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Power Loss Reduction in Practical Distribution System

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Abstract

In this paper an attempt is made to reduce the power losses in practical distribution system. Power System faces a big problem of distribution losses. In this paper technical, non technical and administrative losses are calculated of local city. Analysis of various types of distribution losses of radial distribution network is considered. More than 60% power loss due to technical and non technical loss etc. In this paper a new attempt of calculation of various distribution losses in power system and their economic effect on the utility are introduced..With the help of case study of radial distribution of local city, some new concepts are introduced to reduce the power losses and improve the voltage profile in practical distribution.

Keywords*:* Energy Loss, Technical, Non technical, Administrative

Introduction

As we know that the main function of Power system to complete the load and energy requirements of costumer. Large amount of power loss when we transfer the power from one place to other, the transmission system of an area is known as grid. The main function of transmission lines to transfer power from generating station to local substation. Transmission lines supply distribution substations equipped with transformers which step the high voltages down to lower levels. We know that large amount of power loss in the transmission process. The main function of distribution system to provide link between transmission systems and direct to customers so the distribution system plays an important role in any electric power system. It provides the power for local use. More than 40% power loss in distribution system. Mainly we have three types of losses, As technical losses are caused by internal operation of power system or due to transformer loss, corona loss, conductor loss, resistance loss. Non technical losses are caused by electric theft, meter tempering, direct hooking, or

nonpayment of bill. Administrative losses *are* special type of distribution loss, basically it is the energy used in Substations, offices works, warehouses and workshops, and other essential electrical loads are usually considered as part of the administrative loss. So due to this reason large amount of power loss take place in distribution system

Literature Review

PSPCL, come into play under Section 5 of the Electricity Act- 1948 on May, 1967 after the reorganization of the State. The Board was set, up.for.generation, transmission and distribution of electricity in Punjab. Thermal generation is 65% and hydro generation is 35% of the total, electricity generated by the Board. The main function of board to control the power system and full fill the energy requirement of costumers.

1. El-Gammal in their paper 'Shunt Capacitor Sizing for Radial Distribution Feeders with Distorted Substation voltages' present an algorithm for optimizing shunt capacitor sizes on radial distribution lines with distorted voltages, such that the RMS voltages and their total harmonic distortion lie within limits.
2. Acc to Chang 'Optimum Allocation of Shunt Capacitors and Voltage Regulators on Primary Feeders' assume a feeder with a uniform load and a concentrated end load. Accounting for both peak power losses.
3. Samson & Neagle have presented in their paper titled 'Loss Reduction from Capacitors Installed on Primary Feeders' assume the load is uniformly distributed along the feeder. Where two banks are to be installed, they consider equally sized banks or one bank to be twice the size of the other. They consider only peak kilowatt loss savings with fixed capacitors and ignore the cost of capacitors.
4. Nizar.et.al.Presented a new approach to nontechnical loss (NTL) analysis for utilities using the modern computational technique extreme learning machine (ELM). Nontechnical losses represent a significant proportion of electricity losses in both developing and developed countries.
5. J.W. Fourie & J.E. Calmeyer developed a model which minimizes the non-technical electrical energy losses of an electrical network. This model simulated the electrical network and includes different parameters that calculate the estimated technical losses of the electrical distributed network.

Problem Formulation

There is always loss of power in transmission & distribution of power Transmission and Distribution (T&D) losses of the Board include unavoidable losses inherent in the process as well as avoidable ones due to poor engineering, poor maintenance and theft. T&D losses in Punjab in 2001-02 have been estimated at 17.5%, while the average losses of all the SEBs were 27.8%, indicating that the losses in Punjab have been grossly underestimated. This range increase 35% in 2010-11.Non-metering of

agricultural supply makes it difficult to estimate T&D losses accurately. Mainly I am taking the case of technical, non technical, Administrative losses with the of case study of local radial distribution network of city Baghapurana (MOGA).

