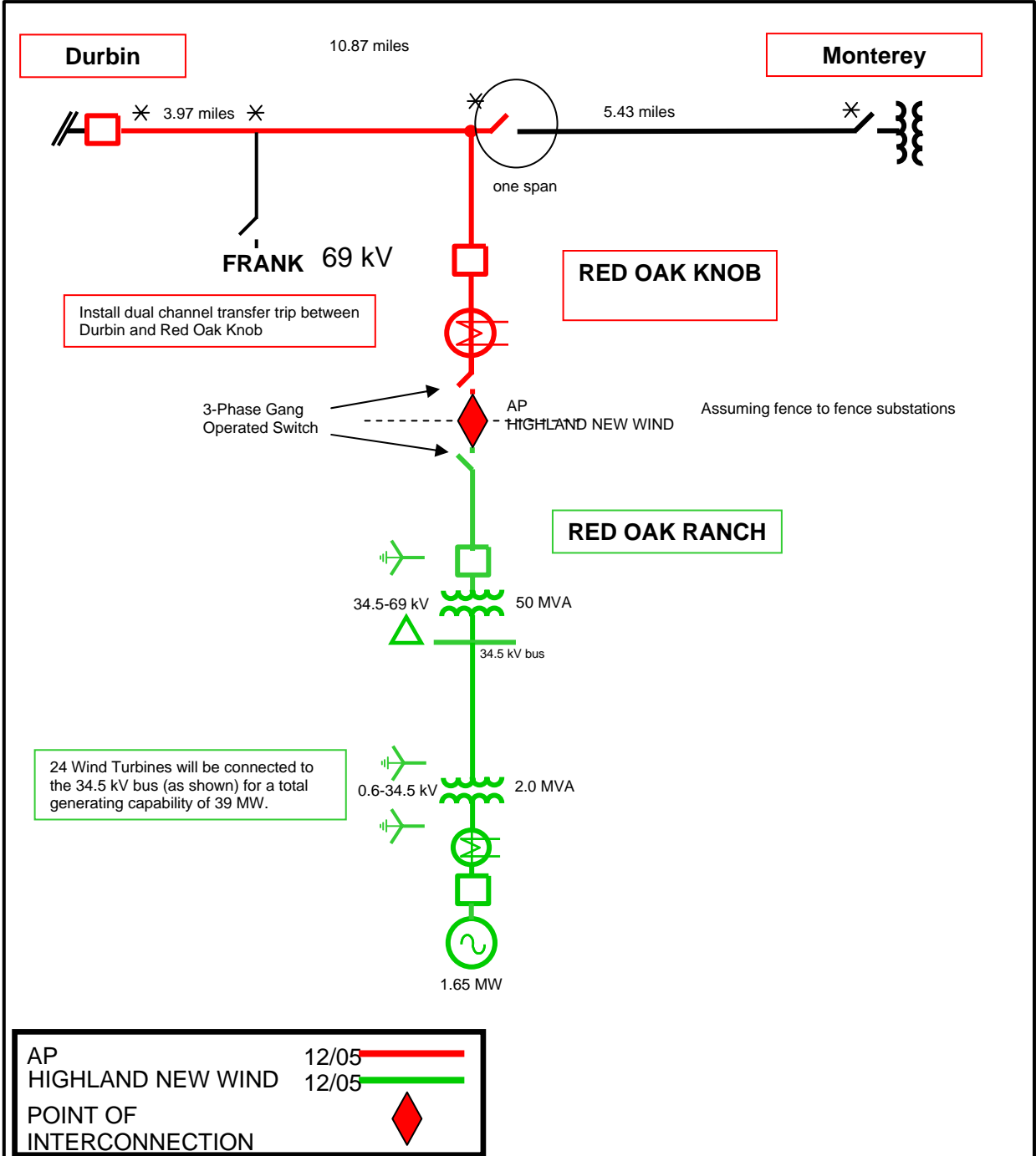
TOTAL COSTS OF NETWORK UPGRADES: \$224,000


COST AND TIMING SUMMARY

Total Estimated Cost for interconnection is **\$1,004,000 in 2005 dollars.**

The construction time for the Allegheny Power facilities is 15 months after the Construction Service Agreement is signed.

Note that the figures above do not include construction of the 69 kV line required to interconnect the customer's proposed new generating facilities with the Allegheny Power Red Oak Knob Substation. Route selection, line design, right-of-way acquisition and construction of such lines will be entirely the responsibility of the interconnection customer.



SOURCE C. Vogel	 Allegheny Power PLAN RED OAK KNOB PROVIDE INTERCONNECTION FACILITIES FOR HIGHLAND NEW WIND NON-UTILITY GENERATION MONTEREY SERVICE CENTER	DRAWN 2-25-05 C. Vogel	PLAN NUMBER
CAD FILE redoakknob.PPT		CHKD	
REVIEWED		SCALE NS	
APPROVED DATE		REVISION	REV

N07 Impact Study Report

Network Impacts:

The #N07 project was studied as a total injection of 38MW (7.6 MW of capacity) into a new switching station on Durbin-Monterey 69 kV circuit. Project #N07 was evaluated for compliance with reliability criteria for summer peak conditions in 2009. Potential network impacts were as follows:

Normal System

No identified problems.

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Single Contingency (ECAR Standard 1)

No identified problems.

