Name: Yazan Yousef
ID: 1170249

Question 1

① $V_{L-L} = 11kV$
② Freq = 50 Hz
③ operating time: 5 cycle
$= 5 \times \frac{1}{50} = 0.1$ sec

④ coordination time = $0.3 \times$ => ~~0.39~~ = 0.39 sec.

⑤ PF => L1 = 0.99
L2 = 0.89
L3 = 0.99

① load currents:

$$I_1 = \frac{4 \times 10^6}{\sqrt{3}(11 \times 10^3) \times 0.99} = 212.066A$$

$$I_2 = \frac{2.5 \times 10^6}{\sqrt{3}(11 \times 10^3) \times 0.89} = 147.433A$$

$$I_3 = \frac{6.75 \times 10^6}{\sqrt{3}(11 \times 10^3) \times 0.99} = 357.861A$$

② The normal current through between bussies.

$I_{21} = I_1 = 212.066A$
$I_{32} = I_{21} + I_2 = 359.499A$
$I_3 = I_{32} + I_3 = 717.36A$.

(3) Normal relay currats:

$i_{21} = \frac{I_{21}}{CT_1} = \frac{212.066}{200/5} = 5.301 \rightarrow$ CTS Avalabile = 6 Ans

$i_{32} = \frac{359.499}{200/5} = 8.987 \rightarrow$ CTS Avalabile = 10 Ans

$i_3 = 8.967 \rightarrow$ CTS Avalabile = 10 Ans

(4) The corrat of relay (1) on th $I_{SC1} = \frac{2500}{200/5} = 62.5A$

can be expressed $\Rightarrow \frac{62.5}{CTS_1} = \frac{62.5}{6} = 10.42$

Choose the lowest TDS $\rightarrow$ $TDS_{(1)} = 1/2$ Ans

~~From relay characteristic.~~

(5) Relay (2) responding Fault at (1) :

$T_{21} = T_1 + \frac{5}{50} + 0.3$

T_1 for TDS $= 1/2$ & $i_{sc} = 10.42 = 0.1$

$T_{21} = 0.1 + 0.1 + 0.3 = 0.5$ sec.

Short circit for a fault at (1)

$\frac{i_{sc1}}{(CTS)_2} = \frac{62.5}{10} = 6.25$, From th curve at (6.25, 0.55 sec)

(e) $TDS_2 = 2$ Ans

(6) For relay 3 :

Fault at bus 2, the short C. current = 3000 A

Calculat T_{22} : a) $\frac{i_{sc2}}{CTS_2} = \frac{3000}{(200/5)\,10} = 7.5$

b) For $TDS_2 = 2$, from the curve $\rightarrow T_{22} = 0.5$ sec

* Now calculate T_{32} =>

$T_{32} = T_{22} + 0.1 + 0.3 = 0.9$

(7) To find $TDS_{(3)}$, we find the current as a multiple of pickup current by :

$\frac{i_{sc2}}{CTS_3} = \frac{3000}{(400/5)\,10} = 3.75$

So, for $T_{32} = 0.9$ & pickup current of 3.75 :
From the curve :

~~$TDS_3 \approx 3$~~ TDS_3 between the 2 & the 3

So we chose $TDS_3 \approx 3$ Ans