Review on Power System Performance in High/Low Voltage Distribution System

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Abstract: **The HVDS system must reconfigure the existing low voltage (LT) network into a high voltage distribution system. The advent of high-power converters makes the modern power grid more active than before. In the existing LT system, large capacity transformers are provided at one point and connections to each load are extended across the LT lines. This document explains the distribution networks of the low voltage distribution system (LVDS) and the distribution system currently in use, the high voltage distribution system (HVDS). This paper presents the advantages and disadvantages of high voltage distribution systems.**

Keywords: **HVDS, LVDS, LT, distribution system**.

I. INTRODUCTION

The HVDS system must reconfigure the existing low voltage (LT) network into a high voltage distribution system, with the 11 kV line being routed to the loads as cleanly as possible and the LT power supply being powered by providing capacity transformers The minimum length of the LT line is committed to providing high quality power, reduced T&D losses and better services for consumers. In the existing LT system, large capacity transformers are provided at one point and connections to each load are extended across the LT lines. This long length of the LT lines leads to low voltage conditions and significant technical losses for most consumers. In HVDS projects, long LT networks are converted to 11 kV networks, which means that the corresponding capacity distribution transformer is installed near the end point and the consumer is supplied with an appropriate voltage level. By converting the LT lines to an HVDS system, the current flowing in the lines is reduced by a factor of 28 and the technical losses in the LT lines are significantly reduced. The HVDS system is the most efficient method to reduce technical losses and improve the quality of power supply to the electrical distribution network. In this system, high-voltage lines are pulled as close as possible to the loads and small transformers are installed. The HVDS system is aimed at a system with no LT or less LT lines and the inevitable short LT lengths that must be covered by insulated wires such as ABC (Aerial Bunched Cables) [1]. The main advantages of using ABC in HVDS are that errors on LT lines are completely eliminated. Since authorized consumers do not allow unauthorized interception by another consumer, as their transformer can be overloaded or damaged, a power outage occurs for a long time. It can be seen that the investment in switching from a traditional low voltage system [2] to an HVDS system is in most cases amortized by reducing losses within 3-5 years.

II. LITERATURE REVIEW

R. Thakur et al. [1] this document presents the different aspects of the high voltage distribution system that has been put into service to improve the voltage drop profile in the distribution sectors in order to find an economic path to customer satisfaction. The current situation is characterized by unacceptable losses, power quality and power reliability, the billing industry, revenue collection, frequent supply disruptions and thus consumer dissatisfaction, etc. The distribution industry requires an economical way to supply electricity at an appropriate price and with minimal voltage drop. Reduction of voltage regulation. So we need an inexpensive way to make electricity from public switchboards available to various consumers with minimal voltage drop and reducing voltage regulation.

M. Barivure Sigalo et al. [2] In this article, the technical effects of decentralized generation on medium voltage (MV) and low voltage (LV) networks are analyzed using ERACS, in particular taking into account changes in voltage profiles and flows. active and reactive power induced by the introduction of small distributed generators (SSDG) both at medium voltage (MV) and low voltage (LV) levels of the distribution networks.

A. Singh Solanki et al. [3] this article describes the previous work of the Low Voltage Distribution System (LVDS) and the HVDS High Voltage Distribution System in various research applications. It is observed that LVDS and HVDS showed a large era of work applications compared to other power system distribution networks. HVDS is one of the most efficient types of the distribution system that controls and maintains the stability of the voltage in the power grid during distribution and transmission. Power flow capacity and control, continuous power flow, line stability index, optimal control, dynamic and transient stability techniques are used in LVDS and HVDS to achieve voltage stability.

A Dembra et al. [4] presents the comparison of the existing low voltage distribution system with the proposed high voltage distribution system in terms of energy losses. The main objective of this project is to show the reduction of losses and to keep constant the voltage profile in the distribution network by placing H.V.D.S on L.V.D.S. The study is based on real-time low voltage agricultural departures in the state of Andhra Pradesh.

III. Low Voltage Distribution System (LVDS) system

To provide electricity to consumers, the distribution company (Discom) generally has the practice of running 11 kV lines from the 33/11 kV substation, an 11 kV / 0.415 kV (DT) three-phase distribution transformer in a suitable location, then lay long LT lines to the next loading center in order to establish links with consumers/households. In this case, DTs of different capacities are installed according to the load requirements to power one or more energy users. If the number of consumers is less, even more consumers are provided by a DT [5].

IV. Disadvantages with LVDS

i. Bad final voltages / bad voltage regulation.
ii. High technical losses due to higher line losses with longer LT lines.
iii. Greater chance of electricity theft thanks to the accessibility of bare LT cables
iv. Frequent bridge cuts and fuse failures at DT level due to overload, etc.
v. A failure in a single high-capacity DT, such as in LVDS, affects all connected loads. This leads to blackouts, low availability, and reliable power for consumers in the region.
vi. It is difficult to increase the DT capacity (if the existing DT is overloaded) because there is no storage space available (for DT more than 200kVA of capacity). To accommodate larger DTs, modifications to the DT mounting structure or installation of the DT to the base structure would be required.
vii. In order to avoid the theft of electricity due to connections/interceptions on LV lines, it is necessary to convert longer LT overhead lines with bare conductors into overhead cables in bundles (ABC) via overhead lines or underground systems.

High Voltage Distribution System (HVDS), as discussed below, is one of the techniques to overcome the above drawbacks.

