FINAL DRAFT

Westar Energy™

System Impact Study

SPP-GEN-2002-004

for

>Omitted Text<

January 24, 2003

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Executive Summary

>Omitted Text<, requested a System Impact Study under the Southwest Power Pool (SPP) Open Access Transmission Tariff (OATT) to determine the impact of developing a 200 MW wind generating plant in Butler County, Kansas. The proposed >Omitted Text< plant includes either a 138 kV interconnection to the Westar Energy, Inc. (WR) Butler 138 kV substation or a 345 kV interconnection to the WR Neosho – Rose Hill 345 kV transmission line. The proposed facility is expected to be in commercial operation by September 2003. Based upon the lead time for engineering, procurement, and construction, it is likely that commercial operation by September 2003 is not possible.

The principal objectives of this study were:

?? Evaluate the potential modifications required to effect the interconnection.

?? Evaluate the potential for system problems resulting from the interconnection with the delivery of the full output of the proposed plant into the WR control area.

The estimated interconnection facility costs to connect the proposed >Omitted Text< plant to the 138 kV transmission system at Butler are estimated at $6.590 million. There are no estimated overdutied equipment replacement costs on the WR transmission. The required interconnection costs for the proposed >Omitted Text< plant are the interconnection facility costs. The estimated transmission service mitigation costs for system improvements on the WR transmission system necessary to transmit the full output of the proposed >Omitted Text< plant are $8.689 million.

The estimated interconnection facility costs to connect the proposed >Omitted Text< plant to the 345 kV transmission system are estimated at $7.630 million. There are no estimated overdutied equipment replacement costs on the WR transmission. The required interconnection costs for the proposed >Omitted Text< plant are the interconnection facility costs. The estimated transmission service mitigation costs for system improvements on the WR transmission system necessary to transmit the full output of the proposed >Omitted Text< plant are $8.689 million.

Power flow studies were conducted to evaluate possible transmission impacts associated with scheduling power out of the proposed >Omitted Text< plant. Power flow studies used 2003 spring, summer, summer-shoulder, fall and winter peak, 2005 summer and winter peak, and 2008 summer and winter peak models. Changes were incorporated to evaluate the proposed >Omitted Text< plant. Short circuit and transient stability studies were conducted to evaluate interconnection impacts of the proposed >Omitted Text< plant. Short circuit studies used 2002 summer peak and 2005 summer peak models. Transient stability studies used a 2005 summer peak model.

Certain facilities are required to connect the proposed >Omitted Text< plant to the existing Butler 138 kV substation. The estimated 138 kV interconnection facility costs are shown in Table 1. Different facilities are required to connect the proposed >Omitted Text< plant to the existing Neosho

– Rose Hill 345 kV transmission line. The estimated 345 kV interconnection facility costs are shown in Table 2.

Results of power flow studies through 2008/09 winter peak conditions are that the addition of the proposed >Omitted Text< plant does not require transmission facility upgrades to effect a transfer of the full output of the proposed >Omitted Text< plant under all conditions regardless of the interconnection voltage. Results of short circuit studies are that the addition of the proposed >Omitted Text< plant does not require equipment upgrades based on fault current considerations regardless of the interconnection voltage. Results of transient stability studies are that the addition of the proposed >Omitted Text< plant does not require additional equipment or equipment upgrades based on transient stability considerations regardless of the interconnection voltage.

Introduction

>Omitted Text<, requested a System Impact Study under the Southwest Power Pool (SPP) Open Access Transmission Tariff (OATT) to determine the impact of developing a 200 MW wind generating plant in Butler County, Kansas. The proposed >Omitted Text< plant includes either a 138 kV interconnection to the Westar Energy, Inc. (WR) Butler 138 kV substation or a 345 kV interconnection to the WR Neosho – Rose Hill 345 kV transmission line. The proposed facility is expected to be in commercial operation by September 2003.

Previously completed was a Feasibility Study. This System Impact Study is a continuation of generation interconnection evaluation under the regional Open Access Transmission Tariff administered by the Southwest Power Pool (SPP).

