



**Interconnection Facilities Study  
For  
Generator Interconnection  
Request  
GEN-2014-057  
(IFS-2014-002-22)**

***SPP Generator  
Interconnection Studies***

***(#GEN-2014-057)  
(#IFS-2014-002-22)***

**September 2015**

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## Revision History

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Date	Author	Change Description
7/9/2015	SPP	Draft Facility Study Revision 0 Report Issued
7/14/2015	SPP	Final Facility Study Revision 0 Report Issued
9/17/2015	SPP	Final Interconnection Facilities Study Revision 1 Report Issued for updated Costs Estimates, Reduced Generation Analysis, and Network Reactor Requirements

## **Summary**

American Electric Power West (AEPW) and Oklahoma Gas and Electric Company (OKGE) performed detailed Interconnection Facilities Studies at the request of Southwest Power Pool (SPP) for Generator Interconnection request GEN-2014-057/IFS-2014-002-22 (250.00 MW/Wind) located in Grady and Stephens Counties, Oklahoma. The Interconnection Customer proposed in-service date for GEN-2014-057/IFS-2014-002-22 is December 31, 2016. SPP has proposed the full interconnection service in-service date will be after the assigned Interconnection Facilities and Non-Shared Network upgrades are completed. Full Interconnection Service will require the Network Upgrades listed in the "Other Network Upgrades" section. 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's generation facility consists of one hundred and twenty-five (125) General Electric (G.E.) 2.0MW wind turbines for a total generation capacity of 250.00 MW. The 34.5kV collector system for this wind farm is planned to be connect to one (1) 345/34.5kV Interconnection Customer owned and maintained transformer at the Interconnection Customer owned substation. An approximate twenty-six (26) mile overhead 345kV transmission circuit will connect GEN-2014-057/IFS-2014-002-22 Interconnection Customer owned substation to a new station tapping the existing AEPW owned Lawton Eastside (LES) - Sunnyside 345kV transmission circuit. The location of the new Terry Road 345kV Switching Station is approximately twenty-seven (27) miles from LES on the LES - Sunnyside 345kV transmission circuit located in Stephens County, Oklahoma. The Interconnection Customer will be responsible for all of the transmission facilities connecting the Interconnection Customer owned substation to the Point of Interconnection (POI), at the new 345kV bus at American Electric Power Transmission Company, Inc. (AEP) owned new 345kV substation.

The Interconnection Customer will 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, including approximately 23.9 Mvar<sup>1</sup> of reactors to compensate for injection of reactive power into the transmission system under light wind conditions. Also, the Interconnection Customer will need to coordinate with the Transmission Owner for relay, protection, control, and communication system configurations.

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

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<sup>1</sup> This approximate minimum reactor amount is needed for the current configuration of the wind farm as studied in the IFS Reduced Generation Analysis Addendum

To allow interconnection the interconnecting Transmission Owner, American Electric Power Transmission Company, Inc. (AEP) will need to construct a new three (3) breaker ring bus station along with any associated terminal equipment for the acceptance of the Interconnection Customer's Interconnection Facilities. AEPW will also need to install two (2) 50Mvar reactors with reactor switchers at the Terry Road Switching Station. At Terry Road Switching Station, one reactor will be in-line towards LES and the other reactor in-line towards Sunnyside. The Transmission Owner, Oklahoma Gas and Electric Company (OKGE) will need to verify relay settings for the Sunnyside substation for acceptance of the Interconnection Customer's Interconnection Facilities.

At this time, GEN-2014-057/IFS-2014-002-22 is responsible for \$20,100,000 of AEP Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades and \$20,000 of OKGE Non-Shared Network Upgrades. The total current allocated cost for GEN-2014-057/IFS\_2014-002-022 Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades is \$20,120,000.

Table 1 displays the estimated costs for Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades.

**Table 1: GEN-2014-057/IFS-2014-002-22 TOIF and Non-Shared Network Upgrades**

Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades Description	Allocated Cost (\$)	Allocated Percent (%)	Total Cost (\$)
Network Upgrades - OKGE – Relay settings verification at Sunnyside Station	\$20,000	100%	\$20,000
Interconnection Substation - Transmission Owner Interconnection Facilities 345kV Substation work for line terminal, 3000A line switch, dead end structure, line relaying, and revenue metering	\$1,000,000	100%	\$1,000,000
Interconnection Substation - Network Upgrades 345kV Substation work for 3-345kV 3000A Breaker, 3000A line relaying, disconnect switches, 2 – 50Mvar in-line reactors with associated switchers and associated equipment	\$19,100,000	100%	\$19,100,000
Total	\$20,120,00	100%	\$20,120,000

