

**GENERATOR INTERCONNECTION
SYSTEM IMPACT STUDY REPORT**

for integration of the proposed

**87 MW [REDACTED]
(GI PROJECT #578)**

to the

IDAHO POWER COMPANY ELECTRICAL SYSTEM

in

ELMORE COUNTY, IDAHO

for

**[REDACTED]
Report v.1**

December 2, 2021

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1.0 Introduction

██████████ has contracted with Idaho Power Company (“Transmission Provider”) to perform a Generator Interconnection System Impact Study (SIS) for the integration of the proposed 87 MW ██████████ project (the Project). The Project location is in Idaho Power Company’s (IPC’s) Capital Region in Elmore County, Idaho. The Project is approximately ██████████ miles on the ██████████ from its point of connection with ██████████. The project is Generation Interconnect (GI) queue number 578 (GI #578). The Project has chosen in the System Impact Study to be studied for 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 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 Project has applied to connect to Idaho Power’s transmission system for an injection of 87 MW at a single Point of Interconnection (POI) at 138kV. The POI is IPC’s ██████████ Station 138kV bus.

This report documents the basis for and the results of this System Impact Study for the GI #578 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.

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2.0 Summary

The impact to the Idaho Power transmission system of interconnecting the Project to the [REDACTED] Station 138kV bus was evaluated.

The GI #578 Project is a combined PV, wind, and BESS and it has been assumed that the BESS will be charged via the PV and/or wind output. [REDACTED] will need to demonstrate the operating procedures and control measures which prevents the BESS from being charged via IPC's transmission system. However, if the intent is also to be able to charge the BESS via IPC's transmission system, [REDACTED] will need to make an IPC Large Load Service request.

GI #578 will be required to control voltage in accordance with a voltage schedule as provided by Idaho Power Grid Operations. GI #578 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 Project to the primary study POI is as follows:

- Energy Resource Interconnection Service at proposed 138kV POI - **\$2,299,742**

See Section 6.5 Energy Resource Interconnection Service Cost Estimate for the required facilities and cost breakdowns.

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

- Network Resource Interconnection Service - **\$15,706,164**
 - Appendix B contains a list of contingent transmission facility upgrades associated with senior queued projects and their estimated costs.

See Section 7.3 Network Resource Interconnection Service Cost Estimate for the required facilities and cost breakdowns.

The cost estimates include 20% contingency and 7.25% 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.

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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 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>.

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4.0 Contingent Facilities

IPC projects queue GI #530, GI #551, GI #557, and GI #567 are senior queued projects in the affected area of IPC's transmission system. GI #570 was included as a senior queued project in GI #578's Feasibility Study, however, more recent information indicates that GI #570 generation will flow North-to-South and not East-to-West and thus does not affect GI #578. Idaho Power studied GI #578 with all Network Upgrades identified for senior queued projects as in-service. Changes to senior queued projects including in-service date and withdrawal from the queue, may trigger a restudy associated with GI #578.

GI #578 Energy Resource Interconnection Service, ERIS, at the [REDACTED] Station 138kV bus POI is not contingent upon upgrades associated with any senior queued project.

GI #578 Network Resource Interconnection Service, NRIS, at the [REDACTED] Station 138kV bus POI is contingent upon upgrades associated with senior queued projects GI #530 and GI #557. Refer to Appendix B for a list of contingent transmission facility upgrades and their estimated costs.

5.0 Description of Proposed Generating Project

Assumptions

[REDACTED]'s Exhibit "B" states that "The [REDACTED] Substation is connected to the [REDACTED] 115 kV line through a single circuit 230 kV transmission line that will be derated to 115 kV. The transmission line will be approximately [REDACTED] miles in length, [REDACTED] miles to the [REDACTED] 115 kV right of way and be constructed of [REDACTED] conductor on [REDACTED] structures."

- Idaho Power does not own the [REDACTED] 115kV line or any 115kV infrastructure at [REDACTED] substation, so the [REDACTED]-mile line was studied at an operating voltage of 138kV and independent of the [REDACTED] 115kV line. To use the [REDACTED] 115kV line as a POI, the customer must submit a Generator Interconnection request in [REDACTED]'s queue.
- The 230kV transformer at the [REDACTED] substation was modeled with a high-side rating of 138kV.

Due to the ambiguity surrounding the developer's Interconnection Facilities the generation facilities were also studied as a "black box," that is, 87 MW was injected into the [REDACTED] 138kV substation.

