Power Finance Corporation Limited

Methodology for Establishing Baseline AT&C Losses

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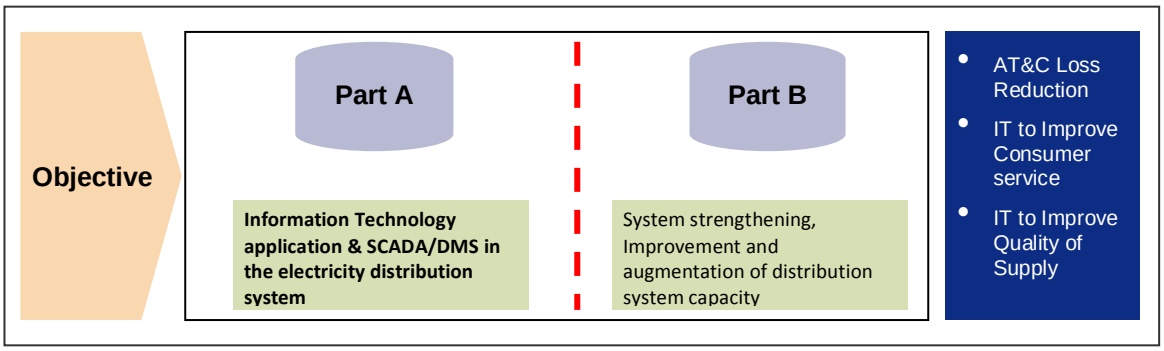
Contents

1 Introduction

Power sector reforms in India have been going on for more than a decade. Initially the focus was more on bringing about structural changes like unbundling of SEBs and creation of independent generation, transmission and distribution companies. In the subsequent period, power generation received maximum focus. However, in the recent past, it is felt that power distribution is the weakest link in the entire value chain and sector cannot achieve viability unless issues in the power distribution sector are resolved, aiming at a sustainable development of the sector.

With these objectives in mind, Ministry of Power, GoI has launched R-APDRP scheme. The programme covers towns with more than 30,000 population (10,000 in case of Special Category States) with a Plan allocation of more than 50,000 crore . The schematic for the entire programme is shown below:-



Part A of the scheme essentially covers the application of information technology in distribution utilities across the country. The scheme shall involve implementation of IT modules for data acquisition, new connections/disconnection, energy accounting & audit, network analysis management, Maintenance management, Asset management, MIS, metering, billing, collection etc. The programme also encompasses implementation of SCADA/DMS, GIS based Consumer Indexing & Asset mapping etc.

This entire exercise is being aimed to establish Base line Data collection system for the distribution utilities through which they are able to capture AT&C losses in a precise manner without manual intervention and also to plan & implement corrective measures in Part B

Part B of the scheme covers system strengthening, improvement and augmentation of distribution system. This shall involve:-

- Identification of high loss areas
- Preparation of investment plans for identified areas
- Implementation of plan
- Monitoring of Losses

Further, distribution utilities shall work with respective regulatory commissions to ensure that a part of financial benefits arising out of the AT&C loss reduction are also passed on to the consumers of the project area.

In the yester-years SEBs/distribution utilities used T&D (Transmission and Distribution) losses as parameter for reporting their losses. 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. Also, the extent of commercial losses cannot be determined, so the T&D losses as defined theoretically cannot be computed.

The Aggregate Technical and Commercial (AT&C) Losses shall be used for purpose of the R-APDRP. The baseline AT&C losses for each of the project areas shall be established. The details of the AT&C losses are provided in the next section. The baseline data and required system shall be verified by an independent agency appointed by the Ministry of Power/Nodal Agency (Power Finance Corporation).

2 Concept of AT&C Losses

The concept of Aggregate Technical & Commercial losses was introduced by some state regulatory commissions in past decade. The advantage of the parameter is that it provides a realistic picture of energy & revenue loss situation. The AT&C Losses comprise of two elements:-

2.1 Technical Losses

The technical losses primarily take place due to the following factors:-

a) Transformation Losses (at various transformation levels)
b) High I^2R losses on distribution lines due to inherent resistance and poor power factor in the electrical network

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 softwares 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 etc

2.2 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:

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.