Case Study (Technical view)

In this case study I am taking the case of Baghapurana substation , This is 132/220 KV s/s that is placed in Moga Distt, Mainly 18 KMs right side from Moga In this substation mainly two incoming lines of 132KV coming from Moga substation . There are two step down transformers in the substation which step downs the 132 kV incoming voltage to 33/11 kV. There are total 13 outgoing 11 kV feeders from the substation and some other rural feeder also connected to this substation. Mainly they supply for irrigation pumps, various Rice mills and more .With the help of capacitor bank an attempt is made to improve the voltage profile in practical distribution system. We are taking the case of agriculture load feeder to overcome this problem, because mostly irrigation pumps operate at lagging power factor load and there is always problem of low power factor.

Table 1: Status of Voltage drop in various Feeders of S/S

Sr no.	Substation Name	Name of Feeders	Voltage drop (%)
1	132/220 KV Substation Baghapurana Moga	Moga road Feeder	17.23
2		Kale Ke road Feeder	8.64
3		N S Wala road Feeder	20.2
4		K K P road Feeder	16.8
5		Mudki road	21.1

Proper Location of Capacitor bank

Installation of capacitor bank is the big problem in distribution system. The capacitor placement problem is the determination of location, type, capacitor size placed at the different location distribution system at the different load level In distribution network all 11KV shunt capacitor bank are installed of each 600 KVAr (200 KVAr per phase) are installed on all 13 feeders all capacitor are fixed type and they operate automatically when power factor decrease. To overcome the problem of power factor, taking the case of city Baghapurana (MOGA), different agriculture load feeder are considered for implementation .Capacitor bank installed in the various feeder and comparison of reading before compensation and after compensation is shown in the following table It is practically shown by installing the capacitor bank that we can improve the power factor and improve the voltage profile.

Table 2: Reading of Feeder Before & After Capacitor Bank

		Before Capacitor Bank		After Capacitor Bank		
S no.	Name of Feeder	PF on June -11	PF on July-11	PF on Non-11	PF on Dec-11	No of Capacitor Bank
1	Moga road Feeder	0.83	0.87	0.99	0.97	2
2	Kale Ke road	0.86	0.87	0.92	0.93	1
3	Nihal Singh road	0.83	0.72	0.98	0.97	2
4	KKP road Feeder	0.85	0.89	0.93	0.99	1
5	Mudki road Fd	0.81	0.81	0.92	0.98	2
6	Channu wala road	0.82	0.78	0.94	0.96	1
7	Jai Singh wale Rd	0.81	0.73	0.97	0.97	1
8	Gill Village Fd	0.84	0.87	0.93	0.95	1
9	Madreean Feeder	0.85	0.84	0.97	0.99	2
10	Channu wala Fd	0.86	0.83	0.93	0.99	1
11	Rajiana Feeder	0.81	0.71	0.98	0.93	1
12	GTB Garh Feeder	0.82	0.81	0.94	0.97	1
13	Rice mills Feeder	0.85	0.86	0.97	0.97	1
14	TOTAL					18

Graphical View of Power factor Variation

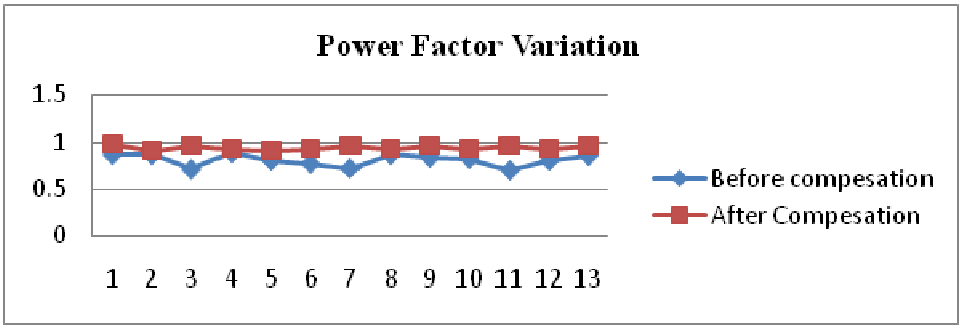
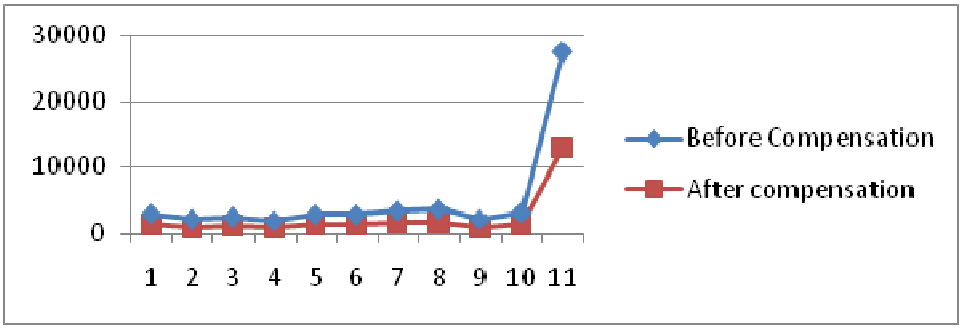


