GENERATOR INTERCONNECTION FEASIBILITY STUDY REPORT

for integration of the proposed



to the

IDAHO POWER COMPANY ELECTRICAL SYSTEM

for



REPORT v.1

December 12, 2017

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Revision History

Date	Revision	Initials	Summary of Changes	
12/11/2017	0	MDH	Feasibility Study Report GI #524 – Original issue	
12/12/2017	1	MDH	Addressed Comments Received	

Feasibility Study Report

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Table of Contents

1.0	Introduction	1
2.0	Summary	1
3.0	Scope of Interconnection Feasibility Study	3
4.0	Description of Proposed Generating Project	3
5.0	Energy Resource (ER) Interconnection Service	4
5.1	Description of Transmission Facilities	4
5.2	Description of Substation Facilities	5
5.3	Description of Distribution Facilities	7
5.4	Short Circuit Study Results	7
5.5	Electric System Protection Results and Grounding Requirements	7
5.6	Energy Resource Cost Estimate	
6.0	Network Resource (NR) Interconnection Service	10
6.1	Description of Power Flow Cases	10
6.2	Network Resource Transmission Upgrades	10
6.3	Network Resource Cost Estimate	11
7.0	Description of Operating Requirements	12
8.0	Conclusion	13
APPE	NDIX A	15
A-1	.0 Method of Study	15
A-2	.0 Acceptability Criteria	15
A-3	.0 Electrical System Protection Guidance	16



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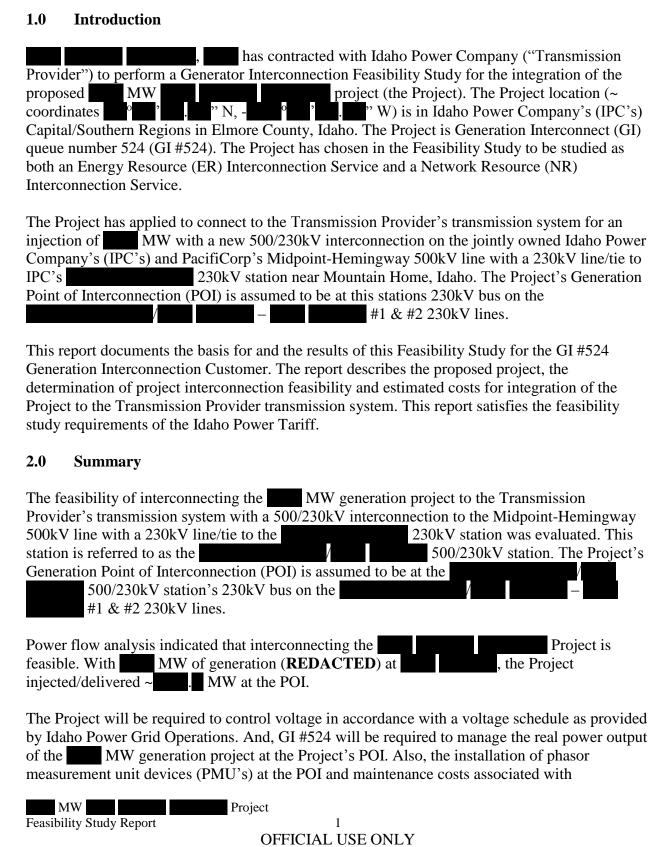
List of Tables

