A GRID CONNECTED HYBRID SYSTEM WITH MULTI-INPUTTRANSFORMER COUPLED BIDIRECTIONAL DC-DC CONVERTER

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Abstract

In this paper, a control strategy for power flow management of a grid-connected hybrid PV-wind-battery based system with a capable multi-input transformer coupled bidirectional dc-dc converter is shown. The proposed structure intends to satisfy the store demand, manage the power flow from different sources, inject surplus power into the grid and charge the battery from grid as and when required. A transformer coupled lift half-associate converter is used to saddle power from wind, while bidirectional buck-help converter is used to handle power from PV nearby battery charging/discharging control. A single-phase full-associate bidirectional converter is used for supporting cooling weights and cooperation with grid. The proposed converter building has diminished number of power conversion stages with less part count, and reduced losses stood out from existing grid-connected hybrid systems.

I. INTRODUCTION

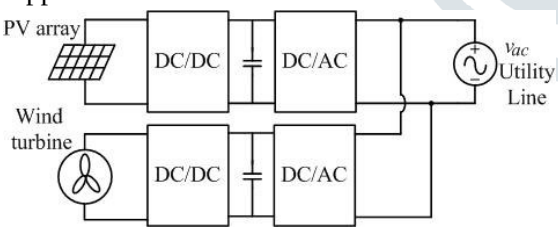
Fast depletion of petroleum product saves, regularly expanding energy request and worries over environmental change persuade power age from renewable energy sources. Sunlight based photovoltaic (PV) and wind have risen as well known energy sources due to their eco-accommodating nature and cost viability. Be that as it may, these sources are discontinuous in nature. Henceforth, it is a test to supply steady and constant power utilizing these sources. This can be tended to by effectively coordinating with energy stockpiling components. The intriguing corresponding conduct of sun powered insolation and wind speed design combined with the previously mentioned preferences, has prompted the examination on their reconciliation bringing about the hybrid PV-wind systems. For accomplishing the coordination of numerous renewable sources, the customary methodology includes utilizing committed single-input converters one for each source, which are connected to a typical dc-transport [1] - [15]. Be that as it may, these converters are not adequately used, because of the discontinuous idea of the renewable sources. What's more, there are numerous power conversion stages which diminish the productivity of the system. Huge measure of writing exists on the combination of sun oriented and wind energy as a hybrid energy age system with spotlight predominantly on its estimating and streamlining [7], [8]. In [7], the estimating of generators in a hybrid system is explored. In this system, the sources and capacity are interfaced at the dclink, through their committed converters. Different commitments are made on their displaying viewpoints and control procedures for a stand-alone hybrid energy system in [9] - [15]. Dynamic execution of a stand-alone hybrid PV-wind system with battery stockpiling is investigated in [9]. In [14], a lack of involvement/sliding mode control is exhibited which controls the activity of wind energy system to supplement the sunlight based energy producing system. Relatively few endeavors are made to enhance the circuit setup of these systems that could diminish the expense and increment the productivity and unwavering quality. In [16] - [19], coordinated converters for PV and wind energy systems are displayed. PV-wind hybrid system, proposed by Daniel et al. [16], has a straightforward power topology however it is appropriate for stand-alone applications. A coordinated four-port topology dependent on hybrid PV-wind system is proposed in [18]. Nonetheless, in spite of basic topology the control plot utilized is mind boggling. In [19], to sustain the dc stacks, a low limit multi-port converter for a hybrid system is introduced.

II.EXISTING SYSTEMS

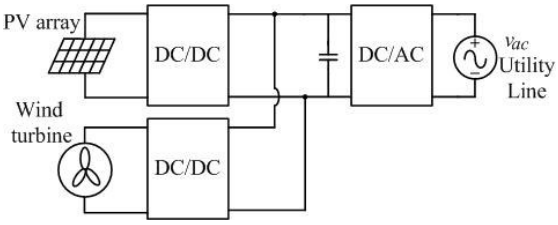
Hybrid PV-wind based generation of power and its interface with the power grid are the significant research territories. Chen et al. in [20], [21] have proposed a multi-input hybrid PV-wind power age system which has a buck/buckboost combined multi-input dc-dc converter and a full-connect dcac inverter. This system is primarily centered around improving the dc-connect voltage guideline. In the six-arm converter topology proposed by H. C. Chiang et al. [22], the

yields of a PV cluster and wind generators are bolstered to a lift converter to coordinate the dc-transport voltage. The relentless state execution of a grid connected hybrid PV and wind system with battery stockpiling is dissected in [4]. This paper centers around system building, for example, energy generation, system dependability, unit measuring, and cost examination.

