FEASIBILITY STUDY FOR
»Text Omitted«

240 MW Wind Farm On Circuit J03
Hansford County, Texas
SPP #GEN-2002-008

Xcel Energy Services, Inc.
Transmission Planning

October 15, 2002

Executive Summary

»Text Omitted« has requested a feasibility study for the purpose of interconnecting a 240 MW wind farm in Hansford County, Texas. The proposed interconnection is on the 345 kV transmission circuit J03, originating from Amarillo, Texas and terminating at Finney Switching Station in Kansas. The interconnection point on this 345 kV transmission circuit is located approximately 1.4 miles south of the Texas-Oklahoma state line.

Powerflow analysis indicates that the interconnection of this 240 MW wind farm does not cause new thermal overloads within the local transmission system. However, voltage on the 345 kV bus at the interconnection facility did exceed the maximum voltage limit during contingencies. To maintain acceptable voltage values, line reactors will be required on the 345 kV transmission lines terminating at the interconnection facility. The cost and final sizing of these reactors will be determined by an EMTP[1] study to be conducted upon the signing of an Interconnection Agreement.

The requirements for interconnection consist of tapping the Xcel Energy 345 kV transmission circuit and building one 345 kV interconnection facility configured in a Ring-Bus. The facility will have three 345 kV line terminals to Potter County Interchange, Finney Switching Station and the »Text Omitted« wind farm. Switchable line reactors will be installed on the 345 kV lines to Potter County and Finney County at the interconnection facility. To interconnect the wind farm to the proposed 345 kV interconnection facility, it is assumed that a new 345 kV transmission line may be required, with the interconnection point at wind farm being located within one thousand feet of the new Xcel Energy 345 kV interconnection facility. A Certificate of Convenience and Necessity from the Public Utility Commission of Texas may be required. In addition, this new 345kV interconnection facility could be built at a location adjacent to the 345kV circuit J03 between Site 1 and Site 2A to better accommodate the interconnection of both sites.

The total cost for this one 345 kV interconnection facility is estimated at $5.7 million dollars, which is based on estimates provided by our engineering department. The cost includes the new 345 kV interconnection facility tapping circuit J03 and one thousand feet of 345 kV transmission line from the switching station to the wind farm interconnection point, inclusive of right-of-way.

This feasibility study takes into account system reinforcements triggered by other generation projects that are positioned ahead in the queue. In the event that the system reinforcements triggered by other projects are not built, this feasibility study may have to be re-visited, changing the requirements necessary for interconnecting the »Text Omitted« 240 MW wind farm.

This study examines the feasibility of interconnecting the new »Text Omitted« 240 MW wind farm 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 Southwest Power Pool (SPP) OASIS.

[1] Electro-Magnetic Transient Program

Introduction

»Text Omitted« is proposing the interconnection of a 240 MW wind farm 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 345 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 primary objective of this study was to determine the feasibility of interconnecting the facility and the level of acceptable generation (up to 240 MW) that could be added to the system without causing adverse impacts. In addition, this study addresses the issues of required construction inclusive of estimated costs, which are associated with the interconnection of this 240 MW wind farm 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 the 240 MW wind farm for each of the respective cases. All base cases include the proposed system reinforcements associated with projects positioned ahead in the queue for the respective year/season studied. All additional cases have the »Text Omitted« wind farm in service, and single element contingency violations within these cases were compared to their respective base case.

Results

The single element contingency analysis performed for this study did not indicate increased values in contingency loading on transmission circuits in the local area. In addition, new thermal overloads were non-evident in the local transmission system. High bus voltage, however, was noticed at the interconnection facility during contingencies. Some of the contingencies and the voltage values are noted below:

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CONTINGENCY: SINGLE 141
OPEN LINE FROM BUS 50887 [POTTRC6 230.00] TO BUS 50888 [POTTRC7 345.00] CKT 1
                         X------ BUS -----X V-CONT V-INIT  X------ BUS -----X V-CONT V-INIT
VOLTAGE GREATER THAN 1.0500: 99991 »Text Omitted«-TP 7 345 1.0633 1.0465

CONTINGENCY: SINGLE 223
OPEN LINE FROM BUS 50858 [FINNEY7 345.00] TO BUS 56449 [HOLCOMB7345.00] CKT 1
                         X------ BUS -----X V-CONT V-INIT  X------ BUS -----X V-CONT V-INIT
VOLTAGE GREATER THAN 1.0500: 50858 FINNEY7  345 1.0901 1.0239  99991 »Text Omitted«-TP 7 345 1.0909 1.0465
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Interconnection Requirements

The minimal requirements for the interconnection of the wind farm are the construction of a new 345 kV interconnection facility approximately 1.4 miles south of the Texas-Oklahoma state line tapping circuit J03. A new 345 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 is supplied locally for all respective levels of generation and not by the transmission owner.

