

**GENERATOR INTERCONNECTION  
SYSTEM IMPACT STUDY REPORT**

for integration of the proposed

**750 kW [REDACTED] PROJECT**

**IPC PROJECT QUEUE #548**

to the

**IDAHO POWER COMPANY ELECTRICAL SYSTEM**

for

[REDACTED]

**REPORT 1.0**

**February, 2020**

**OFFICIAL USE ONLY**

This report contains Idaho Power Company Critical Energy Infrastructure Information (CEII). Distribution of this report must be limited to parties that have entered into a non-disclosure agreement with Idaho Power Company and have a need to know.

## Revision History

Date	Revision	Initials	Summary of Changes
2/26/20	0	DLJ	SIS GI #548 – Original issue.

██████████ Project  
System Impact Study Report

OFFICIAL USE ONLY

This report contains Idaho Power Company Critical Energy Infrastructure Information (CEII). Distribution of this report must be limited to parties that have entered into a non-disclosure agreement with Idaho Power Company and have a need to know.

# Table of Contents

1.0	Introduction.....	1
2.0	Summary .....	1
3.0	Scope of Interconnection Transmission System Impact Study.....	3
4.0	Description of Proposed Generating Project.....	3
5.0	Description of Transmission Facilities .....	3
6.0	Description of Power Flow Case .....	3
7.0	Power Flow Analysis Study Results .....	4
8.0	Description of Substation Facilities .....	4
9.0	Description of Distribution Facilities.....	4
10.0	Short Circuit Study Results.....	4
11.0	Description of Required Facility Upgrades .....	5
12.0	Description of Operating Requirements .....	8
13.0	Conclusion .....	9
	APPENDIX A.....	10
	A-1.0 Method of Study .....	10
	A-2.0 Acceptability Criteria .....	10
	A-3.0 Grounding Guidance.....	11
	A-4.0 Electrical System Protection Guidance .....	11
	A-5.0 WECC Coordinated Off-Nominal Frequency Load Shedding and Restoration Requirements .....	11

██████████ Project  
System Impact Study Report

## OFFICIAL USE ONLY

This report contains Idaho Power Company Critical Energy Infrastructure Information (CEII). Distribution of this report must be limited to parties that have entered into a non-disclosure agreement with Idaho Power Company and have a need to know.

██████████ Project  
System Impact Study Report

OFFICIAL USE ONLY

This report contains Idaho Power Company Critical Energy Infrastructure Information (CEII). Distribution of this report must be limited to parties that have entered into a non-disclosure agreement with Idaho Power Company and have a need to know.

## List of Tables

Table 1: GI #548 Short Circuit Currents, POI .....	4
Table 2: Conceptual-level Primary POI Cost Estimate for GI #548 .....	6
Table 3: Conceptual-level Alternate POI Cost Estimate for GI #548 .....	7

## List of Figures

Figure 1: Operating Requirements (IEEE 1547-2018) .....	8
Figure 2: [REDACTED] GI #548 Site Location .....	12
Figure 3: Alternate POI of [REDACTED] - GI#548 .....	13

## 1.0 Introduction

██████████ has contracted with Idaho Power Company (IPC) to perform a Generator Interconnection System Impact Study for the integration of the proposed 750 kW ██████████ project (the Project). The Project is located in IPC's Eastern Region at ██████████ in ██████████ County, Idaho with an alternative POI at ██████████ (See Figure 2: Primary POI of ██████████ – GI # 548 and Figure 3: Alternate POI of ██████████ – 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 ██████████ distribution voltage level. The POI is located ██████████ from the ██████████ (██████████) substation at ██████████.

This report documents the basis for and the results of this system impact 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 system impact of interconnecting the 750 kW Project to IPC's ██████████ substation was evaluated.

The proposed primary and alternative POI provided is in ██████████ feeder service territory.

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

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

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

The preliminary power flow analysis indicated that interconnecting the ██████████ Project to ██████████ will not adversely impact the IPC system with the upgrades detailed in this report. Additionally, Operating Requirements will

██████████ Project

require the generator to provide leading and lagging reactive power as detailed in section 12.0 of this report

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

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.

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.

[REDACTED] Project

System Impact Study Report

2

OFFICIAL USE ONLY

This report contains Idaho Power Company Critical Energy Infrastructure Information (CEII). Distribution of this report must be limited to parties that have entered into a non-disclosure agreement with Idaho Power Company and have a need to know.

### 3.0 Scope of Interconnection Transmission System Impact Study

The Interconnection Transmission System Impact Study was completed, 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 Transmission System Impact Study agreement, the Interconnection Transmission 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 this 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

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

### 5.0 Description of Transmission Facilities

The ██████████ substation is fed radially from the ██████████ transmission line and is located in the ██████████ Area.

