FEASIBILITY STUDY FOR
>OMITTED TEXT<

>Omitted Text<
SPP #GEN-2002-007

Xcel Energy Services, Inc.
Transmission Planning

December 13, 2002

Executive Summary

>Omitted Text< has requested a feasibility study for the purpose of interconnecting an 1100 MW wind farm in phases over a 5 year span near Dumas, Texas. The proposed interconnection was on the 230 kV and 345 kV circuits that run parallel to each other and are located northeast of Dumas, Texas. Both of these circuits terminate at Potter County Interchange (near Amarillo, Texas). The other end of the 230 kV circuit is terminated at Moore County Interchange, while the 345 kV circuit is terminated at Finney Switching Station (near Holcomb, Kansas). The 230 kV interconnection point is located approximately 5.7 miles south of Moore County Interchange, and the 345 kV interconnection point is located approximately 46.4 miles north of Potter County Interchange.

Powerflow analysis indicates that the interconnection of Phase 1 or 200 MW on the 230 kV network will cause the existing 230/115 kV transformer at Moore County Interchange to overload under system intact conditions. The interconnection of Phase 2 or 400 MW on the 230 kV network will cause overloads to occur at Moore County Interchange and will require a 2nd 230/115 kV transformer, along with a new 230 kV circuit between Pringle Interchange and Moore County Interchange. The interconnection of Phase 3 or 400 MW on the 230 kV network and 200 MW to 450 MW on the 345 kV network does not cause new thermal overloads within the local transmission system. However, the scheduling of the proposed 345 kV circuit from Potter County Interchange to Clovis Station will become critical to the timing of this phase of the project. The interconnection of the Final Phase or 400 MW on the 230 kV network and 700 MW on the 345 kV network indicates that for three single element contingencies, a solution could not be found. At this level, additional lines will be required to disperse the generation outside of this immediate area.

The requirements for Phase 1 of the 230 kV interconnection consist of intercepting the Xcel Energy 230 kV transmission circuit, and building one 230 kV interconnection facility that utilizes a three (3) breaker ring-bus configuration. The facility will have three (3) 230 kV line terminals: One to Potter County Interchange, one to Moore County Interchange, and one to the >Omitted Text< wind farm. The 230/115 kV transformer at Moore County Interchange will have to be replaced with larger capacity transformer. To connect the wind farm to the proposed 230 kV interconnection facility, approximately 2.8 miles of new 230 kV circuit will have to be constructed using 795 ACSR as the conductor type. A Certificate of Convenience and Necessity from the Public Utility Commission of Texas will be required for this circuit.

The requirements for Phase 2 of the 230 kV interconnection consist of constructing a 230 kV four (4) breaker ring-bus and adding a 2nd 230/115 kV transformer at Moore County Interchange. To increase the reliability in the area the 115 kV side of this transformer will be connected to the west 115 kV bus. In addition, a new 230 kV circuit between Moore County Interchange and Pringle Interchange will be required. At Pringle Interchange a straight 230 kV bus will have to be constructed using two (2) 230 kV breakers. The 230 kV circuit will be approximately 35 miles long and will use 795 ACSR as the conductor. A Certificate of Convenience and Necessity from the Public Utility Commission of Texas will be required for this circuit.

The requirements for Phase 3, which is the 345 kV interconnection, consist of intercepting the Xcel Energy 345 kV transmission circuit and building one 345 kV interconnection facility using a three (3) breaker ring-bus configuration. The facility will have three 345 kV line terminals: One to Potter County Interchange, one to Finney Switching Station, and one to the >Omitted Text< wind farm. To connect the wind farm to the proposed 345 kV interconnection facility, approximately 1.3 miles of new 345 kV circuit will have to be constructed using a (bundled) 2-795 ACSR as the conductor. A Certificate of Convenience and Necessity from the Public Utility Commission of Texas will be required for this circuit.

The requirements for the Final Phase of the 345 kV interconnection will consist of a significant amount of 345 kV circuit construction to get the power out of the immediate area. This level of generation will require an additional 345 kV line from the wind facility to a southern station in the Xcel Energy network. It is recommended that both Xcel Energy and >Omitted Text< discuss what will be involved at this level of generation.

The total cost of the 230 kV interconnection for Phase 1 is estimated at $5.1 million dollars. This is based on a 2002 cost estimate and includes right-of-way expenses. This phase of the project is feasible, but with the construction schedule set at over 15 months it is not possible to meet the requested in-service date (end of 2003).

The total cost of the 230 kV interconnection for Phase 2 is estimated at $13 million dollars. This is based on a 2002 cost estimate and includes right-of-way expenses. This phase of the project is feasible, and with the construction schedule set at approximately 17 months, it is possible that the requested in-service date can be met.

The total cost of the 345 kV interconnection for Phase 3 is estimated at $4.6 million dollars. This is based on a 2002 cost estimate and includes right-of-way expenses. This phase of the project is feasible, and with the construction schedule set at over 15 months, it is possible that the requested in-service date can be met.

The total cost for the Final Phase is a moving target. It is known that an additional 345 kV circuit will be need from the interconnection facility, but the southern termination is unknown in this feasibility study. It is estimated that the cost of a 345 kV circuit from the interconnection facility to a station in Amarillo would be at least $20 million and would have to be defined later in the study process. The lead time should be adequate to meet the in-service date.

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 wind farm.

This study examines the feasibility of interconnecting the new >Omitted Text< 1100 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.

