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New Multilevel Inverter Topology for Direct GridIntegration of Renewable Energy Systems

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Abstract

Owing to the fact that we are getting into quick development in innovation, strong state semiconductors have prompted the improvement of medium-voltage control converters which could deflect the requirement for high voltage venture up transformers of sustainable power era frameworks. The particular multi-level Cascade converters (MMCs) have been regard as phenomenal contenders for the advancement of medium-voltage converters. Here the converters require different segregated and adjusted dc supplies. In this way, in this venture, multilevel Cascade medium-voltage converter with a high-recurrence connection is proposed. The normal high-recurrence connection creates numerous separated and adjusted dc supplies for the converter, actually limits the voltage unevenness and basic mode issues. Proposed framework is composed and broke down to gauge the predetermined framework execution, control intricacy, cost, and accessibility of the power semiconductors. For inexhaustible era frameworks when contrasted with PV Cells THD is lessened in Wind vitality frameworks. With a specific end goal to confirm the workability of the proposed framework, a measured five-level Cascade converter utilizing wind vitality is created in this venture. The outcomes were dissected in Matlab/Simulink condition R2009a. It is normal that the proposed new innovation will have extraordinary potential for future inexhaustible era frameworks and brilliant lattice applications.

Key words- Renewable energy, inverter topology, THD

I.Introduction

At present, there are more than 282 GW of wind power era and more than 102 GW photovoltaic (PV) era in-slowed down around the world. Inexhaustible power plants of more than 10 MW in limit have in this way turn into a reality. Since 2011, this has been delivering the wind turbine E-126/7500 with a power limit of 7.5 MW. At present, Sway Turbine and Wind Tec Solutions are creating 10-MW wind turbine generators, which are relied upon to be financially accessible by 2015. In any case, wind ranches cover expansive ranges of land. For instance, the land region secured by a 3.6-MW turbine can be right around 0.37 km to such an extent that 54 turbines would cover around 20 km of land region. Seaward wind ranches spare land rental cost which is equal to 10–18% of the aggregate working and support expenses of a wind cultivate. In this way, seaward wind ranches have pulled in extensive enthusiasm for late years. More than 200 PV control plants have as of now been introduced on the planet; each of them producing a yield of more than 10 MW. Of these plants, 34 are situated in Spain and 26 in Germany. The quantity of PV power plants will keep on rising.

As of late, the semi Z source inverter has pulled in noteworthy consideration because of some unique elements (e.g., the lift and dc/air conditioning transformation can be acknowledged in one dynamic stage and the required capacitance of the aloof system can be decreased), In 2012, by the mix of a couple of semi Z source inverters into a MMC converter, a medium-voltage PV inverter was proposed where the semi Z source inverters produce dc supplies for the MMC converter. The star postured inverter does not have electrical detachment between the PV exhibit and medium-voltage network. Different segregated high-recurrence interface based medium-voltages PV inverter topology was proposed where the high-recurrence joins create dc supplies for the MMC converter. In these proposed frameworks, the voltage adjusting is the testing issue since every module is associated with a PV exhibit through a dc/dc converter. In 2012, a typical dc-interface based PV inverter was proposed, in spite of the fact that this plan may lessen the voltage irregularity issue in the matrix side, the era of basic dc-connect voltage from various PV clusters makes the inverter operation complex and limits the scope of the most extreme power point tracker (MPPT) operation.On the other hand, contrasted and the ordinary power-recurrence transformers, the high-recurrence transformers have considerably littler and lighter attractive centers and windings, and consequently much lower costs For instance, worked at 1.2 kHz, the weight and size of a 3-

