



**Facility Study  
For  
Generation Interconnection  
Request  
GEN-2011-023**

*SPP Generation  
Interconnection Studies*

*(#GEN-2011-023)*

**April 2013**

## **Summary**

ITC Great Plains (ITCGP) performed a detailed Facility Study at the request of Southwest Power Pool (SPP) for Generation Interconnection request GEN-2011-023 (299MW/Wind) located in Ford County in Kansas. The originally proposed in-service date for GEN-2011-023 was December 31, 2012. SPP has proposed the in-service date will be after the assigned interconnection facilities upgrades and shared network upgrades are completed. Also the in-service date will be post completion of the planned Clark County 345kV Substation. The request for interconnection was placed with SPP in accordance with SPP's Open Access Transmission Tariff, which covers new generation interconnections on SPP's transmission system.

## **Phases of Interconnection Service**

It is not expected that interconnection service will require phases however, interconnection service will not be available until all interconnection facilities and network upgrades can be placed in service.

## **Interconnection Customer Interconnection Facilities**

The Interconnection Customer will be responsible for all of the transmission facilities connecting the customer owned substation to the Point of Interconnection (POI), at the planned ITC Great Plains Clark County 345kV substation. The ITCGP Clark County 345kV substation is part of the SPP identified priority projects. The planned ITCGP Clark County 345kV substation will be owned and operated by ITC Great Plains (ITCGP). The Customer will also be responsible for any equipment located at the Customer substation necessary to maintain a power factor of 0.95 lagging to 0.95 leading at the POI.

## **Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades**

To allow interconnection the Transmission Owner will need to construct a 345kV terminal along with a breaker and half bus configuration and associated equipment for acceptance of the Interconnection Customer's Interconnection Facilities. The estimated in-service date for these Interconnection Facilities is unknown but should be after the planned Point of Interconnection (POI) substation is built. At this time GEN-2011-023 is responsible for \$2,942,042 (2014 dollars) of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades.

## **Shared Network Upgrades**

The interconnection customer was studied within the DISIS-2011-001 Impact Study. At this time, the Interconnection Customer is allocated \$82,315,727.85 for Shared Network Upgrades. If higher queued interconnection customers withdraw from the queue, suspend or terminate their GIA, restudies will have to be conducted to determine the Interconnection Customers' allocation of Shared Network Upgrades. All studies have been conducted on the basis of higher queued interconnection requests and the upgrades associated with those higher queued interconnection requests being placed in service. At this time, the Interconnection Customer is allocated the following cost for Shared Network Upgrade:

ERIS Upgrade Description	Allocated Cost	Total Cost
Beaver County 345kV Expansion (Tap & Tie Hitchland - Woodward 345kV circuit #2)	\$306,538.88	\$3,500,000.00
Beaver County - Buckner 345kV circuit #1 - Build approximately 48 miles of 345kV from Beaver County - Buckner (construction by OKGE)	\$9,249,508.44	\$105,609,050.00
Beaver County - Buckner 345kV circuit #1 - Build approximately 48 miles of 345kV from Beaver County - Buckner (construction by Sunflower)	\$5,657,831.82	\$64,600,000.00
Tatonga - Matthewson 345kV circuit #2 - Build Matthewson Substation. Build second 345kV circuit from Tatonga - Matthewson	\$4,964,450.10	\$104,260,473.00
Matthewson - Cimarron 345kV circuit #2 - Build second 345kV circuit from Matthewson - Cimarron	\$2,409,414.91	\$42,903,753.00
Mullergren - Reno 345kV double circuit - Build new double circuit 345kV transmission line from Mullergren to Circle to Reno. Includes substation work at Reno. (Construction by Westar)	\$7,895,303.52	\$53,828,328.00
Spearville - Mullergren - Reno 345kV double circuit - Build new double circuit 345kV transmission line from Spearville to Mullergren to Circle. Includes substation work at Spearville. (Construction by Sunflower)	\$51,832,680.176	\$353,383,059.00
<b>Total</b>	<b>\$82,315,727.85</b>	

