GENERATOR INTERCONNECTION

SYSTEM IMPACT STUDY REPORT

for integration of the proposed

1500 kW [redacted]

IPC PROJECT QUEUE #747

to the

IDAHO POWER COMPANY ELECTRICAL SYSTEM

for

[redacted]

REPORT v.0

October 29, 2024

Revision History

Date	Revision	Initials	Summary of Changes
10/29/24	0	AEF	SISR GI #747 – Original Draft

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1.0 Introduction

[redacted] has contracted with Idaho Power Company (IPC) to perform a Generator Interconnection System Impact Study for the integration of the proposed 1500 kW [redacted] project (the Project). The Project is located in IPC's Southern Region at [redacted] in [redacted] in Twin Falls County, Idaho (See Figure 2: POI of [redacted] – GI # 747).

The Project has applied to connect to the IPC distribution system for an injection of 1500 kW at a single Point of Interconnection (POI) at a 12.5 kV distribution voltage level. The POI is located 3.5 miles from the [redacted] substation at [redacted]

This report documents the basis for and the results of this system impact study for the GI #747 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 system impact study requirements of the Idaho Power Tariff.

2.0 Summary

The feasibility of interconnecting the 1500 kW [redacted] project to IPC's [redacted] substation was evaluated.

The proposed POI provided is in [redacted]16 feeder service territory.

[redacted]16 already hosts 400 kW of customer generation at various locations on the feeder. The addition of 1500 kW [redacted] GI#747 will require the installation of a deadline check at the the distribution recloser [redacted].

The POI ([redacted]) is currently served by three phase 12.47 kV distribution.

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

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

The total preliminary cost estimate to interconnect the [redacted] project to the POI at [redacted] on the [redacted] distribution feeder is $285,090 and includes the following tasks:

- Install a four-pole 12.5 kV 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] distribution recloser, [redacted]

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 System Impact Study

The Interconnection System Impact Study was done and prepared in accordance with Idaho Power Company Standard Generator Interconnection Procedures to provide an evaluation of the system impacts of the interconnection of the proposed generating project to the Idaho Power system. As listed in the Interconnection System Impact Study agreement, the Interconnection System Impact Study report provides the following information:

- identification of additional transformer load tap changer operations, voltage fluctuations (flicker) and additional feeder losses.
- identification of required reactive power support.
- identification of islanding conditions.
- identification of any circuit breaker short circuit capability limits exceeded as a result of the interconnection.
- identification of any thermal overload or voltage limit violations resulting from the interconnection.
- 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 #747, consists of a single POI with [redacted] has requested to connect to Idaho Power's 12.5 kV distribution system. [redacted] requested that 1500 kW injection at the POI be studied.

5.0 Description of Transmission Facilities

The Project, GI #747, is in IPCO's Southern load serving area and does not directly impact any monitored transmission path.

6.0 Description of Substation Facilities

Idaho Power's [redacted] station is located in [redacted], Idaho. [redacted] station is fed by a 138 kV transmission line. The substation transformer feeding [redacted], [redacted], is a three-phase

138-12.5/7.2 kV delta wye-grounded transformer rated for 44.8 MVA. [redacted] currently serves [redacted] 12.5 kV distribution feeders: [redacted], [redacted], [redacted], and [redacted].

7.0 Description of Distribution Facilities

The Project was studied with a 12.5 kV connection to [redacted]. This is a grounded-wye feeder operating at 12.5 kV. 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] 12.5kV Generator POI:

SLG Fault (A)	717.6
LL Fault (A)	1020.5
3PH Fault (A)	1193.2

Fault Duty at [redacted] 12.5kV Generator POI Without Generator Online:

SLG Fault (A)	646.5
LL Fault (A)	753.2
3PH Fault (A)	871.5

Fault Duty at [redacted] Substation:

SLG Fault (A)	12943.1
LL Fault (A)	11166.1
3PH Fault (A)	13579.8

Fault Duty at [redacted] Substation Without Generator Online:

SLG Fault (A)	12726.3
LL Fault (A)	10889.4
3PH Fault (A)	13269.4

The protection package would be a standard SEL-421 interconnection relay, setup with a standard 4-pole installation. The 4-pole setup includes a 3-phase PT on the IPC side of the recloser and a single-phase PT on the customer side of the recloser for dead-checking prior to recloser closing.