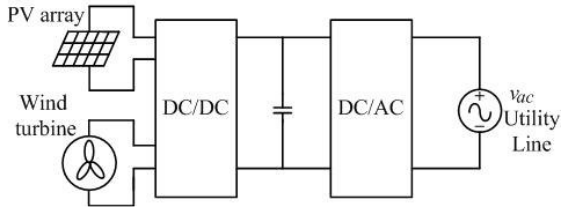
Diverse circuit topologies for the grid-connected hybrid PV/Wind power system are appeared in Fig. 1. Since the yield voltage of the PV exhibit is not the same as the one of the breeze turbine and the most extreme power point following (MPPT) highlight is requested, a dc/dc converter and a dc/air conditioning inverter are required for the PV/Wind power system. Fig. 1(a) demonstrates an air conditioner shunted grid-connected hybrid PV/Wind power system utilizing two individual dc/dc/air conditioning converters. Every single one of them is skilled to convey the most extreme power delivered by the PV exhibit or the breeze turbine. Notwithstanding, in view of the correlative property of the sun based energy and the breeze energy, the circuit topology appeared in Fig 1(a) can be decreased as the one appeared in Fig. 1(b) where the two dc/dc converters are shunted at the dc transport. The power rating of the dc/air conditioning inverter for the dc-shunted grid-connected power system is not exactly the complete power appraisals of the two individual dc/air conditioning inverters. It can lessen the size and the expense of the power system. By the by, the circuit topology appeared in Fig. 1(b) can be additionally streamlined as the one appeared in Fig. 1(c), where a multi-input dc/dc converter is utilized to supplant the two individual dc/dc converters.



(a) The ac-shunted grid-connected hybrid PV/Wind power system



b) The dc-shunted grid-connected hybrid PV/Wind power system.



(c) The multi-input grid-connected hybrid PV/Wind power system.

Fig. 1 Different circuit topologies for the grid-connected hybrid PV/Windpower system

III.PROPOSED SYSTEM

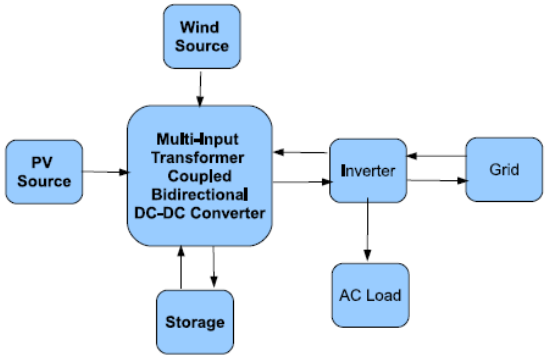


Fig. 2. Grid-connected hybrid PV-wind-battery based system for household applications.

The proposed system has two renewable power sources, burden, grid and battery. Subsequently, a power flow management system is fundamental to adjust the power flow among every one of these sources. The primary targets of this system are as per the following:

• To investigate a multi-target control plot for ideal charging of the battery utilizing different sources.

• Supplying un-interruptible power to loads.

• Ensuring departure of surplus power from renewable sources to the grid, and charging the battery from grid as and when required.

The grid-connected hybrid PV-wind-battery based system for family applications is appeared in Fig. 1, which can work either in stand-alone or grid connected mode. This system is appropriate for family unit applications, where an ease, basic and reduced topology fit for independent activity is alluring. The center of the proposed system is the multiinput transformer coupled bidirectional dc-dc converter that interconnects different power sources and the capacity component.