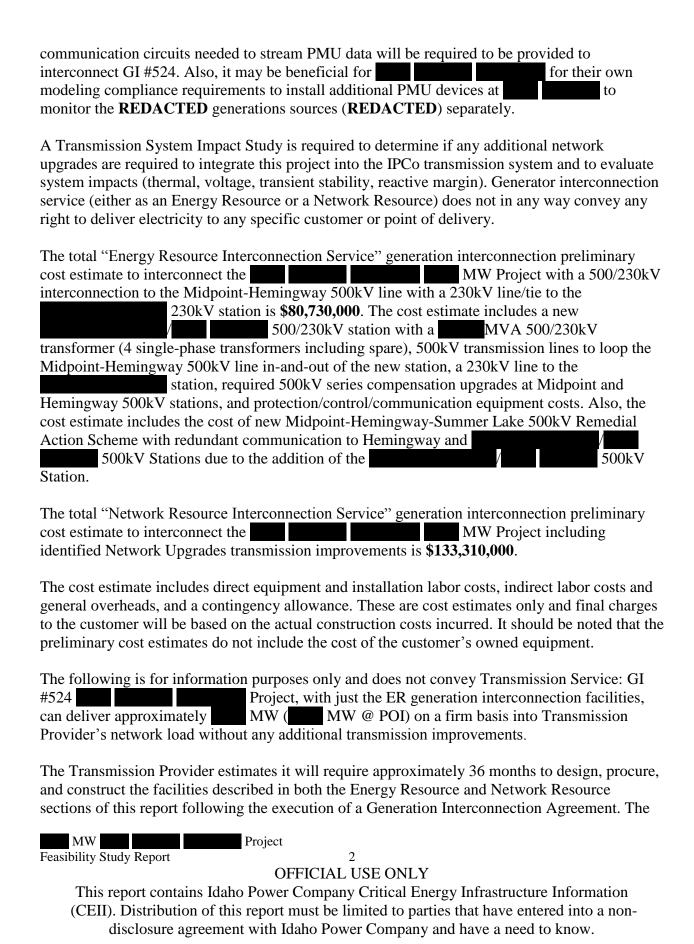
Table	1	/	230kV Terminal Fault Duty	. 7
Table	2 Estimated GI	#524 Project'	's Energy Resource Generation Interconnection Costs	. 9
Table	3 Estimated GI	#524 Project'	's Network Resource Generation Interconnection Costs	12

List of Figures



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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 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:

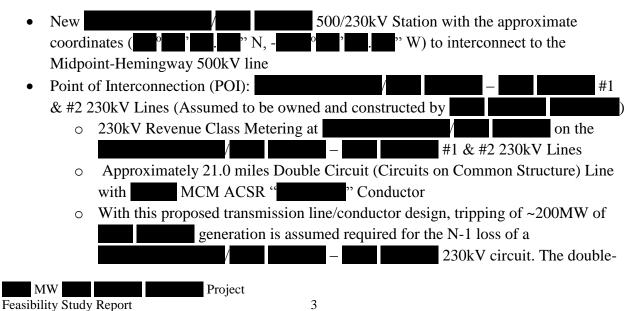
- preliminary identification of any circuit breaker short circuit capability limits exceeded because of the interconnection;
- preliminary identification of any thermal overload or voltage limit violations resulting from the interconnection; and
- preliminary description and non-binding estimated cost 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:

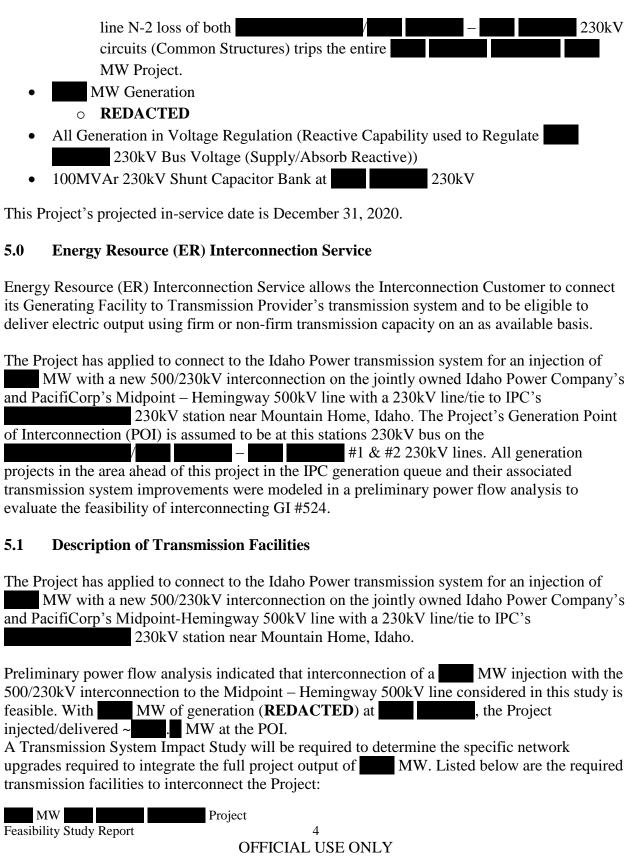
http://www.oatioasis.com/ipco/index.html.

