Southwest Power Pool

Feasibility Study For Generation Interconnection Request GEN-2003-019

SPP Tariff Studies
(#GEN-2003-019)

Revised June 30, 2004

Executive Summary

<OMITTED TEXT> (Customer) has requested a feasibility study for the purpose of interconnecting 250MW of wind generation within the service territory of Midwest Energy (MIDW) in Lincoln and Ellsworth County Kansas. The proposed point of interconnection is in the existing Summit – Knoll 230kV line at a new switching station located about 25 miles west of Salina, KS and in Ellsworth County north of Ellsworth, KS. This 230kV line is owned by MIDW and Westar Energy (WERE), and the proposed generation interconnect is with MIDW. The proposed in-service date is November 1, 2005.

Power flow analysis has indicated that for the powerflow cases studied, it is possible to interconnect the 250MW of generation with transmission system reinforcements within the local MIDW and WERE transmission systems. In MIDW's Knoll service area, insufficient capacity is available to transfer 250MW without substantial upgrades and maintain adequate bus voltages with an outage of the Summit – Customer Interconnnect 230kV line outage. With replacing the Knoll 230-115kV 120/200MVA transformer with a 170/280MVA unit and adding a 20MVAR switched capacitor bank at Knoll, switched capacitor banks are still required at the Customer's facilities.

Two of 20MVAR capacitor banks plus other switched banks for a total of 60MVAR are required at the Customer's facilities if a 20MVAR SVC is installed. If an SVC is not required per the impact study, then at least 20MVAR of additional switched capacitor banks will be required at the customer's 34kV facilities. A capacitor bank of no more than 20MVAR may be installed at 230kV. Dynamic Stability studies performed as part of the impact study will provide guidance as to how much additional dynamic reactive compensation may be needed.

The requirements for interconnection consist of adding a 230kV switching station. This 230kV addition shall be constructed and maintained by MIDW. The Customer did not propose a specific 230kV line extending to serve its 230-34.5kV facilities. It is assumed that obtaining all necessary right-of-way for the necessary substation additions in the WERE Summit – MIDW Knoll 230kV line will not be a significant expense.

The total cost for adding the 230kV switching station, the interconnection facility, is estimated at $3,500,000. In addition, a 230kV 20MVAR capacitor bank and a 230-115kV 280MVA autotransformer will be required as Network Upgrades in MIDW's Knoll Substation at an estimated cost of $3,200,000. Other Network Upgrades in the WERE system are required that are listed in Table 1. Therefore, the total estimated cost to the Customer is $25,600,000. This cost does not include building 230kV line from the Customer substation into the new MIDW switching station. This cost does not include the Customer's 230-34.5kV substation.

There are several other proposed generation additions in the general area of the Customer's facility. It was assumed in this preliminary analysis that all of these other projects within MIDW's and WERE's service territory will be in service. Those

previously queued projects that have advanced to nearly complete phases were included in this feasibility study.

The Customer also requested a review of an alternative generation level. With only 190MW of generation at the requested location, the requirements of Network Upgrades are significantly reduced. Included in Tables 4 and 5 are the minimum requirements for interconnection. The number of capacitor bank requirements and additional reactive power generation, referred to as an SVC, at the Customer site are also reduced for an outage of the Summit – Customer POI 230kV line. The estimated costs for Network Upgrades are $8,540,000. These costs do not include any cost that might be associated with dynamic stability study results. These costs will be determined when and if a System Impact Study is conducted.

Introduction

<OMITTED TEXT> (Customer) has requested a feasibility study for the purpose of interconnecting 250MW of wind generation within the service territory of Midwest Energy in Lincoln and Ellsworth County Kansas. The existing Summit – Knoll 230kV line is owned by MIDW and WERE, and the proposed generation interconnect is with MIDW. The proposed point of interconnection is at a new 230kV switching station. The proposed in-service date is November 1, 2005.

