GI Q#567

GENERATOR INTERCONNECTION
FEASIBILITY STUDY

for integration of the proposed

200 MW [redacted] PROJECT

(GI PROJECT #567)

to the

IDAHO POWER COMPANY ELECTRICAL SYSTEM

in

ADA COUNTY, IDAHO

for

[redacted]

Feasibility Study Report

REPORT

December 30, 2019

Revision History

Date	Revision	Initials	Summary of Changes
12/12/2019	0		FeSR GI #567 – Issued for Interconnection Customer review and comment
12.22.2919	FINAL	OAC	Some edits, table updates and re-structuring.
12.30.2019	FINAL	MMP	Some minor edits

Table of Contents

1.0 Introduction

[redacted] has contracted with Idaho Power Company (IPCo) to perform a Generator Interconnection Feasibility Study for the integration of the proposed 200 MW [redacted] Project (GI Project #567). The location of the project is in Ada County, Idaho.

The specific point of interconnection studied is a 230-kV line tap connection southeast of Boise to the existing IPCo owned Danskin-Hubbard 230 kV line [redacted].

This report documents the basis for and the results of this Feasibility Study for the Generation Interconnection Customer. It describes the proposed project, the determination of project interconnection feasibility and estimated costs for integration of the Project to the Idaho Power Transmission System at 230 kV.

2.0 Summary

The feasibility of interconnecting the 200 MW solar generation project to Idaho Power's Danskin-Hubbard 230 kV line was evaluated.

Power flow analysis indicated that interconnecting the [redacted] Project (GI#567) is feasible. Identification of transmission system network upgrades for Network Transmission Service for the 200 MW Project on the IPCo Transmission System was not evaluated in this Feasibility Study.

The integration of the [redacted] project did not result in voltage violations or thermal violations that cannot be mitigated. Further details are provided the *Post-Transient Study Results* section. The reactive reserve study indicated that shunt capacitor banks are needed to meet the lagging power factor requirements. Further details are provided the *Description of Operating Requirements – Reactive Reserve Results* section.

GI Project #567 will be required to control voltage in accordance with a voltage schedule as provided by Idaho Power Grid Operations. Therefore, GI Project #567 will be required to install a plant controller for managing the real and reactive power output of the 200 MW inverter array at the project POI. And, the installation of a phasor measurement unit device (PMU) at the POI and maintenance costs associated with communication circuits needed to stream PMU data will also be required to be provided in order to interconnect GI Project #567.

A Transmission 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 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. Transmission Network

Upgrade requirements to integrate this project will be determined during the System Impact Study phase of the generator interconnection process.

The total preliminary cost estimate to interconnect the [redacted] Project at 230 kV to the Danskin-Hubbard 230 kV line is $4,750,625. The cost estimate includes a 230-kV transmission line tap and structure, three 230 kV sectionalizing air-break switches/structures at the tap location, a 230-kV interconnection substation with a breaker and isolating switches, and protection/control/communication equipment costs.

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 of $4,750,625 does not include the cost of the customer's owned equipment to construct the solar generation site.

3.0 Scope of Interconnection Feasibility Study

The Interconnection Feasibility Study was done and prepared in accordance with Idaho Power Company 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 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 IPCo 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 Description of Proposed Generating Project

GI Project #567 [redacted], proposes to connect to the Idaho Power transmission system at 230 kV with a total injection of 200 MW (maximum project output) using [redacted]

[redacted] inverters. The proposed transmission interconnection is a 230-kV line tap connection to IPCO's Danskin-Hubbard 230 kV line.

This project's projected in-service date is [redacted].

5.0 Description of Transmission Facilities

The [redacted] Interconnection to the Danskin-Hubbard 230 kV line was identified as the most promising option in this feasibility study. All generation projects in the area ahead of this project in the IPCo generation queue and their associated transmission system improvements were modeled in a preliminary power flow analysis to evaluate the feasibility of interconnecting GI Project #567.

Preliminary power flow analysis indicated that interconnection of a 200 MW injection at the POI considered in this study is feasible; a transmission system impact study will be required to determine the specific network upgrades required to integrate the full project output of 200 MW.

