GENERATOR INTERCONNECTION

FEASIBILITY STUDY REPORT

for integration of the proposed

3 MW [redacted]

IPC PROJECT QUEUE #532

to the

IDAHO POWER COMPANY ELECTRICAL SYSTEM

for

[redacted]

REPORT v.0

July 18, 2018

Revision History

Date	Revision	Initials	Summary of Changes
07/18/2016	0	PMA	FeSR GI #532 – 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 3 MW [redacted] (the Project). The Project is located in IPC's Western Region [redacted] in Malheur County, Oregon (See Figure 2: Location of [redacted] – GI # 532 in Appendix A). The project latitude and longitude are approximately [redacted]. The Project is Generation Interconnect queue number 532 (GI #532).

The Project has applied to connect to the Idaho Power distribution system for an injection of 3 MW at a single Point of Interconnection (POI) at 12.47 kilovolts (kV). The POI evaluated is located in the Ontario (ONTO) 019 distribution circuit boundary approximately 0.9 miles southwest of the ONTO substation [redacted].

This report documents the basis for and the results of this feasibility study for the GI #532 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 3 MW [redacted] to IPC's 12.47 kV ONTO-019 distribution circuit was evaluated. The POI evaluated is to the east of the project approximately located at [redacted].

The power flow analysis indicated that interconnecting the [redacted] to ONTO-019 is feasible with 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. Therefore, GI #532 will be required to install a plant controller for managing the real and reactive power output of the 3 MW inverter array at the project POI. Also, the installation of a phasor measurement unit device (PMU) at the POI and the installation and maintenance costs associated with communication circuits needed to stream PMU data will be required in order to interconnect GI #532. The project will need to increase the inverter count or increase the inverter size to meet the reactive power requirements for the interconnection. The project also will need to size the step-up transformers appropriately for the total plant MVA.

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] to the ONTO-019 distribution circuit is $234,379, 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 PMU device at the POI.
- Install a single-phase PT and wiring for dead-line check on ONTO-019.
- Install Beckwith M2001-D load tap changer (LTC) controllers on the T135 transformer at ONTO substation.
- Upgrade the ONTO T023 AMI transformer.

The cost estimate includes direct equipment and installation labor costs, indirect labor costs and general overheads. The estimate does not include 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 of $234,379 does not include the cost of the customer's owned equipment to construct the solar 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

The proposed [redacted] GI #532, consists of a single 3 MW photovoltaic solar plant which requested to be connected to Idaho Power's 12.47 kV ONTO-019 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]. The drawing shows [redacted] The project will need to

increase the inverter count or increase the inverter size to meet the reactive power requirements for the interconnection. The project also will need to size the step-up transformers appropriately for the total plant MVA. The project proposes to use [redacted] photovoltaic modules.

A conductor size and type of [redacted] was assumed to connect the generating project to the POI for the study.

The Project's estimated commissioning date is [redacted].

5.0 Description of Transmission Facilities

Preliminary power flow analysis indicated that interconnection of a 3 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 full project output of 3 MW.

6.0 Description of Substation Facilities

Idaho Power's ONTO substation is located in Malheur County, Oregon. The existing substation transformer, ONTO T135, is a three-phase 138-13.09 kV transformer rated for 37 MVA.

7.0 Description of Distribution Facilities

The requested POI for the Project is on the ONTO-019 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.

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

8.0 Short Circuit Study Results

Fault Duty at ONTO (T135) 12.5 kV Bus:

SLG Fault (A)	[redacted]
3PH Fault (A)	[redacted]

Fault Duty at POI – Solar 12.5 kV Bus:

SLG Fault (A)	[redacted]
3PH Fault (A)	[redacted]

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 3 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 #532:

- 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 PMU device at the POI.
- Install a single-phase PT and wiring for dead-line check on ONTO-019.
- Install Beckwith M2001-D load tap changer (LTC) controllers on the T135 transformer at ONTO substation.
- Upgrade the ONTO T023 AMI transformer.

See the conceptual-level cost estimate in Table 1.

Table 1 Conceptual-level Cost Estimate for GI #532

Item of Work	Estimate
Generation interconnection and protection package	$191,400
Substation upgrades	$17,400
Distribution upgrades	$0
Transmission upgrades	TBD in SIS
Unloaded costs	208,800
Total unloaded costs	$208,800
Overheads (1)	$25,579
Total loaded costs	$234,379
Total Conceptual-level Cost Estimate in 2018 dollars (2)	**$234,379**

(1) Overhead costs cover the indirect costs associated with the Project.
(2) 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, PMU, 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 1.452 MVAR at all active power output between 20% and 100% of nameplate active power rating.

