Generation Interconnection Facilities Study Report
For GBX Clean Line High Voltage Direct Current Facility
In Ford County, Kansas.
March 19, 2015

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1.0 Overview

ITC Great Plains ("ITCGP") has performed a Facility Study at the request of Southwest Power Pool ("SPP") for Generation Interconnection request GBX Clean Line under the SPP Open Access Transmission Tariff. The subject request entails interconnecting a High Voltage Direct Current (HVDC) facility in Ford County, Kansas. The project will interconnect at a new ITC GP GBX Clean Line switching station approximately 13 miles north of the Clark County Substation. It is scheduled for completion by January 1, 2018.

The ITCGP scope of this Facility Study is to provide a cost estimate for the Customer's interconnection facilities. This study does not directly address any of the facilities that are being constructed by the interconnection customer, or any potential sub-transmission facilities (if any) that may be required.

1.1 Facility Study Summary

ITCGP estimates the total project cost of the customer's interconnection facilities will be **$ 21,448,762** (+/ - 20 % accuracy) including applicable company overheads and potential tax gross-ups in 2015 dollars. It includes **$ 20,126,790** for Network Upgrades and **$ 1,321,971** for Transmission Owner Interconnection Facilities. It is further estimated that the required legal/real estate acquisition, design, procurement, and construction activities will require approximately 27 months after the Generator Interconnection Agreement (GIA) is executed. The attached report contains additional details regarding the estimate as well as results of short circuit studies, review of reactive compensation, and information on Interconnection & Operating requirements.

The GBX Clean Line interconnection facilities will require Network Upgrades on the ITCGP system to connect the new generation. Network Upgrades consist of the following:

- A new 9-breaker 345 kV ITCGP GBX Clean Line interconnection switching station at the Point of Interconnection (POI) on the Spearville to Clark County and Ironwood to Clark County 345 kV lines
- Looping the Spearville to Clark County and Ironwood to Clark County 345 kV lines into the new switching station

In addition to the identified Network Upgrades, there are specific Interconnection Facilities which ITCGP will construct, own, operate, and maintain. These facilities include the new line entrance structure and 345kV disconnect switch on the end of each radial line from GBX Clean Line at the ITCGP switching station as well as any ITCGP relaying and control equipment required for the protection of the developer's radial lines.

The Interconnection Customer is responsible for constructing all sole-use facilities such as the HVDC convertor station, AC collector station, and the radial 345kV lines from the collector station to the new ITCGP switching station. While this report does define Interconnection Customer owned Interconnection Facilities in enough detail to explain basic requirements, it does not define or contain all of the detailed requirements. Additional metering, communications, and operational requirements may be identified as the Interconnection and Operating Agreements are developed and further communications between the Transmission Owner and Interconnection Customer take place. The Interconnection Customer's low voltage system is not defined in this report.

The ITCGP interconnection facilities require that no power interchanges occur, either real or imaginary or a combination, as this was the premise and understanding of the DC Interconnection.

The reactance and short circuit calculations will need to be repeated when the SPP Criteria 3.5 assumptions are better defined. ITCGP reserves the right to require additional reactive power capability, including dynamic reactive power compensation, if the final HVDC Facility design does not meet SPP or ITCGP defined planning criteria. The requirements for an SPP interconnection of the GBX Clean Line project may require this Facility Study to be revised at a later date.

2.0 Voltage Guidelines:

Reactive power, voltage regulation and operating requirements will be as per Transmission Operator (TOP) and Transmission Provider directives. Interconnection Customer will operate the HVDC Facility to a voltage schedule of 350 kV (1.014 pu) with a bandwidth of +9kV (0.0261 pu) / -5 kV (0.0145 pu) at the Point of Interconnection (POI). As per Siemens PTI Report Number R052-12: *Steady State Assessment of the Grain Belt Express Clean Line HVDC Project* and Siemens PTI Report Number: R022-13 *Dynamic Stability Assessment of Grain Belt Express Clean Line HVDC Project*, the Interconnection Customer's final HVDC Facility design has not been determined. Therefore, there is insufficient information to determine reactive power requirements or the sufficiency of a design. The TOP reserves the right to require additional reactive power capability, including dynamic reactive power compensation, if the final HVDC Facility design does not meet SPP or TOP defined planning criteria.

Reactive capability may not be assumed for all yet to be commissioned wind generation that does not have a finalized DISIS study proving a need for reactive power capability.