MW transformer can be under 8% of an identical 50 Hz unit They have, thusly, as of now been broadly utilized as a part of the low-voltage applications. Presently, the high exchanging recurrence control protected entryway bipolar transistors (IGBTs) and rectifiers are financially accessible (e.g., the Semikron 1200 V, 422 An IGBT SKM300GB12T4 and1700 V, 330 A quick recuperation diode module SKKE330F can be worked at up to 20-kHz exchanging frequencies). For manufacture of high-recurrence transformers, the nebulous material has amazing attractive attributes, for example, high immersion flux thickness and generally low particular center misfortunes at medium to high frequencies. The monetarily accessible undefined material is Metglas (e.g., the Metglas amalgams 2605S3A and 2605SA1), which is fabricated by Hitachi Metals. The immersion flux thickness of the Metglas composite 2605S3A and the particular center misfortune at 10 kHz sinusoidal excitation of 0.5 T is 20 W/kg. Because of the framework prerequisites and late advances of energy semiconductor gadgets and attractive materials, the power electronic transformer (PET) has been getting critical considerations over the most recent two decades. Today, MVA level PET has turned into a reality. Actually, there are right now different MVA level PETs in pragmatic applications. For instance, a 1.2-MVA PET is presently being used by the Swiss Federal Railways. Thus, the propelled magnetics material-based regular high-recurrence connection might be the normal decision to create various separated and adjusted dc supplies for the MMC converters.

In this venture, a high-recurrence interface multilevel Cascade medium-voltage converter is proposed for direct matrix joining of sustainable sources. The regular attractive connection creates various separated and adjusted dc supplies for the majority of the H - connect inverter cells of the MMC converter from a solitary or different sustainable sources. The network electrical segregation and voltage awkwardness issues are settled through the basic high-recurrence link.The high-recurrence interface multilevel Cascade medium-voltage converter-based matrix coordination framework will have the accompanying favorable circumstances:

1) No prerequisite for exceptional, different generators for the wind turbine generator frameworks.

2) An extensive variety of MPPT operation for PV frameworks;

3) A characteristic dc-connect voltage funds to be paid to the basic attractive connection;

4) Direct Grid association without utilizing the progression up transformer;

5) A general minimized and lightweight framework; and

6) Inherent minimization of the matrix seclusion issue through the high-recurrence connect.

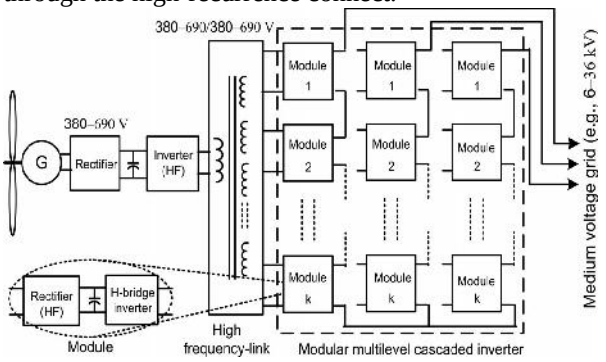


Fig. 1.Proposed three-phase wind turbine generator system for directmedium-voltage grid integration.

II.Modulation Scheme for MMC Converters

Diverse sorts of real reference signals utilized as a part of the customary converters can likewise be utilized in the multilevel converter framework (e.g., sinusoidal, third consonant infused sinusoidal, 60◦ adjusted sinusoidal and trapezoidal) [9], [10]. Each has novel points of interest and drawbacks. It is conceivable to Calculated THD at various number of levels going from 7-level to 19-level with four adjustment strategies. diminish the exchanging misfortunes by lessening the quantity of exchanging events in every period. Flatting the highest point of the reference flag waveforms (e.g., third symphonious infused sinusoidal, 60◦ adjusted sinusoidal and trapezoidal) not just permits the likelihood of exchanging misfortune diminishment additionally builds the scope of straight regulation. In this paper, four regulation plans (e.g., the stage moved bearers with sinusoidal references (SPWM), the stage moved transporters with third symphonious infused sinusoidal references (THPWM), the stage moved transporters with 60◦ tweaked sinusoidal references (SDPWM), and the stage moved bearers with trapezoidal sort references (TRPWM)) are connected on 7-level to 19-level MMC converter frameworks to investigate the execution. Of these four tweak plots, the THPWM conspire gives the best symphonious execution, as . The SDPWM and TRPWM plans have higher lower arrange consonant substance than that of the SPWM and THPWM plans. What's more, the

