GENERATOR INTERCONNECTION
SYSTEM IMPACT STUDY REPORT

for integration of the proposed

300 MW [redacted]
(GI PROJECT #573)

to the

IDAHO POWER COMPANY ELECTRICAL SYSTEM

in

[redacted]

for

[redacted]

REPORT v.1

Jan 28, 2021

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1.0 Introduction

[redacted] (Customer) has contracted with Idaho Power Company (IPCO) to perform a Generator Interconnection System Impact Study (SIS) for the integration of a proposed 300 MW [redacted] plus Storage Project (Project) located in IPCO's Eastern Region in [redacted] (~ coordinates [redacted]° N, [redacted]° W). The Project has stated that the storage devices will be self-charging and as such this SIS has not studied the impact of charging from IPCO's transmission system.

The Project has been assigned an IPCO Generation Interconnect (GI) queue number 573 (GI #573). In the SIS Agreement, the Project has chosen to have studies performed for both Energy Resource (ER) Interconnection Service and Network Resource (NR) Interconnection Service.

The specific point of interconnection studied is the [redacted].

This report documents the basis for and the results of the SIS for the GI #573 Generation Interconnection. The report describes the proposed Project, the determination of interconnection requirements and estimated costs for integration in to the IPCO transmission system. This report satisfies the SIS requirements of the Idaho Power Tariff.

2.0 Summary

The impact to the IPCO transmission system of interconnecting the Project at the [redacted] was evaluated.

The Project will be required to control voltage in accordance with a voltage schedule as provided by IPCO grid operations, manage the real power output at the POI to not exceed 300 MW and control charging of storage devices to only charge from the solar arrays. Any energy flowing from the IPCO transmission system into the Project in excess of local service will result in opening of the interconnection power circuit breaker.

The following is for information purposes only and does not convey Transmission Service. For ER service a Transmission Service Request will be required. The ER cost estimate provided does not include dedicated transmission capacity to deliver energy to any customer.

The total ER Interconnection Service preliminary cost estimate to interconnect the Project is:

- Energy Resource Interconnection: $1,684,800

  See Section 6.6, Energy Resource Cost Estimate, for the required ER facilities and cost breakdowns.

For this SIS the analysis of NR service assumed that the Project will displace other generation utilizing the existing transmission capacity. Therefore, the NR Interconnection Service preliminary cost estimate is the same as the ER interconnection. If this assumption proves not to be true, network upgrades to provide increased capacity will be required.

The estimate includes 20% contingency and 10% overhead costs. 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 estimates do not include the cost of the customer's owned equipment.

IPCO estimates it will require approximately 36 months to design, procure, and construct the facilities described in this report following the execution of a Generation Interconnection Agreement. A more specific schedule will be developed during the Facility Study should the Project move to that study phase of the interconnection process.

Generator interconnection service (either as an Energy Resource or a Network Resource) does not in any way convey any right to deliver electricity to a specific customer or point of delivery.

3.0 Scope of Interconnection System Impact Study

This SIS was performed in accordance with IPCO Standard Generator Interconnection Procedures, evaluating the impact of interconnecting the Project to the transmission system. The scope of the SIS is detailed in the System Impact Study Agreement.

4.0 Contingent Facilities

The Project has no contingent facilities.

5.0 Description of Proposed Generating Project

[redacted], GI #573, proposes to interconnect to the IPCO transmission system at [redacted] kV with a total injection of 300 MW (maximum Project output). The POI is assumed to be on the [redacted].

Table 1: Project Specifications

Project Location	**[redacted]° N, [redacted]° W**
Number and Type of Generators **Solar:** **Battery:**	 Power Electronics 3.45 MVA inverters Quantity = 94 Power Electronics 3.45 MVA inverters Quantity = 94
Individual Generator Nameplate Rating	3450 KVA
Total Output Rating **Solar:** **Battery:**	648.6 MVA 324.3 MVA 324.3 MVA
New Step-Up Transformer	(2) 102/136/170 MVA ONAN/ONAF/ONAF @ 65°C [redacted]Y / 34.5 - 13.8 Delta kV Z=8.5% @ BASE MVA
Interconnection Voltage	[redacted] kV

6.0 Energy Resource (ER) Interconnection Service

ER Interconnection Service allows the Interconnection Customer to connect its Generating Facility to a Transmission Provider's transmission system and to be eligible to deliver electric output using firm or non-firm transmission capacity on an "as available" basis.

Power flow analysis indicated that the Project's full output of 300 MW can be interconnected at the POI.

6.1 Transmission Line Facilities

As an ER, a Transmission Service Request will be required to determine the specific Network Upgrades required to deliver the Project output to a designated point of delivery. At this time, no network upgrades have been identified for the Project as an ER interconnection.

6.2 Substation Facilities

The proposed interconnection will require the [redacted] to be modified to prepare an available line position by installation of a new [redacted] kV power circuit breaker and associated switches, protective relaying, metering package and communications.

The actual station layouts and detailed equipment requirements will be determined in the Facility Study should the interconnection customer choose to move to that study phase of the interconnection process.