4.0 Description of Proposed Generating Project

Assumptions:



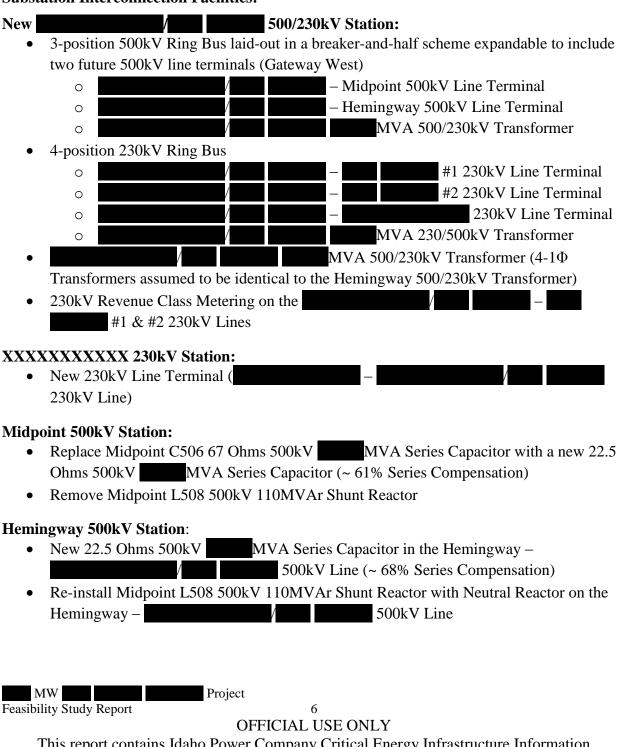
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Transi	mission Interconnection Facilities:
•	Two ~0.75-mile 500kV Lines with 3 x MCM ACSR "Conductor (Loop In-and-Out off the Midpoint-Hemingway 500kV Line to create - Midpoint and - Hemingway 500kV Lines)
•	One ~0.5-mile 230kV Line with 2 x MCM ACSR "Conductor (230 kV Line)" Conductor
5.2	Description of Substation Facilities
station assume	coposed interconnection of GI #524 Project to the Midpoint – Hemingway 500kV line will a new 500/230kV station near IPC's existing 230kV station with a 230kV tie/line to IPC's 230kV a. The proposed MVA 500/230kV (4 single-phase transformers including spare) is ed to be identical to IPC's existing Hemingway500/230kV transformer. See 500/230kV and 230kV Station options below.
Midpo approx station determ 65% by Hemin also at and to line, it to Hen	didpoint-Hemingway 500kV line series compensation due to the existing 67 Ohms bint 500kV series capacitor is just less than 96% series compensated. Splitting this line stimately in half due to the addition of the stimately in half due to the addition of the stimately in half due to the addition of the stimately in half due to the addition of the stimately in half due to the addition of the stimately in half due to the addition of the stimately in half due to the addition of the stimately stimately of the series compensation to be replaced. For the Feasibility Study, it was bined to compensate the two new 500kV lines (Midpoint – 500kV) to approximately y installing 22.5 Ohms 500kV series capacitors (~1/3 of original bank) at Midpoint and agway 500kV stations. And, installing the remaining 22.5 Ohms 500kV series capacitor Hemingway 500kV in the Hemingway – Summer Lake 500kV line. For line switching keep single-pole switching enable on the new Hemingway – 500kV was determined to move one of the existing 110MVAr 500kV shunt reactors at Midpoint mingway and install it with a neutral reactor. See Midpoint and Hemingway 500kV Station options below.
two ne Hemin	the addition of the white segments Midpoint — white segments Midpoint — segments Midpo
Feasibil	Project ity Study Report OFFICIAL USE ONLY This report contains Idaho Power Company Critical Energy Infrastructure Information

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. Listed below are the required substation facilities to interconnect the Project:

Substation Interconnection Facilities:



New 22.5 Ohms 500kV MVA Series Capacitor in the Hemingway – Burns – Summer Lake 500kV Line (~ 70% Series Compensation including Burns Series Compensation)

Midpoint-Hemingway-Summer Lake 500kV RAS:

• New Midpoint-Hemingway-Summer Lake 500kV Remedial Action Scheme with redundant communication to Hemingway and \$\frac{1}{2}\$ 500kV Station and the creation of two new line segments Midpoint \$\frac{1}{2}\$ 500kV.

