GENERATOR INTERCONNECTION
SYSTEM IMPACT STUDY REPORT

for integration of the proposed

329 MW [redacted]

(GI PROJECT #690)

to the

IDAHO POWER COMPANY ELECTRICAL SYSTEM

in

MORROW and UMATILLA COUNTY, ID

for

[redacted]

Report v.1

July 28, 2023

Table of Contents

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 329 MW [redacted] (the Project) at a single Point of Interconnection (POI) at 500 kV at Idaho Power's Boardman to Hemingway 500 kV line. The Project is located in Morrow and Umatilla County, OR at approximately [redacted]. The project is assigned Generation Interconnect (GI) queue number 690 (GI #690). The Project has chosen in the System Impact Study to be studied for Energy Resource Interconnection Service (ERIS) and Network Resource Interconnection Service (NRIS).

This report documents the basis for and the results of this System Impact Study for the GI #690 Generation Interconnection Customer. The report describes the study assumptions, 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.

1.0 Study Assumptions

- 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. 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. NR Interconnection Service in and of itself does not convey Transmission Service.

- Senior queued generator interconnection requests that were considered in this study are listed in Section 5.0. If any of these requests are withdrawn, the Transmission Provider reserves the right to restudy this request, and the results and conclusions could significantly change.

- The need for transmission modifications, if any, that may be required to provide Network Resource Interconnection Service will be evaluated on the basis of 100 percent deliverability of the interconnection request under study.

- Power flow analysis requires WECC base cases to reliably balance under peak load conditions the aggregate of generation in the local area, with the Generating Facility at full output, to the aggregate of the load in the Transmission Provider's Transmission System. However, Idaho Power's balancing authority area has proposed generation in the interconnection queue that far surpasses projected load. To reliably balance the power flow case, it is necessary to assume some portion of other resources are displaced by this Project's output in order to assess the impact of interconnecting this Project's generation and that some generation is being transferred regionally through the transmission system.

- The Most Severe Single Contingency (MSSC) is the balancing contingency event, due to a single contingency, that results in the greatest loss (measured in MW) of resource output used by the Balancing Authority at the time of the event to meet firm system load and export obligation. Idaho Power's MSSC is 330 MW. An NRIS interconnection request above 330 MW must mitigate single contingencies that would result in the loss of more than 330 MW. This includes, but is not limited to, single contingencies in [redacted] Interconnection Facilities.

- Idaho Power will not mitigate thermal violations with remedial action schemes (RAS) in the generation interconnection process.

- The following Transmission Provider planned system improvements were assumed in service:
  - Boardman to Hemingway 500 kV transmission line (Q2 2026)
  - 50% series capacitance compensation on the Kinport to Midpoint 345 kV transmission line (2025)
  - Midpoint Substation transformer T502 500:345 kV transformer (2025)
  - Hemingway to Bowmont 230 kV transmission line (2025)
  - Bowmont to Hubbard 230 kV transmission line (2025)

2.0 Description of Proposed Generating Project

The primary POI for the Project is Boardman to Hemingway 500 kV line with a maximum injection of 329 MW. The requested Project's Commercial Operation Date (COD) is December 2026.

Project Location	[redacted]
Generator Nameplate Rating	[redacted]
Total Output Power Rating	[redacted]
Number and Type of Inverters	[redacted]
Main Power Transformer	[redacted]
Rated Power Factor	[redacted]

Table 1. GI #690 Project Specifications

3.0 Protection and Control

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

For 500 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 500 kV collector substation and Idaho Power will be the responsibility of the interconnection customer.

The proposed 500 kV Wye-Grounded/Wye Grounded with 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.

4.0 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 east to west power flow and a heavy west to east power flow conditions to determine the required Network Transmission Upgrades.

The WECC 2026 Heavy Summer base case was modified to represent a summer month with high west to east (eastbound) transfers across Idaho - Northwest.

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

5.0 Senior Queued Interconnections

Idaho Power generation interconnection projects GI #557, GI #567, GI #610, GI #619, GI #624, GI #625, GI #629, GI #632, GI #634, GI #635, GI #638, GI #643, GI #656, and GI #660 are senior queued projects in the affected area of Idaho Power's transmission system. Idaho Power studied GI #690 with all Network Upgrades for the identified senior queued projects as in-service. Changes to senior queued projects including withdrawal from the queue, may trigger a restudy associated with GI #690.

