GENERATOR INTERCONNECTION

FEASIBILITY STUDY REPORT

for integration of the proposed

750 kW [redacted]

IPC PROJECT QUEUE #548

to the

IDAHO POWER COMPANY ELECTRICAL SYSTEM

for

[redacted]

REPORT 1.0

July 31, 2019

Revision History

Date	Revision	Initials	Summary of Changes
7/31/19	0	PTP	FeSR GI #548 – Original issue.

Table of Contents

1.0 Introduction 1

2.0 Summary 1

3.0 Scope of Interconnection Feasibility Study 2

4.0 Description of Proposed Generating Project 3

5.0 Description of Transmission Facilities 3

6.0 Description of Substation Facilities 3

7.0 Description of Distribution Facilities 3

8.0 Short Circuit Study Results 4

9.0 Description of Required Facility Upgrades 4

10.0 Description of Operating Requirements 5

11.0 Conclusion 7

APPENDIX A 8

A-1.0 Method of Study 8

A-2.0 Acceptability Criteria 8

A-3.0 Grounding Guidance 9

A-4.0 Electrical System Protection Guidance 9

A-5.0 WECC Coordinated Off-Nominal Frequency Load Shedding and Restoration Requirements 9

APPENDIX B 10

B-1.0 [redacted] GI Project #548 Site Location 10

List of Tables

Table 1 Conceptual-level Primary POI Cost Estimate for GI #548..... 4
Table 2 Conceptual-level Alternate POI Cost Estimate for GI #548..... 5

List of Figures

Figure 1 Operating requirements (IEEE 1547-2018)..... 6
Figure 2 Primary POI of [redacted] - GI #548..... 10
Figure 3 Alternate POI of [redacted] - GI#548..... 11

1.0 Introduction

[redacted] has contracted with Idaho Power Company (IPC) to perform a Generator Interconnection Feasibility Study for the integration of the proposed 750 kW [redacted] project (the Project). The Project is located in IPC's Eastern Region at [redacted] in [redacted], Idaho with an alternative POI at [redacted] (See Figure 2: Primary POI of [redacted] – GI # 548 and Figure 3: Alternate POI of [redacted] – GI # 548 in Appendix B). The Project is Generation Interconnect queue number 548 (GI #548).

The Project has applied to connect to the IPC distribution system for an injection of 750 kW at a single Point of Interconnection (POI) at a [redacted] distribution voltage level. The POI is located 19.1 miles from the Lemhi ([redacted]) substation at [redacted].

This report documents the basis for and the results of this feasibility study for the GI #548 Generation Interconnection Customer. The report describes the proposed project, the determination of project interconnection feasibility and estimated costs for integration of the Project to the Idaho Power System. This report satisfies the feasibility study requirements of the Idaho Power Tariff.

2.0 Summary

The feasibility of interconnecting the 750 kW [redacted] project to IPC's [redacted] substation was evaluated.

The proposed primary and alternative POI provided is in [redacted] feeder service territory.

[redacted] is a lightly loaded feeder that already hosts a 400 kW hydro electric generator near the GI#548 POI. The addition of 750 kW [redacted] Project GI#548 will closely match the load on [redacted] and will require the installation of a deadline check at the substation.

The primary POI ([redacted]) is currently served by single phase 12.47 kV distribution, a 1.5 mile extension of 3 phase [redacted] #4 ACSR conductor will be required.

The alternate POI ([redacted]) is approximately 400 feet from the nearest 3 phase [redacted] distribution circuit, a 400' extension of 3 phase [redacted] #4 ACSR conductor will be required.

The preliminary power flow analysis indicated that interconnecting the [redacted] project to [redacted] is feasible.

The Project will be required to control voltage in accordance with a voltage schedule as provided by Idaho Power Grid Operations.

A Transmission System Impact Study is required to determine if any additional network upgrades are required to integrate the Project into the IPC transmission system and to evaluate system impacts such as thermal, voltage, transient stability, and 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.

Additionally, a Distribution System Impact Study will be required.

