A Comparative Study for Effective Distribution Network System Among LVDS and HVDS

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ABSTRACT

This paper discusses the previous work done for Low voltage distribution system (LVDS) and High voltage distribution system HVDS distribution system in various research applications. It is observed that LVDS and HVDS have shown vast era of work applications in comparison other distribution networks of the power system. HVDS is one of the most effective ways of distribution system which controls &maintains the voltage stability in power system during distribution and transmission. Power flow capability & control, continuation power flow, line stability index, optimal control, dynamic & transient stability techniques are used with LVDS and HVDS to achieve voltage stability. In this paper various works of LVDS and HVDS is deeply studied and described that in various efficient manner they can used for distribution network.

Keywords- HVDS, LVDS, Distribution System, Radial Network.

1. INTRODUCTION

Distribution networks are mainly of two kinds, namely radial and or interconnected. A spiral system leaves the station and pass through the system zone without a conventional association with an alternate supply. This is frequently a very long non-urban line with the area of isolated loads. An interconnected system generally found in them with increasingly urban zones and furthermore has various associations with an alternate purpose of supply. These purposes of association are ordinarily open yet to permit different designs by the working utility by shutting and opening switches. The activity of those switches could likewise be constrained by remote from an effective place or by an operator. The upside of the interconnected model is that inside the occasion of an issue or required support for a little region of system which are regularly disengaged and along these lines the rest of on supply.

Electrical dispersion framework contains those segments of electrical force framework between the sub-transmission and furthermore the buyer's administration. It incorporates, circulation substations, essential appropriation feeders, conveyance transformers, auxiliary circuits, additionally as administrations to the client, and satisfactory securing and the executive's gadgets. Electrical dispersion systems convey power from age by means of the transmission frameworks to the appropriation. During a variable interest office, age, transmission and dispersion of current include a few misfortunes. They epitomize every specialized and non-specialized misfortune that happen all through age of current are frequently actually characterized; any place in light of the fact that the transmission and conveyance misfortunes can't be actually evaluated from causing finish data. This demonstrates that there is an association of a non-specialized parameter in the transmission and distribution of current.

In recent issues of power system maintenance of reactive power and voltage collapse is major factor on which various works are done from last few decades. Due to complexity and modernization in design of network of distribution and transmission it's more challenging task to improve and maintain the stability in system. There are various techniques and methodologies are used in modern technology to system, to make them more reliable, secure and efficient.

The main concern is kept over transmission system because of its higher value of voltage and power to emit from a place to another. Day by day increase in demand of transmission system network results in decrease of stability and provides chances of risk factor of faults and damage to functionality of system. Infrequent and undesired load demands cause voltage collapse in network which led to the higher range of losses and diffraction of power in present system.

Devices at present accessible for transient over-voltage control either plan to limit the transient over-voltage (or over-current) at the motivation behind application or point of confinement the overvoltage at remote areas. Some of the methods utilized at the utilities are switched capacitor bank incorporate; pre-insertion resistors, pre-insertion inductors, fixed inductors, MOV (Metal. Oxide Varistor) arresters, series inrush-current-limiting reactors, partitioning the capacitor bank into littler size banks, and staying away from the machine of capacitors at multi-voltage levels to wipe out the secondary resonance. Another way to deal with diminishing energizing transients is to time the switching device to close at the least complex conceivable time (when the voltage over the switch is zero) rather than adjusting the circuit parameters.

Table 1 – Characteristics of LVDS & HVDS

CHARACTERISTICS	LVDS	HVDS
Load Voltage & Current	Unbalanced	Balanced
Real Power Transfer	Unbalanced	Balanced
Transmission Line Stability	Over damping	Under damping
Power Factor Improvement	Unbalanced	Balanced
Real Power & Active Power Flow Control	Unbalanced	Balanced
Transient & Dynamic Stability	Unbalanced	Balanced
Fault Current Limiter	Higher Chances	Lower Chances
Power Oscillation Damping	Higher Chances	Lower Chances

The Table 1enlists the comparison characteristics of LVDS and HVDS, through which the selection of best distribution system can be achieved. The described distribution networks provide various benefits to system such as, reduces system losses, improves dynamic and transient stability, control real and reactive power, optimized system for working, increases power flow capability.

