GENERATOR INTERCONNECTION

FEASIBILITY STUDY REPORT

for integration of the proposed

2.333 MW [redacted]

IPC PROJECT QUEUE #526

to the

IDAHO POWER COMPANY ELECTRICAL SYSTEM

for

[redacted]

REPORT v.1

June 18, 2018

Revision History

Date	Revision	Initials	Summary of Changes
11/27/17	0	PMA	Initial Issue
6/7/2018	1	PMA	Changed POI to [redacted] [redacted]. Changed project name to [redacted]. Adjusted cost estimate to account for 0.3 miles less reconductoring.

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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 2.333 MW [redacted] project (the Project). The Project is located in IPC's Capital Region near the corner of [redacted], [redacted] in Ada County, Idaho The POI is located at latitude [redacted]. (See Figure 1: Location of [redacted] – GI #526 in Appendix B). The Project is Generation Interconnect queue number 526 (GI #526).

The Project has applied to connect to the IPC distribution system for an injection of 2.333 MW at a single Point of Interconnection (POI) at a 12.47 kV distribution voltage level. The POI is located approximately [redacted] from [redacted] substation.

This report documents the basis for and the results of this feasibility study for the GI #526 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 a 2.333 MW project to IPC's [redacted] substation was evaluated.

The preliminary power flow analysis indicated that interconnecting the [redacted] project to [redacted] is feasible with the upgrades detailed in this report. Additionally, 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 be required to control voltage in accordance with a voltage schedule as provided by Idaho Power Grid Operations.

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.

A Distribution System Impact Study will also be required.

The total preliminary cost estimate to interconnect the [redacted] project to the [redacted] substation is $614,272 and includes the following:

- Install a four-pole 12.47 kV generation interconnection package at the POI
    - This includes a 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 interconnect customer side of the IPC recloser
- Install dead-line check at the [redacted] substation for [redacted]

- Rebuild and reconductor approximately [redacted] of existing feeder with 3 phase, larger 336 AAC conductor.
- Relocate [redacted] fuses.

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 $614,272 does not include the cost of the customer's owned equipment to construct the 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 #526, consists of a single POI with a single 2.1 MW rated synchronous generator with a 10% service factor and has requested to connect to Idaho Power's 12.47 kV distribution system. The Project will use a single [redacted] The project has applied for 2.333 MW injection.

The Project's projected in-service date is August 2018.

5.0 Description of Transmission Facilities

Preliminary power flow analysis indicated that interconnection of a 2.333 MW injection at the POI considered in this study is feasible with the upgrades detailed in this report. Additionally, Operating Requirements will require the generator to provide leading and lagging reactive power as detailed in section 10.0 of this report.

A Transmission System Impact Study will be required to determine the specific network upgrades required to integrate the full project output of 2.333 MW.

6.0 Description of Substation Facilities

Idaho Power's [redacted] substation is located in Ada County, Idaho. [redacted] station is fed by a 138-kV transmission line. The existing substation transformer, [redacted], is a three-phase 138-13.09 kV delta wye-grounded transformer rated for 28 MVA. [redacted] currently serves four 12.47 kV distribution feeders: [redacted].

7.0 Description of Distribution Facilities

The Project was studied with a 12.47 kV connection to [redacted]. This is a grounded-wye feeder operating at 12.47 kV. The Project must have a grounded-wye transformer connection on the IPC side of the transformer.

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

The existing single phase and two phase portions of the IPC circuit feeding the Project will need to be rebuilt to 3 phase. Modeling studies show that using 336 AAC 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 not satisfy the voltage requirements at the POI. The model included the Project's proposed 1/0 conductor connecting the project to the POI. While the voltage at the POI remains acceptable during times of peak Project output during light load conditions, modeling indicates the Project may experience high voltage. If 4/0 conductor were used to connect the Project to the POI, modeling indicates that this would mitigate high voltage at the project. It is recommended that the Project consider using larger conductor between the Project and the POI.

8.0 Short Circuit Study Results

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

9.0 Description of Required Facility Upgrades

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.