### 6.0 Description of Power Flow Case

The Project was studied using DNV-GL Synergi load flow analysis software to analyze the impact to the ██████████ distribution feeder. The Project was studied at peak load and minimum load conditions with all generators on the feeder generating at 100% output. The model included approximately ██████████ (primary POI) and

██████████ Project



[REDACTED] (alternate POI) of upgraded 3-phase #4 ASCR conductor on the feeder to the Project POI. The Project was also reviewed for potential impacts on the IPC transmission system.

**7.0 Power Flow Analysis Study Results**

The modeling studies showed that using #4 ASCR conductor will ensure that voltage requirements should be met at the POI, even during periods of light load and peak Project output. Modeling showed that smaller conductor will satisfy the voltage requirements at the POI.

The impact of the proposed Project on the IPC transmission system was analyzed. Due to the size and location of this Project, the review determined that there would not be an adverse impact on the IPC transmission system. The generation at this location does not cross any IPC transmission paths nor will it impact operation of any IPC transmission paths.

**8.0 Description of Substation Facilities**

Idaho Power’s [REDACTED] station is located in [REDACTED] County, Idaho. [REDACTED] station is fed by a [REDACTED] transmission line. The substation transformer feeding [REDACTED], [REDACTED] T061, is a three-phase [REDACTED] delta wye-grounded transformer rated for 6.25 MVA. [REDACTED] T061 currently serves two [REDACTED] distribution feeders: [REDACTED] and [REDACTED].

**9.0 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.

**10.0 Short Circuit Study Results**

	Feeder Breaker	POI
Without the Project	104 A	108 A
With the Project	169 A	179 A

**Table 1: GI #548 Short Circuit Currents, POI**

[REDACTED] Project

This report contains Idaho Power Company Critical Energy Infrastructure Information (CEII). Distribution of this report must be limited to parties that have entered into a non-disclosure agreement with Idaho Power Company and have a need to know.

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. Since the interconnection is less than 3MW, the protection package will not require a remote access communication connection.

Additionally, dead-line check will need to be installed at the [REDACTED] substation for [REDACTED].

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

**11.0 Description of Required Facility Upgrades**

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 [REDACTED] from the nearest 3 phase [REDACTED] service to the POI.
- Alternate POI: Extend the existing [REDACTED] #4 ACSR line section for approximately [REDACTED] from the nearest 3 phase [REDACTED] service to the alternative POI.

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

Item of Work	Estimate
Generation interconnection and protection package	\$ 203,000
Substation upgrades	\$ 11,600
Distribution upgrades	\$ 272,600

[REDACTED] Project

This report contains Idaho Power Company Critical Energy Infrastructure Information (CEII). Distribution of this report must be limited to parties that have entered into a non-disclosure agreement with Idaho Power Company and have a need to know.

<b>Item of Work</b>	<b>Estimate</b>
Transmission upgrades	\$ TBD
Unloaded costs	\$ 487,200
20% Contingency (1)	\$ 97,440
Total unloaded costs	\$ 584,640
Overheads (2)	\$ 86,234
<b>Total Conceptual-level Cost Estimate in 2019 dollars (3)</b>	<b>\$ 670,874</b>

**Table 2: Conceptual-level Primary POI Cost Estimate for GI #548**

(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.

<b>Item of Work</b>	<b>Estimate</b>
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

██████████ Project

System Impact Study Report

**OFFICIAL USE ONLY**

This report contains Idaho Power Company Critical Energy Infrastructure Information (CEII). Distribution of this report must be limited to parties that have entered into a non-disclosure agreement with Idaho Power Company and have a need to know.

Item of Work	Estimate
<b>Total Conceptual-level Cost Estimate in 2019 dollars (3)</b>	<b>\$ 327,451</b>

**Table 3: Conceptual-level Alternate POI Cost Estimate for GI #548**

(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.

