CENTRAL VALLEY ELECTRIC COOPERATIVE MOTOR START AND LOAD ADDITION FROM SOUTHWESTERN'S STATION PINE LODGE

Central Valley Electric Cooperative (CVEC) is considering serving the conversion of a compressor station from its present energy source to electric. This would add 9,000 hp or 6.7 MW of load to CVEC and SPS 69 kV system and is located approximately 7.4 miles from the Pine Lodge tap. This study will consider 3-3000 hp motors or 2-4500 hp motors. This load will be served from a new substation located next to CVEC's North Roswell substation with a new transformer rated 7.5 MVA, base 7% impedance, 69/4.16 kV w/o LTC. CVEC's 69 kV lines from Pine Lodge were added to our 2005 summer peak model, which is mostly # 1/0 ACSR conductor. Both a load impact study and a motor start study were performed, with the two different motor sizes (3,000 hp and 4,500 hp).

RECOMMENDATIONS

Power Flow analysis indicates that the addition of this 9,000hp load does not cause significant adverse effects on CVEC's 69 kV transmission system or SPS's transmission system. It is recommended that the load can be added as mentioned.

It is also recommend that the customer not be allowed to start the 3000 Hp or the 4500 Hp motors across the line. This site is located next to CVEC North Roswell substation. These motors can be started when using an autotransformer on the 65% tap or using an autotransformer on the 50% tap for the 3000 hp and 4500 hp motors respectively.

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. In addition, the customer should contact SPS System Operations to determine if it is possible to start the motors at the time startup is being requested. Finally, the customer needs to maintain a 95% power factor at the point of common coupling (Pine Lodge) during normal operation. CVEC may want to consider adding a capacitor bank on their 69 kV system in this area if this new load is added.

STUDY/RESULTS

The 2005 Summer Peak Model was used for this study. Power flow analysis did not indicate any violations that should prevent the addition of this new 9,000hp load. There are no new overloads during n-1 contingencies, but the existing overloads are higher when the new load has been added. The customers voltage on the 4 kV system is 0.941 per unit.

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:	0.86
Rated Load – Efficiency:	0.95
Starting Power-Factor:	0.15
Locked Rotor kVA/Hp:	5.95

Horsepower Requirements			
Compressor Load	**Motor HP**	**QTY**	**Total HP**
Motor Sizes	3000	3	9,000
Motor Sizes	4500	2	9,000

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, autotransformer was 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 69/4.16kV, 7.5MVA transformer without a LTC and 7% impedance on a 7.5MVA base.

Two conditions were studied in determining the starting limitations of the 3000hp or the 4500hp motors. The first was the startup of either motor under a no load condition and second was the startup of either motor, under a full load condition, less the 3000hp or 4500hp motor that would be started. Since the largest motor at this location is either a 3000hp or 4500hp motor, only these motors were considered for start-up. This was done to determine the maximum permissible MVA at startup and still maintain a voltage dip of less than 3% on the 69kV transmission system.

Using an autotransformer on the 65% tap, the startup of a 3000hp motor under a no-load condition caused a voltage dip of 2.4% on the 69kV bus at CVEC's North Roswell substation. This is equivalent to across-the-line startup of 6.468 MVA at a 15% starting power-factor. When the entire new load was added (less the 3000hp motor that is starting), a 2.4% voltage dip was noted. This means that as long as the motor is started with an autotransformer on the 65% tap, the 3000hp motor may be within the 3% maximum allowable voltage dip.

Using an autotransformer on the 50% tap, the startup of a 4500hp motor under a no-load condition caused a voltage dip of 2.5% on the 69kV bus at CVEC's North Roswell substation. This is equivalent to across-the-line startup of 5.741 MVA at a 15% power-factor. When the entire new load was added (less the 4500hp motor that is starting), a 2.3% voltage dip was noted. This means that as long as the motor is started with an autotransformer on the 50% tap, the 4500hp motor may be within the 3% maximum allowable voltage dip.

These results are base with 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 and the customer may have to use an autotransformer set to a lower tap when starting a 3000hp of a 4500hp motor.

CONCLUSIONS

The 4500hp motor can only start with an autotransformer at a 50% tap. If an autotransformer is not used for startup, the voltage dip at startup on the 69 kV bus must be limited to not more than 3% during startup.

The 3000hp motor can only start with an autotransformer at a 65% tap. If an autotransformer is not used for startup, the voltage dip at startup on the 69 kV bus must be limited to not more than 3% during startup.