GENERATOR INTERCONNECTION
SYSTEM IMPACT STUDY REPORT

for integration of the proposed

120 MW XXXXXX PROJECT
(GI PROJECT #558)

to the

IDAHO POWER COMPANY ELECTRICAL SYSTEM

in

JEROME COUNTY, IDAHO

for

XXXXXX, LLC

REPORT v.0

March 26, 2020

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1.0 Introduction

XXXXXX, LLC has contracted with Idaho Power Company (IPCO) to perform a Generator Interconnection System Impact Study (SIS) for the integration of the proposed 120 MW XXXXXX Park (Project). The Project location (~ coordinates XXXX N, XXXX W) is in the IPCO Southern Region in Jerome County, Idaho. The Project has been assigned an IPCO Generation Interconnect (GI) queue number 558 (GI #558). The Project has chosen in the System Impact Study to be studied as both an Energy Resource (ER) Interconnection Service and a Network Resource (NR) Interconnection Service.

The specific Point Of Interconnection (POI) studied is a new 138 kV two breaker substation inserting the Project into the existing IPCO owned 138 kV XXXXXX Transmission Line approximately 3.5 miles south of the XXXX Substation.

This report documents the basis for and the results of this SIS for the GI #558 Generation Interconnection Customer. 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 120 MW XXXXXX Park, GI #558, to XXXXXX 138 kV line was evaluated.

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

The studies performed to date have not identified any system upgrades beyond that needed to electrically connect the Project; therefore, the cost estimates for Network Resource (NR) and Energy Resource (ER) Interconnection Services are equal. The total preliminary cost estimate to interconnect the XXXXXX Park, GI #558, to Idaho Power's 138 kV system between XXXX and XXXX substations is **$4,131,710**.

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. The schedule will be further 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 IPCO transmission system. The scope of the SIS is detailed in the System Impact Study Agreement.

4.0 Contingent Facilities

The Project's NR or ER service is not contingent on upgrades associated with senior queued projects.

5.0 Description of Proposed Generating Project

XXXXXX Park, GI #558, proposes to interconnect to the Idaho Power transmission system at 138 kV with a total injection of 120 MW (maximum project output). The POI is assumed to be a new 138 kV class substation inserted in the IPCO 138 kV XXXXXX Transmission line.

Table 1: Project Specifications

Project Location	XXXX N, XXXXX W
Number and Type of Generators	Solar Photovoltaic, XXXX, Quantity = 31
Individual Generator Nameplate Rating	3981 kW
Total Output Power Rating	119,669 kWac
Rated Power Factor	0.9 Leading / 0.9 Lagging
New Step-Up Transformer	145 MVA, 3-phase, 138/34.5/13.8 kV, Z = 8% on 87 MVA base
Interconnection Voltage	138 kV

6.0 Description of Substation/Transmission Facilities

The XXXXXX Park, GI #558, interconnection to the XXXXXX 138 kV line was studied in this SIS. The Project is located adjacent to the proposed POI.

Power flow analysis indicated that the Project's full output of 120 MW can be interconnected at the POI. The only local transmission system improvement required will be the new 138 kV class substation for this project.

6.1 Transmission Line Facilities

The Project will be inserted in the XXXX-XXXX section of the XXXXXX 138 kV line. The POI will be the 138 kV breaker on the high side of the Project 138/34.5 kV transformer.

6.2 Substation Facilities

A new 138/34.5 kV substation will need to be constructed adjacent to the existing XXXX-XXXX 138 kV line section. IPCO will break the line adjacent to the substation and terminate the line sections in the substation as two individual lines in a manner similar to Figure 1.

Figure 1 - Proposed interconnection station

The new substation will consist of two 138 kV line terminals with associated protective relaying systems and a customer owned 138/34.5 kV transformer. The POI will be the 138 kV breaker on the high side of the 138/34.5 kV transformer.

