PACIFICORP
A MIDAMERICAN ENERGY HOLDINGS COMPANY

Small Generator Interconnection
System Impact Study Report

Completed for

("Interconnection Customer")
A Qualifying Facility (QF)

Proposed Interconnection
20.8 kV Peoria Circuit, 4M133
out of Buchanan Substation

June 3, 2008

1.0 DESCRIPTION OF THE GENERATING FACILITY

("Interconnection Customer") is installing a biogas generation facility located at 3122 Stahlbush Island Road, in Benton County, Oregon. The biogas generation facility will be comprised of a 1.6 MW synchronous generator. The generation facility will be interconnected to PacifiCorp's ("Transmission Provider") 20.8 kV Peoria Circuit, 4M133, out of the Buchanan Substation.

Interconnection Customer will operate this generator as a Qualified Facility as defined by the Public Utility Regulatory Policies Act of 1978 (PURPA).

2.0 SCOPE OF THE STUDY

The System Impact Study Report shall consist of a short circuit analysis, a stability analysis, a power flow analysis, voltage drop and flicker studies, protection and set point coordination studies, and grounding reviews, as necessary. The System Impact Study shall state the assumptions upon which it is based, state the results of the analyses, and provide the requirement or potential impediments to providing the requested interconnection service, including a preliminary indication of the cost and length of time that would be necessary to correct any problems identified in those analyses and implement the interconnection. The System Impact Study shall provide a list of facilities that are required as a result of the Interconnection Request and non-binding good faith estimates of cost responsibility and time to construct.

3.0 DESCRIPTION OF PROPOSED INTERCONNECTION

Figure 1, located in Appendix A, represents a one-line diagram that illustrates the proposed interconnection.

4.0 ASSUMPTIONS & RESULTS

4.1 STUDY ASSUMPTIONS

The generator is expected to operate 24 hours a day and seven days a week. The primary meter (point of interconnection) power factor range studied was 80% leading and 80% lagging.

Seven case studies were assembled and studied:

1. Base case full load;
2. Base case with 2000 kVA generation at 80% power factor;
3. 30% of base case full load;
4. 30% of base case with 2000 kVA generation at 80% power factor;
5. 15% of base case full load;
6. 15% of base case with 2000 kVA generation at 80% power factor; and

7. 15% of base case with 2000 kVA generation at 80% power factor.

4.2 RESULTS

It has been determined that the addition of Interconnection Customer's proposed generation facility to Transmission Provider's distribution system will operate satisfactorily with management of the protection and control issues that arise with the addition of the generation facility to this point in the distribution system. Power factor may be an issue. The residual VARs from the generation facility will require addition of 1200 kVA switched capacitors as one bank or as two staged banks.

5.0 REQUIREMENTS

5.1 GENERATING FACILITY MODIFICATIONS

The Transmission Providers 20.8 kV system is a four wire multi-grounded neutral system. To provide a neutral reference in the event that the generation facility becomes isolated with the Transmission Provider's customers' load the step-up transformer at the facility must have a wye winding on the 20.8 kV side with the neutral solidly grounded and a delta winding on the 480 V side.

5.2 DISTRIBUTION MODIFICATIONS

Fuses at the Peoria Road tap to Q0176 must be replaced with a recloser providing hot-line block protection as the generation approaches matching the loads at Q0176. Addition of one switched 1200 kVA capacitor bank or two switched 600 kVAR capacitor banks will off-set the 1200 kVAs predicted to be consumed by the generator.

5.3 EXISTING BREAKER MODIFICATIONS – SHORT-CIRCUIT

The increase in the fault duty on the system as a result of the addition of the generation facility with the 1600 kW generator connected to the distribution system through a 2 MVA transformer with 5.75% impedance will not require the replacement of any of the existing fault interrupting devices.

5.4 PROTECTION REQUIREMENTS

Figure 1 illustrates how the generation facility will be connected to the 20.8 kV distribution feeder out of Buchanan Substation. The generator needs to disconnect from the system any time that the breaker 4M133 at Buchanan Sub, or the new line recloser (which replaces the existing line fuses) are opened due to a problem on the feeder.

To accomplish this; the protective relays at the generation facility will be set to trip the generator breaker high speed for any faults on the feeder. To ensure that the generation facility's protection will respond to all fault conditions on the feeder, the relays will also

respond to some faults on the other 20.8 kV feeders lines fed out of Buchanan Substation. The consequences of having the protection operating this way is that the generation facility will be interrupted for fault events that the facility would not need to be disconnected if a more coordinated protection could be applied. The alternative to this arrangement is to install a transfer trip circuit between Buchanan Sub, the line recloser, and the generation facility. The 20.8 kV breaker at the generation facility would then be tripped by this communication circuit any time the Buchanan breaker or the line reclosers operate. The protective relays at the generation facility would be set in a time delay backup mode of operation thus keeping the generation on line the maximum amount of time. Because of the length of the feeder from Buchanan Sub to the generation facility and the need for the line recloser; the addition of communication to support the transfer trip does not seem practical so it will be assumed that the Interconnection Customer will prefer to implement the system without the transfer trip. This can be changed at the Interconnection Customer's request.

