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Study Committee B3
PS2: Existing Substations, new challenges

Study and solution of Series Compensation Faults in Trunk Electrical System of Chile

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In 2005, the Chilean trunk system had to be expanded to allow that the big (relatively) hydro plant was able to deliver its power from the south of the country to the central load located 500km at north. The special characteristic of the Chilean transmission system is this has two main generation zones, one of them located around of 100km to the north-west of the central load, which main combustible is Gas, Coal or even Diesel, and the other generation zone is located around 600 km at south of the central load.

The central and main load of the system is Santiago Metropolitan Area whose peak demand is 2200 MW and the total peak demand is around 6200 MW, it means more than 30% of the peak.

The other and important characteristic of the Chilean electrical system is that the south generation is almost 100% hydro, and all of north generation is thermal. So, there are two well clear extremes of operating the system: high power flow from the south, (around of 1400 MW in the mentioned corridor) and the other is very low transmission from south and high dispatch of central generation.

The project had to include 500 kV Series Compensation which was between 45% and 55% of the line impedance; all of this installed in a same substation (Ancoa), as the figure 1 shows.

During the operation of the electrical system several faults occurred in the lines, which caused important fault in the series compensation equipment without finding the root cause of the fault of the equipment.

Unfortunately the faults occurred when the system was operating with high transfers power came from south, it means, close to 1400 MW.

The problem was that when occurred fault in the 500 kV line, sometimes the equipment was damaged and other times was not. In cases when the equipment was damaged different part and even different level of damage occurred, being the most severe which the circuit damping circuit was entire burned. The layout of the series compensation is showed in figure 2.

As it was said, there was a random behavior of the system with and without fault in the series compensation even in cases where apparently similar fault occurred.

To find out the causes of the faults, several directions were taken.

One was to analyze the faults, oscilographies, and review original design. Two, was to simulate the series compensation equipment considering its distribution and detail of

equipment used. Three, to contact the factory to find out what special design could have caused these problems.

The review of the design was focused in to check that the elements used in the design were right.

The simulation focused in to re-create the events by using EMTP/ATP to try of finding the problem. This part was done with help of factory of the equipment

The Factory helped TRANSELEC coming to field and participating to find the problem.

According with the developing of the studies and activities, the problem was found and some changes in the design were done. All of these actions were done with the participation of the factory people which gives information about statistics of fault and different design between TRANSELEC's series compensation and other ones installed in other places.

This paper tries to show up the experience of TRANSELEC finding and solving problems with a special design of the series compensation installed in its system which caused important constraints in the trunk systems during more than one month and making the operation prices of the system higher than expected when all is good.

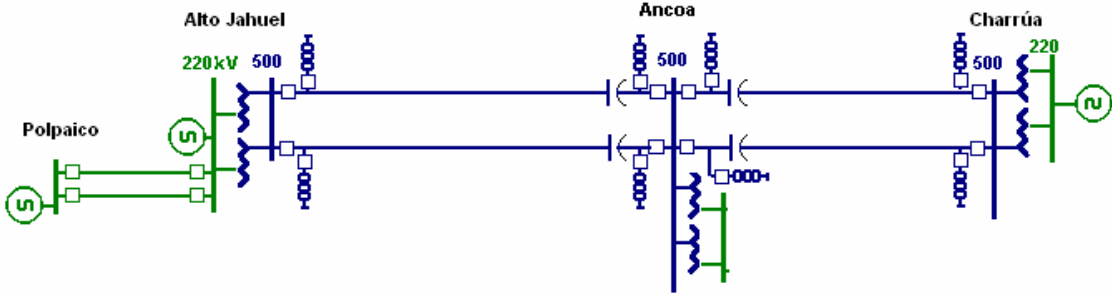


Figure 1. TRANSELEC 500 kV Trunk System

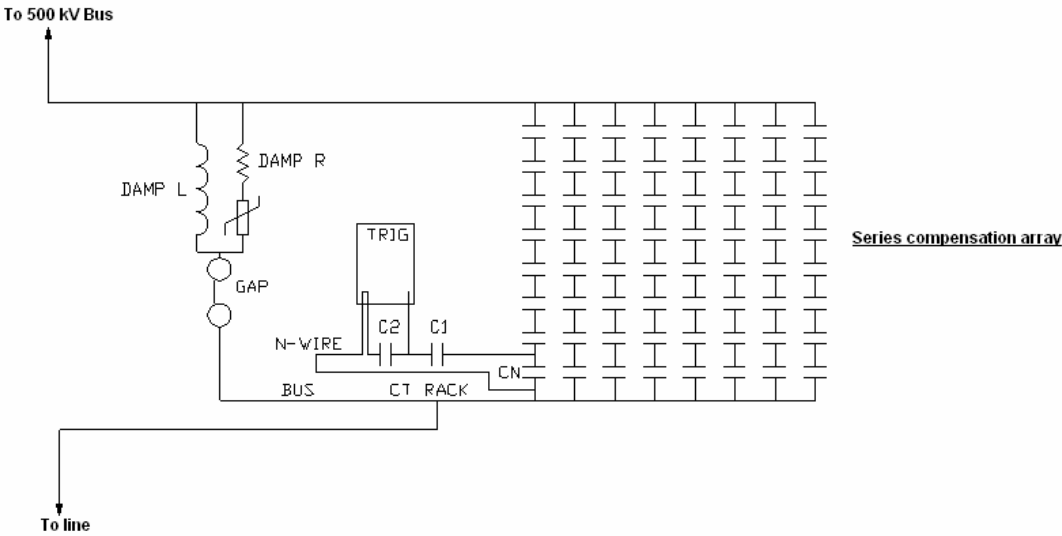


Figure 2. Layout of Series compensation equipment