GENERATOR INTERCONNECTION
FEASIBILITY STUDY REPORT

for integration of the proposed

300 MW XXXXXX PROJECT
(GI #XXX)

to the

PACIFICORP ELECTRICAL SYSTEM

in

SWEETWATER COUNTY, WYOMING

for

XXXXXX

REPORT v.1

September 16, 2021

Revision History

Date	Revision	Initials	Summary of Changes
9/16/2021	1	GMT	Feasibility Study Report GI #XXX

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1.0 INTRODUCTION

XXXXXX has contracted with Idaho Power to perform a Generator Interconnection Feasibility Study (FeS) for the integration of the proposed 300 MW XXXXXX (Project) located in PacifiCorp's Wyoming service territory in Sweetwater County, Wyoming. Reference number GI #XXX has been assigned to the Project in the Idaho Power Generation Interconnection queue.

The specific Point of Interconnection (POI) studied is the XXXXXX 345 kV bus, jointly owned by PacifiCorp and Idaho Power and operated by PacifiCorp.

This report documents the basis for and the results of this FeS for the Generation Interconnection Customer. It describes the Project, the determination of interconnection feasibility and estimated costs for integrating the Project into the PacifiCorp transmission system at the POI. This report will be reviewed by PacifiCorp.

Note:
Because the proposed Project location is outside of Idaho Power's Operating Area, an analysis of Network Upgrades needed to provide transmission capacity to transfer its output to Idaho Power will be required if the Project wishes to pursue Idaho Power NR service. The existing transmission capacity available between the POI and Idaho Power is insufficient for the Project's output.
The analysis of available transmission capacity usually occurs as part of a Transmission Service Request (TSR).

2.0 SUMMARY

The feasibility of interconnecting the 300 MW XXXXXX, GI #XXX, to the XXXXXX 345 kV bus was evaluated and determined feasible with the identified system upgrades.

The Project will be required to control voltage in accordance with a voltage schedule as provided by PacifiCorp's Grid Operations. Therefore, the Project will be required to install a plant controller for managing the real and reactive power output at the POI. As an interconnection in the PacifiCorp territory on transmission facilities operated by PacifiCorp a phasor measurement unit device (PMU) at the POI and the installation and maintenance costs associated with communication circuits needed to stream PMU data may be required.

An Interconnection System Impact Study (SIS) is required to determine if any additional Interconnection Facilities or Network Upgrades are required to integrate the project into PacifiCorp's transmission system. Energy Resource Interconnection Service and/or Network Resource Interconnection Service in and of themselves do not convey transmission service. In addition to Network Upgrades identified in the Interconnection System Impact Study:

- For Energy Resource Interconnection Service, the Interconnection Customer's ability to inject its Large Generating Facility output beyond the Point of Interconnection will depend on the existing capacity of Transmission Provider's Transmission System at such time as a transmission service request is made that would accommodate such delivery. The provision of firm Point-to-Point Transmission Service or Network Integration Transmission Service may require the construction of additional Network Upgrades.

- For Network Resource Interconnection Service, additional studies to reduce or eliminate congestion may be required and these studies may identify the need for additional upgrades. To the extent Interconnection Customer enters into an arrangement for long term transmission service for deliveries from the Large Generating Facility outside Transmission Provider's Transmission System, such request may require additional studies and upgrades in order for Transmission Provider to grant such request.

The total preliminary cost estimate to interconnect the XXXXXX, GI #XXX, as requested to the 345 kV bus at XXXXXX transmission station is **$6,447,951**.

The cost estimate includes direct equipment and installation labor costs, indirect labor costs and general overheads, and a contingency allowance. These are cost estimates only and final charges to the customer will be based on the actual construction costs incurred. It should be noted that the preliminary cost estimate does not include the cost of the customer's equipment to construct the generation facility.

