Generator Interconnection Feasibility Study

for

[redacted]

500 MW Connection

[redacted]

SPP #GEN-2001-008

Transmission Reliability & Assessment
Xcel Energy

August 8, 2001

Table of Contents

1. Executive Summary

[redacted] has requested a generator interconnection feasibility study for a new plant located near [redacted], Texas. The requested date of operation is May, 2003 but the plant could provide energy as early as May 2002. The requested point of interconnection is at [redacted]. Up to 500 MW from the 1000 MW plant could be inserted into the Southwestern Public Service (SPS) system.

The objective of this feasibility study is to determine if the proposed plant can interconnect with the SPS system at [redacted] and to determine what facilities or system improvements will be required for the proposed output of the generator.

The study was based on powerflow and contingency analysis, using 2004 summer peak conditions. Two network expansion options were developed to support the 500 MW generation: a 230 kV option and a 345 kV option that are similar in design.

The study indicates that the SPS and SPP thermal overload criteria will be satisfied with either the 230 kV or 345 kV expansion alternative. The system stability and fault current levels were not checked in this feasibility study; they will be considered as part of the impact study if [redacted]elects to proceed with the development. Additional system upgrades may therefore be needed to satisfy the SPS and SPP criteria.

Costs for two interconnection alternatives are detailed in the Appendix, and summarized as follows:

- 230 kV Option - $29,731,680
- 345 kV Option - $33,204,346

2. Introduction

[redacted] has requested a generator interconnection feasibility study of their proposed plant near Odessa, Texas. The desired point of interconnection is at [redacted]

The objective of the study is to determine the interconnect facilities required to support the new plant. Power export to systems outside the SPS area was not studied.

The impact of connecting 500 MW of generation was studied with a 230 kV system expansion option and with a 345 kV expansion option.

The study includes a steady state contingency analysis (PTI PSS/E function ACCC) which considers the impact of 500 MW of [redacted] plant generation on transmission line loading, transformer loading, and transmission level bus voltages for outages of single transmission lines and transformers in the SPS and Cap Rock systems. Rotor angle stability, voltage stability and current flows under faulted conditions are not considered for this feasibility analysis.

3. Study Methodology

This [redacted] generation interconnection feasibility study was requested by [redacted]. The proposed 500 MW interconnection includes a dedicated circuit from the plant located near [redacted] The predicted 2004 summer peak conditions were represented in the powerflow studies.

This analysis is intended to determine if the current SPP criteria and SPS planning requirements can be met if 500 MW of [redacted] generation is connected to the SPS system. The SPS planning requirements are stated in its annual FERC Form No. 715 filing. In general, they require that all facilities be within emergency ratings after a contingency and that there are no base case overloads. The voltage must be between 0.95 and 1.05 per unit during normal operation and between 0.9 and 1.1 per unit during contingencies.

The latest SPP 2004 summer peak model, with SPP updated files applied, was used as a starting point for the analysis. The following modifications were made to this case to create the reference base case without the [redacted] generation:

- The proposed Cap Rock 138 kV line from Tate to McDonald was modeled (as recommended in Oasis request #233490).
- To maximize transmission system loading in the southern part of SPS a 200 MW transfer from WSCC through the Eddy County HVDC was represented.
- Generation at Harrington and Tolk was decreased to balance the 200 MW transfer from WSCC.
- The Long Term Emergency (LTE) rating for the Grassland 230/115 kV transformer was corrected and changed from 100 to 112 MVA.

For the base cases that represent the 230 kV and 345 kV options with [redacted] generation the generation at Harrington and Tolk is decreased by an additional 500 MW so the SPS interchange stays roughly constant.

For the three base cases the automatic contingency analysis option (ACCC) of PSS/E was used to simulate the loss of each transmission element in SPS. Any circuits that would be overloaded with the base case generation dispatch, at peak system load, with or without the [redacted] plant were identified using the results of this analysis. Only the overloads that are related to the [redacted] project are reported in this discussion.