Metering:-

Most of utilities across India 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 of PT circuits, CT/PT ratios (in case of HT meters)etc.

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.

Collection efficiency:-

Typically in a billing cycle, a distribution utility issues bills against metered energy and 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. 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%. In such cases efficiency shall be restricted to 100% and shall be used for computation of AT&C losses.

The amount attributing collection efficiency higher than 100% shall be treated as collection against arrears.

The formula for computing AT&C Losses has been provided in Section 4.5

3 Prerequisites

The project area is an area of the town covered in the Part –A project sanctioned under RAPDRP for the utility. The utility shall be required to meet certain pre-requisites before baseline AT&C losses of the project area can be established. The same has been discussed in following sections.

3.1.1 Metering of Energy Input points of Project area

Utility shall need to ensure that energy input points of project area's electricity network are metered. For achieving this meters need to be installed on all such points so that the same can be read accurately. It is preferable that meters with capability of being read remotely be installed as the same is requirement of Part-A R-APDRP. This shall include installation of meters :-

1) On incoming lines of 33/11 kV sub-stations located within project area.

2) On 33 kV, 11 kV feeders emanating from sub-station located outside project area but supplying power to HT/LT consumers located within project area

3.1.2 Ring-fencing of Project area electrical network

As a next pre-requisite, utilities shall ensure that the project areas is electrically ring fenced. It is worth mentioning here that as per Guideline issued by GoI, ring fencing is essential for considering funding of project area under Part-B of R-APDRP. Ring fencing shall be done to measure net input energy (difference of energy entering into and leaving) of the project area through installation of :

i) Import/export meters at the boundary of those lines that are feeding outside as well as inside project area so that import and export of energy can be measured for project area. These lines may emanate from the sub-stations located within or outside project area.

ii) Import/export meters on the dedicated feeder emanating from sub-stations located within project area but feeding outside project area.

iii) Import/export meters on 33/11 kV sub-stations LILO/tie lines.

3.1.3 Segregation of rural loads within project area

For HT (11kV) feeders, providing power to mixed category of consumers including agricultural (rural), commercial, domestic etc., within project area, utilities may segregate these feeders through installation of separate HT feeder for such loads.

3.1.4 Billing & Revenue Collection System

It is preferred that current billing system is able to provide data like sales, revenue billed and collected for entire project area. However, if such a system is not available, utility shall be required to make certain modifications in the billing system to capture the respective town data.

Usually under the prevailing system in utilities, billing system is designed in a way that sale data can be extracted for 11 kV feeder or for a distribution centers (DCs) as whole. This data may include sales which may have happened outside project area.

In such cases the utilities may have to make provisions to account for sales happening outside project area. Similarly for extracting the data for revenue billed and collected within and outside project area necessary provisions in billing systems shall be required to be made by utility.

The above data for three billing cycle shall be required for computation of initial base line AT&C losses.

4 Methodology for establishing AT&C Losses for Project Area

This section details out methodology for establishing AT&C level for project area as a whole. This methodology is also to be used by utilities before IT infrastructure comes in to being so that baseline losses can be established for project area (town). After IT infrastructure comes in place as envisaged under part A of RAPDRP, losses for project area 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 and DTR level also.

The intent is that methodology should be followed for establishing the baseline AT&C losses for different towns (hereafter referred as project area), having population of 30,000 (10,000 for special category states) across different distribution utilities across the country. The identified project areas can be prioritized on basis of computed AT&C losses by utilities

4.1 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 LILO, net input energy to the project area of the feeder shall be considered. In addition, if 66 kV or 33 kV feeder 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.

4.2 Computation of Sales

Of the total energy supplied some is lost in the form of technical losses as heat dissipation which is termed as I^2R 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 states 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 respective state regulatory commission. R-APDRP, in principle envisages for 100% of metering of consumer so that there is no assessment of the energy. However, given the constraints of the utility in metering 100% of the consumers in limited time, following options are being provided to the utilities for assessment of unmetered consumption:-

a) Norms established by respective state regulatory commission (SERC) for assessment of unmetered consumption.

b) In case SERC norms are not defined, a consumption of 150 (Units) Kwh for each 1 kW of sanctioned connected load.

