Expedited System Impact Study

SPP-GEN-2002-003

for

>Omitted Text<

December 13, 2002

Table of Contents

Executive Summary

>Omitted Text<, requested an Expedited System Impact Study under the Southwest Power Pool (SPP) Open Access Transmission Tariff (OATT) to determine the impact of developing a 110 MW wind generating plant in Butler County, Kansas. The proposed >Omitted Text< plant includes a 138 kV interconnection to the Westar Energy, Inc. (WR) Altoona – Butler 138 kV transmission line. The proposed facility is expected to be in commercial operation by February 2003.

The principal objectives of this study were:

?? Evaluate the potential for system problems resulting from the interconnection.

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

The estimated interconnection facility costs to connect the proposed >Omitted Text< plant to the WR transmission system are estimated at $0.630 million. There are no estimated overdutied equipment replacement costs on the WR transmission system. 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 $8.358 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 Altoona – Butler 138 kV transmission line. The estimated interconnection facility costs are shown in Table 1.

Results of power flow studies through 2008/09 winter peak conditions are that the addition of the proposed >Omitted Text< plant requires transmission facility upgrades to effect a transfer of the full output of the proposed >Omitted Text< plant under all conditions. The estimated transmission service mitigation costs are shown in Table 2. Results of short circuit studies are that the addition of the proposed >Omitted Text< plant requires no equipment upgrades based on fault current considerations. 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.

Introduction

>Omitted Text<, requested an Expedited System Impact Study under the SPP OATT to determine the feasibility of developing a 110 MW generating plant in Butler County, Kansas. The proposed >Omitted Text< plant includes a 138 kV interconnection to the Westar Energy, Inc. (WR) Altoona – Butler 138 kV transmission line. The proposed facility is expected to be in commercial operation by February 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 also studied using power flow for both normal (no lines out) and single-contingency outage conditions to evaluate possible transmission service limitations. 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 general area of the proposed >Omitted Text< plant. The power flow studies assume that the 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 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.

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 were identified and are shown in Table 2. 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. 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. The studies were repeated without and with the proposed >Omitted Text< plant in service. The transient stability studies did not consider whether or not certain prospective merchant plants with requests for interconnection ahead of the proposed >Omitted Text< plant were in service, because of locational distances.

Required Interconnection Facilities

In order to connect the proposed >Omitted Text< plant to WR's electric transmission system, system improvements are required. A double circuit tap from the existing Altoona – Butler 138 kV line connects to the >Omitted Text< plant substation. Existing protective relaying at Butler will be relocated to the >Omitted Text< plant substation and new relaying installed at Butler. Interconnection metering is installed at the >Omitted Text< plant substation. Lightning protection is added on the Butler – >Omitted Text< plant 138 kV transmission line. No additional facilities are required solely for interconnection to the Altoona – Butler 138 kV transmission line. Estimated interconnection facility costs total $0.630 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 $0.819 million. It is assumed that >Omitted Text< will construct and own the proposed plant substation.

Discussion of Results – Power Flow Studies

2003 Spring Peak

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

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 summer peak conditions, the full output of the proposed >Omitted Text< plant causes new overloads during single-contingency outage conditions. Facilities that exceed emergency rating during a single-contingency outage and the emergency rating are:

5.73-mile Weaver – Rose Hill Tap 69 kV line, 43 MVA

2003 Summer Shoulder Peak

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 summer shoulder peak conditions, the full output of the proposed >Omitted Text< plant does not cause new overloads during single-contingency outage conditions.

