

# A Review Article of Vsc Based Hvdc Loss Less Transmission Line

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**Abstract-**Beginning with a brief historical perspective on the development of High Voltage Direct Current (HVDC) transmission systems, this paper presents an overview of the status of HVDC systems in the world today. It then reviews the underlying technology of HVDC systems, and discusses the HVDC systems from a design, construction, operation and maintenance points of view. The paper then discusses the recent developments in HVDC technologies. The paper also presents an economic and financial comparison of HVDC system with those of an AC system; and provides a brief review of reference installations of HVDC systems. The paper concludes with a brief set of guidelines for choosing HVDC systems in today's electricity system development.

**Index Terms-** HVDC circuit breakers (CBs), HVDC converters, HVDC transmission, power electronics, power engineering education, power systems

## I. INTRODUCTION

Historical Perspective on HVDC Transmission It has been widely documented in the history of the electricity industry, that the first commercial electricity generated (by Thomas Alva Edison) was direct current (DC) electrical power. The first electricity transmission systems were also direct current systems. However, DC power at low voltage could not be transmitted over long distances, thus giving rise to high voltage alternating current (AC) electrical systems. Nevertheless, with the development of high voltage valves, it was possible to once again transmit DC power at high voltages and over long distances, giving rise to HVDC transmission systems. Some important milestones in the development of the DC transmission technology are presented.

## II. LITERATURE REVIEW

**1.P. V. K. Babu, P. B. Prasad, and M. P. Lalitha, (IJERA 2012) et. Al** introduced a paper on, Power Upgrading of Transmission Line by Combining AC-DC Transmission. Long additional high voltage (EHV) air conditioning lines can't be stacked to their warm points of confinement so as to keep adequate edge against transient unsteadiness. With the plan proposed in this undertaking, it is conceivable to stack these lines near their warm points of confinement. The conductors are permitted to convey common air conditioning alongside dc superimposed on it. The additional dc power stream does not bring on any transient insecurity. This venture gives the attainability of changing over a twofold circuit air conditioning line into composite air conditioning dc

control transmission line to get the upsides of parallel air conditioning dc transmission to improve steadiness and damping out motions. Reenactment and trial studies are done for the organized control just as free control of air conditioning and dc control transmissions. No modifications of conductors, protector strings, and towers of the first line are required. Generous increase in the heap capacity of the line is gotten. Ace current controller detects air conditioning current and directs the dc current requests for converters online with the end goal that conductor current never surpasses its limit.[1]

**2.Clerici A, Paris L and Danfors P. (IEEE 1991) et. Al** exhibited a paper on, HVDC change of HVAC line to give significant power updating. The possibility of change of AC lines to DC lines for a significant power updating is broke down and it is demonstrated that increments of 3.5 occasions or more are attainable. The principle plan target is to allow the transformation to be done as a basic retrofit or upkeep task, as opposed to another development activity, in this manner diminishing blackout times and improving conceivable new permitting methods.

Both HV and EHV twofold circuit and single-circuit AC lines of normal qualities have been utilized for instance for transformation to both bipolar and monopole lines separately. Notwithstanding the significant increment in power move capacity, the transformation to DC additionally considerably decreases the per unit misfortunes and upgrades dependability through the improved lightning execution of the changed over line. HVDC task has demonstrated points of interest in

streamlining activity of the all out framework. The information displayed give a reference structure to encourage primer assessments, albeit point by point transformation studies must be presented on a defense by case basis.[2]

**3.P. Zuniga-Haro, J. M. Ramirez (EPCS 2009) et. al** exhibited a paper on Multi-beat Switching Functions Modeling of Flexible AC Transmission Systems Devices. This article builds up a novel exchanging capacity model for the static synchronous compensator, the static synchronous arrangement compensator, and the bound together power stream controller adaptable AC transmission framework gadgets situated in a multi-beat voltage-sourced converter topology for 6-, 12-, 24-, and 48-beat setups. This tale model accurately speaks to recompenses of semiconductor gadgets in a voltage-sourced converter, which subsequently permits an exact portrayal of symphonious parts present in sign of genuine adaptable AC transmission framework gadgets. The models are completed in the first abc control framework arranges. As a prologue to the more unpredictable courses of action, the determination of the most straightforward six-beat voltage-sourced converter-based exchanging capacity model is clarified. The adequacy and accuracy of the proposed models are approved against recreations completed in the expert PC program PSCAD/EMTDC.[3]

