Design of Reboost converter with Induction Motor Drive for Solar PV System

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Abstract

A boost converter (BC) and a re-boost converter (RBC) are Introduced for a solar photovoltaic (SPV) array fed water pumping system driven by an induction motor(IM). To compare proposed boost – Re Boost converter fed IM drive to existing systems a Buck Boost converter with suitable voltage control, DC-DC boost and buck converters are used. The BS converter combines the benefits of BC andRBC, and it emerges as an intriguing solution to problems associated with these converters in SPV applications. RBC have good switch utilization, high efficiency, RBC for open loop speed regulation based water pumping system under varying atmospheric conditions.open loop results are compared with different filter performances

Keywords:RBC,BC, solar photovoltaic (SPV) array, Induction motor drive(IM), Effective utilization of switches**.**

1.INTRODUCTION

Solar photovoltaic (SPV) energy has many benefits. In rural places and water pumping(WP) is a cost-effective use of SPV energy. A three-phase IM is used in SPV exhibit for water pumps for water system and local needs due of its appropriateness for contaminated and disconnected zones, minimal effort, consistent quality, and low support necessary. [1]-[4]. Due to the proximity of the brushes and commutator, DC motors are not recommended for water pumping. The difficult regulation of an IM and the increased efficiency of a permanent magnet synchronous motor (PMSM) have encouraged experts to employ a PMSM drive for a powerful submersible water pumping system. [5]-[10]. Several efforts have been made to pump SPV-fed water using a SyRM.It can run satisfactorily for a limited solar insolation range. An exchanging switched reluctance motor (SRM) has not gotten much attention for SPV continuous WP till recently, likely due to large torque swell and acoustic commotion[11]. In [12], SRM is utilized in an SPV-based WP system, ensuring satisfactory performance under dynamic situations. The BB converter combines the benefits of BB converters and solves SPV difficulties. The BB converter offers good switch utilization, high efficiency, and non-inverting output voltage. This research examines the startup, dynamic, and steady-state performance of an induction motor with a BB converter for SPV-based water pumping. Cascaded DC-DC boost and buck converters provide a BB converter with proper voltage management (MPPT). A DC-DC buck converter has not been employed in SPV array-fed water pumping yet; employing this converter demands a big, expensive information capacitor to get a swell free information current [13]. BB Converters have high switch use, high proficiency, non-changing information and yield voltage, and low weight[14]. -[20] Front phase of two-array SPV grid-connected inverter uses two-switch buck-support converter. A buck converter precedes a boost converter in this two-way switch buck-help converter. Setting the boost converter before the buck converter gives an SPV-fed IM driven water pump more focal points. The positioning of the boost converter at the front end of the buck converter and SPV yield makes the information current permanent.

2.PROPOSED SYSTEM

New system consists of BC and RBC system with IM Drive is shown in Fig 1.Detailed diagram is mentioned in Fig 2.

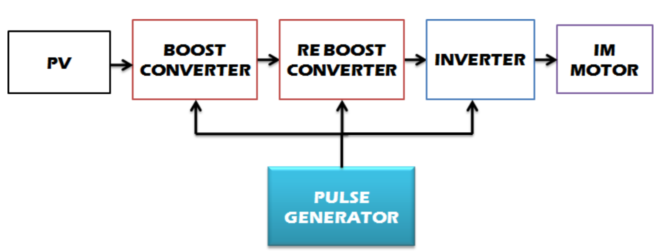

Fig 1 Block System

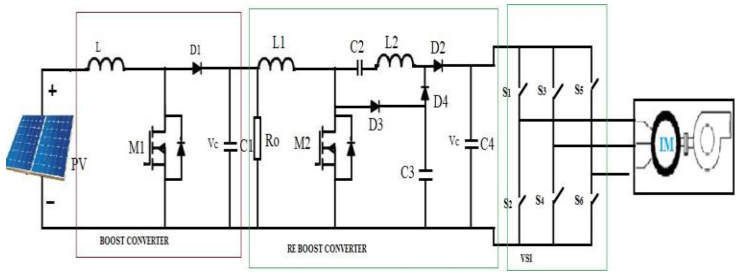

Fig 2.BC and RBC with IM Drive

The switches indicate the converter's two modes: synchronised and joined. If both switches are in the same position, the converter will be synchronised. I In consolidated control mode, a converter is controlled by one switch. Independent and controllable switches.. When sw_2 is turned off and L_1 is turned on, IL1 rises. IL_2 decreases as L_2 exchanges stored energy with the load, vd_1 decreases as C_1 is disconnected from the circuit and its release rate decreases; and when both switches are off, synchronised control mode is established. L_1 transfers energy to C_1. As L_2 exchanges energy with the load, iL_1 and iL_2decrease and vdc1 increases. Vd_2 has a similar range of variation for all possible combinations of sw1 and sw_2. Vd1 rises when L_1 and C_1 are synchronised. When sw1 is on but sw_2 is off, C1 release decreases. $V_{so}$is the SPV Voltage