### Other Network Upgrades

Certain Other Network Upgrades are not the cost responsibility of the Customer but will be required for full Interconnection Service. These Other Network Upgrades include:

1. Hitchland - Woodward 345kV double circuit, scheduled for 6/30/2014 in-service
2. Beaver County Tap on Hitchland - Woodward 345kV circuit #1, assigned to GEN-2008-047
3. Hitchland 345/230kV Autotransformer circuit #2, scheduled for 6/30/2014
4. Spearville - Clark - Thistle - Wichita 345kV double circuit, scheduled for 12/31/2014 in-service
5. Post Rock 345/230/13.8kV Autotransformer circuit #2, assigned to DISIS-2010-001 Customers
6. Thistle - Wichita 345kV double circuit, scheduled for 12/31/2014 in-service
7. TUCO Interchange 345/230/13.2kV Autotransformer circuit #2, scheduled for 3/31/2013 in-service
8. TUCO Interchange - Border - Woodward 345kV circuit #1, scheduled for 5/19/2014 in-service
9. Woodward 345/138kV transformer circuit #2, scheduled for 5/19/2014 in-service

Depending upon the status of higher or equally queued customers, the Interconnection Customer's in-service date is at risk of being delayed or their Interconnection Service is at risk of being reduced until the in-service date of these Other Network Upgrades.

**Conclusion**

Interconnection Service for GEN-2011-023 will be delayed until the Transmission Owner Interconnection Facilities Shared Network Upgrades are constructed. The Customer is responsible for \$2,942,042 (2014 dollars) of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades. At this time, the Interconnection Customer is allocated \$82,315,727.85 for Shared Network Upgrades. After all Interconnection Facilities and Network Upgrades have been placed into service, Interconnection Service for 299 MW, as requested by GEN-2011-023, can be allowed. At this time the total allocation of costs of Interconnection Service for GEN-2011-023 are estimated at \$85,257,769.85.



**FACILITY STUDY  
for  
Generation Interconnection Request 2011-023**

299 MW Wind Generating Facility  
In Ford County, Kansas

January 15, 2013

## **Executive Summary**

ITC Great Plains (“ITCGP”) has performed a facility study at the request of Southwest Power Pool (“SPP”) for Generation Interconnection request GEN-2011-023 under the SPP Open Access Transmission Tariff. The subject request entails interconnecting a 299 MW wind powered generation facility in southwestern Ford County, Kansas. The project will interconnect to the new Clark County Switching Station scheduled for completion no later than December 31, 2014.

ITCGP estimates the cost of the customer’s interconnection facilities will be \$2,942,042, including applicable company overheads and tax gross-ups, in 2014 dollars. It is further estimated that the required legal/real estate acquisition and construction activities will require 73 weeks, or approximately 17 months. However, in no case can the interconnection facilities be placed in service prior to completion of the Clark County Switching Station. The attached report contains additional details regarding the estimate as well results of short circuit studies, review of reactive compensation, and information on voltage guidelines.