3.0 SCOPE OF INTERCONNECTION FEASIBILITY STUDY

The Interconnection FeS was performed and prepared in accordance with Idaho Power Standard Generator Interconnection Procedures, to provide a preliminary evaluation of the feasibility of the interconnection of the proposed generating project to the local transmission system. As listed in the Interconnection FeS agreement, the Interconnection FeS report provides the following information:

- preliminary identification of any circuit breaker short circuit capability limits exceeded as a result of the interconnection;
- preliminary identification of any thermal overload or voltage limit violations resulting from the interconnection; and
- preliminary description and non-binding estimated cost of facilities required to interconnect the Large Generating Facility to the transmission system and to address the identified short circuit and power flow issues.

Generation projects in the Generator Interconnect queue prior to this project could impact the cost of interconnection. A current list of projects in Idaho Power's queue can be found in the Generation Interconnection folder located on the Idaho Power OASIS web site at the link shown below:

http://www.oasis.oati.com/ipco/index.html

4.0 DESCRIPTION OF PROPOSED GENERATING PROJECT

XXXXXX, GI #XXX, proposes to interconnect to the PacifiCorp transmission system on a jointly owned Idaho Power and PacifiCorp facility at 345 kV with a total injection of 300 MW (maximum project output). The POI is the 345 kV bus at XXXXXX transmission station. The project's requested in-service date is June 1, 2025.

Table 1: Project Specifications

POI Location	Lat: XXXXXX Long: -XXXXXX
Number and Type of Generators	(130) GE 2.4 MW WTG - Wind (96) FS3430M 3.26 MW Inverters – Solar (96) FS3430M 3.26 MW Inverters – Battery
Individual Generator Nameplate Rating	Wind 2.4 MW Solar 3.26 MW Battery 3.26 MW
Total Output Power Rating	312.0 MW Wind 312.96 MW Solar 312.96 MW Battery
Rated Power Factor	Unspecified
New Step-Up Transformer	#1: 170 MVA, 3-phase, 34.5/345/13.8 kV, Z = 8.5%, X/R = 40 #2: 170 MVA, 3-phase, 34.5/345/13.8 kV, Z = 8.5%, X/R = 40
Interconnection Voltage	345 kV

5.0 DESCRIPTION OF EXISTING TRANSMISSION FACILITIES

Preliminary power flow analysis indicated that interconnection of a 300 MW injection at the POI will require the following transmission system improvements: 345 kV bus expansion to install a new line bay at the POI.

A SIS will be required to determine specific network upgrades required to transfer the Project output to load.

5.1 Transmission Line Facilities

The Project will be inserted in the XXXXXX 345 kV bus.

5.2 Substation Facilities

The substation yard will need to be expanded and the existing XXXXXX 345 kV bus work extended to make room for a new line bay with two new 345 kV power circuit breakers, associated switches, protective relaying systems, SCADA, communications, and a Generation Interconnection metering package in a configuration similar to Figure 1. The POI will be the circuit breakers for the customer's line.

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Figure 1 – XXXXXX 345 kV Bus w/ GI XXX

5.3 Grounding Requirements

The proposed 345 kV Wye-Grounded/Wye-Grounded with Delta Tertiary transformers specified in the Idaho Large Generator Interconnection Request for XXXXXX, GI #XXX, should provide an adequate ground source for transmission line protection/relaying.

Grounding requirements and acceptability criteria are found in Appendix A.

5.4 System Protection Assessment

Short Circuit details at approximate interconnect location:

PacifiCorp will need to verify fault currents are within all device ratings.

Fault duty at the bus with and without generation.

Fault Study (Baseline w/o additional gen)			
Location	**SLG (A)**	**LTL (A)**	**3PH (A)**
XXXX 345kV Bus	30961.5	24442.9	28239.0

Fault Study (with GI#XXX)			
Location	**SLG (A)**	**LTL (A)**	**3PH (A)**
XXXX 345kV Bus	31379.6	24664.5	28471.4

6.0 DESCRIPTION OF POWER FLOW CASES

PowerWorld simulator software was used to evaluate the 26HS2 and 26HW2 WECC Base Cases simulating both peak summer and winter conditions. The original WECC Base Cases were modified to add the Project and senior projects in the PAC queue. The modified cases were named 26HS2_GIXXX_w_XXXXXX&PAC_QUEUE.pwb and 26HW2_GIXXX_w_XXXXXX&PAC_QUEUE.pwb.