6.0 Description of Substation Facilities

Integration of Project #567 will require a 230 kV tap connection to the Danskin-Hubbard 230 kV line; requiring the construction of a new 230 kV dead-end structure and interconnection substation consisting of a single 230 kV circuit breaker, isolating air break switches, protection, control, metering, PMU, SCADA, 120V DC station battery, and communication equipment including a 48V DC battery. The tap connection requires a three in-line air break switches at the IPCO Owned 230kV line tap and 0.76 mile 230kV single-circuit line from the tap point to the project site.

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. The preliminary estimated cost to interconnect the Large Generating Facility (GI Project #567) to the IPCo System is $4,750,625.

This price does not include costs for control building, or distribution local service, additional reactive compensation equipment, land purchase, assess road construction, ROW or permitting costs.
Cost estimates include direct equipment and installation labor costs, indirect labor costs and general overheads, and a contingency allowance. These are preliminary cost estimates only and final charges to the customer will be based on the actual construction costs incurred.

A conceptual single line diagram showing the interconnection option evaluated in this feasibility study is shown in Figure 1.

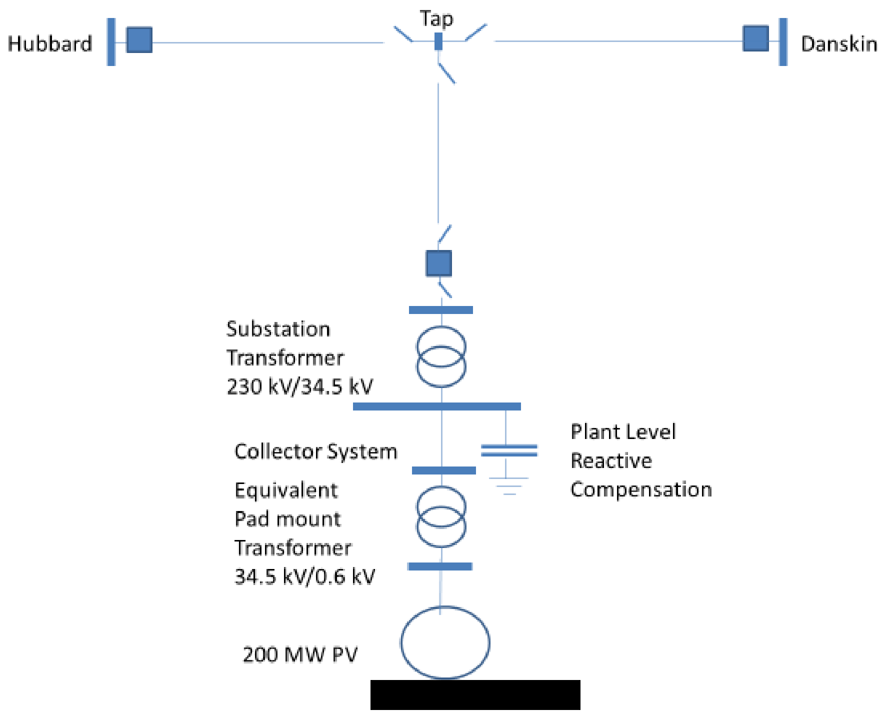

Figure 1: Conceptual Interconnection Single Line Diagram

7.0 Description of Distribution Facilities

No distribution facilities are directly impacted by this project.

8.0 Short Circuit Study Results

Studies indicate that there is adequate load and short circuit interrupting capability on the existing 230 kV breakers to serve this project. GI Project #567 [redacted] short circuit study results:

	Terminal A = DANSKIN 230 kV		
	SLG (A)	L-L (A)	3PH (A)
Existing w/ Queue	18230.2	17005.6	20004.1
With GI Q#567	18292.7	17027.5	20044.6

	Terminal B = HUBBARD 230 kV		
	SLG (A)	L-L (A)	3PH (A)
Existing w/ Queue	23821.7	22328.3	26111.4

With GI Q#567	24811.6	22414.0	25923.2

	At the POI (230kV tap)		
	SLG (A)	L-L (A)	3PH (A)
Existing w/ Queue	13495.6	15109.0	17764.7
With GI Q#567	15495.2	15207.3	17639.1

9.0 Electric System Protection Results and Grounding Requirements

The proposed 230/34.5 kV Wye-Grounded Wye-Grounded with Delta Tertiary station transformer should provide an adequate ground source for transmission line protection/relaying. The Danskin-Hubbard 230 kV line protection utilizes a permissive and a line differential protection schemes integrated with our existing digital communication infrastructure. Digital communication infrastructure will be required for the new [redacted] 230 kV line terminal. The Danskin-Hubbard 230 kV line has an existing optical ground wire (OPWG) digital communication circuits. The station/transmission line cost estimates include the associated equipment and costs to bring this OPWG in to the new station.

