PJM Generator Interconnection Request Queue #M02 Jenkins-Harwood #2(Mountain Top) 69kV Feasibility/Impact Study Report

January 2005
300530

Confidential

Jenkins-Harwood #2 (Mountain Top) 69 kV Feasibility Study

General

Pennsylvania Windpower, Inc. (Energy Unlimited, Inc.) has proposed an 8.1 MW increase at its new, to be constructed, 42.9 MW generating facility called Mountain Top. Total capacity will become 51.0 MW. The facility has been redesigned to consist of thirty-four (34) wind turbines, each rated 1500 kW. The wind park will be installed in Bear Creek Township, Luzerne County, Pennsylvania. Pennsylvania Windpower (PWI/EUI) has proposed an in-service date of December 31, 2005 for the project and the increased generation capability.

Millennium Power, Inc. (MPI) is representing Pennsylvania Windpower, Inc. and Energy Unlimited, Inc. in presenting this project to PJM. The project has been evaluated as an "Energy Only" resource for an output capability of 51.0 MW and as a "Capacity" resource for 20% (10.2 MW) of its capability.

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

Direct Connection

For this latest increase in generation capacity under M02, the direct connection facilities will be of sufficient capability to permit an additional 8.1 MW of generation, resulting in 51.0 MW of generation from Mountain Top project. These direct connection facilities are the proposed Harwood-Jenkins #2 tap into the Mountain Top IPP substation and the surrounding PPL EU 69 kV system.

Transmission Portion: No system reinforcement required.

Substation Portion: No system reinforcement required.

Scope of PPL Electric Utilities Corp. Work

- **Direct Connection Work – Transmission:** No system reinforcement required.
  - Cost Estimate: **$0**

The estimated transmission costs, including applicable PA sales tax, are: **$0**

- **Direct Connection Work – Substation:** No system reinforcement required.

- Cost Estimate: **$0**

The estimated substation costs, including applicable PA sales tax, are **$0**

The total cost for the direct connection of this IPP, including PA sales tax, is estimated to be **$0.**

Note that under queue L07, this wind park will be connected to the Harwood--Jenkins #2 69 kV line, supplied by Jenkins, near transmission structure 52398-N-38119 via a tap to a customer-owned IPP substation. See Figure #1 below. Under queue L07, cost estimates were prepared for the transmission tap and modifications to the relay & control schemes at four substations so that the wind park could be interconnected to the PPL EU 69 kV system.

MPI, representing PWI/EUI, had decided that an alternate outlet for the wind park generation via the Georgetown Tap #2, would not be required.

Changes to the PPL EU system in the future that require facilities to accommodate the generation project will be charged to the generation project at that time. Examples of such changes would include, but are not limited to, conversion to 138 kV operation or rearrangement of the sectionalizing locations.

