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S7E2
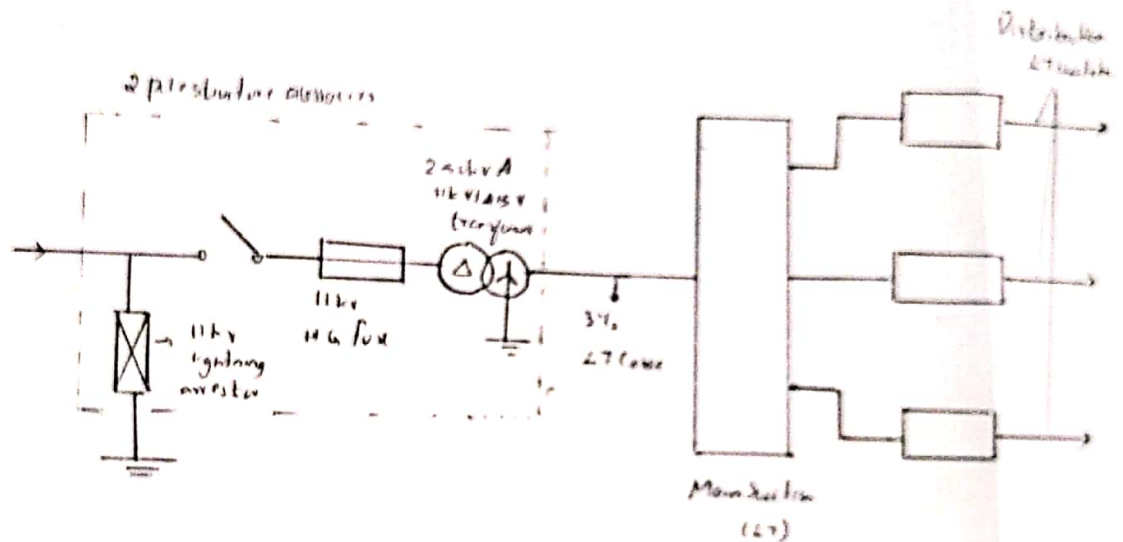Roll no: 37209

ESD

1) Draw a single line diagram of a pole mounted outdoor substation of 250 kVA, 11kv/415v transformer showing all necessary parts

Ans)

2) Calculate the load current, fuse rating, type of starter and cable size for the following motor.

i) 20 HP, 415 V, 50 Hz with 80% efficiency

→ Assume p.f = 0.8

$$I_{FL} = \frac{20 \times 735.5}{\sqrt{3} \times 415 \times 0.8 \times 0.8} \qquad \left[I = \frac{HP \times 735.5}{\sqrt{3} \, v \, (\rho f)} \right]$$

$$= 31.97 A$$

Assume $I_{St} = 1.8 I_{FL}$

$$= 57.16 A$$

∴ fuse rating = 63 A (standard value)

Cable Size = 25 mm², 1100 v grade, 3 core, aluminium conductor, PVC insulation, PVC sheathed, unarmoured / armoured cable

Type of starter = auto transformer (since 20 HP > 15 HP)

ii) 40 H P, 0.8 p.f, 80% efficiency

→ Assume voltage, $V = 415 V$

$$I_{fl} = \frac{40 \times 735.5}{\sqrt{3} \times 415 \times 0.8 \times 0.8}$$

$$= 63.94 A$$

$$I_{st} = 1.67 I_{fl}$$

$$= 102.3 A$$

∴ fuse rating = 125 A (standard value)

Cable size = 70 mm², 1100V grade, 3 Core, Al Conductor, PVC insulated, PVC sheathed unamoured/armoured cable.

Type of starter - auto transformer

iii) 75 HP motor

→ Assume $V = 415 V$, $\eta = 0.85$, $pf = 0.8$

$$I_{fl} = \frac{75 \times 735.5}{\sqrt{3} \times 415 \times 0.85 \times 0.8}$$

$$= 112.85 A$$

$$I_{st} = 1.67 I_{fl}$$

$$= 188.5 A$$

∴ fuse rating = 200 A

Cable size = 150 mm², 1100V grade, 3 Core, Al Conductor, PVC insulated, PVC sheathing unamoured/armoured Cable

Type of starter - auto transformer.

3) Draw a single line diagram of a transformer substation of 400 kVA, 11 kV/415 V dry type transformer. Specify ratings of each units in 1° and 2° sides with proper justification.

11kv lightning
arrester.

11kv fin

11kv underground cable

11kv
Gusuitch

11kv
outdur
cable box

11kv underground cable

(3 metering LT

Protection CT

P7
11kv/110v

11kv, OCB with o/c
and E/f protection

11kv metering
Equipment

400kvA, 11kv/415v
Transformer

3½ core LT cable

LT CB

LT Busbar

Protection
CT

LT
Circuit
breaker

LT
Switch
fuse unit

outgoing LT lines