Grounding requirements and acceptability criteria are found in Appendix A.

10.0 Description of Power Flow Cases

The WECC 2019 Heavy Summer operating case, approved by WECC on June 29, 2019, was chosen as the initial power flow basecase for this feasibility study. First, the power flow basecase was modified to represent a heavy summer (HS) operating case. Next, the basecase was modified to represent transfers across the Idaho transmission system during heavy load conditions. Last, the basecase was modified to include network upgrades assigned to projects ahead of GI#567 in the generation interconnection queue.

The second case used for the study is WECC 2019 Light Winter operating case, approved by WECC on March 27th 2018, was chosen as an additional power flow basecase for this feasibility study to represent a light winter (LW) condition with east to west transfers across the Idaho transmission system which generally occur in the winter. Last, the basecase was modified to include network upgrades assigned to projects ahead of GI#567 in the generation interconnection queue.
The above cases were updated to include the following planned transmission upgrades/additions:

- Cloverdale 230/138 kV Transformer
- In/out at Cloverdale 230kV on the Boisebench – Locust 230kV line
- Cloverdale – Hubbard 230kV line.

11.0 Post-Transient Study Results

A post-transient analysis was performed on the summer heavy load and winter light load cases (pre and post project) to identify if any thermal overload or voltage limit violations result from the interconnection of the 200 MW maximum project output.

11.1 Post-Transient Study Results: 2019 Heavy Summer

Below is a table of N-0 bus and branch violations present as a result of the 200 MW project integration (violations not found in the pre-project N-0 analysis, but found in the post project N-0 analysis) from the **2019 heavy summer case**.

Violating Element	Value	Limit	% of Rating	Category
No violating elements				

No violating elements were found in the (N-0) pre-contingency case due to the [redacted] project integration.

Sixty-seven (67) credible N-1, N-2 branch and substation contingencies were studied for the 2019 Heavy Summer case. Below is a table of the branch and bus violations present because of the 200 MW project integration (violations not found in the pre-project N-X* analysis, but found in the post project N-X* analysis) from the **2019 heavy load summer case**.

CTG	Violating Element	Pre-Ctg Value	Value	Limit	% of Rating	Category
47a. MPSN T501 Xfmr	MIDBOI32 (60239)	0.9607	1.05	1.1	109.3	Change Bus High Volts
47. MPSN-RTSN 500kV	MIDBOI32 (60239)	0.9607	1.05	1.1	109.3	Change Bus High Volts
51. RTSN 500kV Station (BF)	BENNETT4_1 (649097)	0.9174	0.8846	0.9	98.3	Bus Low Volts

None of the contingency violations present themselves as concerning.

- Bennett4_1 bus voltage violation: mitigation possible with generator output control
- MIDBOI132 is the line side bus of the series capacitor on the Midpoint-Boisebch #3 230kV line - bus voltage change violation does not apply at this type of bus.

Below is a table of the branch and bus violations present due to the 200 MW project integration for the 2019 heavy summer case that also includes the following transmission upgrades/additions: Cloverdale 230/138 kV Transformer, in/out at Cloverdale 230kV on the Boisebench – Locust 230kV line, Cloverdale – Hubbard 230kV line.

CTG	Violating Element	Pre-Ctg Value	Value	Limit	% of Rating	Category
47. MPSN-RTSN 500kV	MIDBOI32 (60239)	0.9621	1.052	1.1	109.4	Change Bus High Volts
47a. MPSN T501 Xfmr	MIDBOI32 (60239)	0.9621	1.052	1.1	109.4	Change Bus High Volts
51. RTSN 500kV Station (BF)	BENNETT4_1 (649097)	0.918	0.8851	0.9	98.4	Bus Low Volts

These upgrades/additions did not significantly change the results from the contingency analysis.

