

Harmonic Analysis Assignment

(Based on an assignment by Prof. Michael Conlon)

The objective of this assignment is to investigate the harmonic performance of an 11kV network. The system is shown in Figure 1 below. The 11kV busbar is supplied through a HV supply. Customer A has a connected load of 345kVA load at 0.94 power factor lagging and wishes to connect a variable-speed AC drive using an uncontrolled, three-phase bridge rectifier at the 11kV bus. The full-load fundamental current is measured at 19.6A per phase. Customer B has a normal connected load of 520kVA at a power factor of 0.81 lagging and has installed 266kVA of power factor correction capacitors at the bus.

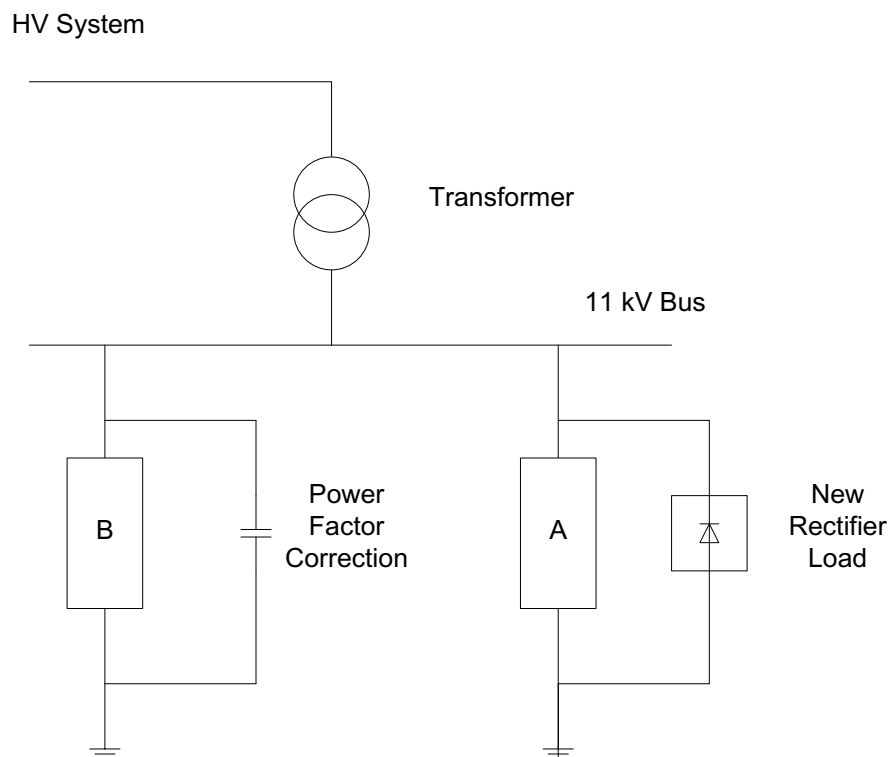


Figure 1: 11kV System with Harmonic Sources

The system fault level at the 11kV bus is 34MVA and the system impedance can be assumed to be purely inductive.

- a) Calculate the magnitudes of the 5th, 7th, 11th and 13th harmonic currents which would be injected into the system from the rectifier. By calculating the sum of the harmonic currents and plotting the waveshape of the current, confirm that the components are correct for a full-wave rectifier.
 - b) Draw the single-phase equivalent circuit of the system. Calculate the elements of the equivalent circuit and include the frequency-dependent nature of the relevant elements.
 - c) Calculate the harmonic voltage component at the 11kV bus. Plot the voltage wave shape at the 11kV bus.
- **Present your results in a report, addressing each of the sections and including relevant calculations as required. Ensure you state any assumptions made. Include references to any sources you use. You can use Matlab, Simulink or any other software you think appropriate.**

This assignment due on **Thursday 4 April 2024.**

Dr. Arash Beiranvand
March 2024