AN INTERSPERSING CONVERTER FOR RENEWABLE VITALITY AMALGAMATION INTO HYBRID GRIDS

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ABSTRACT— In this works, presents an interlinking structure of converter for sustaining the flexible power as a result of integration of renewable power-based sources into the hybrid grid system. The greatest attribute of the proposed converter has two types ports such as one AC port and two DC ports for maintain the stability. However, the reliable of power quality is difficult to sustain as a result of continuous changes in atmospheric conditions. Hence, in this work, fuel-cell (FC) is utilized to stabilized the changes in hybrid grid system. The system has been designed in the MATLAB/Simulink environment. The simulation results mentioned that the FC-based grid integrated renewable sources system has contributed the finest outcomes for improving the system stability

Keywords: Renewable power, hybrid grid system, converter, fuel-cell, stability.

I.INTRODUCTION To foster sustainable, low-emission development, many countries are establishing ambitious renewable energy targets for their electricity supply. Because solar and wind tend to be more variable and uncertain than conventional sources, meeting these targets will involve changes to power system planning and operations [1]-[3]. Grid integration is the practice of developing efficient ways to deliver variable renewable energy (VRE) to the grid. Good integration methods maximize the cost-effectiveness of incorporating VRE into the power system while maintaining or increasing system stability and reliability [4][5]. In the earlier workmanship research, the spotlight has been put on the power the executives and control of cross breed AC/DC matrices. For occasion, in [6], an outline of half and half microgrids was introduced regarding framework structures, activity modes, power the executives and control. The cross breed microgrid is turning out to be much alluring because of the expansion of current DC loads and RESs with energy stockpiling being coordinated into the framework. In such applications, the interlinking converter is basic (e.g., unwavering quality, reasonability, and steadiness), which empowers incorporating different fuel sources into the matrix. To guarantee the activity, power-sharing methodologies were additionally created for interlinking converters under different situations [6]. In any case, endeavors to create interlinking converters have not been seriously made in the writing, which yet can be a promising intends to upgrade the activity of such crossover energy systems. Unmistakably, the interlinking converter ought to have numerous associations (e.g., DC ports and AC ports). There are two ways to achieve so: using separated standard DC-DC and DC-AC converters to form a multistage on version system [6]and developing stand-alone multiport configurations [7]–[13].Compared to the former solution, standalone hybrid topologies bring more benefits (e.g., increased reliability, higher power density, and lower system cost due to the reduced number of conversion stages), and they possess more flexibility. For instance, the split-source inverters were introduced in [9] and[10] to enhance the compactness, efficiency, flexible power flow and voltageboosting, while the leakage current issue was not considered. This is a troublesome challenge when applied in PV systems. To lower leakage currents, transformer less stand-alone converters [12], [13] can be employed, yet lacking bidirectional power flow capability. Additionally, due to adopting of a dual-buck inverter, large AC filter inductors are required, leading to a relatively low power density that contradicts with the benefits of standalone hybrid converters[12]. In all, the state-of-the-art converters have limitations when being used as an interlinking conversion stage in hybrid AC/DC grids. Hence, in this work, fuel-cell (FC) is utilized to stabilized the changes in hybrid grid ystem. The system has been designed in the MATLAB/Simulink environment. The simulation results mentioned that the FC-based grid integrated renewable sources system has contributed the finest outcomes for improving the system stability.

II. SUGGESTED SYSTEM

A. General Concept The general concept of the proposed interlinking converter architecture for hybrid grids is shown in Fig. 1. As seen in Fig. 1, the converter has two DC ports and one AC port, where the low-voltage DC (DCL) side can be PV panels, batteries or other RESs, and the high-voltage DC (DCH) side can be connected to a DC grid or loads (also storages). Similarly, the AC side can be an AC load or an AC grid. Notably, all the power conversions in the proposed architecture should be bidirectional for high flexibility. To realize so, the following should be considered: 1) The control switch of the boost converter is replaced by a VSI with its common-mode voltage(CMV) being clamped to achieve the AC output; 2) An active switch, i.e., a synchronous rectifier switch, is adopted for the bidirectional DCDC conversion, and accordingly, the hybrid converter can achieve boost or buck conversion between the DCL and the DCH sides; 3) A symmetrical impedance network(SIN) is placed at the DCL side, as exemplified in Fig. 1, which is also essential to lower the leakage currents.

