GENERATOR INTERCONNECTION

FEASIBLITY STUDY REPORT

for integration of the proposed

240 MW [redacted] SOLAR PROJECT

(GI PROJECT #553)

to the

IDAHO POWER COMPANY ELECTRICAL SYSTEM

in

ELMORE COUNTY, IDAHO

for

[redacted]

REPORT v.0

August 20, 2019

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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 240MW [redacted] solar project. The Project location [redacted] is in Idaho Power Company's (IPC's) Capital Region in Elmore County, Idaho. The project is Generation Interconnect (GI) queue number 553 (GI #553). The project has chosen in the Feasibility Study to be studied as both an Energy Resource (ER) Interconnection Service and a Network Resource (NR) Interconnection Service.

The project has applied to connect to the Transmission Provider's transmission system for an injection of 240 MW of solar on the Idaho Power Company's (IPC's) [redacted] 230kV line.

IPC project queue GI #530, is a senior queued project and the facilities and subsequent cost to integrate the 240 MW GI #553 240 MW [redacted] solar project are contingent on GI #530 integration facilities. [redacted].

This report documents the basis for and the results of this Feasibility Study for the GI #553 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

The feasibility of interconnecting the 240 MW generation project to the Transmission Provider's transmission system was evaluated. The primary Point of Interconnection (POI) is located on Idaho Power's [redacted] 230kV line.

Power flow analysis indicates that interconnecting the project to the primary POI is feasible with network upgrades.

A System Impact Study is required to determine if any additional network upgrades are required to integrate this project into the IPCo transmission system and to evaluate full system impacts (thermal, voltage, transient stability, reactive margin). Generator interconnection service (either as an Energy Resource or a Network Resource) does not in any way convey any right to deliver electricity to any specific customer or point of delivery.

The project will be required to control voltage in accordance with a voltage schedule as provided by Idaho Power Grid Operations. GI #553 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 at Primary 230kV POI - $8,758,942

See Section 6.6 Energy Resource Cost Estimate for the required Energy Resource 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 - $46,563,950
    - This does not include costs for required facilities from senior queued GI #530.

See Section 7.4 Network Resource Cost Estimate for the required Network Resource facilities and cost breakdowns. The cost estimate includes a 20% contingency and 10% 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 #553 Energy Resource, ER, service at the 230kV POI is not contingent upon upgrades associated with any senior queued project.

IPC project queue GI #530, is a senior queued project. Idaho Power studied GI#553 with all Network Upgrades identified in GI #530 modeled as in service (Contingent Facilities). Contingent Facilities are detailed in Appendix B. Changes to GI #530, including in-service date and withdrawal from the queue, may trigger a restudy associated with GI #553 Network Resource, NR, service, (some or all of the network upgrades identified for GI #530 may be required by GI #553).

5.0 Description of Proposed Generating Project

Assumptions

The point of interconnection for GI #553 is on the [redacted] 230kV line at coordinates [redacted]°.

GI #553

- 240 MW Solar Generation
- All generation in voltage regulation (Reactive capability used to regulate 230kV bus voltage – supply/absorb reactive)

6.0 Energy Resource (ER) Interconnection Service

Energy Resource (ER) Interconnection Service 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 #553 project has applied to connect to the Idaho Power transmission system for an injection of 240 MW with a new 230kV interconnection substation on the [redacted] 230kV transmission 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 preliminary power flow analysis to evaluate the feasibility of interconnecting GI #553.

6.1 Description of Substation/Transmission Facilities

As an Energy Resource, 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 Interconnection Facilities:

The proposed interconnection will require a single breaker line terminal interconnection substation.

The actual station layouts 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.

Transmission Interconnection Facilities:

The [redacted] 230kV line is a series compensated line with 70% compensation from [redacted]. The series capacitor bank is located at the

[redacted] terminal of the transmission line. The bank has a 1/3 segment and a 2/3 segment. Adding the solar interconnection station will over compensate the line section from [redacted] to the GI #553 interconnection station to 125% necessitating the 1/3 segment be moved to the [redacted] end of the line.

6.3 Description of Distribution Facilities

No distribution facilities are directly impacted by this project.

6.4 Short Circuit Study Results

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

6.5 Electric System Protection Results and Grounding Requirements

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

Grounding requirements and acceptability criteria are found in Appendix A.

6.6 Energy Resource Cost Estimate

In Table 1 below a summary is provided of the generation interconnection facilities and conceptual costs required to interconnect the GI #553 solar project to the Transmission Provider's transmission system as an Energy Resource.

