Feasibility Study For Generation Interconnection Request GEN-2006-046

SPP Tariff Studies
(#GEN-2006-046)

June 2007

Executive Summary

<OMITTED TEXT> (Customer) has requested a Feasibility Study for the purpose of interconnecting 130 MW of wind generation within the control area of Oklahoma Gas and Electric (OKGE) in Dewey County, Oklahoma. The proposed point of interconnection is OKGE's Dewey Substation. The proposed in-service date is December 31, 2009.

Power flow analysis has indicated that for the powerflow cases studied, it is possible to interconnect the 130 MW of generation with transmission system reinforcements within the local transmission system. In order to maintain acceptable reactive power compensation, the customer will need to install 26 MVARs of 34.5 kV capacitor banks in the Customer's collector substation on the 34.5 kV bus. Dynamic Stability studies performed as part of the impact study will provide additional guidance as to whether the required reactive compensation can be static or a portion must be dynamic (such as a SVC).

The requirement to interconnect the 130 MW of generation on the existing OKGE Dewey Substation consists of adding a fourth line terminal to the proposed 138 kV ring bus scheduled to be built at Dewey. The Customer did not propose a specific 138 kV line extending to serve its138/34.5 kV facilities. It is assumed that obtaining all necessary right-of-way for the new switching station will not be a significant expense.

The minimum estimated cost for building the required facilities for this 130 MW of generation is $724,697. These costs are shown in Tables 1 and 2. The Network Constraints listed in Table 3 for American Electric Power West (AEPW), Southwestern Public Service (SPS), Missouri Public Service (MIPU), Western Resources (WERE) and Western Farmers Electric Cooperative (WFEC) transmission systems may be verified with a transmission service request and associated studies. These Network Constraints are in the local area of the new generation when this generation is sunk throughout the SPP footprint for the Energy Resource (ER) Interconnection request. With a defined source and sink in a Transmission Service Request (TSR), this list of Network Constraints will be refined and expanded to account for all Network Upgrade requirements. This cost does not include building the 138 kV line from the Customer substation to the Dewey Substation. This cost does not include the Customer's 138/34.5 kV substation or the 34.5 kV, 26 MVAR capacitor bank(s).

Table 4 lists the Available Transfer Capability (ATC) associated with each overloaded facility. These values may be used by the Customer for future analyses including the determination of lower generation capacity levels that may be installed. When transmission service associated with this interconnection is evaluated, the loading of the facilities listed in this table may be greater due to higher priority reservations. If the loading of a facility is higher, the level of ATC will be lower.

There are several other proposed generation additions in the general area of the Customer's facility. It was assumed in this preliminary analysis that not all of these other projects within the SPS control area will be in service. Those previously queued projects that have advanced to nearly complete phases were included in this Feasibility Study. In the event that another request for a generation interconnection with a higher priority withdraws, then this request may have to be re-evaluated to determine the local Network Constraints.

Introduction

<OMITTED TEXT> (Customer) has requested a Feasibility Study for the purpose of interconnecting 130 MW of wind generation within the control area of OKGE in Dewey County, Oklahoma. The proposed point of interconnection is OKGE's Dewey Substation. The proposed in-service date is December 31, 2009.

Interconnection Facilities

The primary objective of this study is to identify the system problems associated with connecting the plant to the area transmission system. The Feasibility and other subsequent Interconnection Studies are designed to identify attachment facilities, Network Upgrades and other direct assignment facilities needed to accept power into the grid at the interconnection receipt point.

The requirements for interconnection of the 130 MW consist of adding a fourth line terminal to the proposed 138 kV ring bus scheduled to be built at Dewey. The project to rebuild the Dewey substation to a ring bus configuration is included in the current SPP Transmission Expansion Plan. The Customer did not propose a route of its 138 kV line to serve its 138/34.5 kV facilities. It is assumed that obtaining all necessary right-of-way for the substation construction will not be a significant expense.

The minimum estimated cost for the required interconnection facilities is $724,967. Other Network Constraints in the American Electric Power West (AEPW), Southwestern Public Service (SPS), Missouri Public Service (MIPU), Western Resources (WERE) and Western Farmers Electric Cooperative (WFEC) transmission systems that were identified are listed in Table 3. These estimates will be refined during the development of the impact study based on the final designs. This cost does not include building the 138 kV facilities from the Customer substation into the new 138 kV termination point. The Customer is responsible for these 138 kV facilities up to the point of interconnection. This cost also does not include the Customer's 138/34.5 kV substation or the 34.5kV, 26Mvar capacitor bank which should be determined by the Customer.