No Special Protection Schemes (SPS) involving or affecting the TOP may be used to meet the voltage schedule or stay within System Operating Limits.

The Interconnection Customer will regulate the HVDC Facility's voltage to the specified voltage set-point within the defined bandwidth stated above using an automatic voltage controller.

The above voltage schedule is subject to change. If a schedule change is needed, appropriate written documentation of the change will be provided to the Interconnection Customer.

The Interconnection Customer is required to have an operator available 24/7 for communication with the TOP. The TOP may, at any time request a variance from the schedule in response to system operating/security requirements.

3.0 Network Upgrades

3.1 New ITCGP GBX Clean Line interconnection switching station

3.1.1 Project Location:

This switchyard will be located at approximately 13 miles north of the Clark County Substation on the Spearville to Clark County and Ironwood to Clark County 345kV lines in Ford County, Kansas.

3.1.2 Project Overview:

The purpose of this project is to build a 345kV switchyard to provide a transmission system interconnection for the Grain Belt Express HVDC Convertor Station and AC Collector facility. The switchyard will consist of nine 345kV circuit breakers arranged in a breaker and a half configuration.

The new 345kV switchyard will have a new control house with adequate AC and DC station service supplies, new control and protection panels and a new RTU for communication with the Transmission Owner's master control station.

The new switchyard will cut into the 345kV Spearville to Clark County line and the 345 kV Ironwood to Clark County line.

3.1.3 Design Criteria:
The Transmission Owner's standards will be applicable. Where no applicable standards are available, the Transmission Owner will substitute industry standards.

3.1.4 One-Line Diagrams:
See Figure 1 for Transmission Owner One-Line.

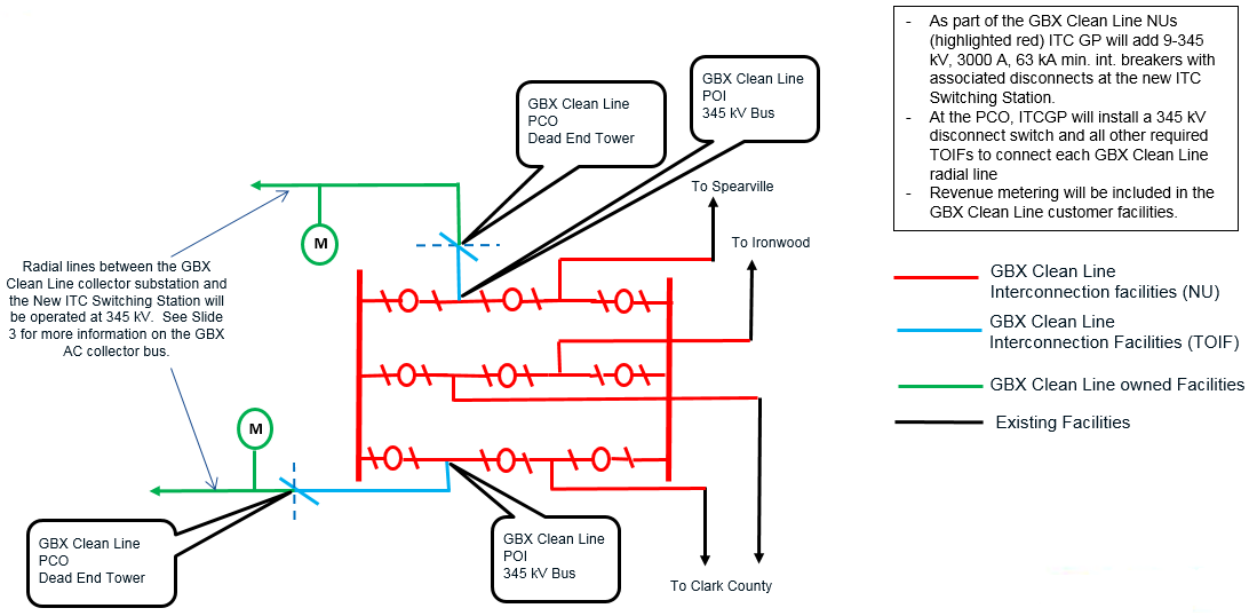

Figure 1 ITCGP GBX Clean Line Interconnection Substation One Line

3.1.5 Site Plan:
See Figure 2 for site plan of Transmission Owner switching station at the POI on Spearville to Clark County and Ironwood to Clark County 345kV lines.

