EVALUATION OF THE ELECTRICITY DISTRIBUTION NETWORKS IN TERMS OF THE INVESTEMENT COST OF THE NETWORK COMPONENTS

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ABSTRACT

This paper is a suggested study which may be applied in the electricity distribution utilities to evaluate the investment costs of the electrical distribution system components.

INTRODUCTION

Evaluation of the investment cost study for the distribution systems is one of the main target of the Electricity distribution utilities from which we can calculate some factors and indices to:-

1-Make the utility able to evaluate the investment cost of the network components

2-Make a good orientation of these investments according to the available financing resources

3- Study the effect of various social, economical and the geographical conditions on these investments.

This study is made for south delta electricity distribution company which is one of (8) distribution utilities in Egypt which serves about (2.6) million customers in three governorates which are named later by sectors (geographical area which is served by the utility and we have in our utility three geographical areas called Ghrabia and we write it as (GH)-Minofia and we write it as (Min) and the third is Kaliobia and we write it as (Kal).

.Some figures and indices are calculated using the distribution system data

THE BASES OF THE STUDY

1-Calculating the rate of utilization of the distribution network components at the maximum and the average demand of the network.

2-Identifying the efficiency of utilization for the network components in each sector and comparing it with the average sector

3-Calculating a global indices of the investment cost to make a distribution of (1 MVA) max which contains the relative weight of cost for the network components in each sector and comparing it with the average sector.

4-Calculating the investment cost required to supply the service for each thousand customers which is essential in estimating the cost for customers service

To make this study it is required to make a survey for all the data related to the distribution network components, also the data related to the annual power demand and annual purchased and sold energy and the number of customers in each sector

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DISTRIBUTION SYSTEM DATA

-Medium voltage (11 kv) network data (table 1)

*Number of distribution boards

*Number of incoming and outgoing feeders in distribution boards

*Lengths of both medium voltage overhead lines and cables in (km).

-Transformers and low voltage network data (table 2)

*Distribution transformers (11/0.4) KV (numbers and capacity in MVA)

*Lengths of both overhead lines and cables in L.V networks in (km)

*Number of low voltage distribution boxes

-Power and energy data (table 3)

*Number of customers in each sector in million

*The average Maximum demand in each sector in (MW)

*The annual purchased and soled energy in each sector in M.KWH.

All the above data are obtained for the distribution network components which exist in the year 2006

THE AVERAGE SECTOR:-

{(sum of each components 'numbers or lengths' for the three sectors)/ (number of sectors)

Table (1) Medium voltage network data

Sector / Net. Component		Gh	Min	Kal.	Ave.
No of dist.Pannels (Medium voltage)		38	33	16	29
Incoming feeders (Medium voltage)		144	105	55	101.33
Outgoing feeders (Medium voltage)		276	239	112	209
Average Number	Incoming	3.79	3.2	3.4	3.46
	Outgoing	7	7	7	7
Total.No.of Average feeders		11	10	10.	10.62
Lengths in km for M.V lines (11 kv)		2339	2365	1230	1978.2
Lengths in km for M.V cables(11kv)		1538.2	573	389	833.2

Table (2) Transformers and low voltage network data

Sector / Net. Component		Gh	Min	Kal.	Ave.
Lengths in km for L.V lines		6144.9	6397	3595	5379
Lengths in km for L.V cables		242.7	251	63	185.8
Distribution. Transformers	No.	3428	2696	1785	2636
	MVA	790	486	406	561
Transformer average power rating in (KVA)		230.64	180	228	213
Low voltage boxes		3428	2696	1785	2636

Table (3) **Power and energy data**

The demand \ Sector		Gh	Min	Kal.	Ave.
The annual max.demand	MW	582	364	263	403
	MVA	662	414	298	458
The annual Ave.demand	MW	372	226	168	255
	MVA	423	256	191	290
The annual energy demand in (GWH)	purchased	3261	1976	1474	2237
	Sold	3010	1881	1421	2104
No. of consumers (million)		1.2	0.885	0.633	0.907
%Energy losses		7.71	4.8	3.6	5.4
Kwh/consumer		2710	2233	2329	2424
Kw/consumer at peak		0.55	0.47	0.47	0.5
KVA/consumer at peak		0.35	0.29	0.3	0.31
KVA /consumer from dist.transformers		0.66	0.55	0.64	0.62
Max. Loading of dist. transformers		0.84	0.85	0.73	0.81
MVA /Distribution stations (at Max.Load)		17.4	12.6	18.7	16.2