The total preliminary cost estimate to interconnect the [redacted] project to the primary POI at [redacted] on [redacted] substation is $670,874 and includes the following tasks:

- Install a four-pole [redacted] generation interconnection package at the POI
    - This includes an SEL-421 protective relay, which requires 3-phase PTs, 3-phase CTs, and remote connectivity
    - Additionally, a single-phase PT shall be installed on the line side of the [redacted] feeder at the [redacted] substation for deadline check
- Build a parallel [redacted] #4 ACSR line section for approximately 8125' from the nearest 3 phase [redacted] service to the POI.

The total preliminary cost estimate to interconnect the [redacted] project to the alternative POI at [redacted] on [redacted] substation is $327,451 and includes the following tasks:

- Install a four-pole [redacted] generation interconnection package at the POI
    - This includes an SEL-421 protective relay, which requires 3-phase PTs, 3-phase CTs, and remote connectivity
    - Additionally, a single-phase PT shall be installed on the line side of the [redacted] feeder at the [redacted] substation for deadline check
- Extend the existing [redacted] #4 ACSR line section for approximately 400' from the nearest 3 phase [redacted] service to the alternative POI.

The cost estimate includes direct equipment and installation labor costs, indirect labor costs and general overheads, and a 20% 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 estimates do not include the cost of the customer's owned equipment to construct the generation site or required communication circuits.

3.0 Scope of Interconnection Feasibility Study

The Interconnection Feasibility Study was done and prepared in accordance with Idaho Power Company Standard Generator Interconnection Procedures to provide a preliminary evaluation of the feasibility of the interconnection of the proposed generating project to the Idaho Power

system. As listed in the Interconnection Feasibility Study agreement, the Interconnection Feasibility Study 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 Small Generating Facility to the IPC system and to address the identified short circuit and power flow issues.

All other proposed generation projects prior to the Project in the Generator Interconnect queue were considered in this study**.** A current list of these projects can be found in the Generation Interconnection folder located on the Idaho Power web site at the link shown below:

http://www.oatioasis.com/ipco/index.html.

4.0 Description of Proposed Generating Project

[redacted], GI #548, consists of a single POI with a 750 kW 3 phase synchronous generator and has requested to connect to Idaho Power's [redacted] distribution system. [redacted] requested that 750 kW injection at the POI be studied.

5.0 Description of Transmission Facilities

Preliminary power flow analysis indicated that interconnection of a 750 kW injection at the POI considered in this study is feasible. A Transmission System Impact Study will be required to determine the specific network upgrades required to integrate the full project output of 750 kW.

6.0 Description of Substation Facilities

Idaho Power's [redacted] station is located in [redacted] County, Idaho. [redacted] station is fed by a 69-kV transmission line. The substation transformer feeding [redacted], [redacted] T061, is a three-phase 69-36.2/20.9 kV delta wye-grounded transformer rated for 6.25 MVA. [redacted] T061 currently serves two [redacted] distribution feeders: [redacted] -041 and [redacted].

7.0 Description of Distribution Facilities

The Project was studied with a [redacted] connection to [redacted]. This is a grounded-wye feeder operating at [redacted]. The Project must have a grounded-wye transformer connection on the IPC side, as well as a wye connection on the Project side of the transformer.

Refer to Appendix A, Section 3, for additional grounding requirements.

8.0 Short Circuit Study Results

Fault Duty at [redacted] GEN POI:

SLG Fault (A)	196.73
LL Fault (A)	129.1
3PH Fault (A)	167.02

The fault current contribution from the synchronous generators does not exceed any circuit breaker rating.

9.0 Description of Required Facility Upgrades

A Distribution System Impact Study will be required to evaluate distribution operational concerns, mitigation options, and costs if the Project chooses to continue to the next phase of the study process.