Interconnection Facilities

The primary objective of this study is to identify the system problems associated with connecting the plant to the area transmission system and estimated costs of system modifications needed to alleviate the system problems.

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 consist of adding a 230kV switching station. This 230kV addition shall be constructed and maintained by MIDW. The Customer did not propose a route of its 230kV line to serve its 230-34.5kV facilities. It is assumed that obtaining all necessary right-of-way for the new MIDW 230kV switching station will not be a significant expense.

The total cost for MIDW to add the new 230kV switching station, the interconnection facility, in the existing Summit – Knoll 230kV line is estimated at $3,500,000. In addition, a 20MVAR capacitor bank and a 230-115kV 170/280MVA autotransformer will be required as Network Upgrades in MIDW's Knoll Substation at an estimated cost of $3,200,000. Other Network Upgrades in the WERE system are required that are listed in Table 1. Therefore, the total estimated cost to the Customer is $25,600,000. These estimates will be refined during the development of the impact study based on the final designs. This cost does not include building 230 kV line from the Customer substation into the new MIDW switching station. The Customer is responsible for this 230kV line up to the point of interconnection. This cost does not include the

Customer's 230-34.5kV substation and the cost estimate should be determined by the Customer.

The costs of interconnecting the facility to the MIDW and WERE transmission systems 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.

Table 1: Network Upgrade Facilities

Facility	ESTIMATED COST (2004 DOLLARS)
MIDW - Ellsworth 230kV 3 terminal ring switching station addition in existing Summit – Knoll 230kV line.	$3,500,000
MIDW – Knoll 20MVAR capacitor bank addition.	750,000
MIDW – Knoll 230-115kV autotransformer replacement with 280MVA unit.	2,450,000
WERE - Auburn 230-115 kV transformer #2 addition.	2,250,000
WERE - Exide Junction - Summit 115kV rebuild and reconductor 4.94 miles with 1192 ACSR.	1,100,000
WERE - Goodyear Junction - Northland 115kV rebuild of 3.44-mile line.	940,000
WERE – Jeffrey Energy Center - Hoyt 345 kV line upgrade to a minimum of 1,093MVA.	14,000,000 *
WERE - Northview - Summit 115kV uprating of line to 100oC and replace wave trap.	610,000
Total	**$25,600,000**

Note: * Estimate of cost to be updated by the Transmission Owner based on the results of a sag analysis that may be completed during the development of an impact study. This estimate does not include re-dispatch expenses that may be required. Upgrading during the spring and fall seasons is assumed and only when the Jeffrey Energy Center is down for maintenance.

Table 2: Direct Assignment Facilities

Facility	ESTIMATED COST (2004 DOLLARS)
Customer - 230-34.5 kV Substation facilities.	*
Customer - 230kV line between Customer substation and new MIDW 230kV switching station.	*
Customer - Right-of-Way for Customer Substation & Line.	*
Customer – Switched capacitor banks, 20MVAR at 230kV, 20MVAR at 34.5kV bus, and other 34.5kV feeder locations totaling 20MVAR.	*
Customer – 20MVAR SVC at Customer facilities.	*
Total	*****

Note: * Estimates of cost to be determined by Customer.
Switched capacitor banks plus additional reactive power generation, currently noted as an SVC, are required to maintain adequate voltages for an outage of the Summit – Customer Interconnection 230kV line.