**4.Clerici A, Valtorta G and Paris L. (1991) et. Al** displayed a paper on , AC or potentially DC significant power updating of Existing OHTL Corridors. The regularly expanding trouble to discover new right of ways (ROW) for the development of overhead transmission lines (OHTL) is driving the investigation of potential choices for significant power updating of existing AC line halls. One conceivable arrangement is to alter existing OHTLs without major new development. The creators examine the two fundamental techniques for change. Change of both twofold circuit and single circuit HVAC lines to bipolar and mono polar lines separately; and substitution of both twofold circuit and single circuit old HVAC lines with new minimized EHV lines having even V congregations and with the conceivable reutilization of existing pinnacle area. The redesigning plausibility offered by the above techniques is broke down with due contemplations to the different plan criteria pertinent to conductors, auxiliary/protection/misfortunes/natural effects.[4]

**5.Brierley R H (IEEE 1991) et. al** presented a paper on Compact Right of Ways with multi-Voltage Towers. Decreased leeway among circuits and the plan of different voltage level circuits on a similar pinnacle have brought about a genuine increment in enlistment impacts. A few designs have been contemplated with up to three circuits, every one of various voltage, on a similar pinnacle. Run

of the mill tower setups are appeared. The creators depict the issues recognized, options considered, and arrangements produced for such circuit plans. Issues with voltage unbalance, leftover burden voltage, ferro reverberation, breaker recuperation voltage, ground switch obligation, and line upkeep have been recognized, and arrangements are presented.[5]

**6.H. Rahman and B H Khan (EPSRJE 2007) et. al** presented a paper on, Stability Improvement of Power System by Simultaneous AC-DC Power Transmission. This paper exhibits the idea of concurrent air conditioning dc control transmission framework with recently structured self-versatile Voltage Dependent control (VDCOL) technique. Long air conditioning transmission lines can't be stacked to their warm constrains because of insecurity happens in the power framework. It is hard to load long air conditioning lines to their warm cutoff points as an adequate edge is kept against transient insecurity.

With the model proposed in this theory, it will be conceivable to stack these lines near their warm breaking points. The transmission lines and the conductors are permitted to convey normal air conditioning alongside dc superimposed on it. This proposition with recently structured controller gives us the attainability of composite air conditioning dc control transmission line to get the upsides of parallel air conditioning dc transmission so as to transient strength and dynamic soundness and hose out motions. Reenactment has been done during 1-stage and 3-stage issue in MATLAB programming bundle (Simulink) to demonstrate framework security enhancement.[6]

**7.N. G. Hingorani (IEEE 1991) et. al** presented a paper on, FACTS—adaptable A.C. transmission framework. For monetary reasons most if not the majority of the world's electric power supply are broadly interconnected, including interconnections inside utilities claim domains which stretch out to between utility interconnections and after that to between local. The creator portrays how in view of this, the Electric Power Research Institute speaking to the communitarian R&D arm of the US utilities, has advanced an idea, a dream of things to come dependent on silicon science, called adaptable AC transmission framework (FACTS). While a portion of the significant innovation i.e., static VAR pay is as of now in wide use, the FACTS idea has brought to the table a huge potential for thyristor based controllers which will definitely change the power system.[7]

**8.N. Flourentzou, V. G. Agelidis, and G. D. Demetriades (IEEE 2009) et. al** presented a paper on, VSC-based HVDC control transmission frameworks. The consistently expanding advancement of high-voltage high-control completely controlled semiconductor innovation keeps on significantly affecting the

improvement of cutting edge control electronic mechanical assembly used to help enhanced activities and effective administration of electrical frameworks, which, by and large, are completely or in part deregulated systems. Improvements advance both the HVDC control transmission and the adaptable air conditioning transmission framework advances. In this paper, a diagram of the ongoing advances in the territory of voltage-source converter (VSC) HVDC innovation is given. Chosen key staggered converter topologies are displayed. Control and demonstrating strategies are talked about. A rundown of VSC-based HVDC establishments worldwide is incorporated. It is affirmed that the ceaseless advancement of intensity gadgets presents financially savvy open doors for the utilities to adventure, and HVDC remains a key innovation. Specifically, VSC-HVDC can address not just regular system issues, for example, mass power transmission, non-concurrent organize interconnections, consecutive air conditioning framework connecting, and voltage/soundness backing to make reference to a couple, yet additionally specialty markets, for example, the coordination of huge scale sustainable power sources with the matrix and most as of late enormous coastal/seaward wind farms.[8-11].

