International Journal of Electrical and Electronics Research (IJEER)
Vol. 2, Issue 1, pp: (36-40), Month: January-March 2014, Available at: www.researchpublish.com

A case study on issues and challenges faced during strengthening of a distribution unit by reducing Aggregate Technical and Commercial loss

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Abstract: **Significant percentage of loss in a power system is contributed by its distribution systems. Reduction of distribution loss brings more profit to the distribution companies. This paper is dealing with a case in which a power generation company operating a small distribution area to distribute power to company employees' residential colonies and to other private domestic, commercial and industrial consumers. Distribution area is having significant loss. The paper discusses the methodology adopted for determination of AT&C loss, various issues and challenges faced during the determination process, reasons for the prevailing loss and recommendations to reduce the loss for the project area.**

Keywords: **AT&C loss, T&D losses, Aggregate technical and commercial losses, Commercial losses, Billing efficiency, Collection efficiency, Loss reduction, Distribution system, Substation, calculation of arrears**

I. INTRODUCTION

An electrical distribution system has many types of losses associated with it. There can be losses due to heat dissipation, metering errors, theft etc. Aggregate Technical and Commercial loss is an appropriate word which can be used in this circumstance where the system is associated with losses which occur due to different reasons.

In the yesteryears, utilities used Transmission and Distribution (T&D) losses as a parameter to represent the loss of the system. The major downside of taking account of T&D loss was that it represented only the loss due to heat dissipation while the system included other aspects of losses such as metering issues, theft etc. which can be called as commercial losses. The concept of AT&C loss was introduced as a solution for this situation by some state regulatory commissions. The advantage of AT&C loss is that it provides a complete picture of energy and revenue loss condition.

According to Pawar, R and Singh.J [1] the loss associated with the 11kV distribution feeders can be low compared to the overall loss but the loss which can occur due to the 11/0.415 kV substation or distribution transformer may be high.

Such high losses occurring in the distribution side can be due to many reasons like aged and low efficient distribution transformers and equipment, inadequate investments, lack of IT infrastructure deployment etc.

A method exists to find the technical losses using three phase unbalanced power flow. In a three phase system if the system is balanced then the unbalanced power flow will be zero, where in case of a fault the unbalanced current will increase. According to Orillaza [2] the method of finding technical losses using unbalanced power flow has adopted in many part of the distribution system. Implementation of Phasor Measurement Unit (PMU) is necessary to measure the unbalanced power flow in real time manner.

II. PROBLEM FORMULATION

In this section, the situation in which the project was undertaken has been discussed. While undertaking the project the condition of distribution division has described which had major contribution in the prevailing AT&C loss.

1. Inadequate and aged sub-transmission & distribution network leading to frequent power cuts and local failures/faults, erratic voltage and low or high supply frequency.
2. Energy meters were not installed in company's own residential colonies.
3. Employees availing more than one quarters since company does not maintain proper ID card or employee information database.
4. Electricity usage by the company colonies were beyond the usage level offered by the company.
5. Lower HT:LT ratio.
6. Inside the project area the company supplies electricity for street lights and water supply. Company considering this as a welfare to their own employees and does not charge for this facility,
7. Inadequate investment for infrastructure improvement.
8. Failure in the systematic maintenance of ledgers causes incorrect calculations and manipulations in the financial records.
9. Energy bill is dispatched on quarterly basis or half yearly basis which leads to the loss of interest and requirement of high working capital to the company.
10. Lack of IT implementation in commercial section and in distribution network.

These conditions are very significant in articulating a precise methodology to calculate the AT&C loss of the project area.

III. METHODOLOGY

The methodology for establishing AT&C loss level for the project area has been elaborated in this section. This methodology is articulated in accordance with the guidelines provided by Power Finance Corporation [3] to calculate the AT&C loss under Restructured Accelerated Power Development and Restructuring Programme (R-APDRP). The single line diagram of the project area was prepared using ETAP simulation software package. According to the guidelines, the project was divided into phases and tasks were performed in sequence.

Important thing to understand here is that before calculating the AT&C loss certain prerequisites should be met regarding the project area. They are;

1. Energy meters should be installed on all incoming feeders of 33kV & 11kV sub-stations located inside project area.
2. Energy meters should be installed on all incoming feeders of 33kV & 11kV feeding power to the HT/LT consumers inside project area.
3. Ring fencing of project area to be carried out. This refers to the installation of export/import meters in lines which are feeding power outside and inside the project area. Ring fencing helps to measure export and import of energy to the project area.
4. There should be export/import meters installed in dedicated feeders connected to sub-stations inside project area but feeding power to outside project area.
5. Segregation of rural HT (11kV) feeders according to category, including agricultural, commercial, domestic etc. Separate feeders can be installed in the absence of segregated feeders.
6. There should be a proper billing and revenue collection system which provide data regarding sales, revenue billed and collected for the project area. These data should be available for at least three billing cycles.