Multiple Facility Contingency (ECAR Standard 3)

No identified problems.

Generator Deliverability

No identified problems.

Contribution to Previously Identified Overloads

None.

New System Reinforcements

None.

Contribution to Previously Identified System Reinforcements

None.

Short Circuit

No breaker replacements are required for this interconnection.

Stability (ECAR Stability Criteria)

Stability (ECAR Stability Criteria)

Stability analysis was performed at 2009 summer light load conditions and peak load conditions. The maximum generation output is considered. An 8.76 MVAR shunt capacitor is assumed to be connected to the low side of GSU to achieve a unity power factor at the interconnection point for the base case. The capacitive affect of the 34.5kV cable connecting the wind turbines was not modeled.

The range of contingencies evaluated was limited to that necessary to assess expected compliance with ECAR criteria. Attachment #1 lists the fault cases evaluated.

The 38 MW wind farm at Monterey (N07) is stable for all criteria contingencies at both peak load and light without maintenance outages. It becomes unstable for several of the criteria contingencies (2a) in both peak and light load cases and (2c) in peak case when there is a maintenance outage of Loughs lane-Tallmansville (Case p). Also, with Pickens- French Creek outaged (Case q) contingency (1a) is unstable in both peak and light load cases.

The considered remedial measure is the reduction of N07 MW output. This output needs to be no more than 30 MW for the peak load for case p (Loughs lane- Tallmansville out of service) and case q (Pickens-French Creek out of service) outages in order to stabilize N07 (the light load base case generally shows slightly higher limits).

Note: While the stability analysis has been performed at expected extreme system conditions, there is a potential that evaluation at a different level of generator MW and/or MVAR output at different system load levels and operating conditions would disclose unforeseen stability problems. The regional reliability analysis routinely performed to test all system changes will include one such evaluation. Any problems uncovered in that or other operating or planning studies will need to be resolved.

Moreover, when the proposed generating station is designed and unit specific dynamics data for the turbine generators and its controls are available, and if it is different than the data provided for this study, a transient stability analysis at a variety of expected operating conditions using the more accurate data shall be performed to verify impact on the dynamic performance of the system. As more accurate or unit specific dynamics data for the proposed facility, as well as Plant layout become available, it must be forwarded to PJM.

Attachment #1

N07 (Monterey 69 KV)

2009 Peak and Light Load Stability Faults

BREAKER CLEARING TIMES (CYCLES)

<u>Station</u>	<u>Primary (3ph/slg)</u>	<u>Stuck Breaker (total)</u>	<u>Zone 2 (total)</u>
APS 138 KV	7	21	36

Faults in Red are unstable

All facilities in service

N07-1a 3ph @ Loughs lane 138 kV on Loughs lane- Tallmansville 138 kV line
N07-1b slg @ Loughs lane 138 kV on Loughs lane- Tallmansville 138 kV line, BF @ Loughs lane
N07-1c slg @ 80% of Loughs lane-Tallmansville 138 kV line, zone 2 clearing from Loughs lane

N07-2a 3ph @ Loughs lane 138 kV on Loughs lane- Pruntytown 138 kV line
N07-2c slg @ 80% of Loughs lane-Pruntytown 138 kV line, zone 2 clearing from Loughs lane

N07-3a 3ph @ Loughs lane 138 kV on Loughs lane- William 138 kV line
N07-3b slg @ Loughs lane 138 kV on Loughs lane- William 138 kV line, BF @ Loughs lane
N07-3c slg @ 80% of Loughs lane- William 138 kV line, zone 2 clearing from Loughs lane

N07-4a 3ph @ Pickens 138 kV on Pickens- Crupperneck 138 kV line
N07-4c slg @ 80% of Pickens-Crupperneck 138 kV line, zone 2 clearing from Pickens

N07-5a 3ph @ Pickens 138 kV on Pickens- French Creek 138 kV line
N07-5c slg @ 80% of Pickens- French Creek 138 kV line, zone 2 clearing from Pickens

N07p-2a Same as N07-2a with Loughs lane- Tallmansville out of service

N07p-2c Same as N07-2c with Loughs lane- Tallmansville out of service

N07p-3a Same as N07-3a with Loughs lane- Tallmansville out of service

N07p-3b Same as N07-3b with Loughs lane- Tallmansville out of service

N07p-3c Same as N07-3c with Loughs lane- Tallmansville out of service

N07p-4a Same as N07-4a with Loughs lane- Tallmansville out of service

N07p-4c Same as N07-4c with Loughs lane- Tallmansville out of service

N07p-5a Same as N07-5a with Loughs lane- Tallmansville out of service

N07p-5c Same as N07-5c with Loughs lane- Tallmansville out of service

N07q-1a Same as N07-1a with Pickens-French Creek out of service

N07q-1b Same as N07-1b with Pickens-French Creek out of service
N07q-1c Same as N07-1c with Pickens-French Creek out of service

N07q-2a Same as N07-2a with Pickens-French Creek out of service
N07q-2c Same as N07-2c with Pickens-French Creek out of service

N07q-3a Same as N07-3a with Pickens-French Creek out of service
N07q-3b Same as N07-3b with Pickens-French Creek out of service
N07q-3c Same as N07-3c with Pickens-French Creek out of service

N07q-4a Same as N07-4a with Pickens-French Creek out of service
N07q-4c Same as N07-4c with Pickens-French Creek out of service