Question 3

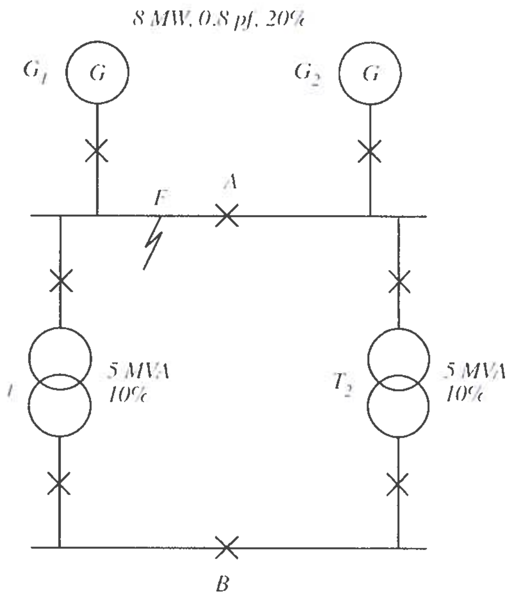
For the system shown in FIGURE 2, using a 10 MVA base, calculate the fault MVA levels through each unit and the base "voltage" MVA across each unit for a fault at F. Draw the impedance diagrams showing the fault levels and the base "voltage" MVA across each unit for:

(a) bus section switch B open and A open

(b) bus section switch B closed and A open.

Other circuit breakers are closed.

The generators have the same rating and characteristics.



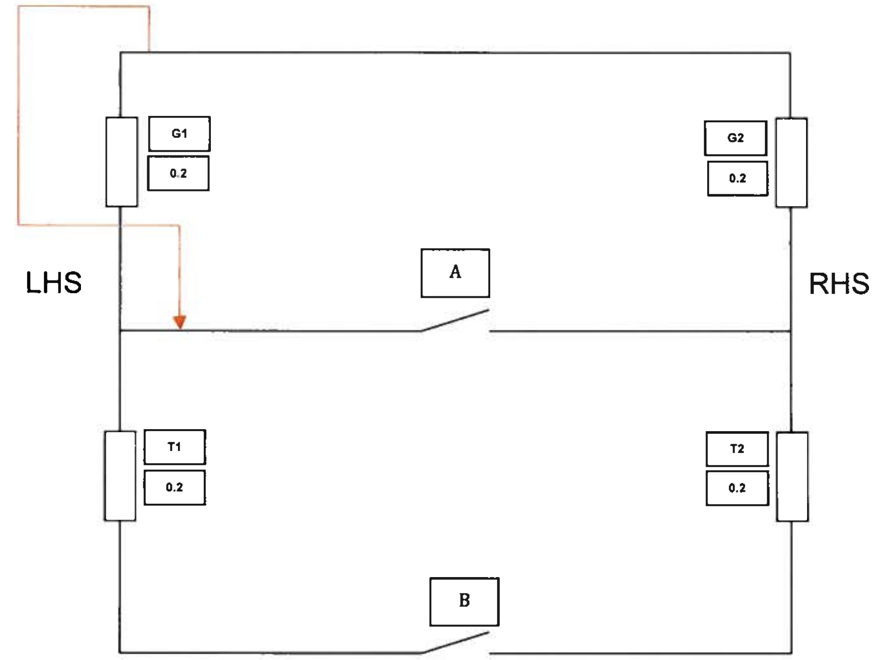
$Each\ generator\ is\ \frac{8}{0.8} = 10MVA$