Further, a control plot for viable power flow management to give continuous power supply to the heaps, while infusing abundance power into the grid is proposed. Along these lines, the proposed setup and control plot give a rich reconciliation of PV and wind energy source. It has the accompanying points of interest:

• MPP following of both the sources, battery charging control and bidirectional power flow are practiced with six controllable switches.

• The voltage boosting capacity is practiced by associating PV and battery in arrangement which is additionally improved by a high recurrence venture up transformer.

• Improved use factor of the power converter, since the utilization of committed converters for guaranteeing MPP task of both the sources is dispensed with.

• Galvanic separation between info sources and the heap.

• The proposed controller can work in various methods of a grid-connected plan guaranteeing legitimate working mode choice and smooth progress between various conceivable working modes.

• Enhancement in the battery charging effectiveness as a single converter is available in the battery charging way from the PV source.

The proposed converter comprises of a transformer coupled lift double half-connect bidirectional converter intertwined with bidirectional buck-help converter and a single-phase full-connect inverter. The proposed converter has decreased number of power conversion stages with less segment check and high productivity contrasted with the current grid-connected plans. The topology is basic and needs just six power switches.

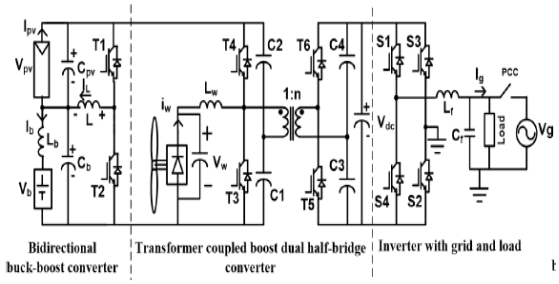


Fig 3. Proposed converter configuration

A. PROPOSED CONTROL SCHEME FOR POWER FLOW MANAGEMENT

A grid-connected hybrid PV-wind-battery based system consisting of four power sources (grid, PV, wind source and battery) and three power sinks (grid, battery and load), requires a control scheme for power flow management to balance the power flow among these sources. The control philosophy for power flow management of the multi-source system is developed based on the power balance principle. In the stand-alone case, PV and wind source generate their corresponding MPP power and load takes the required power. In this case, the power balance is achieved by charging the battery until it reaches its maximum charging current limit Ibmax. Upon reaching this limit, to ensure power balance, one of the sources or both have to deviate from their MPP power based on the load demand. In the grid-connected system both the sources always operate at their MPP. In the absence of both the sources, the power is drawn from the grid to charge the battery as and when required.

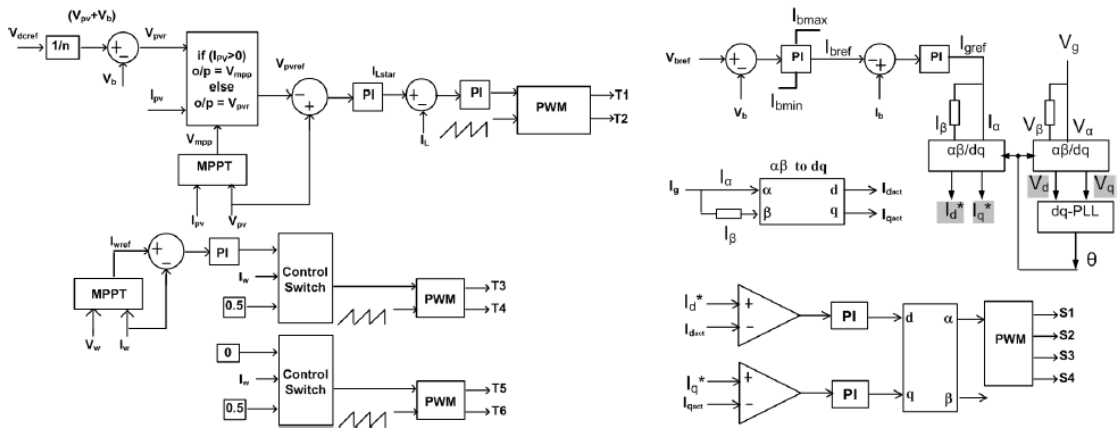
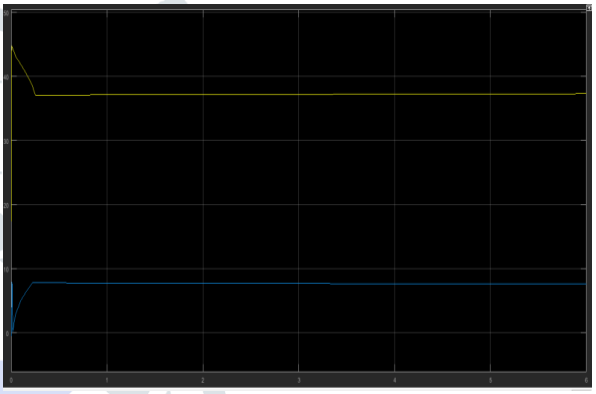
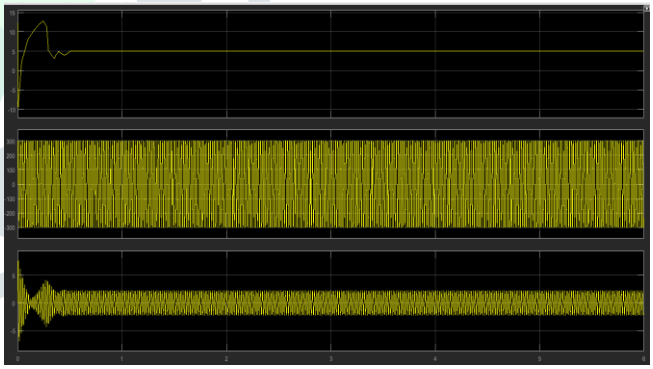