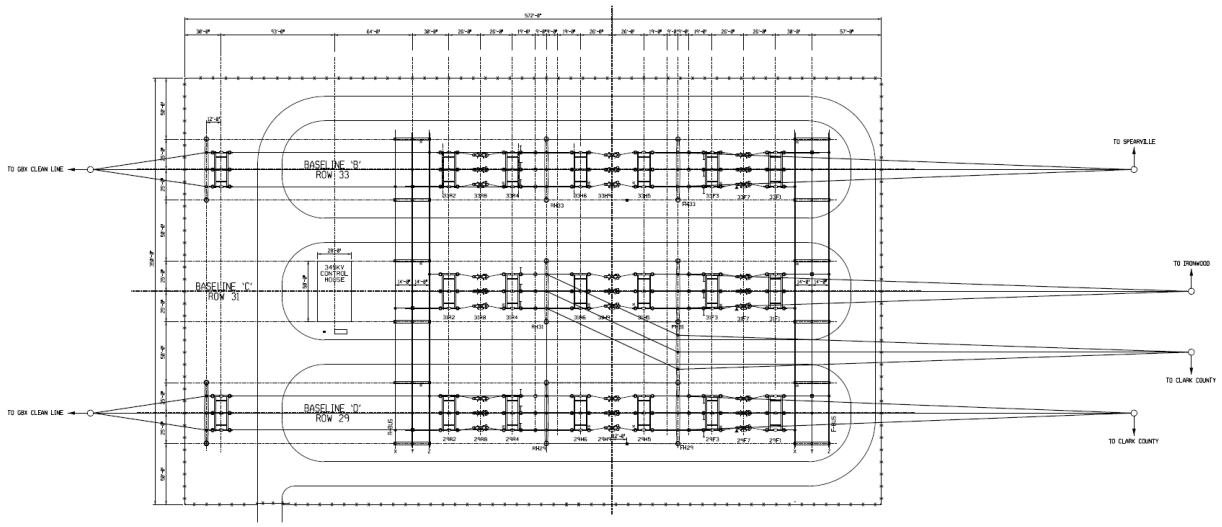

Figure 2 ITCGP GBX Clean Line Interconnection Substation Site Plan

3.1.6 Route Information: N/A

3.1.7 Right-of-Way Information:
It is assumed that the interconnection customer will be responsible for building the 345 kV line required to connect the ITCGP Switching Station at the POI with the customer's substation. As such, the interconnection costs contained herein do not include any costs for extending the ITCGP transmission lines. Please see section 6 for general guidelines.

3.1.8 Permitting:
The Interconnection Customer will be responsible for satisfying all community or governmental site plan or zoning approval requirements which may include wetland or flood plain permits. The Transmission Owner will be responsible for the control center building permit and the KDHE storm water construction permits associated with the Transmission Owner portions of the construction.

3.1.9 Metering & Ownership Demarcation:
Covered in section 4.1.9

3.1.10 Protection & Control Overview:

Fourteen sets of 345kV CCVTs will be installed, one set for each line, and one individual CCVT for each bus.

Nine 345kV breaker control panels with microprocessor based relays will be installed. Breaker failure protection, automatic reclosing supervised by synchronism check will be provided.

Four 345kV line relaying panels with microprocessor based relays will be installed.

Two 345kV bus relaying panels with microprocessor based relays will be installed.

3.1.11 Insulation Coordination:
345kV, 1050kV BIL

3.1.12 Short Circuit Study Results - Bus Fault Levels:
ITCGP calculated bus fault levels for the interconnection substation and adjacent substations to determine if the added generation will cause fault currents to exceed interrupting ratings for existing equipment and for use in sizing future equipment. Calculations are based on a 30 kA available 3 phase fault current (18,000 MVA) on the GBX Clean Line 345 kV Bus as supplied by the Interconnection Customer. ITCGP estimated the value of a single line to ground fault current at the GBX Clean Line 345 kV Bus to be 10% greater than the 3 phase fault current or 33 kA. ITCGP reserves the right to repeat the short circuit analysis when the assumptions are better defined. Variance from supplied data could materially change calculated short circuit values. Results are displayed in Table 1.