2003 Fall Peak

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

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 conditions, the full output of the proposed >Omitted Text< plant causes new overloads during single-contingency outage conditions. Facilities that exceed emergency rating during a single-contingency outage and the emergency rating are:

15.70-mile Butler – >Omitted Text< 138 kV, 110 MVA

2005 Summer Peak

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 causes new overloads during single-contingency outage conditions. Facilities that exceed emergency rating during a single-contingency outage and the emergency rating are:

5.73-mile Weaver – Rose Hill Tap 69 kV line, 43 MVA

2005/06 Winter Peak

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 causes new overloads during single-contingency outage conditions. Facilities that exceed emergency rating during a single-contingency outage and the emergency rating are:

15.70-mile Butler – >Omitted Text< 138 kV, 110 MVA

2008 Summer Peak

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

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 causes new overloads during single-contingency outage conditions. Facilities that exceed emergency rating during a single-contingency outage and the emergency rating are:

15.70-mile Butler – >Omitted Text< 138 kV, 110 MVA

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

Although no requests for transmission service are made concurrent with this request for generation interconnection, based on the results of power flow studies certain transmission system improvements are required to transmit the full out put of the proposed plant into the WR control area under all conditions.

2003 Summer Peak – Rebuild the 5.73-mile Weaver – Rose Hill Tap 69 kV transmission line. The existing transmission line is 1920s vintage and is sag limited by 2/0 AWG copper conductor to 43 MVA. The rebuilding project would be a complete tear-down and rebuild using all new structures and conductor.

2003/04 Winter Peak – Rebuild the 15.70-mile Butler – >Omitted Text< 138 kV transmission line. The existing transmission line is 1924 vintage and is sag limited by 266.8 kcmil ACSR conductor to 110 MVA. The rebuilding project would be a complete tear-down and rebuild using all new structures and conductor.

Table 1

Estimated Interconnection Facility Costs

(Required for Interconnection)

Item	**Cost ($)**
Butler Substation work and metering at plant substation	210,000
Install 138 kV double circuit tap to plant substation	90,000
Install lightning protection from Butler to plant substation	330,000
Subtotal	630,000
Allowance for Tax Consequences	189,000
Estimated Interconnection Facility Costs	819,000

Table 2
Estimated Transmission Service Mitigation Costs

Item	Cost ($)
Rebuild 5.73-mile Weaver – Rose Hill Tap 69 kV line	1,719,000
Rebuild 15.70-mile Butler – >Omitted Text< 138 kV line	4,710,000
Subtotal	6,429,000
Allowance for Tax Consequences	1,929,000
Estimated Transmission Service Mitigation Costs	8,358,000

Appendix 1

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 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

NO NEW OVERLOADS

2003 SUMMER PEAK

```
 1         X-------- C O N T I N G E N C Y   E V E N T S --------X X-- O V E R L O A D E D   L I N E S --X  X--MVA(MW)FLOW--X
                         X---- MULTI-SECTION LINE GROUPINGS ----X   FROM     NAME        TO     NAME    CKT  PRE-CNT  POST-CNT  RATING  PERCENT
     WERE-WERE  OPEN LINE FROM BUS 57039 [ELPASO 4138.00] TO BUS 57042 [FARBER 4138.00] CKT 1 ------------------------------ CONTINGENCY
       WERE-WERE                                                 57604 WEAVER 269.0 57837 RH JCT 269.0 1      34.6     45.5     43.0    101.0
```

2003 SUMMER-SHOULDER PEAK

NO NEW OVERLOADS

2003 FALL PEAK

NO NEW OVERLOADS

2003/04 WINTER PEAK

```
 1         X-------- C O N T I N G E N C Y   E V E N T S --------X X-- O V E R L O A D E D   L I N E S --X  X--MVA(MW)FLOW--X
                         X---- MULTI-SECTION LINE GROUPINGS ----X   FROM     NAME        TO     NAME    CKT  PRE-CNT  POST-CNT  RATING  PERCENT
     WERE-WERE  OPEN LINE FROM BUS 56751 [WCGS U1 25.000] TO BUS 56797 [WOLFCRK7345.00] CKT 1 ------------------------------ CONTINGENCY
       WERE-WERE                                                 56987 BUTLER 4 138 56992 >OMITTED TEXT<4  138 1      96.9    117.6    110.0
102.9
```

