GENERATOR INTERCONNECTION

FEASIBILITY STUDY REPORT

for integration of the proposed

200 MW [redacted] SOLAR PROJECT

(GI #623)

to the

IDAHO POWER ELECTRICAL SYSTEM

in

BINGHAM COUNTY, IDAHO

for

[redacted]

REPORT v.1

December 17, 2021

Revision History

Date	Revision	Initials	Summary of Changes
12/16/2021	1	PP	Feasibility Study Report GI #623

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1.0 INTRODUCTION

[redacted] has contracted with Idaho Power to perform a Generator Interconnection Feasibility Study (FeS) for the integration of the proposed 200 MW [redacted] Solar (Project) located in Idaho Power's service territory in Bingham County, Idaho. Reference number GI #623 has been assigned to the Project in the Idaho Power Generation Interconnection queue. The specific Point of Interconnection (POI) studied is the [redacted] 230 kV transmission line.

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 Idaho Power transmission system at the POI. This report will be reviewed by PacifiCorp.

2.0 SUMMARY

The feasibility of interconnecting [redacted] Solar, GI #623, to the [redacted] 230 kV transmission line was evaluated and determined feasible with the identified system upgrades in section 7.0 Power Flow Study Results and 9.0 Cost Estimate.

The Project will be required to control voltage in accordance with a voltage schedule as provided by Idaho Power'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 Idaho Power territory 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 Idaho Power'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 Feasibility Study:

- For Energy Resource Interconnection Service (ERIS), 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 (NRIS), 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 estimates to interconnect the Project as requested to the [redacted] 230 kV transmission line is dependent upon NRIS or ERIS interconnection and contingent upon a PacifiCorp senior GI queue project in the region.

ERIS: $6,510,676

NRIS With Senior GI Queue Project: $6,510,676

NRIS Without Senior GI Queue Project: $39,781,942

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

[redacted] Solar, GI #623, proposes to interconnect to the Idaho Power transmission system with a total injection of 200 MW (maximum project output). The POI is the [redacted] 230 kV transmission line. The project's requested in-service date is June 1, 2025.

Table 1: Project Specifications

POI Location	Lat: 43.0233 Long: -112.9476
Number and Type of Generators	[redacted] 3600 kVA Inverters – Solar
Individual Generator Nameplate Rating	Solar 3.6 MW
Total Output Power Rating	230.4 MVA Solar
Rated Power Factor	+/- .8
New Step-Up Transformer	230 MVA, 3-phase, 34.5/230 kV, Z = 9.5%, X/R = 38
Interconnection Voltage	230 kV

5.0 DESCRIPTION OF EXISTING TRANSMISSION FACILITIES

The Project's interconnection to the [redacted] 230 kV transmission line was studied in this FeS. 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 [redacted] 230 kV transmission line.

5.2 Substation Facilities

There are no substation facilities at the proposed POI. A new 230 kV class substation will need to be inserted in the existing [redacted] 230 kV transmission line to serve the POI.

5.3 Grounding Requirements

The proposed 34.5 kV to 230 kV Wye-Grounded/Wye-Grounded transformer in the Project application did not specify the tertiary winding configuration. Idaho Power requires a Delta Tertiary transformer for Wye-Grounded/Wye-Grounded transformers.

5.4 System Protection Assessment

Short Circuit details at approximate interconnect location:

Fault duty at the bus with and without generation; no existing breaker ratings are exceeding with the Project.

Table 2: Short Circuit Analysis

Fault Study (system as-is)			
Fault Location	**SLG (A)**	**LTL (A)**	**3PH (A)**
[redacted] **230kV Bus**	947.8	933.0	1075.4
[redacted] **230kV Bus**	1953.3	2277.6	2671.9

Fault Study (with GI#623)			
Fault Location	**SLG (A)**	**LTL (A)**	**3PH (A)**
[redacted] **230kV Bus**	1156.6	1135.2	1278.8
XXXX 230kV Bus	2040.7	2387.6	2740.8

6.0 DESCRIPTION OF POWER FLOW CASES

PowerWorld simulator software was used to evaluate the 25HS2 WECC Base Case simulating peak summer conditions. The original WECC Base Case was modified to add the Project and senior projects in the region and increase loading on WECC Path 18. The modified case was named 25HS2_GI623&GI573&GI580_Hi_Path18_N-S.pwb.

