SYSTEM IMPACT STUDY FOR C.V.E.C TO SERVE NEW COMPRESSION STATION

SPP-2003-235

Xcel Energy Services, Inc.
Transmission Planning

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Executive Summary

Central Valley Electric Cooperative (CVEC) has requested additional delivery point capacity at their Pine Lodge delivery point, near Roswell, NM. The purpose of this increase is serving an electric pipeline compression station, which is currently fueled by pipeline gas. This would add 18,000 hp or 13.4 MW of load to CVEC and Southwestern Public Service (SPS) 69 kV system. This new load is located approximately 7.4 miles from the existing Pine Lodge delivery point and adjacent to CVEC's North Roswell substation. This study will consider installation of 3-6000 hp motors. This load will be served from a new CVEC substation transformer, rated 12.0 MVA, base 8% impedance, 69/4.16 kV with LTC. CVEC's 69 kV lines from Pine Lodge, which is mostly # 1/0 ACSR conductor, were added to SPS's 2005 summer peak model. A load impact study was performed. A motor start study was performed as requested, even though the customer is going to use a Variable Frequency Drives for all motors.

An alternative to serving this load on the existing 69 kV system is to build 115 kV line to this location, construct a 115/4.16 kV substation, thus providing CVEC with another delivery point instead of serving the load from the 69 kV, Pine Lodge delivery point. Studies were also done on the 115 kV as an alternative.

Recommendations

Power Flow analysis indicates that the addition of one 6,000 hp motor did not cause any problems on CVEC's 69 kV transmission system or SPS's transmission system. Another study was done with the addition of 12,000 hp, which caused minor problems on CVEC's 69 kV transmission system and SPS's transmission system. When a 3rd 6000 hp motor was added totaling 18,000 hp or 13.4 MW, significant problem occurred on CVEC's 69 kV transmission system and SPS's transmission system. The customer should also be informed that at no time should more than one motor be allowed to start simultaneously and that all the other motors should be started only when the previous ones have reached full speed. Also, the customer needs to maintain a 95% power factor at the point of common coupling (Pine Lodge) during normal operation. It is also recommend that the customer not be allowed to start the 6000 Hp motors when using an autotransformer on the 50% tap. Customer's motor type starter type should be the Variable Frequency Drives for all motors under consideration as mentioned in the report to SPP from Mike Martin; Xcel Energy Markets (XEM) dated October 8, 2003. Based on the starting restrictions and the system impacts, the addition of the 18,000 HP of new load the existing 69 kV Pine Lodge delivery point is not acceptable.

The studies with a new 115 kV delivery point, a new 115/4.16 kV substation, worked well. This is the recommended solution for CVEC to serve this load.

Study

Studies were 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 under single element contingencies. The 2005 Summer Peak Model was used for this study.

Results

The motor characteristics in this motor start study and the horsepower rating of the motors are noted below. Some of these values were provided and some are assumed comparative values.

Induction Motor Characteristics	
Rated Running Power-Factor:	0.885
Rated Load – Efficiency:	0.964
Starting Power-Factor:	0.20
Locked Rotor kVA/Hp:	6.6

69 KV Service from CVEC's Pine Lodge

Using the 69 kV service from Pine Lodge Delivery Point in determining the allowable voltage dip at startup, the 69 kV bus voltages on CVEC system from Pine Lodge to North Roswell substation to Macho substation and SPS's 69 kV system from Pine Lodge station to Chaves and Roswell Interchanges, 115/69 kV, autotransformers were monitored. This study located the new customer load at a new substation next to CVEC's North Roswell substation, which tapped the 69 kV bus serving CVEC's North Roswell substation. The new substation transformer is a 69/4.16 kV, 12.0 MVA transformer with a LTC and 8% impedance on a 12.0 MVA base. It is recommended that these motors use the Variable Frequency Drives for all motor starts as indicated on the request to the Southwest Power Pool dated October 8, 2003 from Mike Martin-XEM.