### III. THE COMPONENTS OF AN HVDC TRANSMISSION SYSTEM

To assist the designers of transmission systems, the components that comprise the HVDC system, and the options available in these components, are presented and discussed. The three main elements of an HVDC system are: the converter station at the transmission and receiving ends, the transmission medium, and the electrodes.

**1. The converter station-** The converter stations at each end are replicas of each other and therefore consist of all the needed equipment for going from AC to DC or vice versa. The main component of a converter station is.

**2. Thyristor valves-** The thruster valves can be build-up in different ways depending on the application and manufacturer. However, the most common way of arranging the thyristor valves is in a twelve-pulse group with three quadruple valves. Each single thyristor valve consists of a certain amount of series connected thyristors with their auxiliary circuits. All communication between the control equipment at earth potential and each thyristor at high potential, is done with fibre optics.

**3. VSC valves-** The VSC converter consists of two level or multilevel converter, phase-reactors and AC filters. Each single valve in the converter bridge is built up with a certain number of series connected IGBTs together with their auxiliary electronics. VSC valves, control equipment and cooling equipment would be in enclosures (such as standard shipping containers) which make transport and

installation very easy. All modern HVDC valves are water-cooled and air insulated.

**4. Transformers-** The converter transformers adapt the AC voltage level to the DC voltage level and they contribute to the commutation reactance. Usually they are of the single phase three winding type, but depending on the transportation requirements and the rated power, they can be arranged in other ways.

**5. AC Filters and Capacitor Banks-** On the AC side of a 12-pulse HVDC converter, current harmonics of the order of 11, 13, 23, 25 and higher are generated. Filters are installed in order to limit the amount of harmonics to the level required by the network.. In the conversion process the converter consumes reactive power which is compensated in part by the filter banks and the rest by capacitor banks. In the case of the CCC the reactive power is compensated by the series capacitors installed in series between the converter valves and the converter transformer. The elimination of switched reactive power compensation equipment simplify the AC switchyard and minimize the number of circuit-breakers needed, which will reduce the area required for an HVDC station built with CCC. With VSC converters there is no need to compensate any reactive power consumed by the converter itself and the current harmonics on the AC side are related directly to the PWM frequency. Therefore the amount of filters in this type of converters is reduced dramatically compared with natural commutated converters.

**6. Filters-** HVDC converters create harmonics in all operational modes. Such harmonics can create disturbances in telecommunication systems. Therefore, specially designed DC filters are used in order to reduce the disturbances. Usually no filters are needed for pure cable transmissions as well as for the Back-to-Back HVDC stations. However, it is necessary to install DC filters if an OH line is used in part or all the transmission system the filters needed to take care of the harmonics generated on the DC end, are usually considerably smaller and less expensive than the filters on the AC side. The modern DC filters are the Active DC filters. In these filters the passive part is reduced to a minimum and modern power electronics is used to measure, invert and re-inject the harmonics, thus rendering the filtering very effective.

### IV. TRANSMISSION MEDIUM

For bulk power transmission over land, the most frequent transmission medium used is the overhead line. This overhead line is normally bipolar, i.e. two conductors with different polarity. HVDC cables are normally used for submarine transmission. The most common types of cables are the solid and the oil-filled ones. The solid type is in many cases the most economic one. Its insulation

consists of paper tapes impregnated with a high viscosity oil. No length limitation exists for this type and designs are today available for depths of about 1000 m. The self – contained oil-filled cable is completely filled with a low viscosity oil and always works under pressure. The maximum length for this cable type seems to be around 60 km.

## V.CONCLUSION

In this paper, recent advances of the VSC-based HVdc technology are presented. The development of high-voltage high-power semiconductors have successfully assisted utilities to exploit the benefits of the four-quadrant static converter interlinking two ac systems through HVdc with a number of key benefits, namely independent control of active and reactive power through the PWM control of the converter, fast dynamic response, and possibility to connect ac island with no synchronous generation in the grid. It is confirmed that developments associated with VSC-based HVdc technology have delivered system sat voltage levels up to 350 kV and power levels up to 400 MW.VSC-HVdc undoubtedly will continue to provide solutions in many areas of the power systems where installations necessitate proven solutions

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