Literature Review on LVDS and HVDS

Sarwar [1] studied Techno-Economic Feasibility of HVDS Concept for Distribution Feeder Power Loss Minimizations following CYMDIST package for the reduction in technical power losses by implementing HVDS over LVDS. The researchers obtained huge reduction in technical losses by replacing LVDS over HVDS in order to improve the overall efficiency of system. They confirmed saving of annual energy around two Lacs KWH by cutting the distribution losses as well as deliberation in the total payback period and suggested that this scheme can be further enlarged for complicated system. The findings indicated

that HVDS system is far better than LVDS in following way, initially the literature review of IEEE-published paper under HVDS. Then paper shows the workable capability between the HVDS and LVDS system on various aspects like load flow analysis, short circuit analysis, voltage stability and also cost analysis. Researcher presents the simulation analysis of both the system by using ETAP software. Also, paper gives percentage of losses around 22.77 for transmission and distribution network in India. [2]

In such an increasing demand load of electrical energy in industrial sector, it's very important to meet the demand with all optimization of losses which may occurred during transmission and distribution. During the transfer of energy from one location to other through long line conductors there is a possibility of losses may occur in small amount. These losses may be technical or non-technical losses in the overhead line used in transmission system. The real time data is collected through regular time intervals recording done for losses, which are calculated through Load Flow Analysis (LFA) because such losses should be minimized to enhance the flow of energy with smooth and efficient manner. By using Load Flow Analysis (LFA) these losses can be minimizing up to the lowest level so that it may not affect the distribution system. The network mapping is done and implemented on 132 KV line to proof the control strategy Load Flow Analysis (LFA) is capable to minimize the losses in the line. The results achieved by using followings steps such as bundling of conductors, doubling the existing circuit, by upgrading the grid from 132 KV to 220 KV, by doing power injection from other generating station, and also by replacing the conductors. [3]

This paper presents the superiority of the high voltage distribution system (HVDS) over the low voltage distribution system (LVDS). The proposed work is implemented by installing large capacity transformer near to the load centers on the place of small capacity transformer. The high voltage distribution system gives improved voltage profile, less power loss. It is obvious that the initial cost of HVDS system is higher than LVDS but long-term benefits of HVDS are much higher than LVDS system. This paper also calculates the losses in HVDS system i.e. 4726 KW, which is almost half of the current LVDS system and here also calculate the payback period of HVDS system which is around 7 years. [4]

A Linear Programming technique in MATLAB is used to exemplify the High Voltage Distribution System, which is imposed on radial Low Voltage Distribution System. The required number of unit transformers for the proposed system is calculated with the help of optimization techniques. This procedure is helpful in replacing single high rated transformer by optimal number of low rating transformers. This paper also focused on the minimization of No-Load losses of transformer and also improved the operational cost. [5]

This paper introduces problem solving of power quality in Moscow Region. This paper carries out the practical measurement and also analysis of the radial distribution system. A capacitor bank is used to improve the reactive power in the considered region. The Genetic Algorithm and PSO (particle swarm optimization) techniques are used. [6]

Due to introduction of non-linear loads in electrical distribution system, the real power transfer scheme has been affected a lot. This paper talks about the effect of harmonic generation in low voltage distribution system, it also analyzes the

research algorithm based on FFT. The control strategy used in the said work is Fast Fourier Transform (FFT) harmonic measurement theory. The vector sum of all voltage drops produced there of results in a total voltage distortion. Therefore, whether it is the source or the load that is non-linear, harmonics are generated. When nonlinear currents pass through the linear source impedance, the source voltage suffers distortion. This distortion is as a result of the presence of the nonlinear load. The design provides a basis for the analysis of the causes of harmonics, the level of effects and methods of reducing harmonics in the power grid. [7]