The assessment is allowed only for limited period of time and the utilities are required to complete 100% metering within 6 months of sanction / commencing implementation of Part-A project. Further these assessment norms shall not be changed by utilities, without adequate justification.

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 (Appendix A2)

4.3 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:-

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

4.4 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 by it resulting in commercial losses. Collection efficiency is measured using formula given below:-

$$\textbf{Collection Efficiency} = \frac{\textbf{Revenue Collected (in Rupees)*}}{\textbf{Billed Amount (in Rupees)}}$$

*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%. In such cases efficiency shall be restricted to 100% considering r, percentage point above 100% 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.

4.5 Computation of AT&C Losses

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

Formula for AT&C Losses

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

Where,

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

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

AT&C Loss of Project Area # 1 (Sample)

Sl. No.	Description		Base Line (Year-00)	Current Year
1	Input Energy (Import-Export) 33-11kV Fdrs LU	E_i	100	
2a	Energy Billed (Metered) LU	E_1	60	
2b	Energy Billed (Un-Metered) LU	E_2	10	
2c	Total Energy Billed (E1 + E2)	E_b	70	
3	Amount Billed (Rs Lac)	A_b	400	
4a	Gross Amount Collected (Rs Lac)	A_G	410	
4b	Arrears Collected (Rs Lac)	A_r	40	
4c	Amount Collected w/o Arrears (Rs Lac)	$A_c=A_G-A_r$	370	
5	Billing Efficiency	$\phi = E_b/E_i *100\%$	70%	
6	Collection Efficiency	$\omega = A_c/A_b *100\%$	93%	
7	AT&C Loss	$\{1-(\phi *\omega)\}*100\%$	35%	

Baseline = Based on 3 cycle billing Data {If A_r is not known, assume $A_r = A_G - A_b$ }

5 Establishing base line (initial) AT&C Losses for Project Area (Pre -IT Implementation)

There shall be significant manual intervention in the entire computation process Pre-implementation of IT Infrastructure under Part-A. 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 project 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 project 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 at 4.5 above.

Source of Information and Data

The source of information for establishing initial AT&C losses for the town 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, collection record maintained by the utilities.
- The assessed energy sale, energy billed shall be as per para 4.2 above and should be based on the record for such consumers maintained by the utilities.
- Norms established by respective state regulatory commission (SERC) for assessment of unmetered consumption
- Any other relevant record / data and regulation / guidelines issued by respective SERC,

(The above data shall be for the period of three billing cycle).

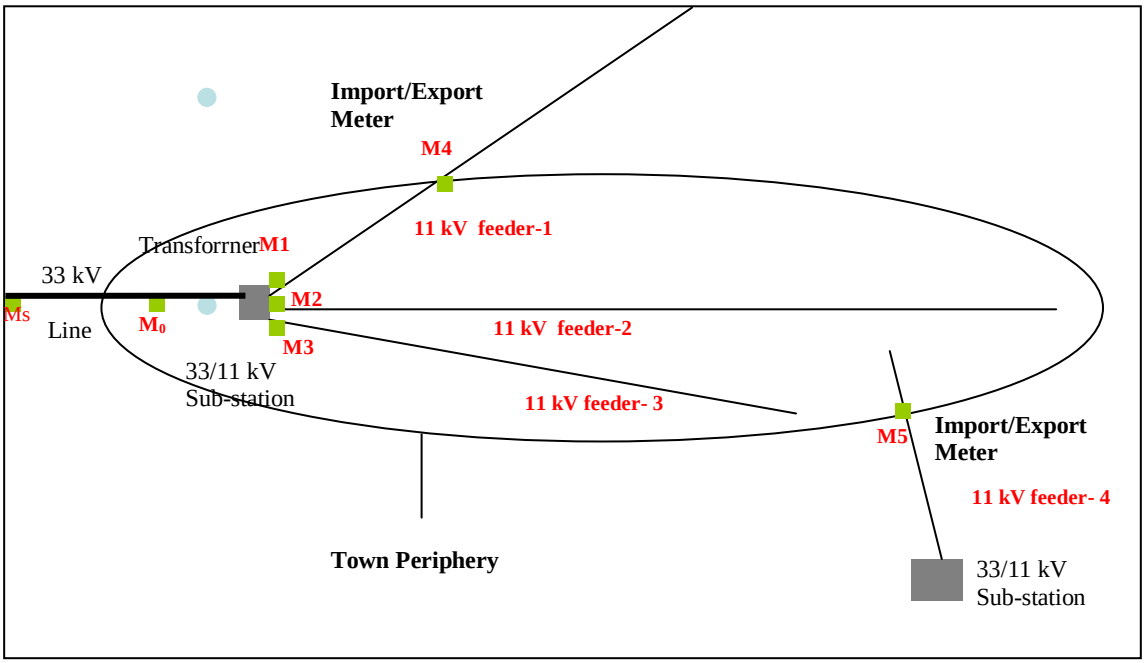
6 Methodology for establishing AT&C Losses for Project Area (Post-IT Implementation)

