FEASIBILITY STUDY FOR
»Text Omitted«

240 MW Wind Farm On Circuit V68
Hansford County, Texas
SPP #GEN-2002-009

Xcel Energy Services, Inc.
Transmission Planning

October 31, 2002

Executive Summary

»Text Omitted« pursuant to the Southwest Power Pool (SPP)
Open Access Transmission Tariff (OATT) has requested a feasibility study for the purpose of interconnecting 240 MW of wind generation on the Xcel Energy transmission system. This wind generation project is in addition to one that was requested by »Text Omitted« under SPP #GEN-2002-008. The proposed interconnection point of this second wind farm is on the Southwestern Public Service Company (SPS) 115kV circuit V68. The interconnection point on this 115 kV transmission circuit is located approximately 1.7 miles south of the Texas-Oklahoma state line.

In a meeting with the customer, the customer recognized that an additional 240 MW of generation, connected to this 115kV circuit, might not be possible without significant transmission system reinforcements. It was the customer's request therefore, that the maximum allowable generation up to 240 MW be explored in this feasibility study. In so doing, powerflow analysis indicated that an additional 65 MW of generation, in addition to that in SPP #GEN-2002-008, could be connected to the 115kV circuit V68 without significant improvements to the local transmission system for the cases studied. This 65 MW however, does not address reinforcements deemed necessary as a result of the outcome of a Dynamic Stability Analysis. Stability Analysis may determine a need for system reinforcements that could not be determined by powerflow analysis, and this type of analysis is typically performed during the System Impact Study.

The requirements to interconnect this additional generation consist of tapping the 115kV SPS transmission circuit V68 and building one 115kV interconnection facility configured in a Ring-Bus. The facility will have three (3) 115kV line terminals to Spearman Interchange, Texas County and the »Text Omitted« wind farm. In addition, a new 115kV transmission line may be required from the Xcel Energy interconnection facility to the wind farm, having an estimated distance of one thousand feet to the wind farm interconnection point.

The total cost for this one 115kV interconnection facility is estimated at $1.32 million dollars, based on estimates provided by our engineering department. The cost includes the 115kV interconnection facility and one thousand feet of 115kV transmission line to the wind farm interconnection point, inclusive of right of way.

This feasibility study takes into account system reinforcements and system impacts triggered by other generation projects that are positioned ahead in the queue. In the event that the system reinforcements triggered by these other projects are not built, this feasibility study may have to be re-visited, changing the requirements necessary for interconnecting this second »Text Omitted« wind farm on circuit V68.

This study examines the feasibility of interconnecting this additional »Text Omitted« wind generation on the local Xcel Energy transmission system and does not address any issues that exist in determining the available transmission capacity. In order to determine the available transmission capacity, the customer needs to request transmission service through the SPP OASIS.

Introduction

»Text Omitted« is proposing the interconnection of additional wind generation in the northern part of the Texas Panhandle with a scheduled in-service date of October 31, 2003. This farm will interconnect to an existing 115 kV transmission line currently owned by Xcel Energy, Inc. The farm will consist of approximately 132 to 159 individual wind turbine generators (WTGs) having a net generation capacity of 1.8 MW or 1.5 MW, respectively. The request as submitted to the SPP is for 240 MW of wind generation interconnecting to the 115kV SPS circuit V68. In a meeting with the customer, the customer recognized that the possibility of trying to interconnect an additional 240 MW of wind generation could trigger significant system reinforcements in the Texas Panhandle. Based on the discussions, the customer requested that the transmission owner investigate the level of acceptable generation that could be added, in addition to that in SPP #GEN-2002-008, without requiring significant system reinforcements.

The primary objective of this study was to determine the level of acceptable generation (up to 240 MW) that could be added to the system without causing adverse system impacts. In addition, this study addresses the issues of required construction inclusive of estimated costs, which are associated with the interconnection of this additional generation to the Xcel Energy transmission system.

Study Approach

This study uses the 2003 Fall and Winter Peak Models, the 2004 April Minimum and Summer Peak Models and the 2005 Summer Peak Model as presented to the SPP in January of 2002. In addition, a 2004 Summer Peak Model was developed using the 2003 Summer Peak Model (as presented to the SPP in January 2002) by scaling the 2003 summer peak load in Area 526 (SPS). Modifications to these models include all the new generation projects in the area and necessary system reinforcements triggered by these generation projects, which are positioned ahead in the queue.

