

Evaluation Of Power Transmission Efficiency And Losses

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Abstract: This paper is concerned with the calculation of power transmission losses and efficiency during power generation and its distribution from power plant to sub-station and from sub-station to the distributor transformer of the street to houses of Indore. Firstly the power is generated in power plant or power generating unit at 19KV, this is then transmitted to the power transformer. This power transformer steps up the voltage to 765KV in India. It can be transferred in A.C. or D.C. In D.C. transmission the initial cost is high because it uses rectifier and convertor but the running cost is low and the power capability is more compared to the A.C. In D.C. there is no need for the synchronization of the frequency. From the power transformer the power is transmitted to sub-station through the lines. At the time of this transmission losses take place in the lines. Then in the sub-station, the voltage is step-down by the help of Step-down transformer to 11KV. Then this 11KV is transmitted to the distribution transformer. This voltage is transmitted from distribution transformer or local transformer or the transformer of the street or locality at 230V to the houses. In the whole transmission, the frequency remains same as there is no oscillating part in the transmission line. At the end of transmission, losses have calculated between different sections. In this power loss factor and efficiencies have also been calculated regarding power supply from the power plant to consumption units.

Keywords- Transmission, distribution, losses, loss factors, transmission and distribution, sub-transmission.

Introduction: The distribution of supply of power to the Indore city is under purview of **M.P.PASCHIM KSHETRA VIDYUT VITRAN Co. Ltd. (MPPKVVCL)**. The total electricity consumption of the city was 1218 MU in year 2009-10. During the last five years, the city has observed more or less steady annual growth rate of 8 -10 % in terms of electrical energy consumption. The peak electric load of the city was 330 MW during the year 2009-10 and 360 MW during 2010-11. T & D losses of the city were indicated to be 25% (for the year 2010-11). MPPKVVCL indicated gradual reduction of T&D losses from 28% to 23.52% by the end of January 2013.

Objective:

The main objectives are to achieve efficiency gains and make the Company commercially viable, progressively self sustainable, less government dependent and at the same time, balancing the interest of the consumers in regard to quality of service and economical tariff.

The plan would include among other things as metering, billing, collection, identifying the present deficiencies and the improvements to be made, mapping supply feeders, measurement of energy supplied to feeders and energy audit, study of losses and scheme for progressive reduction, reduction in input costs, consumer affairs handling, investments required for improvements in the distribution system etc.

Paschim Kshetra encompasses an area served by 77021 km of HT and 137105 km of LT distribution network. The size of the administrative set-up is as below. The brief information about Electric Power Stations present & programmed as per MPPKVVCL is as

ELECTRIC SUBSTATION	PRESENT	PROPOSED
400kV	1 No	2 No
200kV	4 No	2 No
132kV	6 No	7 No
33/11	58 No	12 No
Distribution Transformers	6000 Nos	6000 Nos

Table (1) Electric Power station Present in Indore

The pattern of utilization of the electric energy in 2009-10 indicates that the domestic category contributes around 46% followed by industrial category 23%, commercial 17% and others 14%.

ELECTRICAL ENERGY REQUIREMENT

The total electrical energy requirement of the city has been deduced by adding T&D losses in the total electrical energy consumption at consumer level. The slightly higher growth in the category of domestic, commercial and industrial sectors has been credited to wipe out the present shortage in the city as shown in figure 1. The total energy requirement of the city during the year 2009-10 was 1665 MUs.

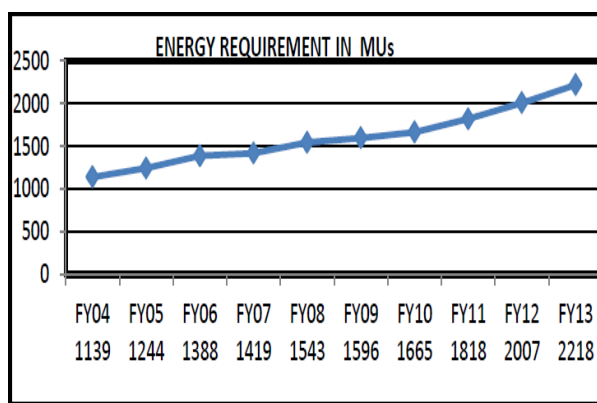


Fig 1. Energy Requirement of the city

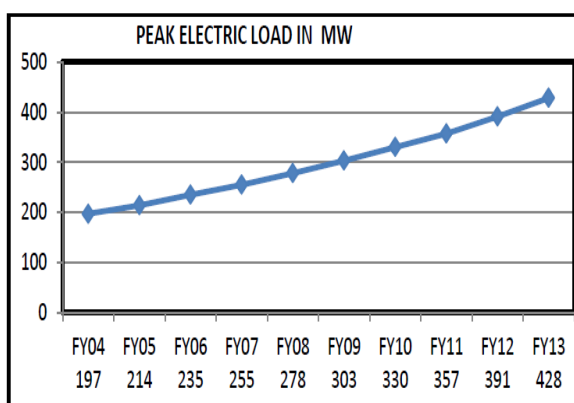


Fig 2. Peak Electric Load of the city

Peak electric load

According to the data furnished by MPPKVVCL, the Peak Demand of City was 197 MW during 2005-06 which rose to around 330MW by 2009-10. As the result of the study of pattern of utilization of various categories and the present shortage in the city, the peak electric load will be 621 MW.

