ANALYSIS OF AGGREGATE TECHNICAL AND COMMERCIAL LOSSES OF APCPDCL

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Abstract

The Aggregate Technical and Commercial (AT&C) losses have registered 29 per cent of the total generation in India, which equals a shocking Rs.45,000 crore in the fiscal year 2009-10. Andhra Pradesh stands first in ranking by CRISIL and ICRA on performance evaluation of the Discoms. The same is 18.43 per cent for APCPDCL with a lowest AT&C loss during 2008-09 financial year. Aggregate Technical and Commercial (AT&C) losses are mainly due to low metering efficiency, theft and pilferages. This may be eliminated by improving metering efficiency, proper energy accounting & auditing and improved billing and collection efficiency. After IT infrastructure comes in place as envisaged under of Restructured Accelerated Power Development Programme (RAPDRP), losses can be computed applying the base line data system and energy audit module created under IT infrastructure. The Base Line AT&C losses are be computed using above methodology and consideration of three billing cycle data of each project area.

Key Words: - Technical losses-Commercial losses- RAPDRP-Three Billing Cycle

Transmission and Distribution (T&D) losses were used as a parameter for reporting their losses in the yester-years by SEBs/Distribution utilities. Theoretically, T&D losses are nothing but losses due to heat dissipation and transformation which are strictly technical in nature. Over the years T&D losses became common parlance, which include commercial losses as well. The same cannot be accepted as there is significant quantum of losses that occur due to problems with metering reading, metering issues, theft by direct hooking etc. High technical losses in the system are primarily due to inadequate investments over the years for system improvement works, which has resulted in unplanned extensions of the distribution lines, overloading of the system elements like transformers and conductors, and lack of adequate reactive power support. Due to lack of adequate investment on T&D works, the T&D losses have been consistently on higher side, and reached to the level of 32.86 per cent in the year 2000-01.The reduction of these losses was essential to bring economic viability to the State Utilities. The paper provides a comprehensive view of methodology of computation and analysis of AT&C losses for APCPDCL.

Concept of AT&C Losses

The concept of Aggregate Technical and Commercial (AT&C) losses was introduced by some state regulatory commissions in past decade. As the T&D loss was not able to capture all the losses in the net work, concept of Aggregate Technical and Commercial loss was introduced. The commercial losses are mainly due to low metering efficiency, theft and pilferages. This may be eliminated by improving metering efficiency, proper energy accounting & auditing and improved billing and collection efficiency. Fixing of accountability of the personnel (feeder managers) may help considerably in reduction of AT&C loss. The advantage of this parameter is that it provides a realistic picture of energy & revenue loss situation. The AT&C Losses comprise of two elements namely;

i. Technical Losses

The technical losses primarily take place due to the following factors;

a) Transformation Losses (at various transformation levels)
b) High I2 R losses (Copper loss) on distribution lines due to inherent resistance and poor power factor in the electrical network (where I is the current flowing in the conductor and R the resistance of the conductor. With I in amperes and R in ohms, the calculated power loss is given in watts)

The level of technical losses varies with type of conductors used, transformation capacity of Transformers and reactive loads among other factors. There are number of software packages available in market through which losses can be

computed. The essential requirements for calculating technical loss on power distribution network of any project areas are:-

- 33 kV and below HT network Line Diagrams.
- Line Diagrams for each of distribution transformers and LT circuits upto poles/ feeder pillars.
- Voltage levels, Power factor and Current loading on HT/LT network & network equipments.
- Line lengths, cross section & nature of material, network equipment's load curve.

ii. Commercial Losses

Any illegal consumption of electrical energy, which is not correctly metered, billed and revenue collected, causes commercial losses to the utilities. The commercial losses are primarily attributable to discrepancies in;

a) Meter Reading

Commercial losses occur due to discrepancy in meter reading. Meter reading problems are manifested in form of zero consumption in meter reading books which may be due to premises found locked, untraceable consumers, stopped/defective meters, temporarily disconnected consumers continuing in billing solution etc. Further, coffee shop reading, collusion with consumers is also source of commercial losses to utilities which are primarily due to meter reading.

b) Metering

Most of utilities are using either electro-mechanical or electronic meters for consumer metering. Commercial losses through metering can be in form of meter tampering in various forms, bypassing of meters, usage of magnets to slow down the meters, tampering etc.

c) Theft by direct hooking

This is most common and visible form of commercial losses in which people tend to tap LT lines to indulge in theft through direct hooking.

d) Collection Efficiency

Typically in a billing cycle, a distribution utility issues bills against metered energy an assessed (generally in case of agricultural loads and temporary connections) energy. However, in most of instances utility is not able to collect the complete amount billed by it. The ratio of amount collected to total amount billed is termed as collection efficiency. It is needless to say that low collection efficiency implies higher commercial losses.

