GENERATOR INTERCONNECTION
SYSTEM IMPACT STUDY REPORT

for integration of the proposed

200 MW XXXXXXXXXXXX SOLAR PROJECT
(GI PROJECT #567)

to the

IDAHO POWER COMPANY ELECTRICAL SYSTEM

in

ADA COUNTY, IDAHO

for

XXXXX XXXXX, LLC

REPORT v.0

June 30, 2020

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1.0 Introduction

XXXXXXXXX Solar, LLC (Customer) has contracted with Idaho Power Company (IPCO) to perform a Generator Interconnection System Impact Study (SIS) for the integration of a proposed 200 MW XXXXXXXXXXXX Solar project (Project) located in the IPCO Capital Region in ADA County, Idaho (~ coordinates XXXXX N, XXXXX W). The Project has been assigned an IPCO Generation Interconnect (GI) queue number 567 (GI #567). In the SIS Agreement, the Project has chosen to have studies performed for both Energy Resource (ER) Interconnection Service and Network Resource (NR) Interconnection Service.

The specific point of interconnection studied is a line tap connection southeast of Boise to the existing IPCO owned XXXXXXXX 230 kV line approximately XX miles from the XXXX 230 kV station.

This report documents the basis for and the results of the SIS for the GI #567 Generation Interconnection. The report describes the proposed project, the determination of interconnection requirements and estimated costs for integration in to the IPCO transmission system. This report satisfies the SIS requirements of the Idaho Power Tariff.

2.0 Summary

The impact to the IPCO transmission system of interconnecting the Project to the XXXXXXXX 230 kV line was evaluated.

The following is for information purposes only and does not convey Transmission Service.

The Project will be required to control voltage in accordance with a voltage schedule as provided by IPCO Grid Operations. GI #567 will be required to manage the real power output of their generation project at the POI.

The total ER Interconnection Service preliminary cost estimate to interconnect the Project is:

- Energy Resource Interconnection: $9,745,618

  See Section 6.6, Energy Resource Cost Estimate, for the required ER facilities and cost breakdowns.

The NR Interconnection Service preliminary cost estimate is the same as the ER interconnection however is contingent on transmission facility upgrades associated with senior queue Generator Interconnection projects.

  Appendix B contains a list of transmission facility upgrades associated with senior queue projects and their estimated costs.

The estimate includes 20% contingency and 10% overhead costs. 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.

IPCO estimates it will require approximately 36 months to design, procure, and construct the facilities described in this report following the execution of a Generation Interconnection Agreement. A more specific schedule 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

This SIS was performed in accordance with IPCO Standard Generator Interconnection Procedures, evaluating the impact of interconnecting the Project to the transmission system. The scope of the SIS is detailed in the System Impact Study Agreement.

4.0 Contingent Facilities

The Project's NR service is contingent on transmission facility upgrades associated with senior queued projects. Refer to Appendix B for a list of possible contingent facilities.

5.0 Description of Proposed Generating Project

XXXXXXXXXXXX Solar, GI #567, proposes to interconnect to the IPCO transmission system at 230 kV with a total injection of 200 MW (maximum project output). The POI is assumed to be on the XXXXXXXX 230 kV line.

Table 1: Project Specifications

Project Location	**XXXXX N, XXXXX W**
Number and Type of Generators **Solar:**	XXXXXXXX Quantity = 61
Individual Generator Nameplate Rating	3600 KVA
Total Output Rating	219.6 MVA
New Step-Up Transformer	133.3/177.8/222.2 MVA ONAN/ONAF/ONAF @ 65°C 230Y / 34.5 - 13.8 Delta kV Z=10% @ BASE MVA
Interconnection Voltage	230 kV

6.0 Energy Resource (ER) Interconnection Service

ER Interconnection Service allows the Interconnection Customer to connect its Generating Facility to a 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.

Power flow analysis indicated that the Project's full output of 200 MW can be interconnected at the POI.

6.1 Transmission Line Facilities

As an ER, 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. At this time, no network upgrades have been identified for the Project as an ER interconnection.

6.2 Substation Facilities

The proposed interconnection will require a new 230 kV substation with a three-position ring bus to connect to the XXXXXXXX 230 kV line.

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.

6.3 Grounding Requirements

The proposed 230/34.5 kV Wye-Grounded/Wye-Grounded with Delta Tertiary station transformer specified in the Idaho Large Generator Interconnection Request for XXXXXXXXXXXX Solar, GI #567, should provide an adequate ground source for transmission line protection/relaying.

Grounding requirements and acceptability criteria are found in Appendix A.

6.4 System Protection Assessment

Studies indicate that there is adequate load and short circuit interrupting capability on the Transmission Provider's existing breakers.

6.5 Electric System Protection Results

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 will be the customer's responsibility.

6.6 Energy Resource Cost Estimate

In Table 2 below a summary is provided of the generation interconnection facilities and conceptual costs required to interconnect the GI #567 solar project to the Transmission Provider's transmission system as an Energy Resource.

