UNIVERSITY OF THE WITWATERSRAND
SCHOOL OF ELECTRICAL AND INFORMATION ENGINEERING
ELEN4018A/ELEN5008A: POWER SYSTEMS
TUTORIAL 4: CALCULATION OF FAULT CURRENTS

Question 1

Express an impedance of 100 Ω at 132 kV as a percentage impedance on a 100 MVA base.

Question 2

The sequence impedances seen upstream from the fault position on an 88 kV network are as follows

Positive: 38 Ω
Negative: 38 Ω
Zero: 152 Ω

What is the

(a) three phase fault current?
(b) phase-to-phase fault current?
(c) phase-to-ground fault current?
(d) positive, negative and zero phase sequence currents for a two-phase-to-ground fault?

Question 3

Demonstrate for a delta/star connected power transformer where positive sequence currents on the star side are 30° ahead of the positive sequence currents on the delta side that the negative sequence currents are 30° behind the negative sequence currents on the delta side.

Question 4

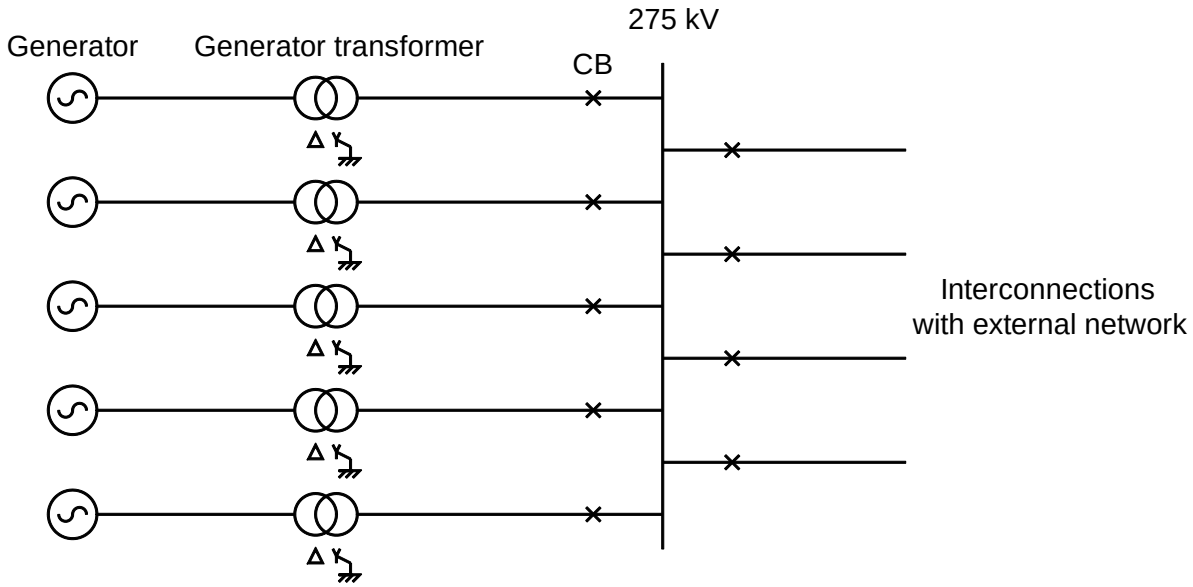
What are the zero sequence impedances, when viewed from first the primary side and secondly the secondary side, of the following transformers

(a) star/star with both neutrals unearthed?
(b) star/star with both neutrals earthed?
(c) star/star with only the primary neutral earthed?
(d) star/delta with the primary neutral unearthed?
(e) star/delta with the primary neutral earthed?

Include sketches with your answers. Indicate whether the zero sequence impedances are small (i.e. of leakage inductance magnitude) or large (i.e. of magnetizing inductance magnitude).

Question 5

A power station is to be constructed in order to increase the capacity of an existing system by 500 MW. The power station will consist of five 100 MW generators feeding into the existing 275 kV network and the layout of the 275 kV switchgear will be as indicated below



The details of the generators are

Rating: 100 MW
Power factor: 0,9
Transient reactance: 12%

The details of the generator transformers are

Rating: 110 MVA
Connection: delta/star
Leakage reactance: 10%
Zero sequence reactance (secondary side): 10%

The interconnections with the external network may be represented, for fault calculations, by a single equivalent generator having the following characteristics

Generated voltage: 275 kV
Positive sequence reactance: 7,5% on a 250 MVA base
Negative sequence reactance 7,5% on a 250 MVA base
Zero sequence reactance: 15% on a 250 MVA base

Calculate

(a) the three-phase fault current for a fault on the 275 kV busbar
(b) the phase-to-ground fault current for a fault on the 275 kV busbar
(c) the minimum rupturing capacity (in MVA) needed for the 275 kV circuit breakers

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