System conditions were studied using power flow for both normal (no lines out) and single-contingency outage conditions to evaluate possible transmission service limitations. The power flow studies were performed for both the 138 kV and 345 kV interconnection options. The seasons evaluated were 2003 spring, summer, summer-shoulder, fall and winter peak, 2005 summer and winter peak, and 2008 summer and winter peak. Power flow analyses were evaluated using SPP Criteria. Specifically, facility loading greater than 100 percent of normal rating during base case conditions or facility loading greater than 100 percent of emergency rating during single-contingency outage conditions required mitigation. Transmission facilities subject to monitoring for adverse impact were those operated at 69 kV or greater in the WR control area. Because no request for transmission service has been made, the power flow studies assume that the full output of the proposed >Omitted Text< plant is delivered into the Westar Energy control area and not transmitted out of the control area.

For purposes of evaluating the interconnection of the proposed >Omitted Text< plant, short circuit and transient stability studies were performed. These studies identified any equipment that may require upgrades due solely to the generation interconnection. System conditions studied using a short circuit model were 2002 summer peak conditions. System conditions studied using a transient stability model were 2005 summer peak conditions using data provided by SPP. The short circuit and transient stability studies were performed for both the 138 kV and 345 kV interconnection options.

Power Flow Studies

SPP-developed base cases for the seasons studied were used. Data representing the proposed >Omitted Text< plant was added to each base case. The full output of the proposed >Omitted Text< plant was assumed to be delivered to the WR control area. Automatic single-contingency analysis of the base case and of the case with the proposed plant added was performed for each season to determine if facility overloads were created due to the addition of the proposed >Omitted Text< plant. Incremental improvements were made to mitigate any overloads. In this way, the minimum improvements necessary were determined. Estimated transmission service mitigation costs for connection at 138 kV were identified and are shown in Table 3. Estimated transmission service mitigation costs for connection at 345 kV were identified and are shown in Table 4. The results of the power flow studies are summarized in Appendix 1.

Short Circuit Studies

An SPP developed base case for the 2002 summer peak season was used. Data representing the proposed >Omitted Text< plant was added to the base case to evaluate each interconnection option. Automatic short circuit calculations were performed to determine if equipment were overdutied due to the addition of the proposed >Omitted Text< plant. System improvements determined by the power flow studies were then added to the appropriate short circuit models and the fault calculations repeated. The fault calculations were repeated for the two proposed >Omitted Text< plant configurations. Three-phase and single-phase-to-ground faults were applied at buses in the vicinity of the proposed plant to evaluate the impact on equipment. Overdutied equipment was reported. Estimated overdutied equipment replacement costs were identified.

Transient Stability Studies

An SPP developed base case for the 2005 summer peak season was used. Data representing the proposed >Omitted Text< plant was added to the base case, fault conditions were applied, and the transient performance of the area was monitored to evaluate each interconnection option. The studies were repeated without and with the proposed >Omitted Text< plant in service.

Required Interconnection Facilities

In order to connect the proposed >Omitted Text< plant to WR’s 138 kV electric transmission system, certain facilities are required. A new 138 kV terminal at the existing Butler 138 kV substation is required as well as a 25-mile 138 kV transmission to the >Omitted Text< plant substation. Interconnection metering is installed at the Butler substation. No additional facilities are required solely for interconnection to the Butler 138 kV substation. Estimated interconnection facility costs total $6.590 million (excluding potential tax consequences) and are shown in Table 1. The costs in Table 1 are required costs for interconnection of the proposed >Omitted Text< plant. Also shown in Table are potential tax consequences, which may increase the cost to $8.567 million. It is assumed that >Omitted Text< will construct and own the proposed plant substation.

In order to connect the proposed >Omitted Text< plant to WR’s 345 kV electric transmission system, certain facilities are required. A new 345 kV ring-bus substation is required to connect to the Neosho – Rose Hill 345 kV transmission line together with an 8.8-mile 345 kV transmission line to the project substation. Interconnection metering is installed at the 345 kV substation on the Neosho – Rose Hill line. No additional facilities are required solely for interconnection to the 345 kV system. Estimated interconnection facility costs total $7.630 million (excluding potential tax consequences) and are shown in Table 2. The costs in Table 2 are required costs for interconnection of the proposed >Omitted Text< plant. Also shown in Table 2 are potential tax consequences, which may increase the cost to $9.919 million. It is assumed that >Omitted Text< will construct and own the proposed plant substation.

Discussion of Results – Power Flow Studies

2003 Spring Peak

138 kV Option

During 2003 spring peak conditions with no lines out of service, the full output of the proposed >Omitted Text< plant does not cause overloads or low voltages. During 2003 spring peak conditions, the full output of the proposed >Omitted Text< plant does not cause new overloads during single-contingency outage conditions.

