GENERATOR INTERCONNECTION

SYSTEM IMPACT STUDY REPORT

for integration of the proposed

400 MW [redacted]

(GI PROJECT #663)

to the

IDAHO POWER COMPANY ELECTRICAL SYSTEM

in

ADA COUNTY, IDAHO

for

[redacted]

Report v.1

February, 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 400 MW [redacted] (the Project). The Project location is in Idaho Power Company's (IPC's) Capital Region in Ada County, Idaho. The Project latitude and longitude coordinates are approximately [redacted]. The project is Generation Interconnect (GI) queue number 663 (GI #663). The Project has chosen 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 400 MW at a single Point of Interconnection (POI) at 230kV. The POI is IPC's Hubbard – Danskin 230-kV transmission line.

This report documents the basis for and the results of this System Impact Study for the GI #663 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 the Hubbard - Danskin 230-kV line was evaluated. The GI #663 Project is a Solar PV plus Battery Energy Storage System (BESS).

GI #663 will be required to control voltage in accordance with a voltage schedule as provided by Idaho Power Grid Operations. GI #663 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 230-kV POI - **$4,948,785**

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 Idaho Power Company – Power Production project is as follows:

- Network Resource Interconnection Service - **$14,125,980**
    - Appendix B contains a contingent transmission facility upgrade associated with a planned Idaho Power transmission project and its 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 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

IPC projects queue GI #610, GI #619, GI #622, GI #629, GI #632, GI #634, GI #636, GI #638, GI #639, GI #640, GI #643, GI #646, and GI #649 are senior queued projects in the affected area of IPC's transmission system. Idaho Power studied GI #663 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 #663.

GI #663 Energy Resource Interconnection Service, ERIS, at the Hubbard - Danskin 230-kV line is not contingent upon upgrades associated with the senior queued projects.

GI #663 Network Resource Interconnection Service, NRIS, at the Hubbard - Danskin 230-kV line POI is contingent upon upgrades associated with planned Idaho Power projects and senior GI projects. Refer to Appendix B for a list of contingent transmission facility upgrades.

5.0 Description of Proposed Generating Project

Project Location	[redacted]
Commercial Operation Date	[redacted]
Interconnection Voltage	[redacted]
Point of Interconnection	[redacted]
Number and Type of Generators **Solar:** **Battery:**	[redacted]
Individual Battery Generator Nameplate Rating	[redacted]
Total Battery Output Rating	[redacted]
Total PV Output Rating	[redacted]
Substation Step-Up Transformer	[redacted]

Table 1. *GI #663 Project Specifications*

The primary point of interconnection for GI #663 is the Hubbard – Danskin 230-kV line. The assumed GI #663 Project's maximum generation is 400 MW from the PV plus BESS. The Project's Commercial Operation Date (COD) is December 31, 2025.

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 #663 Project has applied to connect to the Idaho Power transmission system for an injection of 400 MW with a new 230kV interconnection at the Hubbard - Danskin 230-kV line. 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 #663. Power flow analysis indicates that the Project's full output of 400 MW can be interconnected at the POI with the identified upgrades.

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.

The proposed interconnection will require a three 230-kV breaker ring-bus on the Hubbard – Danskin 230-kV 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.

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 #663 POI 230-kV bus location and adjacent buses was evaluated

Studies indicate that there is adequate load and short circuit interrupting capability on the Transmission Provider's existing 230kV breakers after this Project is interconnected.

6.4 Electric System Protection Results and Grounding Requirements

For 230-kV 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 230-kV line terminal will be the responsibility of said interconnection customer.

6.5 Energy Resource Interconnection Service Cost Estimate

In Table 4 below, a summary is provided of the facilities and conceptual costs required to interconnect the GI #663 Project to the Transmission Provider's transmission system.

GI #663 [redacted] **Energy Resource Interconnection Service Facilities**	
ERIS Transmission Upgrades:	**Cost**
Interconnection Facilities:	
[redacted]	$4,948,785
ERIS – Total Estimated Cost (3)	**$4,948,785**

Table 4. *Estimated GI #663 Energy Resource Interconnection Service 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.

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.

The project exceeds Idaho Power's Most Severe Single Contingency (MSSC) of 330 MW and would be required to have a redundant tie-line and redundant collector system to prevent the tripping of the entire project of an N-1 condition.

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.

For the first and second case, the WECC 2023 Heavy Summer case was modified to represent a summer month with high west to east (eastbound) transfers across Idaho-to-Northwest.

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

For the third case, the WECC 2023 Heavy Summer case was modified to represent a summer month with high generation in the Mountain Home area

Power Flow Analysis was performed on the cases described above. The cases were used to simulate the impact of the proposed GI #663 400 MW Solar plus Storage Project interconnection during normal and contingency operating conditions (TPL-001). Mitigation of any adverse changes in loading or voltage from pre- to post-Project was identified.

The contingencies simulated include:

- All transformers and transmission lines in the local area of the proposed Project.
- Breaker Failures
- The proposed project.