Table 2 – Literature Review on LVDS & HVDS in Various Applications

Sr. No.	Work done	Methods	Outcomes	Reference
1	LVDS is replaced by HVDS	CYMDIST (CYME software for distribution system analysis)	The analysis revealed that huge reductions in technical losses are gained in order to improve the overall efficiency of system.	[1]
2	Compares both the distribution system by using simulation platform and also performed cost analysis.	ETAP software	Direct comparison between HVDS and LVDS system as per present scenarios and various test recorded the results proving HVDS system is much better than LVDS system	[2]
3	The Network mapping through bundling the conductors, doubling the circuits, power injection in the existing circuit, upgrading the grid from 132 KV to 220 KV, and then implemented on 132 KV line by using LFA technique.	Load Flow Analysis (LFA), Network Mapping	The technical losses are controlled by using Load Flow Analysis technique in 132 KV line.	[3]
4	Installation of large capacity transformer near to the load centers on the place of small capacity transformer.	Simulated power flow is done using ETAP software.	The high voltage distribution system gives improved voltage profile, less power loss. It is also observed that the initial cost of HVDS is no doubt higher than LVDS but payback period is less.	[4]
5	High Voltage Distribution System is imposed on radial Low Voltage Distribution System by calculating the required number of unit transformer.	Linear Programming techniques in MATLAB	This procedure is helpful in replacing single high rated transformer by optimal number of low rating transformers. Focused on the minimization of No-Load losses of transformer and also improved the operational cost.	[5]

6	Practical measurement, analysis of the radial distribution system and find correct size and location of capacitor bank in the considered region.	Genetic Algorithm and PSO techniques in MATLAB/ Simulink	With the help of PSO and genetic algorithm optimal location of capacitor bank can be determined. Also, by using capacitor bank reactive power is improved.	[6]
7	Study the fundamental causes of harmonic generation. And the algorithm based on improved FFT is presented for harmonics of low voltage distribution system.	improved Fast Fourier Transform (FFT)	This study improves the electrical power quality.	[7]
8	Proposed MVDS over LVDS and capacity distribution transformer are introduced over existing high capacity distribution transformer.	Medium voltage distribution system	The technical losses are reduced to 84% and consequently enhance the system performance. This huge difference in the losses can supplied to additional loads without any expenditure in generation sector.	[8]
9	Proposed the reconfiguration of electrical distribution system, by shifting partial load of heavily loaded feeders to lightly loaded feeders,	Ant colony optimization (ACO)	By using the reconfiguration technique balanced load on the feeders and loss minimization can be achieved.	[9]
10	Discuss the solutions of power flow study, short circuit, stability, transient problems over MATLAB	MATLAB	Symmetrical fault is calculated and allocated.	[10]
11	Calculates the power system instability.	Artificial neural network (ANN)	Proposed the artificial neural network (ANN) algorithm to judge the accurate voltage collapse.	[11]

As the proliferation of power demand all over the world, the existing system is suffering from low voltage regulation at the tail end. This paper proposed MVDS (Medium Voltage Distribution System) over LVDS (Low Voltage Distribution System). In this system small capacity distribution transformer are introduced over existing high capacity distribution transformer. The simulation on MATLAB is performed to achieve the validity of the proposed system in the matter of economic and technical suitability. In this paper 11KV line is imposed over 416V line and hence the technical losses are reduced. As the initial cost of MVDS is high but it can be refunded within the payback period of 36 months for the existing system. [8].

This paper proposed the reconfiguration of electrical distribution system. In the network reconfiguration the reduction in burden of extra loaded feeder is done by shifting partial loads over lightly loaded feeders. By the reconfiguration technique balanced load on the feeders can be achieved. This paper presents Ant colony optimization (ACO) which is used to balance load by system reconfiguration. It is also concluded that by using this technique the load balancing index (LBI) is reduced drastically. The reconfiguration is a technique to minimize loss and balance load. [9].

CONCLUSION

This study shows that HVDS system is most reliable system in comparison of LVDS system for power system. By using HVDS System we can achieve these following parameters such as reduction in system losses, improves dynamic and transient stability, control real and reactive power, optimized system for working, increases power flow capability. It also increases the system stability and works efficiently by removing reduces system losses, improves dynamic and transient stability, control real and reactive power, optimized system for working, increases power flow capability.

Conflict of interest

The author declares no conflict of interest.

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