The costs of interconnecting the facility to the SPS transmission system are listed in Tables 1 and 2. **These costs do not include any cost that might be associated with short circuit study results or dynamic stability study results**. These costs will be determined when and if a System Impact Study is conducted.

A preliminary one-line drawing of the interconnection and direct assigned facilities are shown in Figure 1. The location of the interconnection facility is shown in Figure 2.

Table 1: Direct Assignment Facilities

FACILITY	ESTIMATED COST (2007 DOLLARS)
Customer – 138/34.5 kV Substation facilities.	*
Customer – 138 kV transmission line facilities between Customer facilities and the Dewey Substation.	*
Customer - Right-of-Way for Customer facilities.	
Customer – 34.5 kV, 26 MVAR capacitor bank(s) in Customer substation.	*
OKGE – Add 138 kV line terminal equipment including revenue metering at Dewey Substation	$589,697
Total	$589,697

Note: * Estimates of cost to be determined by Customer.

Table 2: Required Interconnection Network Upgrade Facilities

FACILITY	ESTIMATED COST (2007 DOLLARS)
OKGE – Add 138 kV circuit breaker, disconnect switches, and associated equipment at Dewey Substation	$135,000
Total	$135,000

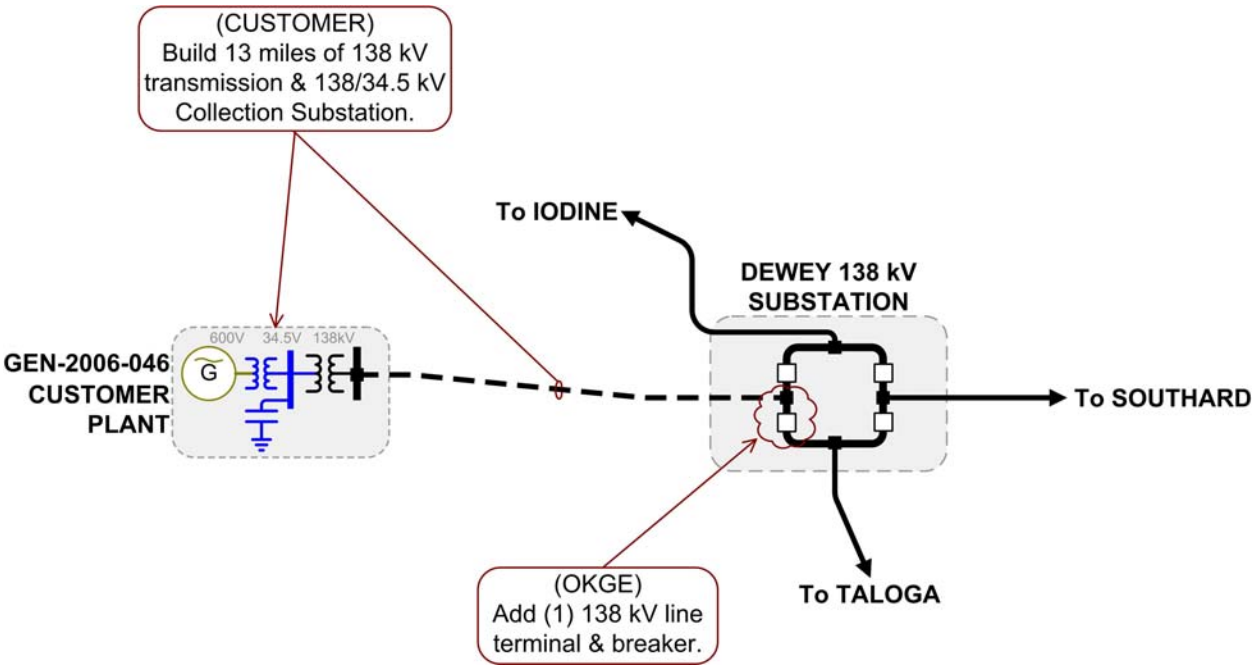

Figure 1: Proposed Interconnection
(Final substation design to be determined)

Powerflow Analysis

A powerflow analysis was conducted for the facility using modified versions of the 2009 and 2012 Winter Peak, and 2012 and 2017 Summer Peak models. The output of the Customer's facility was offset in each model by a reduction in output of existing online SPP generation. This method allows the request to be studied as an Energy Resource (ER) Interconnection request. The proposed in-service date of the generation is December 31, 2009. The available seasonal models used were through the 2017 Summer Peak which is the end of the current SPP planning horizon.

