International Journal of Electronics and Electical Engineering

Volume 3 | Issue 2 Article 6

October 2014

DISTRIBUTION SYSTEM IMPROVEMENT

KIRAN M KESHYAGOL
Department of Electrical and Electronics Engineering, Angadi Institute of Technology and Management, Belgaum, INDIA, kirankeshyagol2393@gmail.com

DISTRIBUTION SYSTEM IMPROVEMENT

KIRAN M KESHYAGOL

Department of Electrical and Electronics Engineering, Angadi Institute of Technology and Management, Belgaum, INDIA
Email:Kirankeshyagol2393@gmail.com

Abstract: This paper incorporates power transmission and distribution system with usually one major control system which enables the system to supply electricity. In this paper an attempt is made to solve the problems occurring in transmission and distribution system such as over loading of 'Distribution transformers', losses in Transmission and Distribution system, getting low voltage at end consumer who is far away from the distribution transformer, we then present our approach to an efficient and healthy power system. And this offers a healthy and efficient Transmission and Distribution system compared to existing one.

I. INTRODUCTION

The aim of this paper is to make an approach to an efficient and healthy power system. The demand for electrical energy is ever increasing. Today over 21% (apart from theft) of the total electrical energy generated in India is lost in transmission (4-6%) and distribution (15-18%). The electrical power deficit in the country is currently about 18%. Clearly, reduction in distribution losses can reduce this deficit significantly. The main reason for having high losses in developing countries like India is stretching of distribution lines beyond the limits of load centers, increase of load abnormally without considering the current carrying capacity of the conductors and imbalance of generation and load causing reactive power generation etc [3].

Hence proper selection of conductors in the distribution system is important as it determines the current density and the resistance of the line. A lower conductor size can cause high I^2r losses and high voltage drop which causes a loss of revenue as consumer's consumption lowered and hence revenue is reduced. The recommended practice is to find out whether the conductor is able to deliver the peak demand of the consumers at the correct voltages, that is, the voltage drop must remain within the allowable limits as specified in the Indian Electricity Act, 2003. The preferred solution for problems like high losses and voltage drops is network reconductoring [3]. This scheme arises where the existing conductor is no more optimal due to rapid load growth. This is particularly relevant for the developing countries, where the annual growth rates are high and the conductor sizes are chosen to minimize the initial capital investment.

Depending on the current carrying capacity of the feeders the size of the conductors will select optimally. Funk Houser and Huber [4] worked on a method for determining economical aluminum conductor steel reinforced (ACSR) conductor sizes for distribution systems. They showed that three conductors could be standardized and used in combination for the most economical circuit design for the loads to be carried by a 13 kV distribution system. They also studied the effect of voltage regulation on the conductor selection process. This method however cannot be used in general as it is based on uniform load distribution for the feeders.

Now a days if we see the causes behind the burning of transformer or getting low voltage level at the end consumer (Who is far away from the distribution transformer), we will find three major technical causes. They are as follows

A. *Not Maintaining the Ratio of HT to LT Line as 1:1.*

Transmission or distribution of electric power at low voltage level causes higher line losses. For e.g, 'Hukkeri Rural Electrical Co-Operative Society' HRECS [1] have got HT line 1054.13km length and LT line have 3302.36km length. Here LT line is more compared to HT line. It is necessary to have short low voltage distribution to minimize the line losses. If the last consumer is far away from the distribution transformer the obviously he will get low voltage because of large amount of line losses. Hence the electrical distribution system is said to be unhealthy if it does not have the ratio of HT to LT line as 1:1.

B. *Advantages of High Voltage Transmission:*

There are so many advantages in transmitting high voltage; the important advantages are discussed below.

Power loss in the line (per phase), $W = I^2R$ (1)

But, Resistance of conductor, $R = \rho\frac{l}{a}$ (2)

Load current per phase, $I = \frac{P}{V\,COS\,\emptyset}$ (3)

Power loss in the line (per phase),

$W = I^2R = (P^2/V^2\,COS^2\emptyset)\,\frac{\rho l}{a}$ (4)

Where, l= is the length of line,
a=cross section of conductor and
ρ= Resistivity of conductor material
I=current Amps,
R=Resistance in Ω

From Ohms low, V=IR i.e voltage is inversely proportional to the current, provided resistance is constant. If voltage increases, current decreases. If we transmit low voltage then obviously current will be high and square of that will be again a large value and from the equation of power loss that is equation 1, if the value of square of 'I' increases the losses also increases [2].