Table 1 – Short Circuit Results

Fault Bus Location	(kV)	Maximum Fault Current (Amps) with GBX		Maximum Fault Current (Amps) without GBX	
		Phase	Ground	Phase	Ground
CLARKCOUNTY7	345	25594.7	20785.3	10039.3	9926.4
IRONWOOD7	345	22740.4	21468.8	11026.9	11263.5
POSTROCK6	230	11745.1	13958.9	11092.9	13473.5
SPEARVL1	34.5	1110	1447.6	1107.8	1445.6
SPEARVL3	115	12221.5	13432.7	11377.4	12741.1
SPEARVL6	230	16836	17782.3	12806.8	14016
SPERVIL7	345	23408.3	21985.2	11600	12095.5
THISTLE4	138	17953.2	15166	16753.4	14538.7
THISTLE7	345	16590.7	10821.7	13696.8	9855.9

Fault currents shown in Table 1 are within the circuit breaker interrupting capabilities with the addition of 30 kA three phase fault current contributed by GBX Clean Line.

3.1.13 Reactive Compensation:
Because the type of convertor is unknown at this time, the ITCGP studies are inconclusive. GBX Clean Line has indicated that it is possible that a 900 MVA reactor may be needed near the point of interconnection and GBX Clean Line has also indicated that technology may be available which if utilized would eliminate the need for any additional reactance. Until a determination is made defining the

type of convertor to be used, the studies will be placed on hold. ITCGP will re-evaluate the need for reactance once the choice of a convertor is made and shared with ITCGP. ITCGP will re-evaluate the impact of the proposed interconnection on the reactive compensation equipment presently planned or in service for the Spearville and Clark County Substation facilities, including the addition of a reactor at the GBX Clean Line interconnection substation.

3.1.14 Other Equipment & Materials:

- Gas Circuit Breakers (GCB): nine (9) 345 kV, 3000A rated, 63kAIC.
- Disconnect Switch: eighteen (18) 345 kV, 3000A rated, 1050 kV BIL.
- CCVTs: fourteen (14) 345kV, 3-winding, 1550kV BIL.
- Insulators: fifty-four (54) 345 kV, 1050 kV BIL station post, porcelain.
- Surge Arresters: twelve (12) 345kV, vertical mount, 209MCOV, polymer.
- Control Cable: Control cables per Transmission Owner standards will be installed in direct buried PVC conduits, above grade LFMC conduits and in pre-cast cable trench. All control cables from the yard will be terminated at the relaying control panels. The control building will have overhead cable trays for necessary cable runs and inter-panel connections.

3.1.15 Relaying, Control, & SCADA:
Panel Requirements

- 9 – RD3064 – Line Breaker Control (SEL-351S)
- 2 – RD1035 – Total Differential (SEL-587Z & -551)
- 4 – RD3048 – Line Differential (SEL-311L)
- 2 – RD4025 – Synchronizing Control (SEL-351S)

3.1.16 Grounding System:
The grounding system will be designed and installed per Transmission Owner's standards. These standards follow the IEEE 80 standards.

3.1.17 Lightning Shielding Design:
Lightning shielding will be provided per Transmission Owner's standards. Multiple H-frame structures along with shield wire will be used for lightning protection.

3.1.18 Yard Lighting:
Yard lighting will be installed to be sufficient for visual indication of the disconnect switch positions or egress of personnel, and will not serve as task lighting.

3.1.19 Structures:
The required new outdoor steel structures listed below will be hot-dipped galvanized wide flange structures or tubular steel:

- Eighteen (18) 345 kV disconnect switch stands
- Eighteen (18) 345 kV bus support
- Five (5) H-frame line entrance structures
- Fourteen (14) 345kV CCVT stands

- Twelve (12) 345kV surge arrester stands

3.1.20 Foundations:
Foundations and slabs will be designed and installed in accordance with the owner's standards and specifications. The minimum design depth to firm bearing is contingent upon soil borings at the site.

3.1.21 Scheduling Requirements:
Legal/Real Estate Procurement 9 weeks
Material Procurement / Design 52 weeks
Substation Construction 52 weeks
Closeout Activities 4 weeks

3.1.22 Site Work:
Site grading will be required for the new 345kV switchyard.

3.1.23 Total Cost: $17,115,280
Total Cost Estimate Accuracy: +/- 20%

Note that the cost estimate provided is expressed in 2015 terms and includes applicable company overheads and potential tax gross ups.

3.2 Loop Spearville to Clark County and Ironwood to Clark County lines into GBX Clean Line interconnection switching station

3.2.1 Project Location:
The new switchyard will be located approximately 13 miles north of the Clark County Substation on the Spearville to Clark County line in Ford County, Kansas.

3.2.2 Project Overview:
The project involves opening the existing Spearville to Clark County 345 kV line and the existing Ironwood to Clark County 345 kV line and looping them into the new GBX Clean Line Interconnection Substation.

