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Restructuring of Existing Distribution System with High voltage Distribution system

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Abstract: The Power Requirement in urban and metro areas is very high with an exponential growth. The distribution system with LVDS results in multiple loads fed from a bulk power transformer resulting in higher regulation in the tail ends. Moreover there is an increase in the system losses, power factor, voltage profile and performance are affected in the existing distribution system. Losses in an electrical system should be around 8 to 14% .In developed countries it is not greater 10%, however in developing is country, the percentage of active power losses is around 30%.In this work comparative analysis between high voltage distribution system and low voltage distribution system has been done and also payback calculated. the studies were carried out for an existing distribution system. This may result in extended lifetime of the equipment and reduction in system loss. New transformers of low capacity may have to be introduced for implementing the proposed system and the existing transformer of high capacity have to be relocated suitably to achieve the advantage of HVDS.The investment may be two times compared to LVDS and the increased cost is affordable as HVDS is more beneficial.

I. Introduction

India is world's 6th largest energy consumer, accounting for 3.4% of global energy consumption. Due to India's economic rise, the demand for energy has grown at an average of 3.6% per annum over the past30 years. In June 2010, the installed power generation capacity of India stood at 156,783 MW. The country's annual energy production increased from about 190 BU in 1986 to more than 638 BU in 2010. The Indian government has set an ambitious target to add approximately 78,000 MW of installed generation capacity by 2012. The total demand for electricity in India is expected to cross 950,000 MW by 2030. India is lagging behind in achieving power generation capacity target. According to Central Electricity Authority (CEA), the country will achieve only 18,600 MW of power generation capacity in 2011-12 compared to around 20,400 MW in 2010-11.under current circumstances, total new capacity by the end of the 11th Five-Year Plan in March 2012 is expected to be 62,000 MW, against the target of 78,700 MW set by the Planning Commission. The present installed capacity in India is approximately 156,000 MW. The power shortage in the country is hovering around 13 per cent during the evening peak hours between 17:00 hrs and 22:00hrs.Electricity losses in India during transmission and distribution are extremely high and vary between 30 to 45%. In 2008-09, electricity demand outstripped supply by 8-13%. Due to shortage of electricity, power cuts are common throughout India and this has adversely effected the country's economic growth. Theft of electricity, common in most parts of urban India, amounts to 1.5% of India's GDP. Despite an ambitious rural electrification program, some 400 million Indians lose electricity access during blackout. However, due to lack of adequate investment on transmission and distribution (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.

II. Factor contributing for technical and commercial losses

Over Loading And Unbalancing a) High voltage drops in lines leading to low voltage consumer premises. b) High voltage drop at tail end of effected consumer`s phases. c) High voltage drop due to large reactive current causing I^2R in lines and resulting in lesser voltage and low consumption.

Improper Load Management Improper management of the load has led to the overloading of conductor and transformers in the system causing higher losses. Too Many Transformation Stages in the Indian distribution system the energy is transformed into many intermediate stages before it reaches the consumer. Too many transformation stages result in higher component of transformation losses.

Large Scale Rural Electrification

Large scale rural electrification programmed undertaken in the country resulted in long LT lines and extension of distribution network. This was done without strengthening the backup transmission and sub transmission system the distribution lines were extended over large rural areas. This has resulted in high line loss.

Low Power Factor

Due to pumping load in rural areas, air conditioners coolers and industrial loads in urban load areas the system has a low power factor which result in higher losses. Distribution Transformers Not Located At Load Center Often distribution transformers are not located centrally with respect to consumers. Consequently the overall length of the distribution network increases and the consumers obtain an extremely low voltage even though a reasonably good voltage level is maintained at the transformer secondary. Low Quality Of Equipment, Poor Construction And Inadequate Maintenance Poor quality of equipment results in increased technical losses. Poor workmanship contributes significantly towards increasing distribution losses. Joints are constant sources of power losses, deteriorated wires and services which are not well maintained cause of leakage and loss of power. Low Investment In T&D The investment in T&D system in our country has generally been then that on generation ratio 1:07 investment has led to the neglect of the distribution sector the funds provide were mostly used for meeting normal the low development works which comprised giving new connection without adequate reinforcement needed thereof.

III. Using various techniques for minimizing the technical losses

a) Network Reconfiguration
b) Network Reconductoring
c) Preventing Leakages at Insulators
d) Employing AVB (Automatic Voltage Booster)
e) Better Management of Distribution Transformers
f) Load Balancing and Load Management
g) Capacitor Installation (Shunt or Series)
h) Improving Joints and Connections
i) Laying Additional Link Lines
j) Increase in HT:LT Ratio
k) Adoption of High Voltage Distribution System (HVDS)
l) Regular Maintenance of Distribution Network

IV. Adoption of High Voltage Distribution System (HVDS)

Adoption of HVDS (High Voltage Distribution System)by converting existing LVDS to HVDS reduces the technical losses appreciably. This can be explained by one single illustration that for a 100 kVA load, the amperage at 11 kV is 5 Amps whereas it is 140 Amperes at LT voltage of 415 Volts. The loads in rural areas are widely dispersed and to feed a small load, LT lines run for long distances. Prior to the introduction of HVDS 11 kV 3-phase lines were being run up to large sized 3-phase transformers 11 kV/433 V from which lengthy 3-phase LT lines were run. Such a system is not suitable for Indian conditions, especially in rural areas, as voltage profiles are poor, losses are high and outages in supply are also high .HVDS envisages running 11 kV lines right up to a cluster of 6 to 10 consumers, employ in small sized distribution transformers (15 kVA) and extending supply to these 6 to 10 consumers with least (or almost nil) LT lines.

