GENERATOR INTERCONNECTION

FEASIBILITY STUDY REPORT

for integration of the proposed

[redacted]

(GI #573)

to the

IDAHO POWER COMPANY ELECTRICAL SYSTEM

in

[redacted]

for

[redacted]

REPORT v.1

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Revision History

Date	Revision	Initials	Summary of Changes
2/10/2020	0	GMT	Feasibility Study Report GI #573 – Original issue

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1.0 INTRODUCTION

[redacted] has contracted with Idaho Power Company (IPC) to perform a Generator Interconnection Feasibility Study (FeS) for the integration of the proposed 300 MW [redacted] Project (Project) [redacted]. Reference number GI #573 has been assigned to the Project in the IPC GI queue.

The specific Point of Interconnection (POI) studied is [redacted].

This report documents the basis for and the results of this FeS for the Generation Interconnection Customer. It describes the Project, the determination of interconnection feasibility and estimated costs for integrating the Project into the Idaho Power Transmission System at [redacted] kV.

2.0 SUMMARY

The feasibility of interconnecting the Project, GI #573, to [redacted] was evaluated.

Power flow analysis indicated that interconnecting the Project is feasible. The Project will be required to control voltage in accordance with a voltage schedule as provided by Idaho Power Grid Operations. Therefore, the Project will be required to install a plant controller for managing the real and reactive power output of the 300 MW inverter array at the 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.

IPC Transmission Network Upgrades associated with transmission service may be necessary if firm transmission is required to deliver the Projects generation from the POI to a point of delivery. A Transmission Service Request (TSR) will be required to secure transmission rights on the IPC system, either through latent capacity, or Network Upgrades. Either the interconnection customer, or the merchant purchasing the generation from the interconnection customer, will have to make this TSR. Transmission rights are beyond the scope of this FeS. **IPC Transmission Network Upgrade costs associated with transmission service are not included in this FeS; however, these costs could be sizeable.**

A Transmission System Impact Study (SIS) is required to determine if any additional network upgrades are required to integrate the Project into the IPCo transmission system and to evaluate system impacts (thermal, voltage, transient stability, 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.

This FeS has determined that it is feasible for the Project to interconnect to [redacted] with a total preliminary cost estimate of [redacted].

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 does not include the cost of the customer's equipment to construct the generation facility.

3.0 SCOPE OF INTERCONNECTION FEASIBILITY STUDY

The Interconnection FeS 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 FeS agreement, the Interconnection FeS 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-bonding estimated cost of facilities required to interconnect the Large Generating Facility to the Transmission System and to address the identified short circuit and power flow issues.

Generation projects in the Generator Interconnect queue prior to this project could impact the cost of interconnection. A current list of these projects can be found in the Generation Interconnection folder located on the Idaho Power OASIS web site at the link below:

http://www.oasis.oati.com/ipco/index.html

4.0 DESCRIPTION OF PROPOSED GENERATING PROJECT

[redacted], GI #573, proposes to interconnect to the Idaho Power transmission system at 345 kV with a total injection of 300 MW (maximum project output). Inverters have not been specified. The POI is [redacted]. This project's expected in-service date is November 30, 2022.

Table 1: Project Specifications

Project Location	[redacted]
Number and Type of Generators	Solar Photovoltaic, Type TBD, Quantity = 94
Individual Generator Nameplate Rating	not specified in application
Total Output Power Rating	300 MW
Rated Power Factor	0.9 Leading / 0.9 Lagging
New Step-Up Transformer	(2) 170 MVA, 3-phase, 345/34.5/13.8 kV, Z = 8.5% on 170 MVA base
Interconnection Voltage	[redacted]

5.0 DESCRIPTION OF EXISTING TRANSMISSION FACILITIES

The Project POI is [redacted]. There is currently an [redacted].

A SIS will be required to determine specific network upgrades required to transfer the Project output of 300 MW to load.

5.1 Line Facility Modifications

Local transmission lines around the POI will not require modification to support the Project.

5.2 Substation Facility Modifications

The [redacted] will require the following facility modification, shown in Figure 1:

One, [redacted] kV power circuit breaker
Two, [redacted] kV air break switches
One, line termination structure for customer line
Protective relaying
Generation interconnection metering package

Figure 1 - Proposed interconnection (removed)

5.3 Grounding Requirements

The proposed [redacted] kV Wye-Grounded/Wye-Grounded with Delta Tertiary station transformer specified in the Idaho Large Generator Interconnection Request for [redacted], GI #573, should provide an adequate ground source for transmission line protection/relaying.

Grounding requirements and acceptability criteria are found in Appendix A.

5.4 System Protection Assessment

Short Circuit analysis shows the addition of [redacted] does not exceed the fault current rating of any power circuit breakers.