The analysis of the Customer's project indicates that, given the requested generation level of 130 MW and location, additional criteria violations will occur on the existing AEPW, SPS, WERE, MIPU, and WFEC transmission systems under steady state and contingency conditions in the peak seasons.

The Available Transfer Capability (ATC) associated with each overloaded facility is shown in Table 4. These values may be used by the Customer to determine lower generation capacity levels that may be installed. When transmission service associated with this interconnection is evaluated, the loading of the facilities listed in this table may be greater due to higher priority reservations. When a facility is overloaded for more than one contingency, only the highest loading on the facility for each season is included in the table.

In order to maintain a zero reactive power flow exchanged at the point of interconnection, additional reactive compensation is required at the point of interconnection. The Customer will be required to install 26 MVAR of capacitor banks on the 34.5 kV bus in its substation. Dynamic Stability studies performed as part of the impact study will provide additional guidance as to whether the reactive compensation can be static or a portion must be dynamic (such as a SVC or STATCOM). It is possible that an SVC or STATCOM device will be required at the Customer

facility because of FERC Order 661A Low Voltage Ride Through Provisions (LVRT) which went into effect January 1, 2006. FERC Order 661A orders that wind farms stay on line for 3 phase faults at the point of interconnection even if that requires the installation of a SVC or STATCOM device.

There are several other proposed generation additions in the general area of the Customer's facility. Some of the local projects that were previously queued were assumed to be in service in this Feasibility Study. Those local projects that were previously queued and have advanced to nearly complete phases were included in this Feasibility Study.

Powerflow Analysis Methodology

The Southwest Power Pool (SPP) criteria states that: "The transmission system of the SPP region shall be planned and constructed so that the contingencies as set forth in the Criteria will meet the applicable *NERC Planning Standards* for System Adequacy and Security – Transmission System Table l hereafter referred to as NERC Table l) and its applicable standards and measurements".

Using the created models and the ACCC function of PSS\E, single contingencies in portions of or all of the modeled control areas of Sunflower Electric Power Corporation (SUNC), Missouri Public Service (MIPU), Westar (WESTAR), Kansas City Power & Light (KCPL), West Plains (WEPL), Midwest Energy (MIDW), Oklahoma Gas and Electric OKGE, American Electric Power West (AEPW), Grand River Dam Authority (GRDA), Southwestern Public Service Company (SPS), Western Farmers Electric Cooperative (WFEC) and other control areas were applied and the resulting scenarios analyzed. This satisfies the 'more probable' contingency testing criteria mandated by NERC and the SPP criteria.

Table 3: Network Constraints

AREA	ELEMENT
MIPU	LAKE ROAD 161/34.5kV TRANSFORMER CKT1
MIPU	LAKE ROAD 161/34.5kV TRANSFORMER CKT2
OKGE	ALVA - KNOBHILL 69kV CKT1
OKGE-WFEC	WOODWARD - WOODWARD 69kV CKT1
SPS	MOORE COUNTY INTERCHANGE 230/115kV TRANSFORMER CKT1
WERE	EXIDE JUNCTION - NORTH AMERICAN PHILIPS 115kV CKT1
WERE	EXIDE JUNCTION - SUMMIT 115kV CKT1
WERE	NORTHVIEW - SUMMIT 115kV CKT1
WFEC	MOORELAND - MOREWOOD SW 138kV CKT1
WFEC	TALOGA 138/69kV TRANSFORMER CKT1
WFEC-AEPW	ELK CITY - MOREWOOD SW 138kV CKT1
WFEC-OKGE	GLASS MOUNTAIN - MOORELAND 138kV CKT1
AEPW	American Electric Power West
MIPU	Missouri Public Service
OKGE	Oklahoma Gas and Electric
SPS	Southwestern Public Service
WERE	Western Resources
WFEC	Western Farmers Electric Cooperative