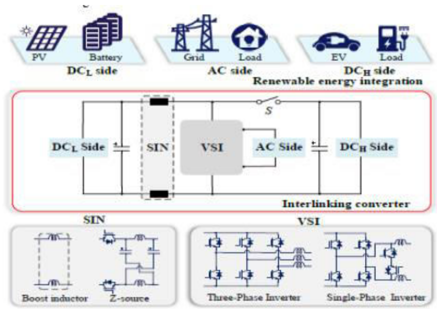

Fig: General concept of the proposed interlinking converter architecture, where S represents an active switch, allowing the bidirectional power flow

In such an architecture, the CMV will be clamped to be half of the DCL voltage by the symmetrically arranged impedance and the VSI. To demonstrate the CMV clamping, the proposed interlinking converter architecture with a single-phase inverter is exemplified as shown in Fig. 2.

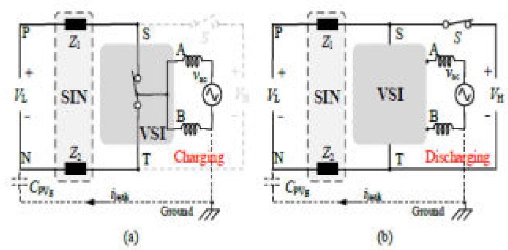

Fig. 2. Operational states of the proposed interlinking converter architecture with a single-phase inverter: (a) charging state and (b) discharging state, whereZ1 and Z2 are the equivalent impedances of the SIN (Z1 = Z2),

OPERATIONAL FLEXIBILITY As shown in Fig. 1, the adoption of the synchronous rectifier switch enables the bidirectional power flow between the DC ports. Furthermore, the VSI can also achieve reactive power injection with a dedicated modulation method, where the power factor can be adjusted between [-1, 1]. In all, the proposed hybrid converter has high flexibility and controllability for RES integration into hybrid grids. As shown in Fig. 3, the flexibility is reflected by the possible operation modes, which include: the power feed-in mode (Mode I), the power feedback mode (Mode II), and the power factor mode (Mode III): (1) In Mode I, the DCL side is a source (e.g., PV panels) to provide power to the DCH side, the AC side or both. In this case, the converter achieves the boost DC-DC conversion and DC-AC conversion from the DCL side to the DCH and the AC sides, respectively. Additionally, in this mode, both the DC Land the DCH/AC sides can feed power into the AC/DCH side. (2) In Mode II, there are three operation cases. Firstly, the power from the AC side is fed back to the DCL and DC H sides (i.e., the two DC ports are loads), where the converter operates in the active rectification for the DCH side and the buck DC-DC conversion for the DCL side from the AC side. Secondly, the power feed-back mode is the case where only the DCL side is working as a load (e.g., charging batteries). That is, both the DCH and AC sides are providing power. Thirdly, both the DCL and the AC sides are acting as loads, where the DCH side should perform the buck DC-DC and the DC-AC conversions, respectively. (3) In Mode III, whatever power flow modes between the DCL and DCH sides are, the power factor at the AC side should be controlled flexibly to enable grid-connected applications. The proposed converter architecture can achieve

SIMULATION RESULTS

The simulation diagram of an interlinking converter is modeled in the MATLAB/SIMULINK environment.

The simulation diagram of an interlinking converter operating in Mode I is as shown in figure

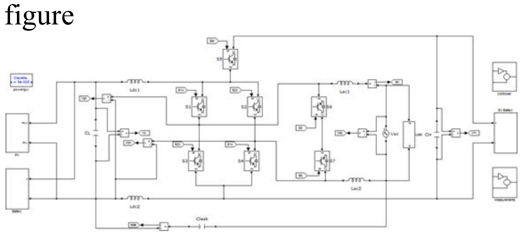

Fig Simulation diagram of an interlinking converter operating in Mode I

The performance of the proposed converter in Mode I is shown in figure 7.2, where the DCL side provides power to the DCH side and the AC output. As shown in figure 7.2, the proposed converter architecture can provide an AC and DC outputs simultaneously. In addition, both DC voltages have ripples in figure 7.2 due to the power coupling and also the characteristics of the commercial DC source(i.e., having an internal resistance and a large output capacitor). The power decoupling strategies for the conventional VSI may also be applied to alleviate this.

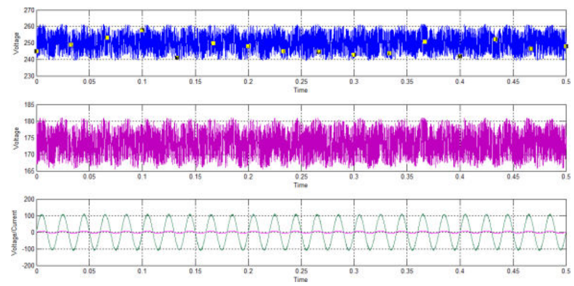

Fig Performance of the proposed interlinking converter operating in Mode I

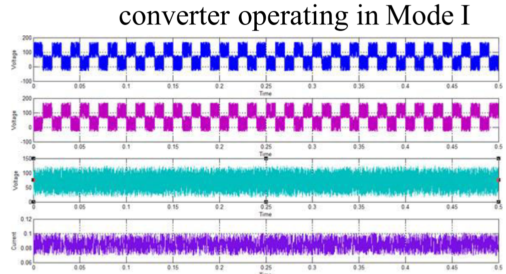

Fig Performance of the proposed interlinking converter operating in Mode I, where v_{AN} and v_{BN} are the voltage of the terminals A and B to N respectively, and v_{cm} and i_{leak} are the leakage current.