Voltage Drop when 1-6000 Hp starts using 50% auto start					
Compressor Load	**Motor HP**	**QTY**	**69kV Bus @ CVEC-motor**	**69kV Bus @ SPS**	**4.61 kV @ Customer**
No Load	6000	1	3.5%	2.3%	10.4%
4.5 MW	6000	1	2.9%	1.9%	9.6%
9.0 MW	6000	1	2.8%	1.9%	8.8%

The table below has the overloads and voltage violations listed for each motor load. The load increases when another motor is in service. The new motor loads were added using a 90 % power factor.

Load Added	**Motor HP**	**QTY**	**CVEC**		**SPS**	
			Overloads	Voltage Violations	Number of contingencies causing Overloads	Voltage Violations
No Load	None	None	None	None	Existing (3) 117%, 117% & 100.4%	None
4.5 MW	6000	1	None	None	New (1) Existing (3) Inc by 8%	None
9.0 MW	6000	2	None	2	New (1) Existing (3) Inc by 18%	None
13.4 MW	6000	3	None	12	New (6) Existing (3) Inc by 30%	26

When two motors are in service representing 9.0 MW, there are two-voltage violations that can be corrected by adding a 7.2 MVAR capacitor bank on CVEC's 69 kV system serving these new motors. In order to serve the 13.4 MW of new load on the 69 kV at this site, CVEC needs to add a 7.2 MVAR capacitor bank on their 69 kV system and SPS would need to add a 14.4 MVAR capacitor bank on the 69 kV at Chaves Interchange. Also, another 40 MVA, 115/69 kV autotransformer needs to be added at Roswell Interchange due to the additional overloading during contingencies.

115 kV Alternative

Using the 115 kV system to serve CVEC New Substation/Delivery Point another study was performed to serve this load from the 115 kV. A new 115 kV line would be built from Chaves Interchange to CVEC's North Roswell Substation, which is approximately eight (8) miles.

Using an autotransformer on the 50% tap, the startup of a 6000 hp motor under a no-load condition caused a voltage dip of 1.2% on the 115 kV bus at CVEC's new 115 kV North Roswell substation. When the entire new load was added (less the 6000 hp motor that is starting), a 1.2% voltage dip was noted. This means that as long as the motor is started with an autotransformer on the 50% tap, the 6000 hp motor may be within the 2% maximum allowable voltage dip. Since the customer has indicated they plan to use the Variable Frequency Drives to start these motors, this study recommends using the Variable Frequency Drives to start these motors.

Voltage Drop when 1-6000 Hp starts using 50% auto start					
Compressor Load	**Motor HP**	**QTY**	**115kV Bus @ SPS**	**115kV Bus @ CVEC-Motor**	**4.61 kV @ Customer**
No Load	6000	1	.8%	1.2%	5.9%
4.5 MW	6000	1	.8%	1.2%	5.7%
9.0 MW	6000	1	.7%	1.2%	5.8%

These results are based on the understanding that the substation transformer described in this study will be used to serve this new load. If the transformer impedance or base MVA change, the starting limitations will change. If the customer uses the Variable Frequency Drives, the transformer impedance should not make any difference.

Estimated Costs and Construction Schedule

Table 1 lists the costs associated with serving the new load on the 69 kV system (although this is not the recommended alternative) and Table 2 lists the costs associated with serving the new load on the 115 kV system.