The primary point of interconnection for GI #578 is the [REDACTED] Station 138kV bus. Assumed GI #578 Project's maximum generation is 87 MW from the combined Photovoltaic (PV), wind, and Battery Energy Storage System (BESS).

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Project Location	██████████
Interconnection Voltage	138kV
Number and Type of Generators Solar:	██████████
Individual Solar Generator Nameplate Rating	██████████
Total Solar Output Rating	██████████
Number and Type of Generators Wind:	██████████
Individual Wind Generator Nameplate Rating	██████████
Total Wind Output Rating	██████████
Number and Type of Generators Battery:	██████████
Individual Battery Generator Nameplate Rating	██████████
Total Battery Output Rating	██████████
Substation Step-Up Transformer	██████████

Table 1. GI #578 Project Specifications

6.0 Energy Resource Interconnection Service (ERIS)

Energy Resource Interconnection Service (ERIS) allows the Interconnection Customer to connect its Generating Facility to 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.

The GI #578 Project has applied to connect to the Idaho Power transmission system for an injection of 87 MW with a new 138kV interconnection at the ██████████ Station 138kV bus. All generation projects in the area ahead of this Project in the IPC generation queue and their associated transmission system improvements were modeled in a power flow analysis to evaluate the system impact of interconnecting GI #578. Power flow analysis indicates that the Project’s full output of 87 MW can be interconnected at the POI.

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6.1 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:

- The proposed interconnection will require two new line terminal interconnections at the [REDACTED] Station 138kV bus.

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.

6.2 Description of Distribution Facilities

No distribution facilities are directly impacted by this Project.

6.3 Short Circuit Study Results

The short circuit/fault duty at approximate GI #578 POI 138kV bus location (with/without GI #578 modeled) is as follows:

Fault Study (w/o GI #578)			
Location	SLG (A)	LTL (A)	3PH (A)
[REDACTED] 138kV Bus	[REDACTED]	[REDACTED]	[REDACTED]

Fault Study (w/ GI #578)			
Location	SLG (A)	LTL (A)	3PH (A)
[REDACTED] 138kV Bus	[REDACTED]	[REDACTED]	[REDACTED]

Studies indicate that there is adequate load and short circuit interrupting capability on the Transmission Provider's existing 138kV breakers after this Project is interconnected.

6.4 Electric System Protection Results and Grounding Requirements

For 138kV 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 138kV line terminal will be the responsibility of said interconnection customer.

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6.5 Energy Resource Interconnection Service Cost Estimate

In Table 2 below, a summary is provided of the facilities and conceptual costs required to interconnect the GI #578 Project to the Transmission Provider's transmission system.

GI #578 ██████████ Project Energy Resource Interconnection Service Facilities	
ERIS Transmission Upgrades:	Cost
Interconnection Facilities	
██████████ 138kV Line Terminal to GI #578.	\$1,152,095
Network Upgrades	
██████████ 138kV Line Terminal to ██████████.	\$634,807
Subtotal	\$1,786,902
Contingencies (~20.0%) (1)	\$357,380
Subtotal	\$2,144,282
Overheads (~7.25%) (2)	\$155,460
Energy Resource Interconnection Service – Total Estimated Cost (3)	\$2,299,742

Table 2. Estimated GI #578 Project's 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

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

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

The WECC 2023 Heavy Summer case was chosen as a power flow base case for the study. The case was modified to represent a summer month with high west to east (eastbound) transfers across Midpoint West.

For the second case, a WECC 2022 Light Winter case was modified to represent a shoulder month condition with high east to west (westbound) transfers across Midpoint West.

For the third case, the WECC 2023 Heavy Summer case was modified to represent a summer month with high solar, wind, and gas generation east of Boise with high transfers into the Boise area.

7.2 Network Resource Interconnection Service Transmission Upgrades

From the power flow/contingency analysis, additional Network Transmission upgrades were identified for the integration of GI #578 in addition to the Energy Resource generation interconnection facilities. Listed below are the required transmission facilities to interconnect the Project for NRIS:

- Reconductor [REDACTED] – [REDACTED] 138kV line (~[REDACTED] miles) with [REDACTED] conductor.