Energy Consumption

Total electricity consumption of the city during the year 2009-10 was 1218 MUs and is predicted to increase to 2781 MU in 2013. The annual growth rate approximately is 12.52%.

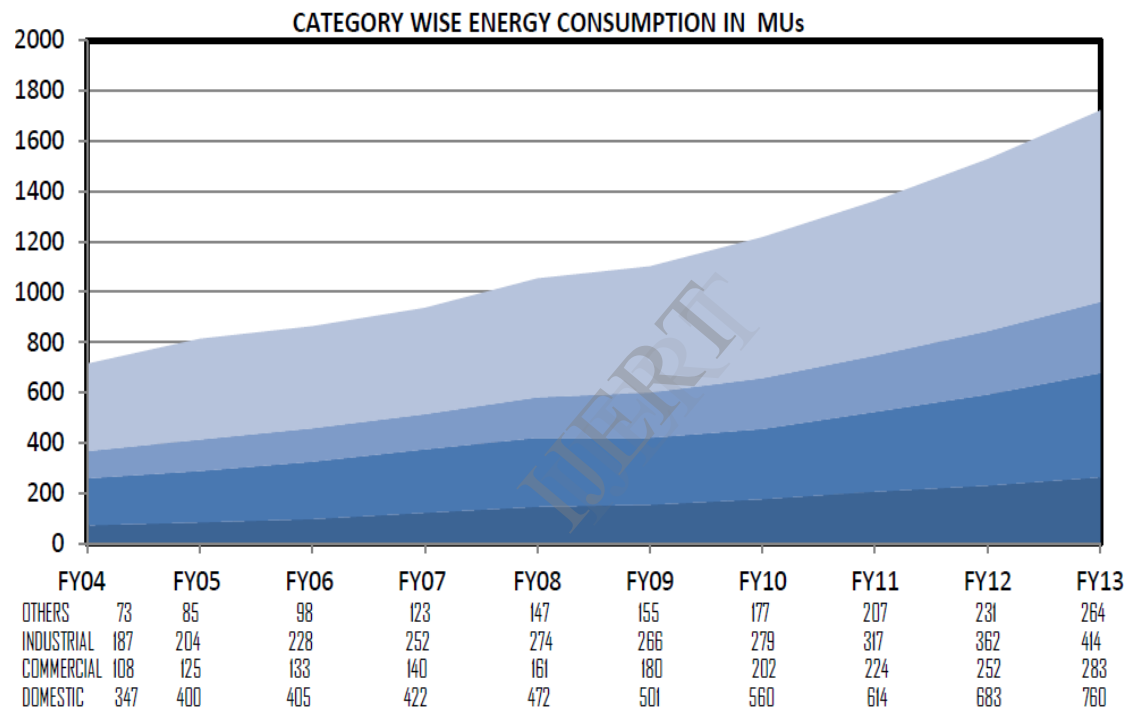


Figure (3) Category wise Energy Consumption In MUs

From the utilization pattern for the year 2009-10, it can be seen that the highest energy is consumed by domestic category (46%) followed by industries (23%), commercial (17%) and other remaining categories (14%).