As noted earlier a three phase fault interrupting device will need to be installed on the high-side of the step-up transformer at the generation facility. The fault interrupting device can be either a circuit breaker or a circuit recloser.

The Transmission Provider will design a protective relay application for the protection of the Transmission Provider's system that will be installed at the generation facility. In this protection package is a relay designed to detect faults on the 20.8 kV feeder that connects the generation to Buchanan Substation. This relay will be connected to current transformers on the 20.8 kV breaker and voltage transformers on the 20.8 kV line. For line faults detected on the 20.8 kV system the 20.8 kV breaker will be tripped. Functions in the relays will be set to operate for faults in the step-up transformer and for detecting loss of phase events on the Transmission Provider's system.

Also installed in this facility will be a relay that monitors the voltage magnitude and frequency at the generation location. If the magnitude or frequency of the voltage is outside of normal range of operation the 20.8 kV breaker at the generation facility will need to be tripped.

At Buchanan Sub on 4M133, and on the new line recloser, hot line blocking of the automatic reclosing of those devices will need to be added. The hot line blocking is to prevent the inadvertent automatic reclosing of those fault interrupting devices when the generator is operating and due to some failure of the protection system the generation facility does not get disconnected in a timely matter. With the hot line blocking the automatic reclosing is delayed until the line is no longer energized. At Buchanan Sub on 4M133 three single phase 20.8 kV voltage transformers and a voltage relay will need to be installed to provide the hot line blocking of the reclosing relay. The new recloser in the feeder line will be ordered with the hot line blocking of the reclose.

The protective relay on the new line recloser on the Peoria feeder will need to have directional overcurrent functions to prevent the recloser from opening on faults on the

other feeders out of Buchanan Sub due to the fault current produced by the generation facility.

All of the protective relaying that has been noted in this report is for the protection and safe, reliable operation of the transmission facility. Additional relaying is needed for detecting problems in the generation facility. The relaying for the generation facility is the responsibility of the Interconnection Customer.

5.5 DATA REQUIREMENTS (RTU)

Due to the size of the generation facility an RTU is not required.

5.6 COMMUNICATION REQUIREMENTS

For Line Protection

No communications for line protection required.

For Data Delivery to the Control Centers

A land line will need to be installed to provide dial-up access to the generation facility's metering point for meter interrogation. This circuit is to be procured and installed by the Interconnection Customer. No other communication related additions are needed unless the Interconnection Customer determines that they would like to proceed with the transfer trip options discussed in section 5.4.

5.7 SUBSTATION REQUIREMENTS

Adding hot line blocking to 4M133 will require the installation of three (3), 20.8kV single phase voltage transformers (Ritz VEF 25-10) and associated 12/C cable. The feeder structure will be modified to allow mounting of the new VTs.

5.8 METERING REQUIREMENTS

The Transmission Provider will procure and install a revenue grade, bi-directional meter at the change of ownership. This meter will measure MW and MVAR quantities for generation received from the customer as well as any customer load delivered. A data quality phone line will be installed so the Transmission Providers MV-90 data acquisition system can download metering data. The current transformers will be dedicated solely for metering, and must be 0.15% metering accuracy. The potential transformers will be wye connected and 0.3% metering accuracy. A digital or analog signal output signal from the meter may be provided to the customer, but must be requested before materials are procured.

In the event that the Interconnection Customer provides its parasitic loads for the generator from any other point other than the generator bus; an additional metering point

will be required to measure the energy usage of these auxiliary loads. An approved EUSERC socket will be installed according to the Transmission Provider's Electric Service Requirements. Control cable must be installed between the auxiliary meter and the bi-directional meter. Energy pulses will be sent to the bi-directional meter to determine a net generation quantity.

6.0 COST ESTIMATE

The following estimate represents only scopes of work that will be performed by the Distribution Provider. Costs for any work being performed by the Interconnection Customer are not included.

Distribution Line		$ 50,000
Distribution Metering		$ 50,000
Q0176 Gen Site	$ 68,400	
Buchanan Substation		$ 54,400
Total Project		**$ 222,800**

Note: Costs for all excavation, duct installation and easements shall be borne by the Interconnection Customer and are not included in this estimate. This estimate is as accurate as possibly given the level of detailed study that has been completed to date and approximates the costs incurred by PacifiCorp to interconnecting this generator to PacifiCorp's electrical distribution system. A more detailed estimate is calculated during the Facilities Study. The Interconnection Customer will be responsible for all actual costs, regardless of the estimated costs communicated to or approved by the Interconnection Customer.

7.0 SCHEDULE

At this time, it is estimated that the upgrades required to place this project in service could be completed within six to nine months of a signed interconnection agreement. Further details regarding the schedule will be available through the Facilities Study when a more detailed estimate has been prepared.

8.0 PARTICIPATION BY AFFECTED SYSTEMS

No Affected Systems were identified in relation to this Interconnection Request.

9.0 APPENDICES

Appendix A: Simplified System Oneline

APPENDIX A: SIMPLIFIED SYSTEM ONELINE