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A Novel Approach for Design and Analysis of A Modular Multilevel Converters For HVDC Networks

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***Abstract:* -- Modular multilevel converters are a rising voltage source converter topology reasonable for some applications. The expanded usage of HVDC power transmission arrangements has brought about Modular Multilevel Converter sturning into a more regular converter sort. Different applications incorporate interfacing renewable vitality power sources to the system and engine drives. Measured multilevel converters are gainful for medium voltage engine drives in light of the fact that the properties of this converter topology, for example, low twisting, take into account an effective engine drive plan.**

In this paper we exhibited the configuration and execution of a vigorous Modular Multilevel Converter which can be interconnected with the conventional HVDC power dispersion systems which gives various remarkable execution highlights like bidirectional power flow coordination, dependable step up and step down operation particular multilevel dc/dc converter, termed the DC-MMC, that can be sent to interconnect and bidirectional adaptation to internal failure which is as often as possible found in the DC circuit breakers. The center part of the proposed Modular Multilevel Converter make utilization of interleaved strings of fell submodules.The proposed converter model actualizes an open circle voltage control technique to guarantee the power equalization of each discrete capacitor module with the assistance of flowing AC ebbs and flows. The proposed converters are composed, executed and tried in the Matlab Environment. The recreation results pronounced that the proposed methodology is best in all viewpoints and beats all the current methodologies.

I. INTRODUCTION

The normal yearly development rate of definite power utilization over the EU-27 was 1.7 % in this period [2]. This rate is not especially high in contrast with for occasion China, yet the current high-voltage rotating current (HVAC) system in Europe is worked nearer and nearer as far as possible. In mix with the exchanging systems of free power markets, expanded clog issues are normal. Moreover, renewable vitality sources, for example, wind power may create power at different moments and different areas than those that are ideal from a power system viewpoint. Unexpectedly, monstrous blockage issues are anticipated, and to adjust the fluctuating era of electric power from wind ranches, far off power sources, in all probability hydro power sources, will be utilized. As most climate systems have a land dispersion of roughly 1000 km, the impacts of total must be represented if wind ranches can be interconnected by an adequately solid matrix covering a few a large number of kilometers. Despite the fact that the possibility of HVDC-based systems offers numerous advantages, one of the standard difficulties confronting their far reaching organization is the interconnection of various dc systems what's more administration of power streams between them.

To oblige both capacities, bidirectional dc/dc converters can be dispatched [1]–[3] (albeit different gadgets custom fitted for power stream control exist [1], [4]). By utilizing dc/dc converters to modify line voltages, or the voltage between various system sections, the power controllability inside dc systems can be developed [5]. Besides, arrangement of bigger dc systems can be acknowledged by using dc/dc converters to work together littler prior dc network sections. In any case, due to the high voltage (i.e., many kilovolts) and high-control (i.e., several megawatts) necessities, few dc/dc topologies are appropriate for HVDC applications. The utilization of two fell dc/air conditioning stages [7], [6]–[8] is exorbitant and ruins general transformation productivity while transformer less dc/dc converters are regularly not completely measured [9]–[10] and can experience the ill effects of uncontrolled engendering of shortcoming streams [10] because of outside dc deficiencies.

The total situation includes an electric transmission system that ought to have a considerably higher limit than today, and that enormous vacillations in power could be taken care of without losing dependability. An answer taking into account redesigning of the current HVAC matrix is deficient in thickly populated ranges as a result of open restriction, tight transmission halls and constrained accessibility of right of way (ROW). In the vast majority of focal Europe, and in numerous different areas, the main sensible option is a high-voltage direct present (HVDC) matrix. Such a matrix would permit a relative direct underground usage of a lattice. Up to this point, no conspicuous converter contender for such HVDC Super Grids was accessible. Contingent upon the power semiconductor utilized as a part of the converter topology, the HVDC transmission can be named thyristor based line-commutated converters (LCC) and protected entryway bipolar transistor (IGBT) based voltage source converters (VSC).

Because of its secluded structure and numerous operational favorable circumstances, the surely understood particular multilevel converter (MMC) [11]–[12] has turned into a favored answer for dc/air conditioning change in different power system applications. The MMC is especially alluring for use in HVDC transmission [11], [13]–[14], where its versatile design empowers expansive working voltages to be acknowledged by essentially stacking the imperative number of sub modules (SMs) in course. Be that as it may, the fundamental downside of MMC-based dc/dc topologies is that they require two fell dc/air conditioning transformation stages [7], [21], [22]. This is a moderately expensive arrangement as every dc/air conditioning stage must process the same information power, bringing about poor use of total introduced SM rating. In addition, the natural requirement for a middle of the road air conditioning connection and transformer evaluated for the full info control facilitate antagonistically affects the total expense and in addition general change effectiveness.

