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Energy Audit on a Secondary Distribution System and Measures to Improve its Performance- A Case Study

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Abstract
This paper presents the energy audit work carried out in low tension(LT) distribution network and various alternative proposals have been examined for the improvement of performance of the LT network. The network is simulated for a peak load using Mipower package to segregate technical and commercial losses. The various alternative proposals examined are relocating of DTC, addition of DTC, providing express line and reconductoring. The present worth analysis is also carried out for each alternative proposal.

Keywords: *Low Tension (LT) distribution system, Distribution Transformer Centre (DTC),* *meter reading instrument(MRI)*

INTRODUCTION

In India, there are forty power dissemination organizations in different states and Union Territories providing power. Circulation framework in creating nations like India experience the bad effects of the issue of low voltage and high vitality loss. The significant piece of the misfortune is occurring in circulation division which represents 80-90% of aggregate transmission and dissemination misfortunes. Out of aggregate vitality created, around just 55% is charged and just 41% is acknowledged bringing about total specialized and business (AT&C) misfortunes of the request of 45-half.With the large amount of electricity now being handled by the power utilities, 1 % reduction in AT&C losses would provide substantial financial benefits to the utilities. To realize the benefits, a systematic approach to reduce commercial and technical losses would be necessary. The reduction of technical losses can be achieved through system improvement and upgradation schemes to reduce overloading of lines, transformers, improvement of voltage profile, etc. but require large capital investments.

Improvement of comprehensive energy accounting system would empower measurement of misfortunes in various sections of the framework and vitality examining would give the way to recognize the regions of spillage, wastage or wasteful use. This would help in distinguishing estimates appropriate for decrease of circulation losses.

Accounting and Auditing in power area includes developing systems and checks to represent vitality from producing stations down to buyer level. In the present situation, the center would be from Grid sub-stations where sub-transmission frameworks (66/33/11kV) take off for the most part as a spiral framework to supply capacity to shoppers at various voltage levels. This leads to identification of high loss areas which in turn would help in evolving strategies and action plans for reduction of losses. The underlying idea is to treat One Energy Unit (kWh) as a unit of electrical moneyand follow and develop a system for accounting each unit similar to that is followed in financial accounting and auditing which has established

practices to enable proper accountingof cash to distinguish the spillages, misappropriation, deceitful exchanges, and so forth and contribute in enhancing the monetary execution of the association. In vitality bookkeeping framework, every unit of power (kWh) is to be treated as a unit of electrical cash. The accounting system should ensure that the energy made available at sub-station/11kV feeder/Distribution transformer and units utilized by consumers are checked to see whether the difference between the two are reasonable and within permissible limits. In addition it should ensure that all energy is billed and revenue realized in an effective manner.

PROPOSED METHODOLOGY

The Proposed methods used for carrying out energy audit work are:

DATA COLLECTION

The following data of Low Tension (LT) distribution system are collected by walk over survey. (i) Single line diagram which shows Important land marks of the area, The distance between the LT line supports and number of phases of the LT line. (ii) Consumer installations and energy meter details which includes RR number, reference pole number, applicable tariff and connected load in KW. (iii) Category of installations- domestic, commercial, public lighting etc.

ASSESSMENT OF TOTAL ENERGY CONSUMPTION

The energy meter readings of all the metered category consumer installations is taken on the starting and ending date of the study period. The difference between the two-meter readings taken between starting and ending date along with consumption values of non-metered category loads such as public lighting and irrigation pump sets gives the total energy consumption of the consumers catered from the DTC.

ASSESSMENT OF ENERGY SENT OUT FROM DTC

The difference between the Kwhr readings of Electronic Tri Vector (ETV) meter of the DTC on the starting date and ending date of the study period gives the total energy sent out from the DTC.

ANALYSIS OF THE LOAD SURVEY DATA

The stored data of load survey, billing, Tamper counts of the ETV meter was downloaded to a meter reading instrument(MRI) and then to the personal computer for analysis. The analysis gives the information such as single phase and three phase power failures, the tampering information like potential failure, current reversal etc. and the half hourly readings of phase wise currents, voltages active and reactive loads.