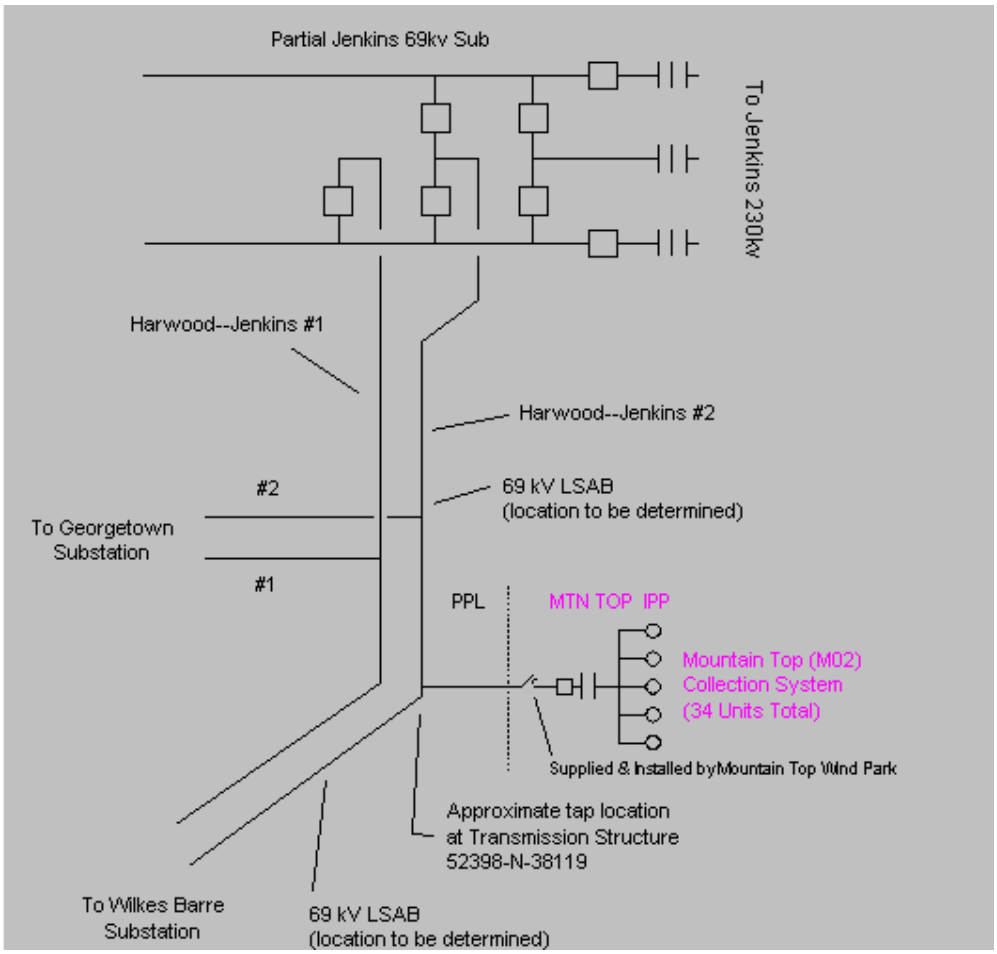
Regulation Requirements of the Generation Project

Mountain Top IPP will use induction machines to produce electrical power. Depending upon the design of the collector system for the generation at the wind park facility, self-excitation of the induction machines may be possible. If self-excitation is determined to be a concern, protection requirements as well as the circuit breakers used by the IPP wind park to isolate its system from the PPL EU transmission system may change significantly during the PJM Facilities Study (engineering detailed design). These changes may include the stipulation that Mountain Top IPP must purchase circuit breakers rated twice the nominal phase-to-phase voltage for the intertie 69 kV CB and the low side 34.5 kV CB.

In order to eliminate significant voltage deviation, Mountain Top project will need to operate at approximately a 95.9% leading power factor (generator absorbing VARs) at the 69 kV point of connection. The power factor calculation was based upon the wind park using a single 30/40/50 MVA, 69-34.5 kV power transformer with an impedance of 8.0% and and an X/R ratio of 10. The project may be required to install automatically controlled shunt reactors to reduce the voltage change and to achieve the above leading mode of operation. Load Flow Studies indicate that at maximum 51.0 MW output with 3.5 MVAR of 34.5 kV cable reactance connected to the generator bus, the Mountain Top wind park will be required to absorb approximately 14.9 MVAR from the PPL EU system, as measured at the 69 kV intertie connection point. The intertie transformer will absorb some of the MVAR. Mountain Top wind park must ensure that they have the

capability to absorb the remainder and hold a 95.9% power factor as measured on the 69 kV side of the interconnection transformer over the entire MW output range.

Figure #1



Network Impacts

The M02 project was evaluated as an additional 8.1 MW injection to the L07 project resulting in an overall 51.0 MW injection at the Jenkins 230/69 kV substation, consisting of 10.2 MW of capacity and the remainder of the capability as "Energy-only". Project M02 was evaluated for compliance with reliability criteria for winter and summer peak conditions in 2008. Potential network impacts were as follows:

Normal System

No identified problems.