Table: Change in KVA due to Capacitor Bank installation

S no.	Feeder Name	KVA Loading Before	KVA Loading After	Change in KVA
1	Moga Rd Feeder	1525	1450	75
2	Kale Ke Rd Feeder	1145	996	149
3	N.s wala Rd Feeder	1305	1185	120
4	KKp Rd Feeder	995	915	80
5	Mudki Rd Feeder	1490	1355	135

6	Channu W Rd Fd	1505	1298	207
7	Jai Singh w Rd Fd	1810	1630	180
8	Gill Village Fd	1965	1715	250
9	Madreean Fd	1145	995	150
10	Channuwala Fd	1630	1525	105
	TOTAL	14515	13064	1451

Graphical View of Change in KVA due to Capacitor Bank



Case 2 (Non Technical View)

Taking the case of non technical view, more than 40% power loss due to non technical losses. So it is very important to measured the non technical losses in our power system The calculation requires energy consumption accumulated up to the beginning of the time period and the consumption accumulated at the end of the time period. The accumulated consumption at the end of the period is subtracted by the accumulated consumption at the beginning of the period. The result is the total consumption during the time period in kilowatt-hours, and the portion of the bill for energy consumption is based on this number. This has been clearly shown in the following

Table (a): Detail of Transformer ICT (1) Table (b) Detail of Transformer ICT (2)

S . No	Name of Feeder	Type of Feeder
1	Gill village	Rural
2	Jai singh wala	Rural
3	Alam Wala	Rural
4	Langyana	Rural
5	Rajiana	Rural
6	Channu wala	Rural
7	G T B Garh	Rural
8	Smadh bahi	Rural

S . No	Name of Feeder	Type of Feeder
1	Moga Road Fd	Rural
3	KKP Rd	Rural
2	Nihal singh wala	Rural
4	Mudki Rd	Rural
5	Channu Wala Rd	Rural

The readings have been taken from the 11 KV energy meters installed at substation. The readings of whole one month have been collected which are shown in Table. The bus bar losses in terms of percentage have been calculated. After that total losses have been shown which includes sum of transmission, distribution and non technical losses. The P.S.P.C. has proper record of all the incoming and outgoing.units.in the form of a log sheet. For this, we have to first find out the total number of consumers.in.that particular area and their type i.e. whether they are domestic, commercial or small.power.units. Then units consumed in each area have been calculated and have been added up. This sum has been subtracted from the actual incoming units given to that area. The difference will give the idea of transmission, distribution and non technical losses. Generally major portion of this sum is covered by nontechnical losses, because transmission and distribution losses are generally less in nature than nontechnical losses. Table shows the detailed analysis of incoming and outgoing units from the main132 kV

Table 5: Reading of Different Feeders at Substation

Sr no.	Name of the Feeder	Reading on 1-Jan -11	Reading on 1-Feb11	Difference Of Reading	Total units (Kwh)
1	Main 1	159081	176895	17814	17814
2	Gill	12268	14275	2007	2007
3	Jai Singh Wala	57935	58408	473	473
4	Alam Wala	8225	8441	216	216
5	Langyana	8091	8278	187	187
6	Rajiana	3921	4211	290	290
7	G T B Garh	20211	21441	1230	1230
8	Channu Wala	28230	29154	924	924
9	Smadh bhai	25421	26352	931	931
10	Main II	55706015	60908121	5202106	5202106
11	Moga Road	15214551	166271901	1412639	1412639
12	N.S.Wala	14621720	15582109	960389	960389
13	Mudki Road	7841786	7981320	139534	139534
14	K K P Road	5421604	5502211	80607	80607
15	Various Rice Mills	2144	2348	204	204

