

**ABSTRACT**

This paper presents a converter free system to improve the loss minimization and to reduce the cost of power distribution. The high voltage distribution system is implemented to reduce the loss in the present distribution system. The detailed cost estimation and loss minimization in high voltage distribution system is calculated through simulation results. These performance analysis are presented in this paper.

**KEYWORDS:** LVDS,HVDS,MTR,DTR.

**INTRODUCTION**

Day by day due to increase of electrical appliances in the modern generation. the load on the alternator increases which in turn causes losses in the transmission and distribution system. Due to increase in losses in distribution system, the line voltage at remote areas will decrease. Due to advancements in power electronic converters to maintain the load voltage as constant equipment like DVR, D-STATCOM are used. The usage of the system in practical applications is complex because the load rating is not constant. The compensation level of these equipment may or may not satisfy consumers & also it is cost effective method, complex control method. For maintenance of these power electronic converters skilled persons are required. To remove all the above problems due to power electronic converters, to reduce the complex control an alternative is to choose high voltage distribution system which replaces low voltage distribution system. Due to increase in voltage level of primary distribution system the losses will reduce by greater extent, power theft is not possible.

The main advantage of using high voltage for distribution is to reduce the theft of energy and decrease in unauthorized connection as the LT lines are virtually eliminated and even short LT lines required will be with insulated cables. This makes direct tapping very difficult and thus increases the authorized connection which will improve revenue. Also the current in the proposed method is low due to high voltage and thus low power losses. It also helps in avoiding unnecessary iron losses in overrated distribution transformer which otherwise occur in the existing system and hence reduces technical losses.

To check the feasibility of the proposed work, the annual saving and payback period of the proposed method is also determined. Here B.E.E(Bureau of Energy Efficiency) rated transformers are used in order to save the energy and also power generation which in turn helps to reduce the global warming and carbon emissions into the atmosphere. Carbon credits are also calculated.

The goal is to allow market mechanisms to drive industrial and commercial processes in the direction of low emissions or less carbon intensive approaches than those used when there is no cost to emitting carbon dioxide and other GHGs into the atmosphere. Since GHG mitigation projects generate credits, this approach can be used to finance carbon reduction schemes between trading partners and around the world.

D.S.M(Demand side Management) measures are considered for the project which includes:-

- ISI marked pumps.
- Friction less foot valves.
- ISI marked delivery & Section pipes.

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**LOSSES IN DISTRIBUTION NETWORK**

The losses prevailing in the existing power distribution system can be classified as: a) Technical losses b) Non-Technical losses. Technical losses on distribution systems are primarily due to heat dissipation resulting from current passing through conductors and from magnetic losses in transformers. Technical losses occur during transmission and distribution and involve substation, transformer, and line related losses. These include resistive losses of the primary feeders, the distribution transformer losses (resistive losses in windings and the core losses), resistive losses in secondary network, resistive losses in service line and losses in KWh meter. These losses are inherent to the distribution of electricity and cannot be eliminated but can be reduced. Non-Technical losses include tampering with the meter to create false consumption information used in billings, to making unauthorized connections to the power grid. Non-payment, as the name implies, refers to cases where customers refuse or are unable to pay for their electricity consumption. It is estimated that electricity theft costs in India is in crores in a year. Electricity theft is part of a phenomenon known as "Non-Technical Losses" (NTL) in electrical power systems. And thus it is necessary to focus on both sides" i.e. on technical losses as well as on nontechnical losses and it can be achieved by using proposed HVDS method for distribution.

**Reasons for Higher Losses**

- Lengthy distribution lines.
- Inadequate size of conductors.
- Over-rated distribution transformers and hence their underutilization.
- Low voltage (less than declared voltage) appearing at transformers and consumers terminals.
- Distribution transformer not located at load center on the secondary distribution system.
- Low power factor.
- Poor HT/LT ratio.
- Poor quality of equipment.
- Too many stages of transformations.
- Transformer Losses.
- Bad workmanship.
- Direct tapping by the non-customers.
- Pilferage by the existing customers.
- Defective metering, billing and collection functions.

