

Large Generator Interconnection System Impact Re-Study Report

For

Q0026

Lincoln County, Wyoming

Prepared by: PacifiCorp

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Generation Interconnection System Impact Re-Study Report

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I. Project Description

Q0026 (“Interconnection Customer”) plans to interconnect a 300 MW wind farm in Lincoln County, Wyoming, in the vicinity of Township 20 N, Range 117 W for commercial operation on July 1, 2006 (“Project”). The initial point of interconnection studied was to be approximately 8.25 line miles from Naughton on the Naughton-Ben Lomond 230 kV right-of-way. The study results were described in an impact report dated March 10, 2004. Interconnection Customer subsequently requested a re-study of the facility with a new point of interconnection on the Naughton-Birch Creek 230 kV line. This line is adjacent to PacifiCorp’s (“Transmission Provider”) Naughton-Ben Lomond line in the vicinity of Interconnection Customer’s Project. The Point of Interconnection on the new line segment will also be approximately 8.25 line miles from Naughton.

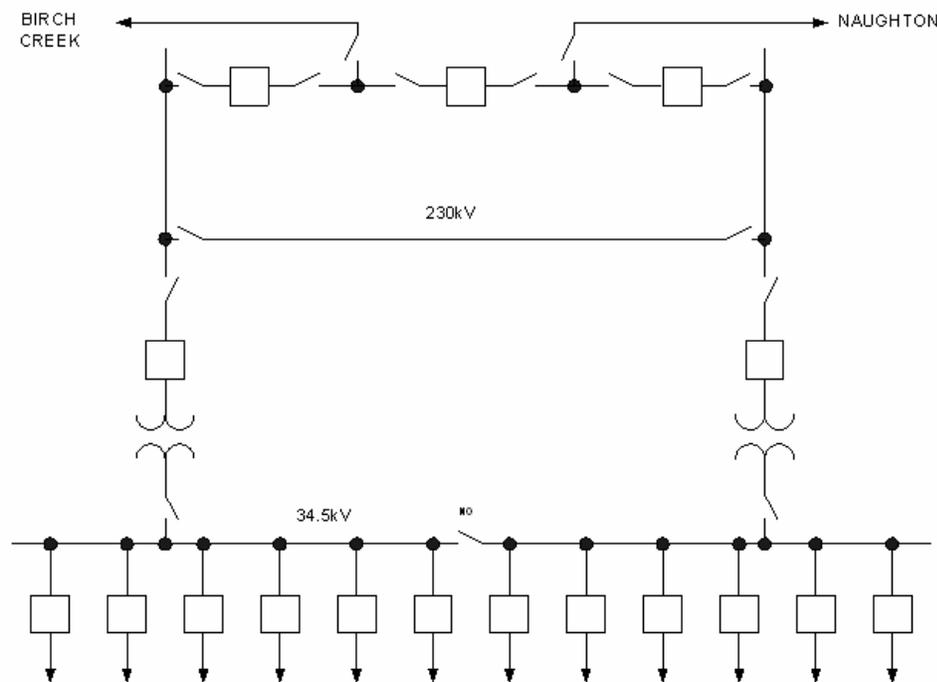
The wind farm will use two step-up transformers, each with six wind turbine-generator feeders. At Interconnection Customer’s request, the study assumed that GE 1.5 MW wind turbines would be used. The wind farm collector system and step-up transformers will be located in the vicinity of the existing transmission right-of-way.

II. Study Objective

The objective of the Generation Interconnection System Impact Study Report is to provide a high level definition of system modifications and additions required for generation interconnection. Design detail, schedule and costs will be dealt with next, in the Facilities Study. The scope of the modifications for this Interconnection Impact Study does not include modifications required to deliver power beyond the point of interconnection. Such modifications are considered in a Transmission Service Impact Study.

III. Study Results**A. Modifications and Additions to Facilities at Transmission Provider’s Interconnection Location**

The following is one line diagram of the switching station that will be needed at the plant interconnection.



A three breaker ring bus 230V switching station would be built near the existing Naughton – Birch Creek 230kV line. The two step-up transformers for the generation facility will be connected through individual breakers but tied to the same position on the ring bus. Each of the 230kV line sections will be protected with communication dependent relay systems. To provide the communication needed for the transmission line protection, SCADA, and remote metering a digital communication system will be installed between the new switching station and Naughton Substation. There is an existing microwave system between Naughton, Birch Creek and back to the dispatch centers where the control and monitoring signals from the new switching station will need to be delivered to and sent from. All of the communication system except for the last hop into Naughton (from Naughton to Quealy) the whole path is digital. That one hop of microwave will be replaced with digital microwave which will simplify and reduce the cost of the line protection.

An RTU will be installed at the new switching station. It will receive data from the switchyard and the wind farm and deliver it to Transmission Provider's Control Center.