$$V_{d1} = \frac{1}{1-\Delta 1} V_{so} \text{ ....(1)}$$

$$V_{d1} = \frac{1}{\Delta 2} V_{d2} \text{ ....(2)}$$

$$\frac{V_{d2}}{V_{d1}} = \frac{\Delta 2}{1-\Delta 1} \text{................(3)}$$

The SPV array is designed using the formula 4,5,6. The maximum current of the SPV array is determined by the array's power and voltage.

$$I_m = \frac{P_m}{V_m} \quad \text{........} \quad (4)$$

$$N_{ms} = \frac{V_m}{V_{in}} \text{..........} \quad (5)$$

$$N_{mp} = \frac{I_m}{I_{in}} \text{........} \quad (6)$$

The voltages of the converter were used to calculate $\Delta_1$and Δ_2. As Vp = Vm, Vmpp appears as the boost converter's input voltage. $\Delta_1 and\ \Delta_2$were calculated using the formula 7,8 respectively.

$$\Delta_1 = \frac{V_{d1-Vso}}{V_{d1}} \text{......(7)}$$

$$\Delta_2 = \frac{V_{d2}}{V_{d1}} \text{............(8)}$$

3. SIMULATION RESULTS

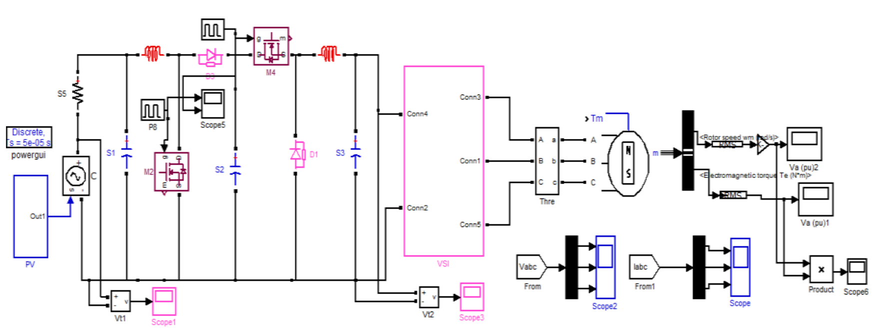

Fig 3.BB converterwith PMBLDC

Open loop diagram for BB Converter with PMBLDC is shown in fig 3. TheI/P voltage is shown in fig 4 and it is is 30V. Voltage across BB converteris shown in fig 5 anditis 64V.Ripple Voltage across boost and buckconverter is presented in fig 6 and its value is 2.3V.