Short Circuit details at approximate interconnect location:

[redacted]	SLG (A)	L-L (A)	3PH (A)
Existing w/ Queue	16111.3	16650	19644.9
With GI Q#573	18376.2	16737	19653.2

[redacted]	SLG (A)	L-L (A)	3PH (A)
Existing w/ Queue	22472.1	20390.6	23991
With GI Q#573	24204.7	20396.5	23985.7

[redacted]	SLG (A)	L-L (A)	3PH (A)
Existing w/ Queue	2885.2	3484.5	3982.4
With GI Q#573	3002.9	3495.5	3982.5

[redacted]	SLG (A)	L-L (A)	3PH (A)
Existing w/ Queue	5333.9	6050.3	6786.2
With GI Q#573	5442.6	6034	6786.3

[redacted]	SLG (A)	L-L (A)	3PH (A)
Existing w/ Queue	2119	2109.3	2452.7
With GI Q#573	2134.9	2121.2	2453.4

[redacted]	SLG (A)	L-L (A)	3PH (A)
Existing w/ Queue	5548	5535	6556.4
With GI Q#573	5864.9	5547.3	6556.6

[redacted]	SLG (A)	L-L (A)	3PH (A)
Existing w/ Queue	1677.8	1935.3	2228.4
With GI Q#573	1682	1940	2227.3

[redacted]	SLG (A)	L-L (A)	3PH (A)
Existing w/ Queue	6973	6999.8	8238.4
With GI Q#573	7285.4	7006.3	8238.2

[redacted]	SLG (A)	L-L (A)	3PH (A)
Existing w/ Queue	2637	3013.9	3453.8
With GI Q#573	2662.5	3016.1	3456

6.0 DESCRIPTION OF POWER FLOW CASES

For the power flow analysis of this FeS, a WECC Heavy Summer PowerWorld model was used to represent peak load conditions. It was modified by adding the Project and two senior que projects in the same local region and saved as "[redacted]_GI573.pwb".

Original WECC cases provide a baseline for thermal flows and voltages in the IPCo area prior to adding the Project.

The levels of flow represented in the study cases are intended to capture potential impact of the Project on the existing transmission system.

7.0 POWER FLOW STUDY

Power Flow Analysis was performed on both the pre- and post-Project cases described above to simulate the impact of interconnecting the proposed Project during normal and contingency operating conditions (TPL-001). Mitigation of any adverse changes in loading or voltage from pre- to post-Project was identified.

The contingencies simulated include:

- All transformers and transmission lines connected one bus away from the proposed location of Project.
- The proposed project.

The results of the power flow studies were evaluated using WECC/NERC planning standards and IPC planning standards. The power flow analysis related evaluation criteria that were used are summarized below:

- All transmission facilities must remain within their thermal limits.
- Pre-contingency bus voltages within the study area must be between 0.95 per unit and 1.05 per unit.
- Maximum voltage deviation allowed at all buses under contingency conditions will be 5% for N-1 (NERC Category B).

Power flow solution was achieved for each of the N-1 outages simulated. Key findings from the power flow analysis are as follows:

- Overloading. There were no significant overloads in the power flow analysis.
- Voltage Deviation. There were no significant voltage deviations.
- Voltage Violations. There no significant voltage violations in the power flow analysis.

8.0 DESCRIPTION OF OPERATING REQUIREMENTS

The installed reactive power capability of the Project must have a power factor operating range of 0.95 leading to 0.95 lagging over the range of real power output. At full output of 300 MW, the Project would need to be able to provide approximately +/- 93.7 MVAr reactive support at the POI.

Identification of any additional equipment required at the Project to meet Idaho Power reactive power capability interconnection requirements will be provided in the SIS.

The Project will be required to control voltage in accordance with a voltage schedule as provided by Idaho Power Grid Operations. The Project is required to install a plant controller for managing the real and reactive power output of the 300 MW inverter array at the POI.

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*.

9.0 COST ESTIMATE

The following upgrades will be required to facilitate the interconnection of Project, GI #573:

- Install one [redacted] power circuit breaker and air break switches with associated protection systems for the transmission lines.
- Install 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), SCADA and remote connectivity.
- Line termination structure at substation.
- Note that this cost estimate does not include the cost of the customer's equipment/facilities or required communication circuits.
- These are estimated costs only and final charges to the customer will be based on the actual construction costs incurred.

Table 2: Conceptual Cost Estimate

Item of Work	Estimate
Substation construction and Generation interconnection and protection package	[redacted]
Transmission upgrades	TBD
Unloaded costs	[redacted]
Contingency 20% (1)	[redacted]
Total unloaded costs	[redacted]
Overheads (2)	[redacted]
Total loaded costs	[redacted]
Total Conceptual-level Cost Estimate in 2020 dollars (3)	

(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.

These are non-binding conceptual level cost estimates that will be further refined upon the request and completion of Transmission and Distribution System Impact Studies.

10.0 CONCLUSIONS

The requested interconnection of the [redacted], GI #573, to Idaho Power's system was studied.

The results of this study work confirm that it is feasible to interconnect the Project to the existing Idaho Power system. The results from the power flow analysis and short-circuit analysis confirm that the interconnection of the Project will have a negligible impact on the surrounding local transmission system.

A SIS is required to determine the specific Transmission Network Upgrades required to integrate the Project as a Network Resource and to evaluate the system impacts (thermal overload, voltage, transient stability, 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. Transmission requirements to integrate the Project will be determined during the SIS phase of the generator interconnection process.

APPENDIX A

A-1.0 Method of Study

The FeS 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. 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; these state, 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 POI, 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) 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 POI.

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.

http://www.idahopower.com/pdfs/BusinessToBusiness/facilityRequirements.pdf

APPENDIX B. PROJECT LOCATION

Figure 2 - Project Location (removed)