Single Contingency (MAAC Criteria IIA)
No identified problems.

Second Contingency (MAAC Criteria IIB)
No identified problems.

Multiple Facility Contingency (MAAC Criteria IIC)
No identified problems.

Generator Deliverability
No identified problems.

Stability (MAAC Criteria IV)
Stability analysis was performed at 2008 light load conditions and for maximum generation output for the proposed project**.** The facility was modeled at a 0.959 leading power factor at the interconnection point for base case. The modeling did not include any capacitive affect of the 34.5kV cable connecting the wind turbine units. See Attachment #1 for the fault cases evaluated. The range of contingencies evaluated was limited to that necessary to assess expected compliance with MAAC Stability criteria.

No stability problem was identified.

Note: While the stability analysis has been performed at expected extreme system conditions, there is a potential that evaluation at different level of generator MW and/or MVAR output at different 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 this 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 becomes available, it must be forwarded to PJM.

CETO/CETL (MAAC Criteria III / VIIB)
No identified problems.

Short Circuit Analysis
No identified problems. The three-phase duty at the 69 kV intertie connection point, based on the assumptions listed above, will be 1039 MVA, symmetrical

System Reinforcements and Cost Allocation

None.

Thermal overload conditions and the Northeast PA Stability Limit interface will be monitored by PJM and PPL. If the Jenkins LMP bus price computed by PJM falls below the developer bid price of the units, the units will be curtailed at the request of PJM operations control room. Since these are unmanned units, the PPL Electric Utilities control room will then issue a SCADA control signal via telephone line to disconnect the units.

Attachment #1

M02
2008 Light Load Stability Faults

BREAKER CLEARING TIMES (CYCLES)