GI #553 [redacted] Solar Project **230kV Station** **Energy Resource Generation Interconnection Facilities**	
Direct Assigned	**Cost**
New 230kV tapped interconnection station Air break switches, metering, relaying, etc.	$2,635,562
Network Upgrade	
Series Capacitor Bank Move Move 1/3 segment of [redacted] to [redacted]	$4,000,000

Subtotal	**$6,635,562**
Overheads (~10.0%)	$663,556
Subtotal	**$7,299,118**
Contingencies (~20%)	$1,459,824
Energy Resource – Total Estimated Cost	**$8,758,942**

Table 1. Estimated GI #553 Project's Energy Resource Generation Interconnection Costs

The cost estimates include 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 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.

7.0 Network Resource (NR) Interconnection Service

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, 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.

The WECC 2019 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 2019 Light Winter operating case, was modified to represent a shoulder month condition with high east to west (westbound) transfers across Midpoint West.

For the third case the WECC 2019 Heavy Summer case was modified to represent a summer month with high solar, wind, and gas generation east of Boise with high transfers into the Boise area.

7.3 Network Resource Transmission Upgrades

From the power flow/contingency analysis, the following Network Transmission upgrades were identified for the integration of GI #553 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.

GI #553 230kV Ring Bus Station

- Build a three-position ring bus station for NR Interconnection

GI #553 230kV [redacted] 230kV line

- Rebuild approximately 46 miles of 230kV line with bundle 954 MCM ACSR "Cardinal" Conductor

7.4 Network Resource Cost Estimate

Table 2 below is a summary of the Network Transmission generation interconnection facilities and conceptual costs required to interconnect the GI #553 solar 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 #553 [redacted] 240 MW Solar Network Upgrades Network Resource Generation Interconnection Facilities	
Network Resource Transmission Upgrades:	**Cost**
New 230kV ring interconnection station	$6,103,000
GI #553 [redacted] 230kV Rebuild	$25,172,489
Subtotal	**$31,275,720**

Overheads (~10%)	$3,127,572
Subtotal	**$34,403,292**
Contingency (~20.0%)	$6,880,658
Network Transmission – Total Estimated Cost	**$41,283,950**
Energy Resource –Estimated Costs (Series Cap Move)	$5,280,000
Network Resource – Total Estimated Cost	**$46,563,950**

Table 2. Estimated GI #553 Network Resource Generation Interconnection Costs

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 #553 will be required to control voltage in accordance with a voltage schedule as provided by Idaho Power Grid Operations, and GI#553 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 #553. 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 #553 can be interconnected to the Idaho Power transmission system.

Interconnection requirements, detailed in Section 6.6 totaling $8,758,942 are required to interconnect the project as an Energy Resource to the primary 230kV POI . If the project connects as a Network Resource, the cost to integrate the project is $46,563,950. The Network Resource connection is also reliant on network facility upgrades identified in senior queued generation interconnection.

A System Impact Study 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 or a Network Resource) 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 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 Idaho Power'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. 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 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) 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 soon. 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 Electrical System Protection Guidance

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

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

APPENDIX B

Table B2 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	
Network Resource Transmission Upgrades:	**Cost**
[redacted] **230kV Line** Rebuild 35.6 miles of 230kV line with 1590 MCM ACSR "Lapwing" Conductor	$30,470,000
[redacted] **230kV Line** Rebuild 3.1 miles of 230kV line with 1590 MCM ACSR "Lapwing" Conductor	$2,655,000
[redacted] **230kV Line Loop in-and-out of** [redacted] **Station** Build 1.25 miles 230kV Double Circuit Line with 1272 MCM ACSR "Bittern" Conductor	$1,040,000
[redacted] **230kV Station** Add two 230kV Line Terminals	$1,775,000
[redacted] **230kV Line** Rebuild 31.7 miles of 230kV line with 1272 MCM ACSR "Bittern" Conductor	$27,130,000
Subtotal	**$63,070,000**
Contingencies (~20%)	$12,615,000
Subtotal	**$75,685,000**
Overheads (~10.0%)	$7,570,000
Network Transmission – Total Estimated Cost	**$83,255,000**
Energy Resource – Total Estimated Cost	$86,020,000
Network Resource – Total Estimated Cost	**$169,275,000**

Table B2 GI #530 Network Resource

Revision History

Date	Revision	Initials	Summary of Changes
08/20/2019	0	CAW	Initial Report