Chapter 7

Conclusion and Future Scope

7.1 Conclusion

An investigation of the challenges posed by the characteristics of the photovoltaic and wind power generation system is presented, and solutions from the perspective of power electronic converters are provided. The requisite of a low voltage and ripple-free operation for photovoltaic generation and elimination of DBR and direct drive turbines in WECS are specifically dealt with in this thesis. The HECS fed by photovoltaic and WECS are designed with BESS control and single-phase grid control. The stability and transient responses are presented with the acquired results from both systems. The compendium of the conclusive remarks are as follows:

- An interleaved converter with high gain and low voltage stress is designed and developed. The converter has high efficiency, owing to the fact that the low voltage stress enables the use of diodes and switches with low forward voltage and lower on-resistance, respectively.

- The complete elimination of the current ripple is achieved by using a novel quadratic gain boost topology, with the input side switches operating at a fixed duty of 50%. This converter has high voltage stress on output side active devices as the disadvantage but has low energy losses in the solar(PV) panel.

- The presence of front-end DBR in the WECS reduces the system efficiency; thus, a single-stage three-phase AC to DC converter is developed. The developed converter is tested with a SEIG fed WECS, and the absence of the DC link prompts the

development of an improvised MPPT technique. The converter is designed to work in DICM on the input side and CICM mode on the output side for inherent PFC.

- The developed converter is tested with a PMSG; it is found to have the added advantage of using stator inductors of the PMSG as the input inductors. The high value of the stator inductors enables the use of the converter at a lower switching frequency.

- Using the ripple-free input current converter for MPPT of the photovoltaic generation and PMSG based WECS, the HECS is developed. The DC microgrid of the developed HECS is then controlled by BESS and the single-phase grid. The advantages and disadvantages of these systems are explored, and it has been found that the BESS-based HECS has superior performance but has added cost of BESS.

7.2 Future Scope

Finally, in this Section, the thesis is concluded with some ideas and possible directions for further research. These recommendations are based on developing new converters and adding more fields of study on the subject matter. The possible future scopes are:

- The ripple in the current from PMSG can be eliminated by using a synchronous bridgeless converter.

- The quality of research on the WECS can be further improved by including reliability studies of the generator and developing converters to mitigate the associated problems.

- The effects of faster control actions can be studied with multiple HECS connected in parallel, and a methodology to damp and eliminate the oscillations can be developed.

- A single multiport converter for hybrid power conversion can be designed with the desired characteristics of higher efficiency for wind and ripple-free operation for solar power generation.