$Generator\ X\ p.u. = \frac{10\ MVA}{10\ MVA} \times \frac{20}{100} = 0.2$

I need to convert the transformer to 10 MVA so: -

$Transformer\ X\ p.u. = \frac{10\ MVA}{5\ MVA} \times \frac{10}{100} = 0.2$

See next page

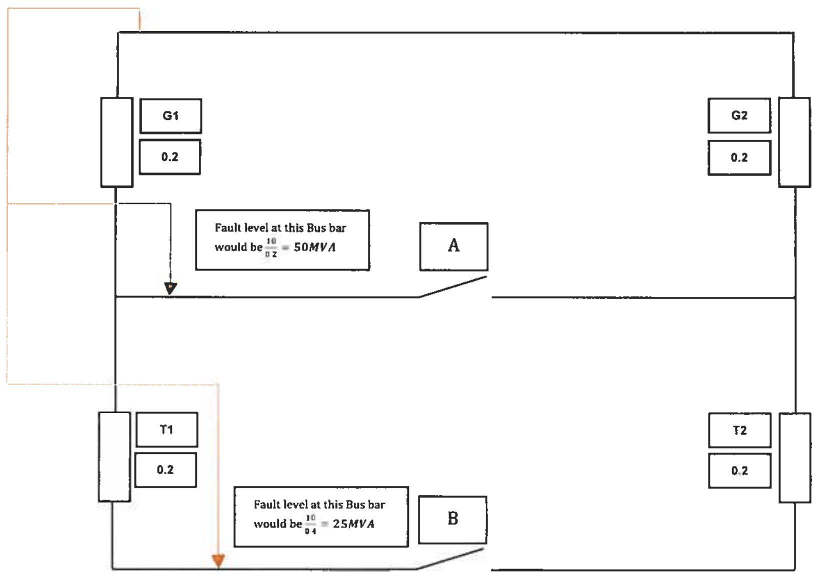


(a)

With Circuit breakers A and B open my understanding of the impedance diagram is shown above. The generators and transformers are not in parallel because bus coupler's A and B are open

$$The\ total\ fault\ level\ through\ the \frac{G1}{T1} leg, using\ a\ 10MVA\ base\ \text{"will be"} \frac{10}{0.2+0.2} = 25MVA$$

$$The\ total\ fault\ level\ through\ the \frac{G2}{T2} leg, using\ a\ 10MVA\ base\ \text{"would be"} \frac{10}{0.2+0.2} = 25MVA$$



In the first example, above, the RHS of the system is not affected by the fault

The 2 legs are completely isolated from each other in this first case. In effect we have 2 series impedances.

The voltage MVA base for each generator is 10MVA.

For the LHS side leg we get: -

$For\ generator\ 1\ we\ get\ 25 \times 0.2 = 5MVA$

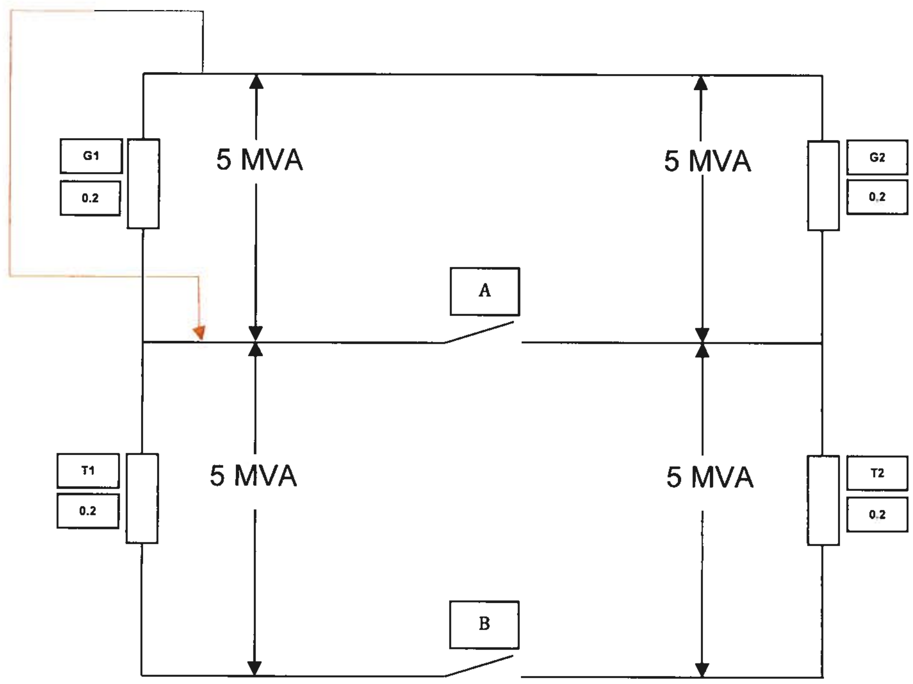
$For\ transformer\ 1\ we\ get\ 25 \times 0.2 = 5MVA$