Table 1, 69 kV System Costs

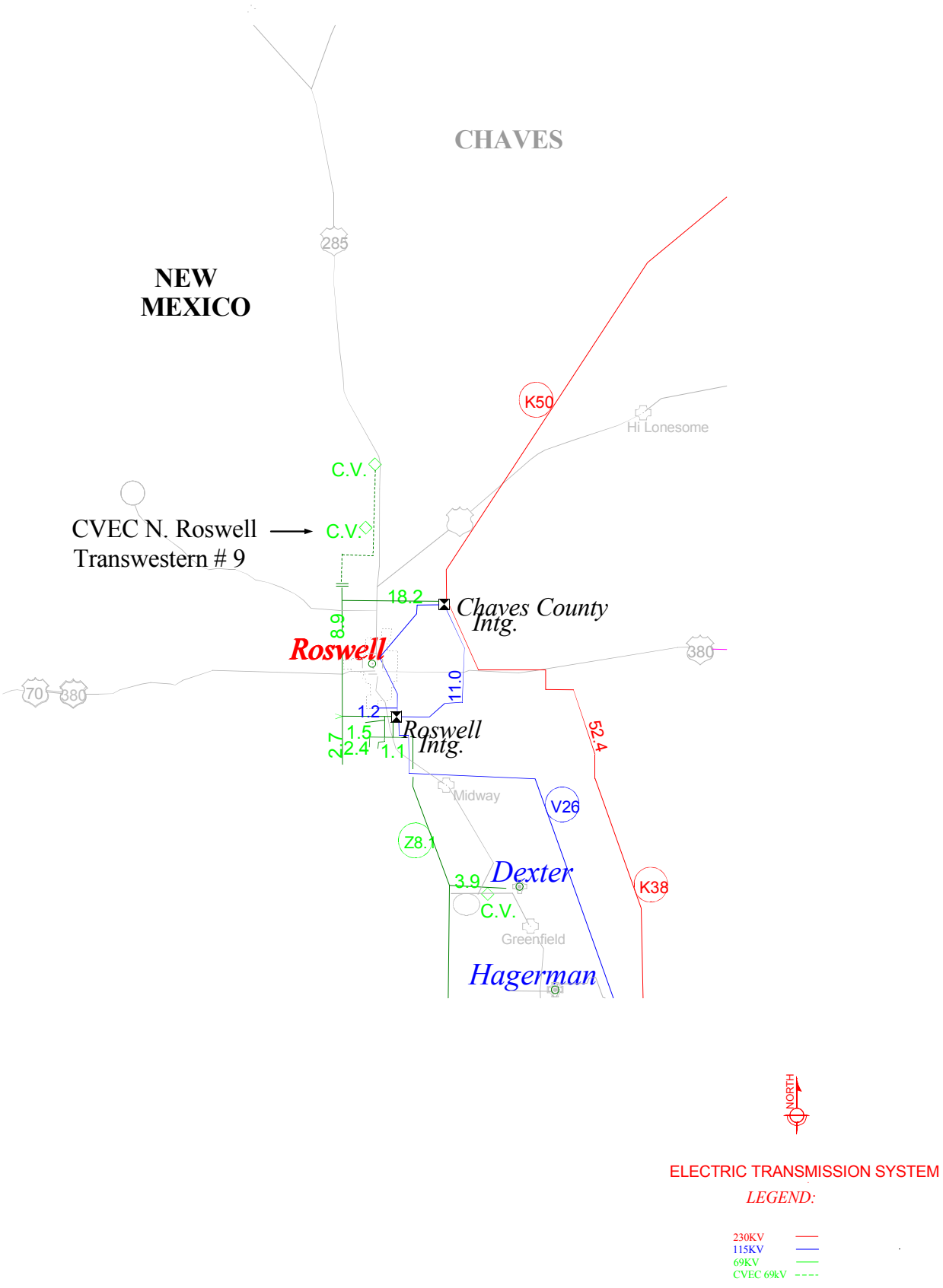
Estimated Costs	**Cost**
New 14.4 MVAR Capacitor Bank at Chaves Intg	$ 379,000
2nd 40 MVA, 115/69 kV auto at Roswell Intg.	$ 1,008,000
Total	**$ 1,387,000**

Table 2, 115 kV System Costs

Estimated Costs	**Cost**
New 8 miles of 115 kV, 397 MCM, H-Frame transmission line, Chaves to CVEC N. Roswell.	$ 1,689,000
New 115 kV Breaker at Chaves	$ 345,000
Right-Of-Way for 8 miles of 115 kV line.	$ 320,000
Total	**$ 2,354,000**

Construction Schedule

The estimated completion times are stated assuming that appropriate agreements have been signed with CVEC and Xcel Energy management has authorized proceeding on the project. The engineering, procurement, and construction time for the 69 kV alternative (not recommended) is estimated to be 9 months. The engineering, procurement, and construction time for the 115 kV alternative (recommended) is estimated to be 12 months. The following page is a transmission map of the Roswell, New Mexico area.