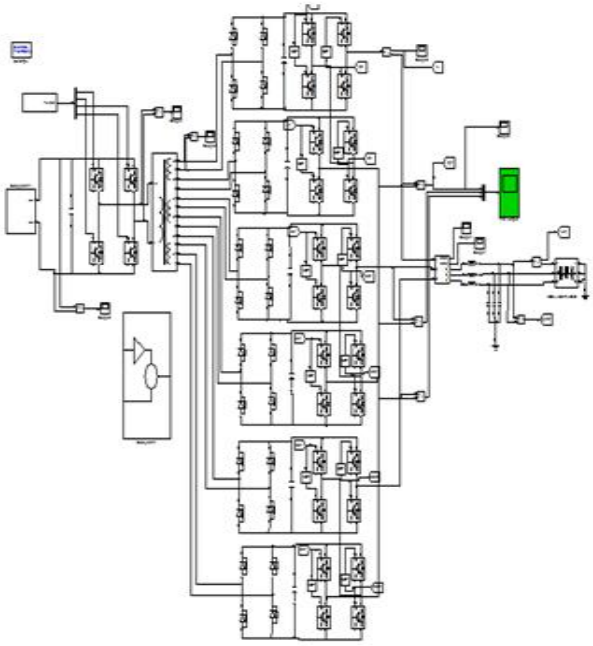
SPWM has demonstrated a higher lessening rate for the abnormal state number.

III.Plan of Medium & High Frequency Link

Toward the start, as per the power converter rating, the transformer-connect details, for example, appraised control, recurrence, excitation current, and voltage, are computed. The center material is chosen by the accessibility, framework prerequisites, and cost. From the particulars of the transformer-connection and information sheets of center materials, the transformer-interface introductory parameters are figured. These parameters are utilized as introductory estimations of the advancement procedure. The volume and weight of the transformer should be improved by choosing legitimate parameters. The winding measurements rely on upon the distance across and number of the conductors, and winding structure. Single layer winding gives low air conditioning/dc resistance proportions; however it builds the winding and center dimension significantly. For simplicity of the winding process, a toroid structure core is considered. Different factors are also considered during the selection of core dimensions, such as the winding dimensions, toroid hole reserve for natural cooling, maximum temperature limits, maximum power loss, availability of core material stripe dimensions, leakage inductance, and the possibility to induce an equal voltage in multiple secondary. Proposed topology is simulated through the reference paper[1].

IV. Matlab Designs & Results

MATLAB (**mat**rix **lab**oratory) is a multi numerical computing environment and fourth-generations programming language. A proprietary programming language developed by MathWorks, MATLAB data allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces. The MATLAB application is built around the MATLAB scripting language.



