

## ELSPEC EQUALIZERS REDUCE TURKISH STATE RAILWAYS ELECTRICITY COSTS

The Turkish State Railways (TCDD) controls approximately 11,000 km of railways all around the country over two continents.

The electricity is supplied through single phase 154 kV. Substations are used to reduce the voltage to 25 kV using two 7.5 MVA transformers (Figure 1). When a train reaches the substation network, the load is rapidly increased and goes back to nearly zero when the train leaves this network segment. The changes are of Mega watts in tenth of a second.



The main objectives of the Turkish State Railways were:

- Capacity: to allow more trains on the same railway segment simultaneously.
- Stability: rapid load changes create voltage fluctuations.
- Power Factor penalties: strict penalties regulations include both leading and lagging limits.
- Infrastructure: reducing the costs of electricity generation and transportation.

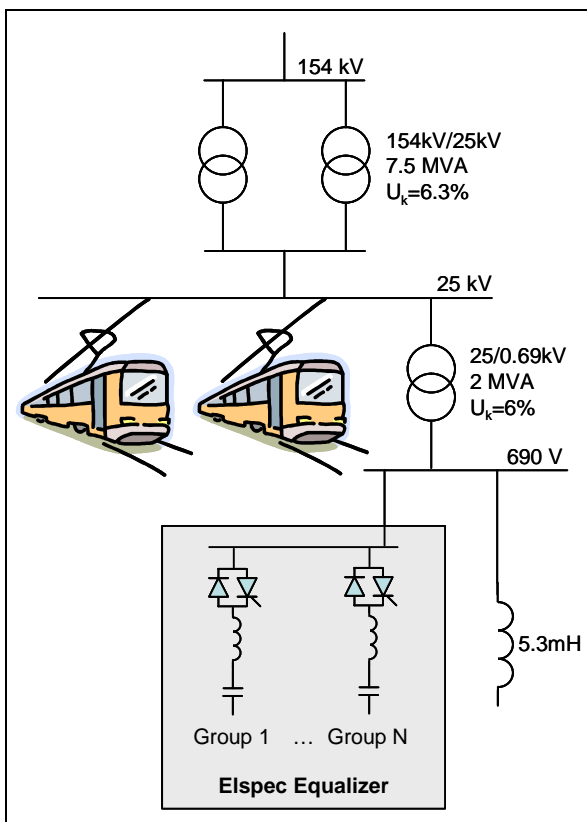


Figure 1: General Diagram

Turkish State Railways installed 23 single phase Elspec Equalizer systems, with nominal size ranging from 1250 kVAR to 3000 kVAR each (Figure 2). The systems had nominal voltage of 500V or 690V (line-to-ground), and were connected to the 25kV network using step-up transformer. Parallel inductor is permanently connected to compensate the capacity of the long lines, while there is no load.

