GENERATOR INTERCONNECTION

FEASIBILITY STUDY REPORT

for integration of the proposed

50 MW [redacted]

IPC PROJECT QUEUE #536

to the

IDAHO POWER COMPANY ELECTRICAL SYSTEM

for

[redacted]

REPORT v.0

November 21, 2018

Revision History

Date	Revision	Initials	Summary of Changes
11/21/2018	0	AV	FeSR GI #536 – Original issue

Table of Contents

List of Tables

List of Figures

1.0 Introduction

[redacted] has contracted with Idaho Power Company (IPC) to perform a Generator Interconnection Feasibility Study for the integration of the proposed 50 MW [redacted] (the Project). The Project is located in IPC's Western Region [redacted] in Malheur County, Oregon (See Figure 1: Location of [redacted] – GI # 536 in Appendix B). The Project is Generation Interconnect (GI) queue number 536 (GI #536).

The Project has applied to connect to the IPC transmission system for an injection of 50 MW at a single Point of Interconnection (POI) at a 69-kV voltage. The POI is located at [redacted]. The POI is on IPC's Hope Junction (HPJN) – Harper Junction (HRPJ) 69-kV line approximately [redacted] from the VALE station.

This report documents the basis for and the results of this feasibility study for the GI #536 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 50 MW [redacted] to IPC's HPJN - HRPJ 69-kV line was evaluated. The power flow analysis indicated that interconnecting the [redacted] is feasible.

The Project will be required to control voltage in accordance with a voltage schedule as provided by Idaho Power Grid Operations. Therefore, GI #536 will be required to install a plant controller for managing the real and reactive power output of the 50 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 to interconnect GI #536.

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.

Idaho Power anticipates significant upgrades to the Idaho Power Bulk Electric System (BES) will be required to integrate the 50 MW of [redacted]. The necessary upgrades and their cost will be identified during the system impact study.

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.

The total preliminary cost estimate to interconnect the [redacted] project to the HPJN – HRPJ 69 kV line is $22,638,800 and includes the following tasks:

- Subtransmission upgrades
    - Reconductor 38.7 miles of 69-kV line
    - Upgrade 69-kV voltage regulator at VALE substation
- Substation upgrades
    - Yard preparation of fenced yard
    - Prefab control building with AC and DC systems installed
    - Conduits and yard cables run between all yard apparatus/equipment and the control building
    - 69-kV circuit breaker with disconnects
    - Instrumentation transformers for protective relaying and metering
    - Interconnect package
        - SEL 421/411L Protective relaying panels with PMU capability
        - SEL 2506 mirror bit boxes with fiber communications
        - Interconnect metering
- SCADA

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 $22,638,800 does not include the cost of:

- The customer's equipment/facilities.
- The land needed for the interconnection yard. This land will be IPC owned but is the responsibility of the interconnection customer to permit and purchase.
- The cost of the dedicated communications circuits required.
    - Interconnection Customer to provide one dedicated 64 kilo-bit per second DDS leased line communications circuit between the POI and IPC Boise Bench substation for PMU data.
    - Interconnection Customer to provide one dedicated 64 kilo-bit per second DDS leased line communications circuit between the POI and IPC Boise Bench substation for SCADA data.
    - Interconnect Customer to provide one POTS (Plain Old Telephone Service) dial-up circuit for querying the revenue meter at the generation interconnection site. The dial-up circuit should be of sufficient quality to accommodate a dial-up modem connection.

- Any 69 kV connection between the Project and the POI including the line termination apparatus. These facilities will be constructed, owned and operated by the Interconnection Customer.

- The overhead rates are subject to change during the year and tax gross-up percentages vary from year to year.
- These are estimated costs only and final charges to the customer will be based on the actual construction costs incurred, including overheads and tax gross-up.