Fig. 3. Proposed control scheme for power flow management of a grid-connected hybrid PV-wind-battery based system



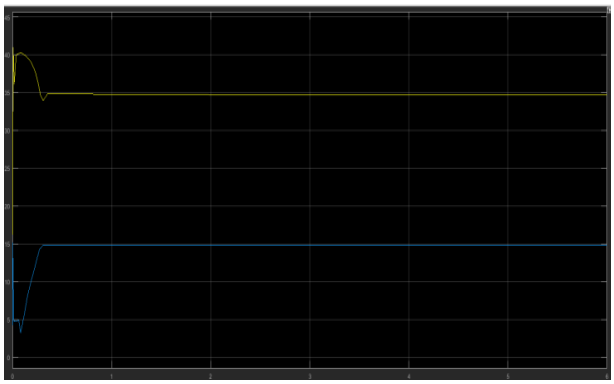
(b) Wind voltage and current



(c) Battery current, Grid voltage and Current

Fig. 4.Steady state operation in MPPT mode.

IV. SIMULATION RESULTS AND DISCUSSION



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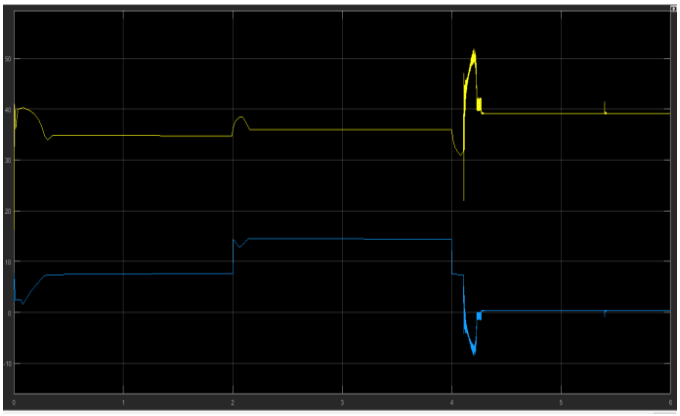

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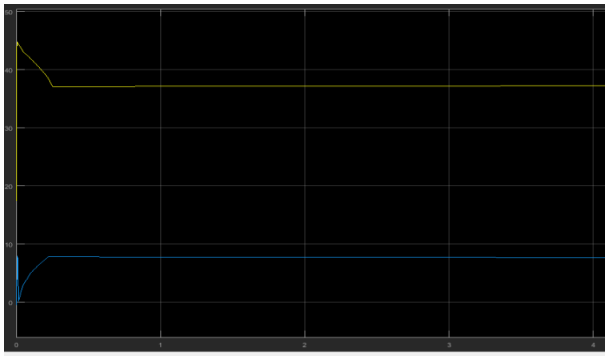