The contingency analysis described in the previous paragraph was only done with a base case generation dispatch. In addition, for each system element that carries at least 5% of the power from the [redacted] generator, the most critical outage was simulated with the generation dispatch in SPS adjusted to find the maximum loading. The reported overloads thus represent the flow with the worst possible generation dispatch for each overload. Overloads related to the [redacted] plant that only occurs for particular SPS generation dispatches are also identified.

4. Study Results

The Reference Case

A reference analysis was done without the [redacted] plant to identify existing problems. Several transformers are loaded in excess of their long term emergency (LTE) rating for single contingency outages including:

- The Midland – CR Tate 230/138 kV transformer will be loaded at 111.3% when the Grassland to Borden 230 kV line is out
- The Borden – CR Vealmoor 230/138 Kv transformer will be loaded at 101.3% when the Midland – CR Tate 230/138 kV transformer is out

Due to the loading characteristics of these transformers, SPS permits a 15% overload.

The 345 & 230 kV Options

Since the overload criteria specifies that the system must be designed for a single contingency outage, it is obvious that at least two transmission circuits rated for 230 kV or 345 kV will be needed at Midland for interconnecting the new generation. A new Midland to Borden line is the most economical way to provide a second circuit with the Lea to Midland line being the other circuit. We therefore modeled a Midland to Borden line in the cases that included the new [redacted] generation.

Two viable options were developed to support the [redacted] generation: a 230 kV option and a 345 kV option.

The 230 kV Option

The 230 kV option, shown in Figure 1 of the Appendix, uses a 345 kV line only from th[redacted] [redacted] plant to Midland where a 345/230 kV, 500 MVA transformer ties the plant to the 230 kV system. The line from Lea County to Midland continues to operate at 230 kV. The new line from Midland to Borden will be built for 345 kV operation, but operated at 230 kV in this option. This option was evaluated with the existing 230/138 kV transformers that connect SPS to the Cap Rock system, one at Midland and one at Borden. For the 230 kV option with the 2004 summer peak load, the following overloads were found for the worst single contingency outage:

- The Midland – CR Tate 230/138 kV transformer would be loaded at 182.3 MVA, 121.5%, when the new Midland to Borden line is out.
- The Grassland 230/115 kV transformer would be loaded at 117.8 MVA, 105.2%, when the Grassland to Jones Plant 230 kV line is out (SPS permits a 15% overload on this transformer).

- The Borden – CR Vealmoor 230/138 kV transformer would be loaded at 151.7 MVA, 101.1%, when the Midland – CR Tate 230/138 kV transformer is out

The loading of the Grassland transformer could be higher when the system load is less.

For the 230 kV option the following equipment additions or changes are therefore needed:

- A 500 MVA 345/230 kV transformer at Midland
- A 345 kV designed transmission line from Midland to Borden (operated at 230 kV)
- A 225 MVA 230/138 kV transformer at Midland

The 345 kV Option

The 345 kV option, [redacted], represents the line from Lea County to Midland to Borden operating at 345 kV. A 345/230 kV 500 MVA transformer is then needed at Borden and another one is required at Lea County. The 230/138 kV transformer that connects to the Cap Rock Cooperative at Midland is also replaced by a 345/138 kV transformer. Only the 230/138 kV transformer connecting the SPS Borden bus to the Cap Rock Vealmoor bus was existing for the evaluation of this option. For the 345 kV option the following overloads were found for the worst single contingency outage at peak load:

- The Grassland 230/115 kV transformer would be loaded at 115.3 MVA, 102.9%, when the Grassland to Jones Plant 230 kV line is out
- The Borden – CR Vealmoor 230/138 kV transformer would be loaded at 152.8 MVA, 101.9%, when the Midland – CR Tate 230/138 kV transformer is out

The loading of the Grassland transformer could be higher when the system load is less. The new 345/138 kV transformer at Midland would be loaded to 167.9 MVA when the new Borden 345/230 kV transformer is outaged.

For the 345 kV option the following major equipment additions or changes are required:

- A 500 MVA 345/230 kV transformer at Lea County
- A 500 MVA 345/230 kV transformer at Borden
- A 345 kV transmission line from Midland to Borden
- A 175 MVA 345/138 kV transformer at Midland

As indicated previously every transmission line or transformer that carries more than 5% of the power injected at [redacted] was considered in our analysis. With no system outage at peak load

none of these devices would be loaded above its normal rating for either the 230 kV option or the 345 kV option.