The transmission system of primary concern in this feasibility study includes the Texas Panhandle excluding the Amarillo Metro area and all the Xcel Energy transmission system south of the Amarillo Metro area.

This powerflow study was performed using the Power Technologies, Inc. (PTI) Power System Simulator/Engineering (PSS/E) program and contains a steady-state analysis using AC Contingency Checking (ACCC) with a Fixed Slope Decoupled Newton–Raphson (FDNS) solution. Thermal and voltage limit checks are set in accordance with SPP criteria, which state that for system intact conditions bus voltages must be maintained between 0.95 – 1.05 per-unit of their nominal value. Under single element contingencies, the voltages are allowed to deviate between 0.90 – 1.05 per-unit of their nominal value. Thermal limit checks are comprised of both an A-rating and a B-rating. The A-rating is for system intact conditions, while the B-rating is an emergency rating for single element contingencies.

A comparative study approach was used in determining impacts caused by the interconnection of this additional wind generation for each of the respective cases. All base cases include the proposed system reinforcements associated with projects

positioned ahead in the queue including the »Text Omitted« wind generation in SPP #GEN-2002-008 for the respective year/season studied. All additional cases have the additional 65 MW of »Text Omitted« wind generation in service, and single element contingency violations within these cases were compared to the respective base case.

Results

The results from this study include general findings from the interconnection of the requested 240 MW and the steps taken to determine the level of generation (65 MW) that the local transmission system would permit, without the need for additional transmission system reinforcements. The addition of 240 MW of additional generation resulted in numerous low bus voltage violations and thermal overloading on the 115kV circuit V68 during system intact conditions. Single element contingencies produced countless low bus voltage conditions in the presence of numerous thermal violations. The more detrimental contingencies were those that resulted in non-convergence due to voltage collapse in the Texas Panhandle. As a result, forty-two (42) single element contingencies triggered non-convergent results. An inexpensive solution to interconnect all the 240 MW of generation was explored; however, all leads pointed to the construction of new transmission lines. This was due in part to the installation of a 500 MVAR Static VAR Compensator (SVC) connected to the 115kV bus at the wind farm that did not provide the necessary support to eliminate all the non-convergent results. With the installation of this SVC, eleven non-convergent contingencies were still present. The lack of “highway” lines emanating from this part of the Xcel Energy transmission system will need to be addressed in order to accommodate the additional generation.

To mitigate these non-convergent contingencies without building new transmission system reinforcements, the generation at this »Text Omitted« wind site was scaled down until a solution for each of these non-convergent contingencies was achieve during a full ACCC solution. The acceptable generation level resulted in 65 MW that could be added without the need for additional reinforcements. The only way to interconnect the remaining 175 MW of generation will be to build new transmission lines.

Interconnection Requirements

The minimal requirements for the interconnection of the wind farm are the construction of a new 115 kV interconnection facility approximately 1.7 miles south of the Texas-Oklahoma state line tapping circuit V68. A new 115 kV transmission line approximately 1000 feet in length may be required for interconnection of the wind farm to the Xcel Energy transmission system. In addition, the wind farm needs to be sufficiently compensated so that the reactive power required by the wind farm for all respective levels of generation is supplied locally and not by the transmission owner.

Conclusion

Based on the results of this study, it is feasible to interconnect 65 MW of the proposed 240 MW wind farm to the existing Xcel Energy transmission system without the need for additional transmission system reinforcements. Depending on how much additional generation is requested, new transmission lines may be required in addition to some

sort of dynamic VAR compensation to maintain acceptable voltage and prevent voltage collapse in the Texas Panhandle.

Estimated Costs

Table 1 below lists costs associated with the interconnection of the 240 MW wind farm.

Table 1, Wind Farm Interconnection Costs

Estimated Costs	Cost
New 115 kV Interconnection Facility[1]	$ 1,086,809
1000' Of New 115 kV Transmission Line[2]	$ 160,000
Right-Of-Way	$ 69,000
Total	***$ 1,315,809***

[1] The cost includes three (3) 115kV breaker line terminals, and associated equipment (control house, relays, metering, labor, etc.)