6.3 Grounding Requirements

The proposed 138/34.5 kV Wye-Grounded/Wye-Grounded with Delta Tertiary station transformer specified in the Idaho Large Generator Interconnection Request for XXXXXX Park, GI #558, 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

Short Circuit details at approximate interconnect location:
Fault current contribution: the rated fault current contribution from GI #558 (as per the interconnection request) is rated at 1.00 p.u. of full load current. For a 120 MVA array this would equal 1200 amps at 138 kV, and 3000 amps at 34.5 kV. Fault current contributions from the IPCO system to the GI Project #558 buses are as follows:

Single line-to-ground (SLG) fault on the 138kV bus POI = 12204.1 amps, 3 phase fault on the 138kV bus = 12323.4 amps

Single line-to-ground (SLG) fault on the 138kV XXXX bus = 18204.7 amps, 3 phase fault on the 138kV XXXX bus = 17008.5 amps

Single line-to-ground (SLG) fault on the 138kV XXXX bus = 9500.7 amps, 3 phase fault on the 138kV XXXX bus = 9840 amps

IPCO does not anticipate that the fault current contribution will exceed any existing circuit breaker interrupter ratings.

Due to the number of generation sources in the Project area, two circuit breakers will be required in order to meet IPCO electrical system protection requirements.

6.5 Description of Distribution Facilities

No distribution facilities are directly impacted by this project.

6.6 Network Resource and Energy Resource Cost Estimate

The following upgrades will be required to facilitate the interconnection of XXXXXX, GI #558:

- Construct a 138 kV substation
- Install one 138 kV power circuit breaker with associated protection systems for the transmission lines.
- Install generation interconnection package at the POI. This includes one 138 kV power circuit breaker, an SEL-421 protective relay, which requires 3-phase potential transformers (PTs), 3-phase current transformers (CTs), SCADA and remote connectivity.
- Line work to break existing 138 kV line and terminate at substation.
- Note that this cost estimate does not include the cost of the customer's equipment/facilities or required communication circuits.
- These are estimated costs only and final charges to the customer will be based on the actual construction costs incurred.

Table 2: Conceptual Cost Estimate

Item of Work	Estimate
Substation construction and Generation interconnection and protection package	$2,976,702
Transmission upgrades	TBD
Unloaded costs	$2,976,702
Contingency 20% (1)	$779,398
Total unloaded costs	$3,756,100
Overheads (2)	$375,610
Total loaded costs	$4,131,710
Total Conceptual-level Cost Estimate in 2019 dollars (3)	

(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 Transient Stability Analysis

The WECC 2021 Light Winter operating case modified to increase WECC Path 17 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 138 kV POI. The results showed no transient stability violations. 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.

8.0 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 (absorbing) to 0.95 lagging (supplying) at the POI over the range of real power output. At full output of 120 MW, the Project would need to be able to provide approximately +/- 39.5 MVAr reactive support at the POI. If the proposed inverters cannot supply the +/-39.5 MVAr reactive power required at the POI plus that which is consumed by the Project's own facilities, the Project will be required to install additional XXXX reactive. The Project has not supplied sufficient detail of its collector system to evaluate the need for additional XXXX reactive.

GI #558will be required to control voltage in accordance with a voltage schedule as provided by Idaho Power 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 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 #558. 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. Also, it may be beneficial for XXXXXX, LLC, for their own modeling compliance requirements, to install additional PMU devices at their facilities to monitor the generations sources separately.

9.0 Conclusion

Interconnection requirements, detailed in Section 6.6, are required to interconnect the Project as either a NR or ER Interconnection Service.

The requested interconnection of the XXXXXX Park, GI #558, to Idaho Power's system was studied.

The results of this study work confirm that GI #558 can be interconnected to the existing IPCO transmission system. The results from the power flow analysis and short-circuit analysis confirm that the interconnection of the Project will have a negligible impact.

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 or GE Positive Sequence Load Flow (PSLF) 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 IPCO 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 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 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

Revision History

Date	Revision	Initials	Summary of Changes
03/26/2020	0	GMT	Original