From table (1) and table (2) we can compare the network components in each sector with the average sector.
Also from table (3) we can compare the network performance in each sector with respect to the average sector

RATE OF UTILIZATION OF DISTRIBUTION NETWORK COMPONENT

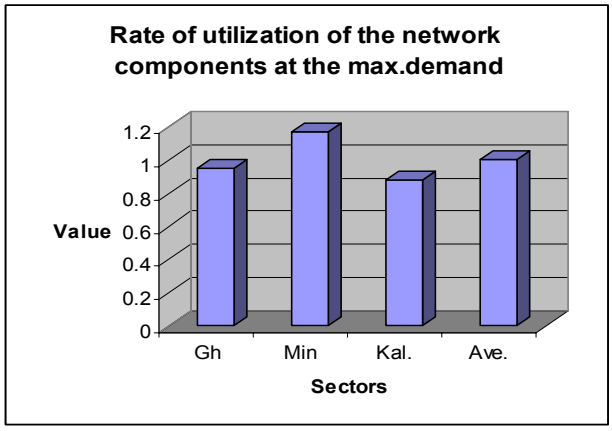
The rate of utilization for each component from the distribution network at any loading condition from the following relation such as:-
*Rate of utilization) at max MVA =the network component (number, length, capacity) / (MVA) max.
*The rate of utilization for any network components in each sector is calculated and also is calculated for the average sector

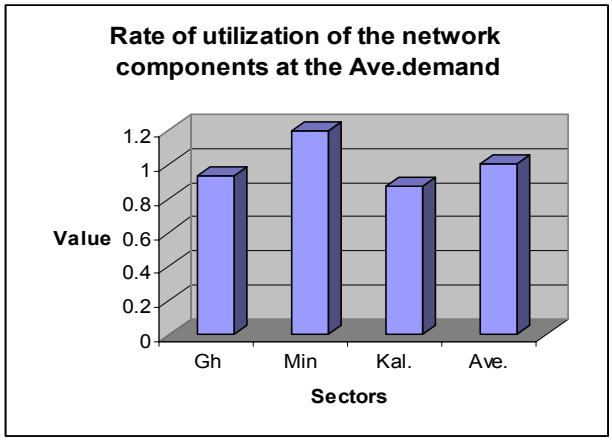
DISTRIBUTION NETWORK UTILIZATION INDICES

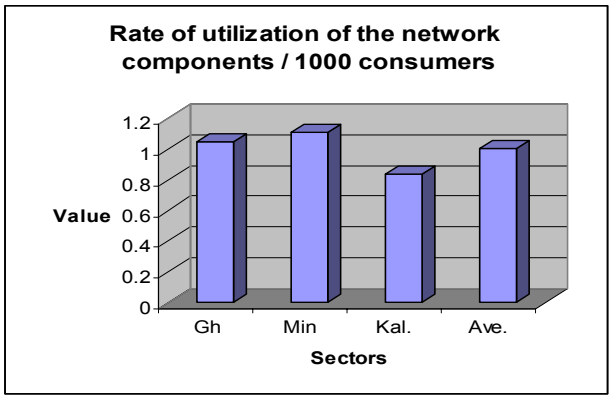
.Distribution network utilization indices =
Rate of utilization for any network component / rate of utilization in the average sector.
In addition to the above figures and Indies we can deduce the global indices for the investment cost for the distribution network components which contains the relative cost weight for all the network components in all sectors refered to the average sector.
and the following table (4) shows the global indices of the network components utilization in all the sectors and also the investment cost for these components.