- With the increase in transmission voltage the size of the conductor is reduced .This further reduces the cost of the supporting structure materials.
- With the increase in transmission voltage, line current is reduced, which results in higher reduction of line losses.
- With the increase in transmission voltage reduction in line losses results in higher efficiency.
- Due to low current at high transmission voltage, the voltage drop in the lines is low. This leads to better voltage regulation.

C. Adding Loads on the Transformer more than its Rating.

The transformer is said to be healthy if it has 80 to 90 percent of load of its rated. For example on transformer of 63KVA rating we can have load up to 59 to 60KVA that is 80 to 90 percent load of rating of the transformer. But we observed that all most transformers are running under overload condition.

Causes for overloading

- Peoples think in economical way, so they try to take tapping from nearest transformer for their new connection.
- In villages peoples are not educated they hesitate to come forward and talk with officers to get new transformer or replacing existed transformer.

D. During Single Phase Supply, Starting the IP (Irrigation Pump) (3 Phase) Sets Using Capacitors.

In villages farmers will take the permission of 5hp for irrigation pump sets that is IP sets run at 3 phase supply only but IP consumers (farmers) run the IP set at 1 phase supply using capacitors. Running the IP sets under single phase supply using capacitors is not good practice and is not legal also. This increases the load on the transformer and this affects the transformer that is burden on the transformer and transformer may bust due to overload condition.

Due to overload condition electric power supply board will supply the power for limited time duration (for 3 to 4 hours). That is in village places power supply will be there for only 3 to 4 hours at day time. Because of this peoples living in villages are getting power for full day, they are totally unhappy about electricity board. By observing the 'Table a' we can make out, suppose 100 KVA distribution transformer has burnt due to overloading, for its repairing we have to invest up to 40,000 rupees, after repairing and replacing that transformer we can't assure that as it is in healthy condition, because that part is overloaded.

II. SOLUTIONS FOR THESE PROBLEMS

E. Separating Overload Part by Giving Separate Transformer of Required Rating.

In this method we calculate the total load on the particular transformer, suppose the transformer is overloaded then we calculate how much extra load causing overload condition. For example 25hp is the extra load, and then we can separate that part and can have separate transformer of that part of consumers by giving 25hp and it can be connected to HT line. By this we can maintain the ratio of HT to LT line as 1:1. Hence we can make system healthier than Existed system.

The figure c. shows line diagram of typical overloaded transformer. To separate overloaded part, we will start calculating the loads from end consumer who is not getting exact voltage level. We will check how much load is extra for the particular distribution transformer and will give the separate transformer of required load rating. Figure (d) shows a typical line diagram for healthy transformer, by giving 25KVA transformer for few consumers overloading minimizes, if someone try to run IP set under single phase easily others can find out and they can be warned him. They feel that the transformer is there property responsibility about transformer increases.

ADVANTAGES OF SEPARATING OVERLOAD PART

- We can reduce LT line length and hence we can minimize the LT line losses.
- We can provide equal voltage level to all consumers up to end consumer.
- All transformers will be in healthy condition and hence we can reduce the rate of busting of transformer.

Table. a
Following table shows manufacturing, repairing cost of different ratings of transformer

Serial no.	Rating of transformer (KVA)	Manufacturing cost (Rupees)	Repairing cost (Rupees)
01	23	65,000	Approximately 20,000
02	63	1,25,000	35,000 to 40,000
03	100	1,60,000	40,000 to 45,000

F. Providing Separate Feeders for the 3 Phase and Single Phase Power Supply.

- In this method we can separate the three phase supply and single phase supply.
- We can provide separate feeders for domestic purpose. By separating single phase power supply from three phase power supply we can provide continuous power supply for domestic purpose (villages).
- Important point is that maximum load on the existing transformer will reduces.
- We can make maintain good Consumers relation by providing continuous power supply.

G. *Replacing HT Line of 'Weasel ACSR' Conductors by 'Rabbit ACSR' Conductors.*

Resistance is given by

R= —

Where

ρ = Resistivity of the material of conductor

l = Length of the conductor

a = Cross sectional area of the conductor

From the figure (a) and figure (b) we can observe the cross sectional area of "Rabbit ACSR" conductor is more than that of "Weasel ACSR" conductor, hence "Rabbit ACSR" conductors gives less resistance and hence I^2R losses reduces. Capacity of weasel ACSR conductor For 120 A and 50' Temp rise is enough. And we have to consider voltage regulation which should not exceed

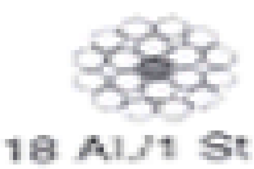

Figure a. Weasel ACSR Conductor

Figure b. Rabbit ACSR Conductor

6% and further development. Rabbit ACSR conductor is the next one with carrying current capacity of 148 amps for 30' temperature rise and 183 amps for 50 ' temperature rise [5].

