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LOSS MINIMIZATION TECHNIQUES IN DISTRIBUTION SYSTEM

KEYWORDS: Distribution system, losses, network reconfiguration, Automatic Voltage Regulation

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ABSTRACT *An el ectric distribution system plays an important role in achieving satisfactory power supply. The quality of power is measu red by voltage stability and profile of voltage. But because of losses in distribution system, its voltage profile affects. Basically, the losses could be defined as the difference between the metered units energy input into the distribution system and the total energy paid that leaving the network through electricity accounts, whether calculated or estimated, in any given period. As total distribution losses equals to sum of technical losses and non-technical losses. This paper presents various techniques to reduce these losses and their contribution in improving power efficiency of distribution system. Also, presents merits and demerits of techniques.*

I INTRODUCTION

The distribution system is the most visible part of the supply chain, and as such the most exposed to the critical observation of its users. It is, in many cases, the largest investment, maintenance and operation expense, and the object of interest to government, financial agencies, and associations of concerned citizens. About 30 to 40 % of total investments in the electrical sector go to distribution systems , but nevertheless, they have not received the technological impact in the same manner as the generation and transmission systems. Ideally, losses in an electric system should be around 3 to 6%. In developed countries, it is not greater than 10%.However, in developing countries, the percentage of active power losses is around 20%; therefore, utilities in the electric sector are currently interested in reducing it in order to be more competitive, since the electricity prices in deregulated markets are related to the system losses. In India, collective of all states, in 2008 the technical and non technical losses are accounted as 23% of the total input energy. To manage a loss reduction program in a distribution system it is necessary to use effective and efficient computational tools that allow quantifying the loss in each different network element for system losses reduction. Various authors have discussed loss minimization in different aspects. India's transmission and distribution losses are among the highest in the world. When non-technical losses such as energy theft are included in the total, losses go as high as 65% in some states and average about 35- 40%. The financial loss has been estimate at 1.5% of the national GDP.

TABLE 1 COMPARISON OF LOSSES IN DIFFERENT STATES OF INDIA

Less than 20%	Between 20-30%	Between 30-40%	Above 40 %
Goa	Andhrapradesh	Karnatak	Delhi
	West Bengal	Assam	Bihar
	Himachal pradesh	Harayana	Zarkhand
	Maharashstra	Rajasthan	Uttar Pradesh
	Tripura	Meghalay	Madhya Pradesh
	Panjab	Mizoram	Arunachal Pradesh

II Losses in Distribution system

a. Technical losses: The losses that occurs naturally and depend upon the type of conductor used, transformer capacity, and other component used for transmission and distribution of electricity. These losses are inherent to the distribution of electricity and cannot be eliminated but can be reduced. These losses are stated as losses that occurs due to heat dissipation resulting from current passing through conductors and magnetic losses in transformers.

b. Non-technical losses: The losses that occurs because of illegal consumption of electricity. These are caused due to discrepancy in reading of meters, theft of power, faulty meter and inefficiency in collection of bills. Non-payment, as the name implies refers to cases where customers refuse or unable to pay bill for their electricity consumption. It is estimated that electricity theft costs in our country is in crores in a year.

Reason for high t&d losses

The main reason for a such high rate of T&D losses in the transmission and distribution system are the investments have been low in sub-transmission and distribution. While, in generation part the investment has increased steadily, transmission has not kept with generation part. Because of which there is mismatch in generation and supporting transmission system. The other reasons for high transmission and distribution losses are used of lengthy distribution lines, unbalanced phases, use of poor quality of equipments, inadequate size of conductors, low power factor, etc. But in India, the major causes of T&D losses are power theft. Inefficiency in the power distribution system has led to failure in checking of power theft and this leakage continues to plague the sector. According to the Economic Survey, loss due to theft and pilferage is estimated to be Rs.20,000 crores annually.

Factors Influencing Losses

Primary and secondary feeders that extend over a long distance to feed loads which cover large areas. These feeders are extended indiscriminately over very long distances resulting in increase line losses and poor voltage regulation.

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III LOSS REDUCTION AND VOLTAGE IMPROVEMENT TECHNIQUES

- Network reconfiguration
- Use of static capacitors
- DTC relocation (Change of feeder)
- Network reconductoring
- Voltage regulator placement
- High Efficient of Transformers
- Use of express feeder
- Adoption of High voltage distribution system (HVDS)
- Building new substation

Network Reconfiguration

Optimal distribution planning involves network reconfi-guration for distribution loss minimization, load balancing under normal operating conditions and fast service restoration minimizing the zones without power under failure conditions. Network Reconfiguration is the process of operating switches to change the circuit topology so that operating costs are reduced while satisfying the specified constraints.