* N-X analysis refers to credible N-1, N-2 and substation outages

11.2 Post-Transient Study Results: 2019 Light Winter

The table below shows the N-0 bus and branch violations present from the 200 MW project integration (violations not found in the pre-project N-0 analysis, but found in the post project N-0 analysis) in the **2019 light load winter case**.

Violating Element	Value	Limit	% of Rating	Category
No violating elements				

No violating elements were found in the (N-0) pre-contingency case due to the PVS project integration.

Over eighty (87) credible N-1, N-2 and substation contingencies were studied for the 2019 Light Winter case. The table below shows the branch and bus violations present due to the 200 MW project integration (violations not found in the pre-project N-X* analysis, but found in the post project N-X analysis) in the **2019 light load winter case**.

CTG	Violating Element	Pre-Ctg Value	Value	Limit	% of Rating	Category	Mitigation (if applicable)
01a. HMWY-SMLK 500 kV (Trip 2 JBRG Unit RAS)	QUARTZ (61068)	0.9834	0.9292	0.93	99.9	Bus Low Volts	
01a. HMWY-SMLK 500 kV (Trip 2 JBRG Unit RAS)	INVEN_649060 (649060) -> INVEN_649059 (649059) CKT 1 at INVEN_649060	[redacted]	[redacted]	[redacted]	[redacted]	Branch Amp	
01a. HMWY-SMLK 500 kV (Trip 2 JBRG Unit RAS)	INVEN_649062 (649062) -> INVEN_649061 (649061) CKT 1 at INVEN_649062	[redacted]	[redacted]	[redacted]	[redacted]	Branch Amp	

02. BOBN-MPSN #2 230 kV	MIDBOI32 (60239) -> BOISEBCH (60045) CKT 3 at MIDBOI32	[redacted]	[redacted]	[redacted]	[redacted]	Branch Amp	Mitigated by RAS 1/3 series capacitor bypass
02. BOBN-MPSN #2 230 kV	MIDPOINT (60232) -> MIDBOI31 (60236) CKT 3 at MIDPOINT	[redacted]	[redacted]	[redacted]	[redacted]	Branch Amp	Mitigated by RAS 1/3 series capacitor bypass
02. BOBN-MPSN #2 230 kV	MIDBOI31 (60236) -> MIDBOI32 (60239) CKT 3 at MIDBOI31	[redacted]	[redacted]	[redacted]	[redacted]	Branch Amp	Mitigated by RAS 1/3 series capacitor bypass
03. BOBN-MPSN #3 230 kV	MIDBOI22 (60234) -> BOISEBCH (60045) CKT 2 at MIDBOI22	[redacted]	[redacted]	[redacted]	[redacted]	Branch Amp	Mitigated by RAS 1/3 series capacitor bypass
03. BOBN-MPSN #3 230 kV	MIDPOINT (60232) -> MIDBOI21 (60233) CKT 2 at MIDBOI21	[redacted]	[redacted]	[redacted]	[redacted]	Branch Amp	Mitigated by RAS 1/3 series capacitor bypass
03. BOBN-MPSN #3 230 kV	MIDBOI21 (60233) -> MIDBOI22 (60234) CKT 2 at MIDBOI21	[redacted]	[redacted]	[redacted]	[redacted]	Branch Amp	Mitigated by RAS 1/3 series capacitor bypass
14. MPSN 345/230 kV Xfmr #1	MIDPOINT (60235) -> MIDPOINT (60232) CKT 2 at MIDPOINT	[redacted]	[redacted]	[redacted]	[redacted]	Branch MVA	Mitigated by RAS 1/3 series capacitor bypass
14a. MPSN 345/230 kV xfmer #1a - 1/3 cap byp	INVEN_649059 (649059)	0.9356	0.9225	0.93	99.2	Bus Low Volts	NO
14a. MPSN 345/230 kV xfmer #1a - 1/3 cap byp	INVEN_649061 (649061)	0.9356	0.9225	0.93	99.2	Bus Low Volts	NO
14a. MPSN 345/230 kV Xfmr #1a	MIDPOINT (60235) -> MIDPOINT (60232) CKT 1 at MIDPOINT	[redacted]	[redacted]	[redacted]	[redacted]	Branch MVA	Mitigated by RAS 1/3 series capacitor bypass
26a. RATTLESNAKE 230 kV Substation	MIDBOI22 (60234) -> BOISEBCH	[redacted]	[redacted]	[redacted]	[redacted]	Branch Amp	Present in pre-project case at 96.25%.