CHAVES
NEW MEXICO
285
K50
Hi Lonesome
C.V.
CVEC N. Roswell
Transwestern # 9
C.V.
18.2
Chaves County Intg.
8.9
Roswell
380
70
380
11.0
1.2
1.5
2.4
1.1
2.7
Roswell Intg.
52.4
Midway
V26
Z8.1
3.9
Dexter
C.V.
K38
Greenfield
Hagerman
NORTH
ELECTRIC TRANSMISSION SYSTEM
LEGEND:
230KV
115KV
69KV
CVEC 69kV

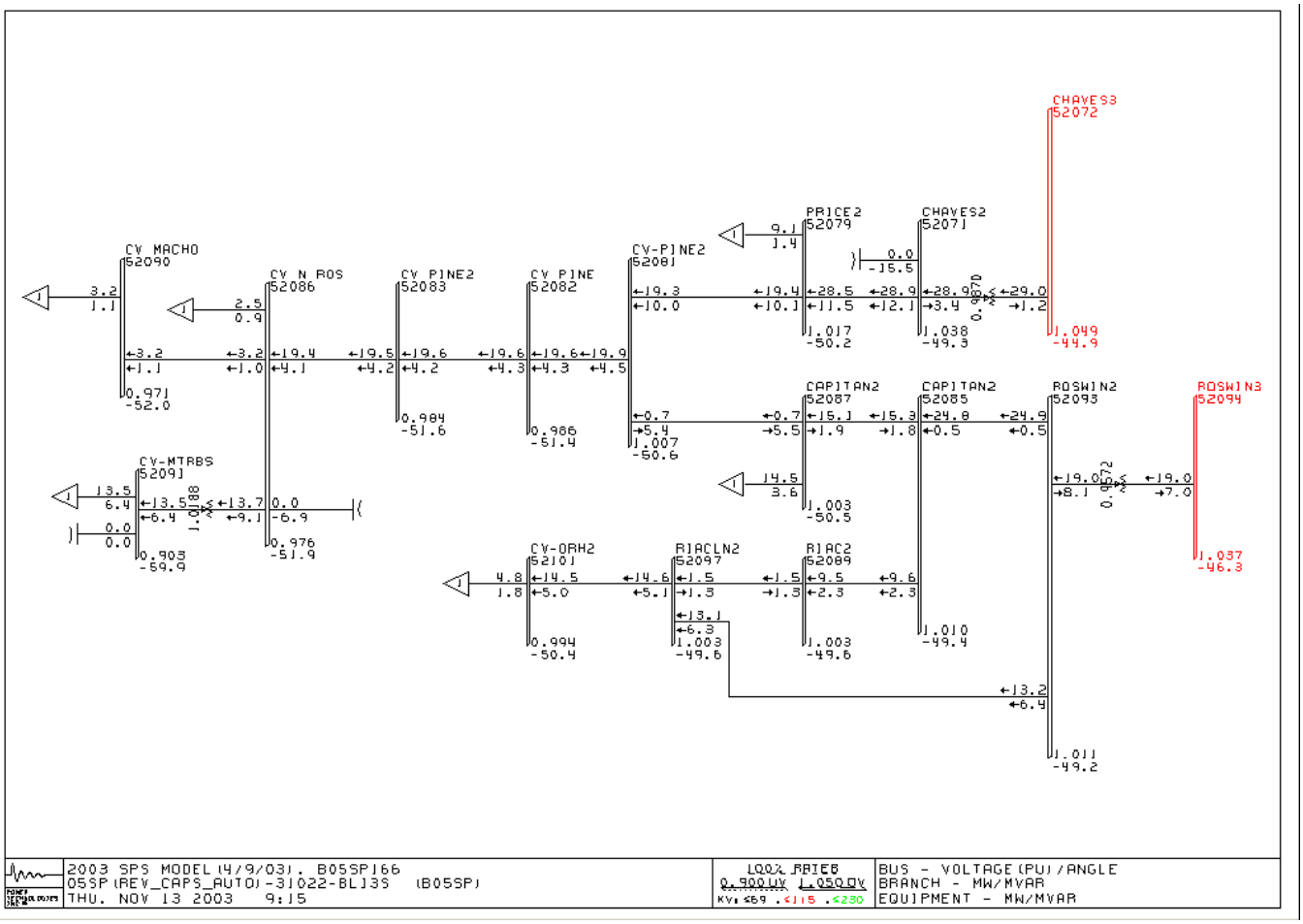


Figure 1. One line diagram for 69 kV proposal.