The original WECC case provide baseline loads and voltages in the area prior to adding the Projects. The base case was 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 tripping transformers and transmission lines in the local area of 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 evaluation criteria that were used are summarized below:

- Pre-contingency: All transmission facilities must remain within their normal thermal limits and bus voltages within the study area must be between 0.95 per unit and 1.05 per unit.
- Post-contingency: All transmission facilities must remain within their emergency thermal limits and voltage deviations at all buses will not exceed 8% for N-1 (NERC Category B).

7.0 POWER FLOW STUDY RESULTS

Preliminary power flow analysis determined that interconnection of a 200 MW injection at the POI will require the following transmission system improvements and are contingent upon a PacifiCorp senior GI queue project (PacifiCorp Q2611) and whether the connection is studied as a Network Resource Interconnection Service (NRIS) or an Energy Resource Interconnection Service (ERIS).

- Overloading (NRIS): The following overload occurred without the interconnection and upgrades associated with the senior GI queue project. When the 230 kV line from the POI to [redacted] substation was taken offline, the [redacted] at the [redacted] substation and [redacted] from [redacted] substation to substation were both overloaded beyond the emergency rating. This overload will be mitigated by installing a four-position ring bus at the POI to integrate a new 230 kV line from the POI to the [redacted] substation in addition to the existing 230 kV POI to [redacted] substation transmission line.
    - There were no overloads when modeling the senior GI queue project and their associated upgrades. However, if the senior queue project is constructed, it is not expected prior to the commercial operations date for [redacted] Solar.
- Overloading (ERIS): There were no significant thermal overloads in the power flow analysis.
- Voltage Deviation (NRIS and ERIS). There were no significant voltage deviations in the power flow analysis.
- Voltage Violations (NRIS and ERIS): There were 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 200 MW, the Project would need to be able to provide approximately +/- 66 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 Idaho Power Grid Operations. The Project is required to install a plant controller for managing the real and reactive power output of the 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 the Project and are dependent on NRIS or ERIS interconnection and contingent upon a senior GI queue project.

9.1 ERIS or NRIS With Senior GI Queue Project

- Construction of a new 230 kV class substation at the POI with three 230 kV power circuit breakers, associated switched, protective relays, 3-phase potential transformers (PTs) and 3-phase current transformers (CTs), SCADA and remote connectivity.

Table 3: ERIS or NRIS with Senior GI Queue Project

Item of Work	Estimate
Substation construction and Generation interconnection and protection package	$5,058,800
Contingency 20% (1)	$1,011,760
Total unloaded costs	$6,070,560
Overheads (2)	$440,116
Total Conceptual-level Cost Estimate in 2021 dollars (3)	**$6,510,676**

9.2 NRIS Without Senior GI Queue Project

- Construction of a new 230 kV class substation at the POI with four 230 kV power circuit breakers, associated switches, protective relays, 3-phase potential transformers (PTs) and 3-phase current transformers (CTs), SCADA and remote connectivity.
- 20 miles of new 230 kV transmission line from the POI to [redacted] substation.
- Additional 230 kV line terminal at [redacted] substation.

Table 4: NRIS without Senior Queue GI Project and Associated Upgrades

Item of Work	Estimate
Substation construction and Generation interconnection and protection package	$6,985,600
230 kV transmission line build	$23,925,000
Contingency 20% (1)	$6,182,120
Total unloaded costs	$37,092,720
Overheads (2)	$2,689,222
Total Conceptual-level Cost Estimate in 2021 dollars (3)	**$39,781,942**

(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. 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.

10.0 CONCLUSION

The requested interconnection of [redacted] Solar, GI #623, to the [redacted] 230 kV transmission line in Idaho Power's operating area was studied.

Interconnection requirements at the POI detailed in section 9.0 Cost Estimate are dependent upon connection service (NRIS or ERIS) and are contingent upon a PacifiCorp senior GI queue project. ERIS or NRIS interconnection with senior GI queue project and associated upgrades costs are estimated $6,510,676. If the Project interconnects for NRIS without the senior GI queue project and associated upgrades, the cost to integrate the Project is $39,781,942.

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 Idaho Power'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.

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,

https://docs.idahopower.com/pdfs/BusinessToBusiness/FacConnReq.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.

https://docs.idahopower.com/pdfs/BusinessToBusiness/FacConnReq.pdf

APPENDIX B. PROJECT LOCATION

[redacted] Solar is located adjacent to the POI on the [redacted] 230 kV transmission line.