

## Stability Issues in Power Systems: Operation and Control of Turkish Transmission Grid

Recent advances in modern power system such as increase on the electricity consumption, need for low carbon emission targets due to climate changes and the increasingly widespread use of electrical vehicles worldwide lead to considerable changes in transmission networks. In terms of the generation, while traditional power systems are mostly based on thermal, hydro and nuclear plants those consist of high-power synchronous generators, modern power structures include renewable sources that use power electronics interfaces in order to transfer the generated energy to the grid. This situation requires great changes not only infrastructure of power grids but also their operational management. One of the most important reflections of this change is experienced in stability issues.

In similar to other developed and developing countries, the share of renewable sources in installed electricity capacity in Turkey has increased rapidly in the last 15 years. According to March 2022 data, installed power capacity is approximately 100 GW and the share of renewables in this power is about 54%. Utilizing distributed generation by taking the advantage of renewable sources those close to the loads is an advantage for system operators in terms of reducing the infrastructure requirements of transmission networks. However, especially for the systems those have instantly variable power energy sources like renewables, it is very important to be aware of the system dynamics in real time in order to have an idea about the operational stability of the grid and to prevent the system from the failures. Otherwise, protection systems activate automatically and disconnect some plants from the grid, which may lead to either separation of interconnected systems or blackout of whole system as experienced in Turkish power system on March 31, 2015. Therefore, it is of great importance to comprehend the stability issues in a power system such as frequency deviations, supply-demand imbalances, difference between the busbar power angles and so on.