ASSESSMENT OF TECHNICAL LOSSES

The distinction between the vitality conveyed from the DTC and vitality utilization of all the buyer establishments is the aggregate vitality loss i.e. Aggregate Technical and Commercial losses (AT&C).Having aggregate technical and commercial loss, the technical and commercial losses are separated by determining the technical losses by conducting load flow studies using Mipower simulation package. The simulation is conducted for one peak load condition during the study period and by adopting balanced condition.

PROPOSED MEASURES AND PRESENT WORTH ANALYSIS

The technical losses are reduced by undertaking the following measures: (i) Relocating of existing DTC (ii)Addition of DTC (iii) Providing express line (iv)Reconductoring. The reduced technical losses are determined by simulating modified network by adopting the above measures. By taking into account of cost consideration present worth analysis is

also carried out using Mipower simulation package to determine Benefit to investment ratio and also the payback period.

CASE STUDY AND RESULTS

The secondary distribution system chosen for conducting energy audit is the 'Shanthala Distribution Transformer centre (DTC)'. It is situated near Shanthala theatre in Mysore city. It is a 250KVA Transformer which is feed from 11Kv 'Maharaja feeder'. This DTC is catering the loads of domestic, commercial and public street lights.

Total energy consumption: The total energy consumption of all the consumers for the period of 30 days is shown in Table 1

Table: 1. *Total energy consumption*

SI No	Details	Energy in Kwhr
1	Metered consumption	21579
2	Unmetered consumption	2480
Total		24059

Energy sent out from DTC: The energy catered from the DTC during study period is tabulated in Table 2

Table: 2. *Energy sent out from the DTC*

SI No	Details	Energy sent out
1	Kwhr reading on the starting date	51.85
2	Kwhr reading on the ending date	1393.69
3	Difference	1341.84
4	Meter constant	30
Energy sent out		40255

The energy audit results: The energy audit results are tabulated in Table. 3

Table: 3. *Energy audit result*

SI No	Description	Energy in Kwhr	Energy in %
1	Energy sent out	40255	100
2	Energy consumption	24059	59.77
3	AT & C losses	16196	40.23
4	Total technical losses	4428	11
5	Commercial losses	11768	29.23

RECOMMENDATIONS AND CONCLUSIONS

From the energy audit analysis conducted on the DTC and based on the downloaded information of ETV meter, following observations are drawn.

(i)The technical losses: The LT line loss in the system is 4227Kwhr and percentage loss is 10.50%during study period of the month, which is beyond acceptable limits of 4% for the urban LT distribution network.

(ii) Voltage regulation: The minimum voltage observed at the tail end of the system in the load flow studies is 266 volts(0.6417pu). The percentage voltage regulation is 36.14%which is beyond the permissible voltage regulation limits of 9%.

(iii) Proposals for improvement of LT distribution system: The following proposal has been made for the improvement of LT distribution system.

(a) Providing additional DTC: A DTC of capacity 63KVA is to be established at or convenient place near pole No A-45 and the existing line between A44-A45 should be opened. The LV line for a distance of about 50m is required to be constructed for the proposed 63KVA DTC.

(b) Replacement of existing conductors: The existing weasel ACSR conductor to be replaced by rabbit conductor for the spans between DTC-A1 and A1-A2 for a distance about 50m.

(c) Estimated cost: The estimated cost of the proposals is about Rs 1,40,000/-.

(d) Reduction of line losses: The LT line losses will be reduced from 4227kWhr(10.5%) to 1445kWhr(3.59%).

There will be reduction of 2866 kWhr per month and 33384 kWhr per annum.
(e) Benefit to investment ratio and payback period: The Benefit to investment ratio is 6.57 and payback period will be 2 years.
(f) The minimum phase to phase tail end voltage will improve from 266 to 386 volts and voltage regulation will improve from 36.14% to 6.98%.

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