Table 4: Contingency Analysis

ELEMENT	SEASON	RATE (MVA)	LOADING (%)	ATC (MW)	CONTINGENCY
2009 Winter Peak Model					
WOODWARD - WOODWARD 69KV CKT 1	09WP	38	207.2	0	FPL SWITCH - MOORELAND 138KV CKT 1
TALOGA 138/69KV TRANSFORMER CKT 1	09WP	56	136.9	40	DEWEY - SOUTHARD 138KV CKT 1
GLASS MOUNTAIN - MOORELAND 138KV CKT 1	09WP	124	116.7	42	DEWEY - SOUTHARD 138KV CKT 1
2012 Summer Peak Model					
ALVA - KNOBHILL 69KV CKT 1	12SP	48	112.2	0	GLASS MOUNTAIN - MOORELAND 138KV CKT 1
WOODWARD - WOODWARD 69KV CKT 1	12SP	38	175.6	0	FPL SWITCH - MOORELAND 138KV CKT 1
GLASS MOUNTAIN - MOORELAND 138KV CKT 1	12SP	124	118.1	23	DEWEY - SOUTHARD 138KV CKT 1
TALOGA 138/69KV TRANSFORMER CKT 1	12SP	56	142.9	27	DEWEY - SOUTHARD 138KV CKT 1
ELK CITY - MOREWOOD SW 138KV CKT 1	12SP	158	104.2	109	DEWEY - SOUTHARD 138KV CKT 1
MOORELAND - MOREWOOD SW 138KV CKT 1	12SP	130	100.4	127	BASE CASE
2012 Winter Peak Model					
WOODWARD - WOODWARD 69KV CKT 1	12WP	38	212.3	0	FPL SWITCH - MOORELAND 138KV CKT 1
TALOGA 138/69KV TRANSFORMER CKT 1	12WP	56	131.2	54	DEWEY - SOUTHARD 138KV CKT 1
GLASS MOUNTAIN - MOORELAND 138KV CKT 1	12WP	124	103.7	110	DEWEY - SOUTHARD 138KV CKT 1
2017 Summer Peak Model					
EXIDE JUNCTION - NORTH AMERICAN PHILIPS 115KV CKT 1	17SP	239	110.1	0	NORTHVIEW - SUMMIT 115KV CKT 1
EXIDE JUNCTION - SUMMIT 115KV CKT 1	17SP	211	130.0	0	NORTHVIEW - SUMMIT 115KV CKT 1
LAKE ROAD 161/34.5KV TRANSFORMER CKT 1	17SP	83	131.1	0	LAKE ROAD 161/34.5KV TRANSFORMER CKT 2
LAKE ROAD 161/34.5KV TRANSFORMER CKT 2	17SP	83	129.7	0	LAKE ROAD 161/34.5KV TRANSFORMER CKT 1
NORTHVIEW - SUMMIT 115KV CKT 1	17SP	196	130.6	0	EXIDE JUNCTION - SUMMIT 115KV CKT 1
WOODWARD - WOODWARD 69KV CKT 1	17SP	38	177.4	0	FPL SWITCH - MOORELAND 138KV CKT 1
ALVA - KNOBHILL 69KV CKT 1	17SP	48	111.7	1	GLASS MOUNTAIN - MOORELAND 138KV CKT 1
TALOGA 138/69KV TRANSFORMER CKT 1	17SP	56	144.8	23	DEWEY - SOUTHARD 138KV CKT 1
MOORELAND - MOREWOOD SW 138KV CKT 1	17SP	130	109.9	51	BASE CASE
ELK CITY - MOREWOOD SW 138KV CKT 1	17SP	158	113.8	55	DEWEY - SOUTHARD 138KV CKT 1
GLASS MOUNTAIN - MOORELAND 138KV CKT 1	17SP	124	112.6	56	MOORELAND - MOREWOOD SW 138KV CKT 1
MOORE COUNTY INTERCHANGE 230/115KV TRANSFORMER CKT 1	17SP	252	100.8	102	HERRING TAP - RIVERVIEW INTERCHANGE 115KV CKT 1
MOORELAND - MOREWOOD SW 138KV CKT 1	17SP	170	102.0	116	DEWEY - SOUTHARD 138KV CKT 1

Note: When transmission service associated with this interconnection is evaluated, the loading of the facilities listed in this table may be greater due to higher priority reservations. If the loading of a facility is higher, the level of ATC will be lower.

Conclusion

The minimum cost of interconnecting the Customer's interconnection request is estimated at $724,697 for Direct Assignment facilities and Network Upgrades listed in Tables 1 and 2. These costs exclude upgrades of other transmission facilities that were listed in Table 3 Network Constraints. At this time, the cost estimates for other Direct Assignment facilities including those in Table 1 have not been defined by the Customer. In addition to the Customer's proposed interconnection facilities, the Customer will be responsible for installing 26 MVAR of 34.5 kV capacitors in the Customer substation for reactive support. Dynamic stability analysis will determine if a portion of this should be dynamic (SVC). As stated earlier, some but not all of the local projects that were previously queued are assumed to be in service in this Feasibility Study.