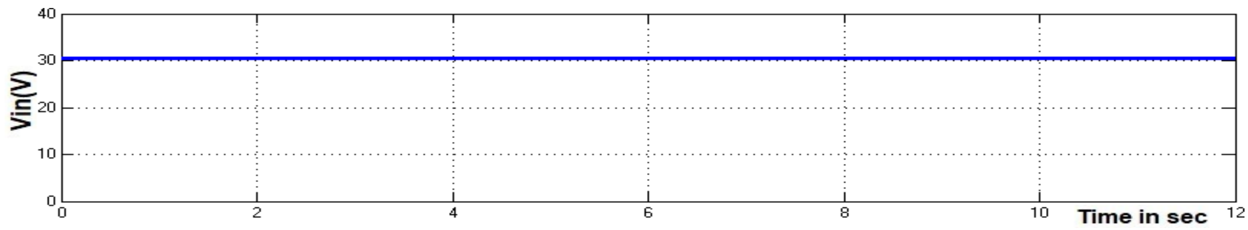

Fig4. I/P voltage

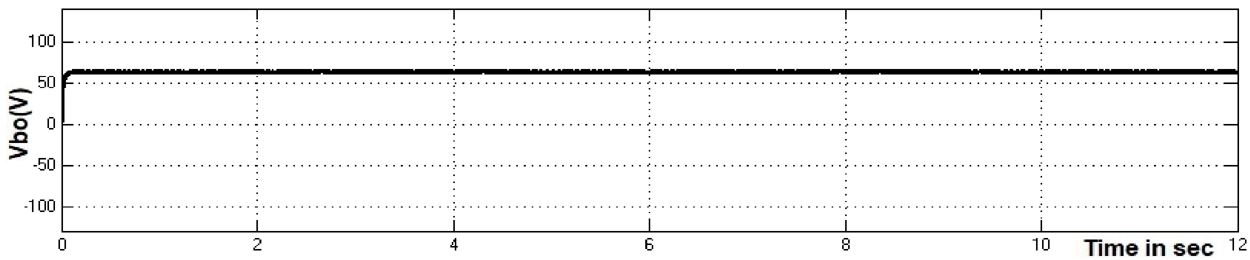

Fig 5.VoltageacrossBB converter

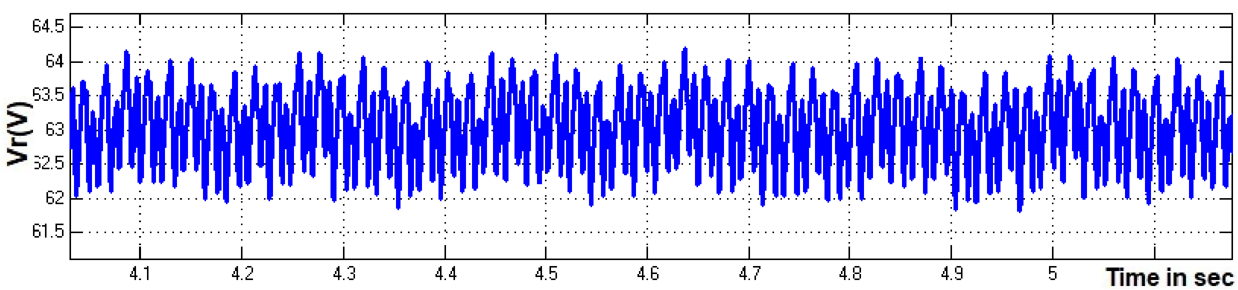

Fig 6. Ripple Voltage across BB converter

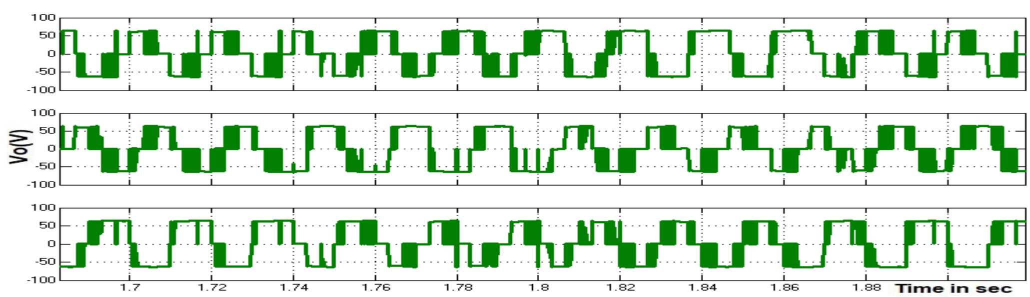

Fig7O/Pvoltageacrossinverter

Output voltage across inverter is shown in fig 7 and its value is 54V. Motor speed isshown in fig 8 and its value is 500rpm. Motor Torque is shown in fig 9 and its value is 1Nm.Mechanicaloutputpowerisshowninfig10and its power is 500 w.

