MODULE IV

ESTIMATION OF 11kV OH LINES AND SUBSTATIONS

Transmission and Distribution Lines

Transmission lines are the links between generating stations and substations. Distribution lines are the links between substations to consumers. Transmission lines carry power at high voltages such as 66kV, 132kV,220kV, 400kV…etc. Distribution lines carry power 11kV and 240 V. 11 kV power for industrial purpose and 240 for domestic purpose.

Major components of Over Head lines

1. Supports:- Poles or towers- steel, wood..etc
2. Insulators:-Pin, Disc, suspension, strain
3. Cross arms and clamps:- support insulators
4. Conductors:- ACSR, AAC…etc
5. Guys and Stays:- support for poles
6. Lightning Arrestors:- protect from lightning
7. Fuses and Isolators :- to isolates different parts of transmission lines
8. Earth wires:- runs over the top of High voltage transmission lines and substations to protect from lightning
9. Vee Guards:- Runs below the lines, normally crossing the streets, river, railway line..etc.
10. Guard Wires:- Same as above
11. Barbed wires:- To protect some portion of support to avoid the climbing of un-authorized persons.

Guide lines for Transmission line Estimation

1. Find the no of poles required $\left(\frac{dis\tan ce}{span}\right)$
2. Calculate length of conductors :- (distance $\times 2$ or no of phases)+ 5% wastage
3. Calculate no of insulators
    a) Pin insulator:- (Total pole -1) $\times$ 2
    b) Disc insulator:- (starting + ending pole)x no of phases
4. Cross arms:- Total no of poles +1 (for existing pole)
5. Stay Set(one for each 3^{rd} pole + start and end)
6. Earth set (one for every 5^{th} pole)
7. Danger plate (one for each pole)

Substation Estimation

Substations serve as sources of energy supply for the local areas of distribution in which these are located. Their main functions are to receive energy transmitted at high voltage from the generating stations, reduce the voltage to a value appropriate for local distribution and provide facilities for switching. Some substations are simply switching stations where different connections between

various transmission lines are made, others are converting substations which either convert AC into DC or vice-versa

CLASSIFICATIONS

The substations may be classified in numerous ways. Some of the common ones are;

a) On the basis of nature of duty

i) Step up or primary substations

These are the substations where from power is transmitted to various load centers in the system network and are generally associated with generating stations.

ii) Step- up and Step-down or secondary substations

These are located at generating points where from power is fed directly to the loads and balance power generated is transmitted to the network for transmission to other load centers.

iii) Step-down or distribution substations

Such substations receive power from secondary substations at extra high voltage (above 66kV) and step down its voltage for secondary distribution.

b) On the basis of operating voltage

i) High Voltage substation (HV) - voltage between 11kV and 66kV

ii) Extra High Voltage - (b/w 132 kV – 400kV)

iii) Ultra High Voltage - (above 400kV)

c) On the basis of importance

i) Grid Substation

These are the substations from where bulk power is transmitted from one point to another point in the grid. These are important because any disturbance in these substations may cause the failure of the grid.

ii) Town Substations

These are EHV substations which step down the voltage at 33/11kV for the distribution in the town and any failure in such substations results in the failure of supply for the entire town.

d) On the basis of Design

i) Indoor type substations

in such substation the apparatus is installed within the substations building. Such substations are usually for voltages up to 11kV but can be erected for the 33kV and 66kV and the surrounding atmosphere is contaminated with impurities such as metal corroding gases and fumes, conductive dust etc.

ii) Outdoor substations

These are further sub divided into;

a) Pole mounted substations

Such substation is erected for distribution of power in localities. Single strut pole or H- type pole or 4 pole structures with suitable platforms are employed for transformer's of capacity up to 25kVA, 100kVA respectively.

b) Foundation mounted substations (Plinth)