Introduction

>Omitted Text< is proposing the interconnection of an 1100 MW wind farm in the Texas Panhandle near Dumas, Texas. The wind farm will consist of 1 MW and 2.5 MW individual units. The developer is proposing to stage or phase into service groups of these units in the following manner:

?? 200 MW group scheduled to be on-line by the end of 2003. -(Phase 1)
?? 200 MW group scheduled to be on-line by the end of 2004. -(Phase 2
?? 200 MW group scheduled to be on-line by the end of 2005. -(Phase 3)
?? 250 MW group scheduled to be on-line by the end of 2006. -(Phase 3)
?? 250 MW group scheduled to be on-line by the end of 2007. -(Final Phase)

The interconnection is requested on the existing 345 kV and 230 kV Southwestern Public Service Company (SPS) transmission network near Moore County Interchange. SPS is a wholly owned subsidiary of Xcel Energy. A geographical representation of this interconnection point along with existing transmission network is depicted below in Figure 1.

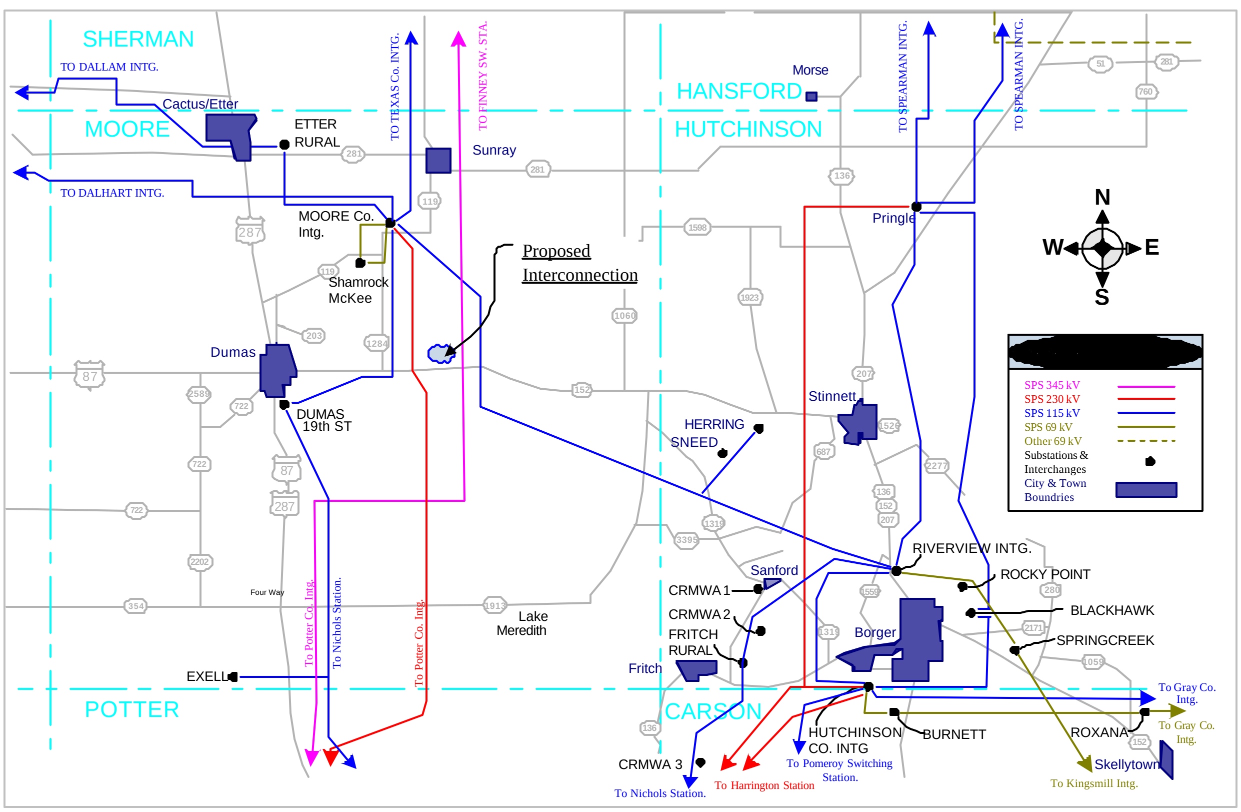


Figure 1

The objective of this study was to determine the feasibility of interconnecting the wind farm at the proposed location, and to ascertain if the proposed level of generation (1100 MW) is acceptable. As part of this feasibility study, estimates will be provided for the interconnection cost associated with this project.

Study Approach

The peak loading for SPS occurs during the summer; therefore the Southwest Power Pool (SPP) 2002 series of summer peak models was used to evaluate the impact of the different stages of the wind farm. The 2005 and 2008 Summer Peak Models were used along with an SPS developed 2004 Summer Peak Model. This later model was developed by scaling the SPS loads in the SPP 2003 Summer Peak Model. These models were updated to include all the SPS generation projects that are positioned ahead of this project in the SPP queue. In addition to the generation, all necessary system reinforcements triggered by these projects are included in the base case models.

The transmission system of primary concern in this feasibility study consists of 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 that uses an AC Contingency Calculation (ACCC) within the program. 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 equipment during a system intact condition, while the B-rating is an emergency equipment rating for a n-1 or single element contingency condition.

A comparative study approach was used in determining impacts caused by the interconnection and the different capacity stages of the wind farm. Additional cases were developed that included different stages of the wind farm in service, and single element contingency violations within these cases were compared to those in their respective base cases.