LCCs having high effectiveness don't perform well in coincided lattice associations as the voltage must be turned around if the bearing of power is switched. Furthermore, LCCs experience the ill effects of being a weight to the interconnected HVAC lattice due to the requirement for receptive power. Another issue identified with the same wonder is the danger for compensation disappointments, ordinarily amid inverter operation [15]-[16].VSCs, be that as it may, can change power course through the inversion of current heading as opposed to voltage extremity. Therefore, the VSC innovation can utilize Cross-connected polyethylene (XLPE) links. They can give receptive power and don't have replacement issues. They additionally don't have a base prerequisite for the short out proportion for the associated AC system. They have littler impression and permit dark begin. Since the late nineties, along these lines, HVDC transmission in light of a few level VSCs has been advanced furthermore introduced in different parts of the world [15]-[16]. An option VSC topology is the secluded multilevel converter (M2C) [17], which can possibly have efficiencies higher than 99 % and is likewise encouraging concerning unwavering quality and issue taking care of. The M2C is exceedingly adaptable concerning the quantity of levels. The quantity of sub-modules can be expanded or diminished as the quantity of levels increments or abatements to get the coveted yield voltage.

II.PROPOSED WORK

The Fig. 1 shows the three-string architecture of the MMC for deployment in bipolar HVDC networks. The MMC performs single-stage dc/dc conversion by utilizing interleaved strings of cascaded SMs. Each string is comprised of two pairs of arms; each pair of arms consisting of an inner arm and an outer arm, where an arm is defined as a set of cascaded SMs. The arms of each string are series-stacked in symmetric relation about an associated midpoint, i.e., o1, o2, o3, with the inner arms flanked by the outer arms. Each inner arm and outer arm employs m half-bridge SMs (HB/SMs) and k full-bridge SMs (FB/SMs), respectively. Circuit configurations for the HB/SM and FB/SM switching cells are given in Fig. 1(b). Arm chokes La accommodate the switching action of the SMs. A path, enabled here by inductor Lr, links the strings together via their midpoints and serves to establish circulating ac currents required by the dc/dc conversion process. Input filtering for the MMC is optionally provided by Ls and Cs.

However, output filter element Lf is necessary to attenuate ac voltages present at the dc output nodes of

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each string. The magnetizing inductance Lf of each set of coupled.

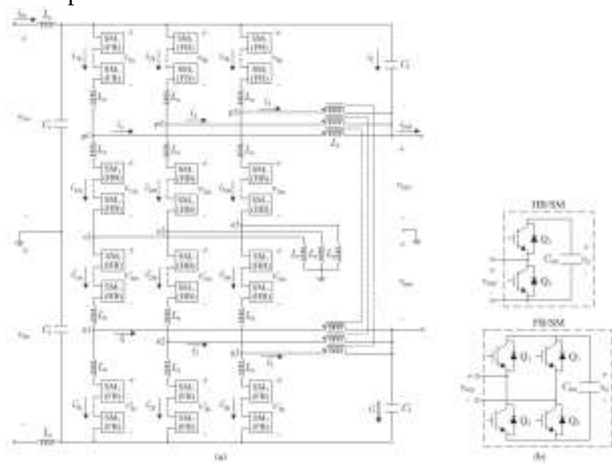

Fig. 1. Three-string Modular Multilevel Converter architecture.

Inductors is reasonable to give the expansive impedance expected to weakening of the air conditioner yield channel streams. In addition, utilization of coupled inductors as demonstrated guarantees cancelation of dc flux inside the center. Capacitors Cf are a pragmatic thought to sink high-recurrence air conditioning streams presented by exchanging activity of the SMs. The utilization of latent elements Lf and Cf is a generally minimal effort and basic usage when contrasted with option dynamic separating arrangements. In contrast with the three-stage dc/air conditioning MMC, the three-string engineering in Fig. 1 shares a comparable particular structure. As will turn out to be more evident in ensuing areas, the three-string usage of the proposed MMC may be seen as the three-stage dc/air conditioning MMC structure adjusted for single-stage dc/dc transformation. Not at all like the as of late proposed dc/dc converter in [6], which is shaped by arrangement stacking two routine three-stage dc/air conditioning MMCs, the operation and control of Fig. 1 is on a very basic level not quite the same as that of the dc/air conditioning MMC. The MMC in Fig. 1 uses three interleaved strings of fell SMs. By expelling one of the strings, a two-string