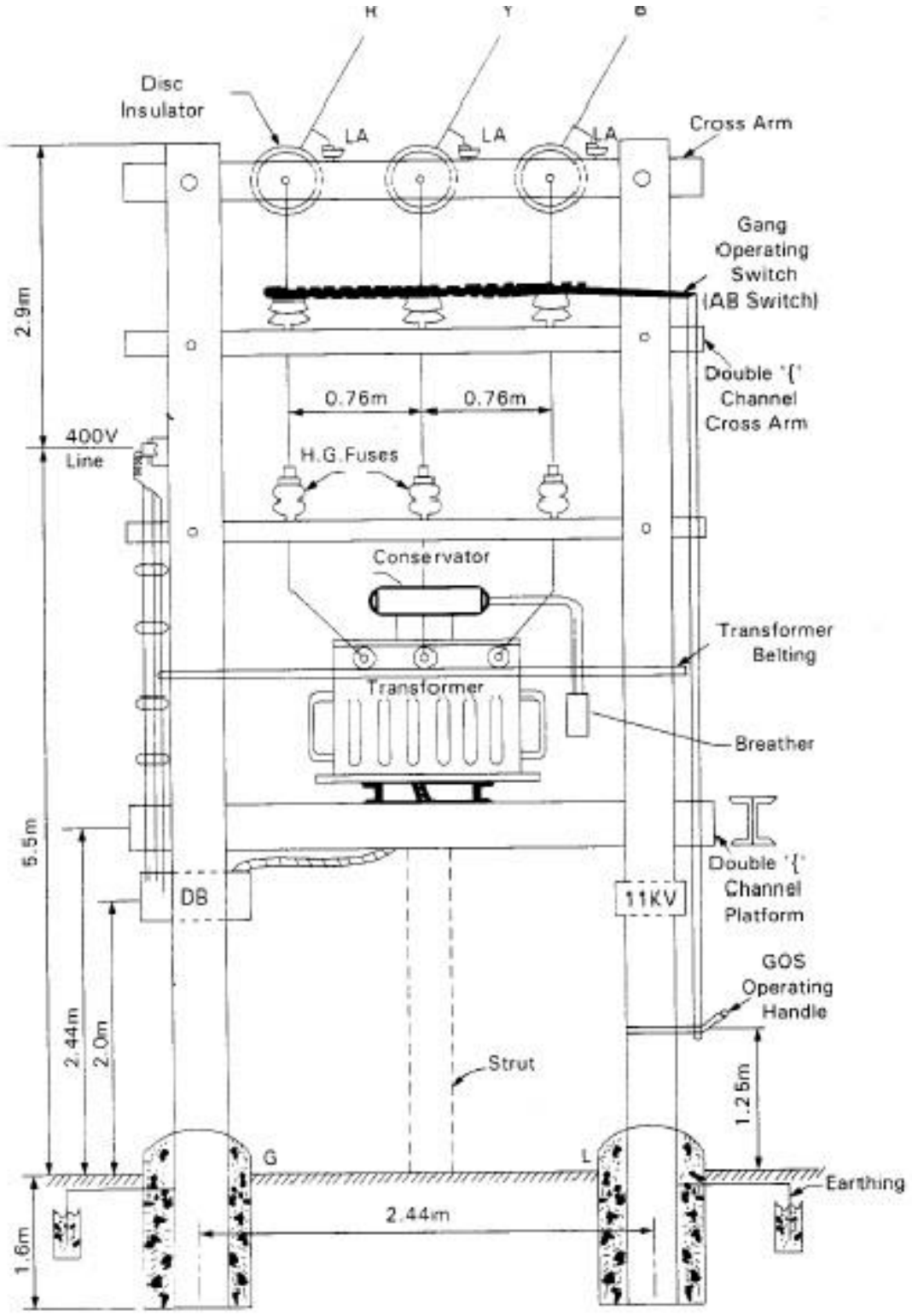
The capacity above 250 kVA, the foundation is used.

Advantages and Disadvantages of outdoor substations

1. All the equipment is within view and therefore fault location is easier.
2. The extension of the installation is easier if required
3. The time required in erection of such substation is lesser
4. The smaller amount of building material is required (steel, concrete..etc)
5. The construction work required comparatively small and cost of the switchgear installation is low
6. There is practically no danger of fault which appears at one point being carried over to another point in the installation.

Disadvantages

1. The various switching operation with the isolators as well as supervision and maintenance of the apparatus is to be performed in the open air during all kinds of weather
2. More space is required for the substation
3. The influence of rapid fluctuations in ambient temperature and dust and dirt deposits upon the outdoor substations equipment makes it necessary to install apparatus specially designed for outdoor service and therefore more costly.