The previous section detailed out methodology for establishing AT&C level for project area, before IT systems come into place. There shall be significant manual intervention in the entire computation process.

Thus, once IT infrastructure comes into place, suitable mechanism should be place in energy audit module so that losses may be computed directly from the system. Further, mechanism to be put in energy audit module should be in occurrence with process used for establishing baseline losses without IT systems and should ensure that manual intervention is minimal.

Provisions should also be made so that losses can be computed and monitored at 11 kV and DTR level also.

7 Sample Computation of AT&C Losses for Project Area



M represents meters installed at various points

represents 33/11 kV transformer

From the illustrative diagram above, significant number of data points shall be captured for computation of AT&C Losses as tabulated below:-

S.No.	Particulars	Units	Notation	
1	Input Energy at Mo (incoming point on 33 kV line)	Lakh Units		E1
2	Input Energy at M5 (incoming point on 11 kV Feeder No. 4)	Lakh Units		E2
3	Export of Energy through Feeder No.1 at M4	Lakh Units		E3
4	**Net Input Energy in Project Area**	Lakh Units	**(E1+E2)-E3**	**A**
5	Energy Sales in Project Area (Metered)	Lakh Units		F1
6	Energy Sales in Project Area (Un-metered)	Lakh Units		F2
7	**Net Energy Sales in Project Area**	Lakh Units	**F1+F2**	**B**

S.No.	Particulars	Units	Notation	
8	Total Amount Billed (current) in Project Area	INR		**C**
9	Total Amount Collected in Project Area (excl arrears)	INR		**D**
	Billing Efficiency	Ratio		**P=B/A**
	Collection Efficiency	Ratio		**Q=D/C**
	AT&C Losses for Project Area			**Z={1-(P * Q)}*100**

A sample illustration has been provided in Appendix-A-2 for reference.

8 Methodology for computing Annual AT&C Losses for Utility

As per guidelines, losses for entire utility are to be computed. The annual AT&C losses for the entire utility, for the requirement for R-APDRP shall be computed based on the methodology adopted by PFC in its annual performance report of the state power utilities. This methodology is attached in Appendix A3. The source of information / data is also identified.

A Appendix

A.1 Template for Data Collection

A.1.1 Input Energy to 33/11 kV Sub-station within project area

Name of Distribution Company
Name of the Project Area
Bill Month and Year

Name of the 33/11 kV sub-station	Sub-station Code	Input Energy (Kwh)

A.1.2 Feeders supplying energy within project area

Name of Distribution Company

Name of the Project Area

Bill Month and Year

Name of the feeder	Feeder Code	Input Energy in Kwh	Energy Sales within project area in Kwh		Amount Billed within project area (INR)	Revenue Collected within project area (INR)
			Metered Sales in Kwh	Unmetered Sales in Kwh		

Please note that, collection efficiency exceeding 100% shall be treated due to collection against arrears. As such for the purpose of loss computation collection efficiency shall be taken as 100% only.

