GENERATOR INTERCONNECTION
FEASIBILITY STUDY REPORT

for integration of the proposed

100 MW XXXXXX PROJECT
(GI #603)

to the

IDAHO POWER ELECTRICAL SYSTEM

in

XXXXXX COUNTY, IDAHO

for

XXXXXX

REPORT v.2

August 11, 2021

Revision History

Date	Revision	Initials	Summary of Changes
8/3/2021	1	GMT	Feasibility Study Report GI #603 – Original draft
8/11/2021	2	GMT	Incorporated feedback from peer review

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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 100 MW XXXXXX (Project) located in Idaho Power's Western Idaho service territory in XXXXXX County, Idaho. Reference number GI #603 has been assigned to the Project in the Idaho Power GI queue.

The specific Point of Interconnection (POI) studied is a XXXXXX substation inserting the Project into the existing XXXXXX XXXXXX-XXXXXX-XXXXXX transmission line, owned by Idaho Power, approximately 3.5 miles south of XXXXXX.

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 XXXXXX.

2.0 SUMMARY

The feasibility of interconnecting the 100 MW XXXXXX Project, GI #603, to the XXXXXX-XXXXXX-XXXXXX XXXXXX line was evaluated.

Power flow analysis indicated that interconnecting the Project is feasible with the identified system upgrades. 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. 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 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 #603, as requested to the XXXXXX XXXXXX-XXXXXX-XXXXXX transmission line is **$8,054,026**.

It should be noted that the transmission line selected for interconnection is constructed as a XXXXXX line, operated at XXXXXX. Idaho Power's future transmission plans include converting this line to operate at XXXXXX; when that happens, the Project will need to have appropriate facilities to interconnect at XXXXXX.

The cost estimate includes Interconnection Facilities, Network Upgrades, 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 or the customer's interconnection facilities.

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 #603, proposes to interconnect to the Idaho Power transmission system at XXXXXX with a total injection of 100 MW (maximum project output) supported by both solar and battery generation. The POI is approximately 3.5 miles south of XXXXXX on the XXXXXX XXXXXX-XXXXXX-XXXXXX transmission line. This project's requested in-service date is January 12, 2023.

Table 1: Project Specifications

POI Location	XXXXXX, XXXXXX
Number and Type of Generators	3,150 kVA PV Inverters Quantity = 34 (APP list both 35 & 34, SLD shows 34) 3,150 kVA BESS Inverters Quantity = 17 (APP list both 18 & 17, SLD shows 14 & 24)
Individual Generator Nameplate Rating	3.15 MW 3150 kVA
Total Output Power Rating	107.1 MW PV 53.55 MW BESS
Rated Power Factor	0.9 Leading / 0.9 Lagging
New Step-Up Transformer	#1: 110 MVA, 3-phase, 138/34.5/13.8 kV, Z = 8.5%, X/R = 42
Interconnection Voltage	XXXXXX

5.0 DESCRIPTION OF EXISTING TRANSMISSION FACILITIES

The XXXXXX, GI #603, interconnection to the XXXXXX-XXXXXX-XXXXXX XXXXXX line was studied in this FeS.

Preliminary power flow analysis indicated that interconnection of a 100 MW injection at the POI considered in this study is feasible with the following transmission system improvements: a new XXXXXX class substation; rebuilding approximately two miles of the existing XXXXXX line from XXXXXX to XXXXXX with XXXXXX conductor.

A SIS will be required to determine specific network upgrades required to transfer the Project output of 100 MW to load.

5.1 Transmission Line Facilities

The Project will be inserted in the XXXXXX-XXXXXX-XXXXXX XXXXXX line which is constructed as a XXXXXX line operating at XXXXXX. Idaho Power's future transmission plans include converting this line to operate at XXXXXX.

5.2 Substation Facilities

A new XXXXXX substation will need to be constructed adjacent to the existing XXXXXX-XXXXXX-XXXXXX XXXXXX line. The line will be broken adjacent to the new substation and the line sections will be terminated in the substation as two individual lines along with the customer owned line in a manner similar to Figure 1.

