Real Time Study on Technical and non-technical Losses in Distribution System and reduction techniques

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***Abstract*- electrical system is combination of different part like generation, transmission and distribution system. There are different types of energy losses occur in the process of electricity supplying. to consumers due to technical and commercial losses. This paper presents a study on technical and non technical losses in distribution system. There is several reasons behind these loss which are also discussed and present the loss reduction techniques.**

I. INTRODUCTION

Electrical system is combination of different part like generation, transmission and distribution system. In past decades, lots of work had done in field of generation and transmission, but only little effort was put into the analysis of the electric distribution network (Willis H.L, 2005). This is the main reason the distribution losses are 25% in India which is very high as compare to other developed countries.

Deepak S. Parekh, Chairman, IDFC stated "The present power sector in India is like a leaking bucket and the efforts made by the government and power companies to generate more electrical power in this leaked sector are nothing but ways of pouring more water into the leaked bucket. The logical thing to make the system leak proof by fix the system leakage. Give first preference to eliminate the leakage of system rather than to especially emphasize shortages of power and forever make exaggerated estimates of future demands for power and only then investing in generating more power will be of worth." The distribution network is 80 percent larger than the transmission system (Broadwater R. et.al, 2010). It is very important for the power companies to understand the reason behind the losses of electric power distribution network. The knowledge of these losses plays an important role in distribution network maintainer and overall planning of power systems.

II. DISTRIBUTION SYSTEM

Distribution of power is the last stage of electric power system, in this electric power carries from the substation to consumers end. Primary distribution network lines carry the medium voltage of 11KV; these lines are connected to consumer through distribution transformers which are located near the consumer's area. Primary Distribution networks are divided into following two types:

a) Radial Distribution System
b) Ring Main Distribution System

A. Radial Distribution System

The radial structure implies that there are no loops in the network and each bus is connected to the source via exactly one path. It is the cheapest and less complex but the least reliable network configuration. In this many feeders are radiate from a single substation and feed the consumer at only one end.

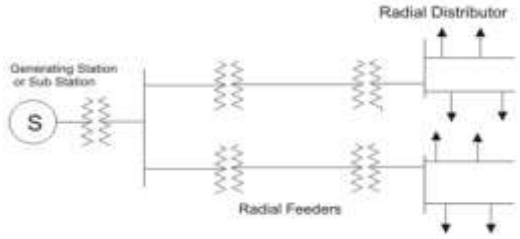

Fig. Simple radial distribution system

In radial distribution network the power is delivered from the main branch to the sub branches then it split out from the sub-branches again as seen in Fig.

B. Ring Main Distribution System

Ring main system is more costly and complicated than the radial system because more switches and conductors are required to construct the ring main system. It is more reliable than radial distribution system.

III. LOSSES IN THE DISTRIBUTION SYSTEM

The losses prevailing in the power distribution network can be classified as:

- Technical losses
- Non-Technical losses

A. TECHNICAL LOSSES

Technical losses on distribution systems are due to current passing through conductors and from magnetic losses in transformers which produce heat in system. These include resistive losses of the primary and secondary network. The distribution transformer losses (resistive loses in windings and the core losses), resistive losses in service drops and losses in KWh meter. Technical losses are normally 22.5%, and directly depend on the network characteristics and the mode of operation. The major amount of losses in a power system is in primary and secondary distribution lines.

B. NON -TECHNICAL LOSSES

Losses which are depends on human activity are known as non-Technical losses (NTL), the main reason of NTL is electricity theft. Electricity theft is an illegal attempt made by a person to minimize or eliminate the amount of bill which he will pay to the utility for electric energy. There are many reason for NTL like meters not read, non performing and underperforming meters, tampering with the meter to create false meter reading i.e. create false consumption information used in billings, making unauthorized connections and direct tapping. Non-payment, as the name implies, refers to cases where customers refuse or are unable to pay for their electricity consumption.