The following upgrades will be required to IPC-owned facilities to facilitate the interconnection of GI #526:

- Install a four-pole 12.47 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 interconnect customer side of the IPC recloser
- Install dead-line check at the [redacted] substation for [redacted]

- Rebuild and reconductor approximately [redacted] of existing feeder with 3 phase, larger 336 AAC conductor.
- Relocate [redacted] and [redacted] fuses.

See the conceptual-level cost estimate in Table 1.

Table 1 - Conceptual-level Cost Estimate for GI #526

Item of Work	Estimate
Generation interconnection and protection package	$ 168,200
Substation upgrades	$ 11,600
Distribution upgrades	$ 266,800
Transmission upgrades	$ 0
Unloaded costs	$ 446,600
Contingency (1)	$ 89,320
Total unloaded costs	$ 535,920
Overheads (2)	$ 78,352
Total loaded costs	$ 614,272
Total Conceptual-level Cost Estimate in 2017 dollars (3)	**$ 614,272**

(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 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

At a rated generator power output, the Project must be able to continuously provide a power factor operating range of 0.9 leading to 0.9 lagging at the POI. The application requests a maximum physical export of 2.333 MW. The generator will be required to provide 1130 kVAr leading and 1130 kVAr lagging at the POI, based on a generator rated power output of 2.333 MW.

Identification of any additional equipment required at the plant to meet Idaho Power reactive power capability interconnection requirements will be provided in the System Impact Study.

GI #526 will be required to control voltage at the POI in accordance with a voltage schedule as provided by Idaho Power Grid Operations.

A Distribution System Impact Study will be required to evaluate the impact of the Project on (1) the number of LTC operations, (2) voltage fluctuation, (3) reactive support, (4) islanding, and (5) feeder losses and create mitigating options, and prepare costs if necessary. These preliminary results indicate that GI #526 will operate within an acceptable voltage range with the recommended upgrades. However, if the voltage falls outside of the acceptable range, reactive power and/or additional system upgrades are required to be implemented by GI #526 to aid in returning the POI voltage within the acceptable range.

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 519-1992 *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 #526, to Idaho Power's system was studied. The project will interconnect to [redacted] feeder at the 12.47 kV distribution voltage level.

The results of this study work confirm that it is feasible to interconnect the [redacted] project, GI #526, to the existing Idaho Power system with the upgrades detailed in this report. A four-pole generation interconnect package at the POI, rebuilding of approximately [redacted] of distribution line to 3 phase 336 AAC conductor, and the addition of deadline check at the [redacted] substation for [redacted] are required to integrate the 2.333 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, Operating Requirements will require the generator to provide leading and lagging reactive power as detailed in section 10.0 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 modeled in a preliminary power flow analysis to evaluate the feasibility of interconnecting GI #526. 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 #526 to the IPC system at the [redacted] feeder at the 12.47 kV point of interconnection considered in this study is approximately $614,272.

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 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, 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,