(b) Pole-Mounted Sub-Station (11 KV/400-V)

Estimate the quantity of material and cost for erection of a 250 kVA pole mounting substation

The quantity of material and cost for erection of a 250 kVA pole mounting substation is estimated as follows;

Calculation line diagram

Capacity: 250 kVA

Voltage rating 11kV/ 433V

H.T Current:

LT current:

Sl no.	Description of material with specification	Quantity Required		Rate		Total	remark
		Qty	unit				
1	PCC poles 11 m long	2	No	2000	each		H-structure
2	11 kV disc insulators	3	No	200	,,	600	
3	Lightning arrestor (1 set of 3)	**1**	Set	2500	,,	2500	
4	Gang operating switch	1	Set	10000	Set	10000	
5	11 kV DO fuse unit(Drop out)	1	,,	2300	,,	2300	
6	250 kVA, 11/440 V 3 phase 4 wire 50 Hz outdoor type T/F with complete accessories and oil filled	1	No	300000	,,	300000	
7	MS angle iron 50mm×50 mm×6mm	6	No	500		3000	Fuses & LT cubicle
8	MS channel iron 100mm × 50mm × 6 mm	2	No	1000	,,	2000	For T/F
9	400A, 500 V, ICTPN switch with rewirable type porcelain Fuses (complete set)	1	No	5000	,,	5000	LT line control
10	ACSR conductor 7/2.11 mm	15	M	100	M	1500	b/w OH and T/F
11	Single core VIR cable 95mm^2	20	M	50	M	1000	
12	19/ 1.63 mm single core VIR cable	7	M	30	M	210	for neutral connection b/w T/F LT side to LT switch
13	Clamps	6	No	60	Each	360	
14	Earthing set	4	No	2000	,,	8000	
15	Stay set with insulation	2	No	1000	,,	2000	
16	Barbed wire	10	Kg	50	Kg	500	

17	Danger plates with clamps	2	No	100	Each	200	
18	Nuts and bolts	Lump sum				1000	
19	Cement	4	Sack	350	Sack	1400	For H- pole footing
20	Sand	4	,,	100	,,	400	,,
21	Pebbles	4	,,	200	,,	800	,,