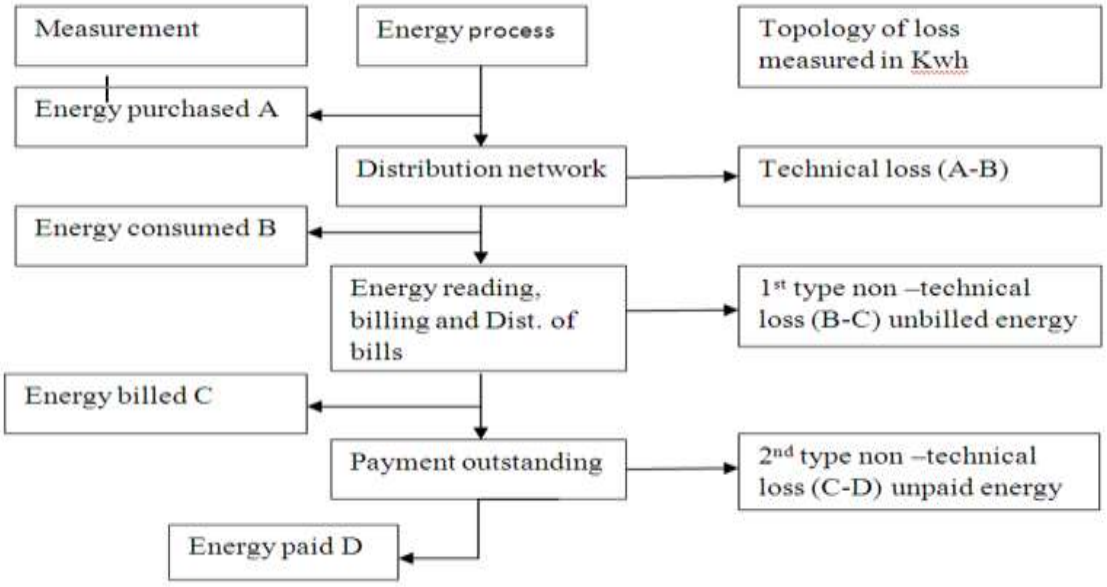

Fig. Losses in Distribution System

IV. REASONS FOR HIGH DISTRIBUTION LOSSES

a) Lengthy distribution lines: Extension of distribution without any analysis leads the losses in system. Mostly in rural areas where loads are scattered over large area the 11 kV and 415 volts lines are hurriedly extended. It results high R/X ratio and high line losses.

b) Inadequate size of conductors: The inadequate size of conductors leads to the overloading of feeder and lead more losses. The size of the conductors should be selected on the basis of KVA X KM. As the loads are usually fed by the radial feeders, extension of feeder led more current result of high losses.

c) Losses related to distribution transformers: Distribution transformer is the main part of distribution system. Different types of losses are depends on it. Higher and under rating transformer lead losses in system.

d) Low voltage level: Most of the domestic and commercial loads are inductive so small

variation in voltage effect the performance of equipment and increase losses in system. Low voltage level at consumer end effect the life of electric goods also

e) Location of Distribution transformer: Inadequate location of distribution transformer (DT) leads energy losses in system e.g. the farthest consumers get an extremely low voltage as compare to consumer near the DTs.

f) Poor quality of equipments: Poor quality of equipment are caused high losses, because these are not as per electrical standard which drawn high current. High current caused heat and I2r losses.

g) Low power factor: It is observed that the power factor varies from 0.65 to 0.75 in most of the LT distribution circuits. Most of the domestic and commercial loads are inductive which drew high current at given load and consequently the losses proportional to i2r losses will be more.

h) Poor HT/LT ratio: Ideally the HT/LT ratio should be 1:1. But, due to the consequent expansion of LT lines because of the extensive electrification of the domestic sector in the State, ratio is now 1:6.25.

i) Unbalanced phases: Since the load points are randomly distributed and it is not possible to divide the load equally among all the phases. This unbalanced phase causes the current to flow in the neutral as well which leads to power losses.

j) Transformer Losses: Distribution transformer losses include resistive loses in windings and the iron losses in the core. Today the majority of transformer's core is made of CRGO (conventional silicon steel) which leads to an increase in copper as well as iron losses in the transformer.

k) Bad workmanship: Increase in distribution losses is also due to bad workmanship. As the power loss occurs at joints and bad workmanship resulting in poor contacts at joints and connections which leads to pilferage of energy.

l) Direct tapping by the non-customers: In certain areas mainly in domestic and agricultural categories, direct tapping of power by non-customers is widely prevalent. Since it is often not possible to find out culprit, the stolen energy cannot be measured and thus cannot be charged to anyone. Stolen energy is, therefore, considered as a part of line losses.

m) Pilferage by the existing customers: Pilferage or theft by the existing consumers is the predominant cause of loss of revenue to the electrical utilities. It is mostly done by direct bypassing the meter and also by tampering the meter. Tampering can be done by mechanical jerks, placement of powerful magnets or disturbing the disc rotation with foreign matters.

V.TECHNIQUES FOR LOSS REDUCTION

a) Network reconfiguration: Network reconfiguration includes the formation of new a tree structure by opening and closing the system switches, and bifurcation of existing feeder to form parallel paths of power flow.

b) Conductor replacing: Replace the existing conductor with optimal conductor size to reduce the active power losses. In country like India load growth is high. The conductor sizes are chosen to minimize the initial capital investment. This scheme is extremely fruitful to minimize the losses and improves the voltage profile.

c) Reactive Power Compensation: The load on the distribution system is mostly inductive and requires large reactive power. Shunt capacitor provide reactive power compensation at its location, independent of the load.

d) Automatic voltage booster: Automatic voltage booster (AVB) boosts the system voltage in steps. It improve the voltage in discrete steps, its working is depend on working voltage level of system. It results in improvement of voltage profile and reduces the losses.

e) Distribution Transformers Locating and Sizing: Location and size of DTs should be as per the load proper location and size will help to reduce the technical loss in secondary distribution system.

f) High voltage distribution system (HVDS): In HVDS system high voltage lines are extended up to the loads as possible and install small size transformers. It is most effective method in reducing the technical losses and improving the quality.

g) Distribution generation is very popular in these day in this a small size generating station installed in the system.

h) Aerial Bunched Cables (ABC): ABC provides lower power losses, eliminates the hooking and higher safety and reliability. It is most popular in hilly area and urban area where space is less. It is less effective for rural area because load area spread over the long distance as compare to urban one.

VI CONCLUSION

This paper based on the study about the technical and nontechnical losses in distribution system. The technical losses depends on the flow of current through lines causes the loss and in non-technical are caused by inaccurate meters, improperly read meters, unauthorized connections as well as administrative errors. In this paper we also try to understand the techniques by using we can reduce these losses in the system. By installing the capacitor bank, resizing of conductors, reconfiguration, using DG, shortening the distances and by phase balancing, the losses can be reduced.

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