**GENERATOR INTERCONNECTION**

**FEASIBILITY 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**

**August 2, 2021**

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## 1.0 Introduction

[redacted] has contracted with Idaho Power Company ("Transmission Provider") to perform a Generator Interconnection Feasibility Study for the integration of the proposed 87 MW [redacted] project (the Project). The Project location is in Idaho Power Company's (IPC's) Capital Region in Elmore County, Idaho. The Project is approximately [redacted] miles on the [redacted] from its point of connection with [redacted]. The project is Generation Interconnect (GI) queue number 578 (GI #578). The Project has chosen in the Feasibility Study to be studied for Energy Resource Interconnection Service (ERIS) and Network Resource Interconnection Service (NRIS).

The Project has applied to connect to the 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 [redacted] Station 138kV bus.

IPC projects queue GI #530, GI #551, GI #557, GI #567, and GI #570 are senior queued projects in the affected area of IPC's transmission system and their associated Network Upgrades and/or Interconnection Facilities may be contingent facilities. Should GI #578 elect to move forward into the System Impact Study phase the facilities that are contingent will be identified.

This report documents the basis for and the results of this Feasibility 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 feasibility study requirements of the Idaho Power Tariff.

## 2.0 Summary

A System Impact Study is required to determine if any additional network upgrades are required to integrate the Project into the IPCo transmission system and to evaluate full system impacts (thermal, voltage, transient stability, reactive margin). Generator 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.

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 - **$2,299,742**
    - This does not include costs for any required facilities from senior queued GI #530, GI #551, GI #557, GI #567, and GI #570 projects (See Appendix B for a list of potential contingent facilities).

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

## 3.0 Scope of Interconnection Feasibility Study

The Interconnection Feasibility Study was done and prepared in accordance with the Transmission Provider's Standard Generator Interconnection Procedures to provide a preliminary evaluation of the feasibility of the interconnection of the proposed generating Project to the Idaho Power system. As listed in the Interconnection Feasibility Study agreement, the Interconnection Feasibility Study report provides the following information:

- preliminary identification of any circuit breaker short circuit capability limits exceeded because of the interconnection;
- preliminary identification of any thermal overload or voltage limit violations resulting from the interconnection; and
- preliminary description and non-binding estimated cost of facilities required to interconnect the Large Generating Facility to the IPC System and to address the identified short circuit 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

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.

IPC projects queue GI #530, GI #551, GI #557, GI #567, and GI #570 are senior queued projects in the affected area of IPC's transmission system. Idaho Power studied GI #578 with all Network Upgrades and Interconnection Facilities identified for GI #530, GI #551, GI #557, GI #567, and GI #570 modeled as in service (Potential Contingent Facilities). Potential Contingent Facilities for each of these GI projects are detailed in Appendix B. Changes to senior queued projects including in-service date and withdrawal from the queue, may trigger a restudy associated with GI #578 Network Resource Interconnection Service, NRIS, (some or all the network upgrades identified for GI #530, GI #551, GI #557, GI #567, and GI #570 may be required by GI #578).

## 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] 138 kV substation.

The primary point of interconnection for GI #578 is the [redacted] 138kV bus. Assumed GI #578 Project's maximum generation is 87 MW from the combined Photovoltaic (PV), wind, and Battery Energy Storage System (BESS). The Project's Commercial Operation Date (COD) is October 1, 2021.

GI #578:

- [redacted]-mile 138kV transmission line from [redacted] Station 138kV bus to Project
- One 138/34.5kV GSU transformer with 133/177/222 MVA capacity and 8% impedance
- All generation in voltage regulation (Reactive capability used to regulate voltage – supply/absorb reactive)
- In addition to the above assumptions, GI #587 was also studied as an 87 MW injection at the POI.

## 6.0 Energy Resource (ER) Interconnection Service

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 [redacted] 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 preliminary power flow analysis to evaluate the feasibility of interconnecting GI #578.

## 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. A System Impact Study will be required to determine the specific network upgrades required to integrate the Project. Listed below are the required transmission facilities to interconnect the Project.