Conclusion

Based on the results of this study, it is feasible to interconnect the 240 MW wind farm to the existing Xcel Energy transmission system without causing any new thermal overloads. However, the interconnection of the wind farm will result in high voltage at the interconnection facility during some contingencies. To maintain acceptable voltage levels at the interconnection facility, the installation of switched line reactors will be required.

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 345 kV Interconnection Facility[2]	$ 5,297,442
1000' Of New 345 kV Transmission Line[3]	$ 285,000
Right-Of-Way	$ 116,000
Total	***$ 5,698,442***

[2] The cost includes three (3) 345kV breaker line terminals, and associated equipment (control house, relays, metering, labor, etc.)
[3] Transmission line from the wind farm to the new switching station. The cost is estimated for 1000 feet of 345 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

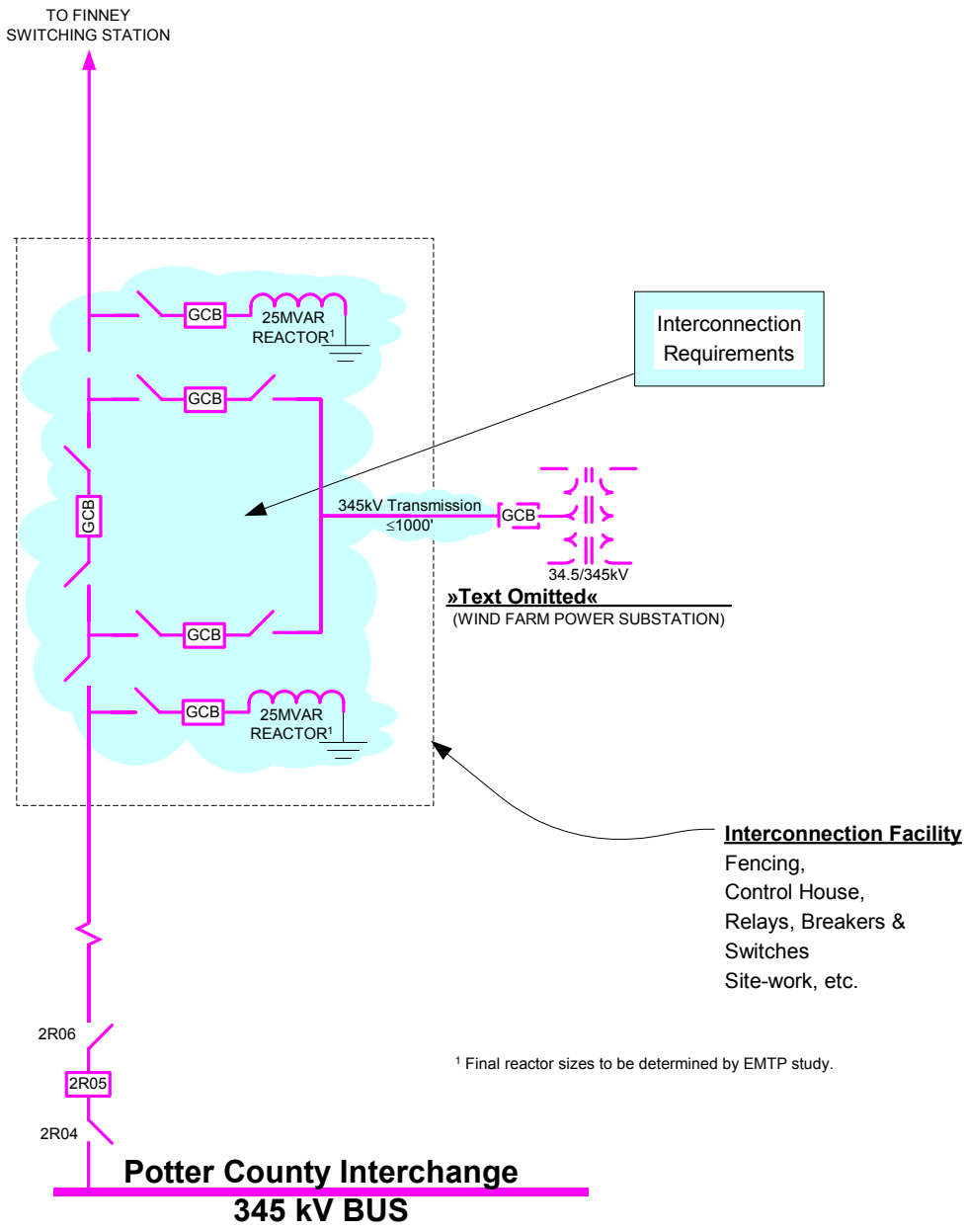

Figure 1, One-line Diagram of the 345 kV Interconnection Facility.