	(60045) CKT 2 at MIDBOI22						
26a. RATTLESNAKE 230 kV Substation	MIDBOI32 (60239) -> BOISEBCH (60045) CKT 3 at MIDBOI32	[redacted]	[redacted]	[redacted]	[redacted]	Branch Amp	
46a. HMWY-RTSN 500 kV (Cross-Trip HMWY-SMLK 500 kV & Trip 2 JBRG Unit)	HUBBARD (60249) -> NAMPA TP (61828) CKT 1 at HUBBARD	[redacted]	[redacted]	[redacted]	[redacted]	Branch Amp	Mitigated by PVS generation reduction
46a. HMWY-RTSN 500 kV (Cross-Trip HMWY-SMLK 500 kV & Trip 2 JBRG Unit)	PVS1_1 (649080)	0.9576	0.9288	0.93	99.9	Bus Low Volts	Mitigated by PVS generation reduction
46a. HMWY-RTSN 500 kV (Cross-Trip HMWY-SMLK 500 kV & Trip 2 JBRG Unit)- reduce PVS gen	HUBBARD (60249) -> NAMPA TP (61828) CKT 1 at HUBBARD	[redacted]	[redacted]	[redacted]	[redacted]	Branch Amp	PVS generation reduction results in lower branch flow (as shown here)

The majority of the violations above fall under one of the following categories:

- Very near the bus voltage limit after contingency, none are severely below or above the lower and upper voltage limits (respectively)
- Midpoint branch violations: Mitigated by RAS 1/3 series capacitor bypass
- Branch violation near [redacted] (Hubbard to Nampa): mitigated via [redacted] generation reduction. [redacted] was found to be the generator with the highest Power injection Sensitivity to MW flows on the Hubbard – Nampa 230kV line.

Below is a table of the branch and bus violations present due to the 200 MW project integration (violations not found in the pre-project N-X* analysis, but found in the post project N-X analysis) from the 2019 light load winter case. These results are for a case which includes the following transmission upgrades in addition to the [redacted] project: Cloverdale 230/138 kV Transformer, in/out at Cloverdale 230kV on the Boisebench – Locust 230kV line, Cloverdale – Hubbard 230kV line.

CTG	Violating Element	Pre-Ctg Value	Value	Limit	% of Rating	Category	Mitigation (if applicable)
01a. HMWY-SMLK 500 kV (Trip 2 JBRG Unit RAS)	INVEN_649060 (649060) -> INVEN_649059 (649059) CKT 1 at INVEN_649060	[redacted]	[redacted]	[redacted]	[redacted]	Branch Amp	

