GENERATOR INTERCONNECTION

FEASIBILITY STUDY REPORT

for integration of the proposed

800 MW [redacted]

(GI #616)

to the

IDAHO POWER COMPANY ELECTRICAL SYSTEM

in

TWIN FALLS COUNTY, IDAHO

for

[redacted]

REPORT v.1

November 11, 2021

Revision History

Date	Revision	Initials	Summary of Changes
11/11/2021	1	MDH	Feasibility Study Report GI #616

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1.0 INTRODUCTION

[redacted] has contracted with Idaho Power Company ("Transmission Provider") to perform a Generator Interconnection Feasibility Study (FeS) for the integration of the proposed 800 MW [redacted] (Project). The Project's location is in Idaho Power Company's (IPC's) Southern Region in Twin Falls County, Idaho. The project is Generation Interconnect (GI) queue reference number 616 (GI #616). The project has chosen in the Feasibility Study to be studied as an Energy Resource Interconnection Service (ERIS).

The Project has applied to connect to the Idaho Power's transmission system for an injection of 800 MW at a single Point of Interconnection (POI) at 345kV at Idaho Power Company's (IPCo's) new Rogerson Switching Station (RGSS) 345kV bus. Because the proposed interconnection is on [redacted]

IPC projects [redacted] (GI #502, GI #503, GI #513, GI #514, GI #517, and GI #523) and GI #549 are senior queued project in the affected area of IPC's transmission system and the facilities and subsequent cost to integrate the 800 MW GI #616 [redacted] project is contingent on these projects' integration facilities.

This report documents the basis for and the results of this FeS for the Generation Interconnection Customer. It describes the Project, the determination of interconnection feasibility and estimated costs for integrating the Project to the Transmission Provider transmission system. This report satisfies the feasibility study requirements of the Idaho Power Tariff. [redacted]

Note:
For the Feasibility Study, the analysis only considered Network Upgrades needed to interconnect the project at the 345kV Rogerson Switching Station on [redacted] *The transmission capacity to provide Idaho Power NR Service will be evaluated in the System Impact Study. The existing transmission capacity available between the POI and Idaho Power Load is insufficient for the Project's output.*

The analysis of available transmission capacity usually occurs as part of a Transmission Service Request (TSR).

2.0 SUMMARY

The feasibility of interconnecting the 800 MW [redacted], GI #616, to Idaho Power's Rogerson Switching Station 345kV bus was evaluated and determined feasible with the identified transmission system upgrades and approximate 200 MW Project generation tripping by a Remedial Action Scheme (RAS) for loss of the [redacted] 345kV line.

The Project will be required to control voltage in accordance with a voltage schedule as provided by Idaho Power's Grid Operations. Therefore, the Project will be required to install a plant controller for managing the real and reactive power output at the POI. As an interconnection on Idaho Power's transmission facilities, a phasor measurement unit device (PMU) will be required at the POI and the installation and maintenance costs associated with communication circuits needed to stream PMU data may be required.

An Interconnection System Impact Study (SIS) is required to determine if any additional Interconnection Facilities or Network Upgrades are required to integrate the project into Idaho Power's transmission system. 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 into 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 chosen in the Feasibility Study to be studied as an ERIS Resource Interconnection Service (ERIS).

Interconnection Facilities for GI #616 [redacted] project:

- [redacted] POI 345kV Line Terminal
- 345kV 35 MVAr Shunt Reactor

For planned outage of the [redacted] 345kV line, the project will be required to slightly curtail to avoid overloading the [redacted] 345 kV line N-0 steady-state. Opening the [redacted] 345kV line, overloads the [redacted] 345kV line's nominal and emergency ratings. And five contingencies which results in opening the [redacted] 345 kV line, one contingency resulted in significant reliability violations due to also tripping GI

#549, and the four other contingencies failed to solve due to voltage collapse in the [redacted]. Required approximately 200 MW of Project generation tripping by RAS to mitigate these five contingencies.

The total preliminary/conceptual cost estimate for ERIS to interconnect the [redacted] project, GI #616, as requested to the 345kV bus at Idaho Power's Rogerson Switching Station transmission station is **$9,652,500**.

The cost estimate includes direct equipment and installation labor costs, indirect labor costs and general overheads, and a contingency allowance. 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 estimate does not include the cost of the customer's equipment to construct the generation facility.

3.0 SCOPE OF INTERCONNECTION FEASIBILITY STUDY

The Interconnection FeS was performed and prepared in accordance with Idaho Power Standard Generator Interconnection Procedures, to provide a preliminary evaluation of the feasibility of the interconnection of the proposed generating project to the local transmission system. As listed in the Interconnection FeS agreement, the Interconnection FeS report provides the following information:

- preliminary identification of any circuit breaker short circuit capability limits exceeded as a result 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 transmission system and to address the identified short circuit and power flow issues.

