GENERATOR INTERCONNECTION

FEASIBILITY STUDY REPORT

for integration of the proposed

1.2 MW [redacted] PROJECT

IPC PROJECT QUEUE #494

to the

IDAHO POWER COMPANY ELECTRICAL SYSTEM

for

[redacted]

REPORT v.0

August 5, 2015

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
08/05/15	0	AV	Feasibility 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

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

List of Figures

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.

1.0 Introduction

[redacted] has contracted with Idaho Power Company (IPC) to perform a Generator Interconnection Feasibility Study for the integration of the proposed 1.2 MW [redacted] project (the Project). The Project is located in IPC's Southern Region approximately [redacted] of the intersection of [redacted] in [redacted] in Lincoln County, Idaho (See Figure 1: Location of [redacted] GI #494 in Appendix B). The Project is Generation Interconnect (GI) queue number 494 (GI #494).

The Project has applied to connect to the Idaho Power distribution system for an injection of 1.2 MW at a single Point of Interconnection (POI) at a 34.5 kV voltage level. The POI is located within the [redacted] feeder boundary approximately [redacted] of the [redacted] substation.

[redacted] has requested that IPC study two options for the interconnection of the project. In the first option (Option 1), the POI is at the end of the existing three phase circuit and [redacted] builds a new three phase line to the intersection of [redacted]. The coordinates used for Option 1 POI are: [redacted].

In the second option (Option 2), the POI is at the Project location and IPC rebuilds the existing single-phase circuit as a three-phase circuit (See Figure 2: Relative Location of Option 1 and Option 2 in Appendix B). The coordinates used for Option 2 POI are [redacted].

This report documents the basis for and the results of this feasibility study for the GI #494 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 1.2 MW [redacted] project to IPC's 34.5 kV [redacted] distribution feeder was evaluated.

The power flow analysis indicated that interconnecting the [redacted] project is feasible.

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.

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] project to the [redacted] distribution feeder is $297,000 for Option 1 and $753,000 for Option 2 and includes the following tasks:

Option 1

- Install a four-pole 34.5 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.
- Replace [redacted] fuse with a sectionalizer.

Option 2

- Install a four-pole 34.5 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.
- Relocate [redacted] step-down transformer 0.1 miles west of its current location.
- Rebuild 1.27 miles of existing single phase circuit with three phase circuit.
- Install a new single phase step-down transformer.
- Replace [redacted] fuse with a sectionalizer.

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 $297,000 for Option 1 and $753,000 for Option 2 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

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.

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 #494, consists of a single 1.2 MW synchronous generator which requested to connect to Idaho Power's 34.5 kV distribution system. It is located approximately [redacted] substation.

Idaho Power requires the step-up transformer to have wye-grounded to either wye-grounded or wye-ungrounded connections with the Idaho Power side always a wye-grounded connection.

Any ground fault current contribution shall be limited to 20A at the point of interconnection.

5.0 Description of Transmission Facilities

A Transmission System Impact Study will be required to determine the specific network upgrades required to integrate the full project output of 1.2 MW.

6.0 Description of Substation Facilities

Idaho Power's [redacted] substation is located in Lincoln County, Idaho. The existing substation transformer [redacted], is a 43.8-13.2 kV transformer rated for 14 MVA.

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.

7.0 Description of Distribution Facilities

The requested POI for the Project is within the [redacted] distribution feeder boundary. This is a grounded-wye feeder operating at 34.5 kV.

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

8.0 Short Circuit Study Results

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

9.0 Description of Required Facility Upgrades

In addition to a Transmission System Impact Study, 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 #494:

Option 1: POI at existing three phase circuit

- Install a four-pole 34.5 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.
- Replace [redacted] fuse with a sectionalizer.

Option 2: Three phase extension to POI

- Install a four-pole 34.5 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.
- Relocate [redacted] step-down transformer 0.1 miles west of its current location.
- Rebuild 1.27 miles of existing single phase circuit with three phase circuit.
- Install a new single phase step-down transformer.
- Replace [redacted] fuse with a sectionalizer.

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.

See the conceptual-level cost estimate in Table 1 for Option 1.

Table 1 Conceptual-level Cost Estimate for GI #494 Option 1

Item of Work	Estimate
Generation interconnection and protection package	$175,000
Substation upgrades	$6,500
Distribution upgrades	$24,500
Transmission upgrades (1)	TBD in SIS
Unloaded costs	$206,000
Contingency 20% (2)	$41,200
Total unloaded costs	$247,200
Overheads (3)	$49,800
Total loaded costs	$297,000
Total Conceptual-level Cost Estimate in 2015 dollars (4)	**$297,000**

Table 2 Conceptual-level Cost Estimate for GI #494 Option 2

Item of Work	Estimate
Generation interconnection and protection package	$175,000
Substation upgrades	$6,500
Distribution upgrades	$341,500
Transmission upgrades (1)	TBD in SIS
Unloaded costs	$523,000
Contingency 20% (2)	$104,600
Total unloaded costs	$627,600
Overheads (3)	$125,400
Total loaded costs	$753,000
Total Conceptual-level Cost Estimate in 2015 dollars (4)	**$753,000**

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.