Results

230 KV Interconnection

- At 200 MW – System intact overloads occurred on the 230/115 kV transformer at Moore County Interchange when the wind farm was added and operated at 200 MW. This transformer capacity will have to be increased prior to the 200 MW wind farm going into service. The 168 MVA transformer should be replaced with a 258 MVA transformer. The addition of this transformer prevented single element contingencies from causing overloads or voltage problems.

?? At 400 MW – System intact overloads occurred on the new 230/115 kV transformer at Moore County Interchange when the 2nd phase of the wind farm was added and the total output of the facility was 400 MW. A 2nd transformer at Moore County will be required to handle the additional capacity. A single contingency analysis indicates that additional overloads occur in the immediate area due to the 400 MW facility. To prevent these overloads, a new 230 kV circuit will be needed between Moore County Interchange and Pringle Interchange.

<u>345 kV Interconnection with 400 MW on the 230 kV network</u>

?? At 200 MW (600 total) – There were not any system intact or single element contingency overloads that occurred for this configuration in the immediate area. But the 'north to south' circuits leaving the Amarillo area are starting to overload for single element contingencies (2005sp model). The scheduling of the 345 kV line from Potter to Clovis will become critical to this stage of the project.

?? At 450 MW (850 total) - There were not any system intact or single element contingency overloads that occurred for this configuration in the immediate area. This study was completed on the 2008 summer peak model, which included the Potter to Clovis 345 kV circuit. Even with this circuit in the model the 'north to south' circuits within the SPS system are overloading during contingencies at this generation level. Another north-south circuit will be needed in the future to alleviate these overloads. Low voltages are occurring in the Lubbock area, but this could be the result of the generation schedule. Without the Potter to Clovis circuit there are a number of system intact overloads. These are provided below:

BUS	NAME	BSKV	AREA	BUS	NAME	BSKV	AREA	CKT	LOADING	RATING	PERCENT
50887	POTTRC6	230	526	50993*	BUSHLND6	230	526	1	453.8	452.0	100.4
51014*	OSAGE--3	115	526	51080	CANYNE3	115	526	1	103.8	90.0	115.3
51020	RANDALL3	115	526	51021*	RANDALL6	230	526	1	258.3	225.0	114.8
51020*	RANDALL3	115	526	51082	PALODU 3	115	526	1	96.8	90.0	107.6
51082*	PALODU 3	115	526	51302	HAPPY3	115	526	1	95.0	90.0	105.5

?? At 700 MW (1100 total) - There were not any system intact or single element contingency overloads that occurred for this configuration in the immediate area, but there were three contingencies that caused the solution to diverge. These individual contingencies are:

1. Potter to Clovis 345 kV circuit.
2. Potter to Wind Farm 345 kV circuit (recognize that this outage will cause the wind farm units trip-off due to low voltage).
3. TUCO to Oklaunion 345 kV circuit.

An additional north-south circuit will be needed to alleviate the divergent contingencies for this level of generation to be considered feasible. This additional circuit would allow the >Omitted Text< Wind Farm to displace generation in the southern part of the SPS system, or possibly provide wind power to other regions.

Requirements for the 230 kV Interconnection

Phase 1 – 200 MW

The minimal requirement for the interconnection of the wind farm is the construction of a new 230 kV interconnection facility approximately 5.7 miles south of Moore County Interchange on the Potter 230 kV circuit. At this location a new station will be built that includes a 3-breaker ring and the termination for approximately 2.8 miles of a new 230 kV circuit using 795 ACSR as the conductor from the >Omitted Text< Wind Farm. At Moore County Interchange the existing 230/115 kV 168 MVA autotransformer will have to be replaced with a larger capacity autotransformer. Drawing 1 in this report depicts a graphical representation of the facilities required for this phase of the interconnection. The interconnection cost is estimated at $5.1 million with a 15 month construction schedule. The detail on these values can be found in Table 1 and Graph 1 of this report. 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.

Phase 2 – 400 MW Total

The minimal requirement for the interconnection of the 2nd phase (additional 200 MW) of the wind farm is the construction of a 230 kV ring bus at Moore County Interchange, along with a 2nd transformer and a new 230 kV line. This phase will require 4-230 kV circuit breakers, 1-115 kV circuit breaker, and a 2nd 230/115 kV autotransformer at Moore County Interchange. In addition, a new 230 kV line using 795 ACSR as the conductor will be required between Moore County Interchange and Pringle Interchange. This circuit will help in dispersing the additional generation at this level. Drawing 2 in this report depicts a graphical representation of the facilities required for this phase of the interconnection. The interconnection cost is estimated at $13 million with a 17 month construction schedule. The detail on these values can be found in Table 2 and Graph 2 of this report. In addition, the 2nd phase of this 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.

Requirements for the 345 kV Interconnection

Phase 3 – 200 to 450 MW on 345 kV or 600 to 850 MW Total (400 MW on 230 kV)

The minimal requirement for the interconnection of this phase of the wind farm is the construction of a new 345 kV interconnection facility approximately 46.4 miles north of Potter County Interchange on the 345 kV circuit to Finney Switching Station. At this location a new station will be built that includes a 3-breaker ring and the termination for approximately 1.3 miles of a new 345 kV circuit using bundled 795 ACSR as the conductor from the >Omitted Text< Wind Farm. Drawing 3 in this report depicts a graphical representation of the facilities required for this phase of the interconnection. The interconnection cost is estimated at $4.6 million with a 15 month plus construction schedule. The detail on these values can be found in Table 3 and Graph 3 of this report. In addition, this phase of 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.