3.2.3 Design Criteria:
Design Standards will be Transmission Owner Standards. Where no applicable standards are available, the Transmission Owner will utilize industry standards.

3.2.4 One-Line Diagrams: N/A

3.2.5 Site Plan: N/A

3.2.6 Route Information**:**
The routing associated with looping the Spearville to Clark County and Ironwood to Clark County circuits into the GBX Clean Line Sub is minimal and will be contained to the property surrounding the GBX Clean Line Substation.

3.2.7 Right-of-Way Information:
The new transmission line structures will be located on existing easement or on the new substation property. Please see section 6 for general guidelines

3.2.8 Permitting:

Same as that covering section 3.1.8.

3.2.9 Metering & Ownership Demarcation: N/A

3.2.10 Protection & Control Overview: N/A

3.2.11 Insulation Coordination: N/A

3.2.12 Short Circuit Study Results - Bus Fault Levels: N/A

3.2.12 Other Equipment & Materials: **N**/A

3.2.13 Relaying, Control, & SCADA: N/A

3.2.14 Grounding System: N/A

3.2.15 Lightning Shielding Design:
Lightning shielding design will be in accordance with the Transmission Owner's standards and specifications.

3.2.16 Yard Lighting: N/A

3.2.17 Structures:
The new transmission line structures will be 345 kV weathering steel monopoles or lattice towers, pending the most feasible and appropriate design. Four structures will be required to loop each line into the new station for a total of eight new structures.

3.2.18 Foundations:
Foundations will be designed and installed in accordance with the Transmission Owner's standards and specifications. The transmission structure foundations will be drilled piers.

3.2.19 Conductors, Shield Wires, & OPGW:
The conductor will be a bundled T2-795 kcmil (26/7) ACSR "Drake" per phase. The shield wire will be fiber optic ground wire (OPGW.)

3.2.20 Insulators:
Insulators will be 345 kV polymer insulators.

3.2.21 Removal of Existing Facilities:
One existing structure will be removed to facilitate the looping of the transmission lines into the new station.

3.2.22 Site Work: N/A

3.2.23 Total Cost: $ 3,011,510
Total Cost Estimate Accuracy: +/- 20%
Total Cost of Network Upgrades: 17,115,280 + 3,011,510 = **20,126,790**

Note that the cost estimate provided is expressed in 2015 terms and includes applicable company overheads and potential tax gross ups.

4.0 Transmission Owner Interconnection Facilities

4.1 GBX Clean Line – Interconnection Facilities

4.1.1 Project Location:
This switching station will be located approximately 13 miles north of the Clark County Substation on the Spearville to Post Rock line in Ford County, Kansas.

4.1.2 Project Overview:
Two new line entrance structures will be added at the ITCGP GBX Clean Line interconnection switching station for termination of both of the lines from the AC collector substation. A disconnect switch will be installed beneath this structure for isolation of each of the developer's line. Line relaying will be added to protect both of the lines. A set of CCVT's and surge arresters will be added for each of the line terminals.

4.1.3 Design Criteria:
The Transmission Owner's standards will be applicable. Where no applicable standards are available, the Transmission Owner will substitute industry standards.

4.1.4 One-Line Diagrams: See Figure 1

4.1.5 Site Plan: See Figure 2.

4.1.6 Route Information: N/A

4.1.7 Right-of-Way Information: N/A

4.1.8 Permitting: Same as that covering section 3.1.8

4.1.9 Metering & Ownership Demarcation:
The Interconnection Customer or others will provide, own, operate and maintain revenue metering. The specifics of the revenue metering will be defined during the detailed engineering phase of the project. The customer must cooperate with the Transmission Provider and Local Transmission Owner requirements in the metering design. Revenue metering equipment will be required at customer's project substation with loss compensation to the Point of Interchange in the Transmission Owner's substation.

The ownership demarcation will be at first substation steel H-frame within the security fence of the Transmission Owner substation.

The Interconnection Customer will be required to provide enough conductor to terminate on the H-frame and extend down to reach grade level.

4.1.10 Protection & Control Overview:

- One set of 345kV CCVTs will be installed on each of the developer's lines. Two sets of 345kV CCVTs total.
- Two paths of fiber optic cable (OPGW) will be required for line protection. They will be supplied by the Interconnection Customer.
- One 345kV line relaying panel with microprocessor based relays will be installed for each line.