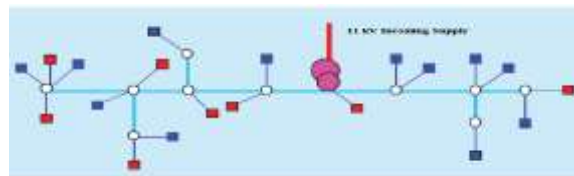
**Loss reduction by HVDS:**

HVDS project is to reconfigure the existing Low voltage (LT) network as High Voltage Distribution System, wherein the 11kV line is taken as near to the loads as possible and the LT power supply is fed by providing appropriate capacity transformer and minimum length of LT line with an objective to provide better quality power supply, reduction of losses and better consumer service. In the existing system, large capacity transformers are provided at one point and the connections to each load is extended through long LT lines. This long length of LT lines is causing low voltage condition to the majority of the consumers and high technical losses. In the HVDS project, long length LT mains are converted into 11 kV mains and thereby installing the appropriate capacity distribution transformer as near as to the end and the supply is provided to the consumer at suitable voltage level. By converting these lines to HVDS, the current flowing through the lines shall reduce and will bring down the technical losses in the LT line drastically. This can be explained by one single illustration that for a 100 KVA load the amperage at 11kV is 5 amperes where as it is 140 amperes at LT voltage of 415 Volts. The prevailing low voltage in the LT line is also affecting the efficiency of the electric gadgets and breakdown is also very high. Also there is a tendency of unauthorized connections to hook to the LT lines which results in over loading of the transformers and failure of the transformers. The scheme consists of converting the existing 3 phase 4 wires lines to 11 kV systems using the existing supports and providing intermediate poles wherever necessary and individual transformers are provided to both agricultural loads and loads other than agriculture. The length of the LT lines is restricted to less than 300 meters. HVDS is most effective method in reducing the technical losses and improving the quality of supply in power distribution system. In this system high voltage lines are extended to as nearer to the loads as possible and erect small size transformers. This system aims at LT less system or less LT and the unavoidable short LT lengths to be covered by insulated wires like ABC (Aerial Bunched Cables). The major advantages of using ABC in HVDS are that the faults on LT lines are totally eliminated, thus improving reliability and also theft by direct tapping is avoided. As the authorized consumers do not allow unauthorized tapping by another as their transformer gets overloaded or may get damaged, resulting in outage of power supply for longer

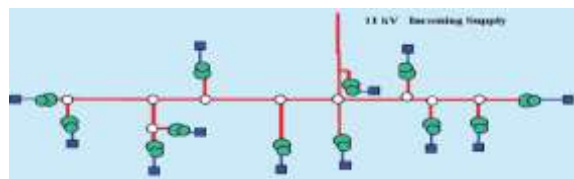
durations. It is noticed that the investment on conversion from conventional system to HVDS is recovered by way of loss reduction within a period of 3 to 5 years in most cases.

### COMPARISON OF EXISTING LT & HT SYSTEM

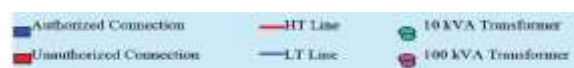
HVDS represents North American practice whereby the HV line is extended up to the load point; in the instant case, supply is tapped off from 3-phase HV mains in proximity of an agricultural pump and provided via a distribution transformer of 10 kVA capacity to serve a 5-7 HP load, thus restricting the LT line to the length of the service cable. A typical schematic diagram of „before and after“ scenario is shown in Fig. The HVDS has been constructed by refurbishing and retrofitting LT lines using the same poles and conductors and erecting new insulators and hardware supports. Once conversion of LT to HT lines is completed, the transformer is installed either on a single or double pole structure, depending on angularity of the lines. The distribution systems shall be at high voltage and the L.T. system shall be the least or eliminated as far as possible. HVDS or high voltage distribution systems by converting existing LVDS is in progress in many Discoms reducing the technical losses appreciably. This can be explained by one single illustration that for a 100 KVA load the amperage at 11KV is 5 Amps where as it is 140 Amperes at L.T. voltage of 415 Volts.



*Fig.4:LT System:*



*Fig.5:HT System:*



#### Disadvantages of LVDS:

- Poor tail end voltages.
- High quantum of losses.
- Frequent jumper cuts and fuse blow outs.
- Motor burn outs almost twice in each cropping period of 100 days.
- DTR failures due to frequent faults.
- Loss of standing crops due to inordinate delays in replacement of failed DTR's.
- Theft of Energy.