**Substation/Transmission Interconnection Facilities:**

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 | 12242.3 | 12470.8 | 14610.2 |

| Fault Study (w/ GI #578) | | | |
|---|---|---|---|
| **Location** | **SLG (A)** | **LTL (A)** | **3PH (A)** |
| [redacted] 138kV Bus | 12781.4 | 12948.6 | 14610.2 |

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.

### 6.5 Energy Resource Interconnection Service Cost Estimate

In Table 1 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 [redacted] Project**<br>**Energy Resource Interconnection Service Facilities** | |
|---|---|
| **ERIS Transmission Upgrades:** | **Cost** |
| **Interconnection Facilities** | |
| [redacted] 138kV Line Terminal to GI #578. | $1,152,095 |
| **Network Upgrades** | |
| [redacted] 138kV Line Terminal to [redacted]. | $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 1. 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 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, two 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.

### 7.2 Network Resource Interconnection Service Transmission Upgrades

From the power flow/contingency analysis, no additional Network Transmission upgrades were identified for the integration of GI #578 in addition to the Energy Resource generation interconnection facilities. A System Impact Study will ultimately be required to determine the specific network upgrades required to integrate the Project.

IPC projects queue GI #530, GI #551, GI #557, GI #567, and GI #570 are senior queued project 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 (Potential Contingent Facilities). Potential Contingent Facilities for each of these GI projects are detailed in Appendix B. Changes to senior queued projects including in-service date and withdrawal from the queue, may trigger a restudy associated with GI #578 Network Resource, NR, service, (some or all the network upgrades identified for GI #530, GI #551, GI #557, GI #567, and GI #570 may be required by GI #578).

### 7.3 Network Resource Interconnection Service Cost Estimate

Table 2 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 as a Network Resource. A System Impact Study will ultimately be required to determine the specific network upgrades required to integrate the Project.

| **GI #578 [redacted] Project**<br>**Network Resource Interconnection Service Facilities** | |
|---|---|
| **NRIS Transmission Upgrades:** | **Cost** |
| Network Resource Interconnection Service – Total Estimated Cost | $0 |
| Energy Resource Interconnection Service – Total Estimated Cost | $2,299,742 |
| **Network Resource Interconnection Service – Total Estimated Cost (3)** | **$2,299,742** |

Table 2. 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.
- 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 Description of Operating Requirements

It is the generation Project's responsibility to provide reactive power capability of the Project to have a power factor operating range of at least 0.95 leading (absorbing) to at least 0.95 lagging (supplying) at the POI over the range of real power output (up to maximum output of the Project).

Identification of any additional equipment required at the plant to meet Idaho Power reactive power capability interconnection requirements will be provided in the System Impact Study if the generation interconnection customer chooses to move to the next study phase of the interconnection process.

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(s) is required to comply with the applicable Voltage and Current Distortion Limits found in IEEE Standard 519-1992 *IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems*.

Installation of phasor measurement unit devices at the POI and maintenance costs associated with communication circuits needed to stream PMU data will also be required to be provided to interconnect GI #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.

Additional operating requirements for this Project may be identified in the System Impact Study when it is performed.

## 9.0 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. No additional upgrades were identified for the integration of the Project for Network Resource Interconnection Service. However, the Network Resource Interconnection Service may be reliant on facilities identified in senior queued generation interconnections.

A System Impact Study is required to determine the specific Transmission Network Upgrades required to integrate the Project for Network Resource Interconnection Service and to evaluate the system impacts (thermal overload, voltage, transient stability, reactive margin). 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 Feasibility 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 Network Transmission generation interconnection facilities and conceptual costs required to interconnect the GI #530 Project to the Transmission Provider's transmission system as a Network Resource.

