Power Electronic Converters Review for Wind Turbine Applications: State of Art, Reliability and Trends.

Presented by : Aimad ALILI
Email: aimad.alili@univ-lehavre.fr
GREAH Laboratory, University of LE HAVRE 75 Rue Bellot, 76600, Le Havre, France

Authors : Aimad Alili; M.B. Camara, Brayima Dakyo, and Jacques Raharijaona

Resume of the presenter

Aimad Alili was born in Algeria in January 1992. He received the M.S. degree in electrical engineering from the University of Bouira, Bouira, Algeria, in 2016 and the M.S. degree from University of Le Havre, Le Havre, France, in 2018. He is currently a PhD student with the Groupe de Recherche en Electrotechnique et Automatique du Havre (GREAH) Laboratory, University of Le Havre. Since 2014, he has been working on power electronics, dc distribution systems, electrically powered systems, wind and solar energy systems, diagnostic.

PLAN

I. INTRODUCTION

Wind energy has recently become the most promising renewable energy.

Fig.1 : Wind Turbine.

The global cumulative installed wind power capacity continues to increase dramatically to reach 627 GW by 2019.

aimad.alili@univ-lehavre.fr

I. INTRODUCTION

The large turbine presents a lot of advantages. They allow capturing a higher power with lower installation and maintenance costs compared to the small turbines. Hence, the size of the commercial wind turbine has greatly increased in the last decade

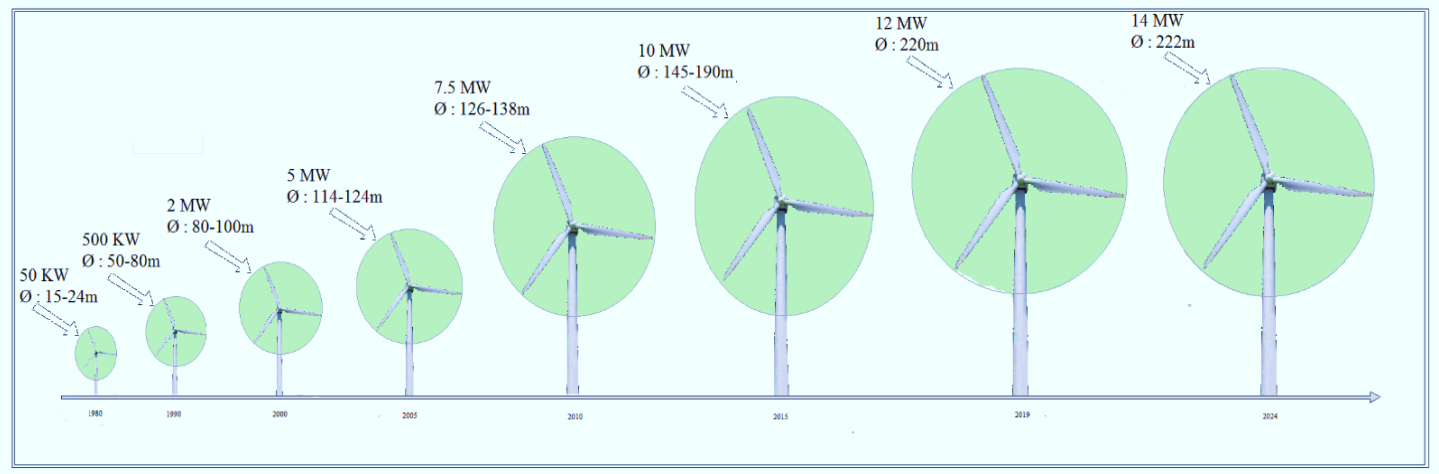

Fig.2 : Evolution of wind turbine size since 1980

aimad.alili@univ-lehavre.fr

II. WIND TURBINE CONCEPTS AND CONVERTERS TOPOLOGIES

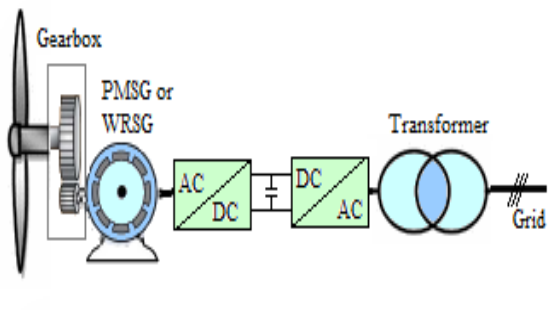

Fig 3 : Variable Speed WT with a Full-Scale Converter.