The revenue collected shall exclude the arrears. However in case figures of arrears not available separately; there is possibility to getting collection efficiency figures of more than 100 per cent. In such cases efficiency shall be restricted to 100 per cent and shall be used for computation of AT&C losses. The amount attributing collection efficiency higher than 100 per cent shall be treated as collection against arrears.

iii) Methodology for establishing AT&C

This methodology is also to be used by utilities before Information Technology (IT) infrastructure comes in to being so that baseline losses can be established. After IT infrastructure comes in place as envisaged under of Restructured Accelerated Power Development Programme (RAPDRP), losses may be computed applying the same methodology through base line data system and energy audit module created under IT infrastructure. Further this methodology may be put in place in the energy audit module so that losses can be computed and monitored at sub-station, 11 kV feeder level. The intent is that methodology should be followed for establishing the baseline AT&C losses for different towns under the DISCOM.

a) Computation of Input Energy

Typically, towns are fed by 66 kV, 33 kV, 11 kV feeders and subsequently by DTRs, LT lines and service lines, number of which depends on size, population and load of the place. The simplest way to measure total energy consumption in the town is to install meters at input points of each of feeders (66 kV, 33 kV, 11 kV etc.) and read them at pre-defined intervals. Usually consumption shall be measured on a monthly/bi-monthly basis.

However, complications arise, as not all the feeders, feed in the project (town) areas. For example, there can be few feeders which feed beyond boundaries of town. These feeders usually few in number cater to the loads within and outside project area. In case of Line in Line out (LILO), net input energy to the project area of the feeder. In addition, if 66 kV or 33 kV feeders is directly feeding to a dedicated consumer and that consumer(s) is within project area, input of such feeder shall be considered as part of input energy to the project area. In order to measure input energy in such cases, utility can do ring fencing of towns through installation of import/export meters at project area boundaries. As mentioned

earlier too, there can be 11 kV feeders feeding within and outside project area. The utility may install import/export meters at town boundaries and account for total energy supplied beyond town boundaries through them. While computing energy consumption of town, this energy may be subtracted from total energy consumption arrived from meter reading.

b) Computation of Sales

Out of the total energy supplied some is lost in the form of technical losses as heat dissipation which is termed as I2 R losses. Some energy also is left unaccounted due to discrepancies in meter reading, non-metering and theft which is termed as commercial losses.

Here it is worth mentioning that across the DISCOMs there exist metered and unmetered consumers. The billing for metered consumers can be done through energy recorded by meters and the applicable tariff. In case of legitimate unmetered consumers billing is generally done according to norms defined by state regulatory commission. R-APDRP, in principle envisages for 100 per cent of metering of consumer so that there is no assessment of the energy. However, given the constraints of the utility in metering 100 per cent of the consumers in limited time, following options are being provided to the utilities for assessment of unmetered consumption;

- Norms established by respective state regulatory commission (SERC) for assessment of unmetered consumption.
- In case SERC norms are not defined, a consumption of 150 (Units) Kwh for each 1 kW of sanctioned connected load.

Thus sales in terms of billed energy and corresponding billed revenue in a project area shall be computed by adding the total energy consumed during the defined period by all consumers indicated in their meters (Meter-Sales as Billed) and energy consumed by consumers based on assessment/ unmetered connection (Unmetered-Sales as Billed). The details of how sales can be computed within project area have been shown in sample illustration.

c) Computation of Billing Efficiency

Billing efficiency is an indicator of proportion of energy that has been supplied to an area which has been billed (includes both metered and unmetered sales) to consumers. Billing Efficiency can be computed using formula provided below

$$\text{Billing Efficiency} = \frac{\text{Total Units Sold (kWh)}}{\text{Total Input (kWh)}}$$

d) Computation of Collection Efficiency

All the consumers are billed on the basis of energy consumed by them which is obtained from meter reading and assessment of unmetered connection. The bill amount is computed on the basis of tariff fixed by regulatory commission for applicable customer category. However, there are quite a few consumers who have tendency to default in their payments for various reasons. Thus utility is not able to recover entire amount billed, resulting in commercial losses. Collection efficiency is measured using formula given below;