345 kV Option

During 2003 spring peak conditions with no lines out of service, the full output of the proposed >Omitted Text< plant does not cause overloads or low voltages. During 2003 spring peak conditions, the full output of the proposed >Omitted Text< plant does not cause new overloads during single-contingency outage conditions.

2003 Summer Peak

138 kV Option

During 2003 summer peak conditions with no lines out of service, the full output of the proposed >Omitted Text< plant does not cause overloads or low voltages. During 2003 spring peak conditions, the full output of the proposed >Omitted Text< plant does not cause new overloads during single-contingency outage conditions.

345 kV Option

During 2003 summer peak conditions with no lines out of service, the full output of the proposed >Omitted Text< plant does not cause overloads or low voltages. During 2003 spring peak conditions, the full output of the proposed >Omitted Text< plant does not cause new overloads during single-contingency outage conditions.

2003 Summer Shoulder Peak

138 kV Option

During 2003 summer shoulder peak conditions with no lines out of service, the full output of the proposed >Omitted Text< plant does not cause overloads or low voltages. During 2003 spring peak conditions, the full output of the proposed >Omitted Text< plant does not cause new overloads during single-contingency outage conditions.

345 kV Option

During 2003 summer shoulder peak conditions with no lines out of service, the full output of the proposed >Omitted Text< plant does not cause overloads or low voltages. During 2003 spring peak conditions, the full output of the proposed >Omitted Text< plant does not cause new overloads during single-contingency outage conditions.

2003 Fall Peak

138 kV Option

During 2003 fall peak conditions with no lines out of service, the full output of the proposed >Omitted Text< plant does not cause overloads or low voltages. During 2003 fall peak conditions, the full output of the proposed >Omitted Text< plant does not cause new overloads during single-contingency outage conditions.

345 kV Option

During 2003 fall peak conditions with no lines out of service, the full output of the proposed >Omitted Text< plant does not cause overloads or low voltages. During 2003 fall peak conditions, the full output of the proposed >Omitted Text< plant does not cause new overloads during single-contingency outage conditions.

2003/04 Winter Peak

138 kV Option

During 2003/04 winter peak conditions with no lines out of service, the full output of the proposed >Omitted Text< plant does not cause overloads or low voltages. During 2003/04 winter peak fall peak conditions, the full output of the proposed >Omitted Text< plant does not cause new overloads during single-contingency outage conditions.

345 kV Option

During 2003/04 winter peak conditions with no lines out of service, the full output of the proposed >Omitted Text< plant does not cause overloads or low voltages. During 2003/04 winter peak fall peak conditions, the full output of the proposed >Omitted Text< plant does not cause new overloads during single-contingency outage conditions.

2005 Summer Peak

138 kV Option

During 2005 summer peak conditions with no lines out of service, the full output of the proposed >Omitted Text< plant does not cause overloads or low voltages. During 2005 summer peak conditions, the full output of the proposed >Omitted Text< plant does not cause new overloads during single-contingency outage conditions.

345 kV Option

During 2005 summer peak conditions with no lines out of service, the full output of the proposed >Omitted Text< plant does not cause overloads or low voltages. During 2005 summer peak conditions, the full output of the proposed >Omitted Text< plant does not cause new overloads during single-contingency outage conditions.

2005/06 Winter Peak

138 kV Option

During 2005/06 winter peak conditions with no lines out of service, the full output of the proposed >Omitted Text< plant does not cause overloads or low voltages. During 2005/06 winter peak conditions, the full output of the proposed >Omitted Text< plant does not cause new overloads during single-contingency outage conditions.

345 kV Option

During 2005/06 winter peak conditions with no lines out of service, the full output of the proposed >Omitted Text< plant does not cause overloads or low voltages. During 2005/06 winter peak conditions, the full output of the proposed >Omitted Text< plant does not cause new overloads during single-contingency outage conditions.

2008 Summer Peak

138 kV Option

During 2008 summer peak conditions with no lines out of service, the full output of the proposed >Omitted Text< plant does not cause overloads or low voltages. During 2008 summer peak conditions, the full output of the proposed >Omitted Text< plant does not cause new overloads during single-contingency outage conditions.

345 kV Option

During 2008 summer peak conditions with no lines out of service, the full output of the proposed >Omitted Text< plant does not cause overloads or low voltages. During 2008 summer peak conditions, the full output of the proposed >Omitted Text< plant does not cause new overloads during single-contingency outage conditions.

