GENERATOR INTERCONNECTION

FEASIBILITY STUDY REPORT

for integration of the proposed

5 MW [redacted] PROJECT

IPC PROJECT QUEUE #566

to the

IDAHO POWER COMPANY ELECTRICAL SYSTEM

for

[redacted]

REPORT v.0

February, 2020

Revision History

Date	Revision	Initials	Summary of Changes
1/09/2020	0	PMA	FeSR GI #566 – Original issue.

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1.0 Introduction

[redacted] has contracted with Idaho Power Company (IPC) to perform a Generator Interconnection Feasibility Study for the integration of the proposed 5 MW [redacted] (the Project). The Project is proposed to be in IPC's Western Region near [redacted] in Malheur County, Oregon (See Figure 2: Location of [redacted] Project – GI # 566 in Appendix B). The project latitude and longitude are approximately [redacted] with a proposed Point of Interconnection (POI) of approximately [redacted]. The Project is Generation Interconnect queue number 566 (GI #566).

The Project has applied to connect to the Idaho Power distribution system for an injection of 5 MW at a single POI at 12.47 kilovolts (kV). The POI evaluated is in the [redacted] distribution circuit boundary.

This report documents the basis for and the results of this feasibility study for the GI #566 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 5 MW [redacted] Project to IPC's 12.47 kV [redacted] distribution circuit was evaluated. The POI evaluated is approximately located at [redacted].

The power flow analysis indicated that interconnecting the [redacted] Project to [redacted] is feasible with the modifications discussed in this report.

The Project will be required to control voltage in accordance with a voltage schedule as provided by Idaho Power Grid Operations. Advanced inverter functionality such as Volt/VAr control can be used to meet the voltage schedule. Therefore, GI #566 will be required to install a plant controller for managing the real and reactive power output of the 5 MW inverter array at the project POI. The project will need to meet the reactive power requirements for the interconnection. This is often accomplished by increasing the inverter count or increasing the inverter size.

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 System Impact Studies will provide more detail regarding any network or system upgrades needed to interconnect the [redacted] Project. Significant system upgrades assigned

to senior generator interconnection applications in the queue may influence the system upgrades that may be needed to support this project.

The total preliminary cost estimate to interconnect the [redacted] Project to the [redacted] distribution circuit is $760,725, and includes the following tasks:

- Install a four-pole 12.47 kV generation interconnection package at the POI. This includes an SEL-421 protective relay, which requires 3-phase potential transformers (PTs), 3-phase current transformers (CTs), SCADA and remote connectivity
- Install a single-phase PT and wiring for dead-line check at recloser [redacted]
- Upgrade line switches [redacted] and [redacted] from 300 amp to 600 amp
- Upgrade three phase voltage regulator [redacted] to 438 amp
- Rebuild approximately 1950'of single phase [redacted] distribution circuit to three phase [redacted]
- Rebuild approximately 5430' of three phase [redacted] distribution circuit to three phase [redacted]

The cost estimate includes direct equipment and installation labor costs, indirect labor costs and general overheads. The estimate includes 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 estimate of $760,725 does not include the cost of the customer's owned equipment to construct the solar generation site, required communication circuits or transmission system upgrades that may be required.

Transmission system upgrades might be required for projects ahead in the queue of this project, GI #566. The system upgrades assigned to projects ahead of GI #566 will be modeled in the system impact study for GI #566, if the project chooses to move forward. In the scenario that a project(s) in the queue prior to this project withdraws or falls out of the queue, the system impact study for this project will need to be reevaluated and potentially re-studied. This may result in additional required system upgrades for GI #566.

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

The proposed [redacted] Project, GI #566, consists of a 5 MW photovoltaic solar plant which requested to be connected to Idaho Power's 12.47 kV [redacted] distribution circuit. The project will need to install a plant controller for managing the real and reactive power output. The supplied single line drawing shows the project using [redacted] inverters. There are two inverter stations. Each station is connected via a 2800 kVA grounded-wye grounded-wye transformer. Each inverter station consists of 23 inverters totaling 2875 kVA.

5.0 Description of Transmission Facilities

Preliminary power flow analysis indicated that interconnection of a 5 MW injection at the POI considered in this study is feasible with the recommended modifications. A Transmission System Impact Study will be required to determine the specific network upgrades required to integrate the project output of 5 MW.

6.0 Description of Substation Facilities

Idaho Power's [redacted] substation is in Malheur County, Oregon. The existing substation transformer feeding [redacted], is a three phase 138-13.09/7.56 kV transformer rated for 30 MVA.