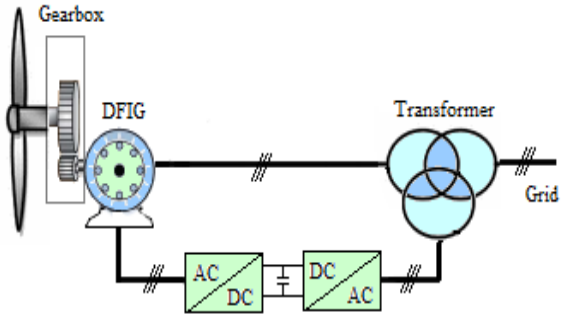

Fig 4 : Variable-speed WT with a partial-scale converter.

aimad.alili@univ-lehavre.fr

II. WIND TURBINE CONCEPTS AND CONVERTERS TOPOLOGIES

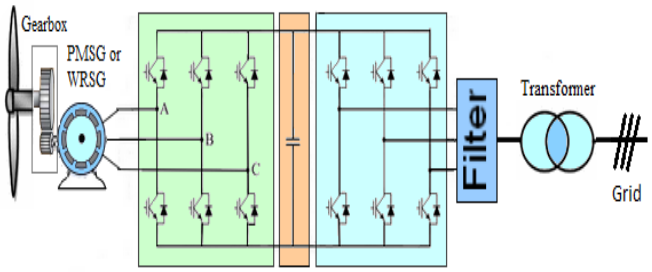

Fig 5 : BTB 2L Voltage source converter.

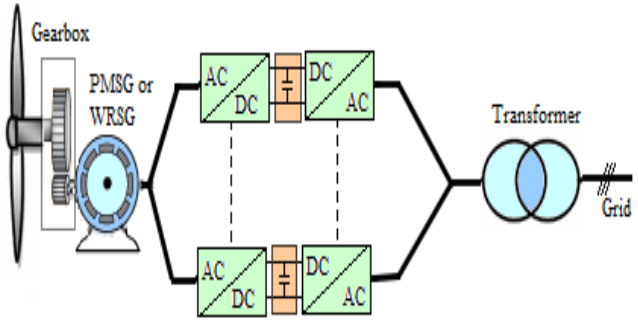

Fig 6 : WES with parallel connected BTB 2-levels VSCs.

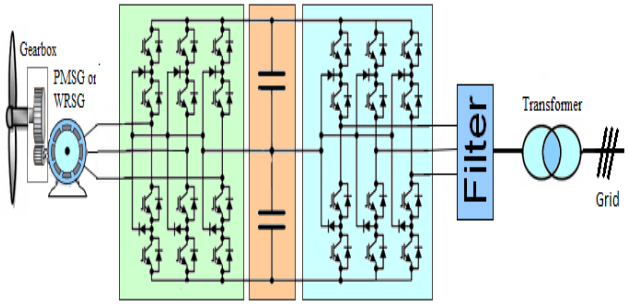

Fig 7 : Three-levels Neutral-Point Clamped Converter (3L-NPC).

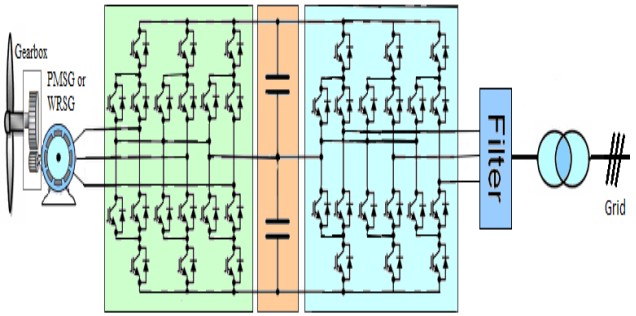

Fig 8 : Three-levels Active Neutral-Point Clamped Converter (3L-ANPC).

aimad.alili@univ-lehavre.fr

III. OBJECTIVE

A more reliable wind power system :

- Identify the most recurring failure in wind energy systems.
- Study the power converters reliability