5.3 Description of Distribution Facilities

No distribution facilities are directly impacted by this project.

5.4 Short Circuit Study Results

Table 1

Studies indicate that there is adequate load and short circuit interrupting capability on the Transmission Provider's existing 500kV and 230kV breakers to serve this project. GI #524

Project's short circuit study results are shown in the following table:

230kV Terminal Fault Duty

	POI =	/ 230kV	
	SLG	L-L	3PH
Existing (230kV)	9.66 kA	9.58 kA	11.06 kA
With GI #524	19.70 kA	16.90 kA	19.50 kA

5.5 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 will be required for the new #1 & #2 230kV lines. It is strongly recommended that the #2 230kV lines be constructed with an optical ground wire (OPWG) digital communication circuits for system protection and communication.

Grounding requirements and acceptability criteria are found in Appendix A.

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5.6 Energy Resource Cost Estimate

In Table 2 below is a summary of the generation interconnection facilities and conceptual costs required to interconnect the GI #524 Project to the Transmission Provider's transmission system as an Energy Resource.

GI #524 Project POI – 500/230kV Station Energy Resource Generation Interconnection Facilities	
Direct Assigned	Cost
230kV Line Terminals Line Protection and Control, Metering, Communication, etc.	\$1,750,000
Network Upgrade	Cost
Transmission Lines Two 0.75-mile 500kV Lines (Midpoint – Hemingway 500kV Loop in- and-out)	\$3,000,000
Transmission Line One 0.5-mile 230kV Line (Tie)	\$700,000
Add new 500/230kV Station with a 500/230kV MVA - 4-1Φ Transformers	\$32,250,000
230kV Station Add 230kV Line Terminal	\$1,000,000
Midpoint 500kV Station Replace Midpoint C506 67 Ohms MVA Series Capacitor with a new 22.5 Ohms 500kV MVA Series Capacitor Remove Midpoint L508 500kV 110MVAr Shunt Reactor	\$6,100,000
Hemingway 500kV Station Add new 22.5 Ohms 500kV MVA Series Capacitor (Hemingway 500kV) Re-install 500kV 110MVAr Shunt Reactor (Hemingway 500kV)	\$16,000,000

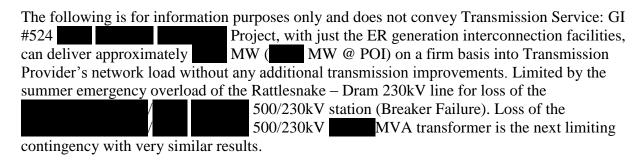
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Add new 22.5 Ohms 500kV MVA Series Capacitor (Hemingway -Summer Lake 500kV)	
Midpoint-Hemingway-Summer Lake 500kV RAS New Midpoint-Hemingway-Summer Lake 500kV Remedial Action Scheme due to the addition of the 500kV Station and the creation of two new line segments Midpoint – 500kV and Hemingway – 500kV	\$500,000
Subtotal	\$61,300,000
Contingencies (~20%)	\$12,260,000
Subtotal	\$73,560,000
Overheads (~9.75%)	\$7,170,000
Energy Resource – Total Estimated Cost	\$80,730,000

Table 2 Estimated GI #524 Project's Energy Resource Generation Interconnection 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 estimates do not include the cost of the customer's owned equipment.



The Transmission Provider estimates it will require approximately 36 months to design, procure, and construct the facilities described in the Energy Resource section of 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.



6.0 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 severely stressed conditions to determine the transmission improvements/upgrades which are necessary to deliver the aggregate generation in the area of the Point of Interconnection to the Transmission Provider's aggregate load. Network Resource Interconnection Service in and of itself does not convey Transmission Service.

