Department of Electrical and Electronic Engineering (EEE)
Faculty of Engineering (FE)
American International University- Bangladesh (AIUB)

Power System Protection

Summer 2020-21

Assignment (Mid-term)

Serial No.

(Find your SL. no. at the end)

34

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Section: D

1. Three types of protective relays that are commonly used in power system and they are

~~i) Short current~~

i) Over load protection relays: This types are specially designed to provide the overcurrent protection of electrical equipments like motors and circuits.

ii) Electromechanical relays: Mainly it have a electromechanical coil and a mechanical movable contact. when the coil receives the current, it creats a magnetic field which control the movable contact. This types of relays are commonly used in power system protection units

iii) Reed Relays: Similar to the electromechanical relay: reed relays also produce the mechanical actuation of physical contacts ~~at~~ to open or close a circuit path. But compared to electromechanical relays these types ~~also~~ of relay contacts are much smaller and have low mass.

So this are some basic comparison between different types of protective relays that are commonly used in power system protection design.

2.

We know,

$$\frac{r_2}{r_1} = \left(\frac{I_2}{I_1}\right)^{2/3}$$

$$R_2 = R_1 \times \left(\frac{I_2}{I_1}\right)^{2/3}$$

$$= 9.78 \times \left(\frac{7}{20}\right)^{2/3}$$

$$= 4.85 \text{ mm} \quad (\text{Ans})$$

Here,

Area $\pi r_1^2 = 300$ mm^2

$r_1 = 9.78$ mm

$I_1 = 20$ A

$I_2 = 7$ A

3.

We know,

$$\text{Symmetrical breaking current} = \frac{2500}{\sqrt{3} \times 33}$$

$$= 43.74 \text{ kA}$$

here,

three phase 33 kV

breaking capacity

2500 MVA

$$\text{Making current} = 2.55 \times 43.74$$

$$= 111.55 \text{ kA}$$

Short time rating 43.74 kA for 4 sec

9. Transformer rating = 350 kVA

Transformer voltage ratio = 400 / 11 kV

$Z_{pu} = 6.5\% = 0.065$

$$I_{base}\ LT = \frac{350 \times 10^3}{\sqrt{3} \times 400} = 505.18\ A$$

$$I_{base}\ HT = \frac{350 \times 10^3}{\sqrt{3} \times 11 \times 10^3} = 18.37\ A$$

$$I_{pu}\ LT = \frac{1}{Z_{pu}} = \frac{1}{0.065} = 15.38\ pu$$

$$I_{fault}\ LT = 505.18 \times 15.38 = 7.77\ kA$$

$$I_{fault}\ HT = 18.37 \times 15.38 = 282.53\ A$$

So for LT side of 630 A should be chosen and for HT side fuse of 20 A should be chosen.

5.

We know,

$$V = i\sqrt{\frac{L}{C}}$$

$$= 13 \times \sqrt{\frac{(4.65 \times 10^{-11})}{(0.01 \times 10^{-6})}}$$

$$= 0.88\ V$$

$$R = \frac{1}{2}\sqrt{\frac{L}{C}}$$

$$= \frac{1}{2}\sqrt{\frac{4.65 \times 10^{-11}}{0.01 \times 10^{-6}}}$$

$$= 0.03\ \Omega$$

Here,

$$C = 0.01\ \mu F$$

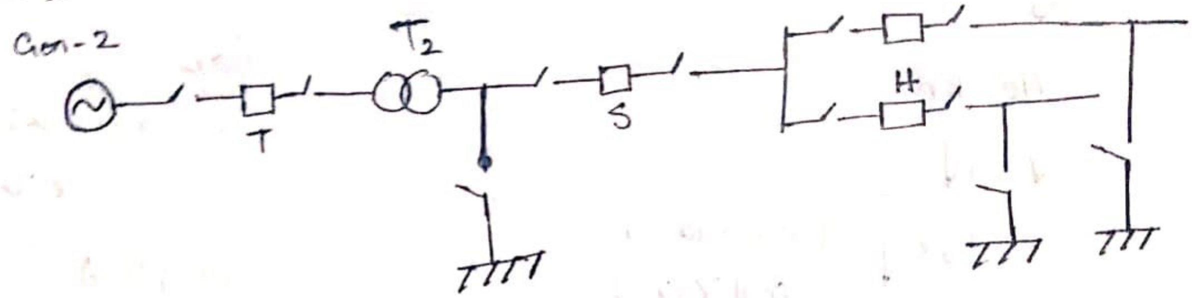
$$= 0.01 \times 10^{-6}\ F$$

$$i = 13\ A$$

$$L = \frac{C}{215}$$

$$= 4.65 \times 10^{-11}\ H$$

6(a)