### Shared Network Upgrades

The Interconnection Customer was studied within the DISIS-2014-002 and DISIS-2014-002-1 Impact Restudies with Energy Resource Interconnection Service (ERIS) only. The Interconnection Customer had updated cost allocation in the DISIS-2014-002-3 Restudies. At this time, the Interconnection Customer is allocated \$0 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:

**Table 2: GEN-2014-057/IFS-2014-002-22 Shared Network Upgrades**

Shared Network Upgrades Description	Allocated Cost (\$)	Allocated Percent (%)	Total Cost (\$)
Currently GEN-2014-057/IFS-2014-002-22 is not allocated Shared Network Upgrades	\$0	n/a	\$0
Total	\$0	n/a	\$0

### **Other Network Upgrades**

Certain Other Network Upgrades are currently not the cost responsibility of the Customer but will be required for full Interconnection Service. Currently, no Other Network Upgrades are assigned to GEN-2014-057/IFS-2014-002-22.

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-2014-057/IFS-2014-002-22 will be delayed until the Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades are constructed. The Interconnection Customer is responsible for \$20,120,000 of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades. At this time, the Interconnection Customer is allocated \$0 for Shared Network Upgrades. After all Interconnection Facilities and Network Upgrades have been placed into service, Interconnection Service for 250.00 MW, as requested by GEN-2014-057/IFS-2014-002-22, can be allowed.

At this time the total allocation of costs assigned to GEN-2014-057/IFS-2014-002-22 for interconnection Service are estimated at \$20,120,000.

## 1. Introduction

<OMITTED TEXT> (Interconnection Customer) has requested an Interconnection Facilities Study under the Southwest Power Pool Open Access Transmission Tariff (OATT) for interconnecting a 250.00 MW wind generation facility in Grady and Stephens Counties, Oklahoma to the transmission system of American Electric Power (AEP). The generator facility, GEN-2014-057, is comprised of one hundred twenty five (125) General Electric (G.E.) 2.0MW wind turbines for a total nameplate of 250.00 MW.

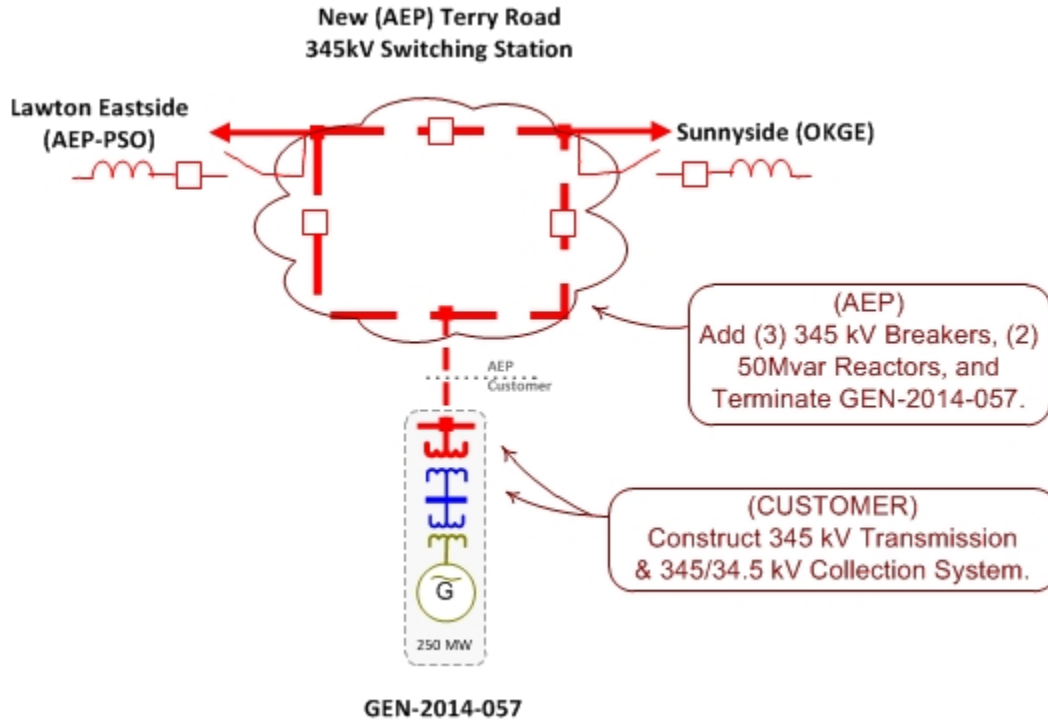
## 2. Interconnection Facilities and Network Upgrades

The cost for the Interconnection Facilities and Network Upgrades is listed below in Table 1. GEN-2014-057/IFS-2014-002-22 is planned to interconnection at a new 345kV station tapping the existing AEPW owned Lawton Eastside (LES) - Sunnyside 345kV transmission circuit. The location of the new Terry Road 345kV Switching Station is approximately twenty-seven (27) miles from LES on the LES – Sunnyside 345kV transmission circuit located in Stephens County, Oklahoma.. The estimated lead time for Transmission Owner Interconnection Facilities and Network Upgrades is twenty-four (24) months after a fully executed Generation Interconnection Agreement (GIA). The one-line diagram is shown in Figure 1.