Table 3: Contingency Analysis Results

Facility	Contingency	Facility Loading (% Rate B) Or Voltage (PU)
MIDW – Knoll 20MVAR capacitor bank addition. Low voltage is at Knoll and Customer facilities.	Summit – Customer Interconnection 230kV	Below 0.9 pu V
MIDW – Knoll 230-115kV autotransformer replacement with 280MVA unit.	Summit – Customer Interconnection 230kV	125
WERE - Auburn 230-115 kV transformer #2 addition. Overloaded facility is the Auburn 230-115 kV transformer.	Auburn Road - Swissvale 230kV	100.9
WERE - Exide Junction - Summit 115kV rebuild and reconductor 4.94 miles with 1192 ACSR.	East McPherson – Summit 230kV	106.8
WERE - Goodyear Junction - Northland 115kV rebuild of 3.44-mile line.	Hoyt - Stranger Creek 345kV	103.9
WERE – Jeffrey Energy Center - Hoyt 345 kV line upgrade to a minimum of 1,093MVA.	Auburn Road – Jeffrey Energy Center 230kV	101.5
WERE - Northview - Summit 115kV uprating of line to 100oC and replace wave trap.	Exide Junction - Summit 115kV	100.5

Note: Listed loading of each facility is the highest value when an operating guide is not applicable.

Powerflow Analysis

A powerflow analysis was conducted for the facility using modified versions of the 2005 April, 2005, 2007 and 2010 Summer and Winter Peak models. The output of the Customer's facility was offset in each model by a reduction in output of existing online SPP generation. The proposed in-service date of the generator is November 1, 2005. The available seasonal models used were the 2005 April and 2005 through 2010 peak models. This is the end of the current SPP planning horizon.

The analysis of the Customer's project indicates that, given the requested generation level of 250MW and location, additional criteria violations will occur on the existing MIDW and WERE facilities under steady state conditions in all seasons out to the end of SPP's planning horizon. Therefore, a 20MVAR capacitor bank and 230-115kV autotransformer upgrade will be required as Network Upgrades in MIDW's Knoll Substation.

In addition to maintain adequate bus voltages at the Customer site and Knoll 230kV, the customer will need to install 60MVAR of switched capacitor banks primarily at 34kV and a 20MVAR SVC at the Customer facilities. A capacitor bank of no more than 20MVAR may be installed at 230kV. Without the SVC given an outage of the Summit – Customer POI 230kV line, voltage collapse may occur as synchronous machines are not used at the wind farm to regulate voltage magnitude. If the LTC tap position of the Knoll 230-115kV autotransformer is not held at the pre-contingency position for this outage, additional reactive support is required.

There are several other proposed generation additions in the general area of the Customer's facility. Previously queued projects were assumed to be in service in this feasibility study. Those previously queued projects that 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 SPP were applied and the resulting scenarios analyzed. This satisfies the 'more probable' contingency testing criteria mandated by NERC and the SPP criteria.

Requirements With 190MW

With only 190MW of generation at the requested location, the requirements of Network Upgrades are significantly reduced. Included in Tables 4 and 5 below are the minimum requirements for interconnection. The number of capacitor bank requirements and additional reactive power generation, referred to as an SVC, at the Customer site are also reduced for an outage of the Summit – Customer POI 230kV line. The estimated

costs for Network Upgrades are $8,540,000. **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.

Table 4: Network Upgrade Facilities To Accommodate 190MW Of Generation

Facility	ESTIMATED COST (2004 DOLLARS)
MIDW - Ellsworth 230kV 3 terminal ring switching station addition in existing Summit – Knoll 230kV line.	$3,500,000
MIDW – Knoll 20MVAR capacitor bank addition.	750,000
WERE - Auburn 230-115 kV transformer #2 addition.	2,250,000
WERE - Exide Junction - Summit 115kV rebuild and reconductor 4.94 miles with 1192 ACSR.	1,100,000
WERE - Goodyear Junction - Northland 115kV rebuild of 3.44-mile line.	940,000
Total	**$8,540,000**

Table 5: Direct Assignment Facilities To Accommodate 190MW Of Generation

Facility	ESTIMATED COST (2004 DOLLARS)
Customer - 230-34.5 kV Substation facilities.	*
Customer - 230kV line between Customer substation and new MIDW 230kV switching station.	*
Customer - Right-of-Way for Customer Substation & Line.	*
Customer – Switched capacitor banks, 20MVAR at 230kV, 20MVAR at 34.5kV bus.	*
Total	*****

Note: * Estimates of cost to be determined by Customer.
Switched capacitor banks are required to maintain adequate voltages for an outage of the Summit – Customer Interconnection 230kV line.