A.1.3 Feeders supplying energy within as well as outside project

Name of Distribution Company

Name of the Project Area

Bill Month and Year

Name of the 11 kV feeder	Feeder Code	Input Energy on Feeder	Energy exported/ imported from feeder	**Net Input in Project Area**	Sales on the feeder (inside project area)		**Total Sales (inside Project Area)**	Amount billed on the feeder (inside project area)	Revenue Collected on the feeder (inside project area)
					Metered Sales (Kwh)	Unmetered Sales (Kwh)			

*To be computed using import/export meter installed at project area boundary

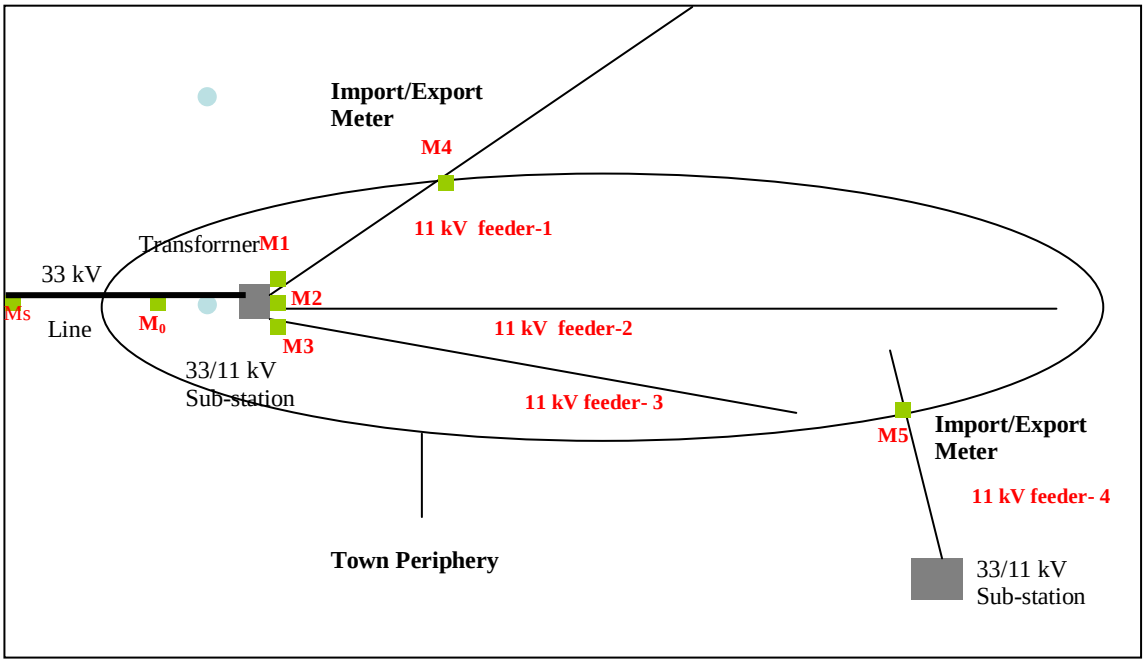
A.1.4 Feeders from which energy is being imported

Name of Distribution Company
Name of the Project Area
Bill Month and Year

Name of the 11 kV feeder	Feeder Code	Total Energy Imported at boundary (Kwh)*	Sales in project area (Kwh)		Amount Billed Inside project area (INR)	Revenue Collected inside project area (INR)
			Metered Sales (Kwh)	Unmetered Sales (Kwh)		

*To be computed using import/export meter installed at project area boundary

A.2 Sample Illustration



M represents meters installed at various points

represents 33/11 kV transformer

The illustrative methodology for establishing baseline losses is explained through figure above. We have in consideration a town having typical one 33/11 kV Sub-station.

There are a total of three feeders emanating from sub-station. While two feeders are feeding within town area, feeder No.1 is feeding areas outside town as well. Furthermore we also have feeder that is emanating from sub-station located outside project area i.e. Feeder No.4, but also feeding to consumers within project area.

For measuring the input energy in the project area, meters have been installed at input point of 33 kV feeder (represented by Mo), outgoing points of 11 kV feeders (represented by M1, M2 and M3), and import/export points (represented by M4 and M5). Further, there is another meter installed at origin of 33 kV feeder (represented by Ms). The difference between corresponding readings of No and Mo can be used to measure technical losses on 33 kV line.

In this case in order to compute the AT&C losses of town as a whole, following details are required:-

a) Total energy input in the town area (over fixed billing cycle)
b) Total sold energy in town area (over same fixed billing cycle)
c) Billing Efficiency
d) Collection Efficiency

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 project 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 project 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.

