PACIFICORP

Generation Interconnection
System Impact Study
Report

Completed for
Q0053

Proposed Interconnection
In Douglas County, Oregon

August 31, 2005

1.0 Description of the Generating Facility

Q0053 ("Interconnection Customer") is installing a steam turbine generator driven by steam supplied from a hog fuel fired boiler located in Winchester, Oregon ("Project"). The generator is a synchronous 13.2kV machine rated 7813kVA producing 6.25MW connected through a 115 – 13.2kV wye ground – delta 9375kVA transformer to a 115kV radial transmission line. The radial line will tap the existing PacifiCorp ("Transmission Provider") 115kV Line 66 between Winchester and Oakland Substations 0.5 miles from the Winchester Substation.

2.0 Scope & Objectives of the Study

The objective of the System Impact Study report is to review the proposed interconnection project, complete transmission system studies, and provide a high-level definition of system modifications and additions required for the reconfigured interconnection.

3.0 Existing Facilities at Transmission Provider's Interconnection Location

A 115kV loop system making up 41.8 miles of transmission lines feeds the area substations from Dixonville Substation. This loop is normally operated open with the normally open point at Winchester Substation on the line section to Oakland Substation. Both sections of the loop are connected to the 115kV bus at Dixonville Substation through 115kV circuit breakers. Figure 1 is a one-line diagram showing the existing 115kV loop and the connection of the new generation facility. The new generation would normally be on the northern section of the loop.

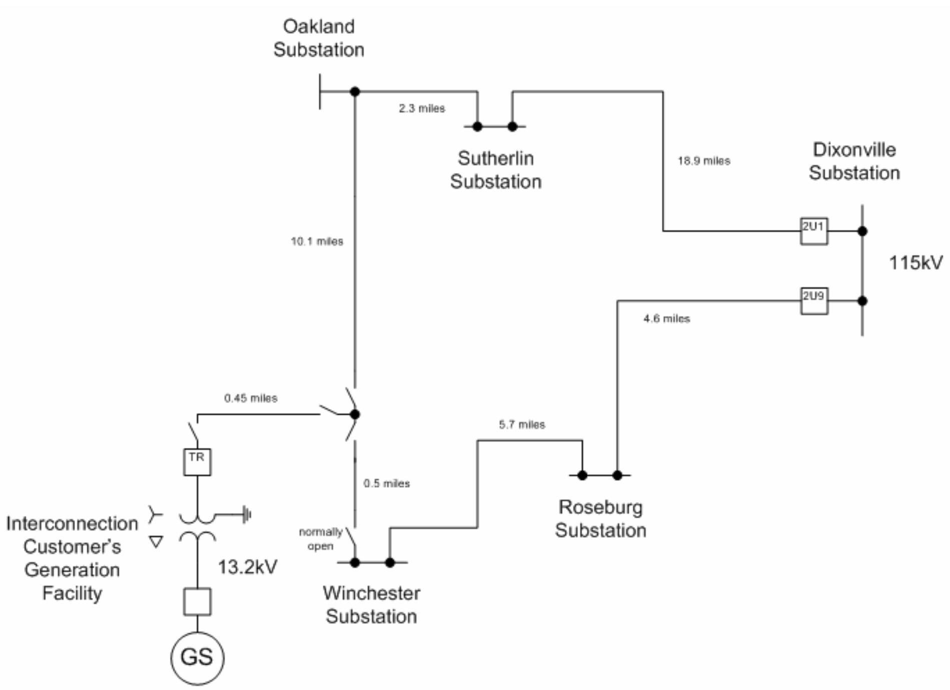


***Figure 1**: One-line diagram showing the existing transmission system and the connection of the Interconnection Customer's Generation Facility*

4.0 System Impact Study Results

4.1 Steady State Power Flow Analysis

The proposed 115 kV tap line, step-up substation, and generator were modeled using power flow software, and a number of generation, load level, and system configuration scenarios were analyzed. Based on the results of this analysis, the existing transmission system will not require alteration for system normal or contingency configurations. All system loading and voltage level quantities remain well within operating standards for all analyzed conditions with the generator interconnected. The generation should be able to operate at 6.25 MW output with a unity power factor as delivered at the 115 kV bus of the step-up substation with bus voltages within normal operating range.

A loop opening analysis was performed to determine if the addition of the generation would require alteration of switch attachments. The results of this analysis indicate that no changes are needed due to addition of the generation.