Conclusion

The minimum cost of interconnecting the Customer 250MW project is estimated at $25,600,000 for MIDW's interconnection facilities including an autotransformer upgrade and capacitor bank at Knoll as well as other transmission upgrades by WERE listed in Table 1 of which are Network Upgrades. At this time, the cost estimates for other Direct Assignment facilities have not been defined by the Customer. As stated earlier, previously queued projects were assumed to be in service in this feasibility study.

With only 190MW of generation at the requested location, the requirements of Network Upgrades to interconnect are significantly reduced to an estimated cost of $8,540,000. The requirements for reactive power generation resources at the Customer site are also reduced given an outage of the Summit – Customer Interconnect 230kV line. The Customer's request to analyze the project at 150MW has the same outcome and estimated cost of interconnecting 190MW of generation.

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 costs do not include any 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.

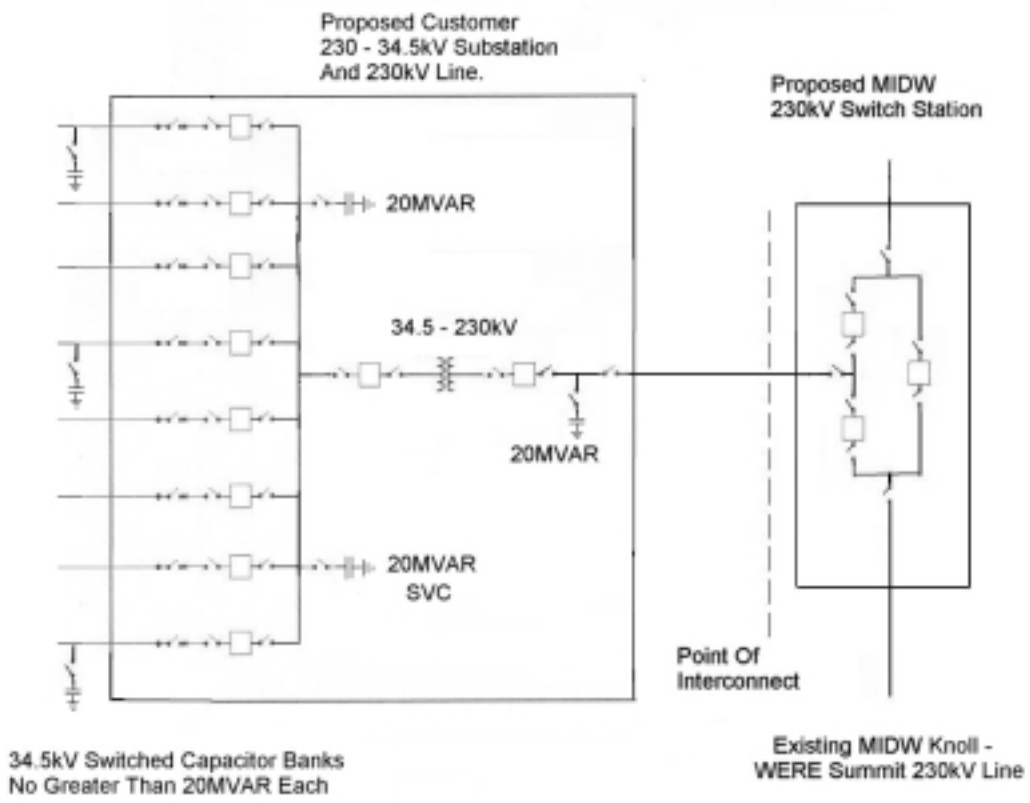

Figure 1: Proposed 250MW Interconnection
(Final substation design to be determined)

Figure 2: Map Of The Surrounding Area