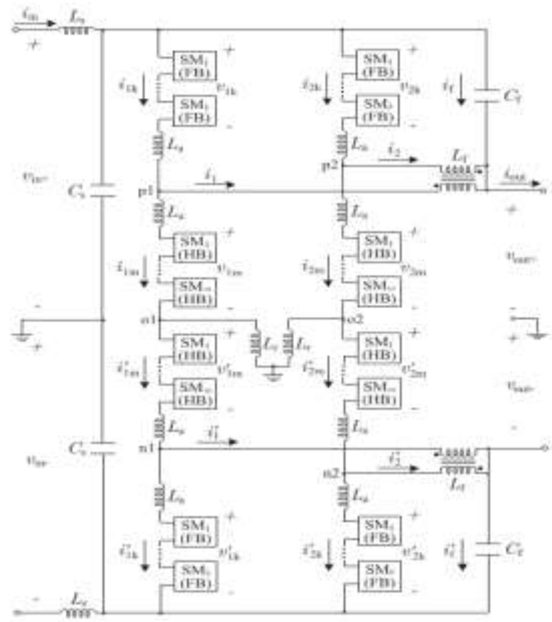

Fig. 2. Two-string MMC architecture with input and output filtering.

Execution is additionally conceivable as appeared in Fig. 2. This design is the most straightforward multi string usage of the DC-MMC. When all is said in done, a subjective number of strings can be interleaved. Note the capacity to introduce a coupled inductor set at every dc yield post has been abused because of the considerably number of interleaved strings. Subsequently, this lessens protection prerequisites on the yield channel inductances when contrasted with Fig. 1. The two-string and three-string structures have the same crucial guideline of operation as every string utilizes an indistinguishable dc/dc transformation process. For equivalent string outlines, the two-string has 2/3 the yield power rating of the three-string.

III. RESULTS AND DISCUSSION

In order to test the operational effectiveness of the proposed Modular Multilevel Converter, we are performing computer simulations. The proposed converter is designed, coded, implemented and tested in the Matlab Environment. The simulation results are presented as follows.

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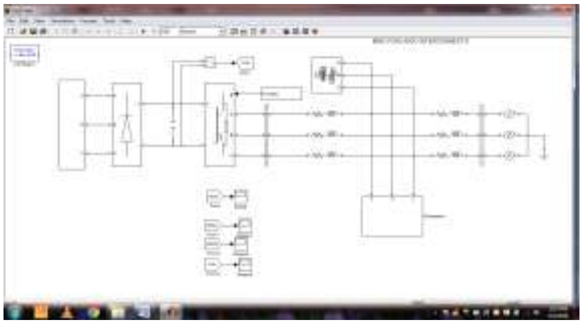
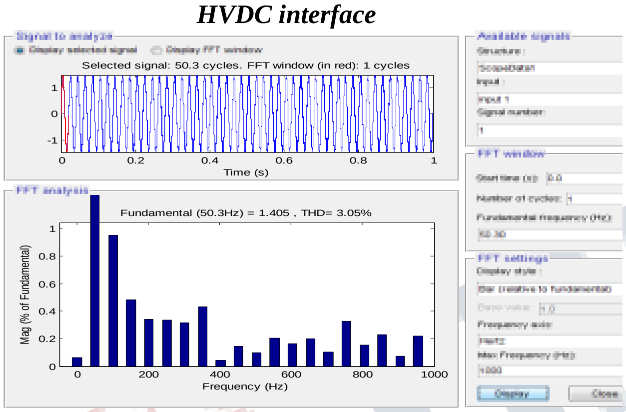
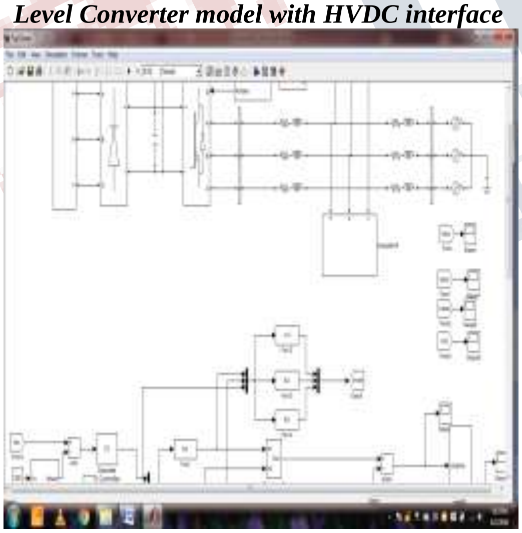