Additionally, dead-line check will need to be installed at the distribution recloser, [redacted].

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

9.0 Description of Required Facility Upgrades

The following upgrades will be required to IPC-owned facilities to facilitate the interconnection of GI #747:

- Install a four-pole 12.5 kV 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] recloser for deadline check

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

Table 1 Conceptual-level POI Cost Estimate for GI #747

Item of Work	Estimate
Generation interconnection and protection package	$ 200,000
Substation upgrades	$ 0
Distribution upgrades	$ 15,000
Transmission upgrades	$ 0
Unloaded costs	$ 215,000
20% Contingency (1)	$ 43,000
Total unloaded costs	$ 258,000
Overheads (2)	$ 27,090
Total Conceptual-level Cost Estimate in 2024 dollars (3)	**$ 285,090**

(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

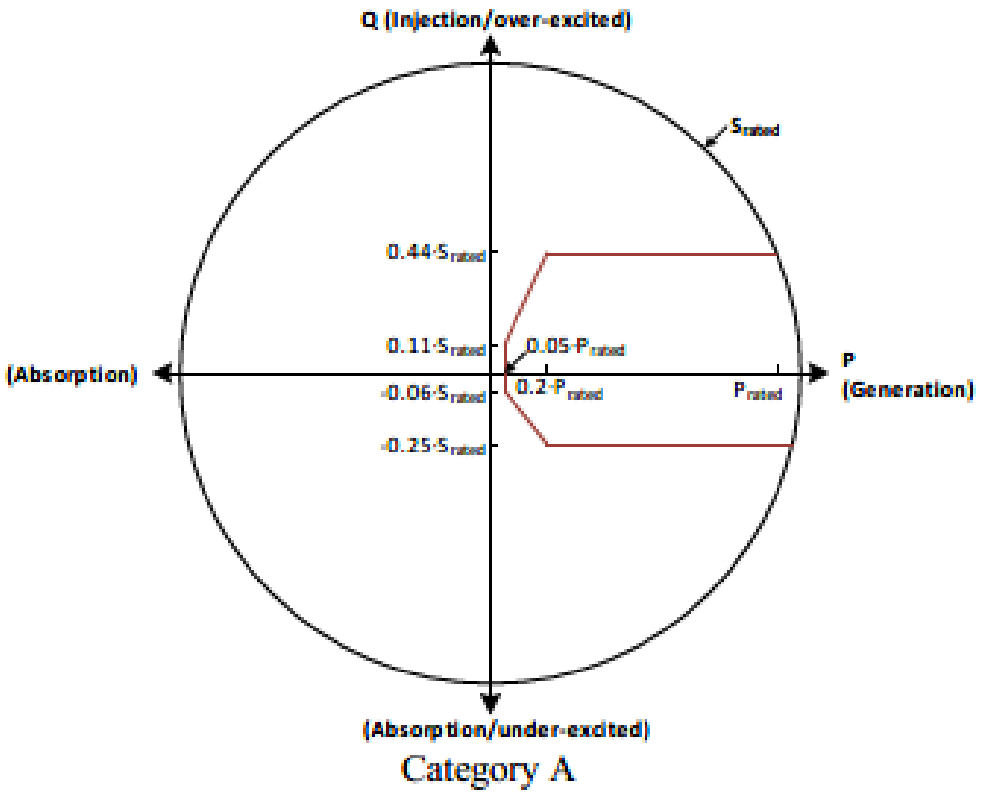

Figure 1 Operating requirements (IEEE 1547-2018)

The Project shall be capable of injecting reactive power (over-excited) equal to 825 kVAR and absorbing reactive power (under-excited) equal to 468.75 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. This is the requirement for the entire project and not just one generator. For clarification:

- Between 20% and 100% of nameplate active power, each generator shall be capable of supporting 275 kVAr and absorbing reactive power of 156.25 kVAr.
- Between 20% and 100% of nameplate active power, two generators shall be capable of supporting 550 kVAr and absorbing reactive power of 312.5 kVAr.
- Between 20% and 100% of nameplate active system power, when all three generators are available, the system shall be capable of supporting 825 kVAr and absorbing reactive power of 468.75 kVAr.