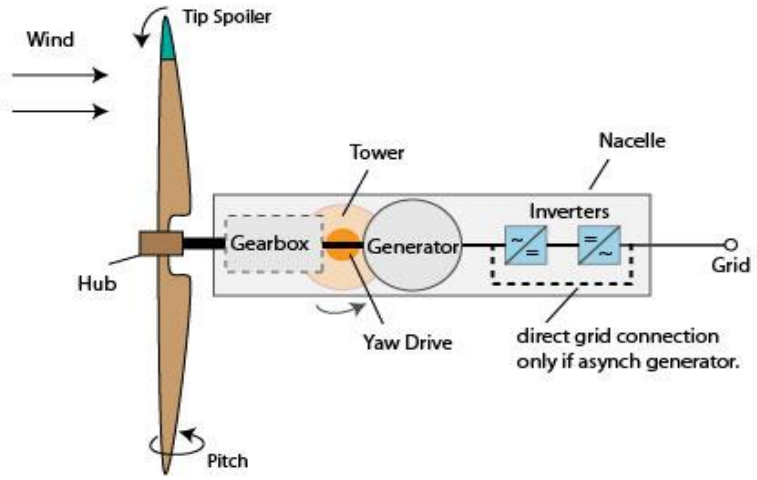

Fig.9 : Wind system composition.