4.1.11 Insulation Coordination:

345kV, 1050kV BIL

4.1.12 Short Circuit Study Results - Bus Fault Levels: See Section 3a above

4.1.13 Other Equipment & Materials:

- Disconnect Switch: Two (2) 345 kV, 3000A rated, 1050 kV BIL.
- CCVTs: Six (6) 345 kV, 3-winding, 1550kV BIL.
- Surge Arresters: Six (6) 345 kV, vertical mount, 209 kV MCOV, polymer.
- Control Cables: Control cables per Transmission Owner standards will be installed in direct buried PVC conduits, above grade LFMC conduits and in pre-cast cable trench. All control cables from the yard will be terminated at the relaying control panels. The control building will have overhead cable trays for necessary cable runs and inter-panel connections.

4.1.14 Relaying, Control, & SCADA:
Panel Requirements: Two RD3048 Panels – Fiber optic current differential (SEL 311L Relays)

4.1.15 Grounding System:
The grounding system will be designed and installed per Transmission Owner's standards. These standards follow the IEEE 80 standards.

4.1.16 Lightning Shielding Design:
The attachment of the OPGW shield wire from the developer's line to the H-frame will provide lightning protection for the Interconnection Facility equipment at the GBX Clean Line interconnection substation.

4.1.17 Yard Lighting:
Yard lighting will be installed to be sufficient for visual indication of the disconnect switch position or egress of personnel, and will not serve as task lighting.

4.1.18 Structures:
The required new outdoor steel structures listed below will be hot-dipped galvanized wide flange structures or tubular steel:

- Two (2) 345 kV disconnect switch stand
- Four (4) H-frame line entrance structures
- Six (6) 345 kV CCVT stands
- Six (6) 345 kV surge arrester stands

4.1.19 Foundations:
Foundations will be designed and installed in accordance with the owner's standards and specifications. The minimum design depth to firm bearing is contingent upon soil borings at the site.

4.1.20 Conductors, Shield Wires, & OPGW: N/A

4.1.21 Insulators: N/A

4.1.22 Removal of Existing Facilities: N/A

4.1.23 Site Work: N/A

4.1.24 Total Cost: $ **1,321,971**

Total Cost Estimate Accuracy: +/- 20%
Total Project cost (Network Upgrades and Interconnection facilities): $ 21,448,762

Note that the cost estimate provided is expressed in 2015 terms and includes applicable company overheads and potential tax gross ups.

5.0 Interconnection Customer Interconnection Facilities

5.1 GBX Clean Line Interconnection facilities

All facilities within the Interconnection Customer's AC collector substation and between the Interconnection Customer's substation and ITCGP's new GBX Clean Line interconnection substation are not included in this report and are the sole responsibility of the Interconnection Customer. Some of the key facilities are briefly mentioned below. The Point of Interconnection (POI) and the Point of Change of Ownership (PCO) are shown in Figure 1.

The Interconnection Customer shall construct the 345 kV radial lines from the AC collector station to ITCGP's new GBX Clean Line interconnection substation. Installation of OPGW shield wire on each of the radial lines from GBX Clean Line containing at least 12 single mode fibers will be required for ITCGP relaying and communication purposes.

The customer's step-up transformer between the AC collector network and the 345 kV facilities will require a high side breaker capable of interrupting a transformer high side winding fault.

All Interconnection Customer owned 345 kV apparatus as well as the revenue metering equipment located in the Interconnection Customer's substation shall comply with ITCGP standards and will be subject to ITCGP approval. ITCGP will provide the Interconnection Customer with standards during detailed design or upon request. The Interconnection Customer is solely responsible for the SCADA and telecommunications facilities necessary to operate and monitor its facility.

Necessary trip and close signal interlocks will be provided by ITCGP to the Interconnection Customer's generation facility for the safe operation of the system. Interconnection Customer will provide breaker status and current transformer signals to ITCGP for system operation and protection.

Total Project Cost: N/A
Total Cost Estimate Accuracy: N/A

6.0 Right Of Way Requirements

The Interconnection Customer shall obtain easements from the Transmission Owner to work in or drive through the Transmission Owner's transmission line right-of-way. The Transmission Owner and Interconnection Customer will also cooperatively negotiate any easements required for the Interconnection Customer's transmission lines and structures. The Transmission Owner agrees to not unreasonably withhold easements.

For the Network Upgrades and any Transmission Owner Interconnection facilities identified in this report, the Transmission Owner agrees to obtain all necessary easements/right-of-way as required to construct those facilities that will be owned and operated by ITCGP.