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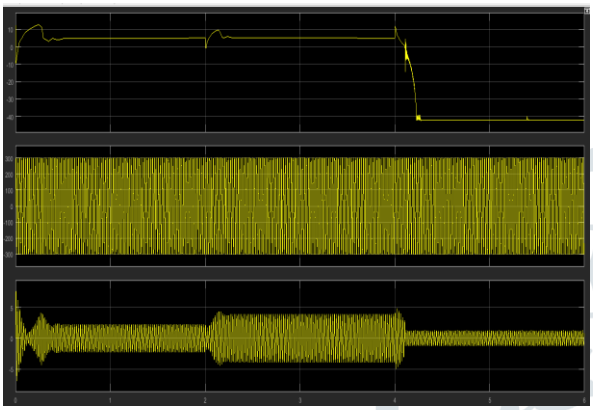
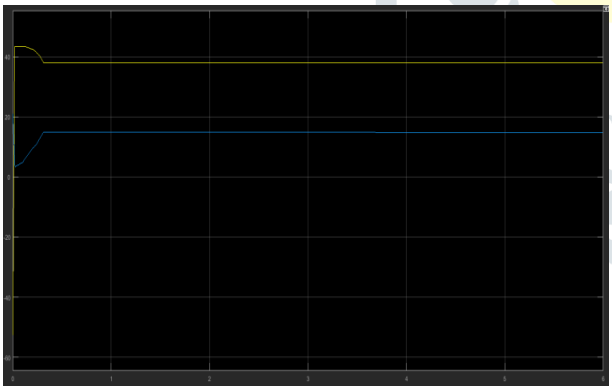
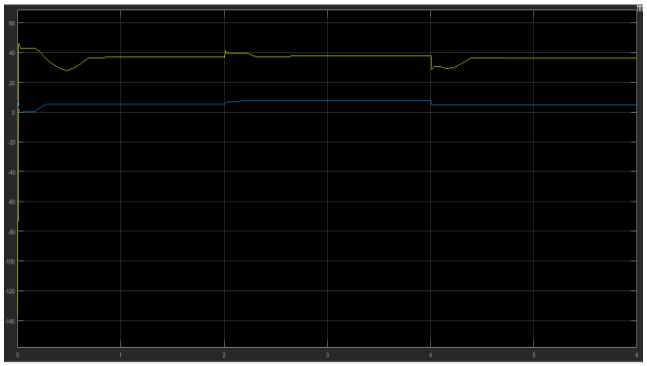


c.Battery current, Grid voltage and Current

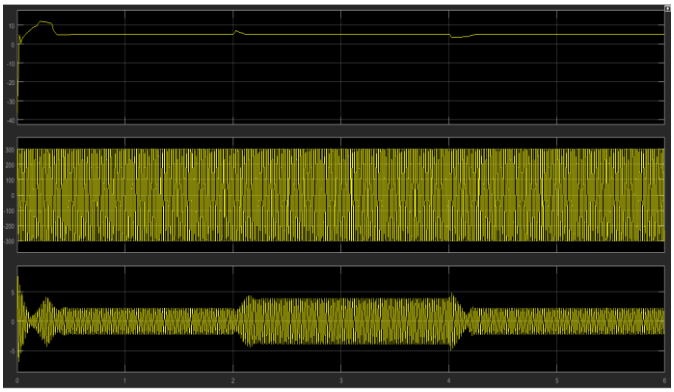
Fig. 5. Response of the system for changes in insulation level of source-1 (PV source) during operation in MPPT mode.