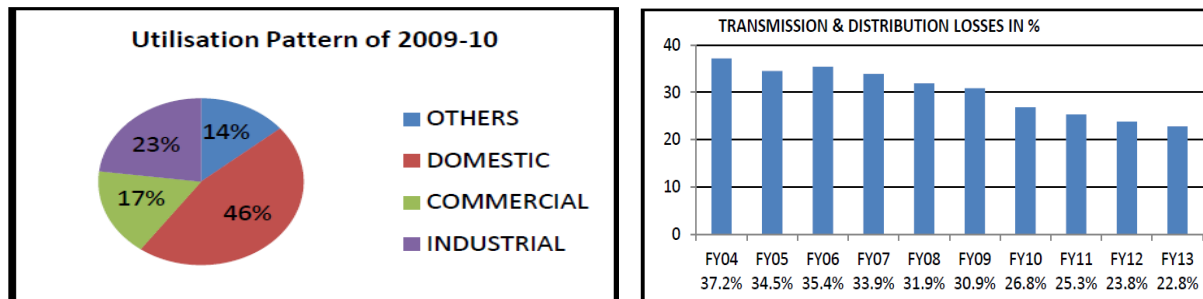


Fig. (4) Utilization pattern of 2009-10

Fig. (5) Transmission & Distribution losses in %

TRANSMISSION AND DISTRIBUTION LOSSES

The Transmission & Distribution loss for Indore during the year 2009-10 was 26.86% which is expected to reduce to 16.36% by the end of 2020 as shown in figure (5). A scheme name RAPDRP is targeted to be complete by 2013-14 which would result in decrease of T&D losses to around 20.86% by 2013-14. Keeping the optimistic approach, T & D losses have been proposed to be brought down at the level of 16.36% by the end of 12th plan (2016-17). The city authorities were consulted before finalizing the T&D losses and as per the RAPDRP scheme, utilities have current T&D loss below 30%. They have to reduce T&D losses at the rate of 1.5% per year. T&D losses reduction programme has been adopted as 1.5% per year during 12th plan period. The technical losses would be brought down by carrying out the T&D system improvement and unaccounted energy would be brought down by administrative steps, introduction of metered supply under RAPDRP to reflect the true level of electricity consumption by consumers and energy audit of electricity supplying feeders. Under RAPDRP Scheme, there is a provision to convert existing distribution network into HVDS and ground cabling. Therefore, reduction in electrical energy loss during transmission & distribution has been considered for future projections.

CATEGORY WISE FORECAST:- The electrical energy consumption in domestic category was 347 MUs and 560 MUs during the year 2003-04 and 2009-10 respectively.

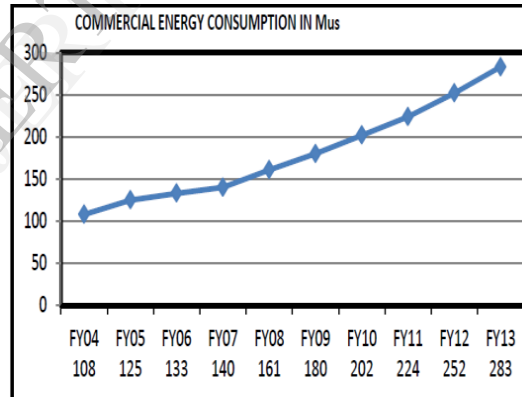
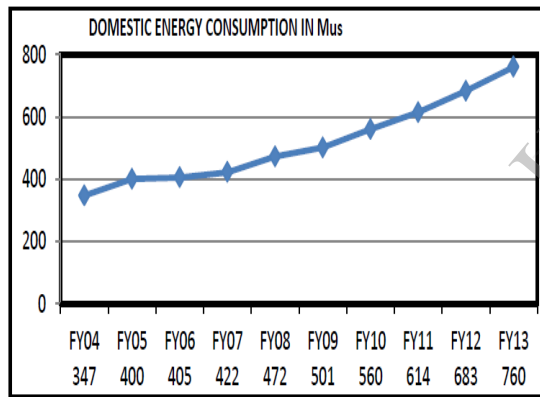
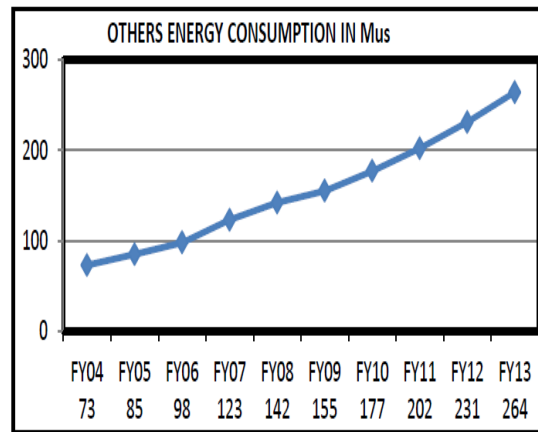
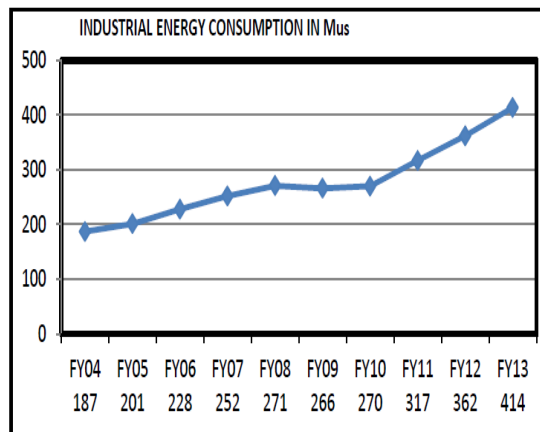


Fig (6) Domestic Energy Consumption in MUs

Fig (7) Commercial Energy Consumption in MUs



(8) Industrial Energy Consumption in MUs Fig (9) Other Energy Consumption in MUs

The electrical energy consumption in commercial category was 108 MUs and 202 MUs during the year 2003-04 and 2009-10 respectively. The electrical energy consumption in industrial sector was 187 MUs and 279 MUs during the year 2003-04 and 2009-10 respectively. Categories included here are public lighting, public water works, irrigation, railways and non-industrial. The electrical energy consumption was 73 MUs and 177 MUs during the year 2003-04 and 2009-10 respectively.