Appendix

Powerflow Saved Case Listing

[redacted]

Cost Estimates

230opt2.sav WAS SAVED ON FRI, AUG 03 2001 11:02 WITH HEADING:
'06-01 SPS POWER FLOW MODEL.'ONLY 2003 PROJECTS IN B04SP.SAV''
[redacted] 500MW GEN - CAP ROCK LOAD FIXED - 230OPT2.SAV '

345opt2.sav WAS SAVED ON FRI, AUG 03 2001 11:01 WITH HEADING:
'06-01 SPS POWER FLOW MODEL.'ONLY 2003 PROJECTS IN B04SP.SAV''
[redacted] 500MW GEN - ROCK LOAD LOAD FIXED - 345OPT2.SAV '

basecase2.sav WAS SAVED ON FRI, AUG 03 2001 11:00 WITH HEADING:
'06-01 SPS POWER FLOW MODEL.'ONLY 2003 PROJECTS IN B04SP.SAV''
[redacted] STUDY - EDDY HVDC 200MW - CAP ROCK LOAD BASECASE2.SAV'

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Scoping Estimate

A "Scoping Estimate" is provided by Xcel Energy for the convenience of the requesting entity (Requester). It is produced before engineering design has been completed. Xcel Energy will make every effort to produce a representative estimate that incorporates as many project-specific factors as possible. However, a Scoping Estimate is generally based on typical conditions encountered on past construction projects and uses historical cost data from other Xcel Energy projects which may or may not be directly comparable. A Scoping Estimate will only give a broad-based estimate of the possible costs that may be incurred during a potential construction project. Xcel Energy will not proceed to construction based on a Scoping Estimate. If a Requester wants a more definitive estimate of the cost of a project, an "Engineering Estimate" should be requested.

This form will be provided to the Requester prior to completion of the Scoping Estimate so that the Requester can verify the Project Scope and Assumptions information, below. Once the estimate is complete, Xcel Energy will fill in the "Estimated Costs" space at the bottom, and provide a copy of this form to the Requester.

Requester Name [redacted] Phone [redacted]
Address

To generate this Scoping Estimate, Requester agrees to pay Xcel Energy : $ Paid to SPP

Requester:

N/A — *Signature*

7/31/2001 — *Date*

The Requester should review the information detailed below and notify Xcel Energy in writing as soon as possible if any of these assumptions are incorrect.

Project Information:

Name: *Generator Interconnection Study*

Location: [redacted]

Scope: Generator Feasibility study examining interconnection at SPS's Midland Co. Interchange

Project Assumptions: include conditions and requirements set by Xcel Energy and responsibilities of Xcel Energy, and, as appropriate, the Requester. Attach additional pages if more room is needed.

Transmission cost estimates are dependent on final route selection

Scoping Estimate of Costs by Xcel Energy: Transmission Costs as shown on attached page

Xcel Energy

G.D. (Jerry) Martinez — *Print Name*

Signature

8/1/01 — *Date*

Scoping Estimate

[redacted] 500 MW Generation Interconnection Request
(SPP #GEN-2001-008)

345 kV Interconnection Option

Transmission Cost	
[redacted] Generator – Midland Co Intg. (22 mi., 345 kV, 2-795 MCM)	$ 5,223,195
Midland Co. Intg. – Borden Co. Intg. (75 mi., 345 kV, 2-795 MCM)	$ 15,302,805
Total Transmission Cost	$ 20,526,000
Substation Cost	$ 12,678,346
Total Cost	**$ 33,204,346**

230 kV Interconnection Option

Transmission Cost	
[redacted] Generator – Midland Co Intg. (22 mi., 345 kV, 2-795 MCM)	$ 5,223,195
Midland Co. Intg. – Borden Co. Intg. (75 mi., 345 kV, 2-795 MCM)	$ 15,302,805
Total Transmission Cost	$ 20,526,000
Substation Cost	$ 9,205,680
Total Cost	**$ 29,731,680**