GENERATOR INTERCONNECTION

SYSTEM IMPACT STUDY REPORT

for integration of the proposed

250 MW XXXXXXX PROJECT

(GI PROJECT #647)

to the

IDAHO POWER COMPANY ELECTRICAL SYSTEM

in

POWER COUNTY, ID

for

XXXX XXXX XXXX

Report v.1

November 2nd, 2022

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1.0 Introduction

XXXX XXXX XXXX has contracted with Idaho Power Company ("Transmission Provider") to perform a Generator Interconnection System Impact Study (SIS) for the integration of the proposed 250 MW XXXXXXX Project (the Project). The Project location is in Bonneville County, ID at approximately XXXX, XXXX. The project is Generation Interconnect (GI) queue number 647 (GI #647). 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 250 MW at a single Point of Interconnection (POI) at 345 kV. The POI is located at Idaho Power's Borah 345 kV substation (BORA 345 kV).

This report documents the basis for and the results of this System Impact Study for the GI #647 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 impact to the Idaho Power transmission system of interconnecting the Project to BORA 345 kV was evaluated.

The Project will be required to control voltage in accordance with a voltage schedule as provided by Idaho Power Grid Operations. The Project will be required to manage the real power output of their generation project at the POI. Also, it may be beneficial for XXXX XXXX XXXX, for their own modeling compliance requirements, to install additional PMU devices at their facilities to monitor the generation source.

The total Energy Resource Interconnection Service generation interconnection preliminary cost estimate to interconnect the Project at the POI is $9,002,632. 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 Project at the POI is $21,934,697. See Section 7.3 Network 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 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.

4.0 Contingent Facilities

Idaho Power studied GI #647 with all Network Upgrades identified for senior queued projects in the area as in-service. GI #647 Energy Resource Interconnection Service and Network Resource Interconnection Service is not contingent upon upgrades associated with any senior queued project. Changes to senior queued projects including in-service date and withdrawal from the queue, may trigger a restudy associated with GI #647.

5.0 Description of Proposed Generating Project

The primary POI for the Project is BORA 345 kV with a maximum injection of 250 MW. The Project's Commercial Operation Date (COD) is XXXX.

XXXX

Table 1. GI #647 Project Specifications

6.0 Energy Resource Interconnection Service (ERIS)

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 Project has applied to connect to the Idaho Power transmission system for an injection of 250 MW with a new interconnection at BORA 345 kV. 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 the Project. Power flow analysis indicates that the Project's full output of 250 MW can be interconnected at the POI.

6.1 Description of Substation/Transmission Facilities

As an ERIS, 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. A new 345 kV line terminal with (2) 345 kV circuit breakers and associated switches and relays will be required to interconnect the Project at the POI. The addition of the Project's XXXX lead line will require an approximate 50 MVAr 345 kV shunt reactor at the XXXX line terminal to mitigate transmission line charging. The reactor size will be further refined when final project line routing and impedances are determined by the developer. Listed below are the required transmission facilities to interconnect the Project for ERIS:

- A generation interconnection and protection package at the POI with 2 new 345 kV power circuit breakers and line terminal at the Borah Substation, associated switches, protective relays, 3-phase potential transformers (PTs) and 3-phase current transformers (CTs), SCADA and remote connectivity
- ~50 MVAr 345 kV switched shunt reactor

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

Studies indicate that there is adequate load and short circuit interrupting capability on the Transmission Provider's existing 345 kV breakers after this Project is interconnected.

6.4 Electric System Protection Results and Grounding Requirements

For 345 kV line protection, the Transmission Provider's System Protection Department utilizes permissive and line differential protection schemes integrated with digital communication infrastructure. Communication infrastructure between the interconnection's customer's 345kV collector substation and Idaho Power will be the responsibility of said interconnection customer.

The proposed 345 kV Wye-Grounded/Delta tertiary transformer specified in the Project should provide an adequate ground return path for transmission line protection/relaying. Grounding requirements and acceptability criteria are found in Appendix A.

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 #647 Project to the Transmission Provider's transmission system.

Item of Work	Estimate
Generation interconnection and protection package	$2,526,000
~50 MVAr 345 kV shunt reactor, circuit breaker, switches, etc.	$4,404,433
Contingency 20% (1)	$1,386,087
Total unloaded costs	$8,316,520
Overheads (2)	$686,113
Total Conceptual-level Cost Estimate in 2021 dollars (3)	**$9,002,632**

Table 2. Estimated GI #647 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, Protection, 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.

7.0 Network Resource Interconnection Service (NRIS)

NRIS 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 and upgrades which are necessary. NRIS in and of itself does not convey Transmission Service.

7.1 Description of Power Flow Cases

For the NRIS study, two power flow cases were used to study the Transmission Provider's transmission system with heavy load conditions and lightly loaded conditions to determine the required Network Transmission Upgrades.