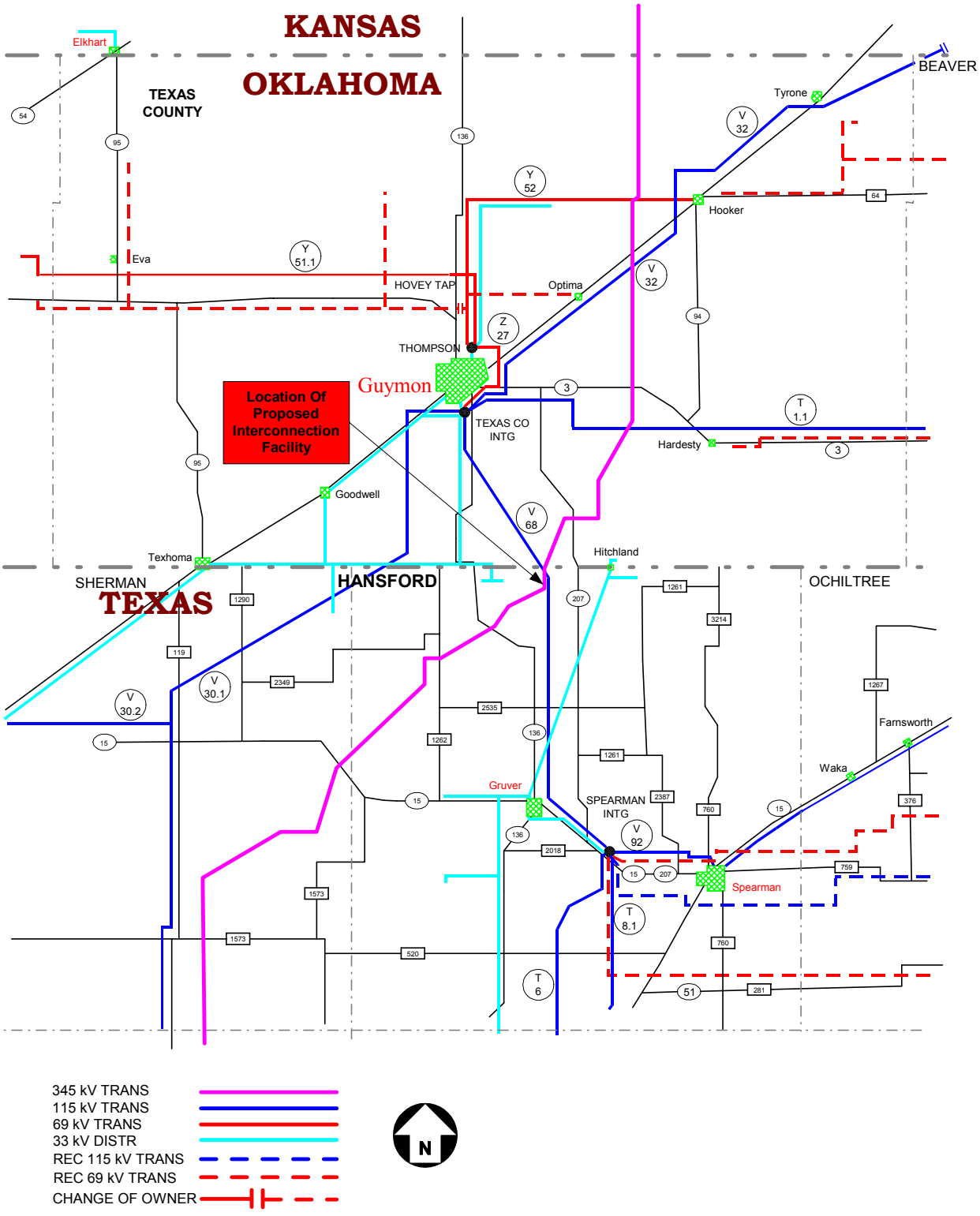

Figure 2, Local Transmission System