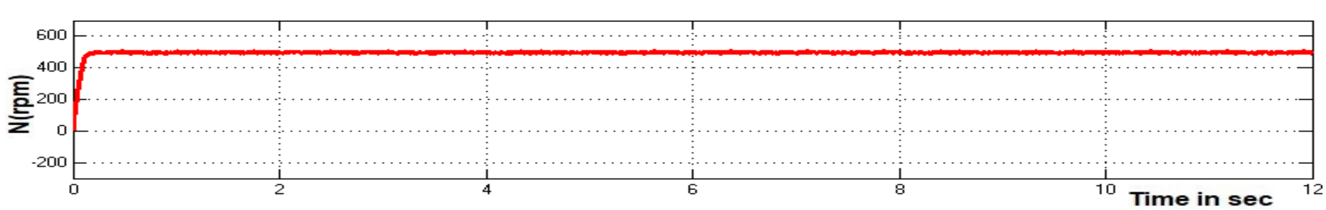

Fig8Motorspeed

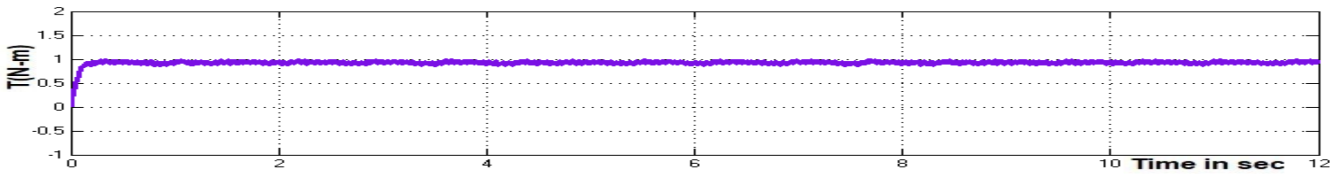

Fig 9MotorTorque

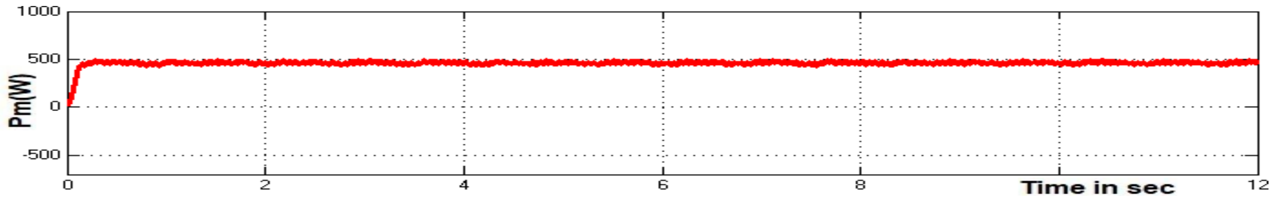

Fig 10. Mechanical output power

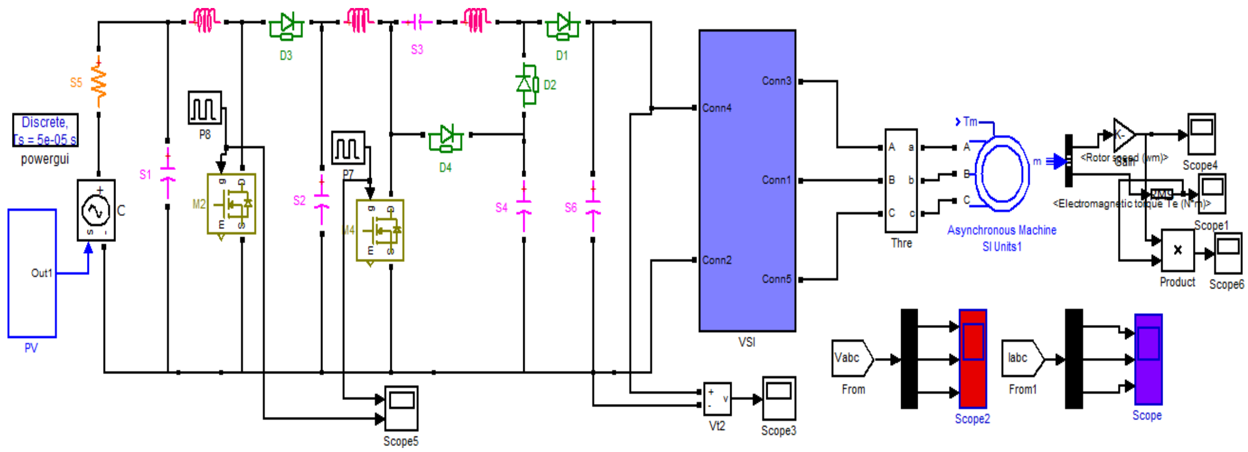

Fig.11 BC and RBC with IM drive

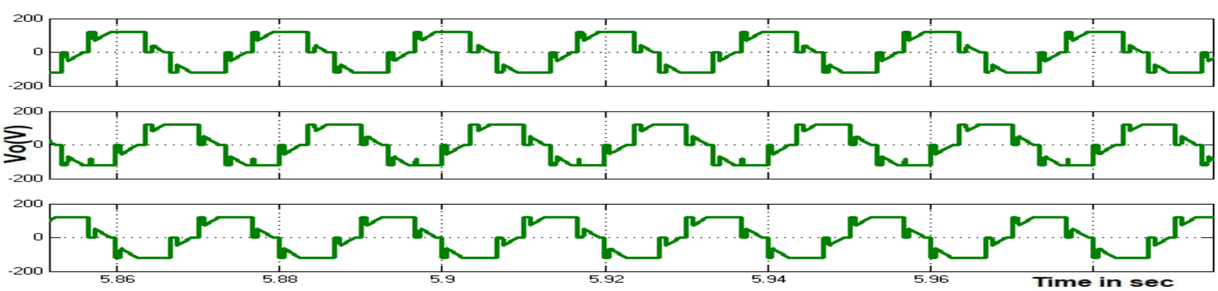

Fig 12. O/P voltage across inverter

Circuit diagram for boost and Re boost converter with IM drive is shown in Fig 11.Output voltage across inverter is shown in fig 12. and its value is 120V. Output currentthrough inverter is shown in fig 13 and its value is 9A. Motor speed is shown in fig 14 and itsvalue is 1000rpm. Motor Torque is shown in fig 15 and its value is 0.9Nm. Mechanical outputpoweris shown infig16anditsvalueis860W.