| **GI #530 Project** | |
|---|---|
| **NRIS Transmission Upgrades:** | **Cost** |
| [redacted] **230kV Line**<br>Rebuild [redacted] miles of 230kV line with [redacted] Conductor | $30,470,000 |
| [redacted] **230kV Line**<br>Rebuild [redacted] miles of 230kV line with [redacted] Conductor | $2,655,000 |
| [redacted] **230kV Line Loop in-and-out of** [redacted] **Station**<br>Build [redacted] miles 230kV Double Circuit Line with [redacted] Conductor | $1,040,000 |
| [redacted] **230kV Station**<br>Add two 230kV Line Terminals | $1,775,000 |
| [redacted] **500/230kV 2nd Transformer** | $10,600,000 |
| **Subtotal** | **$46,540,000** |
| Contingencies (~20%) | $9,308,000 |
| **Subtotal** | **$55,848,000** |
| Overheads (~10.0%) | $5,584,800 |
| **Network Transmission – Total Estimated Cost** | **$61,432,800** |
| ERIS – Total Estimated Cost | $86,020,000 |
| **NRIS – Total Estimated Cost** | **$147,452,800** |

Table B1 GI #530 Network Resource

Table B2 is a summary of the Network Transmission generation interconnection facilities and conceptual costs required to interconnect the GI #551 Project to the Transmission Provider's transmission system as a Network Resource.

| **GI #551 Project** | |
|---|---|
| **NRIS Transmission Upgrades:** | **Cost** |
| **Network Transmission – Total Estimated Cost** | **$0** |
| ERIS – Total Estimated Cost | $917,937 |
| **NRIS – Total Estimated Cost** | **$917,937** |

Table B2 GI #551 Network Resource

Table B3 is a summary of the Network Transmission generation interconnection facilities and conceptual costs required to interconnect the GI #557 Project to the Transmission Provider's transmission system as a Network Resource.

| **GI #557 Project** | |
|---|---|
| **NRIS Transmission Upgrades:** | **Cost** |
| [redacted] **to** [redacted] **138kV Rebuild**<br>Includes Air break switches at [redacted] | $2,020,000 |
| [redacted] **to** [redacted] **138kV Rebuild**<br>Includes Air break switch at [redacted] | $665,000 |
| **Subtotal** | **$2,685,000** |
| Overheads (~10%) | $268,500 |
| **Subtotal** | **$2,953,500** |
| Contingency (~20.0%) | $590,700 |
| **Network Transmission – Total Estimated Cost** | **$3,544,200** |
| ERIS – Total Estimated Cost | $554,400 |
| **NRIS – Total Estimated Cost** | **$4,098,600** |

Table B3 GI #557 Network Resource

Table B4 is a summary of the Network Transmission generation interconnection facilities and conceptual costs required to interconnect the GI #567 Project to the Transmission Provider's transmission system as a Network Resource.

| **GI #567 Project** | |
|---|---|
| **NRIS Transmission Upgrades:** | **Cost** |
| **Network Transmission – Total Estimated Cost** | **$0** |
| ERIS – Total Estimated Cost | $9,745,618 |
| **NRIS – Total Estimated Cost** | **$9,745,618** |

Table B4 GI #567 Network Resource

Table B5 is a summary of the Network Transmission generation interconnection facilities and conceptual costs required to interconnect the GI #570 Project to the Transmission Provider's transmission system as a Network Resource.

| **GI #570 Project** | |
|---|---|
| **NRIS Transmission Upgrades:** | **Cost** |
| **Interconnection Facilities** | |
| [redacted] **Station**<br>2nd 500kV Line Terminal Bay (~5%) | $250,000 |
| **Network Facilities** | |
| [redacted] **Station**<br>2nd 500kV Line Terminal Bay (with two 500kV breakers) | $4,861,329 |
| New T502 2nd 500/345kV 1800 MVA Transformer | $29,587,534 |
| **Subtotal** | **$34,698,863** |
| Contingency (~20%) | $6,939,773 |
| **Subtotal** | **$41,638,636** |
| Overheads (~7.25%) | $3,018,801 |
| **NRIS – Total Estimated Cost** | **$44,657,437** |

| | |
|---|---|
| ERIS – Estimated Costs | $6,578,281 |
| **NRIS – Total Estimated Cost** | **$51,235,718** |

Table B5 GI #570 Network Resource

# Revision History

| Date | Revision | Initials | Summary of Changes |
|---|---|---|---|
| 07/26/2021 | 0 | SWL | Initial Report |
| 07/28/2021 | 1 | SWL | NRIS, ERIS, NR, and ER terminology |