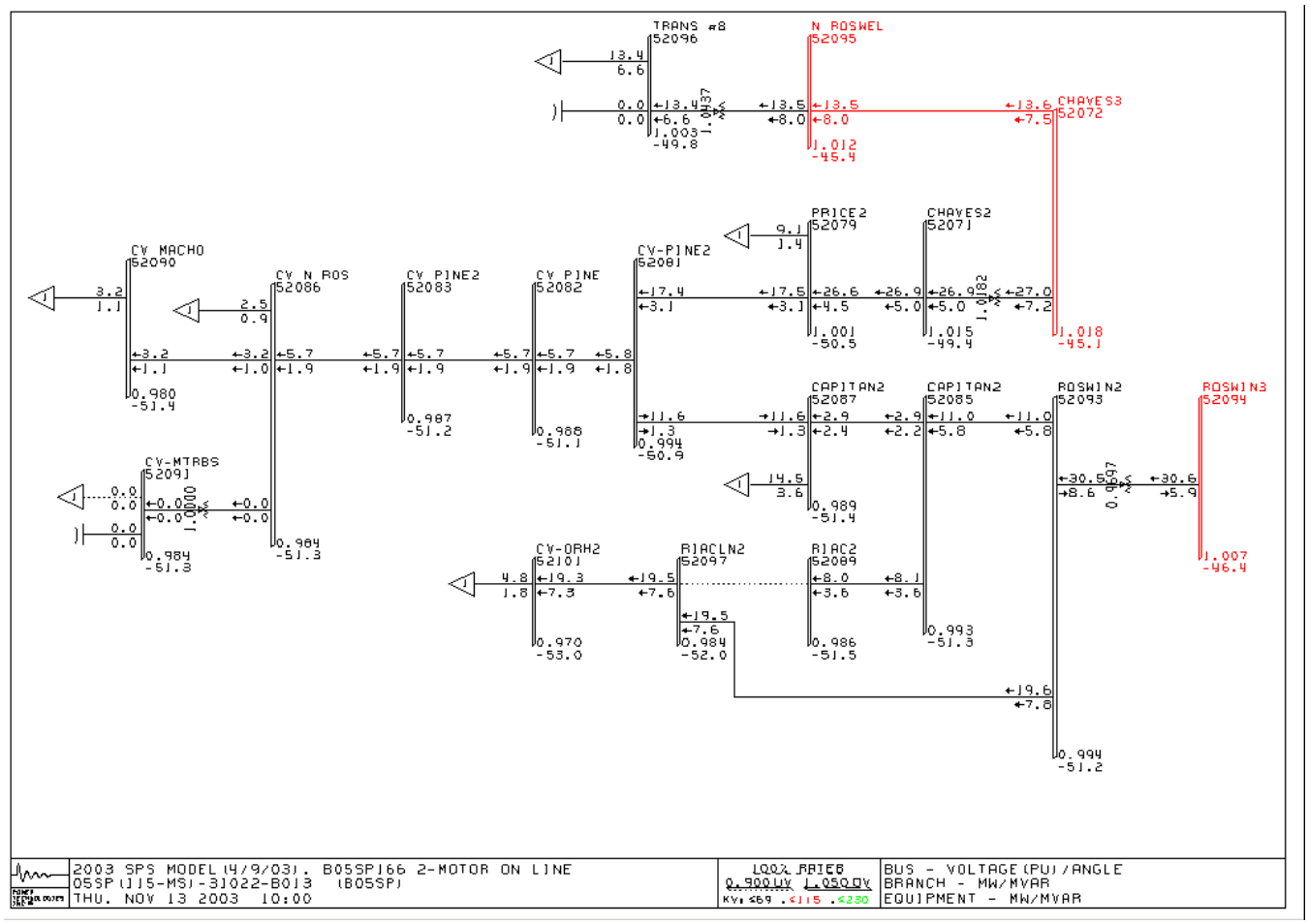


Figure 2. One line diagram fro 115kV proposal.