GENERATOR INTERCONNECTION

TRANSMISSION AND DISTRIBUTION SYSTEM IMPACT 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

November 2, 2015

Revision History

Date	Revision	Initials	Summary of Changes
11/02/15	0	AV	SISR #494—Original Issue.

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1.0 Introduction

[redacted] has contracted with Idaho Power Company (IPC) to perform a Generator Interconnection Transmission and Distribution System Impact 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 2: [redacted] GI #494 Site Location in Appendix B). The Project is Generation Interconnect 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 approximately [redacted] of the [redacted] substation. The Project will connect to the distribution feeder [redacted].

This report documents the basis for and the results of this Transmission and Distribution System Impact 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 Transmission and Distribution System Impact Study requirements of the Idaho Power Tariff.

2.0 Critical Notes

In the Generator Interconnection Feasibility Study Report for GI #494, IPC identified the need to build approximately [redacted] of three-phase 34.5 kV distribution line. The customer will be responsible for building, operating and maintaining the distribution line from the project site to the POI. The customer will be responsible for identifying the route and obtaining the right of way and any required permitting. The customer will not be able to use IPC's existing right of ways, poles or any other equipment. One possible route is shown in Figure 1. The POI will be located [redacted] of the intersection of [redacted]. The coordinates for the POI are: [redacted]

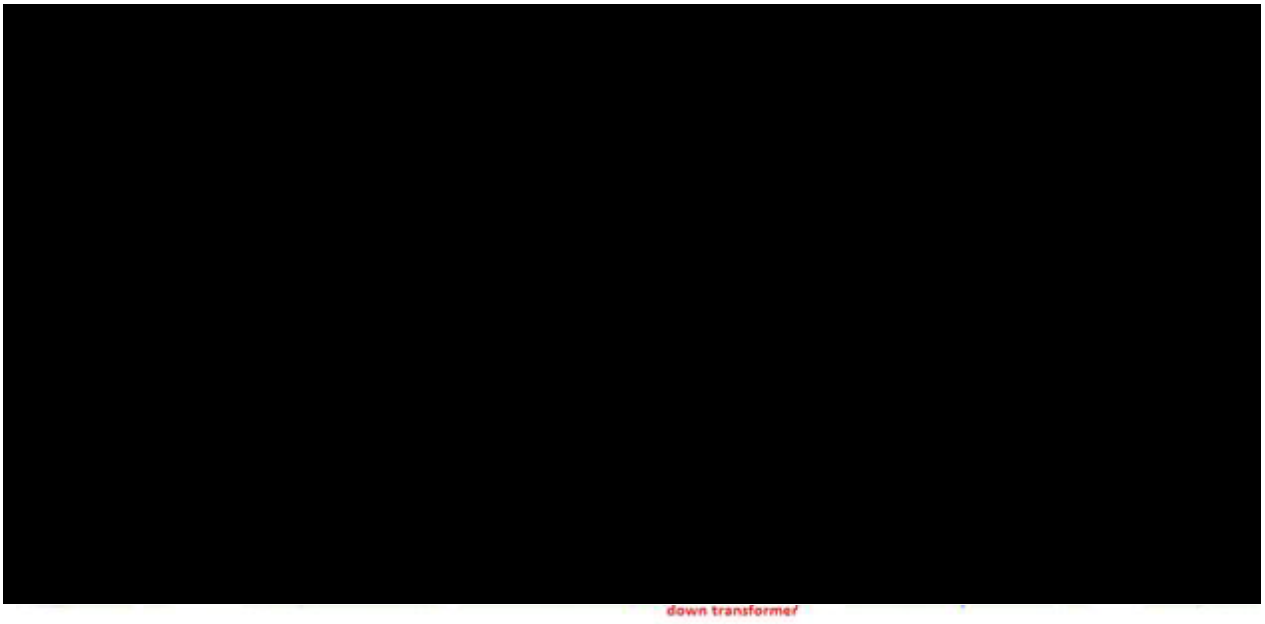

Figure 1 Possible route for new distribution line

The single-line diagram shows a generator step-up transformer with a Delta connection on the project side; this connection is not allowed by Idaho Power. Idaho Power requires the step-up transformers to have wye-grounded to either wye-grounded or wye-ungrounded connections with the Idaho Power side always a wye-grounded connection.