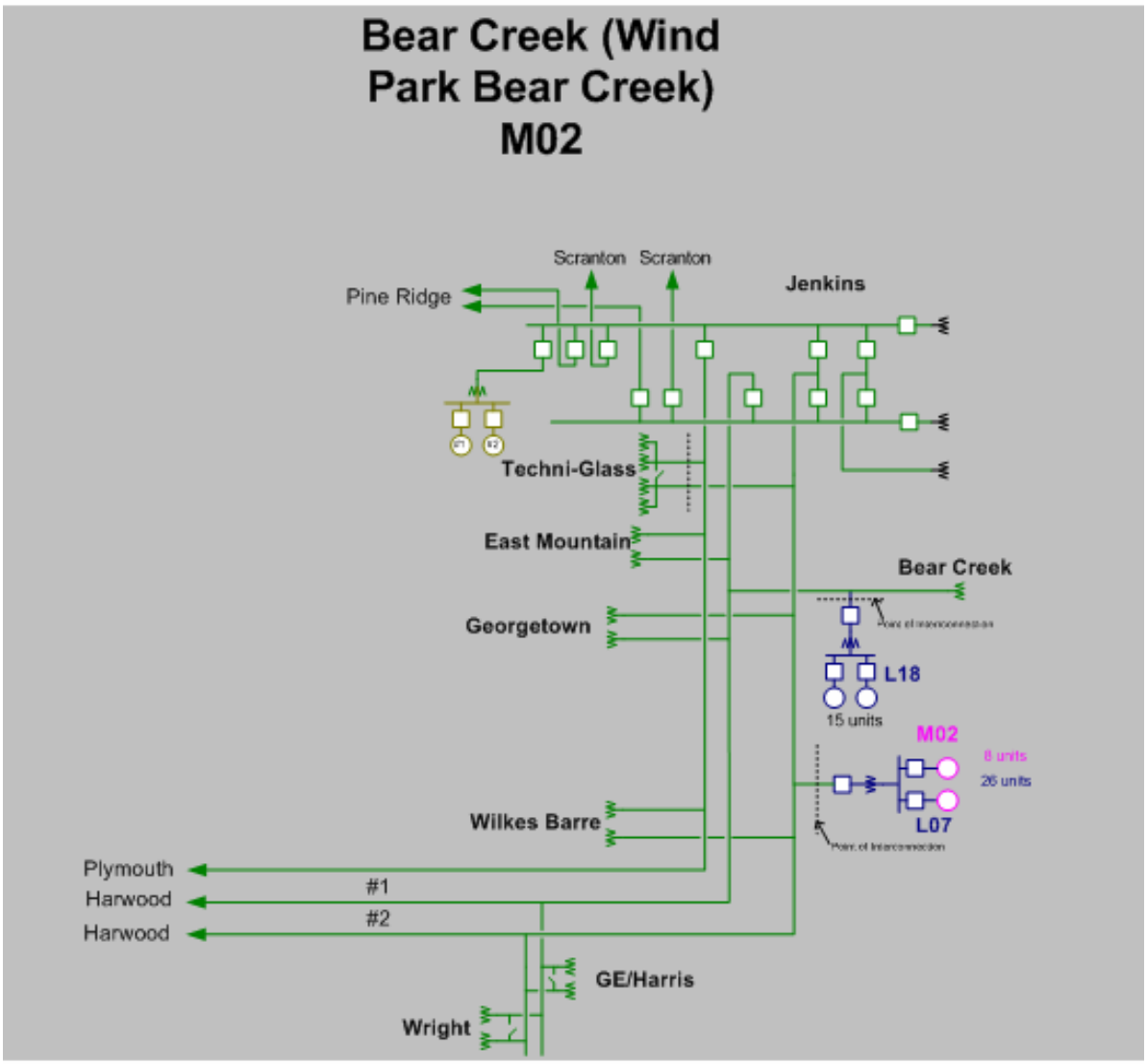
Station	Primary (3ph/slg)	Stuck Breaker (total)	Zone 2 (total)
JENKINS 69 kV	12	60	60
JENKINS 230kV	8	17	--

All cases are stable
All facilities in service

L18-1a	3ph @Jenkins on Jenkins-Scranton_2 69kV line
L18-1b	sgl @ Jenkins on Jenkins-Scranton_2 69kV line, BF@Jenkins breaker
L18-1c	sgl @80% of Jenkins-Scranton_2 69kV line Jenkins, zone II clear the fault
L18-2a	3ph @ Jenkins on Jenkins 69/230 transformer 1
L18-2b	slg @ Jenkins on Jenkins 69/230 transformer 1, BF @Jenkins breaker
L18-3a	3ph @ Jenkins on Jenkins 69/230 transformer 4
L18-3b	slg @ Jenkins on Jenkins 69/230 transformer 4, BF @Jenkins breaker1

P (with Jenkins 69/230KV Transformer 2 out of service)

P-L18-1a	3ph @Jenkins on Jenkins-Scranton_2 69kV line
P-L18-1b	sgl @ Jenkins on Jenkins-Scranton_2 69kV line, BF@Jenkins breaker
P-L18-1c	sgl @80% of Jenkins-Scranton_2 69kV line Jenkins, zone II clear the fault
P-L18-2a	3ph @ Jenkins on Jenkins 69/230 transformer 1
P-L18-2b	slg @ Jenkins on Jenkins 69/230 transformer 1, BF @Jenkins breaker
P-L18-3a	3ph @ Jenkins on Jenkins 69/230 transformer 4


Bear Creek (Wind Park Bear Creek) M02
Scranton
Scranton
Jenkins
Pine Ridge
Techni-Glass
East Mountain
Bear Creek
Georgetown
L18
15 units
M02
8 units
26 units
L07
Wilkes Barre
Plymouth
Harwood
#1
Harwood
#2
GE/Harris
Wright