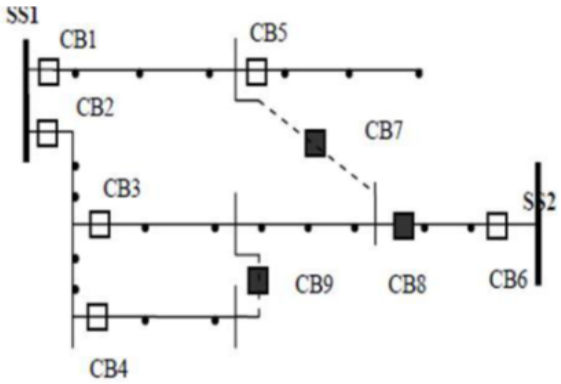

Figure 1

Merits:

- Restoring power to any outage partitions of a feeder,
- Reducing overloads on feeders by shifting the load in real time to nearby feeders, and
- Resistive line losses will be reduced.

Use of Static Capacitors

Another method, which can be used without changing the system configuration, is the use of static capacitors. The use of static capacitors for loss reduction has been intensively studied and very sophisticated computer methods are available to decide on the optimum location of capacitors. Here also the cost benefit ratio to be computed to compare the saving in cost due to reduction in energy losses.

Distribution Transformer (DTC) Relocation

DTC relocation involves the change of feed point. This scheme is adopted as an immediate solution. The new point of connection can be determined by feasibility study.

Merits

- It supports further reconfiguration.
- This technique requires less investment.
- It helps in reduction of peak load and energy losses in the distribution sytem.
- It improves voltage to the tail end consumers.
- Overloading of conductors and overheating of joints avoided.

Demerits

- The extent of voltage improvement is limited
- For further improvement of voltage profile we have to adopt for other methodologies which involves extra investment.

Network Re-conductoring

Replacement of the existing conductor on the feeder with an optimal conductor size for optimal length of the feeder since, size of the conductor is the parameter that decides current density and resistance. This scheme is applied when Network reconfiguration is not possible. The existing conductor is no more optimal due to rapid load growth Re-conductoring depends on Load expected to serve and capacity required in future.

Merits

1. Increases the capability to handle load growth

Demerits

1. Additional investment is required

Voltage Regulator Placement

The capability of a voltage regulator to maintain smooth voltages is an attractive solution. The optimal location of the placement can be determined by conducting feasibility study.

Merits

- Smooth variation of voltage is possible.

Demerits

- The extent of voltage improvement is limited
- Extensive use will further deteriorate the network.

Use of Express Feeder

Express feeder is the feeder running from the source to any load point with no tapping intermediately. The use of express feeder is recommended when Reconfiguration or Re-conductoring is not possible. The point of connection depends upon the quotient of voltage difference.

Merits

- More effective in improving the voltage profile.
- Supports more load growth compared to reconfiguration and re-conductoring schemes.
- Further reconfiguration is made possible.

Demerits

- Additional investment is required.

Building new substation

This involves addition of new substation in addition to the existing. Location of the installation is determined by feasibility study. This scheme has to be adopted as the last option.

Merits

It improves voltage profile effectively.

Demerits

It increases capital cost of power system.

High Efficient of Transformers

The use of high efficient of transformers will also reduces losses, i.e using amorphous core transformers instead of CRGO transformers. As it have high magnetic susceptibility, with low coercively and high electrical resistance. As in transformers, the high resistance leads to low losses by eddy currents.

Merits:

- It reduces CO2 emission.

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- It reduces core losses.

Demerits:
- It increases capital cost of power system.

High Voltage Distribution System (HVDS)
This technique is most effective and efficient in reducing the technical losses and improving the power quality in distribution system. In this technique, conversion of existing Low Voltage Distribution System to High Voltage Distribution System is done. This technique aims at extending high voltage lines as nearer to the load as possible and replacing large transformers with various small rating transformers. By using high this method, we can reduce the losses as current is low in high voltage systems.

Merits:
- It reduces losses, increases energy saving and improves voltage profile.
- It also reduces the theft of electricity and decreases illegal connections as the LT lines are reduced and required will be insulated cables.
- It also helps in avoiding unnecessary iron losses in overrated DTs and hence reduces technical losses.
- It also reduces the number of outages.
- It makes distribution system more reliable.
- It will bring the commercial viability in the power system.

Demerits:
- It requires additional investment.
- It needs regular maintenance.

IV CONCLUSION

The transmission and distribution (T&D) system includes everything between a generation plants to end user site. Along the way, some of the energy supplied by the generator is lost due to the resistance of the wires that is line loss and equipment that the electricity passes through. The loss is mainly depends upon the type of transmission and wire resistance. For better transmission we need some special transmission method and good conductor that's what here we are showing some better methods for transmission and distribution from this all methods we can reduce the T&D losses.

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