Energy losses on the transmission tap between the generator step up substation and the proposed tap point on Line 66 are estimated to be about 150 watts, with the generator output at 6.25 MW.

4.2 Generator Trip Analysis

An analysis was run to calculate the impact of a sudden transition from full generation output to no generation, simulating a generator trip condition. For the worst case system configuration, the power flow results indicate that the 115 kV voltage change at the 115 kV generator bus would be less than 0.7% based on generation of 6.25 MW at unity power factor. This is well within tolerance, indicating no system modifications are required for a generator trip.

4.3 System Stability Analysis

The machine characteristics and capabilities were examined relative to the existing Transmission Provider system, and it was determined that the machine size is such that it would have no measurable affect on system stability. Should islanding occur, the standard under and over voltage, and under and over frequency relaying required for this project would prevent a stability problem by rapidly disconnecting the Interconnection Customers generation from Transmission Provider’s transmission system.

4.4 Transmission System Reliability Review

This information was requested by Interconnection Customer.

Over the past five years there have been 17 momentary or sustained events that resulted in an unscheduled line outage for the six transmission lines connected to Dixonville Substation, with nine of the events occurring in 2001, probably due to weather. Two of the events directly affected the line proposed for the Interconnection Customer's interconnection. Six additional outages on other lines had a significant risk of being detected by simple relaying at the Interconnection Customer's project and nine events would not likely have been detected because the fault occurred at a considerable distance from Dixonville substation.

For a period of 2002 through present, one outage occurred on the line proposed for the interconnection, and two other outages had a significant risk of resulting in a generator trip. It should be noted that future events are not necessarily predictable by past performance.

4.5 Fault Duty

The increase in the fault duty as a result of the addition of the generation facility does not cause existing equipment in the vicinity to be overdutied.

4.6 Configuration at the Tap Point on the Existing Line

The recommended interconnection point with the Transmission Provider's system is at a location on 115 kV Line 66 approximately ½ mile north of Winchester Substation on the east side if the Interstate 5 Freeway. Transmission Provider will construct a 115 kV radial transmission tap line approximately 3 to 4 spans long, crossing the Interstate 5 Freeway and connecting to a transmission tap constructed by the Interconnection Customer and terminating at the north east corner of the Interconnection Customer's property. Two existing transmission structures in Line 66 need to be replaced with steel structures and 1200 amp 115 kV line switches installed on each new structure, and a new steel structure with a 1200 amp 115 kV switch will be inset between structures 14/11 and 15/11 in Line 66 for the tap point. The three new in line switches will not be required to be equipped with motor operators or to be operated remotely, and will be manually operated. A new freeway crossing will need to be permitted and constructed north of the Winchester interchange and lining up with the tap line take off structure. The point of ownership change will occur on jumpers at the last structure in the Interconnection Customer's line where it connects to the Transmission Provider's transmission tap.

4.7 Protection Requirements

Transmission Provider will design and build a panel with protective relays that will be installed at the generation facility. The relays in this protection package will be designed to detect faults on the 115kV lines that connect the generation to Dixonville Substation. The relays will be configured to protect the line regardless of whether the generation is connected to the northern or southern section of the transmission loop. Also installed in this panel 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 13.2kV circuit breaker at the plant will need to be tripped.

The protection on this system will need to disconnect the generation facility from the circuit for any fault on the circuit before or at the same time as the relays at Dixonville Substation operate for those faults. To accomplish this, the generation developer has two options: Installing and maintaining a transfer trip circuit between Dixonville Substation and the generation facility or setting the protective relays at the generation facility to trip the generator breaker high speed for any faults on the transmission line. To insure that the generation facility's protection will respond to all fault conditions on the transmission line between Dixonville Substation and the generation facility, the relays will also respond to faults on the other 115kV transmission lines fed out of Dixonville Substation. The consequences of having the protection operating this way is that the generation will be interrupted for fault events that the facility would not need to be disconnected for if a more coordinated protection could be applied. If the transfer trip circuit is installed the generator breaker will be tripped by this communication circuit any time the Dixonville breaker operates and 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. Since the generation can be connected to either circuit breaker 2U1 or 2U9 at Dixonville Substation a switch will need to be installed at Dixonville Substation that will transfer the logic for the keying of the transfer trip based of the operation of the 115kV transmission loop. This switch will be operated by the Transmission Provider's dispatcher.

At Dixonville Substation on controls for circuit breakers 2U1 and 2U9 dead line checking will need to be added to block the automatic reclosing from closing the breaker if a failure of the protective systems leads to delayed tripping of the generation facility for a transmission line fault. On both line positions line side potential transformers already exist so only the dead line check protective relays need to be added.