Collection Efficiency =

$$\frac{\text{Revenue Collected (Rs.)}}{\text{Amount Billed (Rs.)}}$$

*The revenue collected shall exclude the arrears. However in case figures of arrears are not available separately, there is a possibility of having collection efficiency figures of more than 100 per cent. In such cases efficiency shall be restricted to 100 per cent considering r, percentage point above 100 per cent attributable to arrears. Thus revenue collection in excess to revenue billed shall be treated as arrears and the same shall excluded in the computation of AT&C losses.

e) Computation of AT&C Losses

The aggregate technical and commercial losses shall be measured using formula mentioned below:

AT&C Losses = { 1- (Billing Efficiency x Collection Efficiency) } x 100

Where,

Billing Efficiency =

$$\frac{\text{Total Units Sold (kWh)}}{\text{Total Input (kWh)}}$$

Collection Efficiency =

$$\frac{\text{Revenue Collected (Rs.)}}{\text{Amount Billed (Rs.)}}$$

Establishing base line (initial) AT&C Losses for Project Area

There shall be significant manual intervention in the entire computation process Pre-implementation of IT Infrastructure. Though, the Base Line AT&C losses may be computed using above methodology and consideration of three billing cycle data of each project area in the following manner;

The three billing cycles, data such as energy inflow and outflow and corresponding revenue collected for the project area shall be

considered for computation of baseline (initial level) AT&C losses for a town area. The utility shall ensure that billing cycle doesn't exceed for two months. Necessary measures to achieve the objective shall be taken by utility. In case, in the same area some consumers are read monthly, while others are read bimonthly, sales data shall be considered for corresponding period. For example, there can be a case where HT consumers have monthly billing cycle and other consumers have bimonthly billing cycle. In such cases, sales data of three billing cycle for other category of consumers shall be considered while for HT consumers, sales data for 6 months shall be considered for computing AT&C Losses for the corresponding period. Thus after considering above factors based on three billing cycles data, the base line (initial) AT&C Losses for Project Area shall be computed using formula placed above.

Source of Information and Data

The source of information for establishing initial AT&C losses for the area shall be as follows;

- The input and out flow of energy to the project areas shall be energy recorded by ring fencing meters.
- The energy sale figures, energy billed and revenue collected shall be as per the metering, billing, and collection record maintained by the utilities.
- The assessed energy sale, energy billed shall be be based on the record for such consumers maintained by the utilities.
- Norms established by the state electricity regulatory commission (SERC) for assessment of unmetered consumption.
- Any other relevant record / data and regulation / guidelines issued by respective SERC.

Transmission and Distribution Losses of APCPDCL

The Transmission and Distribution losses are currently 29 per cent of the total generation in India, which equals a shocking Rs 45,000 crore in the fiscal year 2009-10.

i. Technical Losses of APCPDCL

Table 2 presents how APCPDCL endeavored in reduction of technical losses. The technical losses were highest in the first year of the inception of the DISCOMS in Andhra Pradesh (33.34) and reduced gradually. It is lowest in the financial year 2009-10(16.67), which shows the committed approach of the Company in curtailing the technical losses.

ii. Commercial Losses of APCPDCL

The commercial losses were fluctuating from 2000-01 till year 2004-05 recording a highest commercial loss of 10.94 per cent. The company was efficient in collecting the revenue in the year 2008-09 with a lowest commercial loss and highest collection rate of 99.62 per cent. On the whole the demand for the energy was growing along which the collections also were growing during the study period. This is a favorable indication of the company's efficient recoveries. The company mustered highest collections during the financial year 2009-10 (7801.75). The sales and revenue and the collections are in consonance with the increasing assets base with indicates the remarkable growth in the company with highest collections in the year 2003-04.

iii. Average Technical and Commercial Losses(AT&C)

The national level figures show that the energy loss in 2001-02 was 32.86% and increased to 34.78% in 2003-04 . In 2008-09 , it stood at 28.44% but currently the figure is again 29%. It is as high as 51% in Jharkhand, 45% in Madhya Pradesh and 40% in Bihar. Andhra Pradesh Stands first in ranking by CRISIL and ICRA on performance evaluation of the Discoms. The same is 18.43 per cent for APCPDCL with a lowest AT&C loss during 2008-09 financial year.

