GENERATOR INTERCONNECTION

FEASIBILITY STUDY REPORT

for integration of the proposed

3 MW [redacted]

IPC PROJECT QUEUE #520

to the

IDAHO POWER COMPANY ELECTRICAL SYSTEM

for

[redacted]

REPORT v.0

February 28, 2017

Revision History

Date	Revision	Initials	Summary of Changes
02/28/2016	0	PMA	FeSR GI #520 – 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 # 520 in Appendix B). The project latitude and longitude are approximately [redacted]. The Project is Generation Interconnect queue number 520 (GI #520).

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 is located in the Ontario (ONTO) 024 distribution feeder boundary [redacted] of the ONTO substation. The POI latitude and longitude are approximately [redacted].

This report documents the basis for and the results of this feasibility study for the GI #520 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-024 distribution feeder was evaluated. The POI is located at [redacted].

The power flow analysis indicated that interconnecting the [redacted] to ONTO-024 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 #520 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 #520.

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-024 distribution feeder is $849,816, 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), and remote connectivity. Additionally, a single-phase PT shall be installed on the interconnect customer side of the IPC recloser.
- Reconductor approximately 2.25 miles from the POI [redacted] from #4 ACSR to 795 AAC.
- Replace recloser ONTO24R70X with an electronic recloser. Additionally, a single-phase PT shall be installed on the interconnect customer side of the recloser for deadline check.
- Install a PMU device at the POI.
- Install a single-phase PT and wiring for dead-line check on ONTO-024.
- Install Beckwith M2001-D load tap changer (LTC) controllers on the T134 transformer at ONTO substation.
- Upgrade the ONTO T022 AMI transformer.

The cost estimate includes direct equipment and installation labor costs, indirect labor costs and general overheads, and 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 $849,816 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

[redacted], GI #520, consists of a single 3 MW photovoltaic solar plant which requested to be connected to Idaho Power's 12.47 kV ONTO-024 distribution feeder. The Project will need to install a grid connection control system for managing the real and reactive power output of the [redacted] inverters. The design drawing shows sets of [redacted] with fused disconnects to step-up the voltage from 480 V to 12.00 kV. The solar plant will need to size the step-up transformers appropriately for the total plant MVA as well as the 12.47 kV connection. Additionally, the design drawing shows grounded wye delta transformers. Idaho Power will require grounded wye grounded wye or wye grounded wye with the ground on the utility side. The project will use [redacted] photovoltaic modules per inverter, for a total [redacted]

The Project's projected in-service date was not included in the GI application.

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. 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 T134, is a three-phase 138-13.09 kV transformer rated for 30 MVA.

7.0 Description of Distribution Facilities

The requested POI for the Project is on the ONTO-024 distribution feeder. This is a grounded-wye feeder 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 connection on the Project side of the transformer.

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 in order 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 #520:

- 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), and remote connectivity. Additionally, a single-phase PT shall be installed on the interconnect customer side of the IPC recloser.
- Reconducto approximately 2.25 miles from the POI [redacted] from #4 ACSR to 795 AAC.
- Replace recloser ONTO24R70X with an electronic recloser. Additionally, a single-phase PT shall be installed on the interconnect customer side of the recloser for deadline check.
- Install a PMU device at the POI.
- Install a single-phase PT and wiring for dead-line check on ONTO-024.
- Install Beckwith M2001-D load tap changer (LTC) controllers on the T134 transformer at ONTO substation.
- Upgrade the ONTO T022 AMI transformer.

See the conceptual-level cost estimate in Table 1.

Table 1 Conceptual-level Cost Estimate for GI #520

Item of Work	Estimate
Generation interconnection and protection package	$174,000
Substation upgrades	$5,800
Distribution upgrades	$464,000
Transmission upgrades	TBD in SIS
Unloaded costs	643,800
Contingency 20% (1)	$128,760
Total unloaded costs	$772,560

Overheads (2)	$77,256
Total loaded costs	$849,816
Total Conceptual-level Cost Estimate in 2015 dollars (3)	**$849,816**

(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 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 1.45 MVAR at all active power output between 20% and 100% of nameplate active power rating.

