GENERATOR INTERCONNECTION

SYSTEM IMPACT STUDY REPORT

for integration of the proposed

1,650 MW [redacted] PROJECT

(GI PROJECT #659)

to the

IDAHO POWER COMPANY ELECTRICAL SYSTEM

in

JEROME COUNTY, IDAHO

for

[redacted]

Report v2.2

March 3, 2023

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1.0 Introduction

[redacted] has contracted with Idaho Power Company ("Transmission Provider") to perform a Generator Interconnection System Impact Study (SIS) for the integration of the proposed 1,650 MW [redacted] Project (the Project). The Project location is in Idaho Power Company's (IPC's) Southern Region in Jerome County, Idaho. The Project latitude and longitude coordinates are approximately [redacted]. The project is Generation Interconnect (GI) queue number 659 (GI #659). The Project has chosen in the System Impact Study to be studied for Energy Resource Interconnection Service (ERIS).

This report documents the basis for and the results of this System Impact Study for the GI #659 Generation Interconnection Customer. The report describes the proposed Project, the determination of the Project interconnection requirements, and estimated costs for integration of the Project to the Transmission Provider transmission system. This report satisfies the SIS requirements of the Idaho Power Tariff.

2.0 Summary

The Project has applied to connect to Idaho Power's transmission system for an injection of 1,650 MW at a single Point of Interconnection (POI) at IPC's [redacted] 500kV bus. This point of interconnection is a jointly owned facility between Idaho Power and PacifiCorp. Should this project move into Facility Study, PacifiCorp may require an affected party study.

This Project has chosen in the System Impact Study to be studied for Energy Resource Interconnection Service (ERIS) only. As an Energy Resource Interconnection, it was not contemplated that Idaho Power would be an off taker of GI #659 in the System Impact Study.

Energy Resource Interconnection Service in and of itself does not convey transmission 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 the Transmission Provider's Transmission System at such time as a transmission service request is made that would accommodate such delivery. A transmission service request study may identify the need for additional Network Upgrades.

The GI #659 Project is a combined Photovoltaic (PV), Combustion, and Battery Energy Storage System (BESS). GI #659 will be required to control voltage in accordance with a voltage schedule as provided by Idaho Power Grid Operations. GI #659 will be required to manage the real power output of their generation project at the POI. Also, it may be beneficial for [redacted], for their own modeling compliance requirements, to install additional PMU devices at their facilities to monitor the generation source(s).

The total "Energy Resource Interconnection Service" generation interconnection preliminary cost estimate to interconnect the [redacted] project is as follows:

- Energy Resource Interconnection Service - **$4,060,699**
    - Appendix B contains a list of contingent transmission facility upgrades associated with senior queued projects and their estimated costs for Energy Resource Interconnection Service.

See Section 8.0 Energy Resource Interconnection Service Cost Estimate for the required facilities and cost breakdowns.

The cost estimates include 20% contingency and 8.25% overhead. 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.

The schedule for designing, procuring, and constructing facilities 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

The Interconnection System Impact Study was done and prepared in accordance with the Transmission Provider's Standard Generator Interconnection Procedures to provide an evaluation of the system impact of the interconnection of the proposed generating project to the Idaho Power system. As listed in the Interconnection System Impact Study Agreement, the Interconnection System Impact Study report provides the following information:

- 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 instability or inadequately damped response to system disturbances resulting from the interconnection, and
- description and non-binding, good faith estimated cost of facilities required to interconnect the Large Generating Facility to the Transmission System and to address the identified short circuit, instability, and power flow issues.

All other proposed Generation projects prior to this Project in the Generator Interconnect queue of the electrically relevant area were considered in this study.

4.0 Contingent Facilities

IPC projects queue GI #530, GI #549, GI #551, GI #557, GI #558, GI #567, GI #590, GI #604, GI #605, GI #613, GI #616, GI #619, GI #624, GI #625, GI #632, GI #633, GI #634, GI #635, and GI #656 are senior queued projects in the affected area of IPC's transmission system. Idaho Power studied GI #659 with all Network Upgrades identified for senior queued projects as in-service. Changes to senior queued projects including withdrawal from the queue, may trigger a restudy associated with GI #659.

GI #659 Energy Resource Interconnection Service, ERIS, at the [redacted] Station 500kV Bus POI is contingent upon upgrades associated with the senior queued project GI #635. Refer to Appendix B for a list of contingent transmission facility upgrades and their estimated costs.

5.0 Description of Proposed Generating Project

The primary point of interconnection for GI #659 is the [redacted] Station 500kV Bus. Assumed GI #659 Project's maximum generation is 1,650 MW from the combined Combustion Turbine (CT), Photovoltaic (PV), and Battery Energy Storage System (BESS). The Project's Commercial Operation Date (COD) is [redacted].

- [redacted]
- All generation in voltage regulation (Reactive capability used to regulated voltage – supply/absorb reactive)

6.0 Description of Substation/Transmission Facilities

As an Energy Resource Interconnection Service, 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. Listed below are the required transmission facilities to interconnect the Project for ERIS:

- A new line terminal interconnection on the [redacted] Station 500kV Bus.