**Table 1: Required Transmission Owner Interconnection Facilities and Non Shared Network Upgrades**

<b>Description</b>	<b>Estimated Cost</b>
AEP Interconnection Substation - Transmission Owner Interconnection Facilities 345kV Substation work for line terminal, 3000A line switch, dead end structure, line relaying, and revenue metering	\$1,000,000
AEP Interconnection Substation - Network Upgrades 345kV Substation work for 3-345kV 3000A Breaker, line relaying, 3000A disconnect switches, install two 50Mvar in-line reactors, and associated equipment	\$19,100,00
<b>Total:</b>	<b>\$20,100,000</b>

**Figure 1: Interconnection Configuration for GEN-2014-057**



**2.1. Interconnection Customer Facilities** – The Interconnection Customer will be responsible for its Generating Facility and its one (1) 345/34.5 kV transformer that connect to the wind generators to the Point of Interconnection. In addition, the Interconnection Customer will be required to install the following equipment in its facilities.

**2.1.1. Reactive Power Equipment** – The Customer will be responsible for reactive power compensation equipment to maintain 95% lagging (providing vars) and 95% leading (absorbing vars) power factor at the point of interconnection, which may be provided in part by the reactive power capability of the synchronous generators. Any capacitor banks installed by the Interconnection Customer shall not cause voltage distortion in accordance with Article 9.7.4 of the standard SPP Generation Interconnection Agreement.

### **3. Conclusion**

The Interconnection Customer's Interconnection Facilities and Non-Shared Network Upgrades are estimated at \$20,100,000.



# **Interconnection Facilities Study Addendum**

## **Reduced Generation Analysis GEN-2014-057/IFS-2014-002-22**

**September 2015  
Generator Interconnection**





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## Reduced Generation Analysis

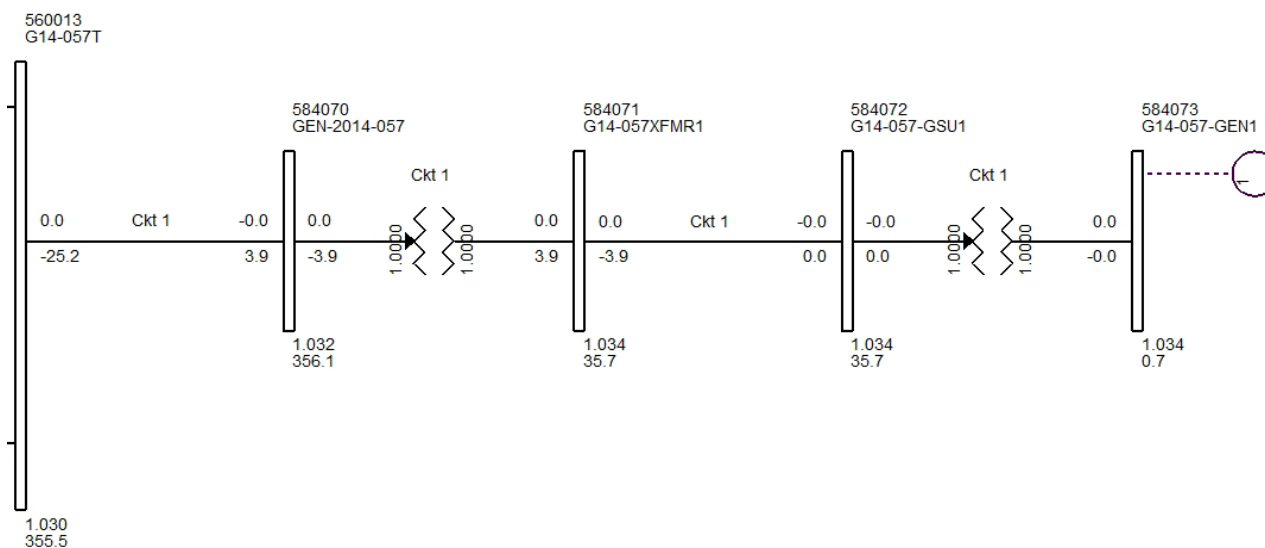
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An updated reduced generation analysis has been performed for the GEN-2014-057 Interconnection Request. The generator lead distance to the Point of Interconnection (POI) change and the large size of the GEN-2014-057 Interconnection Request (250 MW) caused SPP to perform this updated analysis for excessive capacitive charging current for the addition of the GEN-2014-057 facilities. The high side of the 345/34.5kV GEN-2014-057 Interconnection Customer's (IC) transformer will interconnect to Point of Interconnection (POI), GEN-2014-057 Tap, by a twenty-six (26) miles IC owned and maintained overhead 345kV transmission generator lead. The POI is at a new 345kV station tapping the Lawton East Side (LES) – Sunnyside 345kV transmission circuit. This new 345kV switching station will be approximately twenty – seven (27) miles from LES and will loop in and re-terminate both ends of LES – Sunnyside 345kV transmission circuit.

