GENATOR INTERCONNECTION

SYSTEM IMPACT STUDY REPORT

for integration of the proposed

330 MW [redacted]

(GI PROJECT #590)

to the

IDAHO POWR COMPANY ELECTRICAL SYSTEM

in

ELMORE COUNTY, IDAHO

for

[redacted]

REPORT v.1

November 23, 2021

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1.0 Introduction

[redacted] (Customer) has contracted with Idaho Power Company (Idaho Power) to perform a Generator Interconnection System Impact Study (SIS) for the integration of a proposed 330 MW [redacted] project (Project) located in the Idaho Power Capital Region in Elmore County, Idaho (~ coordinates 43° 5' 3.5514" N, -115° 24' 17.3154" W). The Project has been assigned an Idaho Power Generation Interconnect (GI) queue number 590 (GI #590). In the SIS Agreement, the Project has chosen to have studies performed for both Energy Resource Interconnection Service (ERIS) and Network Resource Interconnection Service (NRIS).

Energy Resource Interconnection Service and/or Network Resource Interconnection Service in and of themselves do not convey transmission service. In addition to Network Upgrades identified in the Interconnection System Impact Study:

- For Energy Resource Interconnection Service, the Interconnection Customer's ability to inject its Large Generating Facility output beyond the Point of Interconnection will depend on the existing capacity of Transmission Provider's Transmission System at such time as a transmission service request is made that would accommodate such delivery. The provision of firm Point-to-Point Transmission Service or Network Integration Transmission Service may require the construction of additional Network Upgrades.

- For Network Resource Interconnection Service, additional studies to reduce or eliminate congestion may be required and these studies may identify the need for additional upgrades. To the extent Interconnection Customer enters into an arrangement for long term transmission service for deliveries from the Large Generating Facility outside Transmission Provider's Transmission System, such request may require additional studies and upgrades in order for Transmission Provider to grant such request.

The specific point of interconnection studied is a line connection southeast of Boise to the existing Idaho Power owned Boise Bench-Midpoint #2 230 kV line approximately 51.5 miles from the [redacted] 230 kV station and 54.2 miles from the [redacted] 230 kV station.

This report documents the basis for and the results of the SIS for the GI #590 Generation Interconnection. The report describes the proposed project, the determination of interconnection requirements and estimated costs for integration into the Idaho Power transmission system. This report satisfies the SIS requirements of the Idaho Power Tariff.

2.0 Summary

The impact to the Idaho Power transmission system of interconnecting the Project to the Boise Bench-Midpoint #2 230 kV line was evaluated.

The Project will be required to control voltage in accordance with a voltage schedule as provided by Idaho Power Grid Operations. GI #590 will be required to manage the real power output of their generation project at the POI.

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

- Energy Resource Interconnection Service: $14,607,450

  See Section 6.5, Energy Resource Interconnection Service Cost Estimate, for the required Interconnection Facilities and Network Upgrade cost breakdowns.

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

- Network Resource Interconnection Service: $62,226,450

  See Section 7.4, Network Resource Interconnection Service Cost Estimate, for the required Interconnection Facilities and Network Upgrade cost breakdowns.

The estimates include 20% contingency and 7.25% 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.

Idaho Power 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 and optimized during the Facility Study should the generation interconnection customer choose to move to that study phase of the interconnection process.

3.0 Scope of Interconnection System Impact Study

This SIS was performed in accordance with Idaho Power 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

A contingent facility study was performed, and it was determined that the Project's Network Resource Interconnect Service is not contingent on transmission facility upgrades associated with senior queued projects.

5.0 Description of Proposed Generating Project

[redacted], GI #590, proposes to interconnect to the Idaho Power transmission system at 230 kV with a total injection of 330 MW (maximum project output). The POI is assumed to be on the Boise Bench-Midpoint #2 230 kV line.

The proposed facility is a [redacted] MWac wind turbine plant, [redacted] MWac solar photovoltaic plant with an AC-coupled, battery energy storage system with a gross capacity of [redacted] MW capacity. The POI limit is not to exceed 330 MWac. The wind plant is constructed from [redacted] MW turbines feeding [redacted] MVA transformers which step up the voltage to 34.5 kV. Solar modules will feed into [redacted]MVA inverter/transformer stations which step up the voltage to 34.5kV. The battery energy storage system will consist of [redacted]MVA inverter/transformer stations which step up the voltage to 34.5kV. These plants feed two 34.5kV/230kV grounded Wye-Delta-grounded Wye main power transformers. This transformers will be connected to the 230kV system at the newly proposed 3 position ring bus substation.

