

## Connecting a three winding transformer to a 110kV line owned by Fingrid

According to General Connection Terms (YLE2017), maximum permissible capacity of a single connection to a 110kV line owned by Fingrid is 50MVA given that the transmission capacity of the line is sufficient and other technical preconditions are taken into account. Maximum apparent power for a single transformer is 25MVA (ONAN). Maximum level of power consumption or production to be connected to a single transformer is 30MW if the transformer is equipped with forced cooling (ONAF).

Within the limitations for maximum capacity defined by Fingrid, a single 50/25/25MVA three winding transformer can be used instead of two parallel 25MVA transformers if the following conditions are met:

- The mutual short-circuit reactance of both high voltage and medium voltage windings ( $Z_{12}$  ja  $Z_{13}$ ) shall be at least 48.0  $\Omega$  at the middle position of the tap changer (e.g. S=25MVA,  $U_n=110\text{kV}$ ,  $x_k=10\%$ ,  $X_k=48.4\Omega$ )
- Medium voltage windings (secondary and tertiary) shall not be galvanically connected during operation
- The inrush current of the transformer shall not cause a voltage drop exceeding the target level defined in report Power Quality in Fingrid's 110kV Grid ("110 kV verkon sähkön laaturaportti", 11<sup>th</sup> of September 2015). Design basis for maximum voltage drop at transformer energization shall be <3%. If this target level cannot be reached the transformer shall be equipped with single pole operated circuit breakers and point-on-wave switching.

Figure 1 illustrates connection of a three winding transformer to a 110kV transmission line owned by Fingrid.

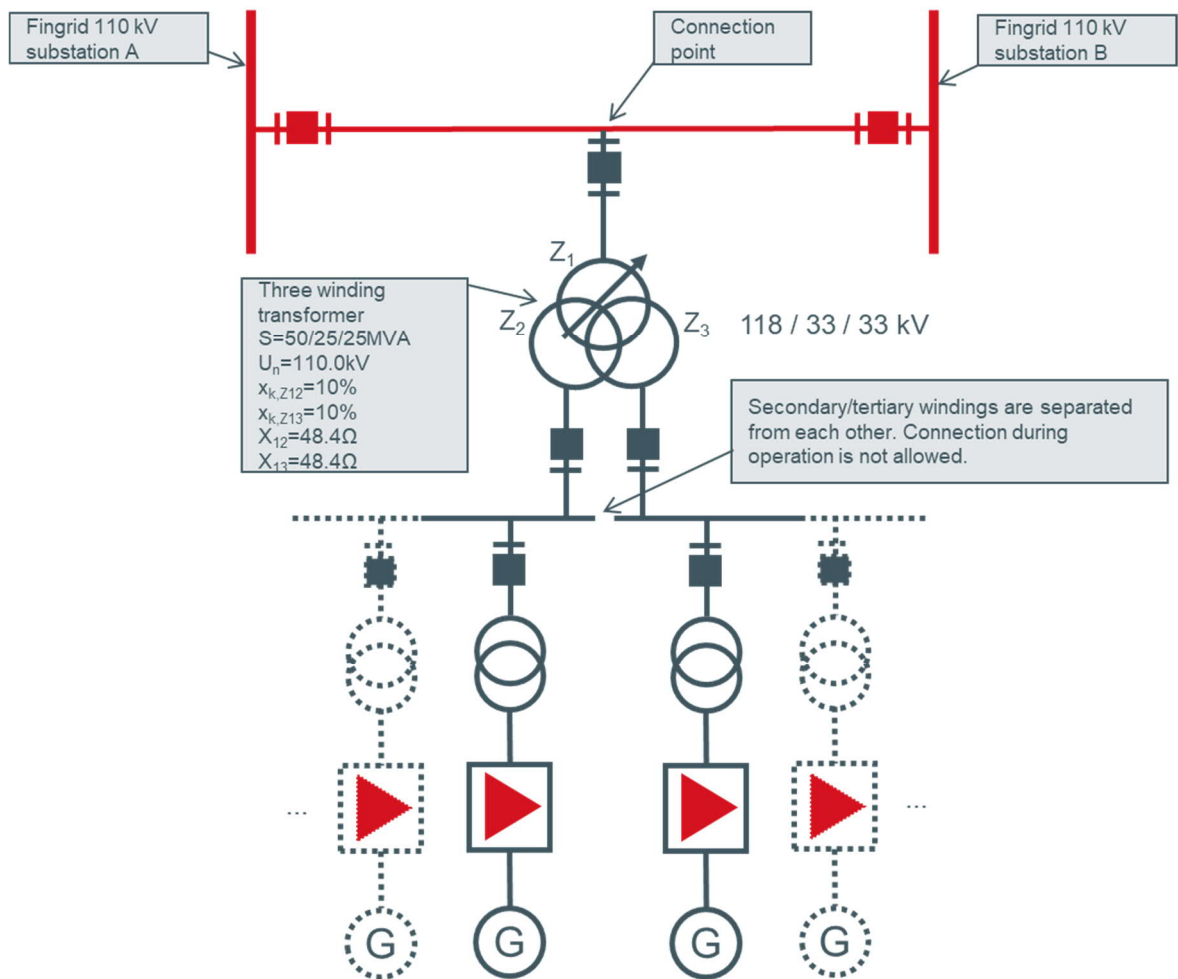


Figure 1. Connection of a three winding transformer to 110kV line owned by Fingrid.