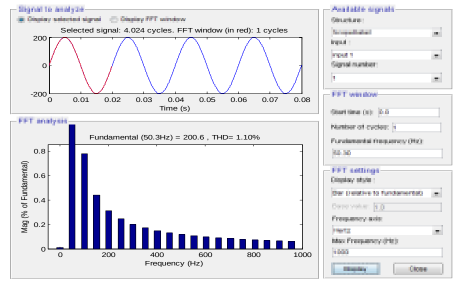
Fig(3):Basic Modular Multi-Level Converter with HVDC interface



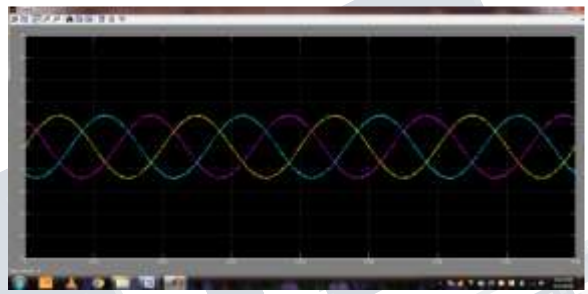
Fig(4):Simulation results of Basic Modular Multi-Level Converter model with HVDC interface



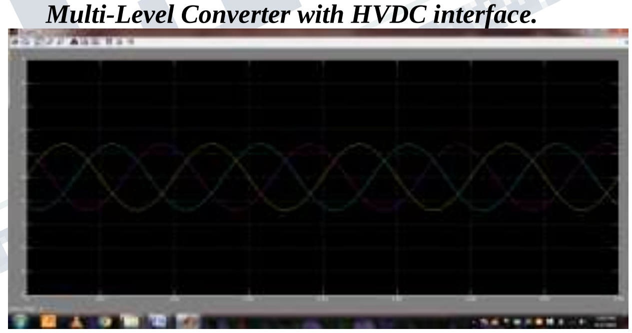
Fig(5):Modular Multi-Level Converter model with SV-PWM for HVDC interface



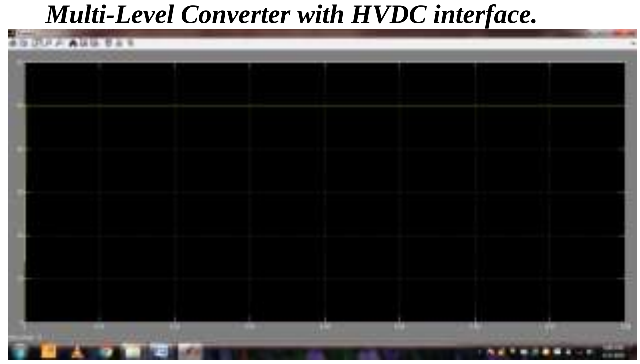
Fig(6):Simulation Results of Modular Multi-Level Converter with SV-PWM for HVDC interface



Fig(7):Source Current Waveforms of Modular Multi-Level Converter with HVDC interface.



Fig(8):Output Current Waveforms of Modular Multi-Level Converter with HVDC interface.



Fig(9):Output DC Voltage Waveforms of Modular Multi-Level Converter with HVDC interface

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IV. CONCLUSION

Modular Multilevel Converters are advantageous for medium voltage engine drives on the grounds that the properties of this converter topology, for example, low mutilation, take into account a proficient engine drive plan. Modular Multilevel Converters utilize various low-appraised IGBTs to create the wanted voltage. The converter is comprised of a progression of IGBT half-connect circuits with a capacitor crosswise over both gadgets. Advantages of this converter incorporate diminished semiconductor gadget costs because of the capacity to utilize all the more financially accessible low-appraised IGBTs and lessened or conceivably the end of channel parts. This paper concentrated on the outline and usage of a vigorous Modular Multilevel Converter which can be interconnected with the customary HVDC power circulation systems which gives various remarkable execution highlights like bidirectional force stream coordination, dependable stride up and venture down operation particular multilevel dc/dc converter, termed the DC-MMC, that can be conveyed to interconnect and bidirectional adaptation to internal failure which is as often as possible found in the DC circuit breakers. The proposed converters are composed, actualized and tried in the Matlab Environment. The reproduction results decreed that the proposed methodology is best in all viewpoints and beats all the current methodologies.

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