The following upgrades will be required to IPC-owned facilities to facilitate the interconnection of GI #548:

- Install a four-pole [redacted] generation interconnection package at the POI
    - This includes an SEL-421 protective relay, which requires 3-phase PTs, 3-phase CTs, and remote connectivity
    - Additionally, a single-phase PT shall be installed on the line side of the [redacted] feeder at the [redacted] substation for deadline check
- Primary POI: Build a parallel [redacted] #4 ACSR line section for approximately 8125' from the nearest 3 phase [redacted] service to the POI.
- Alternate POI: Extend the existing [redacted] #4 ACSR line section for approximately 400' from the nearest 3 phase [redacted] service to the alternative POI.

See the conceptual-level cost estimate in Table 1 and Table 2.

Table 1 Conceptual-level Primary POI Cost Estimate for GI #548

Item of Work	Estimate
Generation interconnection and protection package	$ 203,000
Substation upgrades	$ 11,600
Distribution upgrades	$ 272,600
Transmission upgrades	$ TBD
Unloaded costs	$ 487,200
20% Contingency (1)	$ 97,440
Total unloaded costs	$ 584,640

Item of Work	Estimate
Overheads (2)	$ 86,234
Total Conceptual-level Cost Estimate in 2019 dollars (3)	**$ 670,874**

(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.

Table 2 Conceptual-level Alternate POI Cost Estimate for GI #548

Item of Work	Estimate
Generation interconnection and protection package	$ 203,000
Substation upgrades	$ 11,600
Distribution upgrades	$ 23,200
Transmission upgrades	$ TBD
Unloaded costs	$ 237,800
20% Contingency (1)	$ 47,560
Total unloaded costs	$ 285,360
Overheads (2)	$ 42,091
Total Conceptual-level Cost Estimate in 2019 dollars (3)	**$ 327,451**

(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.

- Note that these estimates do not include the cost of the customer's equipment/facilities.
- Note that the overhead rates are subject to change during the year.
- These are estimated costs only and final charges to the customer will be based on the actual construction costs incurred.
- These are non-binding conceptual level cost estimates that will be further refined upon the request and completion of Transmission and Distribution Facility Studies.

10.0 Description of Operating Requirements

The Project shall be capable of injecting reactive power (over-excited) equal to 366.7 kVAR and absorbing reactive power (under-excited) equal to 208.3 kVAR at all active power output between 20% and 100% of nameplate active power rating as defined in IEEE 1547-2018 Category A reactive power capability and shown in Figure 1.