The results of the power flow studies were evaluated using WECC/NERC planning standards and Idaho Power planning standards. The power flow analysis evaluation criteria that were used are summarized below:

- All transmission facilities must remain within their thermal limits.
- Pre-contingency bus voltages within the study area must be between 0.95 per unit and 1.05 per unit.
- Maximum voltage deviation allowed at all buses under contingency conditions will be 5% for N-1 (NERC Category B).

Power flow solution was achieved for all the N-1 and credible N-2 outages simulated.

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 #663 in addition to the Energy Resource generation interconnection facilities.

- Expand the GI 663 to a four-position ring to accommodate a second tie lie from the generator
- Build a new 230-kV transmission line from [redacted] to [redacted] with [redacted] conductor
- Create a new 230-kV position [redacted] substation
- Create a new 230-kV position [redacted] substation

IPC projects queue GI #610, GI #619, GI #622, GI #629, GI #632, GI #634, GI #636, GI #638, GI #639, GI #640, GI #643, GI #646, GI #649 are senior queued projects in the affected area of IPC's transmission system. Idaho Power studied GI #663 with all Network Upgrades identified for senior queued projects as in-service. Appendix B contains a list of contingent transmission facility upgrades associated with a planned Idaho Power. Changes to senior queued projects including withdrawal from the queue, may trigger a restudy associated with GI #663 Network Resource, NR, service.

7.3 Network Resource Interconnection Service Cost Estimate

Table 5 below is a summary of the Network Transmission generation interconnection facilities and conceptual costs required to interconnect the GI #663 Project to the Transmission Provider's transmission system for Network Resource Interconnection Service.

GI #663 [redacted] **Network Resource Interconnection Service Facilities**	
NRIS Transmission Upgrades:	**Cost**
Network Upgrades:	
Expand the GI 663 to a four-position ring to accommodate a second tie lie from the generator	$931,770
Build a new 230-kV transmission line from [redacted] to [redacted] with [redacted] conductor	$5,997,345
Create a new 230-kV position at [redacted]	$1,124,040

Create a new 230-kV position at [redacted]	$1,124,040
NRIS – Subtotal	$9,177,195
ERIS – Total Estimated Cost	$4,948,785
NRIS – Total Estimated Cost (1)	**$14,125,980**

Table 5. *Estimated GI #663 Network Resource Generation Interconnection Costs*

(1) 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.

8.0 Grid Charging

The battery energy storage system component of the project was studied from charging from the grid. The charging of the BESS was assumed to be interruptible. There may be times during the year where system load in the local area will prevent charging of the BESS at full capacity. No additional network upgrades were identified to support charging of the BESS.

9.0 Voltage Stability Analysis

A Voltage Stability study was performed using the WECC 2023 Heavy Summer case with Midpoint West and Idaho-Northwest (Path 14) West-to-East flows stressed up to 105% of their existing Path Ratings; and the WECC 2022 Light Winter case with Midpoint West and Idaho-Northwest (Path 14) East-to-West flows stressed up to 105% of their existing Path Ratings. All contingencies solved successfully, indicating there were no Voltage Stability issues found for the Project.

10.0 Transient Stability Analysis

The WECC 2022 Light Winter 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.

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 high-side of the generator substation over the range of real power output. At full output of 400 MW, the Project would need to be able to provide approximately +/- 131.47 MVAr reactive support at the high-side of the generator substation. Based on the information provided, the Project meets the required reactive power capability.

GI #663 will be required to control voltage in accordance with a voltage schedule as provided by Idaho Power Grid Operations, and GI #663 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 latest version of the IEEE Standard 519 *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 #6663.

12.0 Conclusion

GI #663 can be interconnected to the Idaho Power transmission system at the proposed Hubbard - Danskin 230-kV line POI with the identified upgrades.

Interconnection requirements detailed in Section 6.5 totaling **$4,948,785** are required to interconnect the Project for Energy Resource Interconnection Service (ERIS) at the proposed Hubbard – Danskin 230-kV line POI. If the Project interconnects for Network Resource Interconnection Service (NRIS), the cost to integrate the project is also **$14,125,980**. The NRIS is reliant on facilities identified in a planned Idaho Power transmission project detailed in Appendix B.

Energy Resource Interconnection Service and Network Resource Interconnection Service do 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.

APPENDIX B

Table B1 is a summary of the planned Idaho Power facility upgrades required by GI #663

500 kV Projects	
Transmission Upgrades:	**Cost**
Build the new [redacted] station	NA
[redacted] 500 kV transmission line and associated substation work	NA

Table B1: Idaho Power Planned Transmission Project Required by GI #663

Table B2 is a summary of the network upgrades assigned to GI 646 required by GI #663

Rebuild [redacted] 230kV	
Transmission Upgrades:	**Cost**
Rebuild [redacted] 230 kV line	$2,158.548

Table B2: Senior GI Network Upgrades Required by GI #663

Table B3 is a summary of the network upgrades assigned to GI 636 required by GI #663

Build [redacted] 230kV Project	
Transmission Upgrades:	**Cost**
Rebuild [redacted] 230 kV line	$25,563,541

Table B3: Senior GI Network Upgrades Required by GI #663

Revision History

Date	Revision	Initials	Summary of Changes
2/1/23	1	AVD	Initial Report