For the RHS side leg we get: -

$For\ generator\ 2\ we\ get\ 25 \times 0.2 = 5MVA$

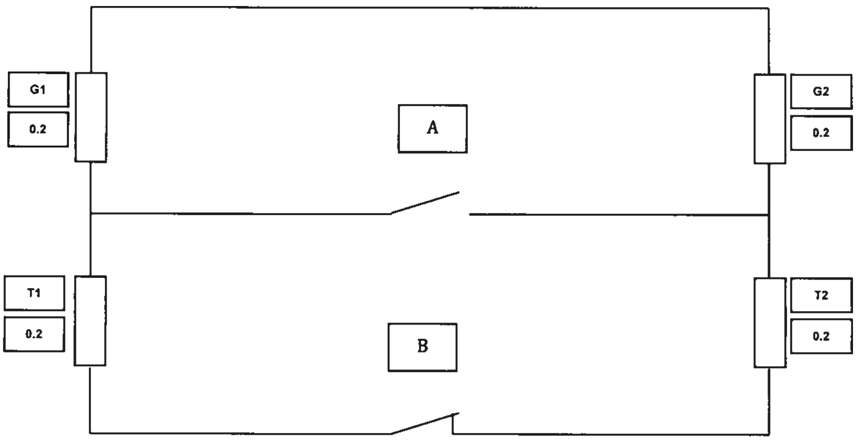
$For\ transformer\ 2\ we\ get\ 25 \times 0.2 = 5MVA$

The above all works out correct so the voltage MVA base for each generator will look like this below



(b)

If we now close bus coupler "B" and leave "A" open then my understanding of the impedance diagram is shown below. The generators and transformers are now in parallel as a result of B being closed.



For 2 generators in parallel

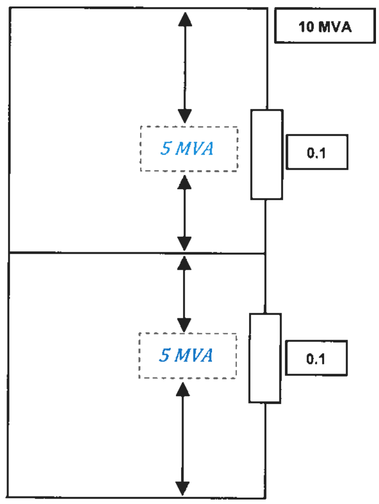
$$Xp.u. = \frac{10\ MVA}{10\ MVA} \times \frac{20}{100} = 0.2\ so\ \frac{0.2}{2} = 0.1\ p.u$$

For 2 transformers in parallel

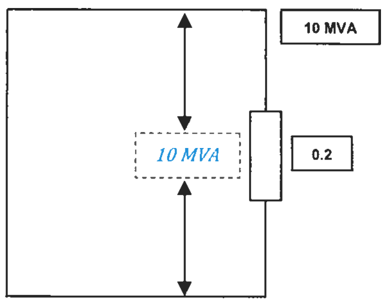
$$Xp.u. = \frac{10\ MVA}{10\ MVA} \times \frac{20}{100} = 0.2\ so\ \frac{0.2}{2} = 0.1\ p.u$$

So the impedance diagram will look like diagram (a) below then reduced again as per diagram (b) below

(a)



(b)



Combined generator impedance = 0.1 p.u.
Combined transformer impedance = 0.1 p.u.

$$fault\ level = \frac{10}{0.2} = 50\ MVA$$