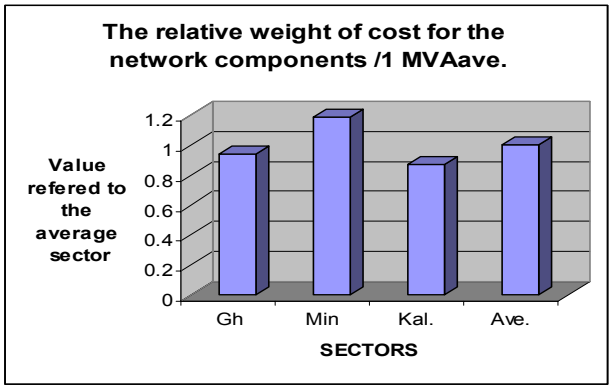
Table (4) the global indices of the network

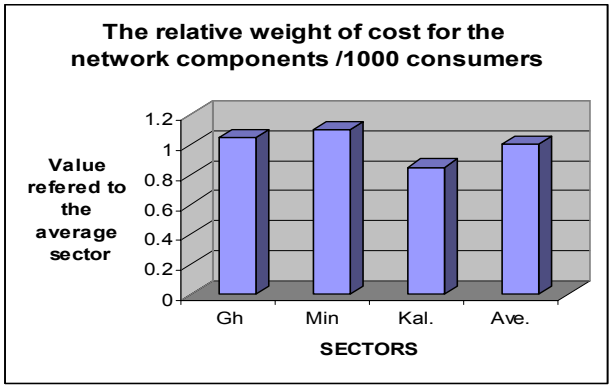
Indices \ Sector	**Gh**	**Min**	**Kal.**	**Ave.**
Rate of utilization of the network components at the Max.demand	0.95	1.17	0.88	1
Rate of utilization of the network components at the Ave.demand	0.93	1.2	0.87	1
Rate of utilization of the network components/1000 consumers	1.05	1.11	0.84	1
The relative cost weight /1MVA max	0.95	1.17	0.89	1
The relative cost weight /1MVA Average	0.94	1.19	0.87	1
The relative cost weight /1000 consumers	1.05	1.1	0.85	1

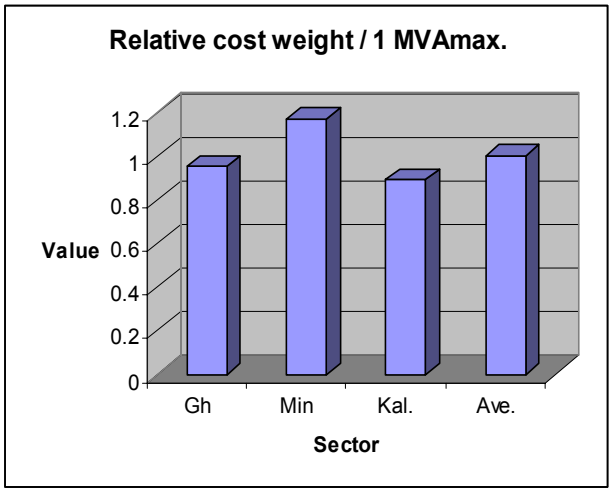












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Conclusion:-

1-From tables (1) , (2) and (3) we can compare the network components in the three sectors of our utility; also we compare the number of consumers, the maximum demand in each sector. Also the annual sold energy and the percentage energy losses.
2-The study also shows that there is a difference in some figures between the three sectors such as
*Max load for each outgoing feeder in distribution panels also the average load
*The number of distribution transformers for each outgoing feeders and also the average capacity of transformers
*The average distance between distribution transformers and the percentage loading of transformers
And to decrease these differences to an acceptable value it is required to make detailed studies for the distribution network in each sector
.3-From the bar chart shown above we notice that:-
* The rate of utilization for the network components and the relative weight of cost at the max.demand ,ave.demand and also the rate of utilization and the relative weight of cost for the network components / 1000 customers in Min.sector is the highest one in the three sectors and so it is required to make a balance in investments in the future plans.
4-The study also shows us that the percentage losses in (Ghr) sector is the highest one in the three sectors and it is required to reduce it .
5-The study may be considered as a starting point to make standard indices to evaluate the distribution network
6-The study shows us the importance of making a data base for distribution network.
7-The study helps the utilities to make a reasonable estimation for the customer service connections cost.
8-The study is made in the three sectors of our utility and their branches to help the utility to make good decisions for its investments in these branches in the utility future planes

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