Conclusion

The power sector in India is going through the second generation of reforms. The Ministry of power is committed in reducing the AT&C on war foot basis. Many utilities across the country have responded very positively by exploiting all their endeavors in down sizing the AT&C losses. The APEPDCL in Andhra Pradesh has set an example in the country by successfully reducing the AT&C losses to a lowest level which can be taken as model for APCPDCL. For reducing the AT&C the collection efficiency has to be improved. The company therefore suggested implementing the available best information technology packages like SAP in mustering the line loss and pilferages.

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Appendix

Table 1

AT & C Loss of Project Area (Sample)

Sl. No	Description	Equation	Base Line (Year -00)	Current Year
1	Input Energy (Import-Export) 33-kV Fdrs LU	Ei	100	100
2a	Energy Billed (Metered) LU	E1	60	60
2b	Energy Billed (Un-Metered) LU	E2	10	10
2c	Total Energy Billed (E1 + E2)	Eb	70	70
3	Amount Billed (Rs Lac)	Ab	400	400
4a	Gross Amount Collected (Rs Lac)	AG	410	410
4b	Arrears Collected (Rs Lac)	Ar	40	40
4c	Amount Collected w/o Arrears (Rs Lac)	Ac=AG-Ar	370	370
5	Billing Efficiency	Φ =Eb/Ei *100%	70%	
6	Collection Efficiency	ω=Ac/Ab *100%	93%	
7	AT & C Loss	{1-(Φ*ω)}* 100%	35%	

Baseline = Based on 3 cycle billing Date { If Ar is not known, assume Ar = AG- Ab }

Table 2
Average Technical Losses of APCPDCL during the Study Period

Year	Power Purchased in MU	Sales to Agriculture	Metered sales in MU	Total Sales in MU	Technical Loss in MU	Loss in Percentage
2000-01	16434	5081.56	5873.33	10954.89	5479.11	33.34
2001-02	16689	5665.74	6568.19	12233.93	4455.07	26.69
2002-03	17252	5584	7716.18	13300.18	3951.82	22.91
2003-04	18287.6	5684.63	8783.71	14468.34	3819.26	20.88
2004-05	20109.4	5772.57	10301.99	16074.56	4034.84	20.06
2005-06	21426.9	6140.53	11377.69	17518.22	3908.68	18.24
2006-07	24185.3	7207.96	12860.14	20068.1	4117.2	17.02
2007-08	26356.5	6213.47	15580	21793.47	4563.03	17.31
2008-09	28942.23	6970.95	17069.04	24039.99	4902.24	16.94
2009-10	31932.93	7749.03	18860.53	26609.56	5323.37	16.67

Source: Compiled from Annual Reports of APCPDCL.

Table 3
Commercial Losses during the Study Period

Year	Demand in crores	Collections in crores	Collections in Percentage	Loss in Percentage
2000-01	2394.83	2295.41	95.85	4.15
2001-02	2659.68	2596.41	97.62	8.38
2002-03	3347.3	3108.53	92.87	7.13
2003-04	4059.71	3615.58	89.06	10.94
2004-05	4360.27	4132.33	94.77	5.23
2005-06	4658.08	4551.19	97.71	2.29
2006-07	5036.93	4988.99	99.05	0.95
2007-08	5955.26	5888.7	98.88	1.12
2008-09	6543.48	6518.42	99.62	0.38
2009-10	7947.32	7801.75	98.17	1.83

Source: Compiled from Annual Reports of APCPDCL.

Table 4
Average Technical and Commercial Losses of APCPDCL (in per cent)

	Technical Loss in Percentage	Commercial Loss in Percentage	Average Technical and Commercial Losses
2000-01	33.34	4.15	37.49
2001-02	26.69	8.38	35.07
2002-03	22.91	7.13	30.04
2003-04	20.88	10.94	31.82
2004-05	20.06	5.23	25.29
2005-06	18.24	2.29	20.53
2006-07	17.02	0.95	17.97
2007-08	17.31	1.12	18.43
2008-09	16.94	0.38	17.32
2009-10	16.67	1.83	18.50