V. High Voltage Distribution System (HVDS)

In order to improve the quality (voltage profile) of the power supply and reduce losses in the system, the HVDS can be used as an alternative to the LVDS, in which lines of 11 kV or as close as possible to the center of gravity are laid load, depending on the load requirements. Small transformers from 10 kVA to 100 kVA etc. it can be installed to supply electricity to consumers.

To prevent the theft of the LT lines from stealing electricity through theft, the LT line can be installed with insulated cables such as ABC (Aerial Bunched Cables) above overhead lines or through a system. This system requires more DT, associated accessories, more HV lines and fewer LT lines than the LVDS system [6].

VI. Advantages of HVDS

i. Low technical losses thanks to the reduction of LT lines
ii. Losses due to theft/interception can be reduced/eliminated with smaller LT lines and using low-cost ABC scales.
iii. Improved user-side voltage regulation due to low voltage drop due to lower load and lower cable length.
iv. A failure in a single DT results in a failure for a limited number of connected consumers, which leads to improved power availability and reliability for other consumers in the region.
v. A reduction in the physical coverage area and a number of consumers by a lower-capacity TD leads to the development of community awareness and a sense of belonging. This is useful for timely maintenance of the transformer and curb in case of theft.
vi. Easily increases DT capacity as load increases.
vii. It helps reduce the demand for distribution, transmission, and production systems when used by large-scale communications.

VII. Disadvantages of HVDS

i. More investments and more operating and maintenance costs thanks to a large number of DTs and their accessories.
ii. The need for accessories and supplies needs to be increased.

iii. HVDS will do more to increase the fault level of the system and therefore it will be necessary to improve the short circuit level of the equipment, the protection system and the restoration of the protection system parameters after a certain period of time.

As with all systems, HVDS also has advantages and disadvantages. Therefore, the choice of HVDS over LVDS should be based on the cost-benefit analysis which was performed by comparing two systems under similar conditions over the course of life. In order to carry out the cost-benefit analysis of LVDS and HVDS, a simple network was considered and the effects on the load branch were analyzed by replacing an LVDS with HVDS [7]. The existing electricity theft elimination scenario (taken into account at 2% of the load) was also taken into account by replacing the bare conductor in the LV lines of the LVDS system with ABC in HVDS.

VIII. Distribution System

The primary and secondary electricity distribution network that is generally of interest to the consumer in India is the 11 kV line or the branch distribution network downstream of the 33 kV substation. Each 11 kV derivation, coming from the 33 kV substations, is divided into several subordinate 11 kV branches in order to transport electricity close to the recharging points (places, industrial areas, villages, etc.). At these load points, a transformer further reduces the voltage from 11 kV to 415 V to provide individual customers with the last mile link via a 415 V line, also known as a low voltage (LT) line, to 240 V as a single-phase power supply. or 415 V to provide three-phase power. A branch can be an overhead line or an underground cable. In urban areas, the length of an 11kV branch can generally be up to 3km due to the density of the customer base. In contrast, in rural areas, the length of the power line is still much greater up to 20 km. A 415V line should generally be limited to about 0.5-1.0km. In existing distribution networks, bus voltage decreases as they move away from the substation, and losses are also high. The reason for the high losses is the use of low voltage for distribution because the current in the low voltage system is high and therefore more losses occur [8]. By using the high voltage distribution, we can reduce the losses because the current in the high voltage distribution system (HVDS) is low. In the existing system, looting is very easy due to the long bare LT conductor, and therefore many unauthorized connections are taken from the bare LT conductor.

IX. Transformer Theory

For example, suppose you have a winding (also known as a coil) powered by an AC power source. Alternating current through the winding creates a constantly changing and changing flow surrounding the winding.

If another winding is brought close to this winding, part of this alternating flow connects with the second winding. As this flux is constantly changing in its amplitude and direction, the flux connection in the second winding or coil must change.

According to Faraday's law of electromagnetic induction, a CEM is induced in the second winding. When the circuit of this secondary winding is closed, a current flows through it. This is the basic principle of a transformer.

We use electrical symbols to illustrate this. The winding that receives electrical energy from the source is called the "primary winding". In the following figure, this is the first coil.

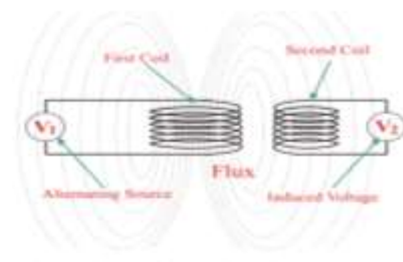

Fig. 1 coil diagram

The winding that provides the desired output voltage due to mutual induction is generally referred to as the "secondary winding". This is the "second coil" in the diagram above.

A transformer that increases the voltage between the primary and secondary winding is called a step-up transformer. Conversely, a transformer that reduces the voltage between the primary and secondary winding is called a step-down transformer.

Whether the transformer increases or decreases the voltage level depends on the relative number of turns between the primary and secondary sides of the transformer.

If the primary coil has more turns than the secondary coil, the voltage will drop (lower).

If the primary coil has fewer turns than the secondary coil, the voltage will rise (rise).

Although the above scheme of the transformer into an ideal transformer is theoretically possible, it is not very practical. In fact, on the outside, only a very small part of the flux generated by the first coil is connected to the second coil. The current flowing through the closed-circuit connected to the secondary winding is therefore extremely low (and difficult to measure).

X. Conclusion

This paper introduces the Low Voltage Distribution System (LVDS) distribution networks and the distribution system currently in use, High Voltage Distribution Systems (HVDS). This article discusses the advantages and disadvantages of high voltage distribution systems. By using the high voltage for distribution, we can reduce the losses because the current in the high voltage distribution system (HVDS) is low.

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