01a. HMWY-SMLK 500 kV (Trip 2 JBRG Unit RAS)	INVEN_649062 (649062) -> INVEN_649061 (649061) CKT 1 at INVEN_649062	[redacted]	[redacted]	[redacted]	[redacted]	Branch Amp	
02. BOBN-MPSN #2 230 kV	INVEN_649061 (649061)	0.9359	0.9273	0.93	99.7	Bus Low Volts	
02. BOBN-MPSN #2 230 kV	MIDBOI31 (60236) -> MIDBOI32 (60239) CKT 3 at MIDBOI31	[redacted]	[redacted]	[redacted]	[redacted]	Branch Amp	Mitigated by RAS 1/3 series capacitor bypass
02. BOBN-MPSN #2 230 kV	MIDPOINT (60232) -> MIDBOI31 (60236) CKT 3 at MIDPOINT	[redacted]	[redacted]	[redacted]	[redacted]	Branch Amp	Mitigated by RAS 1/3 series capacitor bypass
02. BOBN-MPSN #2 230 kV	INVEN_649059 (649059)	0.9359	0.9273	0.93	99.7	Bus Low Volts	
02. BOBN-MPSN #2 230 kV	MIDBOI32 (60239) -> BOISEBCH (60045) CKT 3 at MIDBOI32	[redacted]	[redacted]	[redacted]	[redacted]	Branch Amp	Mitigated by RAS 1/3 series capacitor bypass
03. BOBN-MPSN #3 230 kV	MIDBOI21 (60233) -> MIDBOI22 (60234) CKT 2 at MIDBOI21	[redacted]	[redacted]	[redacted]	[redacted]	Branch Amp	Mitigated by RAS 1/3 series capacitor bypass
03. BOBN-MPSN #3 230 kV	MIDPOINT (60232) -> MIDBOI21 (60233) CKT 2 at MIDPOINT	[redacted]	[redacted]	[redacted]	[redacted]	Branch Amp	Mitigated by RAS 1/3 series capacitor bypass
03. BOBN-MPSN #3 230 kV	MIDBOI22 (60234) -> BOISEBCH (60045) CKT 2 at MIDBOI22	[redacted]	[redacted]	[redacted]	[redacted]	Branch Amp	Mitigated by RAS 1/3 series capacitor bypass
14. MPSN 345/230 kV Xfmr #1	MIDPOINT (60235) -> MIDPOINT (60232) CKT 2 at MIDPOINT	[redacted]	[redacted]	[redacted]	[redacted]	Branch MVA	Mitigated by RAS 1/3 series capacitor bypass
14a. MPSN 345/230 kV xfmer #1a - 1/3 cap byp	INVEN_649061 (649061)	0.9359	0.923	0.93	99.2	Bus Low Volts	

14a. MPSN 345/230 kV xfmer #1a - 1/3 cap byp	INVEN_649059 (649059)	0.9359	0.923	0.93	99.2	Bus Low Volts	Mitigated by RAS 1/3 series capacitor bypass
14a. MPSN 345/230 kV Xfmr #1a	MIDPOINT (60235) -> MIDPOINT (60232) CKT 1 at MIDPOINT	[redacted]	[redacted]	[redacted]	[redacted]	Branch MVA	Present in pre-project case at 96.25%.
26a. RATTLESNAKE 230 kV Substation	MIDBOI22 (60234) -> BOISEBCH (60045) CKT 2 at MIDBOI22	[redacted]	[redacted]	[redacted]	[redacted]	Branch Amp	
26a. RATTLESNAKE 230 kV Substation	MIDBOI32 (60239) -> BOISEBCH (60045) CKT 3 at MIDBOI32	[redacted]	[redacted]	[redacted]	[redacted]	Branch Amp	
46a. HMWY-RTSN 500 kV (Cross-Trip HMWY-SMLK 500 kV & Trip 2 JBRG Unit)	QUARTZ (61068)	0.9832	0.927	0.93	99.7	Bus Low Volts	

The transmission upgrades/additions Cloverdale 230/138 kV Transformer, in/out at Cloverdale 230kV on the Boisebench – Locust 230kV line and Cloverdale – Hubbard 230kV line results in similar contingency analysis results. The main takeaway is the Hubbard – Nampa Tap 230kV line segment is no longer overloaded. Also, all of the Midpoint – Boisebench overloads without RAS schemes were slightly reduced.

Power flow and post-transient analysis indicated that interconnecting the [redacted] Project (GI#567) is feasible.

* N-X analysis refers to credible N-1, N-2 and substation outages

12.0 Description of Operating Requirements – Reactive Reserve Results

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 point of interconnection (POI) over the range of real power output (up to maximum output of 200 MW).

From the inverter specification sheet provided by the developer the maximum reactive power of ± 2,760 kVAr per inverter. It is assumed there are 48 inverters. [redacted] should be able to provide ± 132.48 MVAr maximum reactive capability. The maximum MVA capacity of all 48 inverters is 220.8.