aimad.alili@univ-lehavre.fr

IV. WIND TURBINE SYSTEM RELIABILITY

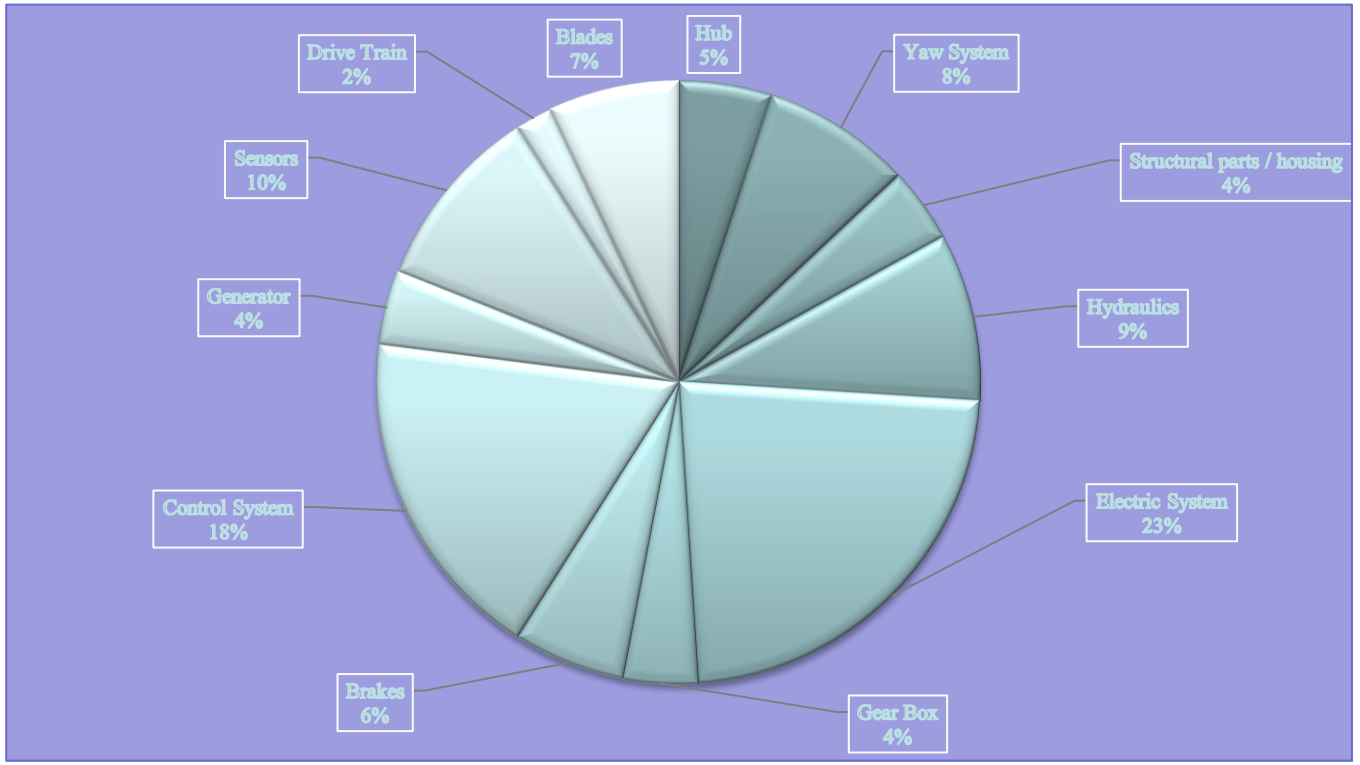

Fig.10. Study Engineering Department, Columbia University, New York 2018

aimad.alili@univ-lehavre.fr

IV. WIND TURBINE SYSTEM RELIABILITY

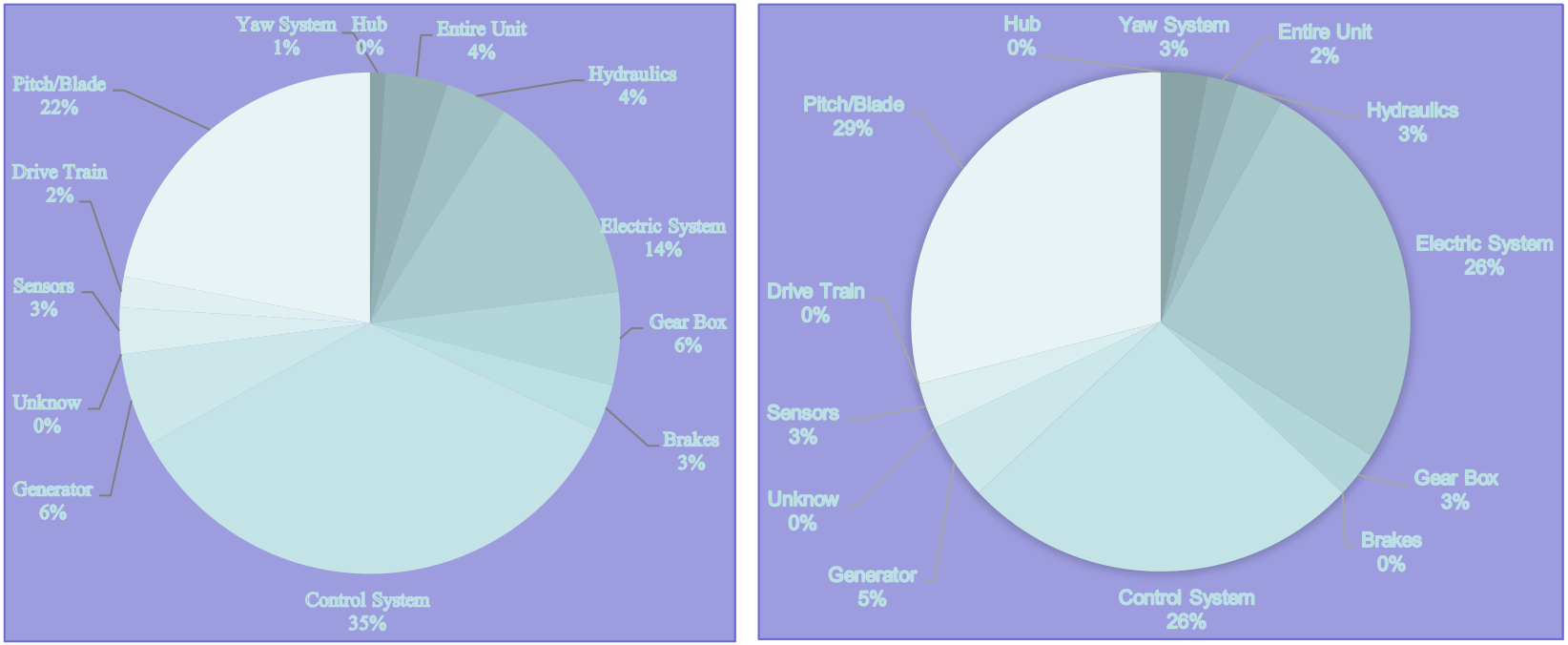

Fig.12 : study on two wind farms in china 2016.

aimad.alili@univ-lehavre.fr

IV. WIND TURBINE SYSTEM RELIABILITY

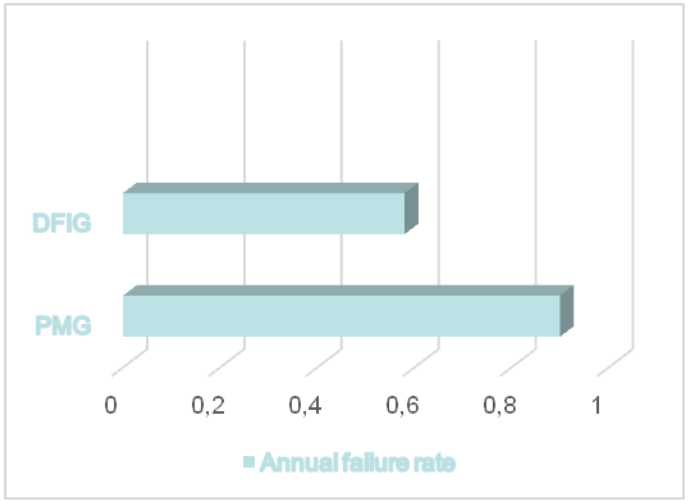

Fig 13 : Power converter annual failure rate Study[33].