7.0 Description of Distribution Facilities

The requested POI for the Project is on the [redacted] distribution circuit. This is a grounded-wye circuit operating at 12.47 kV at the POI. The Project must have a grounded-wye transformer connection on the IPC side, as well as a wye or grounded wye connection on the Project side of the transformer. Modifications to the distribution facilities will be required to integrate the project output of 5 MW. Under daytime light load conditions with both [redacted] and [redacted] operating, facility capacity ratings will be exceeded. These include the [redacted] conductor along [redacted], two switches and a voltage regulator. The conductor along [redacted] will need to be upgraded to [redacted] conductor, the two switches upgraded to 600 amp and the voltage regulator upgraded to 438 amps. Additionally, the line from the POI to the [redacted] POI will need to be upgraded from a single phase [redacted] conductor to three phase [redacted] conductor. The locations of the conductor upgrades can be seen in Figure 3: Location of [redacted] Project Conductor Upgrades– GI # 566 in Appendix B.

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

8.0 Short Circuit Study Results

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

9.0 Description of Required Facility Upgrades

The Project will be required to provide a plant controller that will operate the inverter system in Volt/VAr control mode. This is to regulate voltage according to a voltage schedule that will be provided by Idaho Power.

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. Additionally, a Transmission System Impact Study will be required to determine the specific network upgrades required to integrate the full project output of 5 MW. The cost of potential system upgrades would be determined during the Transmission System Impact Study and have not been included in the Feasibility Study cost estimate.

The following upgrades will be required to IPC-owned facilities to facilitate the interconnection of GI #566:

- Install a four-pole 12.47 kV generation interconnection package at the POI. This includes an SEL-421 protective relay, which requires 3-phase potential transformers (PTs), 3-phase current transformers (CTs), SCADA and remote connectivity
- Install a single-phase PT and wiring for dead-line check at recloser [redacted]
- Upgrade line switches [redacted] and [redacted] from 300 amp to 600 amp
- Upgrade three phase voltage regulator [redacted] to 438 amp
- Rebuild approximately 1950'of single phase [redacted] distribution circuit to three phase [redacted]
- Rebuild approximately 5430' of three phase [redacted] distribution circuit to three phase [redacted]

See the conceptual-level cost estimate in Table 1.

Table 1 Conceptual-level Cost Estimate for GI #566

Item of Work	Estimate
Generation interconnection and protection package	$200,000
Substation upgrades	$0
Distribution upgrades	$375,000
Transmission upgrades	TBD
Unloaded costs	$575,000
Contingency 20% (1)	$115,000
Total unloaded costs	$690,000
Overheads (2)	$70,725
Total loaded costs	$760,725
Total Conceptual-level Cost Estimate in 2020 dollars (3)	**$760,725**

(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, and overheads as shown.

- Note that these estimates do not include the cost of the customer's equipment/facilities or required communication circuits for SCADA, and metering.
- 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) and absorbing reactive power (under-excited) equal to 2.2 MVAR at all active power output between 20% and 100% of nameplate active power rating.

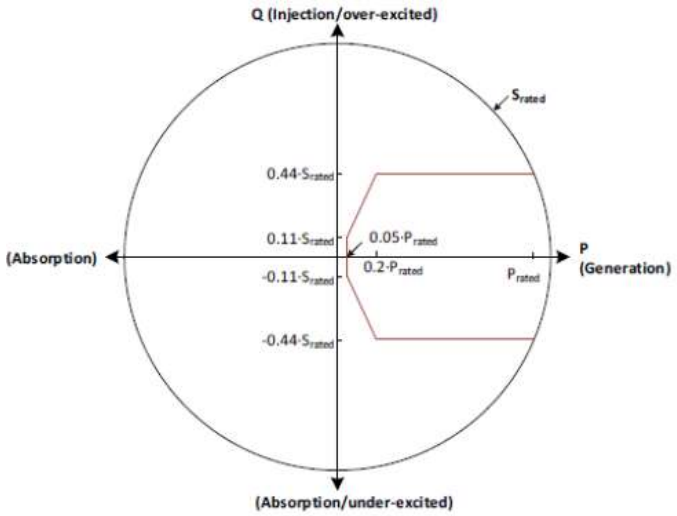

Figure 1 Operating requirements (IEEE 1547-2018)

Idaho Power has determined that the inverter selected by the Project does meet the reactive power capability requirements.

The Project will be required to control voltage in accordance with a voltage schedule as provided by Idaho Power Grid Operations. Therefore, GI #566 will be required to install a plant controller for managing the real and reactive power output of the 5 MW inverter array at the project POI.

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 #566, to Idaho Power's system was studied. The project will need to interconnect using a 12.47 kV grounded-wye connection to the [redacted] 12.47 kV distribution feeder. The results of this study work confirm that it is feasible to interconnect the [redacted] Project, GI #566, to the existing Idaho Power system with the modifications listed. A four-pole generation interconnect package with SCADA, and a dead-line check are required to integrate the 5 MW 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 #566. 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 #566 to the IPC system at the 12.47 kV point of interconnection considered in this study is approximately $760,725. The cost of potential system upgrades would be determined during the Transmission System Impact Study and have not been included in the Feasibility Study cost estimate.

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 circuit 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. These guidelines state, 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 point of interconnection, 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 or 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

APPENDIX B

[redacted]