Generation projects in the Generator Interconnect queue prior to this project could impact the cost of interconnection. A current list of projects in Idaho Power's queue can be found in the Generation Interconnection folder located on the Idaho Power OASIS web site at the link shown below:

http://www.oasis.oati.com/ipco/index.html

4.0 DESCRIPTION OF PROPOSED GENERATING PROJECT

[redacted], GI #616, proposes to interconnect to the Idaho Power transmission system at 345kV with a total injection of 800 MW (maximum project output). The POI is the 345kV bus at IPCo's Rogerson Switch Station transmission station. The project's requested in-service date is [redacted].

Table 1: Project Specifications

POI Location	Project to be located in Twin Falls County approximately [redacted]
Number and Type of Generators	(276) GE 3.03-140 WTG – Wind
Individual Generator Nameplate Rating	Wind 3.03 MW
Total Output Power Rating	800.0 MW Wind
Rated Power Factor	0.95
Transmission Lines	One [redacted] 345kV Line (Project to POI) Four 230kV Lines with [redacted] Four 34.5kV Collector Equivalent Circuits
Transformers	Two Station 3-phase 345/230kV 296/393/491 MVA Z = 7.0%, X/R = 45 A Plant 3-phase 230/34.5kV 150/200/250 MVA Z = 7.0%, X/R = 33 B Plant 3-phase 230/34.5kV 140/186/233 MVA Z = 7.0%, X/R = 33 C Plant 3-phase 230/34.5kV 140/186/233 MVA Z = 7.0%, X/R = 33 D Plant 3-phase 230/34.5kV 135/180/225 MVA Z = 7.0%, X/R = 33 A Plant GSU 3-phase 34.5/0.69kV 271.8 MVA Z = 6.9%, X/R = 7.5 B Plant GSU 3-phase 34.5/0.69kV 234.5 MVA Z = 6.9%, X/R = 7.5 C Plant GSU 3-phase 34.5/0.69kV 234.5 MVA Z = 6.9%, X/R = 7.5 D Plant GSU 3-phase 34.5/0.69kV 217.5 MVA Z = 6.9%, X/R = 7.5
Interconnection Voltage	345kV

5.0 DESCRIPTION OF INTERCONNECTION TRANSMISSION FACILITIES

Preliminary power flow analysis indicated that interconnection of an 800 MW injection at the POI will require the following transmission system improvements: 345kV bus expansion to install a new line bay at the POI.

A SIS will be required to determine specific network upgrades required to transfer the Project output to load.

5.1 Transmission Line Facilities

The Project will be inserted in the Rogerson Switching Station 345kV bus.

5.2 Substation Facilities

The substation yard will need to be expanded and the new Rogerson Switching Station 345 kV bus work extended to make room for a new line bay with one new 345kV power circuit breaker, associated switches, protective relaying systems, SCADA, communications, and a Generation Interconnection metering package.

Prior to the proposed GI #616 interconnection, [redacted] 345kV voltage performance was very marginal for the loss of [redacted] 345kV line with [redacted] (GI #502, GI #503, GI #513, GI #514, GI #517, and GI #523) and GI #549 off-line. The addition of GI #616 project with its 345kV and 230kV transmission collector network will require an approximate 35 MVAr 345kV shunt reactor to mitigate GI #616 transmission collector network charging.

5.3 Grounding Requirements

For 345kV 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 345kV line terminal will be the responsibility of said interconnection customer.

The project single line does not indicate the winding configuration on the 345kV side of the 345/230kV transformers. Idaho Power requires a wye grounded connection on the high side and delta included in the transformer to create a solid ground path for the transmission system. This can be achieved with auto-transformers with a delta tertiary which is a source of ground current, other configurations can and do exist.

Grounding requirements and acceptability criteria are found in Appendix A.

5.4 System Protection Assessment

Short Circuit details at POI interconnection location:

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

Fault duty at the POI 345kV bus with and without generation.

Fault Study (Baseline w/o additional gen)			
Location	**SLG (A)**	**LTL (A)**	**3PH (A)**
[redacted] **345kV Bus**	[redacted]	[redacted]	[redacted]

Fault Study (with GI #616)			
Location	**SLG (A)**	**LTL (A)**	**3PH (A)**
[redacted] **345kV Bus**	[redacted]	[redacted]	[redacted]

6.0 DESCRIPTION OF POWER FLOW CASES

PowerWorld simulator software was used to evaluate the 21HS3a1 WECC Base Case simulating [redacted] represented at its [redacted]. The original WECC Base Case was modified to add the Project and senior projects ([redacted] (GI #502, GI #503, GI #513, GI #514, GI #517, and GI #523) and GI #549) in the affected area. The modified case was named 21HS3a1_[redacted]Post-GI616.

The pre-project power flow case with the senior queue projects provides baseline loads and voltages in the area prior to adding the Project. The case was named 21HS3a1_[redacted]Pre-GI616.pwb.

The levels of flow represented in the study cases are intended to capture potential impact of the Project on the existing transmission system.

7.0 POWER FLOW STUDY RESULTS

Power Flow Analysis was performed on the cases described above. The base cases were used to simulate the impact of the 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.
- 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 related 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 8% for N-1 (NERC Category B).