Final Phase – 700 MW or 1100 MW Total

As stated in the 'Results' portion of this report, there are three contingencies that would not converge. This indicates that another 345 kV circuit from the interconnection facility will be required to disperse this level of generation outside of the immediate area. It is expected that this line will terminate in a southern SPS station, but additional information will be needed to determine the proper location. The minimal requirements should include a 345 kV breaker addition at the interconnection facility, a 345 kV multi-breaker ring at the termination station, and at least 50 miles of new 345 kV circuit. A rough estimate for this interconnection would be at least $20 million (refer to Table 4), and would be dependant upon the termination of the 345 kV circuit. The construction schedule will have to be developed after the line length is determined, but there should be plenty of lead time to schedule for this phase. In addition, this phase of 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 a 400 MW wind farm on the 230 kV network as geographically depicted below in Figure 2, and as detailed in the 2nd phase of the 230 kV interconnection (see drawing 2).

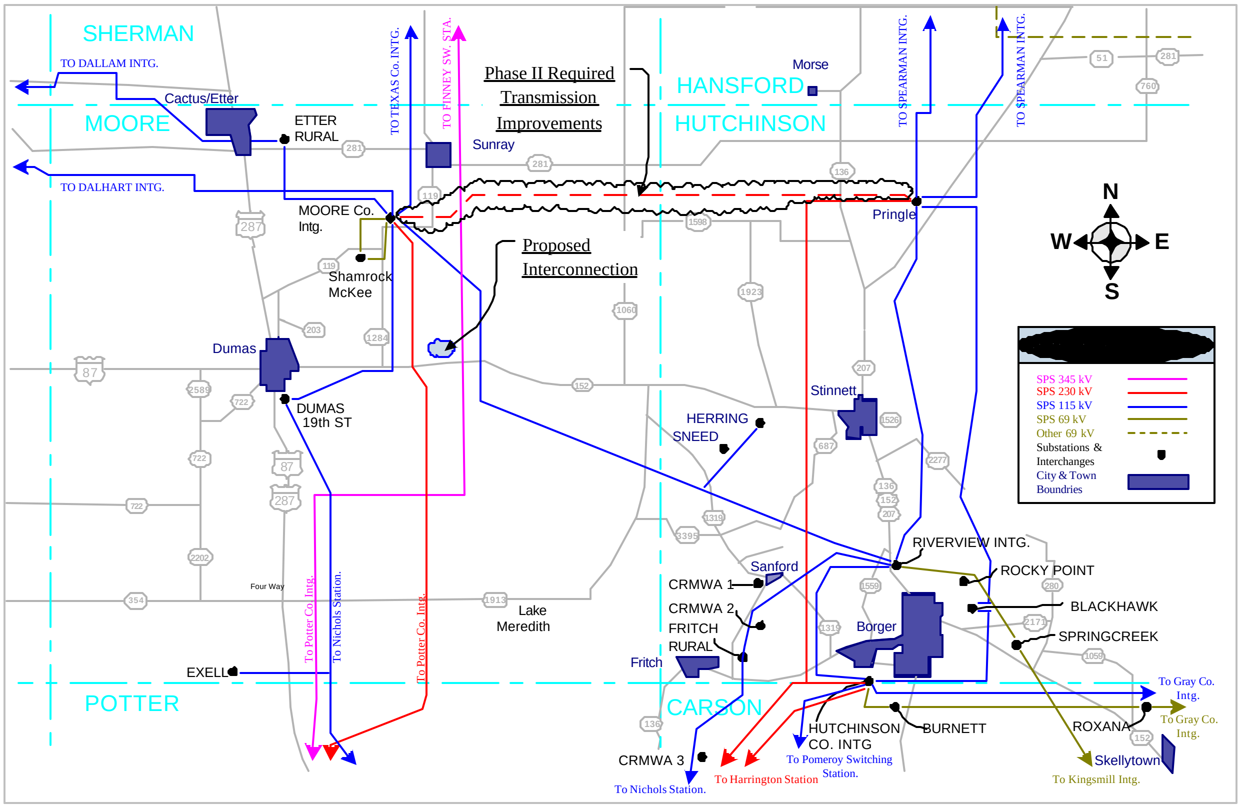


Figure 2

In addition to the 400 MW wind farm on the 230 kV interconnection, it is also feasible to interconnect an additional 450 MW wind farm on the 345 kV network as depicted in Drawing 3. It would also be feasible to connect the final phase (700 MW) to the 345 kV network, but a significant number of limitations would prevent the power from being shipped from the immediate area without adding a new 345 kV circuit from the interconnection facility to a undetermined station. It is recommended that the following subtopic ‘Points of Concern’ is reviewed by >Omitted Text<.

Points of Concern

1. The var consumption of the wind farm facility: These studies were evaluated under the assumption there would not be any vars coming from the SPS network to support the wind farm. Additional studies will be needed to analyze the var requirements, and off-peak season models will be used to evaluate if any reactors are required on the 345 kV interconnection.

2. Stability studies to address the reliability of the wind farm when nearby faults occur. It is strongly suspected that a dynamic voltage control device will be required to enhance the reliability of this wind facility during faults and system swings.

