

EEE8044 - Post Unit Assignment

Figure 1 shows an isolated three-phase load supplied from a 33 kV/11 kV substation via a 30 km long three-phase 11 kV overhead line. The overhead line has the following series parameters:

Series inductive reactance = $0.28 \Omega/\text{km}/\text{phase}$

Series resistance = $0.22 \Omega/\text{km}/\text{phase}$

Line capacitance and shunt leakage effects may be neglected.

The line supplies a small industrial site fed from a 600 KVA, 11 kV/415 V delta/star transformer with an impedance of 6% (calculated on transformer rating) and negligible resistance. The transformer secondary is earthed via a 1Ω earthing resistor.

The site has a load of 450 kVA at a power factor of 0.7 lagging. The voltage at the 33kV bus at the substation is maintained at 33.1kV and the 33kV fault level at the substation is 2000 MVA.

Section A

Calculate the voltage at the LV load bus (V_r), the substation power and reactive power flows and the power loss in the 11kV transmission line.

Calculate the site fault level at the 415 V side of the transformer.

Section B

Calculate the magnitude of the fault current at the transformer secondary terminals for the following types of fault:

- (i) phase-to-earth fault
- (ii) phase-to-phase fault
- (iii) phase-to-phase to earth fault

Section C

The site 450 kVA load is actually a three-phase, six pulse thyristor rectifier feeding a dc bus.

Assuming that the voltage waveform at the site 11 kV bus is purely sinusoidal, calculate the *Total Harmonic Distortion* (THD) at the 415 V point of common coupling. Is this level of harmonic distortion acceptable?

The site engineer has decided that a 75 kVA three-phase power factor correction capacitor bank should be connected across the incoming ac supply to improve the sites' power factor and to support the local voltage level.

Calculate the Total Harmonic Distortion at the 415 V point of common coupling for this new circuit arrangement.

Is this new level of harmonic distortion acceptable? If not, give a brief view on how might you go about solving the problem?

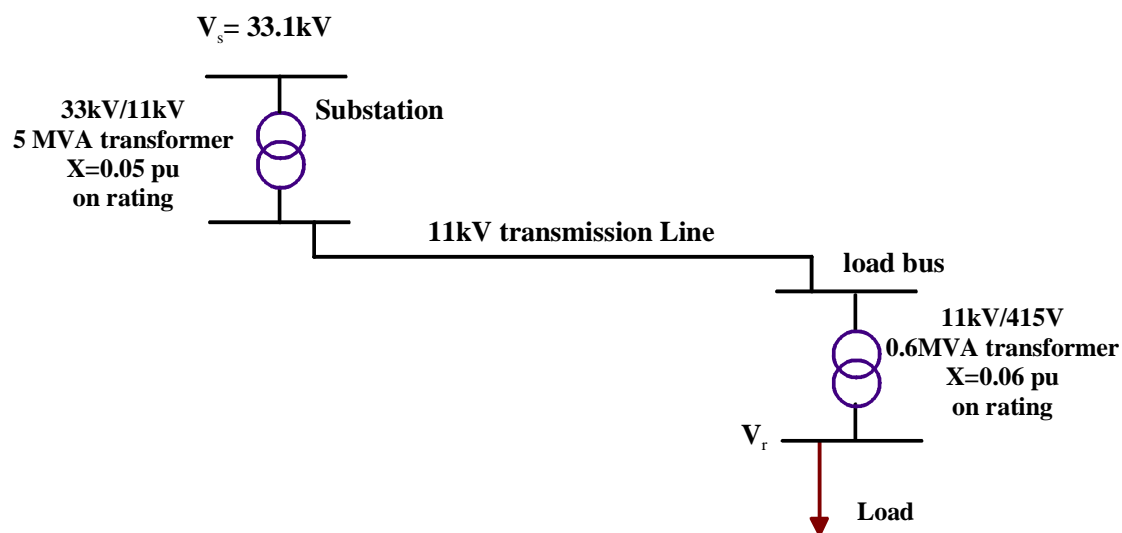


Figure 1