6.1 Description of Power Flow Cases

For the Network Resource Interconnection Service study, two 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 2014 Light Summer operating case, approved by WECC on January 16, 2014, was chosen as the initial power flow base case for this feasibility study. It has been extensively modified to represent a shoulder month condition with high wind, solar, and gas generation east of Boise, and high east to west (westbound) transfers (representing Firm Transmission Service provided by the Transmission Provider) across the Transmission Provider's transmission system which generally occurs in the fall. Last, the base case was modified to include network upgrades assigned to projects ahead of GI #524 in the generation interconnection queue.

The second case used for the study is the WECC 2017 Heavy Summer operating case, approved by WECC on September 22, 2016. This case was chosen as an additional power flow base case for this feasibility study to represent a heavy summer operating case. Next, the base case was modified to represent high west to east (eastbound) transfers across the Idaho transmission system during heavy load conditions. Last, the base case was modified to include network upgrades assigned to projects ahead of GI #524 in the generation interconnection queue.

6.2 Network Resource Transmission Upgrades

From power flow/contingency analysis, the following Network Transmission Upgrades were identified as needed to deliver GI #524 proposed MW of generation to the Transmission Provider's network load and are in addition to the Energy Resource generation interconnection facilities.

Westbound (East to West):

Rattlesnake – Dram 230kV Line:

• Rebuild 35.6 miles of 230kV line with MCM ACSR "Conductor

MW Project
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Dram - Boise Bench 230kV Line:

• Rebuild 3.1 miles of 230kV line with MCM ACSR "Conductor

Boise Bench – Hubbard 230kV Line Loop in-and-out of Dram Station (Creating Boise Bench – Dram #2 230kV and Dram – Hubbard 230kV Lines):

Build 1.25 miles 230kV Double Circuit Line with MCM ACSR "
Conductor

The Conductor

**The Conducto

Dram 230kV Station:

 Two new 230kV Line Terminals (Dram – Boise Bench #2 230kV and Dram – Hubbard 230kV Lines)

Eastbound (West to East):

Justice – Mountain Air Tap 230kV Line:

• Rebuild 31.7 miles of 230kV line with MCM ACSR "Conductor

Lower Malad - King 138kV Line:

• Rebuild 1.8 miles of 138kV line with MCM ACSR "Conductor

6.3 Network Resource Cost Estimate

In Table 3 below is a summary of the Network Transmission generation interconnection facilities and conceptual costs required to interconnect the GI #524 Project to the Transmission Provider's transmission system as a Network Resource.

GI #524 Project POI – 500/230kV Station	
Network Resource Transmission Upgrades:	Cost
Rattlesnake – Dram 230kV Line Rebuild 35.6 miles of 230kV line with MCM ACSR "Conductor"	\$18,500,000
Dram – Boise Bench 230kV Line Rebuild 3.1 miles of 230kV line with "Conductor" MCM ACSR "Conductor"	\$2,500,000
Boise Bench – Hubbard 230kV Line Loop in-and-out of Dram Station	\$1,000,000

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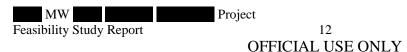
Build 1.25 miles 230kV Double Circuit Line with ACSR "Conductor"	
Dram 230kV Station Add two 230kV Line Terminals	\$1,800,000
Justice – Mountain Air Tap 230kV Line Rebuild 31.7 miles of 230kV line with "Conductor" "Conductor"	\$15,600,000
Lower Malad – King 138kV Line Rebuild 1.8 miles of 138kV line with MCM ACSR "Conductor"	\$525,000
Subtotal	\$39,925,000
Contingencies (~20%)	\$7,985,000
Contingencies (~20%) Subtotal	\$7,985,000 \$47,910,000
	, ,
Subtotal	\$47,910,000
Subtotal Overheads (~9.75%)	\$47,910,000 \$4,670,000