a.PV voltage and current

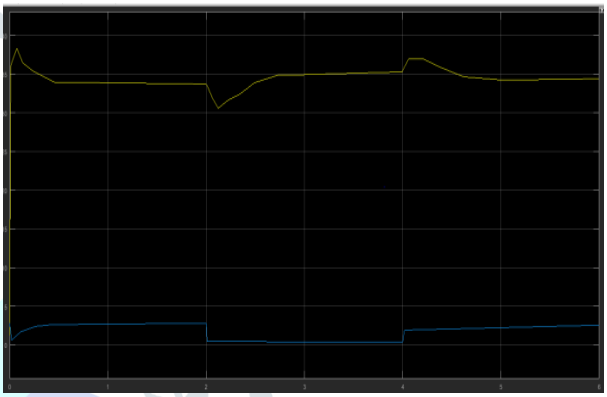


b.Wind voltage and current

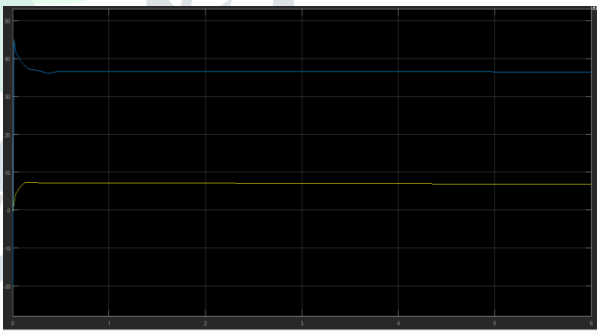


c.Battery current, Grid voltage and Current

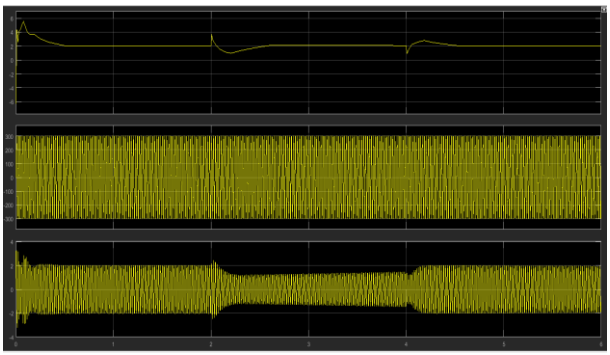
Fig. 6. Response of the system for changes in wind speed level of source-2 (wind source) during operation in MPPT mode



a.PV voltage and current



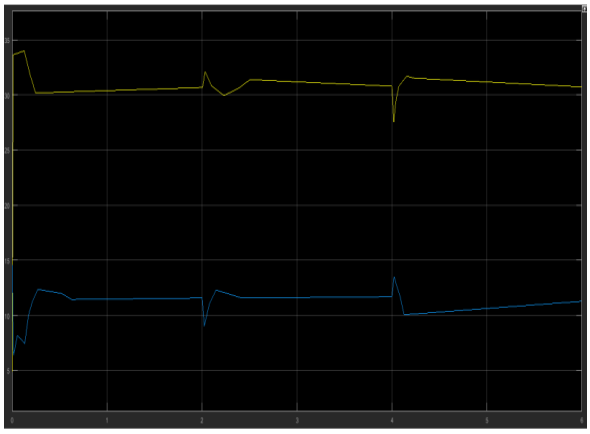
b.Wind voltage and current



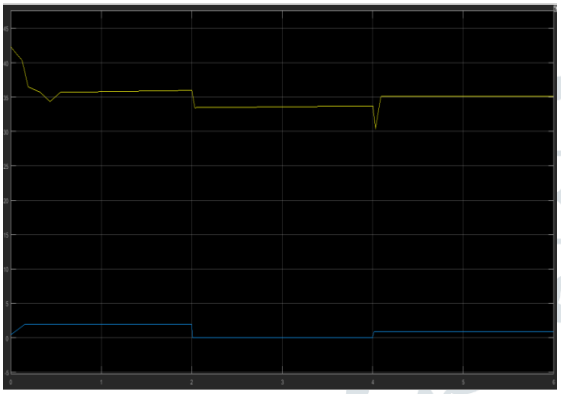
c.Battery current, Grid voltage and Current