3. One or more additional north to south internal circuit(s) will be required for this facility to operate at full output and to be able to send power to the central and southern end of the SPS network.

4. Due to the possibility that the wind farm is unable to ride through nearby faults, it is expected that the Southwest Power Pool (SPP) will change the transmission reliability margin for the SPS area. This is dependant on the overall size of the wind farm, and should be expected if 700 MW is connected to the 345 kV network. To maintain current transmission service agreements, an additional tie line between the SPP and SPS may be required.

5. Since the Potter County to Finney to Holcomb 345 kV line, is a tie line with Sunflower Electric Cooperative, Sunflower will have to evaluate the effects of the wind farm on their system if the 345 kV circuit is used as an interconnection point.

Estimated Costs – 230 kV Interconnection

Table 1 below lists costs associated with the interconnection of the 1st phase or 200 MW wind farm on the 230 kV network.

Table 1, 200 MW Wind Farm Interconnection Costs

Estimated Costs	Cost
New 230 kV Interconnection Facility[1]	$ 2,089,596
Replace Transformer at Moore County	$ 2,273,753
~ 2.8 miles of New 230 kV Transmission Line[2]	$ 573,173
Right-Of-Way	$ 187,270
Total	***$ 5,123,792***

Table 2 below lists costs associated with the interconnection of the 2nd phase or 400 MW wind farm on the 230 kV network. This cost would be in addition to the 1st phase cost listed in Table 1.

Table 2, 400 MW Wind Farm Interconnection Costs

Estimated Costs	Cost
230 kV addition at Moore County Intg.[3]	$ 1,780,469
2nd Transformer at Moore County	$ 2,831,255
230 kV addition at Pringle Interchange[4]	$ 1,040,804
~ 35 miles of New 230 kV Transmission Line[5]	$ 5,158,644
Right-Of-Way	$ 2,184,817
Total	***$ 12,995,989***

[1] The cost includes three (3) 230 kV 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 approximately 2.8 miles of 230 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.
[3] The cost includes four (4) 230 kV breakers to construct a 4 terminal ring bus at Moore County Interchange.
[4] The cost includes two (2) 230 kV line breakers and a straight 230 kV bus at Pringle Interchange.
[5] Transmission line from Moore County Interchange to Pringle Interchange. The cost is estimated for approximately 35 miles of 230 kV transmission line assuming minimal number of corner structures are required. Cost to be adjusted accordingly pending exact configuration and ROW.

Estimated Costs – 345 kV Interconnection

Table 3 below lists costs associated with the interconnection of the 3rd phase or 200 - 450 MW wind farm on the 345 kV network.

Table 3, 200 – 450 MW Wind Farm Interconnection Costs

Estimated Costs	Cost
New 345 kV Interconnection Facility[6]	$ 3,837,900
~ 1.3 miles of New 345 kV Transmission Line[7]	$ 583,978
Right-Of-Way	$ 125,814
Total	***$ 4,547,692***

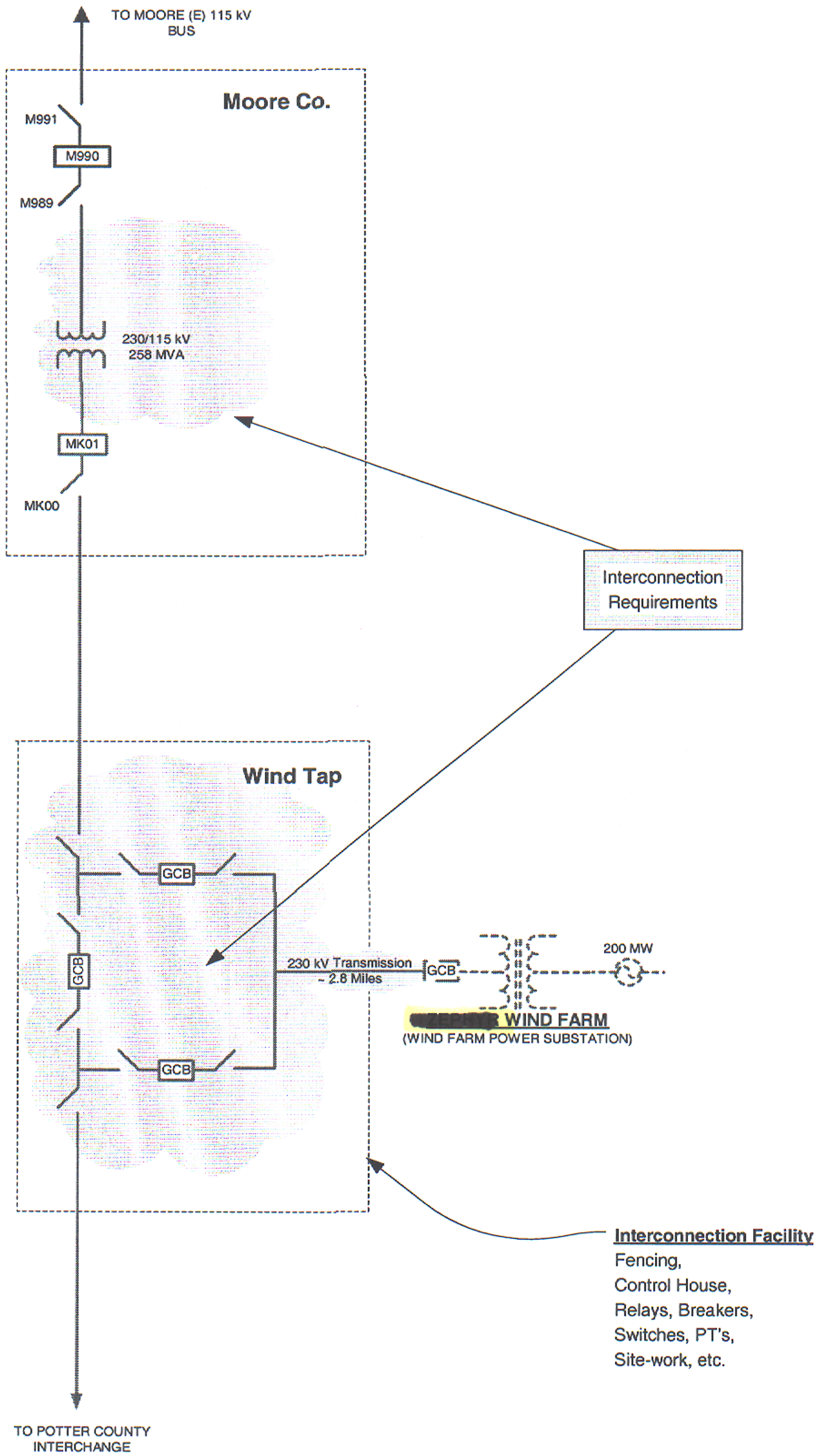
Table 4 below lists costs associated with the interconnection of the final phase or 700 MW wind farm on the 345 kV network. This is a rough estimate that will be better defined once a termination point is selected.