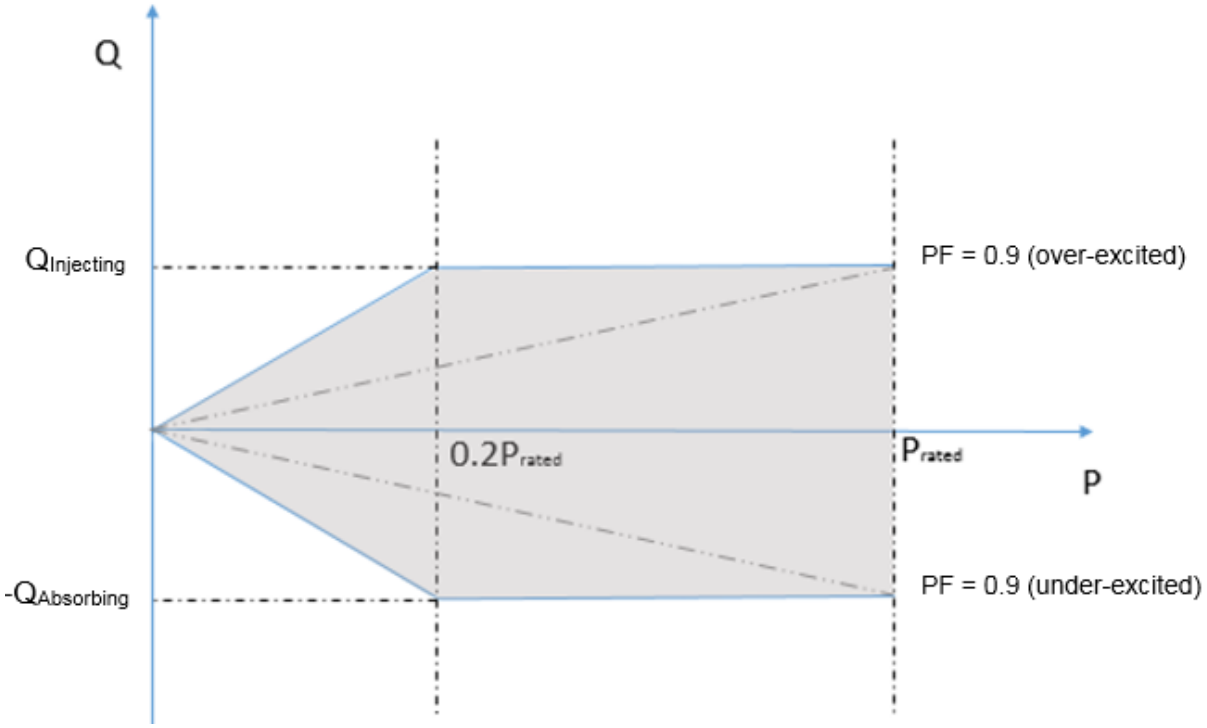

Figure 1 Operating requirements

Idaho Power has determined that the inverter selected by the Project meets 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 #520 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 #520.

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 #520, to Idaho Power's system was studied. The project will need to interconnect using a 12.47 kV grounded-wye connection to the ONTO-024 12.47 kV distribution feeder. The results of this study work confirm that it is feasible to interconnect the [redacted], GI #520, to the existing Idaho Power system with the modifications listed. A four-pole generation interconnect package, a PMU, dead-line check, and a digital tap changer controls on the ONTO T134 are required to integrate the 3 MW project as well as reconductoring approximately 2.25 miles from the POI [redacted] from #4 ACSR to 795 AAC and replacing recloser ONTO24R70X with an electronic recloser. Additionally, a single-phase PT shall be installed on the interconnect customer side of ONTO24R70X for deadline check. 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 #520. 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 #520 to the IPC system at the 12.47 kV point of interconnection considered in this study is approximately $849,816.

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

The Feasibility Study plan inserts the Project up to the maximum requested injection into the selected Western Electric Coordinating Council (WECC) power flow case and then, using Power World Simulator or GE's Positive Sequence Load Flow (PSLF) analysis tool, the impacts of the new resource on Idaho Power's transmission system (lines, transformers, etc.) within the study area are analyzed. The WECC and Idaho Power reliability criteria and Idaho Power operating procedures were used to determine the acceptability of the configurations considered. For distribution feeder analysis, Idaho Power utilizes Advantica's SynerGEE 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]GI Project #520 Site Location