Preliminary power flow analysis indicates that the reactive compensation range of the proposed GI Project #567 has the following results, with the study results summarized in the tables below:

The **leading** plant reactive compensation capacity **is sufficient** to meet the operating requirement of 0.95 leading power factor at the POI at full load

Leading Test	$P = P_{max}$ (205 MW) [redacted] Terminal (inverter) Voltage: 0.95 [redacted] Tap Voltage (230 kV): 1.05 *Note: (+) Line MW/MVAR refers to flow at the POI into the line.*				
Line MW **(+) = flow into tap** **(-) = flow out of tap**	**Line MVAR** **(+) = flow into tap** **(-) = flow out of tap**	**Line PF**	**PF Required**	**MVAR Required for 0.95 PF**	**Power Factor Met? Equipment to meet PF Requirement**
199.6	-118.1	0.861	0.95	-65.7	PF Met

The **lagging** plant reactive compensation capacity **does not have sufficient capacity** to provide a 0.95 lagging power factor at the POI at full output.

- Assumptions:
  - Q_{max} is 82 Mvar at P_{max} (205 MW). This is based on the 220.8 MVA plant rating from all 48 inverters.
  - [redacted] Terminal (inverter) voltage operating at 1.0440 pu, which is less than 1.05 (deemed acceptable)
  - 230 / 34.5 kV Transformer fixed tap ratio set to 1.05

59 Mvar shunt capacitor bank at 34.5 kV required to meet the required 0.95 power factor

Lagging Test	$P = P_{max}$ (205 MW) [redacted] Terminal (inverter) Voltage: <1.05 ~ 1.0440 p.u. (acceptable) [redacted] Tap Voltage (230 kV): 0.95 230 / 34.5 kV Transformer fixed nominal tap ratio set to 1.05 Gen Mvar = 82 Mvar Q_{max} when P_{total} (205 MW) = 82 Mvar $S^2 = P^2 + Q^2$ per inverter S = 4.6 MVA per inverter, P = 205 MW / 48 inverters Q = 1.71 per inverter *Note: (+) Line MW/MVAR refers to flow at the POI into the line.*				
Line MW **(+) = flow into tap** **(-) = flow out of tap**	**Line MVAR (no shunt capacitor)** **(+) = flow into tap** **(-) = flow out of tap**	**Line PF**	**PF Required**	**MVAR Required for 0.95 PF**	**Additional equipment needed to meet PF Requirement at the POI**
200	10	0.9988	0.95	65.7	PF Not Met: **59 MVAR shunt capacitor** at 34.5 kV to fulfill (65.7 Mvar) PF requirement

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.

GI Project #567 will be required to control voltage in accordance with a voltage schedule as provided by Idaho Power Grid Operations. GI Project #567 is required to install a plant controller for managing the real and reactive power output of the 200 MW inverter array at the project 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*.

Installation of a phasor measurement unit device (PMU) at the POI and maintenance costs associated with communication circuits needed to stream PMU data will also be required to be provided in order to interconnect GI Project #567. The specific costs associated with the Idaho Power 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 interconnection customer chose to proceed to that phase of the interconnection process.

Additional operating requirements for this project maybe identified in the System Impact study when it is performed.

13.0 Conclusion

The requested interconnection of the [redacted] Project (GI #567) to Idaho Power's system was studied. The project will interconnect using a 230-kV line tap connection to the Danskin-Hubbard 230 kV line.

The results of this study work confirm that it is feasible to interconnect the [redacted] Project (GI #567) to the existing Idaho Power system. No major transmission system improvements are required to integrate the 200 MW project. The integration of the [redacted] project did not result in voltage violations or thermal violations that cannot be mitigated. The reactive reserve study indicated that shunt capacitor bank (59 Mvar) is needed to meet the lagging power factor requirements. 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 impacts to system performance (thermal overload, voltage, transient stability, reactive margin).

All generation projects in the area ahead of this project in the IPCo generation interconnection queue and their associated transmission system improvements were modeled in a preliminary power flow analysis to evaluate the feasibility of interconnecting GI Project #567. The results and conclusions of this feasibility study are based on the realization of these projects in the unique queue/project order.

The estimated cost to interconnect GI Project #567 to the IPCo System at the 230-kV point of interconnection considered in this study is approximately $4,750,625.

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. Transmission requirements to integrate this project will be determined during the System Impact Study phase of the generator interconnection process.

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 states, 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 (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 IPCo 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 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