This study assumed that the battery energy storage system is charged from the facility generators and is not grid charged. A Large Load Request would need to be submitted to study grid charging.

Table 1: Project Specifications

Project Location	[redacted]
Number and Type of Generators Wind:	[redacted]
Individual Generator Nameplate Rating	[redacted]
Total Output Rating	[redacted]
Number and Type of Generators Solar:	[redacted]
Individual Generator Nameplate Rating	[redacted]
Total Output Rating	[redacted]
Number and Type of Generators Battery:	[redacted]
Individual Generator Nameplate Rating	[redacted]
Total Output Rating	[redacted]
Main Power Transformer x2	[redacted]
Interconnection Voltage	230 kV
Project Maximum Export	330 MW

6.0 Energy Resource Interconnection Service (ERIS)

Energy Resource 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 330 MW can be interconnected at the POI.

6.1 Substation Facilities

This study assumes that the project would connect with a three position 230 kV ring bus substation.

As an Energy Resource, 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.

For 330 MW injected at IPC's Boise Bench-Midpoint #2 230kV line:

Substation/Transmission Interconnection Facilities:

The proposed interconnection will require:

- 230kV 3-position ring bus interconnection substation
- Modify [redacted] 230 kV series capacitor
  - [redacted]
  - [redacted]
- Add a [redacted] 230 kV series capacitor (850/1147 MVA) at the [redacted] end of the [redacted] line.

The actual station layout 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.

Transmission Interconnection Facilities:

The proposed interconnection will not require rebuilding of Transmission Facilities.

6.2 Grounding Requirements

The proposed 230/34.5 kV Wye-Grounded/Wye-Grounded with Delta Tertiary station transformers specified in the Idaho Large Generator Interconnection Request for [redacted], GI #590, should provide an adequate ground source for transmission line protection/relaying.
Grounding requirements and acceptability criteria are found in Appendix A.

6.3 System Protection Assessment

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

The short circuit analysis results are:

ERIS Fault Study (with GI#590)			
Location	**SLG (A)**	**L-L (A)**	**3PH (A)**
[redacted] **230 kV Bus**	[redacted]	[redacted]	[redacted]
[redacted] **230 kV Bus**	[redacted]	[redacted]	[redacted]
NRIS Fault Study (with GI#567+588)			
Location	**SLG (A)**	**L-L (A)**	**3PH (A)**
[redacted] **230 kV Bus**	[redacted]	[redacted]	[redacted]
[redacted] **230 kV Bus**	[redacted]	[redacted]	[redacted]

6.4 Electric System Protection Results

For 230 kV line protection, the Transmission Provider's System Protection Department utilizes [redacted] communication infrastructure for the interconnection customer's 230 kV line will be the customer's responsibility.

6.5 Energy Resource Interconnection Service Cost Estimate

In Table 1 below a summary is provided of the generation interconnection facilities and conceptual costs required to interconnect the GI #590 project to the Transmission Provider's transmission system as an ERIS with 330 MW injected at IPC's Boise Bench-Midpoint #2 230kV line.

GI #590 [redacted] **330 MW injected at IPC's Boise Bench-Midpoint #2 230kV line** **Energy Resource Interconnection Service Facilities**	
Interconnection Facilities	**Cost**
Approximately 20% of a new 230kV 3 position ring bus interconnection station Air-break switches, breakers, metering, relaying, etc.	$670,000.00
Network Upgrades	
Approximately 80% of a new 230kV 3 position ring bus interconnection station Air-break switches, breakers, metering, relaying, etc.	$2,680,000.00
Modify [redacted] 230 kV series. [redacted]	$1,000,000.00
Add a [redacted] 230 kV series capacitor (850/1147 MVA) at the [redacted] end of the [redacted] line.	$7,000,000.00
Subtotal	**$11,350,000.00**
Contingencies (~20.0%) (1)	$2,270,000.00
Subtotal	**$13,620,000.00**
Overheads (~7.25%) (2)	$987,450.00
Total Estimated Cost (3)	**$14,607,450.00**

Table 1. Estimated GI #590 Project's ERIS Generation Interconnection Costs. 330 MW injection at point of interconnection.

(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, and overheads as shown.

- Note that these estimates do not include the cost of the customer's equipment/facilities or required communication circuits for SCADA, PMU, 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 the Facility Study.

7.0 Network Resource Interconnection Service (NRIS)

Network Resource 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. Network Resource Interconnection Service in and of itself does not convey Transmission Service.