Fig. 6.Response of the system in the absence of source-1 (PV source) while

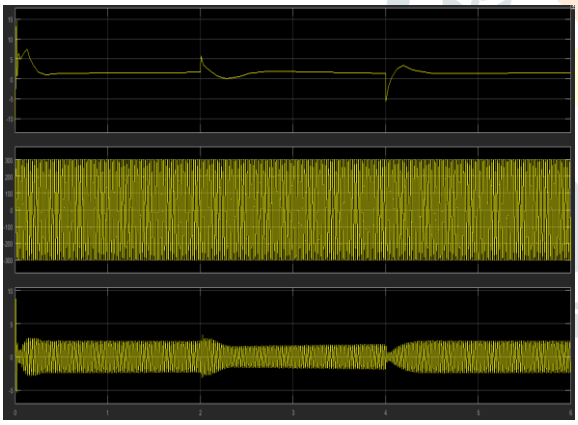
source-2 continues to operate at MPPT.



a. PV voltage and current



b.Wind voltage and current



c.Battery current, Grid voltage and Current

Fig. 7. Response of the system in the absence of source-2 (wind source)while source-1 continues to operate at MPPT.

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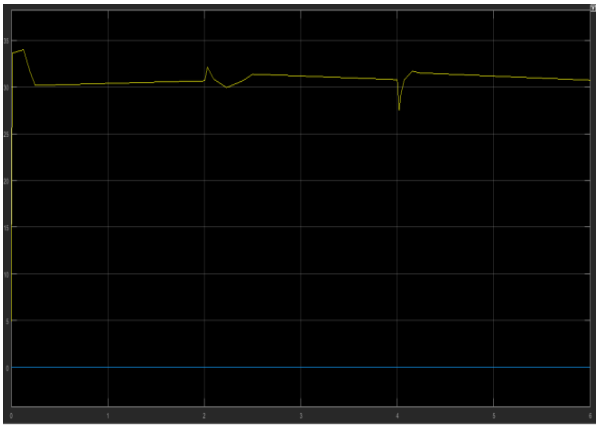
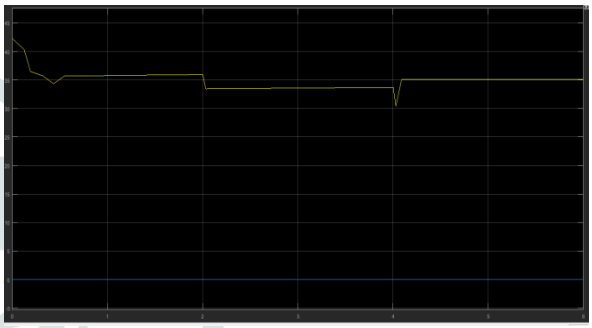
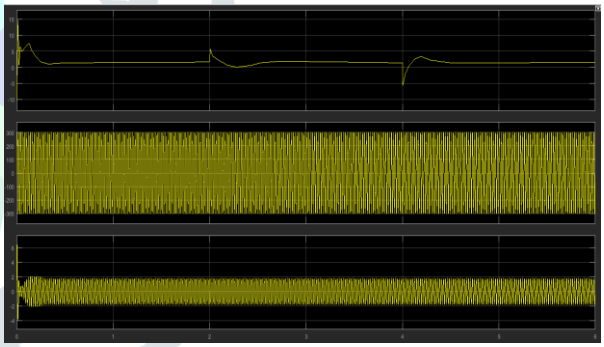


a. PV voltage and current



b. Wind voltage and current



c. Battery current, Grid voltage and Current

Fig. 8. Response of the system in the absence of both the sources and charging the battery from grid.

V. CONCLUSION

A grid-connected hybrid PV-wind-battery based power clearing plan for household application is proposed. The proposed hybrid system gives an exquisite joining of PV and wind source to separate most extreme energy from the two sources. It is acknowledged by a novel multi-input transformer coupled bidirectional dc-dc converter pursued by a traditional full-connect inverter. A flexible control strategy which accomplishes better use of PV, wind power, battery limits without affecting existence of battery and power flow management in a grid-connected hybrid PV-wind-battery based system sustaining air conditioning loads is introduced. The

proposed setup is fit for providing un-interruptible power to AC loads, and guarantees departure of surplus PV and wind power into the grid.

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