Power flow solution was achieved for each of the N-1/N-2 outages simulated. Key findings from the power flow analysis are as follows:

- Overloading. There were no significant thermal violations on [redacted] transmission systems in the power flow analysis.
    - For BF [redacted] contingency ([redacted] 345kV line and GI #549), overloads occurred in GI #616 collector network 230/34.5kV and 34.5/0.69kV transformers.
- Voltage Deviation.
    - For BF [redacted] contingency ([redacted] 345kV line and GI #549), voltage deviation violations occurred in the NVE's transmission system.
- Voltage Violations.
    - For BF [redacted] contingency ([redacted] 345kV line and GI #549), voltage violations occurred [redacted].
- Unsolved Contingencies.
    - [redacted]345
    - [redacted] Internal Fault ([redacted] 345kV line and [redacted] 345kV line)
    - [redacted] Internal Fault ([redacted] 345kV line and [redacted] transformer)
    - [redacted] (Common Structure)

From the power flow/contingency analysis, approximate 200 MW Project generation tripping by a Remedial Action Scheme (RAS) for loss of the [redacted] 345kV line will be required for ERIS integration.

8.0 DESCRIPTION OF OPERATING REQUIREMENTS

The installed reactive power capability of the Project must have a power factor operating range of 0.95 leading to 0.95 lagging at the POI over the range of real power output. At full output of 800 MW, the Project would need to be able to provide approximately +/- 263 MVAr reactive support plus the reactive energy consumed by the customer's own facilities. Detailed analysis of the customer's facilities was not evaluated for this Feasibility Study.

The Project will be required to control voltage in accordance with a voltage schedule as provided by Idaho Power's Grid Operations. The Project is required to install a plant controller for managing the real and reactive power output of the 800 MW Project at the POI.

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

9.0 COST ESTIMATE

In Table 2 below a summary is provided of the facilities and preliminary/conceptual costs required to facilitate the ERIS of [redacted], GI #616:

GI #616 [redacted] Project **Energy Resource Interconnection Service Facilities**	
Direct Assigned:	**Cost**
Approximately 25% of a new [redacted] 345kV Line Terminal for GI #616 Standard one-breaker 345kV line terminal with revenue metering	$750,000
Network Assigned:	
Approximately 75% of a new [redacted] 345kV Line Terminal for GI #616 Standard one-breaker 345kV line terminal with revenue metering	$2,250,000
[redacted] 345kV 35MVAr Shunt Reactor 35 MVAr 345kV shunt reactor, 345kV breaker, 345kV air-break switch, protection, etc.	$4,500,000
Subtotal	**$7,500,000**
Contingencies (~20.0%) (1)	$1,500,000
Subtotal	**$9,000,000**
Overheads (~7.25%) (2)	$652,500
ERIS – Total Estimated Cost (3)	**$9,652,500**

Table 2: Preliminary/Conceptual Cost Estimate

(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, overheads, and contingency 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.
- 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.

10.0 CONCLUSIONS

The requested interconnection of the [redacted], GI #616, to Idaho Power's Rogerson Switching Station 345kV bus was studied.

The results of this study work confirm that it is feasible to interconnect the Project to the existing Rogerson Switching Station 345kV bus with the identified transmission system upgrades and approximate 200 MW Project generation tripping by RAS for loss of the [redacted] 345kV line. The results from the power flow analysis and short-circuit analysis confirm that the interconnection of the Project with the identified upgrades/RAS will not have significant impact on the local transmission system.

A SIS is required to determine the specific Transmission Network Upgrades required to integrate the Project as a Network Resource and to evaluate the system impacts (thermal overload, voltage, transient stability, reactive margin).

Generator interconnection service (either as an Energy Resource Interconnection Service or a Network Resource Interconnection Service) does not in any way convey any right to deliver electricity to any specific customer or point of delivery. Transmission requirements to integrate the Project will be determined during the SIS phase of the generator interconnection process.

APPENDIX A

A-1.0 Method of Study

The FeS plan inserts the Project up to the maximum requested injection into the selected Western Electric Coordinating Council (WECC) power flow case and then, using Power World Simulator or GE's Positive Sequence Load Flow (PSLF) analysis tool, the impacts of the new resource on PacifiCorp's transmission system (lines, transformers, etc.) within the study area are analyzed. The WECC and Idaho Power reliability criteria and Idaho Power operating procedures were used to determine the acceptability of the configurations considered. For distribution feeder analysis, Idaho Power utilizes Advantica's SynerGEE 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 and PacifiCorp. 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; this specifies, 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 POI, 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) 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 Idaho Power or PacifiCorp 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

Idaho Power requires interconnected transformers to limit their ground fault current to 20 amps at the POI.

A-4.0 Electrical System Protection Guidance

Idaho Power requires electrical system protection per Requirements for Generation Interconnections found on the Idaho Power Web site,

http://www.idahopower.com/pdfs/BusinessToBusiness/facilityRequirements.pdf

A-5.0 WECC Coordinated Off-Nominal Frequency Load Shedding and Restoration Requirements

Idaho Power 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.

http://www.idahopower.com/pdfs/BusinessToBusiness/facilityRequirements.pdf