7.1 Description of Power Flow Cases

For the Network Resource 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 2023 Heavy Summer case was modified to represent [redacted]

A WECC 2022 Light Winter case was modified to represent [redacted]

7.3 Network Resource Transmission Upgrades

From the power flow/contingency analysis, the following Network Transmission upgrades were identified for the integration of GI #590.

Point of interconnection, 330 MW injection

1. ERIS upgrades and facilities detailed in Section 6.1.
2. Rebuild the 230 kV [redacted].

IPC projects queue GI #530, GI #551, GI #557, GI #567, GI #570, and GI #588 are senior queued projects in the affected area of IPC's transmission system. Idaho Power studied GI #590 with all Network Upgrades identified for GI #530, GI #551, GI #557, GI #567, GI #570, and GI #588 modeled as in service. A contingent facility study, based on the senior queued projects, was conducted and it was determined that GI #590 is not contingent upon the network upgrades required by these senior projects. Changes to senior queued projects including in-service date and withdrawal from the queue, may trigger a restudy associated with GI #590.

7.4 Network Resource Interconnection Service Cost Estimate

In Table 2 below a summary is provided of the generation interconnection facilities and conceptual total costs required to interconnect the GI #590 project to the Transmission Provider's transmission system as a NRIS with 330 MW injected at IPC's Boise Bench-Midpoint #2 230kV line.

GI #590 [redacted] **330 MW injected at IPC's Boise Bench-Midpoint #2 230kV line** **Network Resource Interconnection Service Facilities**	
Interconnection Facilities	**Cost**
Approximately 20% of a new 230kV 3 position ring bus interconnection station Air-break switches, breakers, metering, relaying, etc.	$670,000.00
Network Upgrades	
Approximately 80% of a new 230kV 3 position ring bus interconnection station Air-break switches, breakers, metering, relaying, etc.	$2,680,000.00
Modify [redacted] 230 kV series capacitor • [redacted] • [redacted]	$1,000,000.00
Add a [redacted] 230 kV series capacitor (850/1147 MVA) at the [redacted] end of the [redacted] line.	$7,000,000.00
Rebuild the 230 kV [redacted]	$37,000,000.00
Subtotal	**$48,350,000.00**
Contingencies (~20.0%) (1)	$9,670,000.00
Subtotal	**$58,020,000.00**
Overheads (~7.25%) (2)	$4,206,450.00
Total Estimated Cost (3)	**$62,226,450.00**

Table 2. Estimated GI #590 Project's NRIS Generation Interconnection Total Costs. 330 MW injection at point of interconnection.

(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, and overheads as shown.

- Note that these estimates do not include the cost of the customer's equipment/facilities or required communication circuits for SCADA, PMU, 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 the Facility Study.

8.0 Transient Stability Analysis

The WECC 2023 Heavy Summer operating case and PowerWorld Simulator version 22 analysis tool were used to perform the transient stability analysis.

When studied the plant controllers were set to control to the 230 kV POI. The results indicated no transient stability violations. However, there were issues with the Plant Controller model and Machine model parameter setpoints. 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 Idaho Power 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 330 MW, the Project would need to be able to provide approximately +/- 108.5 MVAr reactive support at the POI. Based on the information provided, a reactive requirements model indicates that the project can supply the required reactive power at the POI, at full output of 330 MW, provided all inverters, including the BESS inverters, are in service.

GI #590 will be required to control voltage in accordance with a voltage schedule as provided by Idaho Power 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*.

Installation of PMU devices at the POI and maintenance costs associated with communication circuits needed to stream PMU data will also be required to be provided to interconnect GI #590. The specific costs associated with Idaho Power requirements for interconnection customers with aggregate facilities larger than 20 MW to provide PMU data to Idaho Power will be identified in the Facility Study should the generation interconnection customer choose

to proceed to that phase of the interconnection process.

10.0 Conclusion

The requested interconnection of the [redacted] project, GI #590, to Idaho Power's system was studied.

Interconnection requirements, detailed in Section 6.5, totaling $14,607,450, is estimated to be required to interconnect the project as an Energy Resource Interconnection Service. For Network Resource Interconnection Service, the cost to integrate the project is estimated to be $62,226,450 as detailed in Section 7.4.

The results of this study work confirm that GI #590 can be interconnected to the Idaho Power 230 kV transmission system at the proposed POI.

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 Idaho Power transmission system (lines, transformers, etc.) within the study area are analyzed. The WECC and Idaho Power reliability criteria and operating procedures were used to determine the acceptability of the configurations considered.

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 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 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 Idaho Power 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

Idaho Power 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
11/22/2021	0	PMA	Original
11/23/2021	1	PMA	Edits following internal review