[2] Transmission line from the wind farm to the new switching station. The cost is estimated for 1000 feet of 115 kV transmission line assuming no corner structures (i.e. straight line) are required. Cost to be adjusted accordingly pending exact configuration and location of site.

Drawings

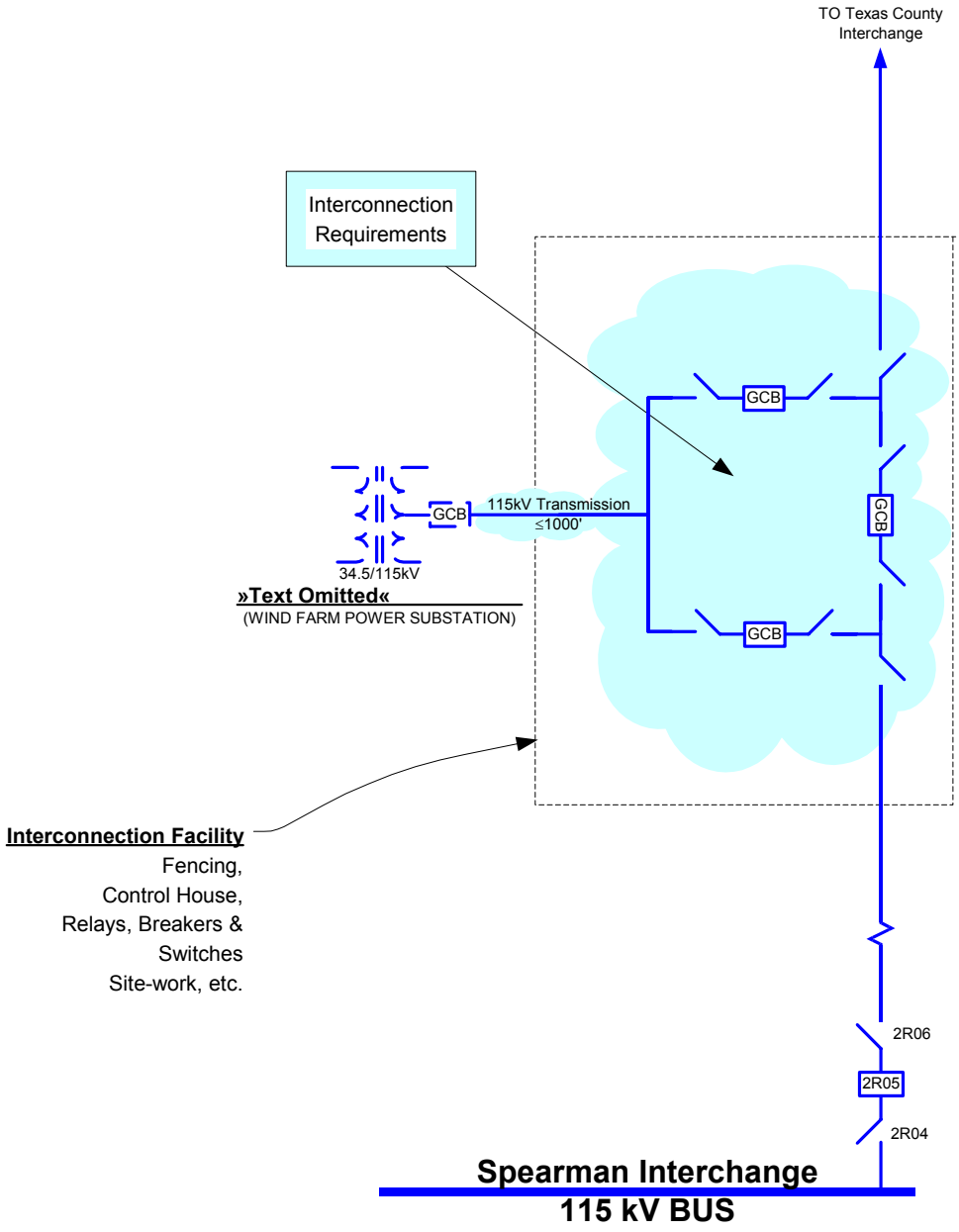

Figure 1, One-line Diagram of 115kV Interconnection Facility.