Table (2) ANALYSIS OF L.T. CONSUMERS FOR MONTH JAN2013

S No	Name of division	Name of zone	No. of customer	Input Unit	Unit sold/ output	% loss
1	East Dn.					
	1	Manoramaganj	17885	58.28	55.17	5.34
	2	O.P.H	17157	30.5	27.61	9.48
	3	Tilak Nagar	22095	47.05	41.99	10.75
	4	Khajrana	20481	46.25	41.37	10.55
	5	Goyal Nagar	16363	45.61	25.74	43.57
	6	Satya Sai	14110	29.93	22.66	24.29
		Total	108091	257.62	214.54	16.72
2	WEST Dn.					
	1	G.P.H	20354	46.99	33.22	29.30
	2	Subhash Chowk	24272	55.15	36.28	34.22
	3	Sangam Nagar	24122	69.77	46.60	33.21
	4	Kalani Nagar	25614	230.63	149.91	34.78
		Total	94362	230.63	149.91	34.78
3	NORTH Dn.					
	1	Sanwer Road	6421	52.87	46.70	11.67
	2	Vijay Nagar	28120	60.08	50.10	16.61
	3	Malwa Mill	27269	65.75	40.97	37.69
	4	Electronic Com	22795	51.01	33.44	34.44
	5	Arynay Nagar	10351	17.51	14.94	14.68
		Total	94956	247.22	186.15	24.70
4	SOUTH Dn.					
	1	O.P.H(west)	15749	40.14	28.73	28.43
	2	Mechanic Nagar	23474	68.23	49.44	27.54
	3	Daly College	24611	63.76	49.18	22.87
	4	Navlakha	18998	52.76	43.47	17.61
		Total	82832	224.89	170.82	24.04
5	CENTRAL Dn.					
	1	Rajendra Nagar	25190	41.94	40.9	2.48
	2	Rajmaholla	15731	34.94	25.66	26.56
	3	Annapurna	22141	46.82	38.41	17.96
	4	Gumastha Nagar	17470	42.63	36.94	13.35
	5	Rau	9716	30.53	20.81	31.84
		Total	90248	196.86	162.72	17.34

		TOTAL(all regions)	470489	1157.22	884.14	23.52
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Calculation

- (1) The overall Transmission & Distribution loss (%) in January month is calculated by taking average of the loss of each division = $(\text{INPUT} - \text{OUTPUT}) / \text{INPUT} = 23.52\%$
- (2) The overall efficiency of the cycle is = $\text{Total Output} / \text{Total Input}$
 $= 884.14 / 1157.22$
 $= 76.41\%$

Results and discussions:

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% in the year 2000-01. The reduction of these losses was essential to bring economic viability to the State Utilities. As the T&D loss was not able to capture all the losses in the network, concept of Aggregate Technical and Commercial (AT&C) loss was introduced. AT&C loss captures technical as well as commercial losses in the network and is a true indicator of total losses in the system.

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. The commercial losses are mainly due to low metering efficiency, theft & pilferages. This may be eliminated by improving metering efficiency, proper energy accounting & auditing and improved billing & collection efficiency. Fixing of accountability of the personnel / feeder managers may help considerably in reduction of AT&C loss. With the initiative of the Government of India and of the States, the Accelerated Power Development & Reform Programme (APDRP) was launched in 2001, for the strengthening of Sub Transmission and Distribution network and reduction in AT&C losses. The main objective of the programme was to bring Aggregate Technical & Commercial (AT&C) losses below 15% in five years in urban and in high-density areas. The programme, along with other initiatives of the Government of India and of the States, has led to reduction of overall AT&C loss from 38.86% in 2001-02 to 34.54% in 2005-06. The commercial loss of the State Power Utilities also reduced significantly during this period from Rs.29331 Crores to Rs.19546 Crores. The loss as percentage was reduced from 33% in 2000-01 to 16.60% in 2005-06.

Conclusion:

Various aspects of transmission & Distribution loss have been discussed and high value of transmission & Distribution loss for the city is featured in this paper. Transmission and distribution loss has been calculated for city and its impact is studied. Also the success rate of government policies implemented to reduce transmission loss is reported.

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