Total outgoing supply from ICT 1= 2007+473+216+187+290+1230+924+931 = 6258 KWh

Total outgoing supply From ICT 2 = 1412639+960389+139534+80607+204 = 2593373 KWh

Loss MAIN –I Feeder = 17814 -- 6258 = 11556, Percentage Loss = 11556/17814 = 0.64% ,

Loss of MAIN –II Feeder = 5202106 –2593373 = 2608733 KWh, Percentage Loss = 2608733/5202106 = 0.50%

Table 6: Power Loss Analysis in units

Sr no	Master Meter reading	Reading at Consumer end	Difference in Reading	Power Loss in Units	Cost Analysis in Rupees Rs 5 per unit
1	17814	6258	11556	11556	57780
2	5202106	2593373	2608733	2608733	13043665

This is power loss analysis for only one month billing cycle .

Analysis of Village Gill Outgoing Feeder

There are mainly three types of consumers in the region. Their total units consumed/billed have been recorded from the log sheet and the following results have been obtained

Table 7: Data of Various types of customers

Sr no	Number of Consumers	Type of consumers	Energy used in units
1	766	Domestics	233338
2	87	Commercial	52254
3	10	Small power	41045
4	102	Agriculture pumps	Constant

Total units billed= (233338+52253+41045) KWh =326636 KWh

Total Energy used in substation = 516800

Difference = (516800- 326636) KWh = 190164 kWh , Percentage losses= 190164/516800= 38%

This way we can compare the two different energy meter reading and easily calculate the non technical loss in the form of electrical theft.

Practical Example of Theft

To check the practical example of theft Vigilance team of Government along with checking squad,goes,to,detect,a,theft,on,the instructions of the government in village LANGIYANA they find that the total load of all village is app 557 KV , that is running on the small rating of 3 transformers. It is measured by complete calculation that when the energy meters were inside the customers home that the range of utility billed was about 2 to 2.5 lakh per month , but when all the energy meters are carried out from the houses than this range vary from 2.5 to 11.5 lakh rupees per month . so this was a big shock . So a large amount of power is lost due to non tech losses , cause by Bribing by employees ,Non payments of bills , By direct hooking , With by passing energy meters, Un accurate energy measurement.

Practical Analysis of Non Technical Losses

In case of practical analysis of NTL's , Vigilance team of Government along with checking squad goes to detect a theft on the instructions of the government they find that a Rice mill with contracted load of 15.6 kW is running with a 63 KVA transformer inside its premises, Further things are more interesting when it was seen that the 21 HP motor is burnt, the consumer is enjoying electricity with 63 KVAtransformer and shows that its load is in fact is more than 35 HP and he has applied for the loadextension only 4 days before. Now question is how to book this consumer under theft while it is known that he is involved in theft of course with connivance of the local staff.

Case study on Administrative Losses

Administrative losses play very important role in distribution losses. These are special types of losses that include the component of distribution network losses that accounts for the electric energy used by the distribution utility in the proper operation of the distribution network. Substations, offices, warehouses and workshops, and other essential electrical loads are usually considered as part of the administrative loss..A big part of electrical energy is used in the operation of substation, maintenance department, warehouse , and various office of administrative block , and large amount of energy loss in this process. It is measured from the technical survey that large amount of power loss due to administrative loss. Every year units in Lakh are consumed in this process, this responsible for financial burden on power system network. So to overcome this problem we should take some step and save energy. This will produced a big effect on the economy of Punjab Govt.