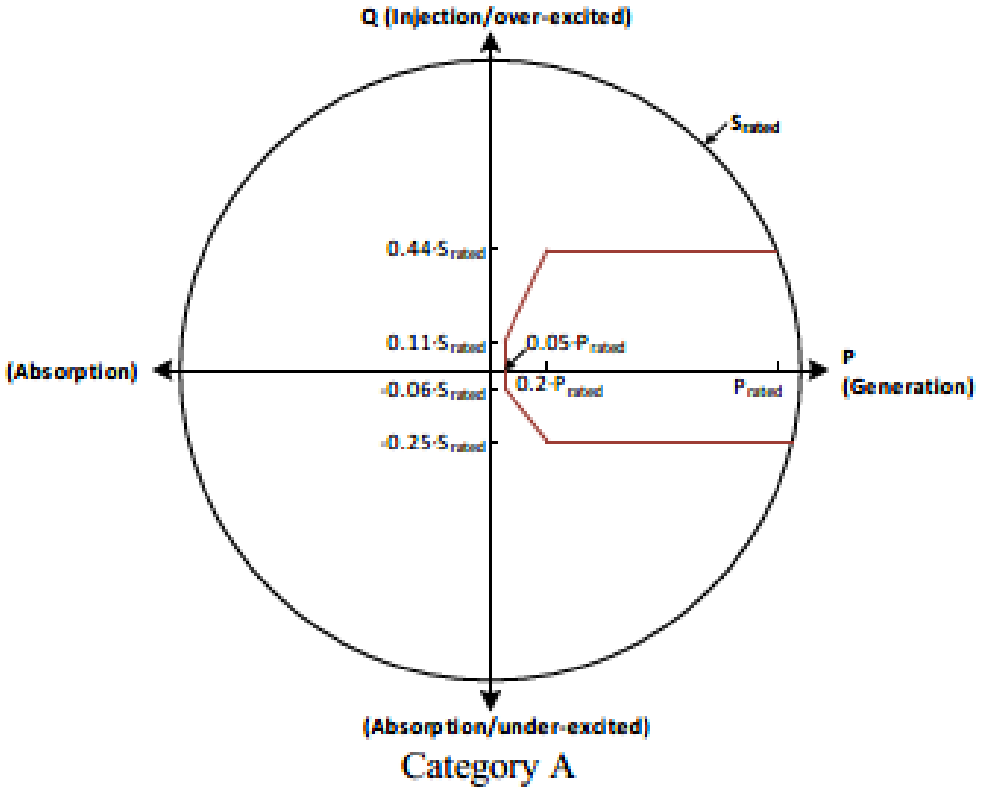

Figure 1 Operating requirements (IEEE 1547-2018)

Idaho Power has determined that the generation equipment selected by the Project does not meet the reactive power capability requirements according to the information provided in the generator interconnection application, clarification of generator specifications is requested. To proceed to the System Impact Study an updated single line, generator capability curve, and generator nameplate will be required.

The Project will be required to control voltage in accordance with a voltage schedule as provided by Idaho Power Grid Operations.

Voltage flicker at startup and during operation will be limited to less than 5% as measured at the POI. The allowable voltage flicker limit is further reduced during operation due to multiple voltage fluctuations per hour or minute, per Idaho Power's T&D Advisory Information Manual.

The Project is required to comply with the applicable voltage fluctuation limits found in IEEE Standard 1453-2004 *IEEE Recommended Practice for Measurement and Limits of Voltage Fluctuations and Associated Light Flicker on AC Power Systems.*

The project is required to comply with the applicable Voltage and Current Distortion Limits found in IEEE Standard 519-2014 *IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems*.

Additional operating requirements for the Project may be identified in the System Impact Study when it is performed.

11.0 Conclusion

The requested interconnection of the [redacted] project, GI #548, to Idaho Power's system was studied. The project will interconnect to [redacted] feeder at the [redacted] distribution voltage level.

The results of this study confirm that it is feasible to interconnect the [redacted] project, GI #548, to the Idaho Power system with the identified upgrades. A four-pole generation interconnect package at the POI, adding 8125' or 400' of [redacted] #4 ACSR parallel line section for primary or alternate POI respectively, and deadline check at the [redacted] substation are required to integrate the 750 kW project. A Transmission and Distribution System Impact Study is required to determine the specific transmission network upgrades required to integrate the project as a Network Resource and to evaluate the system impacts such as thermal overload, voltage, transient stability, and reactive margin.

All generation projects in the area ahead of the Project in the IPC generation interconnection queue and their associated transmission system improvements were modeled in a preliminary power flow analysis to evaluate the feasibility of interconnecting GI #548. The results and conclusions of this feasibility study are based on the realization of these projects in the unique queue/project order.

The estimated cost to interconnect GI #548 to the IPC system at the [redacted] feeder at the [redacted] point of interconnection considered in this study is approximately $670,874 at the primary POI and $327,451 at the alternate POI.

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 System Impact Study phase of the generator interconnection process.

APPENDIX A

A-1.0 Method of Study

For distribution feeder analysis, Idaho Power utilizes DNV GL's Synergi software and EPRI's OpenDSS 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 states, in part, that distribution voltages, under normal operating conditions, are to be maintained within plus or minus 5% (0.05 per unit) of nominal at each meter or POI 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 the starting or stopping of the generator will be limited to less than 5% as measured at the POI. Allowable voltage flicker limit is further reduced during operation due to multiple voltage fluctuations per hour or minute, 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, IEEE1453, IEEE1547, 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 (VArs) 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 IPC 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

IPC requires interconnected transformers to limit their ground fault current to 20 amps at the Point of Interconnection.

A-4.0 Electrical System Protection Guidance

IPC 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

IPC 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.

APPENDIX B

B-1.0 [redacted] GI Project #548 Site Location

Figure 2 Primary POI of [redacted] - GI #548

Figure 3 Alternate POI of [redacted] - GI#548