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 Large 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 #536, consists of a single 50 MW photovoltaic solar plant which requested to be connected to Idaho Power's HPJN - HRPJ 69-kV line. The Project will use [redacted] inverters. Twenty-seven groups of twenty inverters will be connected to a 2.0 MVA transformers to step-up the voltage from 800 V to 34.5 kV. The twenty-seven transformers will be connected to the GSU 34.5 kV / 69kV transformer. The capacity of the system is 54,000 kVA.

5.0 Description of Transmission Facilities

All generation projects in the area ahead of the Project in the IPC generation queue and their associated transmission system improvements were modeled in a preliminary power flow analysis to evaluate the feasibility of interconnecting GI #536.

Preliminary power flow analysis indicated that interconnection of a 50 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 50 MW.

6.0 Description of Substation Facilities

The HPJN – HRPJ line is radially fed by IPC's 69/12.5 kV VALE substation in Malheur County, Oregon.

7.0 Description of Distribution Facilities

No distribution facilities are affected by the Project.

8.0 Short Circuit Study Results

The Project must be a source of ground current for line relaying. This is typically achieved through the proper selection of transformer configurations. For example, an autobank with a delta tertiary is a source of ground current, (other configurations can and do exist).

The fault duty at the approximate POI (with no Project modeling) is as follows.

Single-Line-to-Ground Fault Duty = [redacted] A
Line-to-Line Fault Duty = [redacted] A
Three-Phase Fault Duty = [redacted] A

The sequence network reductions at the point of interconnection are as follows.

Positive Sequence: [redacted]
Negative Sequence: [redacted]
Zero Sequence: [redacted]

9.0 Description of Required Facility Upgrades

Preliminary results indicate that the upgrades will include a new station, 38.7 miles of 69-kV line reconductoring, 69-kV voltage regulator, circuit breaker, and SCADA and PMU at the POI.

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.

The following upgrades will be required to IPC-owned facilities to facilitate the interconnection of GI #536:

- Subtransmission upgrades
    - Reconductor 38.7 miles of 69-kV line
    - Upgrade 69-kV voltage regulator at VALE substation
- Substation upgrades
    - Yard preparation of fenced yard
    - Prefab control building with AC and DC systems installed
    - Conduits and yard cables run between all yard apparatus/equipment and the control building
    - 69-kV circuit breaker with disconnects
    - Instrumentation transformers for protective relaying and metering
    - Interconnect package
        - SEL 421/411L Protective relaying panels with PMU capability
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- SCADA

See the conceptual-level cost estimate in Table 1.

Table 1 Conceptual-level Cost Estimate for GI #536

Item of Work	Estimate
Generation interconnection and protection package	$1,800,000
Substation upgrades	$1,164,000
Distribution upgrades	$0
Transmission upgrades (1)	$12,550,000
Unloaded costs	$15,514,000
Contingency 30% (2)	$4,654,200
Total unloaded costs	$20,168,200
Overheads 12.25%(3)	$2,470,600
Total Conceptual-level Cost Estimate in 2018 dollars (4)	$22,638,800

(1) Does not include upgrades to the BES
(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.
  - The land needed for the interconnection yard. This land will be IPC owned but is the responsibility of the interconnection customer to permit and purchase.
  - The cost of the dedicated communications circuits required.
    - Interconnection Customer to provide one dedicated 64 kilo-bit per second DDS leased line communications circuit between the POI and IPC Boise Bench substation for PMU data.
    - Interconnection Customer to provide one dedicated 64 kilo-bit per second DDS leased line communications circuit between the POI and IPC Boise Bench substation for SCADA data.
    - Interconnect Customer to provide one POTS (Plain Old Telephone Service) dial-up circuit for querying the revenue meter at the generation interconnection site. The dial-up circuit should be of sufficient quality to accommodate a dial-up modem connection.
  - Any 69 kV connection between the Project and the POI including the line termination apparatus. These facilities will be constructed, owned and operated by the Interconnection Customer.
- The overhead rates are subject to change during the year and tax gross-up percentages vary from year to year.
- These are estimated costs only and final charges to the customer will be based on the actual construction costs incurred, including overheads and tax gross-up.
- These are non-binding conceptual level cost estimates that will be further refined upon the request and completion of Transmission and Distribution Facility Studies.

