Introduction

Increasing demand for new innovations in the wind power industry
- P. Jamieson proposed the Multi-Rotor Wind Turbine System (MRWTS) [1]
- Vestas has already installed a 4-rotor system in Denmark [2]

Objectives:
- Propose different electrical collector topologies for a MRWTS
- Develop appropriate control systems
- Develop a way of calculating power electronic losses

Methodology

- Perform a literature search in order to propose three different collector topologies
- Implement the topologies in Matlab/Simulink
- Implement controllers for the power converters used in the topologies
- Perform a literature search on power losses in power converters and implement a way of calculating power losses in Simulink
- Perform simulations and make comparisons of the topologies

Proposed topologies

AC Cluster
- One back-to-back converter for each turbine
- Allows individual optimised operating point
- High number of power electronics and large AC transformers

DC Cluster
- Individual optimised operating point through individual converters
- DC-to-DC converter using medium frequency power converters may save space and weight
- High power DC-to-DC converters still not commercially available

Hybrid Cluster
- Drastically reduces the number of power converters needed
- Issues regarding the controllability, one converter must control several turbines
- High power DC-to-DC converters needed

AC Cluster

DC Cluster

Hybrid Cluster

Loss calculation

Power electronic losses found by [3]:
- IGBT losses
  \[ P_{\text{IGBT}} = N \left( V_{\text{on}}(T) \cdot I_{\text{on}} + R_{C}(T) \cdot I_{\text{on}}^2 \right) \]
- Diode losses
  \[ P_{\text{Diode}} = N \left( V_{\text{fwd}}(T) \cdot I_{\text{fwd}} + R_{D}(T) \cdot I_{\text{fwd}}^2 \right) \]

Simulink loss calculation method [4]:
1. Define IGBT/Diode module specifications in Matlab from datasheet
2. Obtain current and voltage measurement from the Simulink module
3. Divide signals in to IGBT and diode power loss calculation blocks
4. Compute desired energy or voltage
5. Conver energy to power
6. Input power to the thermal model to obtain the temperature in the device

Conclusion and future work

Conclusion
- Similar results at a reasonable level
- Controllers work
- Power loss calculation method works
- Higher complexity needed to favour a topology

Future work
- Increase complexity in terms of number of turbines
- Develop controllers for dynamic conditions
- Investigate the use of medium frequency transformers

References