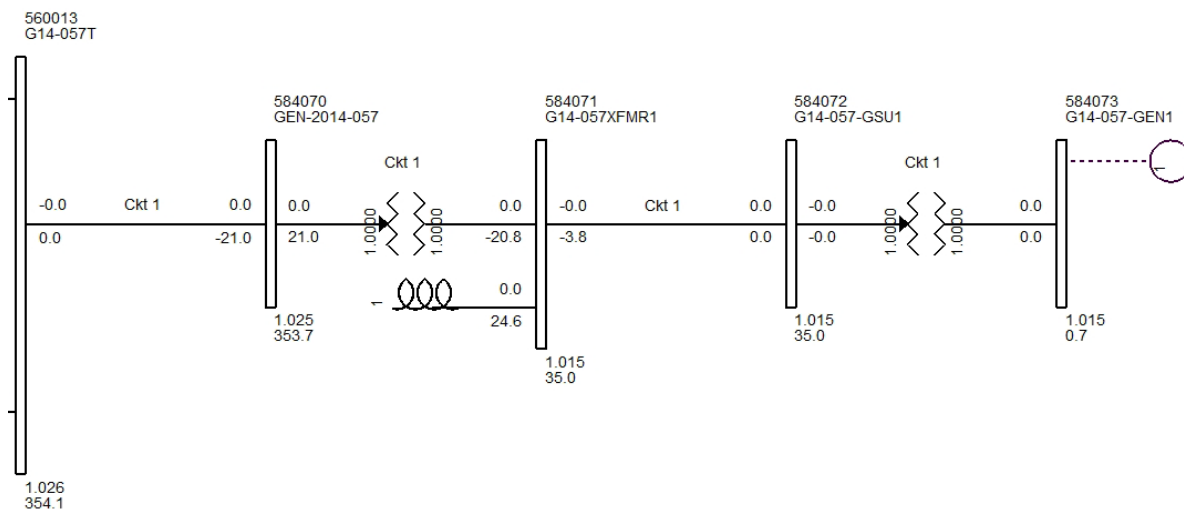
The project generators and capacitors (if any) were turned off in the base case as show in **Figure 1**. The resulting reactive power injection into the transmission network comes from the capacitance of the project's transmission lines and collector cables.

Shunt reactors were added at the study project substation 34.5 kV bus to bring the Mvar flow into the GEN-2014-057 Tap 345kV substation down to approximately zero as show in **Figure 2**. Final shunt reactor requirement for GEN-2014-057 is approximately 23.9 Mvar(s). The one-line diagram in **Figure 2** shows actual Mvar output at the specific voltages in the base case. The results shown are for the 2025SP case.

The other two cases (2015 SP and 2015 WP) were almost identical since the Interconnection Request facilities design is the same in all cases.

**Figure 1: GEN-2014-057 with generator off and no shunt reactor(s)**

**Figure 2: GEN-2014-057 with generators turned off and shunt reactors added to the low side of the GEN-2014-057 substation 345/34.5kV transformer**



**Table 1: Reduced/No Generation Analysis**

Request	Size (MW)	Point of Interconnection	Shunt Reactive Mvar(s) Requirement
GEN-2014-057	250	Tap Lawton East Side (LES) – Sunny Side 345kV	23.9

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## Conclusion

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A reduced generation analysis has been performed for the GEN-2014-057 Interconnection Request. The generator lead distance to the Point of Interconnection (POI) change and large size of the GEN-2014-056 Interconnection Request (250MW) caused SPP to perform this low wind analysis.

The reduced generation analysis has determined the need for the GEN-2014-057 Interconnection Request to install approximately 23.9 Mvar(s) of reactor bank(s).