

Question NO. 1

1-A) Draw a diagram of electrical scheme for 132/ 11 kV indoor substation, double bus bar. The following equipment is to be connected:

- 1- Three overhead 132 kV lines
- 2- 132kV circuit breakers (Qty:6).
- 3- 132/11 kV 30 MVA power transformers (Qty:3).
- 4- 11kV circuit breakers (Qty:9).
- 5- Lightning arresters 132 kV (Qty:3).
- 6- 11kV feeders (Qty:6).
- 7- 132 kV isolators (Qty:12).
- 8- 11 kV isolators (Qty:18).

Show earthing switches where necessary.

1-B) Estimate the preliminary budget required (through a bill of quantities table) for establishing the above-mentioned substation within an installation period of three years. The inflation rate (I) in three years at I = 10% per year.

Cost factor	Total estimated cost in \$
1-Labors (200 operators)	1 operator working 4 hours / day at \$ 22.5/ hr.
2- Hauling per year.	\$ 100000
3- <u>Materials</u>	<u>Assume the unit cost for each item</u>
4- Erection per year	\$ 500000
5- <u>Testing & commissioning</u>	<u>\$ 300000</u>
6- <u>overhead , profit and taxes</u>	<u>50% from the item price</u>

Question NO. 2

2-A) Draw a diagram of electrical scheme for 132/ 11 kV SF6 indoor substation, double bus bar. The following equipment is to be connected:

- 1- Four overhead 132 kV lines (two incoming feeders and two out going feeders)
- 2- 132/11 kV 15 MVA power transformers (Qty:2).
- 3- 11kV feeders (Qty:9).

2-B) Estimate the preliminary budget required for establishing the above mentioned substation within an installation period of three years. The inflation rate (I) in each year at I = 12% per year. Taxes 15% per year.

Cost factor	Total estimated cost in \$
1-Labors (300 operators)	\$ 550000
2- <u>Hauling per year.</u>	<u>\$ 110000</u>
3- <u>Materials</u>	<u>Assume the unit cost for each item</u>
4- <u>Erection per year</u>	<u>\$ 500000</u>
5- <u>Testing & commissioning</u>	<u>\$ 300000</u>
6- <u>overhead , profit</u>	<u>50% from the item price</u>

Question NO. 3

3-A) Explain the relationship between engineering economic analysis and engineering design. How does economic analysis assist decision making in the design process.

3-B) Define the following terms:

Fixed cost – Variable cost – Deflation.

3-C) Compare between the project cost estimating fundamental approaches used to describe the process by which the present and future cost consequences of engineering design are forecast.

3-D) Sketch the type of construction of isolators used in indoor & outdoor high voltage substations.

3-E) Sketch the type of construction of 33 kV isolators used in indoor high voltage substations.

3-F) State the sequence of operation of circuit breaker, isolator, and earthing switch, while opening & closing.

Question NO. 4

4-A) Estimate the preliminary budget required for replacing 10 NO.s of existing isolators with new one erected on 66kV front bus bar side in 66/11 kV substation(double B.B.), within an installation period of three months. The starting time of erection is 1/1/2009. Taking into consideration that the published cost of same work at similar project = \$16000 for the current year, includes Erection-Material-Overhead-profit-Taxes. The other expenses (remain constant) = \$5000. The inflation rate (I) =7% per year.

4-B) Estimate the preliminary budget for establishing 66/33/11 K.V. double bus bar indoor substation. The following equipment is to be connected:

66 kV overhead lines (4 No), 66 kV circuit breakers (7 No),

66/33 kV- 30 MVA power transformers (3 No),

33 kV feeders (underground cables) (6 No),

33/11 kV- 25MVA power transformers (3No),

33 kV circuit breakers (9 No), 11 kV overhead lines (5 No),

11 kV feeders.(underground cables) (5 No), 11 kV circuit breakers (14 No),

11/0.38 kV- 750 KVA local transformer (1No),

0.38 kV feeders (underground cables) (10 No),

0.38 kV air circuit breakers (11 No), 66 kV isolators (14 No),

33 kV isolators (18 No), 11 kV isolators (28 No), Single bus bar on 0.38kV side for local transformer connection with the loads inside the substation building,

All 66 kV CBs are oil, All 33kV& 11kV CBs are SF6, Show earthing switches, lightning arresters where necessary on the substation electrical scheme.

4-C) For establishing the above-mentioned substation within an installation period of 4 years. The inflation rate (I) in 4 years at I = 10% per year \$1=L.E. 5.5

Cost factor	Total estimated cost in \$ & L.E.
1-Labors (200 operators)	1 operator working 4 hours / day at L.E. 30/ hr.
2- Hauling per year.	L.E. 200000
3- Materials	Assume the unit cost for each item
4- Erection per year	\$ 500000
5- Testing & commissioning	\$ 300000
6- overhead , profit	50% from the item price
7- taxes	20%