#### Advantages of HVDS:

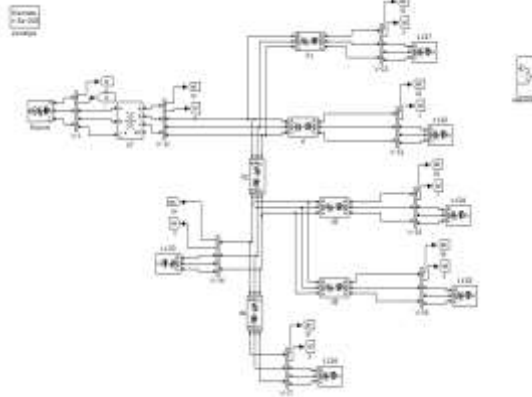
- Reduction in line losses since HV line is taken almost up to consumer load point and on LV side AB cable is used.
- Failure of agriculture DTRs are minimized as LT overhead line is avoided and also load per DTR is restricted. Hence, no failure on account of over load and LT faults.
- Reduction of unauthorized agriculture connections, as one small capacity (25KVA) DTR is erected for two or three agriculture consumers. The agriculture consumers will have a feeling of ownership of transformer due to limited connections on it.
- As 11KV line is taken almost to the load point, improvement in voltage profile near agriculture pump sets is observed resulting in good performance of motor.
- Pilferage of electricity is completely avoided as LT AB cable is used from DTR LV up to consumer bore well.

**CASE STUDY**

Case study of Karampudi SS,Vepakampally Feeder is presented. Vepakampally is located in the premises of Karampudi.It is supplying load for 45 Agricultural Consumers in which, the 11kV is stepped down to 415V by using 100kVA Distribution Transformer.

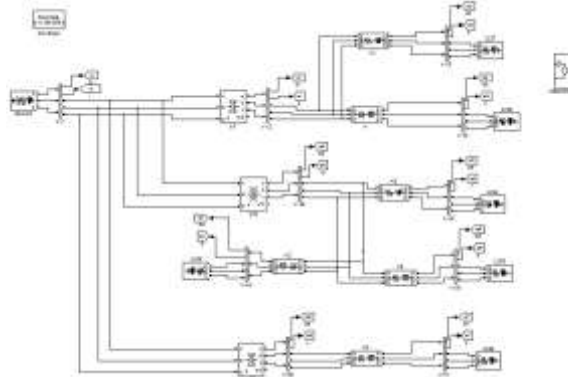
**One of the LVDS Networks:**

*Fig.6: LVDS Network*



**One of the HVDS Networks:**

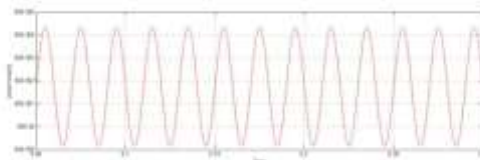
*Fig.7: HVDS Network*



**MATLAB Simulation results:**

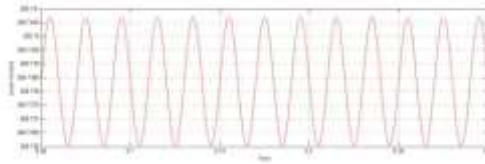
a)Power loss in LVDS: 1587.4W

*Fig.8: Power loss in HVDS System*



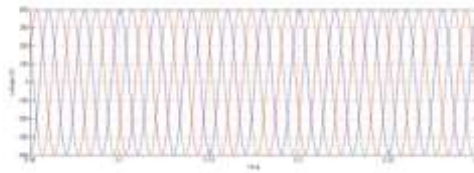
b)Power loss in HVDS: 437.2W

**Fig.9: Power loss in HVDS System**



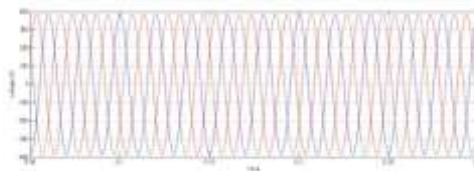
c) Voltage near MTR in LVDS: 390V

**Fig.10: Voltage near MTR in LVDS System**



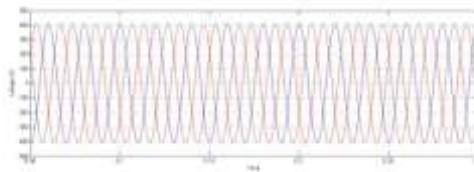
d) Voltage far away from MTR in LVDS: 370V