→ Isolator

→ earthing switch

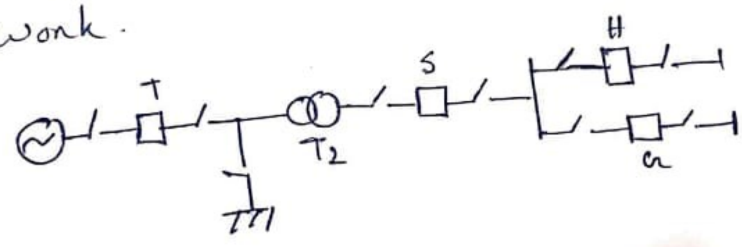
→ Circuit breaker

→ Generator

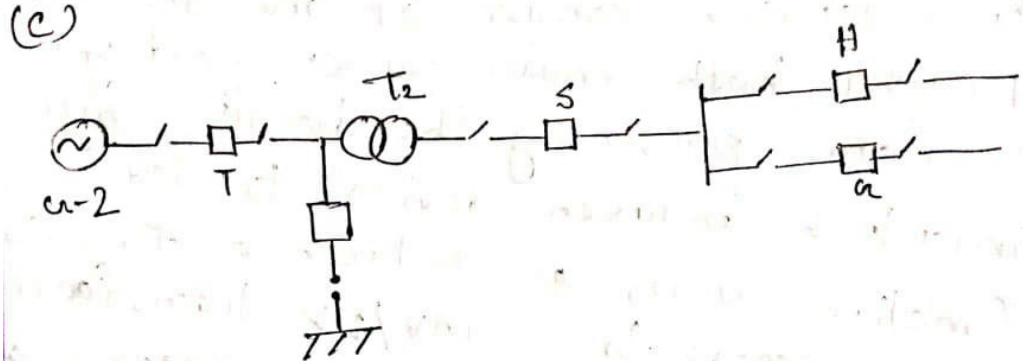
→ Transformer

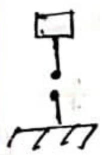
(b) The interlock consist of one or more switch that prevent both main power and generator power from powering the dwelling simultanously. The interlock between devices, located in separate MV function units or between a functional unit and access to a MV/LV transformer for example are performed by means of keys. The principle is based on the possibility of freeing or tapping one according to whenever or not required conditions of operation are satisfied.

If we want to take out T-2 for any maintance work, we have to trun of the link by interlock system from both ~~out~~ outdoor and indoor. First turn off the load, then ~~eat~~ grounded the line and then turn off the generation line. After that we can take off T-2 transformer for maintaince work.



(c)

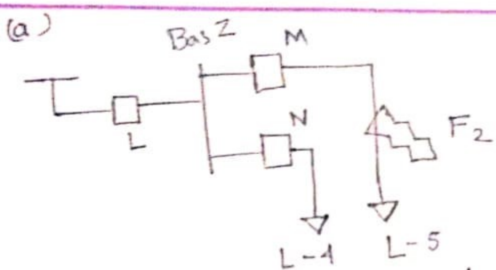




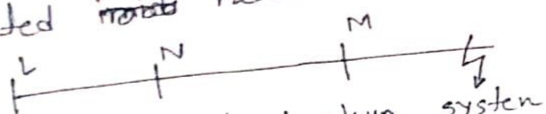
Lightning Arrester

Indicating lightning arrester in SLD. Basically lightning arrester is connected across the transformer ~~p~~ to bypass the high voltage current into the ground. In t substation design it is also connected across the transformer T-2

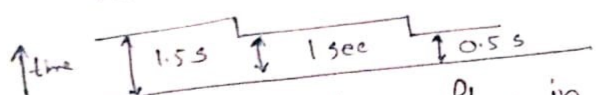
7(a)



A fault occure at the terminal of L-5. have been
In this case, difinite time over current operates for a
used when a difinite time relay trip
fault current, it start a timing unit which which
the circuit breaker after a present time,
located ~~[illegible]~~ near the fault occure



Time current backup systen



When fault current is flow in all the relays. But as the
fault is occuring on M the relay is closed to the
fault should operate first, if this relay fail
then the relay system in N operate ~~[illegible]~~ ~~when~~
So this is the time graded back up system

(b) Considering proper selectivity of a circuit breaker in figure 2 and the circuit breakers which should be tripped for individual fault at location F_1, F_2 and F_3

Figure 2 substation line 1, F_3 fault is happening on Bus U to Bus V which is include circuit breaker A and C. Another fault F_1 is happening transformer 2 line Bus Y. which is include where the F_1 happening.

(c) In this TCC curve this example is non-
selective system. Because in the fault of
Bus X CB-L is firstly responce before CB-J
which is non a proper system example. Also
for fault at Bus Z CB-L has to responce
first before other which is not happend
accordin to the TCC -carve which was
given in Fig-3. Thats why it is not a
proper selective system. If CB-L fail
there are some backup CB's are available
and they are CB-k, CB-M, CB-N which
protect the system.