TOTAL = 342770

for contingencies (2% of total cost) =

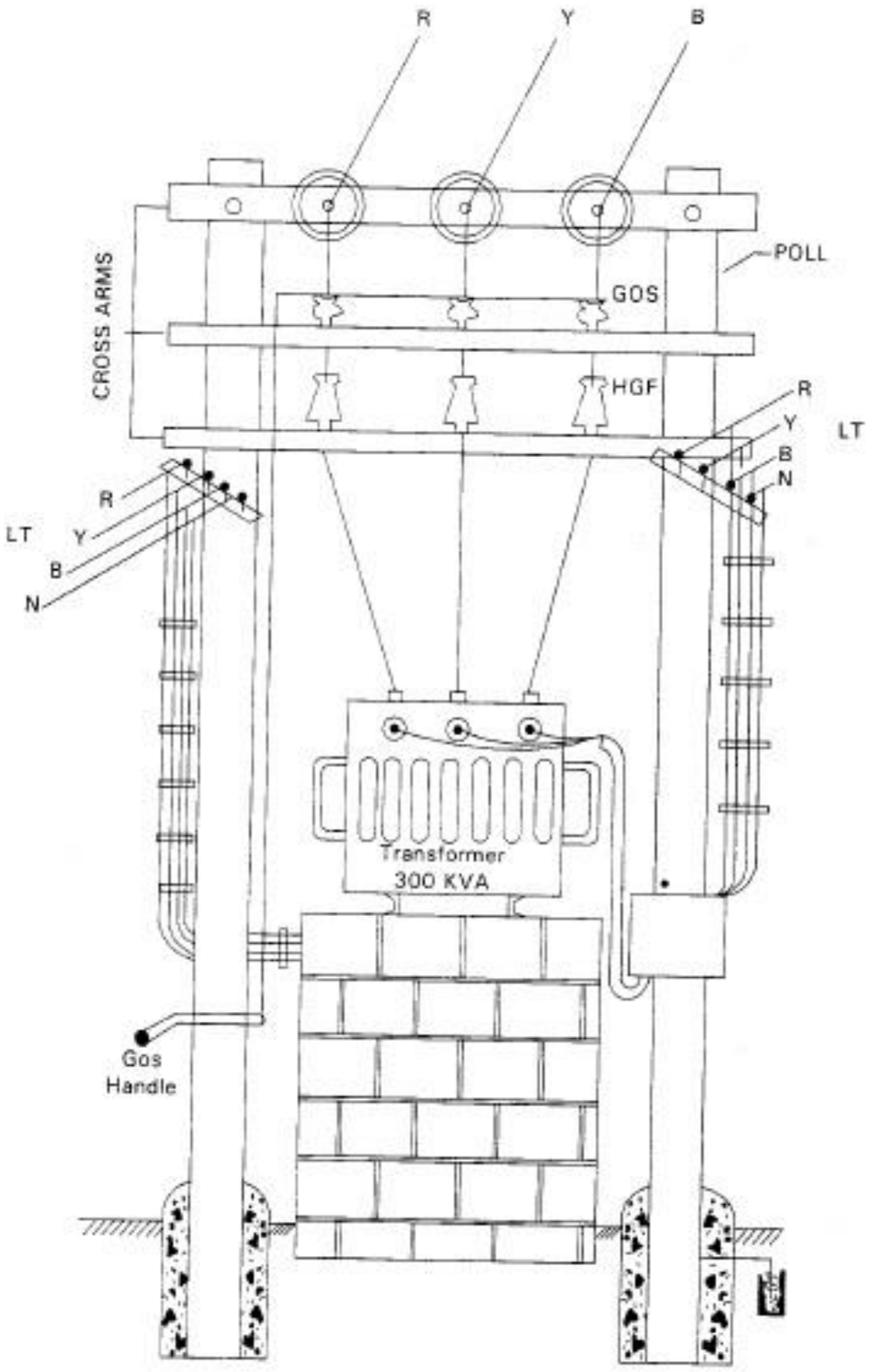
Labour and transportation cost (15 %) =

Super vision charges (5%) =

GRAND TOTAL =

The total amount required for the installation of a 250kVA pole mounted substation on 2-pole structure is rupees…

Estimate the quantity of material and cost for erection of a 500 kVA plinth mounting substation


R
Y
B
POLL
GOS
CROSS ARMS
HGF
R
Y
B
N
LT
LT
R
Y
B
N
Transformer
300 KVA
Gos
Handle

Sl no.	Description of material with specification	Quantity Required		Rate		Total	remark
		Qty	unit				
1	PCC poles 11 m long	2	No	2000	each		H-structure
2	11 kV disc insulators	3	No	200	,,	600	
3	Lightning arrestor (1 set of 3)	**1**	Set	2500	,,	2500	
4	Gang operating switch	1	Set	10000	Set	10000	
5	11 kV DO fuse unit(Drop out)	1	,,	2300	,,	2300	
6	500 kVA, 11/440 V 3 phase 4 wire 50 Hz outdoor type T/F with complete accessories and oil filled	1	No	300000	,,	300000	
7	MS angle iron 50mmX50mmX6mm	6	No	500		3000	Fuses & LT cubicle
8	MS channel iron 100mm X 50mm X 6 mm	2	No	1000	,,	2000	For T/F
9	400A, 500 V, ICTPN switch with rewirable type porcelain Fuses (complete set)	1	No	5000	,,	5000	LT line control
10	ACSR conductor 7/2.11 mm	15	M	100	M	1500	b/w OH and T/F
11	Single core VIR cable 95mm^2	20	M	50	M	1000	
12	19/ 1.63 mm single core VIR cable	7	M	30	M	210	for neutral connection b/w T/F LT side to LT switch
13	Clamps	6	No	60	Each	360	
14	Earthing set	4	No	2000	,,	8000	
15	Stay set with insulation	2	No	1000	,,	2000	
16	Barbed wire	10	Kg	50	Kg	500	
17	Danger plates with clamps	2	No	100	Each	200	
18	Nuts and bolts	Lump sum				1000	
19	Cement	4	Sack	350	Sack	1400	For H- pole footing
20	Sand	4	,,	100	,,	400	,,
21	Pebbles	4	,,	200	,,	800	,,