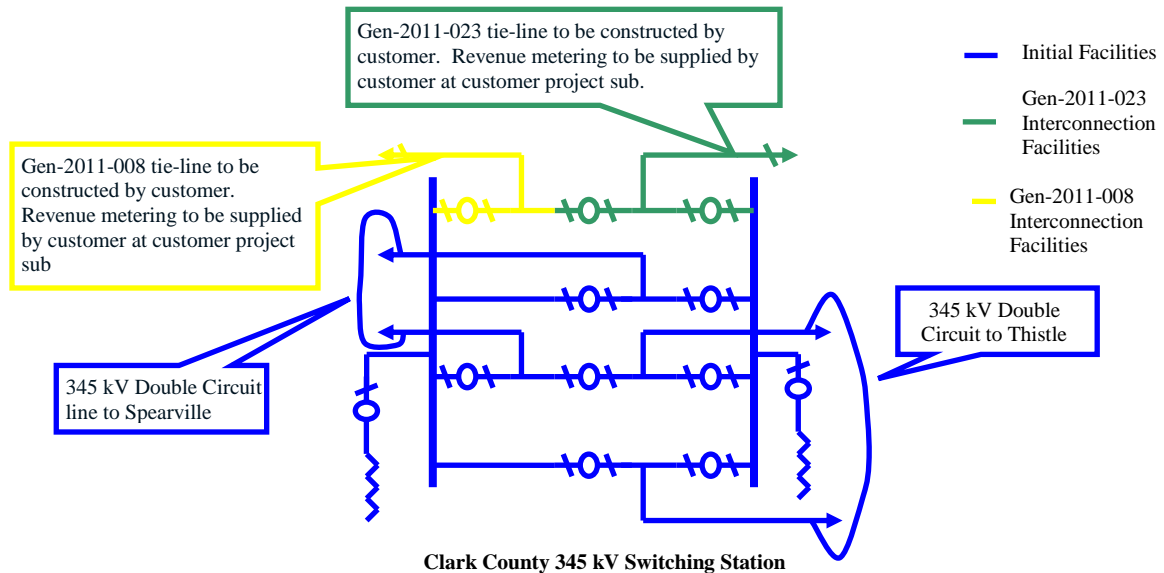
## 1.0 Introduction

ITC Great Plains (“ITCGP”) performed the following study at the request of Southwest Power Pool (“SPP”) for Generation Interconnection request GEN-2011-023 under the SPP Open Access Transmission Tariff (“OATT”). Subject request entails interconnecting a 299 MW wind powered generation facility in southwestern Ford County, Kansas. The project will interconnect to the future Clark County Switching Station scheduled for completion no later than December 31, 2014. The ITCGP scope of this Facility Study was to provide a cost estimate for the Customer’s interconnection facilities.