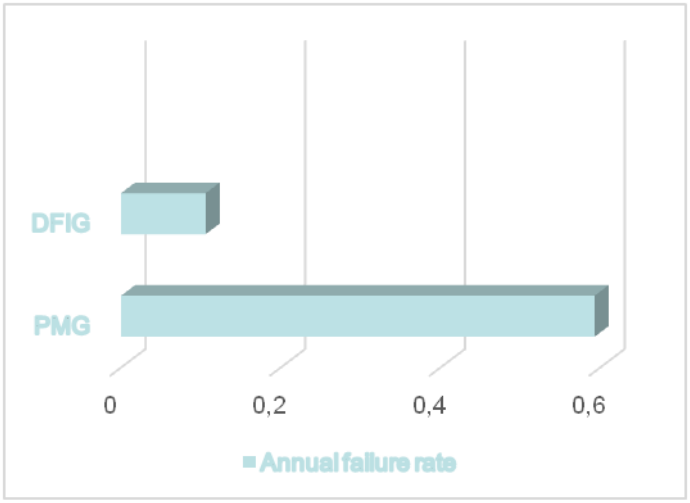

Fig 14 : Power converter annual failure rate study[34].

aimad.alili@univ-lehavre.fr

IV. WIND TURBINE SYSTEM RELIABILITY

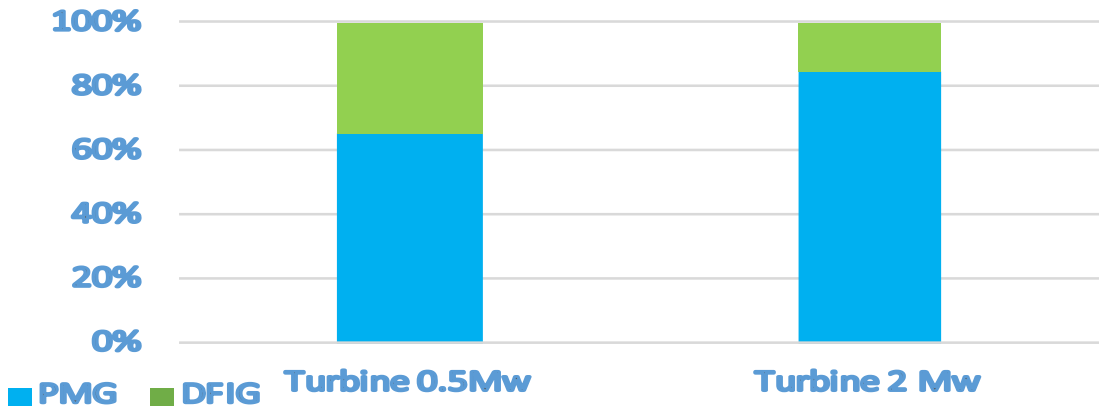

Fig 15: Difference converters failures rates based on the power of the turbine.

aimad.alili@univ-lehavre.fr

V. CONCLUSION

•The reliability of the power converters in wind turbine application is studied.

•From previous studies we deduce that the failures at the level of converters are proportional to the number of switches used in the energy conversion system.

•The majority of recent studies claim that, contrary to popular belief, failures in systems based on a PMSG generator are greater than those in systems based on a DFIG generator. In our study, we explain the reasons which are mainly due to the significant increase in failures in the power electronics system. However, systems based on a PMSG generator remain the most reliable for onshore wind turbines since the downtime caused by a failure at the converter is significantly lower than that caused by a failure of the gearbox. For offshore wind turbines, for reasons of accessibility, all failures are significant and cause considerable downtime.

aimad.alili@univ-lehavre.fr

Power Electronic Converters Review for Wind Turbine Applications: State of Art, Reliability and Trends.

Thank you for your attention!

Aimad ALILI
Alili.aimad@univ-lehavre.fr