Changes to senior queued projects including in-service date and withdrawal from the queue, may trigger a restudy associated with GI #690.

6.0 POI Facilities

Listed below are the required transmission facilities to interconnect the Project at the POI. 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. In Table 2 below, a summary is provided of the facilities and conceptual costs required to interconnect the GI #690 Project to the Transmission Provider's transmission system.

Item of Work	Estimate
A generation interconnection and protection package at the POI with 7 new 500 kV power circuit breaker and three-line terminal at the Substation, associated switches, protective relays, 3-phase potential transformers (PTs) and 3-phase current transformers (CTs), SCADA and remote connectivity	$14,300,000
Series capacitor on the GI #690 station and re-arrangement of series capacitor at the Longhorn end	$25,000,000
Total Conceptual-level Cost Estimate (1)	$39,300,000
(1) This cost estimate includes direct equipment, material, labor, and overheads as shown.	

Table 2. Estimated GI #690 Project's POI Costs

- These estimates do not include the cost of the customer's equipment/facilities or required communication circuits for SCADA, PMU, Protection, and metering.
- Overhead rates are subject to change.
- These costs assume the use of Idaho Power 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.
- These costs include both Interconnection Facilities (direct assigned) and Network Resources (reimbursable). These costs will be explicitly broken out in 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 System Upgrades

Studies discovered the following overloads in the WECC 2025 Heavy Summer base case with high West to East flows on the Idaho to Northwest path.

Interconnection	Contingency	Violation
NRIS	[redacted]	[redacted]
NRIS	[redacted]	[redacted]
NRIS	[redacted]	[redacted]

Table 3. Contingency Violations

The following are Network Upgrades assigned to GI #690 to mitigate the violations outlined in Table 3.

Item of Work	Estimate
New 500/230 kV transformer at POI Approximately 162 miles of 230 kV line from POI to Ontario substation Upgrade two 230/138 kV transformers at Ontario substation	$306,675,432
Total Conceptual-level Cost Estimate in 2023 dollars (1)	$306,675,432
(1) This cost estimate includes direct equipment, material, labor, and overheads as shown.	

Table 4. Estimated GI #690 Network Upgrade Costs

In addition to the Network Upgrades identified above, the following contingent facilities are also required:

- Idaho Power project to build a new 500 kV transmission line from Longhorn to Hemingway (B2H - 2026).

8.0 Voltage

A Voltage Stability study was performed using the WECC 2026 Heavy Summer case with Idaho to Northwest West-to-East flows at 105% of the path rating. All contingencies solved successfully, there were no voltage stability issues found for the Project.

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 [redacted], for their own modeling compliance requirements, to install additional PMU devices at their

facilities to monitor the generation source.

9.0 Transient Stability Analysis

The WECC 2026 Heavy Summer operating case and PowerWorld Simulator version 23 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

GI #690 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 [redacted], for their own modeling compliance requirements, to install additional PMU devices at their facilities to monitor the generations sources separately.

11.0 Conclusion

Interconnection requirements detailed in Section 6.0 totaling $39,300,000 are required to interconnect the Project at the Point of Interconnection. Additional upgrades and contingent facilities totaling $306,675,432 are identified in Section 7.0.

The project is connecting to a series compensated line, which will require an SSCI study. In addition to the SSCI, B2H is expected to operate with single-pole switching capability, thus the project will be required to complete a switching study.

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 power flow case for the System Impact study is built using Western Electricity Coordinating Council (WECC) power flow cases as a base case in Power World Simulator. The base cases are then modified to include the senior queued generation interconnection projects in Section 5.0 and their respective network upgrades and POI facilities. The generation project being studied is then added to the cases with the model provided by [redacted] at the requested 329 MW at the requested POI. The base cases are then rebalanced such that the applicable WECC transmission paths are at their WECC path rating with reasonable pre-contingency energy transfers utilizing the Idaho Power transmission system. The power flow model is then analyzed using P1 and P2 category contingencies contained in Table 1 of NERC standard TPL-001. WECC and Idaho Power reliability criteria are applied to the results of the contingency analysis and any violations listed in Table 3, are mitigated with Network Upgrades or contingent facilities, (see also Section 7.0).

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 system upgrades identified in Section 7.0 mitigate the overload during charging. However, 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 of the energy storage device 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.

Revision History

Date	Revision	Initials	Summary of Changes
07/26/2023	1		Initial Report