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.*

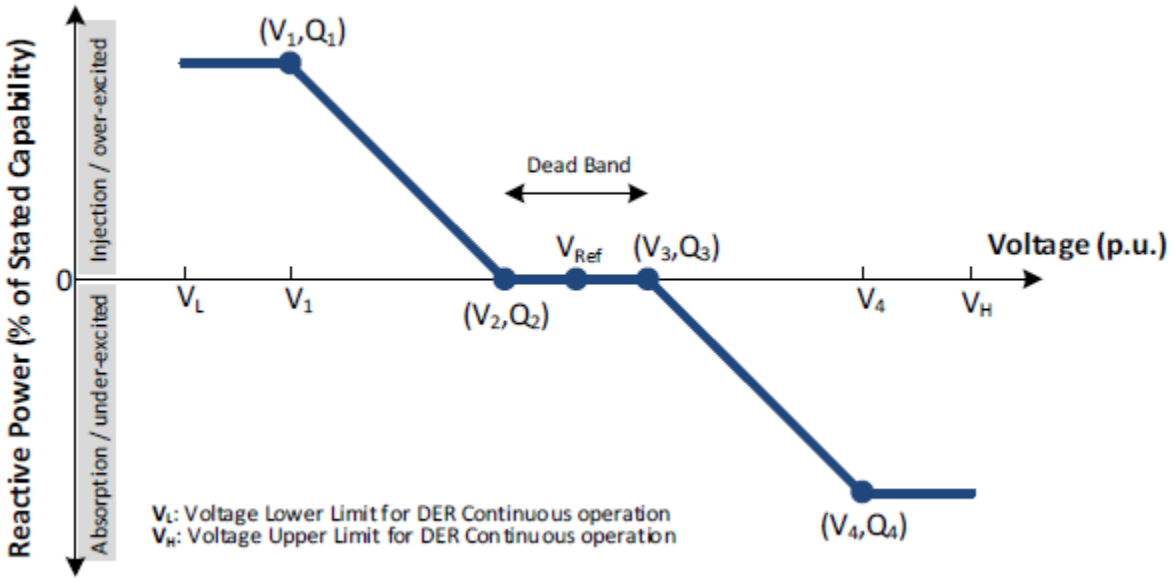

Figure 2 Voltage-Reactive Power Settings (IEEE 1547-2018)

The Project will be required to follow a voltage-reactive power characteristic curve as shown in figure 2. Also, the Project will be required to control voltage in accordance with a voltage schedule as provided by Idaho Power Grid Operations in Figure 3.

Set Point	V (pu)	Set Point	Q (pu)
V1	0.940	Q1	44%, injecting
V2	0.980	Q2	0
V3	1.020	Q3	0
V4	1.060	Q4	25%, absorption

Figure 3 Votlage Schedule Requirements

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*.

The Project shall be capable of anti-islanding and is the responsibility of [redacted] to ensure this capability is maintained.

11.0 Conclusion

The requested interconnection of the [redacted] project, GI #747, to Idaho Power's system was studied. The project will interconnect to [redacted] feeder at the 12.5 kV distribution voltage level.

The results of this study confirm that it is feasible to interconnect the [redacted] project, GI #747, to the Idaho Power system with the identified upgrades. A four-pole generation interconnect package at the POI and deadline check at the [redacted] distribution recloser are required to integrate the 1500 kW project. Operating Requirements will require the generator to provide leading and lagging reactive power as detailed in section 10.0 of this report.The Project will also need to comply with the voltage schedule required by IPC and maintain anti-islanding capabilities.

The estimated cost to interconnect GI #747 to the IPC system at the [redacted] feeder at the 12.5 kV point of interconnection considered in this study is approximately $285,090 at the POI.

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,

https://docs.idahopower.com/pdfs/BusinessToBusiness/FacConnReq.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 #747 Site Location

Figure 2 POI of [redacted] - GI #747