3.0 Summary

GI #494, the [redacted] project is rated for 1.2 MW. The requested POI is located in IPC's 34.5 kV [redacted] existing distribution feeder boundary. The Project will connect to the distribution feeder [redacted].

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

The total preliminary cost estimate to interconnect the [redacted] project to the 34.5 kV [redacted] distribution feeder is $280,200 and includes the following tasks:

- 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.

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 $280,200 does not include the cost of the customer's owned equipment to construct the generation site, required communication circuits or the three-phase circuit from the project site to the POI.

4.0 Scope of Interconnection Transmission and Distribution System Impact Study

The Interconnection Transmission and Distribution System Impact Study was completed, in accordance with Idaho Power Company Standard Generator Interconnection Procedures, to provide an evaluation of the system impacts of the interconnection of the proposed generating project to the Idaho Power system. As listed in the Interconnection Transmission and Distribution System Impact Study agreement, the Interconnection Transmission and Distribution System Impact Study report provides the following information:

- identification of additional transformer load tap changer operations, voltage fluctuations (flicker) and additional feeder losses.
- identification of required reactive power support.
- identification of islanding conditions.
- identification of any circuit breaker short circuit capability limits exceeded as a result of the interconnection.
- identification of any thermal overload or voltage limit violations resulting from the interconnection.
- identification of any angular instability.
- 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 this 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.

5.0 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] of the [redacted] substation.

The data provided by the applicant shows that [redacted] will be used. The synchronous generator is connected to a 1500 kVA, 480V-34.5 kV step-up transformer.

Idaho Power requires the step-up transformers 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.

6.0 Description of Transmission Facilities

[redacted] substation is a 46/12.47 kV substation. The substation is fed from the southern 46 kV loop.

7.0 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.

8.0 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 at the POI. The Project will connect to the [redacted] substation via a 34.5 kV [redacted] distribution feeder.

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

9.0 Short Circuit Study Results

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

10.0 Description of Required Facility Upgrades

The following upgrades will be required to IPC-owned facilities to facilitate the interconnection of GI #494:

- Install a four-pole 34.5 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.

See the conceptual-level cost estimate in Table 1.

Table 1 Conceptual-level Cost Estimate for GI #494

Item of Work	Estimate
Generation interconnection and protection package	$203,000
Substation upgrades	$0

Item of Work	Estimate
Distribution upgrades	$0
Transmission upgrades (1)	$0
Unloaded costs	$203,000
Contingency 20% (2)	$40,600
Total unloaded costs	$243,600
Overheads (3)	$36,600
Total loaded costs	$280,200
Total Conceptual-level Cost Estimate in 2015 dollars (4)	**$280,200**

(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 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.

11.0 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.

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

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*.

12.0 Conclusion

The requested interconnection of the [redacted] project, GI #494, to Idaho Power's system was studied. The Project interconnection request was evaluated for a 34.5 kV grounded-wye connection to the [redacted] distribution feeder.

The results of the Transmission and Distribution System Impact Study show that network upgrades will not be required to interconnect the [redacted] project, GI #494, to the existing Idaho Power system. The installation of a four-pole generation interconnect package at the POI is required to integrate the 1.2 MW project.

The feasibility study prior performed by Idaho Power identified the need to build approximately [redacted] of three-phase 34.5 kV feeder. The customer will be responsible for building the three-phase feeder from the project site to the POI as shown in Figure 1 (Section 2.0 Critical Notes). The POI will be [redacted] of [redacted]. The coordinates for the POI are: [redacted].

The estimated cost to interconnect GI #494 to the IPC system at the 34.5 kV point of interconnection considered in this study is approximately $280,200.

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 Transmission and Distribution System Impact 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.

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 #494 Site Location

Figure 2 Location of [redacted] – GI #494