Fig. demonstrates the CMV and leakage currents of theproposed converter for PV applications. The leakage current i_{leak} is below the limit (i.e., the VDE 0126)[12]. Additionally, it is illustrated by the inverter voltage v_{AN} and v_{BN} in Fig. 7.3 that the adopted modulation method canachieve the same performance as the HERIC with the unipolarPWM.Thus, the proposed converter can maintain low leakagecurrents and good power quality.

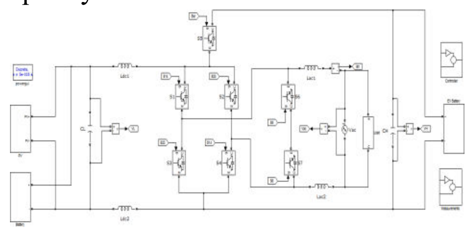

Fig Simulation diagram of an interlinking converter under load step changes at the AC side in Mode I

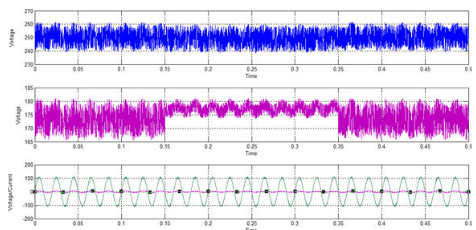

Fig Performance of the proposed interlinking converter under load step changes at the AC sidein mode I

Moreover, the dynamic performance of the converter inMode I has been tested under an AC load change. As shownin Fig. 7.5, the grid current amplitude (RMS) was changed to2.5 A and then back to 5 A. The experimental results indicatethat the proposed converter can operate stably under dynamic load changes. More importantly, due to the separated controlof the DC-DC and DC-AC conversions, the current quality isnot affected by the load changes.

To further validate the performance of the proposed converter,experimental tests in Mode III are carried out and theresults are shown in Fig. 9, where the DC-AC conversionoperates under a non-unity power factor. Observations inFig. 9 indicate that the proposed converter can provide flexiblereactive power injection, which may be beneficial to the entire system operation.

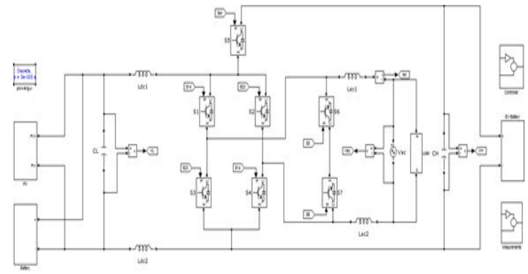

Fig 7.6: Simulation diagram of an interlinking converter operating in Mode III

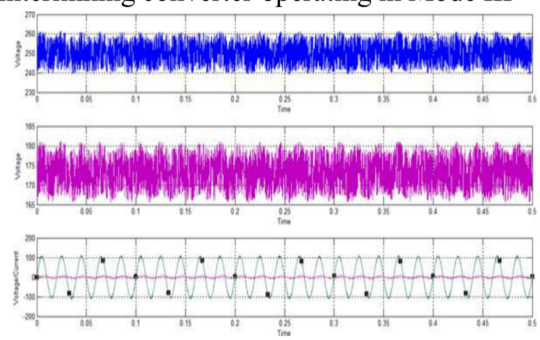

Fig Performance of the proposed interlinking converter operating in Mode III, where iAC islagging vAC

In all, the above results have verified that the proposedconverter can achieve flexible operation. With the dedicatedmodulation scheme, the proposed interlinking converter canobtain good power quality and high efficiency. Besides, whenthe DCL side employs PV panels, it can achieve low leakagecurrents. Thus, the proposed interlinking conversion architecture provides a flexible, secure and reliable solution for future hybrid AC/DC grids with the integration of various RESs.

CONCLUSION

In this study, an interlinking type converter is utilized to ensure the grid stability for incorporating the various renewable sources. The suggested control structure is designed with various new power devices in boost converter for an active switch in VSI converter. The privileges of interlinking converter can be rendered the reliable power, good efficiency, reduce the leakage current, and sustain the flexible power. Moreover, fuel-cell is implemented in the proposed system for overcoming the difficulties in the grid system at different nonlinearities. As per the simulation outcomes, the proposed FC-based system enhances the grid stability while integration of high penetration of renewable sources.

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