V. Case Study

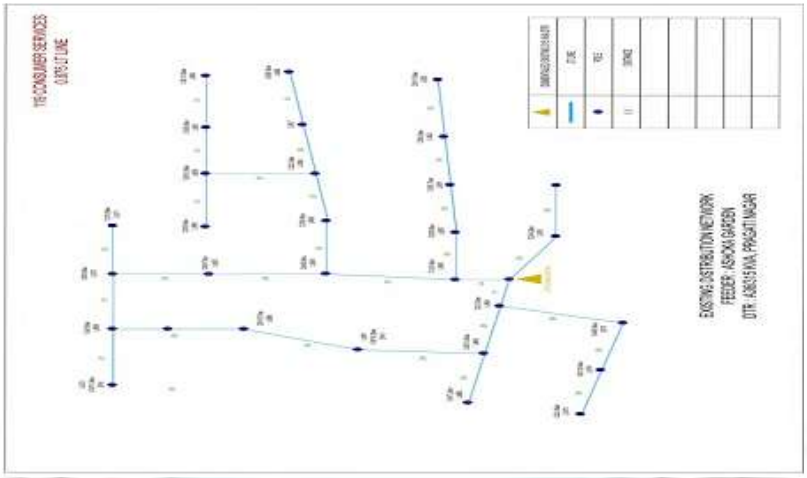
Case study of Pragati Nagar colony Bhopal for reconfiguration involves study of various transformer used, details of overhead lines, calculation of losses (losses in existing system LVD system as well as losses in HVD system), comparison of line losses, voltage of tail end.

Features of LVDS network

Under this figure show Existing low voltage distribution system DTR A36/315 KVA of Pragati Nagar pocket of Ashoka Garden 33/11KV feeder. Following feature of existing distribution system are as:

a. No. of consumer connected with DTRA36/315KVA distribution transformer is 119 Nos.
b. The length of total LT line used is 0.875 km. Total sanction load in existing distribution system system is 210 KM.

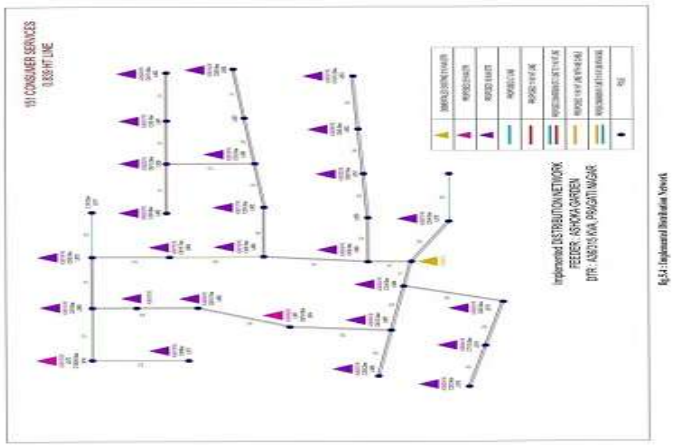
Existing distribution system



Features of HVDS network

After implementation of HVDS project on the Pragati Nagar pocket DTR A36/315KVA, the scenario has totally changed. Following changes has been implemented.

a) The existing 315KVA distribution transformer dismantled and smaller size of distribution transformer capacity 16 KVA & 25 KVA have been adopted. In which 16 KVA distribution transformers used for single phase supply and 25 KVA distribution transformers used for three phase supply.
b) Total number of 16 KVA 1-ph transformer used are 25Nos. and 25 KVA 3-ph transformer used are 2 Nos. instead of one315 KV transformer.
c) The previously used 0.875km of LT line is replaced with 0.839km of HT line and only 0.036km of LT line.
d) No. of consumer increased from 119 to 151 HVD system.
e) Nearly 0.053km of AB cable is used in congested area.
f) Total sanction load increase from 210KW to 254KW in HVD system.