Table 2: Project ER Interconnection Cost Estimate

Item of Work	Estimate
New 230 kV Ring bus substation Air break switches, metering, relaying, etc	$7,282,273
230 kV Line Work	$100,771
Contingency 20% (1)	$1,476,609
Overheads (2)	$885,965
Total loaded costs (3)	**$9,745,618**

(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.

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.

7.0 Network Resource (NR) Interconnection Service

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

7.1 Description of Power Flow Cases

For the NR Interconnection Service study, two power flow cases were used to study the Transmission Provider's transmission system with westbound and eastbound flows to determine the required Network Transmission Upgrades.

A WECC 2020 Heavy Summer case was modified to represent a summer month with high imports from the west on Path 14, Idaho-Northwest.

A WECC 2020 Light Spring case was modified to represent a shoulder month condition with high east to west (westbound) transfers across the Midpoint West path.

7.3 Network Resource Transmission Upgrades

From the power flow/contingency analysis, no additional Network Transmission upgrades were identified for the integration of GI #567 beyond that identified for the Energy Resource generation interconnection; however, the studies were performed with all senior queue Generation Interconnection project and their upgrades in service. If the upgrades assigned to the senior queue projects are not constructed, GI #567 may be required to assume responsibility for those upgrades.

7.4 Network Resource Cost Estimate

For NR Interconnection Service, all cost attributed to the ER Interconnection Service will be required; also, additional transmission upgrades associated with senior queue GI projects may be required if the senior project is not constructed.
Appendix B contains a list of senior queue transmission facility upgrades that are potential contingent facilities and their estimated costs.

8.0 Transient Stability Analysis

The WECC 2020 Heavy Summer operating case modified to increase WECC Path 14 to its limit and PowerWorld Simulator version 21 analysis tool were used to perform the transient stability analysis.

When studied the plant controllers were set to control to the 230 kV POI. The results showed no transient stability violations. The REPC_A plant controller model validated with errors, the developer should validate their dynamic modeling data. 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 IPCO if testing or real-time observations indicate a need.

9.0 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 POI over the range of real power output. At full output of 200 MW, the Project would need to be able to provide approximately +/- 62 MVAr reactive support at the POI. Based on the information provided, the Project's own facilities will require approximately 96 MVAr of reactive support (96 MVAr seems large, the customer may wish to verify the submitted data for the collector system). The documentation provided for the proposed inverters indicate they cannot supply the sum of these needs (+158 MVAr), the Project will be required to install additional shunt reactive.

GI #567 will be required to control voltage in accordance with a voltage schedule as provided by IPCO Grid Operations.

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

Installation of PMU 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 #567. The specific costs associated with IPCO requirements for interconnection customers with aggregate facilities larger than 20 MW to provide PMU data to IPCO will be identified in the Facility Study should the generation interconnection customer choose to proceed to that phase of the interconnection process.

10.0 Conclusion

The requested interconnection of the XXXXXXXXXXXX Solar project, GI #567, to IPCO's system was studied.

Interconnection requirements, detailed in Section 6.6, totaling $9,745,618 are required to interconnect the project as an Energy Resource. If the project connects as a Network Resource, the cost to integrate the project is the same plus the cost of any contingent facility upgrades not provided by senior queue projects.

The results of this study work confirm that GI #567 can be interconnected to the IPCO 230 kV transmission system at the proposed POI without requiring additional network upgrades beyond those identified by senior queue projects.

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.

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 Electric Coordinating Council (WECC) power flow case(s) and then, using PowerWorld Simulator analysis tool, the impacts of the new resource on the IPCO transmission system (lines, transformers, etc.) within the study area are analyzed. The WECC and IPCO reliability criteria and operating procedures were used to determine the acceptability of the configurations considered. For distribution feeder analysis, IPCO utilizes Advantica 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 IPCO. Less than or equal to 100% of continuous rating is acceptable.

IPCO 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 IPCO's T&D Advisory Information Manual.

IPCO'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 IPCO 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 IPCO 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 B1 is a summary of the Network Transmission facility upgrades required by senior queue projects and their conceptual costs

GI #530 Project	
Network Resource Transmission Upgrades:	**Cost**
XXXXXX 230kV Line Rebuild 35.6 miles of 230kV line with 1590 MCM ACSR "Lapwing" Conductor	$30,470,000
XXXXXX 230kV Line Rebuild 3.1 miles of 230kV line with 1590 MCM ACSR "Lapwing" Conductor	$2,655,000
XXXXXXX 230kV Line Loop in-and-out of XXXX Station Build 1.25 miles 230kV Double Circuit Line with 1272 MCM ACSR "Bittern" Conductor	$1,040,000
XXX 230kV Station Add two 230kV Line Terminals	$1,775,000
Subtotal	**$35,940,000**
Contingencies (~20%)	$7,188,000
Subtotal	**$43,128,000**
Overheads (~10.0%)	$4,312,800
Network Transmission – Total Estimated Cost	**$47,440,800**

Table B1 Senior Queue Network Upgrades

Revision History

Date	Revision	Initials	Summary of Changes
06/29/2020	0	GMT	Original
6/30/2020	1	GMT	Incorporated comments from Peer review