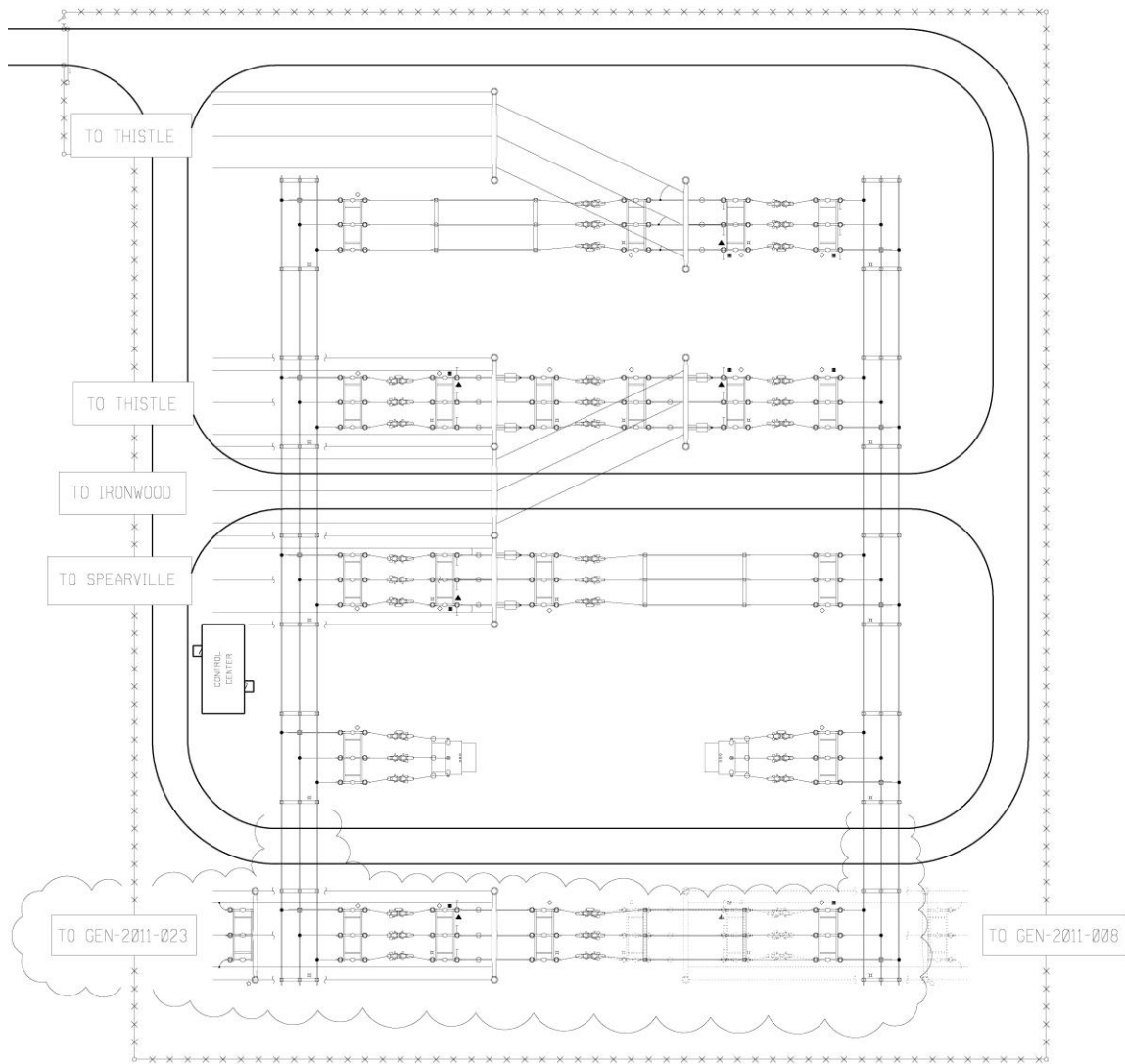
## 2.0 Interconnection Facilities

The Customer’s interconnection request indicated that the new wind generation project’s substation facilities would be located such that the interconnection substation and the Customer’s substation would be interconnected via approximately 21.5 miles of single-circuit 345 kV transmission line.

**Figure 1 – Clark County Switching Station with Gen-2011-023 Interconnection**



**Figure 2 – Interconnection GEN-2011-023 (clouded) at Clark County Switch Station**



**Design Criteria:**

The Transmission Owner's standards will be applicable. Where no applicable standards are available, the Transmission Owner will substitute industry standards and other good utility practices.

**One-Line Diagrams:**

See Figure 1 for Transmission Owner One-Line.

**Site Plan:**

See Figure 2 for site plan of Transmission Owner switching station at Clark County. The equipment that needs added to accommodate the customer's interconnection request is clouded in red.



**Route Information:**

N/A

**Right-of-Way Information:**

It is assumed that the interconnection customer will be responsible for building the 345 kV line required to connect the Clark County Switching Station with the customer's substation. As such, the interconnection costs contained herein do not include any costs for extending the ITCGP transmission line.

**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.

**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.

**Protection & Control Overview:**

One set of three 345kV CCVTs will be installed for the Gen-2011-23 line terminal.

Two paths of fiber optic cable (OPGW) will be required for the line.

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

One 345kV line relaying panel with microprocessor based relays will be installed.

**Insulation Coordination:**

345kV, 1050kV BIL

**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 data for the interconnection transformer and installed wind turbines supplied by the Interconnection Customer. Variance from supplied data could materially change calculated short circuit values. Results are displayed in Table 1.

**Table 1 – Short Circuit Results**

Fault Location	Maximum Fault Current (Amps)*	
	Phase	Ground
Spearville Substation	12877	14034
Clark County 345 kV Bus	12903	13970
Thistle 345 kV Bus	14271	10532
* Fault current calculations included Gen-2011-008 and Gen-2011-023 interconnections at Clark County.		