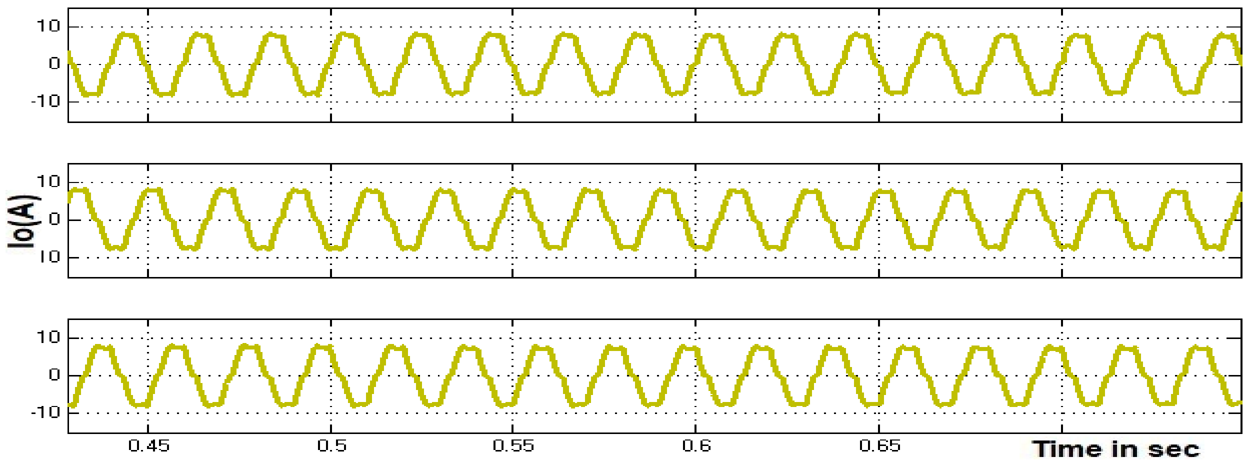

Fig13.O/Pcurrentthroughinverter

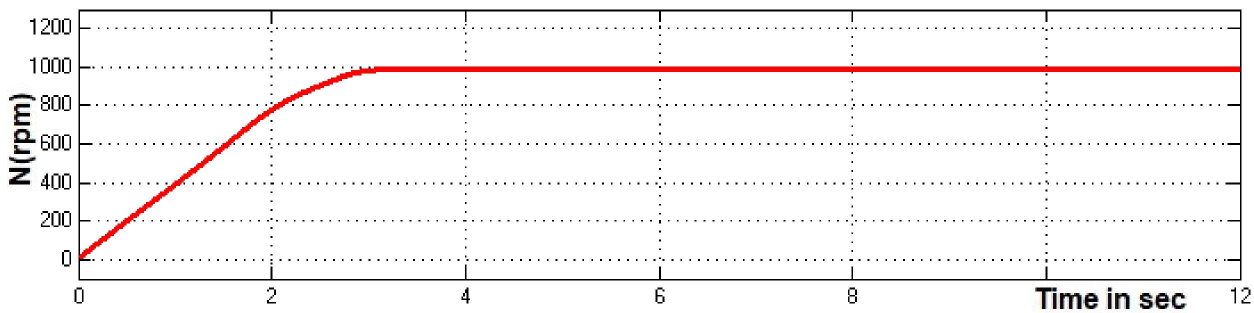

Fig 14 Motor speed

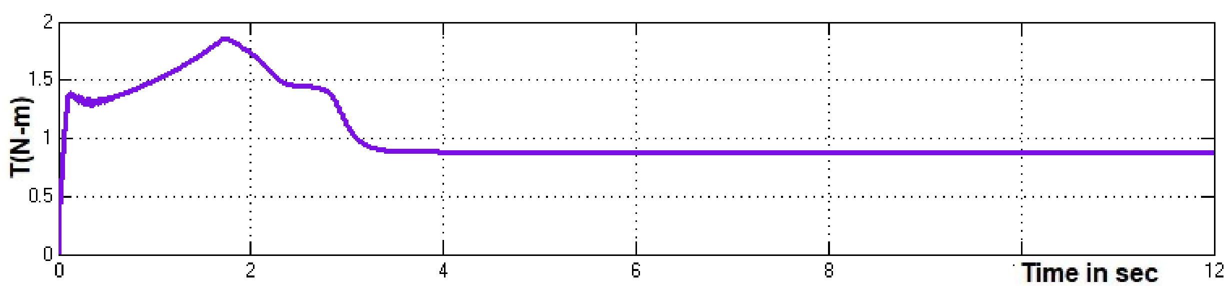

Fig 15. Motor Torque

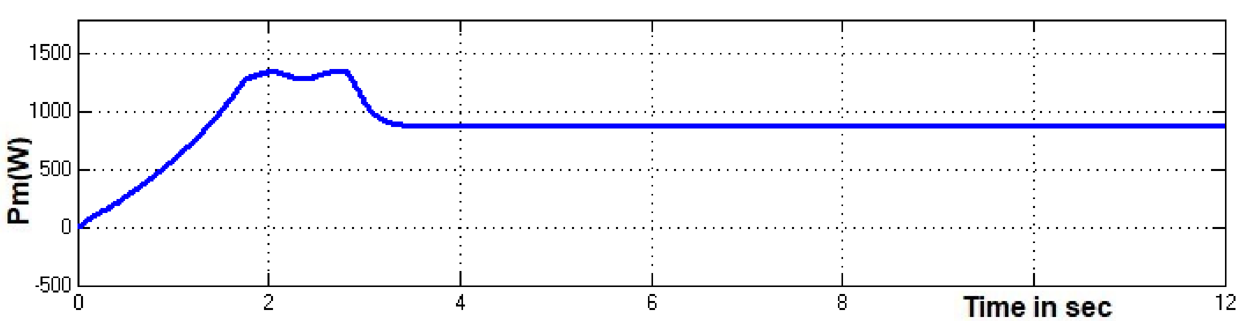

Fig 16. Mechanical output power

Table:1ComparisonofConverter Parameters

	Vo(V)	Vor(V)	N(rpm)	Pm(W)
Boost-Buckconverter	64	2.3	500	**500**
Boost-RebootstConverter	**120**	**0.20**	**1000**	**860**

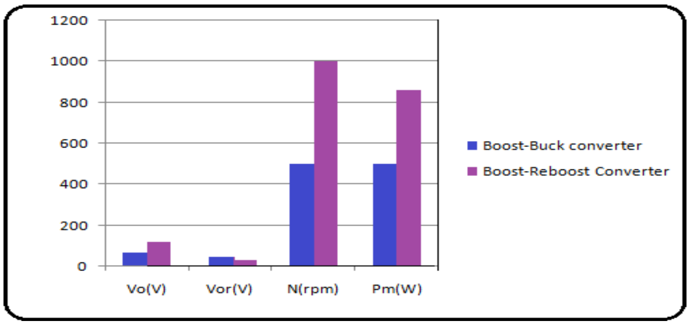

Fig.18.Barchartcomparison ofO/Pvoltage,motorspeed andMechanicalPower

4.CONCLUSION

Table compares the output voltage, motor speed, and mechanical power of PV with three-phase inverter for the existing and proposed systems.. Comparing output voltage, motor speed and mechanical power with a three-phase inverter for the existing and proposed systems is shown in Fig.18. Improvements in output voltage, ripple voltage, motor speed, and mechanical power have been made in the boost and reboost converters, which now output 120 volts and a voltage ripple of just 0.2 volts, respectively. Boost and Re-boost converter systems, on the other hand, are superior in terms of performance.

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