6.3 Grounding Requirements

The proposed [redacted]/34.5 kV Wye-Grounded/Wye-Grounded with Delta Tertiary station transformers 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.

6.4 System Protection Assessment

Studies indicate that there is adequate load and short circuit interrupting capability on the Transmission Provider's existing breakers.

6.5 Electric System Protection Results

For 345 kV line protection, the Transmission Provider's System Protection Department utilizes permissive and line differential protection schemes integrated with our existing digital

communication infrastructure. Digital communication infrastructure for the interconnection customer's [redacted] kV line will be the customer's responsibility.

6.6 Energy Resource Cost Estimate

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

- Install one [redacted] kV 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	$1,300,000
Transmission upgrades	TBD
Unloaded costs	$1,300,000
Contingency 20% (1)	$260,000
Total unloaded costs	$1,560,000
Overheads (2)	$124,800
Total loaded costs	$1,684,800
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.

The cost estimates include 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 estimates do not include the cost of the customer's owned equipment.

7.0 Network Resource (NR) Interconnection Service

NR Interconnection Service allows the Interconnection Customer to integrate its generating facility with the Transmission Provider's Transmission System in a manner comparable to that in which the Transmission Provider integrated its generating facilities to serve native load customers. The transmission system is studied under a variety of conditions to determine the transmission improvements/upgrades which are necessary. NR Interconnection Service in and of itself does not convey Transmission Service.

7.1 Description of Power Flow Cases

For the NR Interconnection Service study, two power flow cases were used to study the Transmission Provider's transmission system with westbound and eastbound flows to determine the required Network Transmission Upgrades.

A WECC 2020 Heavy Summer case was modified to represent a summer month with high imports from the west on Path 14, Idaho-Northwest.

A WECC 2020 Light Spring case was modified to represent a shoulder month condition with high east to west (westbound) transfers across the Midpoint West path.

7.3 Network Resource Transmission Upgrades

From the power flow/contingency analysis, no additional Network Transmission upgrades were identified for the integration of GI #573 beyond that identified for the Energy Resource generation interconnection.

7.4 Network Resource Cost Estimate

For NR Interconnection Service, all cost attributed to the ER Interconnection Service will be required.

8.0 Transient Stability Analysis

The WECC 2020 Heavy Summer operating case modified to increase WECC Path 14 to its limit and PowerWorld Simulator version 21 analysis tool were used to perform the transient stability analysis.

When studied the plant controllers were set to control the [redacted] kV POI. The results showed no transient stability violations. The REPC_A plant controller model validated with and error; "REPC_A, Parameter fdbd1 is usually > 0 or zero". Developer should validate the dynamic modeling data. It is the responsibility (per NERC Standards) of the Generator Owner to ensure the modeling data utilized accurately reflects inverter operations, and to provide updates to IPCO if testing or real-time observations indicate a need.

9.0 Description of Operating Requirements

It is the Project's responsibility to provide the reactive power capability to provide at a minimum a power factor operating range of 0.95 leading (supplying) to 0.95 lagging (absorbing) at the POI over the range of real power output. At full output of 300 MW, the Project would need to be able to provide approximately +/- 94 MVAr reactive support at the POI. Based on the information provided, the Project's own facilities will consume approximately 60 MVAr. The documentation provided for the proposed inverters indicate the combined output from all inverters proposed can supply the sum of these needs.

GI #573 will be required to control voltage in accordance with a voltage schedule as provided by IPCO Grid Operations.

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*.

IPCO requires that interconnection customers with aggregate facilities larger than 20 MW provide PMU data. Installation of PMU devices and maintenance costs associated with communication circuits needed to stream PMU data will be required to interconnect GI #573. The specific costs associated with this requirement will be identified in the Facility Study phase of the interconnection process.

10.0 Conclusion

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

Interconnection requirements, detailed in Section 6.6, are required to interconnect the Project as an Energy Resource or Network Resource.

The results of this study work confirm that GI #573 can be interconnected to the IPCO [redacted] kV transmission system at the proposed POI without requiring additional network upgrades beyond those identified by senior queue projects.

Generator interconnection service (either as an Energy Resource or a Network Resource) does not in any way convey any right to deliver electricity to a specific customer or point of delivery.

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(s) and then, using PowerWorld Simulator analysis tool, the impacts of the new resource on the IPCO transmission system (lines, transformers, etc.) within the study area are analyzed. The WECC and IPCO reliability criteria and operating procedures were used to determine the acceptability of the configurations considered. For distribution feeder analysis, IPCO utilizes Advantica 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 IPCO. Less than or equal to 100% of continuous rating is acceptable.

IPCO 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 point of interconnection, per IPCO's T&D Advisory Information Manual.

IPCO'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 IPCO 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 IPCO upgrade projects that are either currently under construction or whose budgets have been approved for construction soon. 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

IPCO requires electrical system protection per Requirements for Generation Interconnections found on the Idaho Power Web site,

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

Revision History

Date	Revision	Initials	Summary of Changes
01/04/2021	0	GMT	Original
01/05/2021	1	GMT	Incorporating revisions from peer review