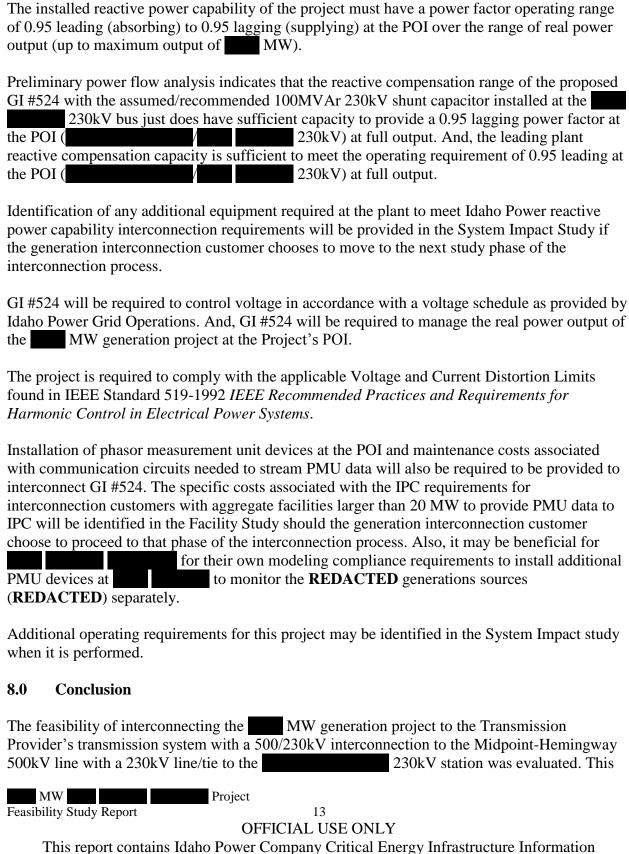
Table 3 Estimated GI #524 Project's Network Resource Generation Interconnection Costs

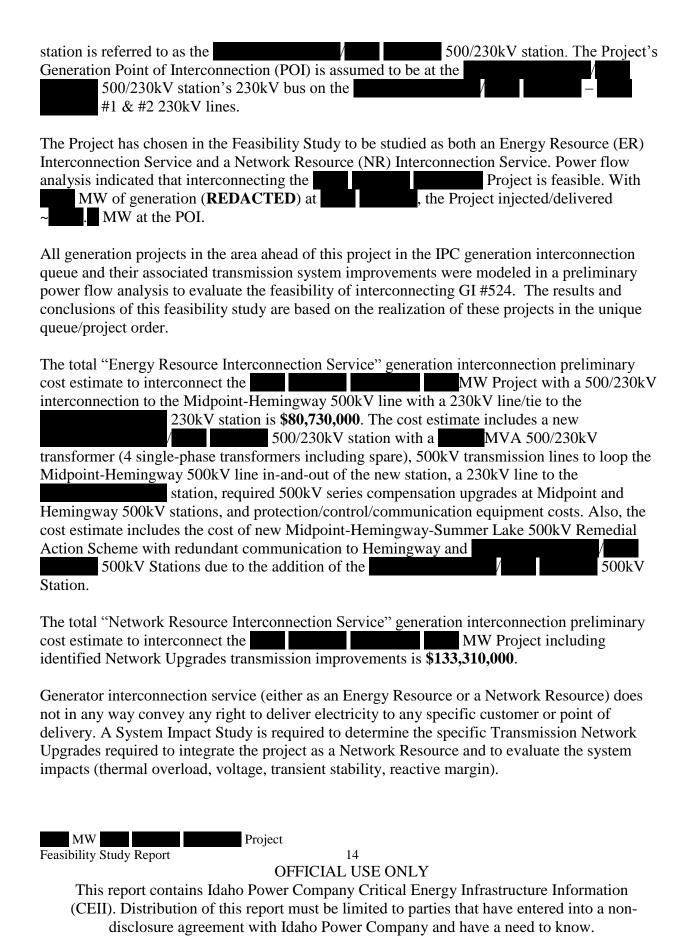
The cost estimate includes direct equipment and installation labor costs, indirect labor costs and general overheads, and a contingency allowance. These are cost estimates only and final charges to the customer will be based on the actual construction costs incurred. It should be noted that the preliminary cost estimates do not include the cost of the customer's owned equipment.

The Transmission Provider estimates it will require approximately 36 months to design, procure, and construct the facilities described in the Network Resource section of 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.

7.0 Description of Operating Requirements







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.



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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 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 <u>Requirements for Generation Interconnections</u> found on the Idaho Power Web site,

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



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