**Fig.11: Voltage far away from MTR in LVDS System**



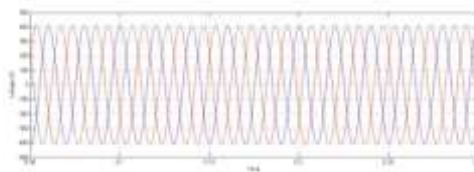
e) Voltage near DTR in HVDS: 413V

**Fig.12: Voltage near DTR in HVDS System**



f) Voltage far away from DTR in HVDS: 413V

**Fig.13: Voltage far away from DTR in LVDS System**



**Statistics:**

**Total Investment Cost**

a) Transformers - 100 DTR's  
 16kva -50t/f's & 25kva- 50t/f's  
 Total cost = 1,75,00,000Rs/.

b) Cable cost:

Cable cost for 4kms= 4\*35,000 = 1,40,000Rs/.

c) Hardware cost

5% of cable cost = 7000Rs/.

Total investment cost= 1,75,00,000+1,40,000+7000 =1,76,47,000Rs/.

**Energy Savings for Five Years:**

Total Unauthorised load: 130hp = 97.5kw  
 Theft in units for 6 months =  $7 \times 97.5 \times 183 = 1,24,897.5\text{kwh}$   
 Loss due to LVDS =  $(5384.3 \times 7 \times 183) / 1000 = 6,897.288\text{kwh}$   
 Total loss due to LVDS =  $124897.5 + 6897.288 = 1,31,794.788\text{kwh}$   
 Total loss due to HVDS =  $(2282.1 \times 7 \times 183) / 1000 = 2,923.370\text{kwh}$   
 Net loss = LVDS - HVDS =  $131794.788 - 2923.370 = 128871.418\text{kwh} = 161089.272\text{kvah}$   
 Savings for 6 months (in rupees) =  $7.35 \times 161089.272 = 11,84,006.15\text{Rs}/.$   
 Savings for 1 year (in rupees) =  $23,68,012.31\text{Rs}/.$   
 Total MTR's = 25  
 Savings for 5 MTR's =  $23,68,012.31$   
 Savings for 25 MTR's =  $((25 \times 2368012.31) / 5) \times 2 = 2,36,80,123.1$  per annum  
 a) Savings for 5 years =  $5 \times 11133910.2 = 11,84,00,616\text{Rs}/.$

b) Savings towards failure of DTR's:

11% in LVDS

Total expenditure towards repair cost =  $((11/100) \times 25) \times 25,000 = 68,750$  per annum

Total expenditure for 5 years =  $3,43,750\text{Rs}/.$

c) Manday's towards replacement of failed DTR's:

For Lineman =  $(2 \times 38,000) / 30\text{days} = 2533$

Percentage of failure = 11% in LVDS

=  $25 \times 11 / 100 = 2.75 \approx 3$  t/f =  $3 \times 2533 = 7599$  for 1 year

Savings towards employees cost against replacement of D.T.R's =  $7599 \times 5 = 37,995\text{Rs}/.$

d) Savings towards carbon credits:

For 1 unit(kwh) generation of power we require 1.5 kgs of coal

For 1,28,871kwh =  $1,28,871 \times 1.5 = 1,93,306.5$  kgs

For 5 years =  $966532.5\text{kgs} = 966.532$  tonns of coal

1 ton of coal on burning releases 2.86 tons of carbon dioxide

$966.532$  tons of coal releases  $2764.281$  tons of carbon dioxide

1 carbon credit = 1 ton of carbondioxide = 30 Euros =  $2190\text{Rs}/.$

Total carbon credits =  $2764.281 \times 2190 = 60,53,776.53$

Total savings =  $12,48,36,138\text{Rs}/.$

Net savings = Total savings - Investment =  $12,48,36,138 - 1,76,47,000 = 1,07,189,138.$

**Payback period calculation**

Payback period = Total cost of the investment / Annual net cash flow

=  $1,76,47,000 / 1,56,04,517$

= 1.13 years

**CONCLUSIONS**

- The conversion of LVDS in to HVDS system results in increase in energy saving and reduction in losses.
- HVDS reduces the wastage of energy and optimization of power intake, there by promoting the environmental concerns.
- The chances of unauthorized connections and theft of energy are reduced.
- So, converting LVDS lines to HVDS lines will become more beneficiary to our future generation with less Distribution loss and less Agricultural Motor Burnouts.

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