Table 8: Various Administrative losses in Distribution System

S no	Source of Losses	%Losses
1	Substation Operation	16%
2	Administrative Losses	11%
3	Energy used in Warehouse	15%
4	Energy used in Workshops	22%
5	Other works	5%

Practical case Electric Theft by Agriculture supply Feeders

A big portion of electrical energy is used Agriculture supply system. It is measured from the survey of Vigilance team of Government along with checking squad goes to detect a theft on the instructions of the government they find that Mostly the Farmers are recommend with load 10 Hp connection, and they using the motor of 15 to 20 Hp on that connection without informing the PSPC limited .This type of more than 102 cases are found on investigation. This way more than double of electric power is waste in this distribution system. As per Govt of Punjab supply for agriculture purpose is free of cost. This is the biggest drawback of Govt, because large amount of energy loss in this process.

Energy Loss due to Government Policies

Large amount of power loss in the process of distribution .Somewhere Govt of Punjab is also responsible for this factor because it is measured from the technical survey that as per Govt policies a big amount of electric energy lost, this will lead the financial burden on the Punjab Govt.

Free Energy to the people of BPL

As per Govt rules this one type of advantage to the people who are living the blew poverty line (BPL) , in this process 200 units of electrical energy free to every house under BPL system . It is measured for the survey that a very big amount of electrical energy loss in the process, and these people miss use the energy. As example under BPL system app. no. of houses wills 2000 than energy loss will be 400000 units. This figure produced a great effect on every mind. So this way large amount of power loss due to Govt policies.

Free Energy to the Employ of PSPCL

This is also a one type of advantage provided by the Punjab Govt to their employs, of PSPCL 200 units of electrical energy is free for every month. This is the big drawback of Punjab Govt, because large amount of electrical energy loss in this process. On survey it is measured that in Punjab power corporation there will be app. 1.5 lakh employs are working and 200 unit is free to every person than on calculation 300000 units are waste in every month . This will creates a big burden on Punjab Govt

Free Energy to Agriculture supply

This is the advantage given by Punjab Govt to the Farmers, that all agriculture supply is free of cost In this process large amount of electrical energy is lost . Basically single phase and 3 phase supply is given to the farmers that is totally free of cost, As we know that they are come under high voltage consumers. Energy used a s following 1 single Phase energy used and 3 Phase energy used .It is measured from technical survey that total no. of approximate connection in Punjab is about 2.5 lakh if every connection of 10HP than energy required more than 2 million units , that is totally free of cost . so this is the big amount of power that we are losing . Due to these type of cheep policies Govt of Punjab suffering with a big Financial problem.

Results & Discussion

As we know that large amount of power is lost in technical and non technical losses in power system So in this paper work we will analysis the power losses than we will find the solution how to remove them Technical losses can be minimize by following techniques as

Table: Different Method to reduce Technical losses

Voltage Level	Techniques	Impact In %age
11 KV , 3phase	Power Capacitor installation	-40%
415/44o Volts	Transformer Relocation	-25%
	Load Balancing	-15%

Suggestions to Minimize the Non Technical Losses

1. Replace all old meters, upgrading of electricity meters to meet standard accuracy must be conducted to support reduction of non-technical losses thru statistical analysis
2. Modify the billing system and prepaid energy meters are the choices which need to be accomplished by the utilities in order to reduce the non technical loss reduction.
3. Smart card technology can play an important role in minimizing the theft of energy.
4. Replace all electromechanical (Black meters) with new electronics meters because they are much efficient and they are very difficult to temper.
5. Replace all 11 KV feeder lines and 3 phase distribution lines with hard core plastic cable .that will lead to minimize the non technical losses. From direct hooking.
6. Proper and regular checking of domestic load and tempering meters should be must.
7. Prepaid Energy meters should be installed in major theft area.

Electric Power by all 2012

The Government of India has an ambitious mission of "POWER FOR ALL BY 2012". This mission would require that our installed generation capacity should be at least 200,000 MW by2012 from the present level of 144,564.97 MW. Power requirement will double by 2020 to 400,000MW.

Conclusion

In this paper i am trying to reduce various power losses in practical distribution system A big portion of power is loss due to technical and non technical losses But technical losses can be minimize by using capacitor bank installation, and non technical losses can be minimize by using new technologies Some power loss due to cheap govt policies, that policies must be stop .We can minimize the various power losses by proper maintence & by proper checking. To minimize the various power losses in distribution in practical distribution system Govt of Punjab must modified his power system.

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