ACSR conductor consists of a solid or stranded steel core surrounded by strands of Al. ACSR conductor is available in a wide range of steel varying from as low as 6% to as high as 40 %.Higher strength ACSR conductors are used for river crossings, overhead ground wires, installations involving extra long spans etc. Against any given resistance of conductor, ACSR conductor may be manufactured for having a wide range of tensile strength as per requirement. The principal advantage of these conductors is high tensile strength and light weight with longer spans as well as with lesser supports. Due to the greater diameter of ACSR conductors a much higher corona limit can be obtained causing big advantages on high as well as extra high voltage overhead lines. ACSR conductors are also known for its aluminum to steel ratio (i.e. 18/1, 26/7, 45/7). ACSRs are also known to have code words which individual has different intrinsic characteristics and they are usually taken from the names of birds others are from animals such as Rabbit, weasel, Dog, Panther etc [5]. Figure (b). and figure (c). shows the cross sectional view of weasel and rabbit ACSR conductors. Existed distribution system has 'ACSR Weasel' conductors for power distribution. Using 'ACSR Rabbit' conductors we can reduce the line losses occurring in distribution system

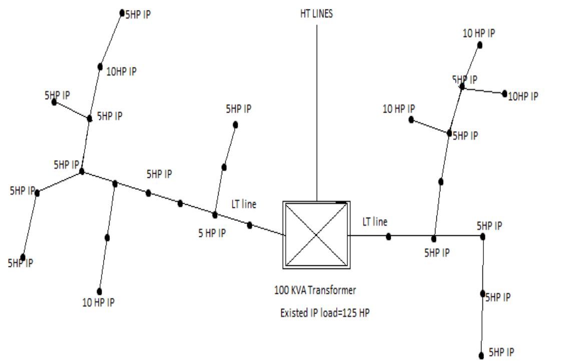

Figure c.
A TYPICAL LINE DIAGRAM FOR AN OVER LOADED TRANSFORMER

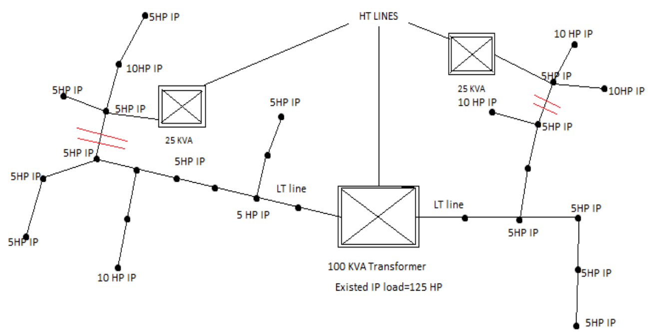

Figure d.
A TYPICAL LINE DIAGRAM FOR HEALTHY TRANSFORMER

III. ADVANTAGES OF 'DISTRIBUTION SYSTEM IMPROVEMENT'

- Line losses can be reduced.
- We can reduce repair work; hence we can minimize investment on repair work.

- Loads on the distribution transformer can be reduced.
- We can make consumer happy by giving continuous power supply.
- We can provide exact voltage level to all consumers**.**
- Efficiency of the transmission system can be improved.
- Totally we can convert the existing unhealthy power distribution system into healthy one.

IV. DISADVANTAGE OF 'DISTRIBUTION SYSTEM IMPROVEMENT'

- Capital cost will be higher.

Capital cost will be higher but by studying all the factors discussed above no one can say that it's a disadvantage that capital cost can be overcome by reducing line losses, and burning of the transformers.

V. CONCLUSION

By implementing this we can minimize line losses, loads on the transformer, repair cost. And also provide power assurance to consumers. And capital cost can be overcome by reducing line losses, burning of transformers. Totally we can convert existed unhealthy system into a healthier and efficient system.

REFERENCES

[1]. Study on "Hukkeri Rural Electric Co-operative Society"

[2]. ' Transmission and Distribution of Electrical Power'- by J.B Jupta-9th Edition.

[3]. Dr. R. Srinivasa Rao / International Journal of Engineering Science and Technology Vol. 2(7), 2010, 2829-2838

[4] Funk Houser A.W.; 1955. A method for determining ACSR conductor sizes for the distribution systems, AIEE Trans. on PAS, pp. 479-484.

[5]. ACSR Conductors-Wikipedia, free encyclopedia.

◈◈◈