As far as the scope of this project is concerned these prerequisites were met and the billing and collection data were available up to date. However, for the calculation of AT&C loss data has to be considered for a complete financial year of the utility in this situation.

After meeting the prerequisites following procedure had followed.

A. Preparation of single line diagram

A single line diagram or a one line diagram is a graphical representation of a three phase power system which may include generation, transmission and distribution. In a single line diagram electrical elements such as bus bars, circuit breakers, isolators, current transformers, capacitors and conductors [4] are shown in its standardized symbols. In single line diagram three phase lines are represented with single line so that it reduces the complexity of the drawing process as well as future analysis.

While calculating AT&C loss it is important to have the proper single line diagram of the project area. By analysing single line diagram the task of identifying the export and import lines to the project area is simplified.
Fig. 1 shows essential symbols required to prepare the single line diagram. The ETAP software which can be used to prepare single line diagram has followed these symbols.

B. Computation of input energy

In the project area there were two 11kV feeders to supply power. These 11 kV feeders were subsequently connected to DTRs, LT lines and service lines, number of which depends on the size, population and load of the place. The simplest way to measure the total energy consumption of the project area is to install energy meters at the input points of each 11kV feeders and read them at regular intervals.

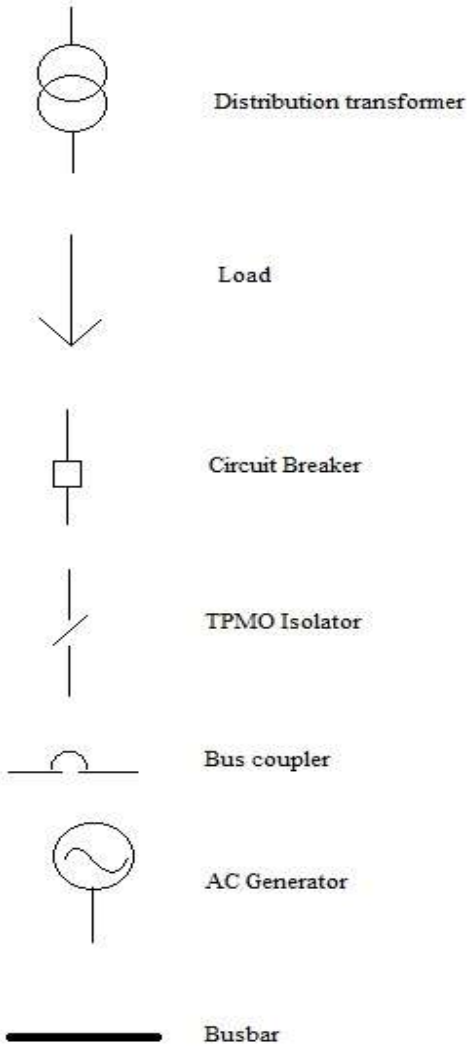

Fig 1: Single line diagram symbols

C. Computation of sales

The sales in terms of billed energy and corresponding billed revenue in the project area can be determined by adding the total energy consumed during the defined period by the metered consumers and unmetered consumers. For the unmetered consumer if the distribution company follows any assumptions then that can be accepted otherwise instructions given by state regulatory commission has to be followed.

D. Computation of billing efficiency

Billing efficiency means that the proportion of energy that has been supplied to the project area which has been billed to the consumer. This billed energy includes both metered and unmetered sales. The formula to determine the billing efficiency is given as follows.

$$\text{Billing efficiency} = \frac{\text{Total Units Sold (kWh)}}{\text{Total Input (kWh)}} \quad (1)$$

E. Calculation of revenue realised

The actual revenue realised by the distribution division is calculated as the difference of revenue collected and arrears pending.

$$\text{Revenue realised} = \text{Revenue collected} - \text{Arrears} \quad (2)$$

Computation of arrears for the financial year considered for the calculation of AT&C loss was done separately. To find the arrears pending for the particular financial year, it is possible to obtain data of arrears carried forward to the financial year and the arrears amount towards the end of the same financial year. The actual arrear amount is the difference of both.

$$\text{i.e., Arrear} = A_{FY-1} - A_{FY} \quad (3)$$

where,

$$A_{FY-1} = \text{Amount brought down by FY} - 1$$
$$A_{FY} = \text{Amount carried forward by FY}$$
$$\text{FY} = \text{Financial year}$$

F. Computation of collection efficiency

The energy billing system is totally depends on the amount of consumption of the energy which can be obtained from the energy meter reading. The energy bill is computed on the basis of tariff fixed by the regulatory commission for the specified type of consumer.