Table 4, 700 MW Wind Farm Preliminary Interconnection Costs

Estimated Costs	Cost
New 345 kV Interconnection Facility[8]	$ 4,157,900
~ 50 miles of New 345 kV Transmission Line[9] and Right-Of-Way	$ 16,450,000
Approximate Total	***$ 20,607,900***

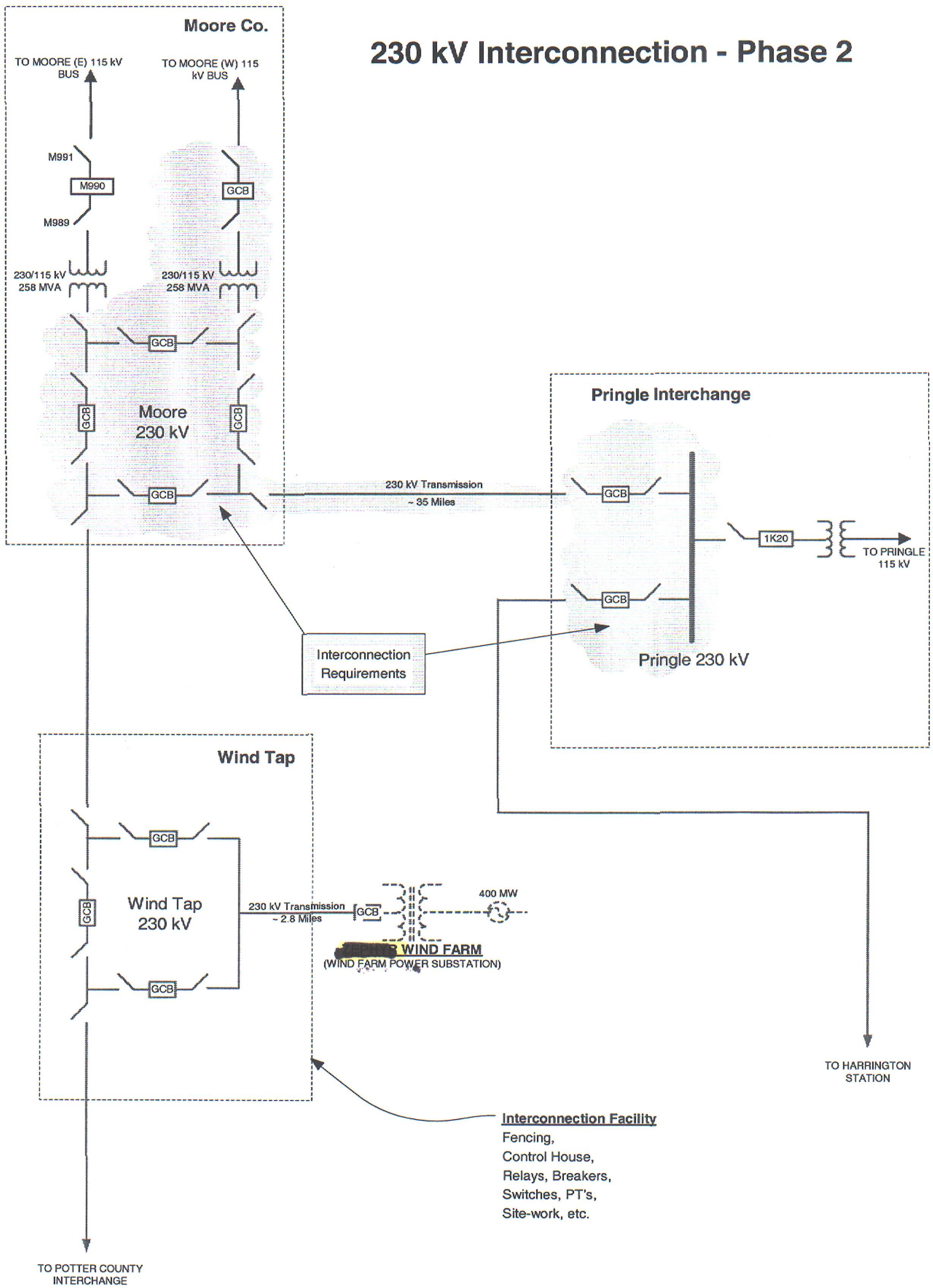
[6] The cost includes three (3) 345 kV breaker line terminals, and associated equipment (control house, relays, metering, labor, etc.)
[7] Transmission line from the wind farm to the new switching station. The cost is estimated for approximately 1.3 miles of 345 kV transmission line assuming no corner structures (i.e. straight line) are required. Cost to be adjusted accordingly pending exact configuration and location of site.
[8] This cost includes three (3) 345 kV breaker line terminals, and associated equipment (control house, relays, metering, labor, etc.), and one (1) 345 kV breaker addition, and associated equipment at the wind interconnection facility.
[9] Transmission line from the wind farm to a new switching station located around Amarillo. The cost is estimated for approximately 50 miles of 345 kV transmission line assuming no corner structures (i.e. straight line) are required, and a right-of-way estimate is included in this cost. Cost to be adjusted accordingly pending exact configuration and location of sites.