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

7.0 Protection and Control

The short circuit/fault duty at the GI #659 POI 500kV bus – modeled with/without GI #659 – is as follows:

Fault Study (without GI #659)			
Location	**SLG (A)**	**LTL (A)**	**3PH (A)**
[redacted]	[redacted]	[redacted]	[redacted]

Table 1. *Fault Study results without GI #659*

Fault Study (with GI #659)			
Location	**SLG (A)**	**LTL (A)**	**3PH (A)**
[redacted]	[redacted]	[redacted]	[redacted]

Table 2. *Fault Study results with GI #659*

Studies indicate that there is adequate load and short circuit interrupting capability on the Transmission Provider's existing 500kV breakers after this Project is interconnected.

For 500kV line protection, the Transmission Provider's System Protection Department utilizes permissive, and line differential protection schemes integrated with digital communication infrastructure. Digital communication infrastructure for the interconnection customer's 500kV Interconnection Facilities will be the responsibility of said interconnection customer.

8.0 Energy Resource Interconnection Service Cost Estimate

Table 3 below is a summary of the facilities and conceptual costs required to interconnect the GI #659 Project to the Transmission Provider's transmission system.

GI #659 [redacted] Project **Energy Resource Interconnection Service Facilities**	
ERIS Transmission Upgrades	**Cost**
Interconnection Facilities	
[redacted] 500kV Line Terminal for GI #659	$3,126,019
Subtotal	**$3,126,019**
Contingencies (~20.0%) (1)	$625,204
Subtotal	**$3,751,223**
Overheads (~8.25%) (2)	$309,476
ERIS – Total Estimated Cost (3)	**$4,060,699**

Table 3. *Estimated GI #659 Energy Resource Generation Interconnection Costs*

(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
- Note that these costs assume the use of in-house resources
- 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

The schedule for designing, procuring, and constructing facilities 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.

9.0 Voltage Stability Analysis

A Voltage Stability study was performed using the WECC 2023 Heavy Summer case with local generating facilities all outputting their rated capacities, and the Transmission Provider's network load scaled up to 105%. All contingencies solved successfully, indicating there were no Voltage Stability issues found for the Project.

10.0 Transient Stability Analysis

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

The results showed no transient stability violations on Idaho Power's system. 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.

The project will be required to perform a Sub-Synchronous Control Interaction (SSCI), and Sub-Synchronous Resonance (SSR) study to identify any potential issues between the synchronous generators, photovoltaic inverters, and the series capacitors in the area.

11.0 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 1,650 MW, the Project would need to be able to provide approximately +/- 542 MVAr reactive support at the POI. Based on the information provided, the Project meets the required reactive power capability.

GI #659 will be required to control voltage in accordance with a voltage schedule as provided by Idaho Power Grid Operations, and GI #659 will be required to manage the real power output of their stated generation at the Project's 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*.

Installation of phasor measurement unit 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 #659. The specific costs associated with the IPC requirements for interconnection customers with aggregate facilities larger than 20 MW to provide PMU data to IPC will be identified in the Facility Study should the generation interconnection customer choose to proceed to that phase of the interconnection process. Also, it may be beneficial for [redacted], for their own modeling compliance requirements, to install additional PMU devices at their facilities to monitor the generations sources separately.

12.0 Conclusion

GI #659 can be interconnected to the Idaho Power transmission system at the proposed [redacted] 500kV Bus POI.

Interconnection requirements detailed in Section 6.1 totaling **$4,060,669** are required to interconnect the Project for Energy Resource Interconnection Service. This service is reliant on facilities identified in senior queued generation interconnections detailed in Appendix B.

Energy Resource Interconnection Service does not in any way convey any right to deliver electricity to any specific customer or point of delivery. A Transmission Service Request will be required to study the Transmission System Impacts.

The Energy Resource Interconnection Service System Impact Study did not evaluate the 1,650 MW of energy being delivered beyond the [redacted] 500kV Point of Interconnection. It is anticipated that additional, possibly substantial, Network Upgrades will be needed to move the energy beyond the Point of Interconnection.

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 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 DNV GL's Synergi Electric 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. 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 or 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 on the distribution system 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 Facility Connection Requirements found on the Idaho Power Web site,

https://docs.idahopower.com/pdfs/BusinessToBusiness/FacConnReq.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.

A-6.0 Grid Charging

The energy storage system (ESS) component of the Project was studied charging from the grid in steady state under N-0 (no contingencies) conditions. The charging of the ESS was assumed to be interruptible. No network upgrades were identified to support charging the ESS. There may be times during the year where system load in the local area will prevent charging of the ESS at full capacity; for example, a forced outage that would require Idaho Power to curtail charging. Should the Project require non-curtailable charging from their energy source then Point-to-Point firm transmission service from the energy market to the battery and from the Project to the point of delivery would be needed.

APPENDIX B

Table B1 is a summary of the GI #635 Network Transmission facility upgrades and their conceptual costs required by GI #659.

GI #635 Network Resource Interconnection Service Facilities	
NRIS Transmission Upgrades	**Cost**
Interconnection Facilities	
Approximately 25% of the cost of the [redacted] 500kV line expansion; including circuit breakers and additional bus rung	$3,325,000
Subtotal	**$3.325,000**
Contingencies (~20.0%)	$665,000
Subtotal	**$3,990,000**
Overheads (~7.25%)	$289,275
ERIS – Total Estimated Cost	**$4,279,275**

Table B1. *GI #635 NRIS Upgrades Required by GI #659*

Revision History

Date	Revision	Initials	Summary of Changes
01/30/23	1.0	CHH	Initial Report
02/03/23	2.0	ELS	Major revisions
02/17/23	2.1	CHH	Added contingent facilities
03/03/23	2.2	CHH	Corrected references to ERIS instead of NRIS