Cost estimates include direct equipment and installation labor costs, indirect labor costs and general overheads, and a contingency allowance. These are preliminary cost estimates only and final charges to the customer will be based on the actual construction costs incurred.

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 16.4 MVARS at all active power output between 20% and 100% of nameplate active power rating.

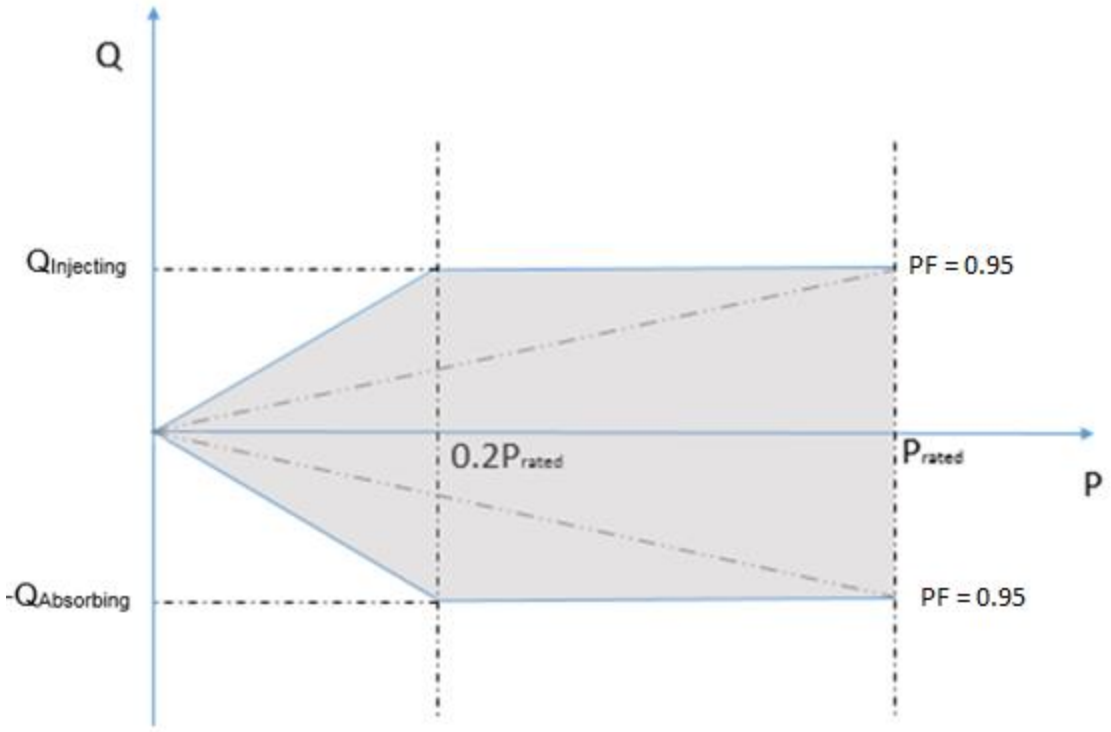

Figure 1 Operating Requirements

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 #536 will be required to control voltage in accordance with a voltage schedule as provided by Idaho Power Grid Operations. GI #536 is required to install a plant controller for managing the real and reactive power output of the 50 MW inverter array at the project POI. Also, the installation of a PMU at the POI and maintenance costs associated with communication circuits needed to stream PMU data will be required to be provided in order to interconnect GI #536.

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 #536, to Idaho Power's system was studied.

The results of this study work confirm that it is feasible to interconnect the [redacted], GI #536, to the existing Idaho Power system. A Transmission System Impact Study is required to determine the specific transmission network upgrades required to integrate the project as a Network Resource.

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 #536. 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 #536 to the IPC system at the 69-kV point of interconnection considered in this study is approximately $22,638,800.

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 System Impact 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 PowerWorld 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. 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 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 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 (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

A-4.0 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 #536 Site Location