230 kV Interconnection - Phase 1



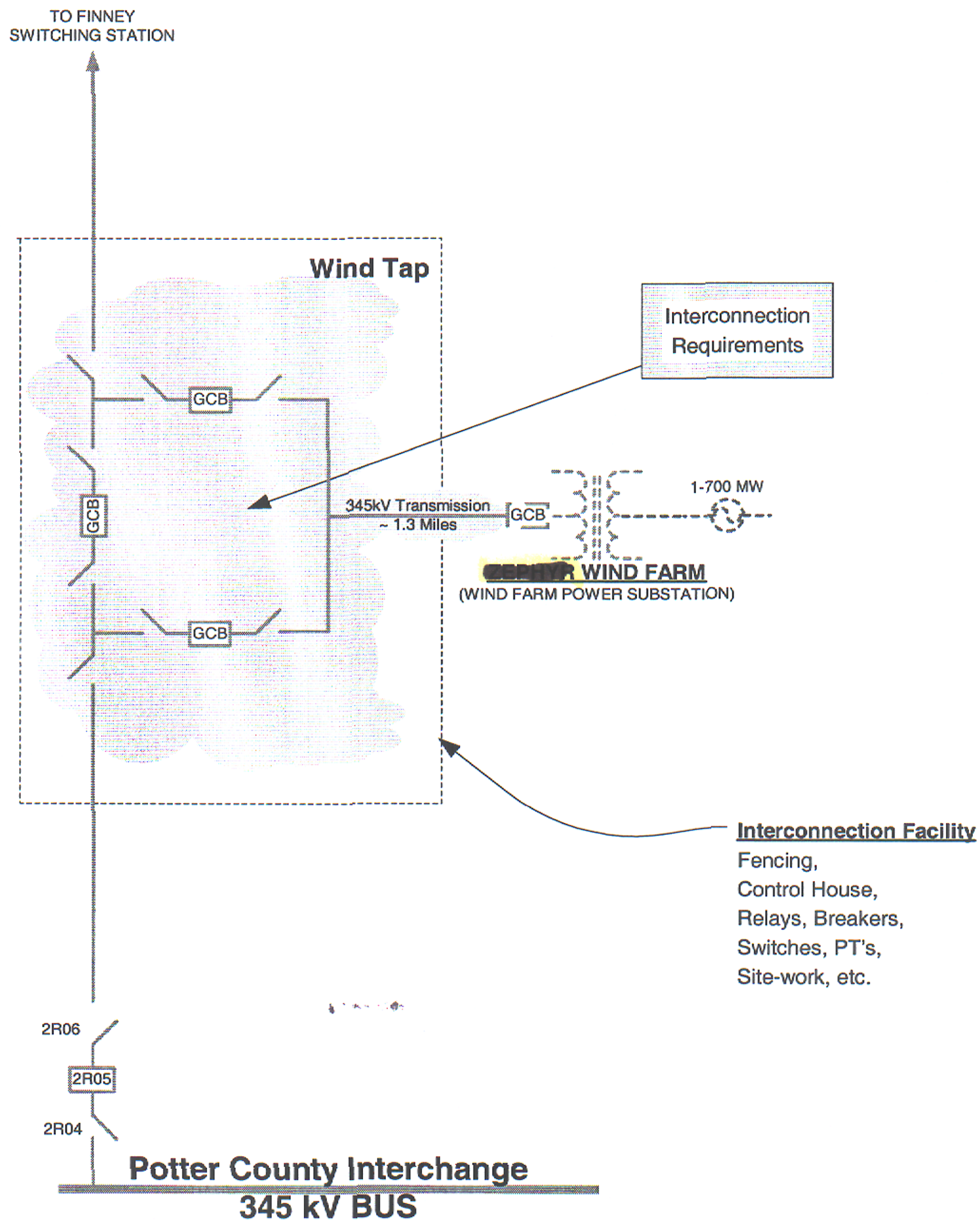
Drawing 1, One-line Diagram of the 230 kV Interconnection Facility.

230 kV Interconnection - Phase 2



Drawing 2, One-line Diagram of the 2nd phase of the 230 kV Interconnection Facility.