## 12.0 Description of Operating Requirements

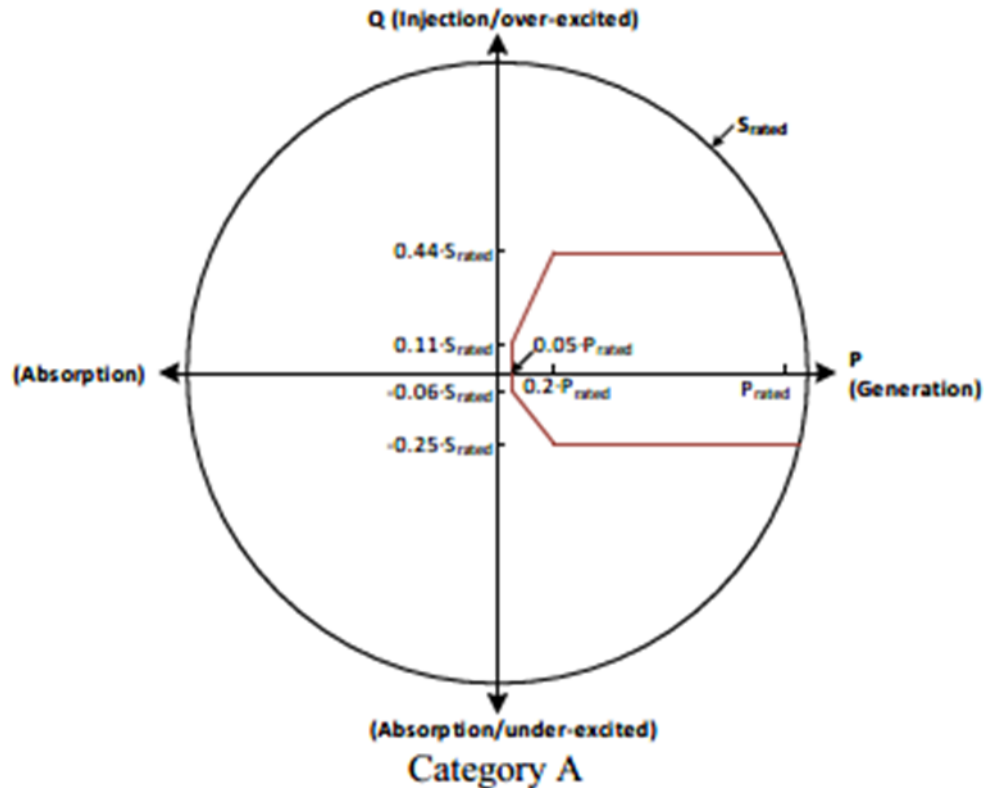


Figure 1: Operating Requirements (IEEE 1547-2018)

The Project shall be capable of injecting reactive power (over-excited) equal to 1.026 MVAR and absorbing reactive power (under-excited) equal to 0.583 MVAR 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.

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*.

██████████ Project

This report contains Idaho Power Company Critical Energy Infrastructure Information (CEII). Distribution of this report must be limited to parties that have entered into a non-disclosure agreement with Idaho Power Company and have a need to know.

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.

### 13.0 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 GI #548, [REDACTED] will not adversely impact the IPC system with the upgrades detailed in this report. A four-pole generation interconnect package at the POI, adding [REDACTED] or [REDACTED] 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. Operating Requirements will require the generator to provide leading and lagging reactive power as detailed in section 12.0 of this report.

All generation Projects in the area ahead of the Project in the IPC generation interconnection queue and their associated transmission system improvements were included in this study.

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.

[REDACTED] Project

System Impact Study Report

9

OFFICIAL USE ONLY

This report contains Idaho Power Company Critical Energy Infrastructure Information (CEII). Distribution of this report must be limited to parties that have entered into a non-disclosure agreement with Idaho Power Company and have a need to know.

## APPENDIX A

### A-1.0 Method of Study

The Transmission System Impact Study plan inserts the Project up to the maximum requested injection into the selected Western Electricity Coordinating Council (WECC) power flow case and then, using Power World Simulator or GE's Positive Sequence Load Flow (PSLF) analysis tool, examines the impacts of the new resource on Idaho Power's transmission system (lines, transformers, etc.) within the study area under various operating and outage scenarios. The WECC and Idaho Power reliability criteria and Idaho Power operating procedures were used to determine the acceptability of the configurations considered. The WECC case is a recent case modified to simulate stressed but reasonable pre-contingency energy transfers utilizing the IPC system. For distribution feeder analysis, Idaho Power utilizes DNV·GL's Synergi Electric 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 that, in part, 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 on the distribution system 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**



**Figure 2:**  **GI #548 Site Location**

 Project

System Impact Study Report

**OFFICIAL USE ONLY**

This report contains Idaho Power Company Critical Energy Infrastructure Information (CEII). Distribution of this report must be limited to parties that have entered into a non-disclosure agreement with Idaho Power Company and have a need to know.

Figure 3: Alternate POI of [REDACTED] - GI#548

[REDACTED] Project  
System Impact Study Report

13

OFFICIAL USE ONLY

This report contains Idaho Power Company Critical Energy Infrastructure Information (CEII). Distribution of this report must be limited to parties that have entered into a non-disclosure agreement with Idaho Power Company and have a need to know.