The original WECC cases provide baseline loads and voltages in the area prior to adding the Projects.

The levels of flow represented in the study cases are intended to capture potential impact of the Project on the existing transmission system.

7.0 POWER FLOW STUDY RESULTS

Power Flow Analysis was performed on the cases described above. The base cases were used to simulate the impact of the Project interconnection during normal and contingency operating conditions (TPL-001). Mitigation of any adverse changes in loading or voltage from pre- to post-Project was identified.

The contingencies simulated include:

- All transformers and transmission lines in the local area of the proposed Project.
- The proposed project.

The results of the power flow studies were evaluated using WECC/NERC planning standards and Idaho Power planning standards. The power flow analysis related evaluation criteria that were used are summarized below:

- All transmission facilities must remain within their thermal limits.
- Pre-contingency bus voltages within the study area must be between 0.95 per unit and 1.05 per unit.
- Maximum voltage deviation allowed at all buses under contingency conditions will be 8% for N-1 (NERC Category B).

Power flow solution was achieved for each of the N-1 outages simulated. Key findings from the power flow analysis are as follows:

- Overloading. There were no significant thermal violations in the power flow analysis.
- Voltage Deviation. There were no significant voltage deviations in the power flow analysis.
- Voltage Violations. There no significant voltage violations in the power flow analysis.

8.0 DESCRIPTION OF OPERATING REQUIREMENTS

The installed reactive power capability of the Project must have a power factor operating range of 0.95 leading to 0.95 lagging at the POI over the range of real power output. At full output of 300 MW, the Project would need to be able to provide approximately +/- 98.6 MVAr reactive support plus the reactive energy consumed by the customer's own facilities. Detailed analysis of the customer's facilities was not evaluated for this Feasibility Study.

The Project will be required to control voltage in accordance with a voltage schedule as provided by PacifiCorp Grid Operations. The Project is required to install a plant controller for managing the real and reactive power output of the 300 MW Project at the POI.

The Project is required to comply with the applicable Voltage and Current Distortion Limits found in IEEE Standard 519-1992 *IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems*.

9.0 COST ESTIMATE

The following upgrades will be required to facilitate the interconnection of XXXXXX, GI #XXX:

- Expand the substation yard and extend the 345 kV bus work to make room for a new line bay consisting of two 345 kV power circuit breakers, SEL-421 protective relay, which requires 3-phase potential transformers (PTs) and 3-phase current transformers (CTs), SCADA and remote connectivity.
- Construct transmission structure to terminate customer's line from the generating facility.
- Note that this cost estimate does not include the cost of the customer's equipment/facilities or required communication circuits.
- These are estimated costs only and final charges to the customer will be based on the actual construction costs incurred.

Table 2: Conceptual Cost Estimate

Item of Work	Estimate
Substation construction and Generation interconnection and protection package	$4,884,812
Contingency 20% (1)	$976,962
Total unloaded costs	$5,861,774
Overheads (2)	$586,177
Total Conceptual-level Cost Estimate in 2020 dollars (3)	**$6,447,951**

(1) Contingency is added to cover the unforeseen costs in the estimate. These costs can include unidentified design components, material cost increases, labor estimate shortfalls, etc.

(2) Overhead costs cover the indirect costs associated with the Project.

(3) This cost estimate includes direct equipment, material, labor, overheads, and contingency as shown.

These are non-binding conceptual level cost estimates that will be further refined upon the request and completion of Transmission and Distribution System Impact Studies.

10.0 CONCLUSIONS

The requested interconnection of the XXXXXX, GI #XXX, to the XXXXXX 345 kV bus in PacifiCorp's Wyoming operating area was studied.