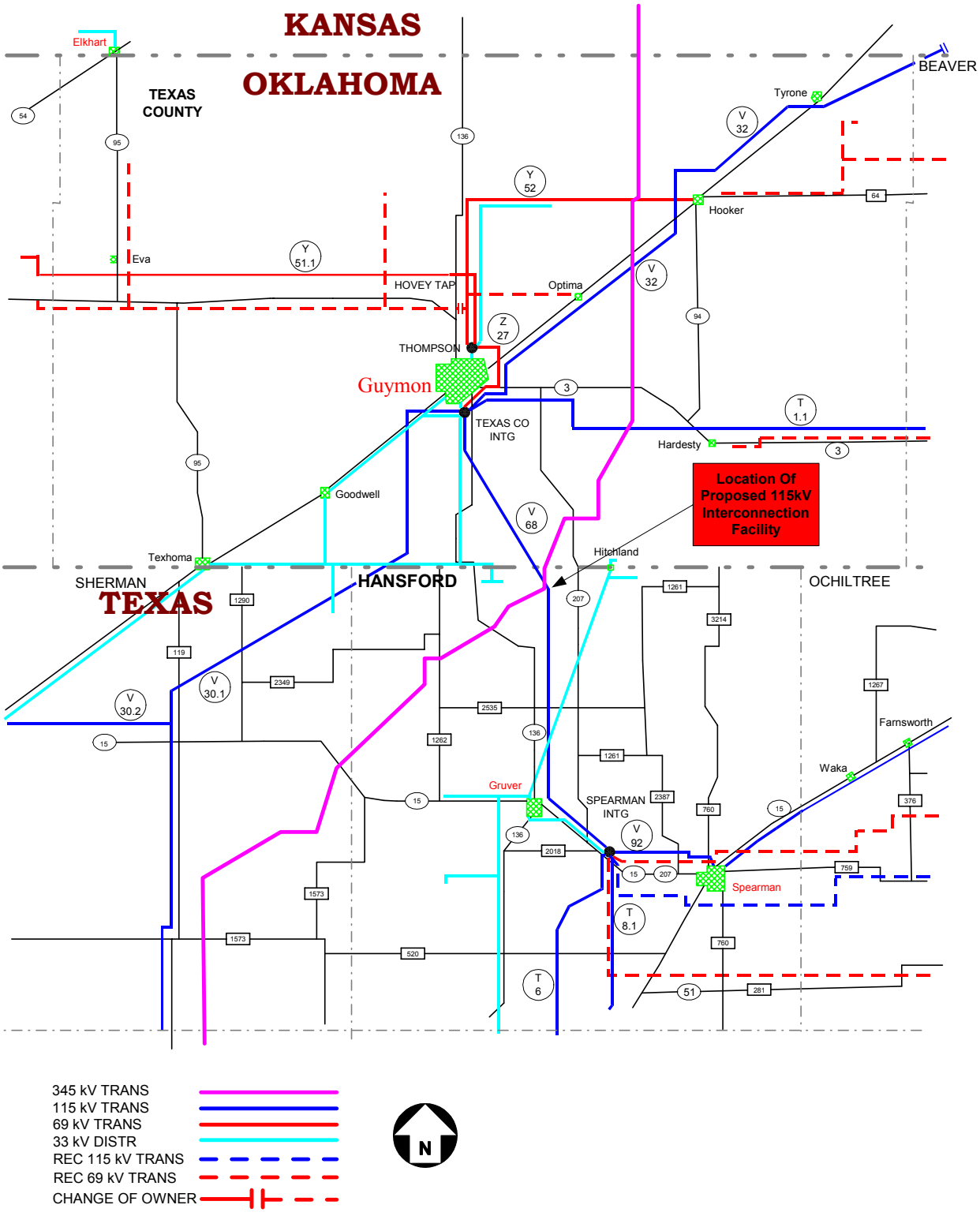

Figure 2, Local Transmission System