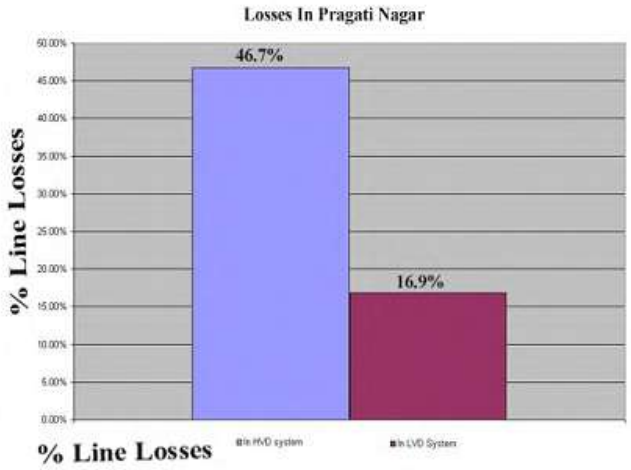
Implemented distribution system

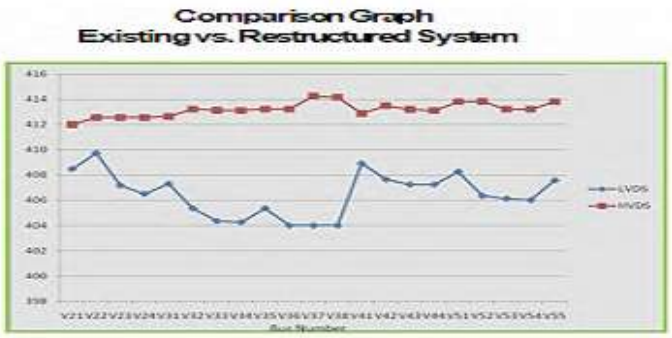
VI. Comparison

Comparison between existing distribution system (LVDS) and HVD system on Pragati nagaar pocket Ashoka garden feeder 33/11KV sub station.

Sr No.	Particulars	LVD System	HVD System
1	Length of LT line	0.875 km	0.036 km
2	Length of HT line	-	0.839 km
3	No. of distribution transformer	315 KVA – 1 nos	16 KVA – 25 nos 25 KVA – 2 nos
4	No. of Consumers	119	151
5	sanction Load (one month)	210KW	250KW
6	Input unit (KWH) (one month)	34193	28024
7	Input billed (KWH) (one month)	18054	22840
8	Loss of unit (KWH) (one month)	16139	5184
9	Distribution losses of the network in %	47.2	18.5
10	Revenue billed (one month)	0.81 lakh	1.02 lakh

DISTRIBITION LOSSES





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VII. Payback Periods

Payback period is the length of time required by the cumulative net cash in-flows to cover-up the fixed capital investments.

CREDITS OF DISMENTAL ITEM

SR.NO	ITEM	UNITS	RATE(INRS)	QTY.	AMOUNT
1	315 kva distribution transformer	No.	175000	1	1750000
2	LT line conductor	km	14400	0.87	1260000
3	Other item charge	-	-	-	1500000
				TOTAL	3376000

FINANCIAL BENEFITS

SR. NO.	PARTICULARS	RATE (Rs)
1	Total Cost of HVDS scheme (lakh)	1911739
2	Total Credits of dismantle items (lakh)	337600
	NET COST	**1574139**
	FINANCIAL BENEFITS	
1	Line losses in LVDS network (%)	47.2%
2	Line losses in HVDS network (%)	18.5%
3	Reduction of line losses (%)	28.7%
4	Saving units in one month due to reduction of losses (unit)	4786
5	Saving units in per annum (unit)	57432
6	Financial benefits due to saving in line losses (Rs in lakh)	258444
7	No of input units fed in to the LVDS network (in one month)	34193
8	No of input units fed in to the HVDS network (in one month)	28024
9	Total saving units per annum	74028
10	Financial benefits due to saving input units (Rs in lakh)	333126
11	**Total financial benefits (6+10) in Rs lakh**	**591570**

TOTAL CAPITAL INVESTMENT IN HVDS NETWORK – Rs 1911739

TOTAL CASH IN FLOW PER ANNUM -- Rs 591570

AY BACK PERIOD OF HVDS NETWORK -- 3.2 year

VIII. Advantage of HVDS system

1. LV system losses can be minimized to the lowest level.
2. Pilferage can be minimized by introducing this system.
3. The registered costumers will feel ownership and take responsibility and not allow others to middle with the L.T Network.
4. Prevention of unauthorized loads by the consumers themselves since the distribution transformers may fail if loaded beyond its capacity.
5. Failure will be minimal because of no over loading and no middling of L.T lines.
6. In the event of equipment failure only limited number of customers will get affected instead of maximum customers in original system.
7. High quality of supply since there is practically no voltage drop.
8. Less burnout of motors because of good voltage and less fluctuations.
9. Considerable reduction in the losses and consequent saving in power purchase cost.
10. Since losses are reduced considerably, power can be supplied to additional loads without any further investment on infrastructure.

IX. Conclusion

The HVDS scheme has generated a learning curve, leading to formulation of new strategy of energy conservation and reduction of transmission and distribution losses and also the reduction in cases of power theft. By using HVDS a continuous watch is kept on reduction in input units and increase in billed units and the amount of energy saved is calculated terms of money. Billing and collection efficiency increases and also the problem of frequent failure of power due to failure of transformer is reduced considerably. A careful study is done in this project on the payback period of Pragati Nagar. The payback period calculated is about 3.2 years. Also various calculations has been done for single phase transformers, three phase transformers and for the distribution and transmission lines is done using given values of these equipments. Finally after all these studies we can conclude that, for long term prospect switching to HVDS from LVDS is an economical, efficient method. However initial cost is more because of use of more number of transformer, but this cost is compensated in a short span of time.

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