The results of this study work confirm that it is feasible to interconnect the Project to the existing XXXXXX 345 kV bus. The results from the power flow analysis and short-circuit analysis confirm that the interconnection of the Project with the identified upgrades will not have significant impact on the local transmission system.

A SIS is required to determine the specific Transmission Network Upgrades required to integrate the Project as a Network Resource and to evaluate the system impacts (thermal overload, voltage, transient stability, reactive margin).

Generator interconnection service (either as an Energy Resource or a Network Resource) does not in any way convey any right to deliver electricity to any specific customer or point of delivery. Transmission requirements to integrate the Project will be determined during the SIS phase of the generator interconnection process.

APPENDIX A

A-1.0 Method of Study

The FeS plan inserts the Project up to the maximum requested injection into the selected Western Electric Coordinating Council (WECC) power flow case and then, using Power World Simulator or GE's Positive Sequence Load Flow (PSLF) analysis tool, the impacts of the new resource on PacifiCorp's transmission system (lines, transformers, etc.) within the study area are analyzed. The WECC and Idaho Power reliability criteria and Idaho Power operating procedures were used to determine the acceptability of the configurations considered. For distribution feeder analysis, Idaho Power utilizes Advantica's SynerGEE Software.

A-2.0 Acceptability Criteria

The following acceptability criteria were used in the power flow analysis to determine under which system configuration modifications may be required:

The continuous rating of equipment is assumed to be the normal thermal rating of the equipment. This rating will be as determined by the manufacturer of the equipment or as determined by Idaho Power and PacifiCorp. Less than or equal to 100% of continuous rating is acceptable.

Idaho Power's Voltage Operating Guidelines were used to determine voltage requirements on the system; this specifies, in part, that distribution voltages, under normal operating conditions, are to be maintained within plus or minus 5% (0.05 per unit) of nominal everywhere on the feeder. Therefore, voltages greater than or equal to 0.95 pu voltage and less than or equal to 1.05 pu voltage are acceptable.

Voltage flicker during starting or stopping the generator is limited to 5% as measured at the POI, per Idaho Power's T&D Advisory Information Manual.

Idaho Power's Reliability Criteria for System Planning was used to determine proper transmission system operation.

All customer generation must meet IEEE 519 and ANSI C84.1 Standards.

All other applicable national and Idaho Power standards and prudent utility practices were used to determine the acceptability of the configurations considered.

The stable operation of the system requires an adequate supply of volt-amperes reactive (VAr) to maintain a stable voltage profile under both steady-state and dynamic system conditions. An inadequate supply of VArs will result in voltage decay or even collapse under the worst conditions.

Equipment/line/path ratings used will be those that are in use at the time of the study or that are represented by Idaho Power or PacifiCorp upgrade projects that are either currently under construction or whose budgets have been approved for construction in the near future. All other potential future ratings are outside the scope of this study. Future transmission changes may, however, affect current facility ratings used in the study.

A-3.0 Grounding Guidance

Idaho Power requires interconnected transformers to limit their ground fault current to 20 amps at the POI.

A-4.0 Electrical System Protection Guidance

Idaho Power requires electrical system protection per Requirements for Generation Interconnections found on the Idaho Power Web site,

http://www.idahopower.com/pdfs/BusinessToBusiness/facilityRequirements.pdf

A-5.0 WECC Coordinated Off-Nominal Frequency Load Shedding and Restoration Requirements

Idaho Power requires frequency operational limits to adhere to WECC Under-frequency and Over-frequency Limits per the WECC Coordinated Off-Nominal Frequency Load Shedding and Restoration Requirements available upon request.

http://www.idahopower.com/pdfs/BusinessToBusiness/facilityRequirements.pdf

APPENDIX B. PROJECT LOCATION

XXXXXX is located approximately 38 miles south of the POI, the XXXXXX 345 kV bus.

Redacted

Figure 2 - Project Location