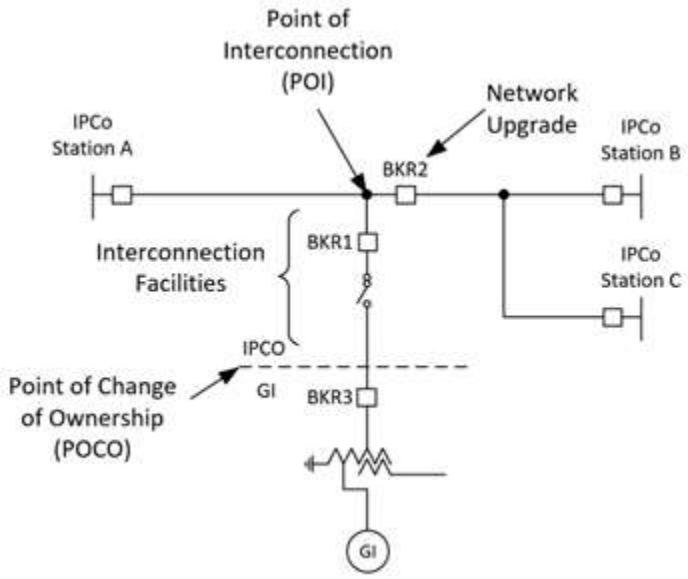

Figure 1 - Proposed interconnection station

The new substation will include protective relaying systems for all three lines, SCADA, communications, and a Generation Interconnection metering package. The POI will be as indicated above.

5.3 Grounding Requirements

The proposed XXXXXX Wye-Grounded/Wye-Grounded with Delta Tertiary transformers specified in the Idaho Large Generator Interconnection Request for XXXXXX, GI #603, 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:

The projected fault currents are within the ratings for all existing breakers with the addition of GI #603.

Fault duty at each of the breakers with and without the generation.

Fault Study (with GI #603)			
Location	**SLG (A)**	**LTL (A)**	**3PH (A)**
XXXXXX	18609	13569	15797
XXXXXX	22139	17455	20027
XXXXXX	8745	11063	13072
XXXXXX POI	11613	12031	13938

Fault Study (w/ out GI #603)			
Location	**SLG (A)**	**LTL (A)**	**3PH (A)**
XXXXXX	17694	13022	15113
XXXXXX	21742	17224	19620
XXXXXX	9049	10912	12809

6.0 DESCRIPTION OF POWER FLOW CASES

PowerWorld simulator software was used to evaluate the power flow case and determine the impact of the Project. The 22HS2-OP.pwb WECC Base Case was used without modification except the addition of the Project and GI #562.

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 proposed XXXXXX, GI #603, 100 MW 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 5% for N-1 (NERC Category B).

Power flow solution was achieved for all the N-1 and credible N-2 outages simulated. Key findings from the power flow analysis are as follows:

- Overloading. For the N-1 contingency of an internal breaker fault in XXXXXX 202A, the XXXXXX line section from the POI substation to XXXXXX Tap overloads to ~112% of its emergency rating due to approximately two miles of smaller conductor. To mitigate this contingency the Project will need to rebuild this two-mile section.

  For the N-2 contingency of the common structure XXXXXX-XXXXXX XXXXXX line and the XXXXXX-XXXXXX-XXXXXX XXXXXX line, the XXXXXX 69 kV line overloads to ~116% of its emergency rating. Mitigating this overload has been assigned to a senior queue project.
- 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 100 MW, the Project would need to be able to provide approximately +/- 31.2 MVAr reactive support plus the reactive energy consumed by the customer's own facilities. Based on the information provided the customer's facilities would require approximately 19 MVAr of reactive support.

Identification of any additional equipment required at the Project to meet reactive power capability interconnection requirements will be provided in the SIS.

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 100 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 section describes the cost estimate for the Project.

The following upgrades will be required to facilitate the interconnection of XXXXXX Solar, GI #603:

- Construct a new XXXXXX interconnection substation.
- Install generation interconnection package at the POI. This includes a XXXXXX power circuit breaker, SEL-421 protective relay, required 3-phase potential transformers (PTs) and 3-phase current transformers (CTs), Revenue Metering, SCADA and remote connectivity.
- Install a XXXXXX power circuit breaker to provide protection systems for the two line sections.
- Line work to break existing line and terminate each end at substation.
- Rebuild approximately two miles of the existing XXXXXX-XXXXXX-XXXXXX XXXXXX Line.
- 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	$3,957,255
Transmission upgrades	$2,144,280
Unloaded costs	$6,101,535
Contingency 20% (1)	$1,220,307
Total unloaded costs	$7,321,842
Overheads (2)	$732,184
Total Conceptual-level Cost Estimate in 2020 dollars (3)	**$8,054,026**

(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 #603, to the XXXXXX-XXXXXX-XXXXXX XXXXXX line in Idaho Power's Western Idaho operating area was studied.

The results of this study work confirm that it is feasible to interconnect the Project to the existing XXXXXX-XXXXXX-XXXXXX XXXXXX line. 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 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. 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. 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 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

XXXXXX2 was studied with a POI approximately 3.5 miles south of XXXXXX power plant on the XXXXXX-XXXXXX-XXXXXX XXXXXX line.

REDACTED

Figure 2 - Project Location