It is a common tendency in some consumers to default in their payments, or there can be consumers who are using power through illegal connections which can be considered as theft. This will increase the difficulty to recover the complete amount billed by the utility.
Collection efficiency can be computed by the formula.

$$\text{Collection efficiency} = \frac{\text{Revenue realized (Rs.)}}{\text{Billed amount (Rs.)}} \quad (4)$$

G. Computation of AT&C loss

The aggregate technical and commercial loss can be calculated by the formula.

$$AT\&C\ loss = [1 - (Billing\ effi. \times Collect\ effi.)] \times 100 \quad (5)$$

IV. ISSUES AND CHALLENGES

Issues and challenges faced during the process of calculation of AT&C loss are discussed in this section.

1. Lack of consumer management system has reflected in very intense way causing the unavailability of precise data about the existing consumers.
2. It has been observed that some entries in ledgers were manipulated which might have affected the end result. Some data seemed to have been entered just to fill up the entry.
3. Ledgers and other data on sales and revenue collections were made only on hard copy format which resulted in more time consuming calculations. Majority of the computations have done using software package hence coding that data was a time consuming process.
4. There were some human errors associated with the ledger entries. Recalculation of data resulted in lengthier computations.
5. Company was not in a condition to take legal action against the illegal habitants staying in company quarters.

V. RECOMMENDATIONS

The suggestions to reduce the aggregate technical and commercial loss prevailing in the project area are discussed in this section.

1. Maintenance of proper employee management system and identity cards for employees. It will help in tracking the persons staying in the quarters and to find the illegal habitants. Illegal habitants are households who consume free electricity and avail accommodation facility but are not the part of the company.
2. LT lines in congested areas can be replaced by aerial bunched cables so that illegal tapping can be prevented. Because aerial bunched cables are insulated using thick material so direct hooking is difficult.
3. Vigilance team should be there to find the thefts and illegal connection.
4. Energy meters should be installed at every quarter of the colony. Amount should be collected for extra usage apart from offered units as per the grade of employees.
5. Installed energy meters should be replaced to outdoor premises for the easier meter reading purpose.
6. Billing should be done bimonthly. Current method of dispatching bills varies according to consumers, which can lead to financially unhealthy situations.

7. Immediate action has to be taken to recover the arrears from default consumers.
8. Maintenance of ledgers and other financial records should be in digital format so that error diagnosis process and data analysis can be done quickly. It will also help in timely billing and dispatch of bills.

Fixed charge for unmetered consumer is very less compared to the actual consumption. Hence meters should be installed immediately and the fixed charge must be replaced with the charge according to the energy meter reading. This will ultimately increase the tendency of consumers to be more conservative.

VI. CONCLUSION

In this paper the various issues and challenges faced during the strengthening of a distribution unit through the reduction of AT&C loss has been discussed. The reasons for the current loss and the actions which can be implemented to reduce the loss have also been presented.
It can be concluded that some of the reasons mentioned above are common problems with every distribution network. Implementation of information technology in technical and commercial area is an adoptable tool for all type of distribution networks. It will improve the efficiency and accuracy of the system.

Distribution system can be said as the weakest system compared to generation and transmission. Majority of the losses are associated with distribution system. Hence reduction of distribution loss or aggregate technical and commercial loss is an important task. If the losses are reduced then the distribution network will become more efficient. As a result, the efficient distribution network will be more reliable and stable

REFERENCES

[1] Pawar.R, Singh.J, "Calculation of T&D loss % based on 11/0.4 kV substation in a distribution utlity", in *Power India conference, 2012 IEEE fifth, 2012, pp. 1-5*

[2] Orillaza, J.R.C, "Development of models and methodology for the segregation of distribution system losses for regulation'", in *TENCON 2006 IEEE region 10 conference, 2006, pp. 1-4*

[3] Power Finance Corp. Report, Methodology for Establishing Baseline AT&C losses, 4th September, 2009.

[4] V.K. Mehta and Rohit Mehta, Principles of Power System, S. Chand Publication, 2008.

[5] Mentor Poveda, A New Method to Calculate Power Distribution Losses in an Environment of High Unregistered Loads, IEEE 0-7803-5515-6/99, 1999.

[6] Costa Rica, Power Sector Efficiency Assessment: Technical Volume, RCG/Hagler, Bailly, Inc. and Oak Ridge National Laboratory, for Office of Energy, USAID, June1991.