In Table 4, a value of Available Transfer Capability (ATC) associated with each overloaded facility is included. These values may be used by the Customer to determine lower generation capacity levels that may be installed. When transmission service associated with this interconnection is evaluated, the loading of the facilities listed in this table may be greater due to higher priority reservations. When a facility is overloaded for more than one contingency, only the highest loading on the facility for each season is included in the table.

These interconnection costs do not include any cost that may be associated with short circuit or transient stability analysis. These studies will be performed if the Customer signs a System Impact Study Agreement.

The required interconnection costs listed in Table 2 and other upgrades associated with Network Constraints listed in Table 3 do not include all costs associated with the deliverability of the energy to final customers. These costs are determined by separate studies if the Customer requests transmission service through Southwest Power Pool's OASIS.

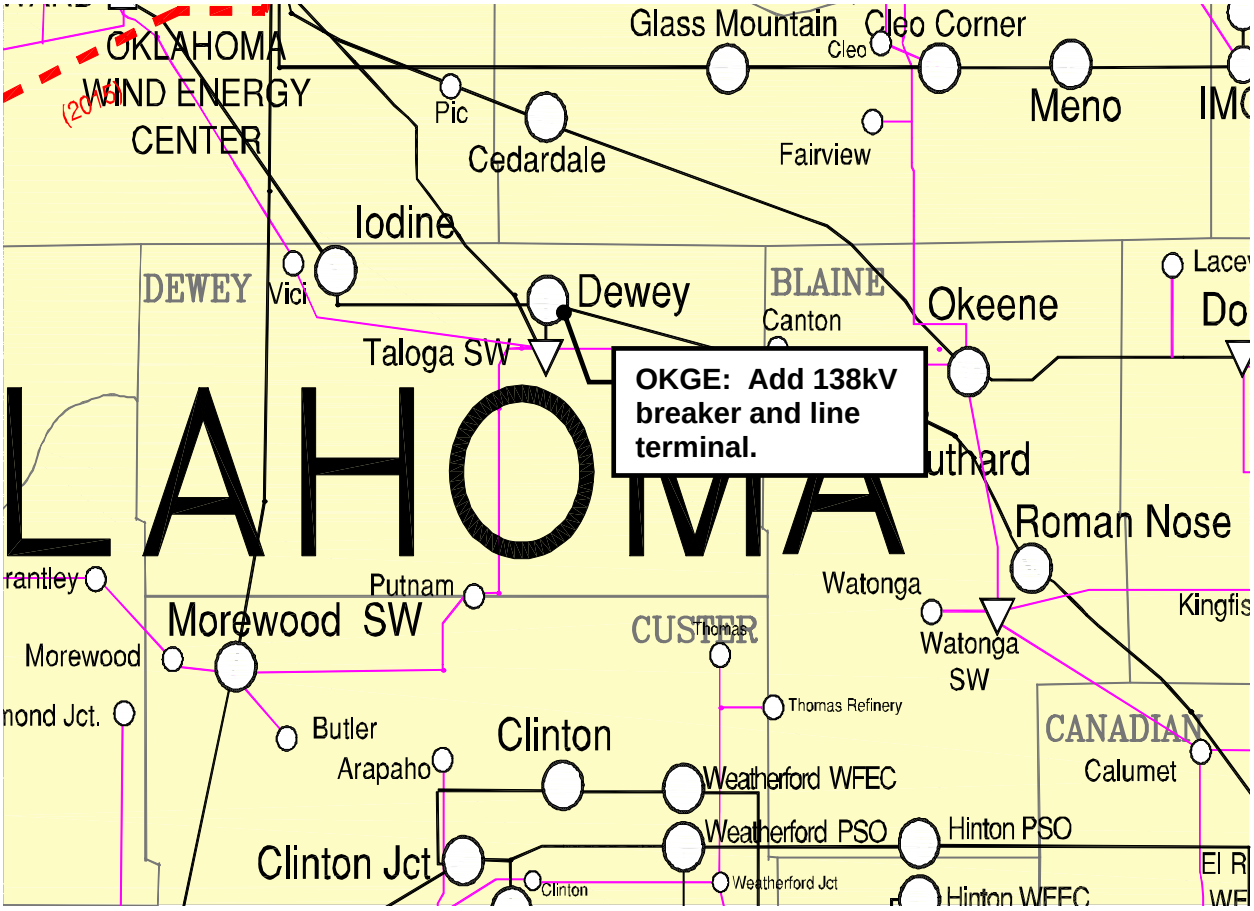

FIGURE 2. MAP OF THE LOCAL AREA