The WECC 2025 Heavy Summer base case was modified to represent a summer month with high west to east (eastbound) transfers across Borah West.

The WECC 2022 Light Winter base case was modified to represent a shoulder month condition with high east to west (westbound) transfers across Borah West.

7.2 Network Resource Interconnection Service Transmission Upgrades

The following overloads were discovered in the WECC 2022 Light Winter case with high East to West flows on the Borah West path. A 345 kV breaker failure at XXXX and a line outage on the XXXX XXXX 345 kV line both resulted in an overload of the emergency rating of the XXXX XXXX 345 kV line. Estimates for rebuilding 345 kV transmission line is approximately $2,000,000 to $2,500,000 per mile, more cost-effective alternatives were evaluated. Adding 50% series compensation to the XXXX XXXX 230 kV line alleviates the 345 kV overload but creates an overload on the bus terminals of the XXXX XXXX 230 kV line and 2.2-mile line from XXXX XXXX 138 kV line. The addition of the Project's XXXX lead line will require an approximate 50 MVAr 345 kV shunt reactor to mitigate transmission lead line charging. Below is a list of required upgrades for NRIS.

- A generation interconnection and protection package at the POI with 2 new 345 kV power circuit breakers and line terminal at the Borah Substation, associated switches, protective relays, 3-phase potential transformers (PTs) and 3-phase current transformers (CTs), SCADA and remote connectivity
- New 50% compensation on the XXXX XXXX 230 kV line for multiple overloads on the 345 kV system between XXXX XXXX XXXX. This upgrade was identified in GI642 (withdrawn).
- Replace 2-inch bus bar with 3.5 at XXXX and XXXX 230 kV bay
- Rebuild 2.2-miles 138 kV XXXX with XXXX
- ~50 MVAr 345 kV switched shunt reactor

Idaho Power generation interconnection projects GI #558, GI#573, GI#580, GI#633, GI#641 and GI#623 are senior queued projects in the affected area of Idaho Power's transmission system. Idaho Power studied GI #623 with all Network Upgrades identified for senior queued projects as in-service. There were no Network Upgrades identified as contingent facilities for GI# 623. Changes to senior queued projects including in-service date and withdrawal from the queue, may trigger a restudy associated with GI #623 Network Resource 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 #647 Project to the Transmission Provider's transmission system for Network Resource Interconnection Service.

Item of Work	Estimate
Generation interconnection and protection package	$2,526,000
~50 MVAr 345 kV shunt reactor, circuit breaker, switches, etc.	$4,404,433
50% series compensation on XXXX 230 kV line	$8,500,000
Rebuild 2.2-mile XXXX 138 kV line	$1,380,400
Replace bus bar at XXXX and XXXX 230 kV substation	$75,000
Contingency 20% (1)	$3,377,167
Total unloaded costs	$20,263,000
Overheads (2)	$1,671,697
Total Conceptual-level Cost Estimate in 2021 dollars (3)	**$21,934,697**

Table 3. Estimated GI #647 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, Protection, 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.

8.0 Grid Charging

The energy storage system (ESS) component of the Project was studied charging from the grid. The charging of the ESS was assumed to be interruptible. There may be times during the

year where system load in the local area will prevent charging of the ESS at full capacity. No network upgrades were identified to support charging the ESS.

9.0 Voltage Stability Analysis

A Voltage Stability study was performed using the WECC 2025 Heavy Summer case with Borah West West-to-East flows at 105% of the path rating and the WECC 2022 Light Winter case with Borah West East-to-West flows at 105% of the path rating. All contingencies solved successfully, there were no voltage stability issues found for the Project.

10.0 Transient Stability Analysis

The WECC 2021 Light Winter operating case 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.

11.0 Description of Operating Requirements

GI #647 will be required to control voltage in accordance with a voltage schedule as provided by Idaho Power Grid Operations. The Project will be required to manage the real power output of their generation project at the POI. The Project will be required to operate at .95 leading/lagging measured at the high side of the main power transformer to maintain voltage within limits at the POI over the range of real power output.

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 the Project. 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 XXXX XXXX XXXX, for their own modeling compliance requirements, to install additional PMU devices at their facilities to monitor the generations sources separately.

12.0 Conclusion

GI #647 can be interconnected to the Idaho Power transmission system.

Interconnection requirements detailed in Section 6.5 totaling $9,002,632 are required to interconnect the Project for Energy Resource Interconnection Service at the proposed POI. Additional upgrades were identified for the integration of the Project for Network Resource Interconnection Service detailed in Section 7.3 totaling $21,934,697.

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.

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.

Revision History

Date	Revision	Initials	Summary of Changes
11/02/2022	1	PTP	Initial Report