The switch yard ground mat and the ground mat under the collection substation will be adequately tied together so that during ground faults the two yards will be at the same potential. By tying the ground mats together control cables can be used to supply ac and dc signals for protection and controls between the two yards. The 230V tie lines between the generation facility collector substation and the switchyard will be protected with conventional bus relays.

B. Other Modifications to Existing Facilities

1. Short Circuit Analysis

A fault analysis was performed using the computer software Aspen. 200 GE 1.5 MW wind turbines connect through the 34.5kV collector system and two 230-34.5kV transformers were added to the latest Aspen One-liner Base Case. The 34.5kV collector system was modeled using the information supplied by the developer. The two 160 MVA transformers are 8.5% impedance on the OA base. The switching station was located in the Birch Creek – Naughton 230kV line 6 miles from Naughton.

Classical faults were simulated at several key locations. These faults were simulated to determine if the existing breakers had sufficient interrupting capacity. The following table lists the in fault duty on buses in the vicinity of the new generation facility.

Interconnection Customer Generation Addition		
Substation Bus	3 phase fault	Single line to ground fault
Naughton 230kV	15,912	18,646
Ben Lomond 230kV	17,433	17,533
Ben Lomond 345kV	13,110	12,053

The study did not show that any circuit breakers would need to be replaced due to increased fault duty due to the addition of the generation facility.

2. Protection & Controls

The line relays at Naughton and Birch Creek on the Naughton – Birch Creek 230kV line will need to be reconfigured but will not need to be replaced as a result of the addition of the new switching station. The new configuration of the existing relays will use a direct digital interface with the digital communication system which will simplify and reduce the cost for the line protection systems on these lines.

Communications

A fiber optics OPGW (optical ground wire) is to be installed between the new substation and Naughton substation on the existing line. Also to be included is the accompanying end and channel equipment. In addition their 2 existing microwave hops from Naughton substation to Quealy Peak and Quealy to Birch Creek needs to be upgraded to digital. This gives mirrored bit protection for the line between Birch Creek and the new substation. There would be several new channels installed for SCADA, line protection and metering at the new substation.

IV. Potential Third Parties Impacted

None anticipated, however this report will be shared with Idaho Power.

V. Possible Additional Studies Required

When a transmission service request is received by either the Interconnection Customer, or its agent, Transmission Provider will conduct power flow and transient stability analyses. These studies will model details of the wind farm distribution system and wind turbines. The Interconnection Customer is responsible for providing the data for these models, including wind turbine models in PTI format, if these models are not already available to Transmission Provider. These studies may show that additional modifications are required to the Interconnection Customer's wind farm. The Interconnection Customer will be responsible for these additional modifications.

VI. Exclusions/Disclaimers

The impacts and modifications discussed in this Report are those required to interconnect the generating facilities to Transmission Provider's transmission system. They may not be sufficient to deliver power beyond the point of interconnection. As soon as Transmission Provider receives a request for transmission service from the Interconnection Customer, or its agent, Transmission Provider will conduct a further study to determine if additional modifications are required to deliver power beyond the point of interconnection.

VII. Conclusions and Recommendations

- A new switching station, consisting of a three breaker ring bus will be built adjacent to the existing 230 kV transmission right-of-way from Naughton to Birch Creek. There are two circuits on this path. The circuit from Naughton to Birch Creek will be looped into the new switchyard. Each step-up transformer will be protected with a high side breaker, and connected to the switchyard at the same position in the ring bus. The new switchyard should be located adjacent to the Naughton to Birch Creek line to avoid crossing under the Naughton-Ben Lomand line with a 230 kV tap line.

- Fault studies show that all the Transmission Provider equipment is adequate to handle the increased short circuit duty from the due to the new generation.
- An RTU will be installed at the new switching station, and a distributed RTU at the generating facility's substation.
- The switchyard ground mat and the ground mat under the wind farm substation will be tied together. Control cables will be used to supply ac and dc signals for protection and controls between the two yards.
- Line relays will be replaced at Naughton and Birch Creek for the Naughton-Birch Creek 230 kV line terminals.
- An optical ground wire will be installed between the new switchyard and the Naughton Substation. A digital switching station will be installed between the new switching station and the existing Naughton Substation. The communication hop from Naughton to Quealy will be replaced with digital microwave.
- The Interconnection Customer has not yet provided its reactive compensation (34.5 kV shunt capacitor banks) design. Transmission Provider will need same prior to conducting its transmission service studies discussed under V. Additionally, the Interconnection Customer must provide Transmission Provider with wind turbine models in PTI format, compatible with its PTI software, if acceptable models are not available to Transmission Provider.
- The wind farm must be designed so it is capable of delivering unity power factor at the Point of Interconnection at all times, except when the operating voltage of Transmission Provider's system is abnormally high. Under such high voltage conditions, the wind farm should operate under voltage control. Additionally, the wind farm's operation should not cause abrupt voltage changes on Transmission Provider's system greater than +/- 3%.