345 kV Interconnection - Phase 3

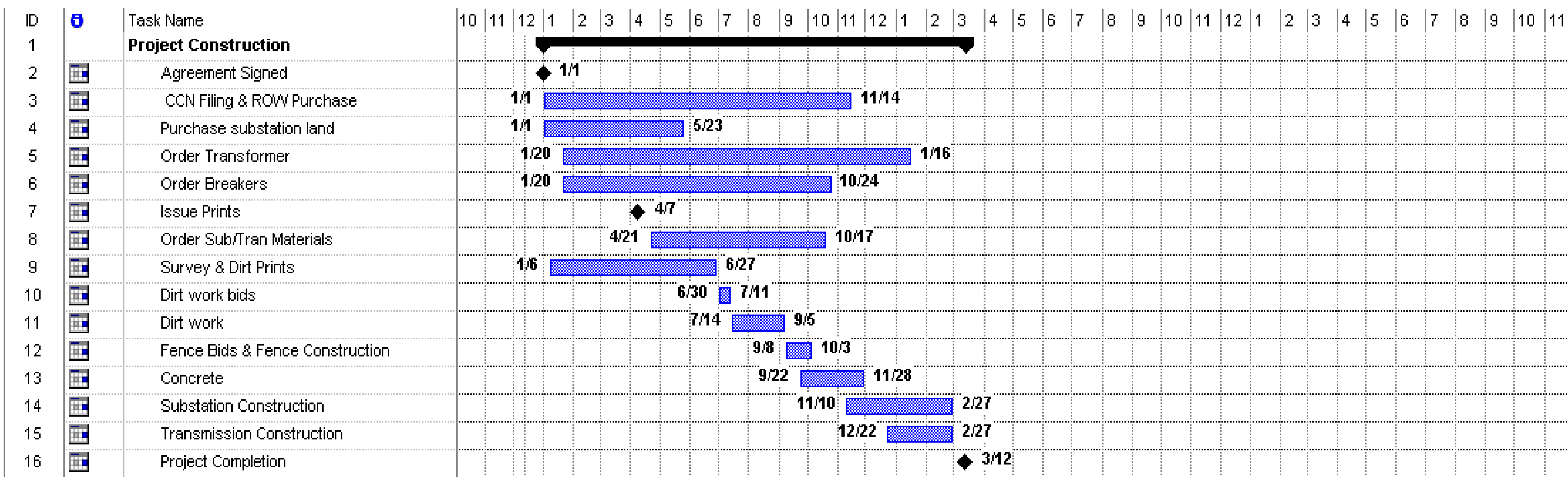


Drawing 3, One-line Diagram of the 345 kV Interconnection Facility.

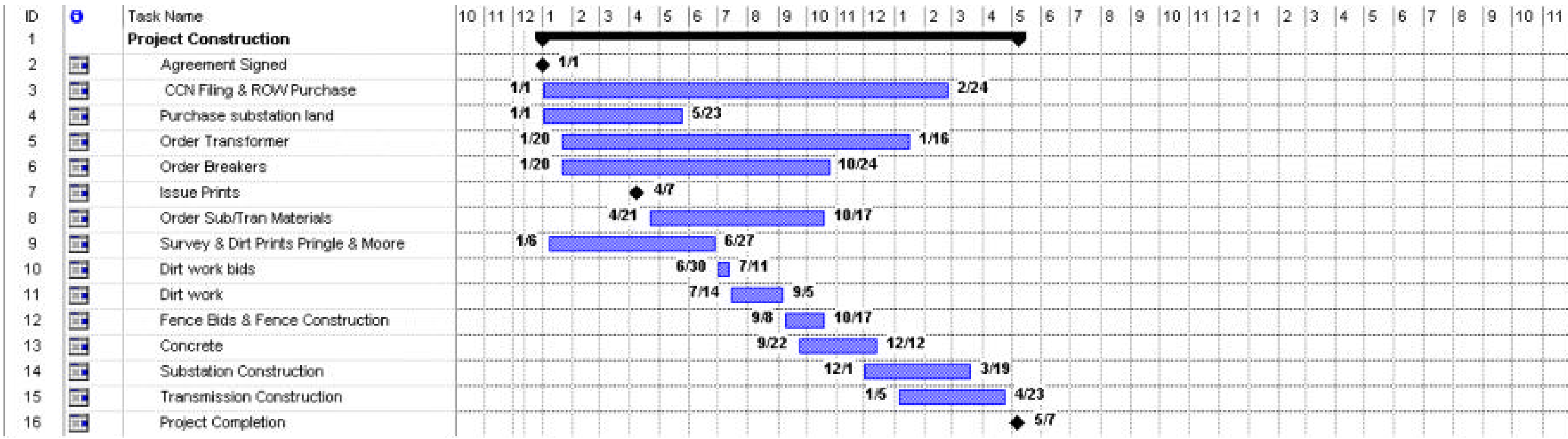
Construction Schedules

The following graphs depict the estimated construction schedule for each of the three (3) phases of the >Omitted Text< Wind Farm. The timeline will start when the Interconnection Agreement is signed. If the agreement is not signed and construction funds have not been provided or approved prior to the date indicated, a new construction schedule would have to be drafted to accommodate any additional projects awaiting construction.

Graph 1: Phase 1 - 230 kV Interconnection



Graph 2: Phase 2 - 230 kV Interconnection



Graph 3: Phase 3 - 345 kV Interconnection