(1) Upgrades to the 46 kV transmission system may be required and would be identified in the Transmission System Impact Study. The given estimate does not include any potential upgrades to the 46 kV system.
(2) 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.
(3) Overhead costs cover the indirect costs associated with the Project.
(4) 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 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

At rated power output (1.2 MW), the Project must be able to continuously provide a power factor operating range of 0.9 leading to 0.9 lagging at the POI.

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

Idaho Power's operations staff has raised concerns regarding the impact of the Project on (1) the number of LTC operations, (2) voltage fluctuation, (3) reactive support, (4) islanding, and (5) feeder losses. For these reasons, a Distribution System Impact Study will be required to evaluate these concerns, create mitigating options, and prepare costs. These preliminary results indicate that GI #494 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 #494 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.*

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.

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 #494, to Idaho Power's system was studied. The Project interconnection request was evaluated for two different POI, both of them to the [redacted] distribution feeder.

The results of this study work confirm that it is feasible to interconnect the [redacted] project, GI #494, to the existing Idaho Power system. 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 #494. 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 #494 to the IPC system at point of interconnection considered in this study is approximately $297,000 for Option 1 and $753,000 for Option 2.

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.

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 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 Advantica's Synergi 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.

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.

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 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

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 B

B-1.0 [redacted] GI Project #494 Site Location

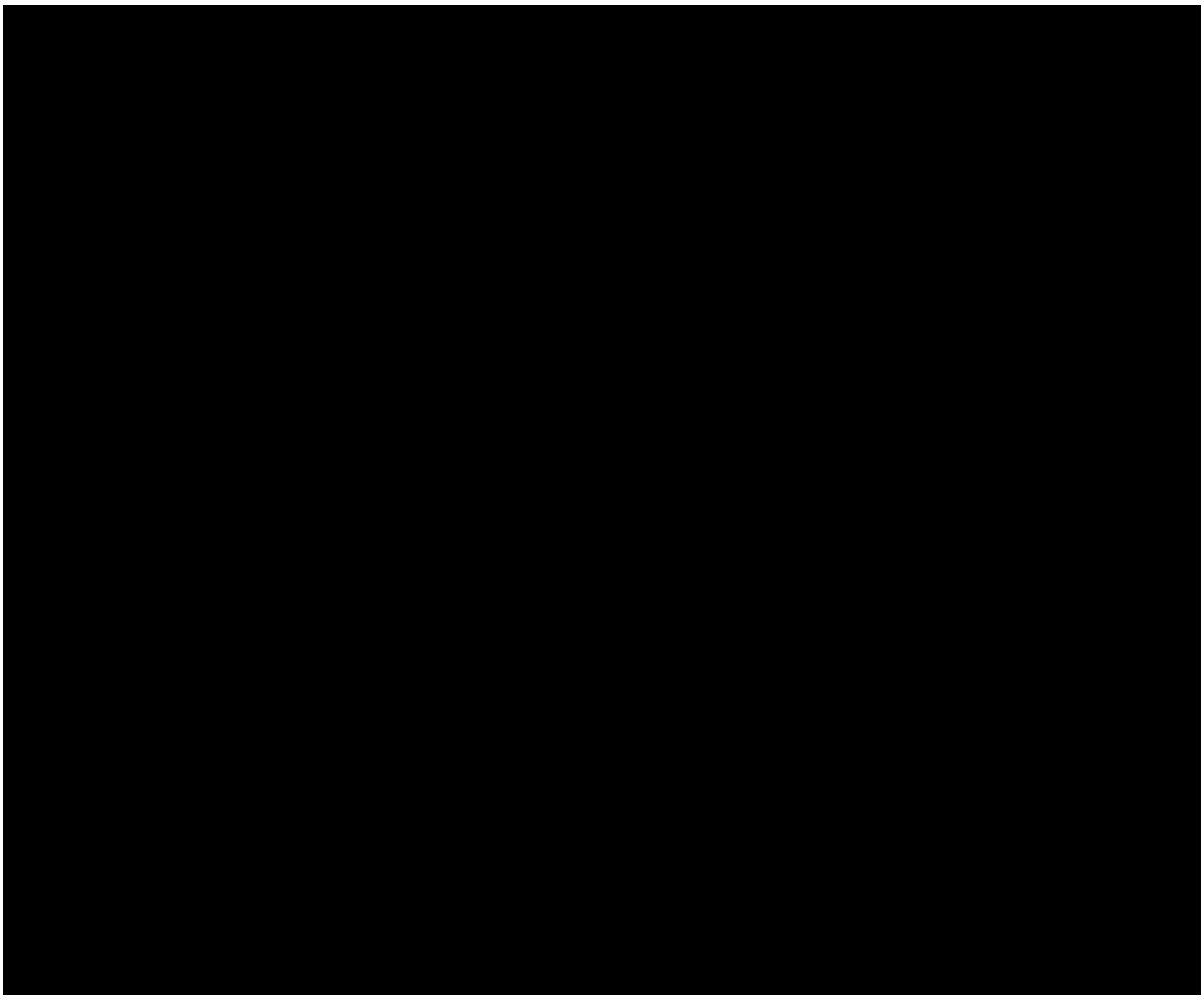

Figure 1 Location of [redacted] – GI #494

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.

B-2.0 [redacted] GI Project #494 POI Options

Figure 2 Relative Locations of Option 1 and Option 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.