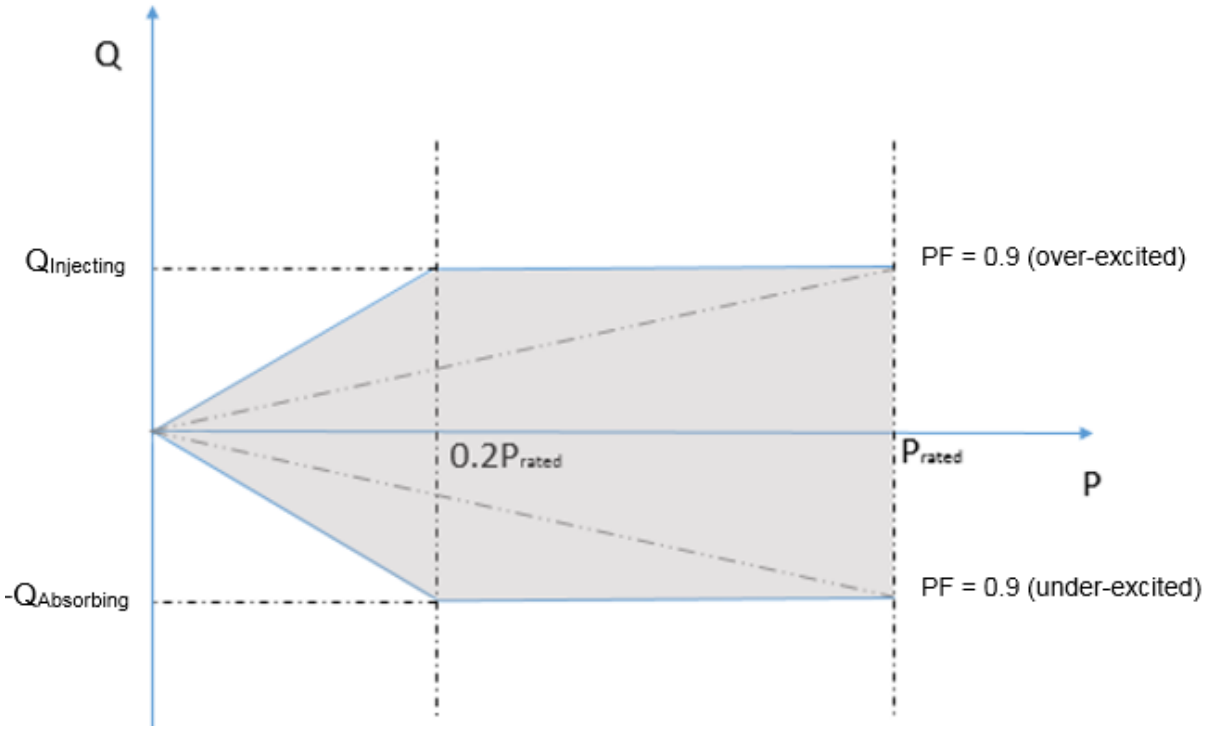

Figure 1 Operating requirements

Idaho Power has determined that the inverter selected by the Project does not meet the reactive power capability requirements. The inverter count will either need to be increased or the inverter kVA capability will need to be increased.

The Project will be required to control voltage in accordance with a voltage schedule as provided by Idaho Power Grid Operations. Therefore, GI #532 will be required to install a plant controller for managing the real and reactive power output of the 3 MW inverter array at the project POI. The installation of a PMU at the POI and maintenance costs associated with communication circuits needed to stream PMU data will also be required in order to interconnect GI #532.

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], GI #532, to Idaho Power's system was studied. The project will need to interconnect using a 12.47 kV grounded-wye connection to the ONTO-019 12.47 kV distribution feeder. The results of this study work confirm that it is feasible to interconnect the [redacted], GI #532, to the existing Idaho Power system with the modifications listed. A four-pole generation interconnect package with SCADA, a PMU, dead-line check, and a digital tap changer controls on the ONTO T135 are required to integrate the 3 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. Additionally, the project will need to increase the inverter count or increase the inverter size to meet the reactive power requirements for the interconnection. The project also will need to size the step-up transformers appropriately for the total plant MVA.

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 #532. 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 #532 to the IPC system at the 12.47 kV point of interconnection considered in this study is approximately $234,379.

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. 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 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

B-1.0 [redacted] GL #532 Site Locations

[redacted]