## Elspec Equalizers Reduce Turkish State Railways Electricity Costs



**Figure 2: Elspec Equalizer at TCDD**

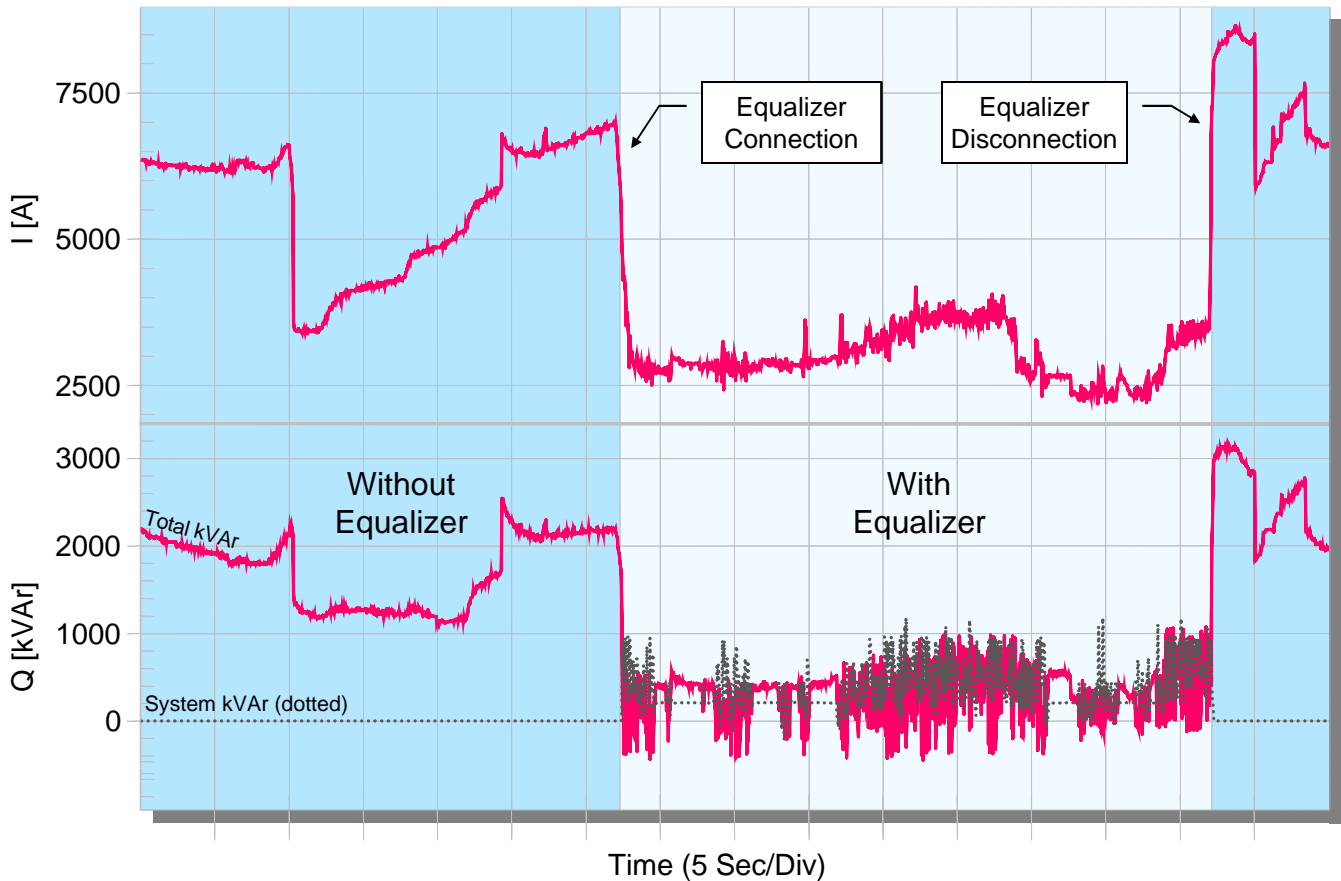
The Equalizer achieves full network compensation within maximum one network cycle. This results in unity power factor, improved power quality and energy savings. Therefore TCDD is able to use smaller transformer for the same load or increase the load on same substation (allowing more trains in the segment), together with enhanced network reliability.

Figure 3 shows the Equalizer system performance, taken using Elspec's advanced software PowerIQ, which allows remote control and operation of the systems. When the Equalizer was switched into Automatic mode the total network current was reduced from approx. 7000A to 3000A (more than 50%).

The project included two stages, and only after the successful installation and operation of the first 6 systems (along the Istanbul to Ankara railway), TCDD continued to the next stage with additional 19 systems along 4 countrywide lines.

### Major Benefits:

- ☑ Increasing Network Capacity
- ☑ Enhancing Network Stability
- ☑ Preventing Power Factor Penalties
- ☑ Reducing Infrastructure Costs



**Figure 3: Idealtepe Station With and Without Equalizer**