2005 SUMMER PEAK

```
 1              X-------- C O N T I N G E N C Y   E V E N T S --------X X-- O V E R L O A D E D   L I N E S --X  X--MVA(MW)FLOW--X
                         X---- MULTI-SECTION LINE GROUPINGS ----X   FROM     NAME        TO     NAME    CKT  PRE-CNT  POST-CNT  RATING  PERCENT
     WERE-WERE  OPEN LINE FROM BUS 57543 [CRESWLN269.000] TO BUS 57547 [OAK    269.000] CKT 1 ------------------------------ CONTINGENCY
       WERE-WERE                                                 57604 WEAVER 269.0 57837 RH JCT 269.0 1      35.2     45.2     43.0    100.5
```

2005/06 WINTER PEAK

```
 1         X-------- C O N T I N G E N C Y   E V E N T S --------X X-- O V E R L O A D E D   L I N E S --X  X--MVA(MW)FLOW--X
                         X---- MULTI-SECTION LINE GROUPINGS ----X   FROM     NAME        TO     NAME    CKT  PRE-CNT  POST-CNT  RATING  PERCENT
     WERE-WERE  OPEN LINE FROM BUS 56751 [WCGS U1 25.000] TO BUS 56797 [WOLFCRK7345.00] CKT 1 ------------------------------ CONTINGENCY
       WERE-WERE                                                 56987 BUTLER 4 138 56992 >OMITTED TEXT<4  138 1      98.3    119.4    110.0
104.3
```

2008 SUMMER PEAK
NO NEW OVERLOADS

2008/09 WINTER PEAK

```
 1         X-------- C O N T I N G E N C Y   E V E N T S --------X X-- O V E R L O A D E D   L I N E S --X  X--MVA(MW)FLOW--X
                         X---- MULTI-SECTION LINE GROUPINGS ----X   FROM     NAME        TO     NAME    CKT  PRE-CNT  POST-CNT  RATING  PERCENT
     WERE-WERE  OPEN LINE FROM BUS 56751 [WCGS U1 25.000] TO BUS 56797 [WOLFCRK7345.00] CKT 1 ------------------------------ CONTINGENCY
       WERE-WERE                                                      56987 BUTLER 4 138 56993 >OMITTED TEXT<4  138 1     107.8    131.7    110.0
115.5

 2         X-------- C O N T I N G E N C Y   E V E N T S --------X X-- O V E R L O A D E D   L I N E S --X  X--MVA(MW)FLOW--X
                         X---- MULTI-SECTION LINE GROUPINGS ----X   FROM     NAME        TO     NAME    CKT  PRE-CNT  POST-CNT  RATING  PERCENT
     WERE-WERE  OPEN LINE FROM BUS 56791 [BENTON 7345.00] TO BUS 56797 [WOLFCRK7345.00] CKT 1 ------------------------------ CONTINGENCY
       WERE-WERE                                                      56987 BUTLER 4 138 56993 >OMITTED TEXT<4  138 1     107.8    118.4    110.0
103.7

 3         X-------- C O N T I N G E N C Y   E V E N T S --------X X-- O V E R L O A D E D   L I N E S --X  X--MVA(MW)FLOW--X
                         X---- MULTI-SECTION LINE GROUPINGS ----X   FROM     NAME        TO     NAME    CKT  PRE-CNT  POST-CNT  RATING  PERCENT
     WERE-WERE  OPEN LINE FROM BUS 56793 [NEOSHO 7345.00] TO BUS 56794 [ROSEHIL7345.00] CKT 1 ------------------------------ CONTINGENCY
       WERE-WERE                                                      56987 BUTLER 4 138 56993 >OMITTED TEXT<4  138 1     107.8    124.2    110.0
108.8

 4         X-------- C O N T I N G E N C Y   E V E N T S --------X X-- O V E R L O A D E D   L I N E S --X  X--MVA(MW)FLOW--X
                         X---- MULTI-SECTION LINE GROUPINGS ----X   FROM     NAME        TO     NAME    CKT  PRE-CNT  POST-CNT  RATING  PERCENT
     WERE-WERE  OPEN LINE FROM BUS 56794 [ROSEHIL7345.00] TO BUS 56797 [WOLFCRK7345.00] CKT 1 ------------------------------ CONTINGENCY
       WERE-WERE                                                      56987 BUTLER 4 138 56993 >OMITTED TEXT<4  138 1     107.8    116.3    110.0
101.7
```