2008/09 Winter Peak

138 kV Option

During 2008/09 winter peak conditions with no lines out of service, the full output of the proposed >Omitted Text< plant does not cause overloads or low voltages. During 2008/09 winter peak conditions, the full output of the proposed >Omitted Text< plant does not cause new overloads during single-contingency outage conditions.

Discussion of Results – Short Circuit Studies

2002 Summer Peak

During 2002 summer peak conditions, the addition of the proposed >Omitted Text< plant does not cause existing equipment to exceed their interrupting duties.

Discussion of Results – Transient Stability Studies

2005 Summer Peak

During 2005 summer peak conditions, the addition of the proposed >Omitted Text< plant does not cause stability problems in the area.

Transmission Service Mitigation

No request for transmission service has been made concurrent with this request for generation interconnection. Absent such a request, it was assumed that the full output of the proposed >Omitted Text< plant is delivered into WR control area. Available gas-fired generation is displaced in order to absorb the full output of the proposed plant. Existing Transmission Operating Directives which may alter the existing transmission configuration or generation dispatch in lieu of construction. These Directives are used until short-term emergency ratings are exceeded. Based on the results of power flow studies no transmission system improvements are required to transmit the full output of the proposed plant into the WR control area under all conditions regardless of the interconnection voltage.

Table 1

Estimated Interconnection Facility Costs – 138 kV Option

(Required for Interconnection)

Item	Cost ($)
Install 138 kV line terminal at Butler Substation	530,000
Install 25-mile 138 kV transmission line to plant substation	5,970,000
Install 138 kV metering	90,000
Subtotal	6,590,000
Allowance for Tax Consequences	1,977,000
Estimated Interconnection Facility Costs	8,567,000

Table 2

Estimated Interconnection Facility Costs –345 kV Option

(Required for Interconnection)

Item	Cost ($)
Install 138 kV line terminal at Butler Substation	530,000
Install 25-mile 138 kV transmission line to plant substation	5,970,000
Install 138 kV metering	90,000
Subtotal	6,590,000
Allowance for Tax Consequences	1,977,000
Estimated Interconnection Facility Costs	8,567,000

Appendix 1 – AC Contingency Results Summary

The results of AC contingency studies on both the base case power flow and power flow with the proposed >Omitted Text< project are compared. Overloads which appear with the proposed project in service that did not occur in the base case are reported below by season. The base case includes previously queued generation operating at full output.

THE OVERLOADS LISTED IN THIS FILE ARE ELEMENTS NOT ORIGINALLY LISTED IN THE INITIAL REPORT BUT ARE INTRODUCED IN THE TEST REPORT. --- ALL CONTINGENCIES ARE ASSUMED TO BE OPEN LINES

2003 SPRING PEAK – 138 kV OPTION
NO NEW OVERLOADS

2003 SPRING PEAK – 345 kV OPTION
NO NEW OVERLOADS

2003 SUMMER PEAK – 138 kV OPTION
NO NEW OVERLOADS

2003 SUMMER PEAK – 345 kV OPTION
NO NEW OVERLOADS

2003 SUMMER-SHOULDER PEAK – 138 kV OPTION
NO NEW OVERLOADS

2003 SUMMER-SHOULDER PEAK – 345V OPTION
NO NEW OVERLOADS

2003 FALL PEAK – 138 kV OPTION
NO NEW OVERLOADS

2003 FALL PEAK – 345 kV OPTION
NO NEW OVERLOADS

2003/04 WINTER PEAK – 138 kV OPTION
NO NEW OVERLOADS

2003/04 WINTER PEAK – 345 kV OPTION
NO NEW OVERLOADS

2005 SUMMER PEAK – 138 kV OPTION
NO NEW OVERLOADS

2005 SUMMER PEAK – 345 kV OPTION
NO NEW OVERLOADS

2005 WINTER PEAK – 138 kV OPTION
NO NEW OVERLOADS

2005 WINTER PEAK – 345 kV OPTION
NO NEW OVERLOADS

2008 SUMMER PEAK – 138 kV OPTION
NO NEW OVERLOADS

2008 SUMMER PEAK – 345 kV OPTION
NO NEW OVERLOADS

2008 WINTER PEAK – 138 kV OPTION
NO NEW OVERLOADS

2008 WINTER PEAK – 345 kV OPTION
NO NEW OVERLOADS