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

B-1.0 [redacted] GI Project #526 Site Location

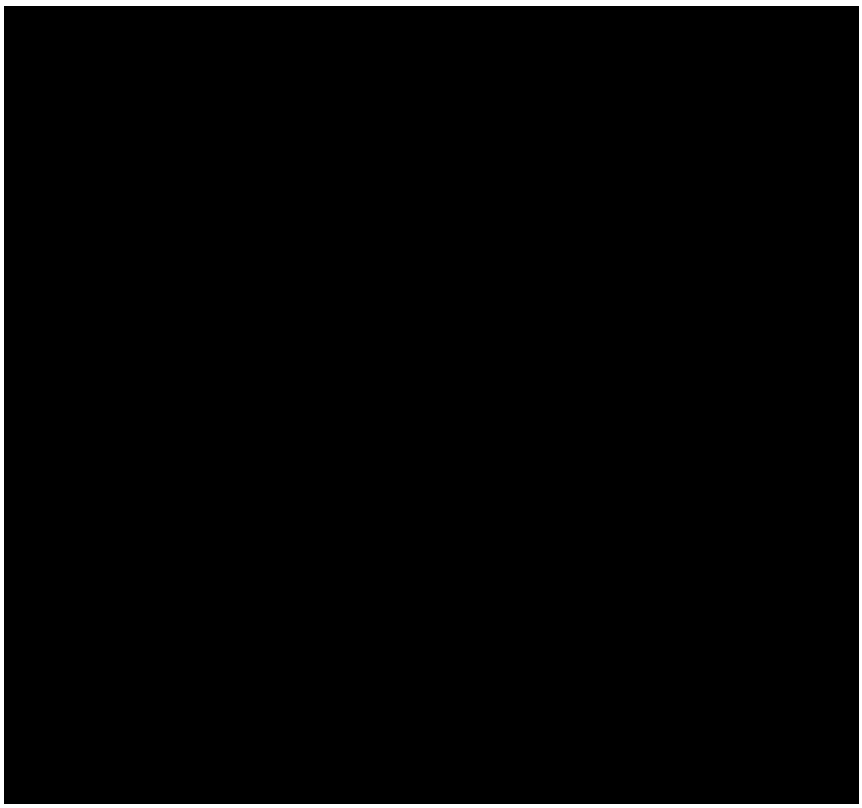

Figure 1 - Location of [redacted] – GI #526 and POI

APPENDIX C

C-1.0 [redacted] GI Project #526 Line Rebuild

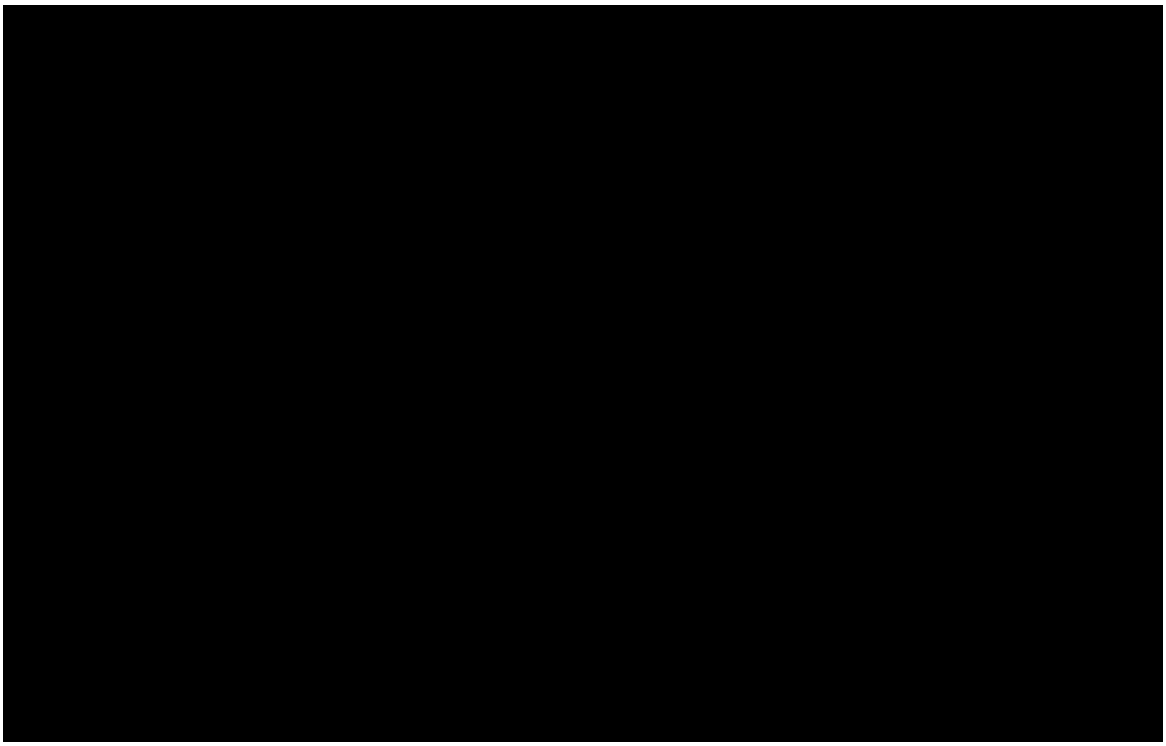

Figure 2 - GI #526 Line Rebuild