Current wave forms

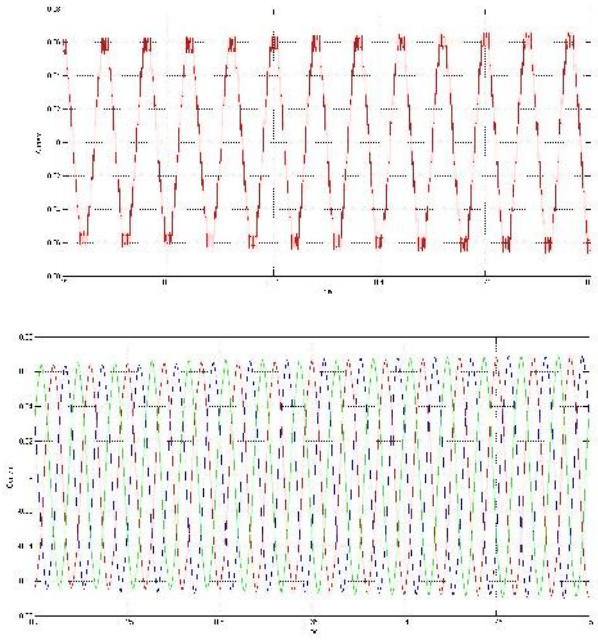


Fig 2 (a) Single Phase Current Wave forms
(b)Three Phase Current Wave forms

Voltage Wave Forms

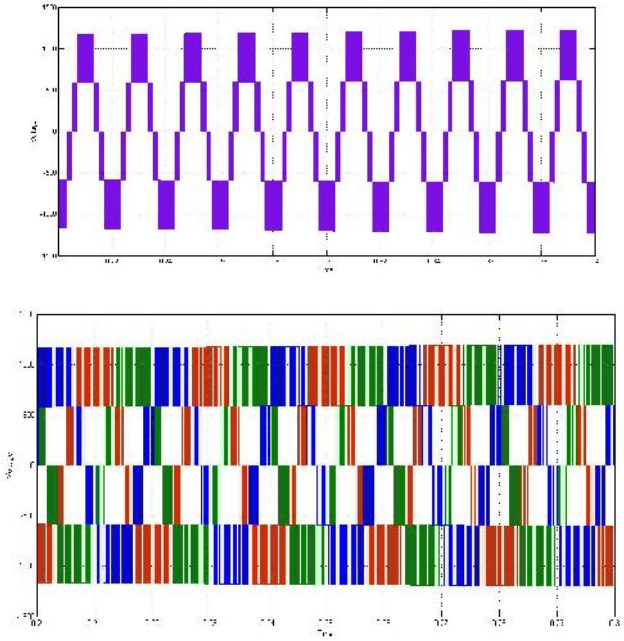


Fig 3 (a) Single Phase voltage Wave forms
(b)Three Phase Voltage Wave forms

Wind Energy THD-Total HarmonicDistortion Wave forms

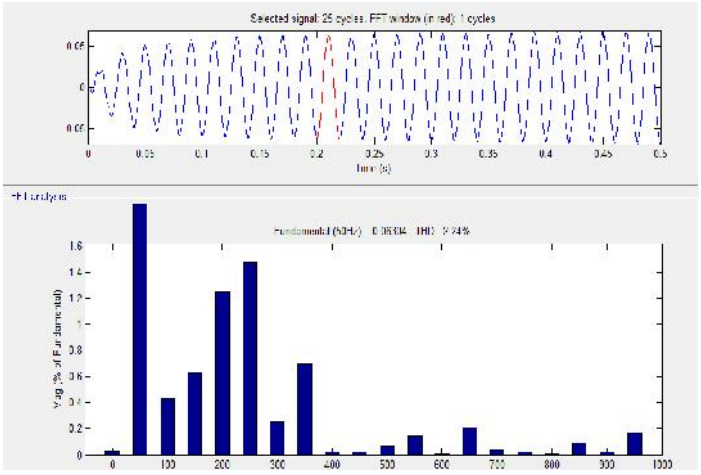


Fig 4 THD for Wind Energy

CONCLUSION

As a proven fact that the multiple secondary winding medium/high-frequency link can be a good solution to provide multiple isolated and balanced dc supplies for the MMC converter and to ensure electrical isolation between grid and renewable generation systems. The modern FPGA-based switching controller may solve the control complexity of the MMC converters. In this, the proposed medium-voltage system has been validated by a scaled down three-phase 1-kV system with a five-level MMC converter topology. The switching scheme and design technique can be used for any other converter with minor modifications in the software environment. All the devices in the proposed system are low- voltage medium power rated, which are mature in terms of technology. The carrier frequency of the multilevel inverter is 1 kHz or lower. Only the medium/high-frequency inverter requires medium/high-frequency switching devices and these are commercially available. For renewable generation systems when compared to PV Cells THD is reduced in Wind energy systems. In order to verify the workability of the proposed system, a modular five-level cascaded converter using wind energy is developed in this project. The results were analyzed in Matlab/Simulink environment R2009a.

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