Computation of Input Energy

Energy received in project area

As a first step, for computing energy input in the town area, energy (over fixed billing cycle) to the 33/11 kV feeder (incomer of the 33/11 kV sub-station located within project area) needs to be measured from the energy meter installed at the 33 kV incoming side of the sub-station.. Thus, for project area (town) under consideration, we have a 33 kV feeder and an 11 kV feeder (feeder No,.4) supplying energy to project area. The energy for both of them can be accounted as given in table below:

S.No.	Feeder Name	Energy (Kwh)
1	33 kV Feeder (incomer of the 33/11 kV sub-station located within project area)	A1
2	Energy Imported by Feeder No. 4	A2
	Total Energy Input in Project Area	P= A1+ A2

Please note that meters need to be installed on HT side of power transformers so that even transformational losses can be captured.

Feeders supplying energy within as well as outside project area:

Accounting for Export/Import of Energy

As can be observed, there are two feeders i.e. feeder No.1 and feeder No.4 which are feeding into as well outside project area. Thus import/export from these have to be suitably accounted for while computing net input of energy into the project area.

From figure it is clear that while there shall be export of energy from feeder No.1 outside project area, energy shall be imported from feeder No.4. The energy fed in to project area can be computed as given in tables below:-

Feeder No.1 (Exporting Energy outside project area)

S.No.	Particulars	Energy (Kwh)
	Energy **exported**, measured through import/export meter (Feeder – 1)	C

Thus Net Input Energy in the project area shall be

S.No.	Feeder Name	Energy (Kwh)
1	Total Input of Energy in the Project Area	**γ = P-C**

Computation of Sales

Sales figure for town area can be obtained from billing system. However, if billing system is such that sale are obtained on a feeder level certain work-outs against mixed feeders (in this case feeder no. 1 & 4) shall be required because only sales figure against consumers within project area shall be required for computation of total sold energy and revenue collection. Again the similar methodology used for measuring input shall be used.

Sales for feeders supplying energy within project area

S.No.	Feeder Name	Metered Sales (Kwh)	Unmetered Sales(Kwh)
1	Feeder No.2	B2	B2’
2	Feeder No.3	B3	B3’
3	Total Sales	**X= B2+B2’+B3+B3’**	

Feeders supplying energy within as well as outside project area:

Feeder No.1 (Exporting Energy outside project area)

S.No.	Particulars	Metered Sales (Kwh)	Unmetered Sales(Kwh)
1	Total sales from feeder no. 1	B1	B1'
2	Sales from Feeder No. 1 for outside project area	C1	C1'
	Net Sales (in Project Area) by Feeder No.1	**Y= B1+B1'-C1-C1'**	

Feeder No.4 (Energy being imported from the feeder)

S.No.	Particulars	Metered Sales (Kwh)	Un-metered Sales (Kwh)
1	Sales from feeder no. 4, inside project area (derived after deducting sales figures outside project area)	E4	E4'
	Net Sales adjustment in project area	**Z= E4+ E4`**	

Thus Net Sales in the project area shall be

S.No.	Feeder Name	Total Sales (Kwh)
1	Sale of Energy for Feeder 2 and 3	X
2	Sale of Energy (in Project Area) on Feeder No.1	Y
3	Sale of Energy (in Project Area) on Feeder No.4	Z
4	**Total Sales in Project Area**	**η= X+Y-Z**

Computation of Billing Efficiency

S.No.	Particulars	(Figures in kWh)
1	Net Input Energy in the project Area	γ
2	Net Sale of Energy in the project Area	η
	Billing Efficiency	$\phi = (\eta/\gamma)$

Computation of Collection Efficiency

Feeders supplying energy within project area

S.No.	Feeder Name	Amount Billed (Rs.)	Revenue Collected (Rs.)
1	Feeder No.2	a	B
2	Feeder No.3	c	D

Feeders supplying energy within as well as outside project area:

Accounting for revenue outside project area

Feeder No.1 (Exporting Energy outside project area)

S.No.	Particulars	Amount Billed (Rs.)	Revenue Collected (Rs.)
1	Feeder No.1 Total revenue	e	F
2	Feeder No.1 (Revenue outside project area)	g	H
	Net Revenue (Feeder-1)	I =e-g	j = f-h

Feeder No.4 (Energy being imported from the feeder)