IPC projects queue GI #530, GI #551, GI #557, and GI #567 are senior queued projects in the affected area of IPC's transmission system. Idaho Power studied GI #578 with all Network Upgrades identified for senior queued projects as in-service. Appendix B contains a list of contingent transmission facility upgrades associated with senior queued projects and their estimated costs. Changes to senior queued projects including in-service date and withdrawal

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from the queue, may trigger a restudy associated with GI #578 Network Resource, NR, service.

7.3 Network Resource Interconnection Service Cost Estimate

Table 3 below is a summary of the Network Transmission generation interconnection facilities and conceptual costs required to interconnect the GI #578 Project to the Transmission Provider’s transmission system for Network Resource Interconnection Service.

GI #578 [REDACTED] Project Network Resource Interconnection Service Facilities	
NRIS Transmission Upgrades:	Cost
Network Upgrades	
Reconductor [REDACTED] – [REDACTED] 138kV line (~ [REDACTED] miles) with [REDACTED] conductor	\$10,416,800
Contingencies (~20.0%) (1)	\$2,083,360
Subtotal	\$12,500,160
Overheads (~7.25%) (2)	\$906,262
Network Resource Interconnection Service – Subtotal	\$13,406,422
Energy Resource Interconnection Service – Total Estimated Cost	\$2,299,742
Network Resource Interconnection Service – Total Estimated Cost (3)	\$15,706,164

Table 3. Estimated GI #578 Network 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.

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- 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.

8.0 Voltage Stability Analysis

A Voltage Stability study was performed using the WECC 2023 Heavy Summer case with Midpoint West West-to-East flows stressed up to 1743 MW (105% of the Path Rating) and the WECC 2022 Light Winter case with Midpoint West East-to-West flows stressed up to 2940 MW (105% of the Path Rating). All contingencies solved successfully so there were no Voltage Stability issues found for the Project.

9.0 Transient Stability Analysis

The WECC 2023 Heavy Summer and WECC 2022 Light Winter operating cases and PowerWorld Simulator version 22 analysis tool were used to perform the transient stability analysis.

The results showed no transient stability violations. 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.

10.0 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 87 MW, the Project would need to be able to provide approximately +/- 28.6 MVAR reactive support at the POI. Based on the information provided, the Project's combined generators can supply [REDACTED] MVAR which meets the required reactive power capability.

GI #578 will be required to control voltage in accordance with a voltage schedule as provided by Idaho Power Grid Operations, and GI #578 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*.

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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 #578. 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.

11.0 Conclusion

GI #578 can be interconnected to the Idaho Power transmission system.

Interconnection requirements detailed in Section 6.5 totaling **\$2,299,742** are required to interconnect the Project for Energy Resource Interconnection Service at the proposed [REDACTED] 138kV bus POI. Additional upgrades were identified for the integration of the Project for Network Resource Interconnection Service detailed in Section 7.3 totaling **\$15,706,164**. The Network Resource Interconnection Service is also reliant on facilities identified in senior queued generation interconnections detailed in Appendix B.

Energy Resource Interconnection Service or Network 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.

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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

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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.

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APPENDIX B

Table B1 is a summary of the GI #530 Network Transmission facility upgrades required by GI #578 and their conceptual costs.

GI #530 Project	
NRIS Transmission Upgrades:	Cost
█ – █ 230kV Line Loop in-and-out of Station Build █ miles 230kV Double Circuit Line with █ Conductor	\$1,040,000
█ 230kV Station Add two 230kV Line Terminals	\$1,775,000
Subtotal	\$2,815,000
Contingencies (~20%)	\$563,000
Subtotal	\$3,378,000
Overheads (~7.25%)	\$244,905
Network Transmission – Total Estimated Cost	\$3,622,905

Table B1: GI #530 Transmission Upgrades Required by GI #578

Table B2 is a summary of the GI #557 Network Transmission facility upgrades required by GI #578 and their conceptual costs.

GI #557 Project	
NRIS Transmission Upgrades:	Cost
█ to █ 138kV Rebuild Includes air break switches at █	\$2,020,000
█ to █ 138kV Rebuild Includes air break switch at █	\$665,000
Subtotal	\$2,685,000

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Contingencies (~20%)	\$537,000
Subtotal	\$3,222,000
Overheads (~7.25%)	\$233,595
Network Transmission – Total Estimated Cost	\$3,455,595

Table B2: GI #557 Transmission Upgrades Required by GI #578

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Revision History

Date	Revision	Initials	Summary of Changes
11/16/2021	1	SWL	Initial Report

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