Fault currents shown in Table 1 are within the circuit breaker interrupting capabilities with the addition of 299 MW contributed by Gen-2011-023.

**Reactive Compensation:**

ITCGP evaluated the impact of the proposed interconnection on the reactors presently planned for the Clark County Switching Station and Thistle Substation facilities. ITCGP studies determined that the planned reactors will not be materially affected by the planned interconnection.

**Voltage Guidelines:**

Reactive power, voltage regulation and operating requirements will be per Transmission Operator (TOP) and Transmission Provider directives. Interconnection Customer will operate the Generating Facility to a voltage schedule of 354 kV (1.026 pu) with a bandwidth of +/- 6 kV (0.017 pu) at the Point of Interconnection (POI) utilizing the Generating Facility's required power factor design capability as indicated in SPP DISIS-2011-001. As per SPP DISIS 2011-001, the Interconnection Customer's required power factor capability is 0.95 lagging to 0.95 leading at the POI.

For further clarification, the Interconnection Customer may meet the +/-0.95 power factor requirement by utilizing reactive capability from the wind generators or by adding external reactive compensation such as capacitors or reactors. Note that any reactive compensation installed by the Interconnection Customer shall

not cause voltage distortion in accordance with Article 9.7.6 Power Quality of the Generation Interconnection Agreement

The Interconnection Customer will regulate the Generating Facility's voltage to the specified voltage set-point within the defined bandwidth stated above using an automatic voltage controller utilizing the inherent reactive power capability in the wind turbines and if applicable external reactive compensation such as capacitors or reactors.

The above voltage schedule is subject to change. If the need for a change is identified, it will be done within the limits of the GIA provisions stated in Section 9.6 and the Generating Facility's power factor design criteria as stated above. 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 a generator operator available for 24/7 communication with the TOP. The TOP may, at any time request a variance from the schedule in response to system operating/security requirements.

**Other Equipments & Materials:**

- Gas Circuit Breakers (GCB):  
Two (2) 345 kV, 3000A rated, 1300 kV BIL, 50 kAIC GCBs.
  
- Disconnect Switch:  
Five (5) 345 kV, 3000A rated, 63kA, 1050 kV BIL disconnect switches.
  
- CCVTs:  
Three (3) 345 kV, 3-winding, 1300kV BIL CCVTs.
  
- Insulators:  
Six (6) 345 kV, 1050 kV BIL station post, porcelain insulators.
  
- Surge Arresters:  
Six (6) 345 kV, vertical mount, 209 kV MCOV, polymer surge arresters
  
- Control Cable:  
Control cables per Transmission Owner standards will be installed in direct buried PVC conduits, above grade IMG 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.

**Relaying, Control, & SCADA:**

Panel Requirements

- 1 – RD3064 – Line Breaker Control (SEL-351S)

- 1 – RD3024 – Tie Breaker Control (SEL-351S)
- 1 – RD3048 – Fiber optic current differential (SEL-311Ls)

**Grounding System:**

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

**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.

**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.

**Structures:**

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

- Five (5) 345 kV disconnect switch stands
- Two (2) H-frame line entrance structures
- Three (3) 345 kV CCVT stands
- Six (6) 345 kV surge arrester stands
- Six (6) 345 kV bus supports
- Three (3) 345 kV metering PT stands
- Three (3) 345 kV metering CT stands

**Scheduling Requirements:**

Legal/Real Estate Procurement	9 weeks
Material Procurement / Design	30 weeks
Substation Construction	32 weeks
Closeout Activities	4 weeks

**Note – in no case can the requested interconnection be completed prior to in-service date of the Clark County Switching Station**

**Total Cost Estimate Accuracy: +/- 20%**

**Total Project Cost: \$ 2,942,042**

Note that the cost estimate provided is in expressed in 2014 terms direct costs only and does not include applicable company overheads and potential tax gross-ups.