S.No.	Particulars	Amount Billed (Rs.)	Revenue Collected (Rs.)
1	Feeder No.4 (Sales inside project area)	m	N

Thus Collection Efficiency for the project area shall be computed as follows:-

Collection Efficiency ω= (b+d+j+n)/ (a+c+i+m)

Computation of AT&C Losses

The AT&C losses shall be computed using the formula provided in Section 4.5. Thus AT&C loss for the project area under consideration shall be

AT&C Losses for Project Area $L_1 = \{1- (\phi * \omega)\} * 100$

Where,
ϕ= Billing Efficiency
ω= Collection Efficiency

A.3 Methodology for calculation of Annual AT&C losses (%) for utilities selling directly to consumers and source of information / data

A	Input Energy(Mkwh)*	Energy Generated – Auxiliary Consumption+Energy Purchased (Gross) – Energy Traded/Inter State sales
B	Transmission Losses(Mkwh)	
C	Net Input Energy (Mkwh)	(A-B)
D	Energy sold (Mkwh)	i) Energy sold to all categories of consumers including trading in Energy/Inter State Sales ii) Energy traded / Interstate sale
E	Adjusted Energy sold (Mkwh)	Energy sold to all categories of consumers excluding Energy traded/ Inter State sales D (i – ii)
F	Revenue From Sale of Energy (Rs.Cr.)	i) Revenue from sale of Energy to all categories of consumers (excluding subsidy) including trading / Inter State sales. ii) Revenue from Trading of Energy /Inter State sale
G	Adjusted Revenue From Sale of Energy (Rs./Cr.)	Revenue from sale of Energy excluding revenue from trading of energy / inter state sale F (i - ii)
H	Opening Debtors For Sale of Energy (Rs./Cr.)	i) Opening debtors for sale of Energy (without deducting provision for doubtful debtors).
I	Closing Debtors For Sale Of Energy (Rs./Cr.)	i) Closing debtors for sale of Energy (without deducting provision for doubtful debts). ii) Any amount written off directly from (i)
J	Adjusted Closing Debtors For Sale of Energy (Rs./Cr.)	I (i + ii)
K	Collection Efficiency (%)	(H+G-J)/G*100
L	Units Realized (Mkwh)	E*K/100

M	Units Unrealized(Mkwh)	C-L
N	AT&C Losses (%)	M/C*100

Note (i) *DISCOMs are required to give input energy at the point of purchase including transmission losses.

(ii) Provision for unbilled energy and debtors for trading of power have not been adjusted for calculation of collection efficiency since provision for unbilled revenue is cyclical in nature and figures of debtors are verifiable from annual accounts.

(iii) Figures in above table wherever available should tally with the annual accounts.

Sources of information for Annual AT&C losses of utilities

S. No.	Parameters	SEBs	DISCOMs	Power Departments / utilities not preparing annual accounts
1	Energy generated (Mkwh)	Annual Accounts		Resource Plan
2	Auxiliary consumption (Mkwh)	Annual Accounts		Resource Plan
3	Energy purchased including energy traded / inter-state sales (Mkwh)	Annual Accounts	Annual Accounts	Resource Plan
4	Transmission losses (Mkwh)	Information from utilities	Information from utilities	Information from utilities, if not available in Resource Plan
5	Energy sold (Mkwh)	Annual Accounts	Annual Accounts	Resource Plan
6	Energy traded / inter state sales (Mkwh)	Information from utilities	Information from utilities	Resource Plan
7	Revenue from sale of energy (Rs. Crores)	Annual Accounts	Annual Accounts	Resource Plan
8	Revenue from trade of energy / inter-state sales (Rs. Crores)	Information from utilities	Information from utilities	Resource Plan
9	Opening debtors for sale of energy (Rs. Crores)	Annual Accounts	Annual Accounts	Resource Plan
10	Closing debtors for sale of energy (Rs. Crores)	Annual Accounts	Annual Accounts	Resource Plan

Note : (i) For SEBs/ DISCOMs, the information is extracted from annual accounts. In case information is not available in the annual accounts, the same is obtained from utilities.

(ii) For Power Departments / utilities not preparing annual accounts, the information is extracted from the Resource Plan. In case information is not available, the same is obtained from the utilities.