4.8 Data Requirements (RTU)

A remote terminal unit (RTU) reporting back to Transmission Provider's Energy Control Center in Portland will be required at the Interconnection Customer's generation facility. With this RTU we will be monitoring the following:

Analogs:
- Generator MW
- Generator MVAR
- 115kV A phase voltage
- 115kV B phase voltage
- 115kV C phase voltage

Status:
- Generator breaker
- Transformer transrupter
- Line relay trouble alarm

Accumulator Pulses:
- Interchange metering kWh

The interchange real power MW will need to be telemetered to the Transmission Provider's Energy Control Center in Portland independent of the analog supplied to the RTU.

4.9 Metering Requirements

The metering shall be 115 kV primary metering with wire wound instrument transformers, voltage and current transformers. These instrument transformers shall have metering accuracy of 0.3%. The Company will install two meters, one main and one backup for redundancy to ensure complete metering registration in case of failure of one meter or the removal of one meter from service for routine maintenance or testing. Included in the metering configuration are data transfer switches that allow digital and analog data signals to be transferred from the main meter to the backup meter. The kWh and kVARh pulses from the meters shall energize standard repeat relays which allow independent energy pulses to be sent to multiple parties (3). Shown below in Figure 2, a typical metering sketch is shown outlining this scheme.

One dialup phone circuit shall be provided to allow the Transmission Provider to obtain 15-minute load profile information of energy and quadergy quantities. This information will be obtained automatically at least daily by the Transmission Provider's MV90 data collection system.

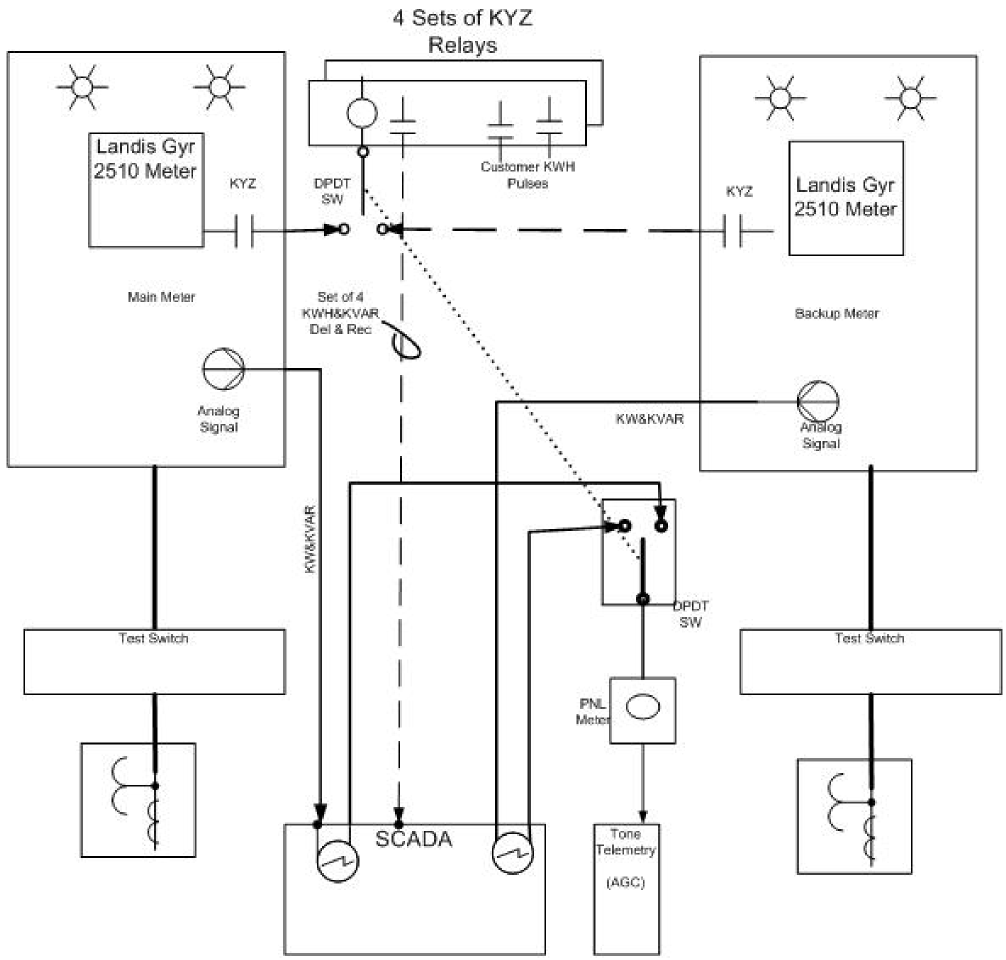
The revenue metering scheme require the following components:

1) Two Landis Gyr 2510 switchboard kWh meters
    a. containing DNP3 protocol board
    b. containing 1200 baud modem
    c. containing 4 channel analog board; 0-1.0 ma full scale
2) Two Isolation relays, one input: three outputs
3) Two digital panel meters for MW and MVAR panel display
4) Three voltage transducers: 0-150 volt AC to 0-1.0 ma DC output.

The display registers of the meters will indicate the Interconnection Customer's generation of kWh and kVARh. The station service energy is supplied through the normal retail distribution system and will not be supplied from the 115 KV line. The metering described here will measure net generation only. The meter display registers will show generation of energy as received energy and any delivery of energy from the Transmission Provider to the generator will be shown as delivered energy which will be negligible.

To obtain the three phase analog voltages, three individual voltage transducers shall be installed to provide 0-1.0 ma analog output for 0-150 volt input. The meters will provide the MW and MVAR analog outputs for the digital panel meters and for tone telemetry equipment for load control.

Figure 2
Standard Interchange
Metering
Switched Digital & Analog



The operation of switching both digital and analog provides for the main meter to be removed from service and the backup meter will send both kWh pulses and analog signal for kWh accounting and generation control without interruption.

4.10 Communication Requirements

If communications is required for protective relaying, then a microwave link will need to be established between the Interconnection Customer's plant and Dixonville 230 Substation. If line-of-site from the plant can be established to Transmission Provider's Mt Nebo or Lane Mtn Communication Sites, then one hop of fractional T-1 microwave radio will be installed between the plant and that site. From either of those sites, an individual channel can be installed to

Dixonville 230 Sub for protective relaying. A SCADA circuit, telemetry circuit, and dial-up phone circuits will also be installed on the microwave system and be routed from that system to various termination points in Transmission Provider's system. If no line-of-site exists between the plant and either of the communications sites, then a new hilltop site will need to be established to route the relay circuits out of the plant to Dixonville Substation. A microwave link would be established between the plant and the new site and between the new site and Lane Mtn Communication site. From there, individual circuits, including the protective relaying circuit, will be routed to their necessary endpoints.

If no protective relaying communication circuit is required, then telco land line leases can be installed between the plant and Dixonville 230 Substation for SCADA, telemetry, and dial-up voice and data. If line-of-site exists between the plant and Mt Nebo, or the plant and Lane Mtn, it may be feasible to install fractional T1 radio between the plant and that site to route circuits from the plant to Transmission Provider's system.

4.11 System Impact Study Conclusions

- Power flow and short circuit analyses were used to determine that the existing transmission system would not need to be upgraded due to the addition of this facility.
- The tap point of the existing Line 66 will require a new steel structure midway between two existing structures. The two existing structures will be replaced by steel structures. New switches will be installed at all three structures. The switches will not require a motor operated or remote control function.
- A relay panel, designed and procured by Transmission Provider, will be installed at the Generation Facility Substation. It will include line, voltage and frequency relay functions.
- Two protection system design options are available (Interconnection Customer must choose one) to disconnect the generation facility from the circuit for any fault on the circuit before, or at the same time as relays at Dixonville Substation operate for those faults. One option is to install and maintain a transfer trip circuit between Dixonville Substation and the Generation Facility. The second option is to set the protective relays at the Generation Facility to trip the generator breaker high speed for any faults on the transmission line. In the second option the relays will trip for faults on other 115 kV transmission lines fed from Dixonville.
- At Dixonville, dead line checking will need to be added to block the automatic reclosing from closing the breaker if a failure of the protective systems leads to delayed tripping of the Generation Facility for a transmission line fault.
- An RTU will be installed at the Generation facility Substation. Analog, status and accumulator pulses will be collected for delivery to Transmission Provider's Control Center.
- Primary and backup bi-directional metering will be required in the Generating Facilities Substation, at 115 kV.
- The communication requirements for protection and SCADA will depend on the protection design option selected to disconnect the generation facility from the circuit for

any fault on the circuit before, or at the same time as relays at Dixonville Substation operate for those faults.

5.0 Affected Systems

It is not anticipated that neighboring utilities will be affected by this interconnection**.**