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Availability Improvements From Condition Monitoring Systems and Performance Based Maintenance Contracts

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Abstract and Introduction

Abstract

- It has been suggested that as wind farms move offshore the business case for condition monitoring systems (CMS) improve.
- The same argument has been made for performance based maintenance contracts (PBMC). These PBMCs come with guarantees in the form of availability or production based guarantees.
- This analysis aims to quantify the benefits or drawbacks of the use of CMS and performance based maintenance guarantees in terms of availability improvement or reduction.

Introduction

- As a means of quantifying the benefits or drawbacks of CMSs and PBMCs an empirical availability analysis was carried out on a population of offshore wind turbines from a number of different wind farms.
- The majority of the wind farms in the analysis had both CMS and PBMCs. However some did not and it is the availability analysis and comparison of both population groups that allow for a empirical quantification of benefits or drawbacks.
- The analysis also focus on the types of CMS and maintenance options available.

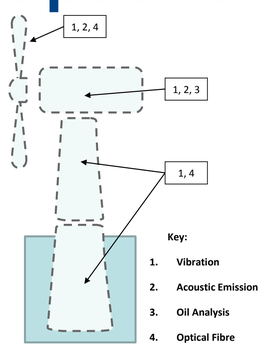
CMS, Maintenance Options and Analysed Population Overview

CMS and Maintenance Options

Condition Monitoring Systems

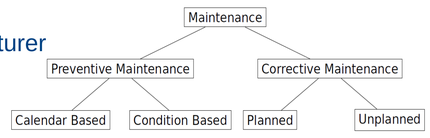
Current condition monitoring systems on the market usually monitor:

- Vibration in the rotor, drivetrain, tower and foundation
- Acoustic Emissions in the rotor and drivetrain
- Oil in the Gearbox
- Optical fibres in the rotor, tower and foundation



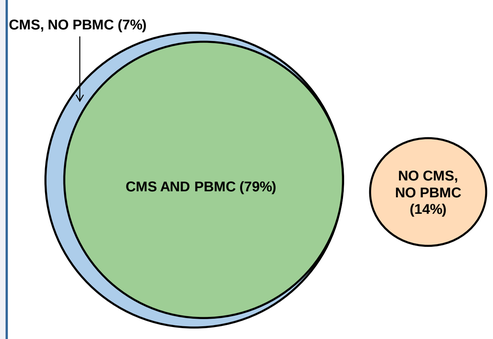
Performance based maintenance contracts (PBMC)

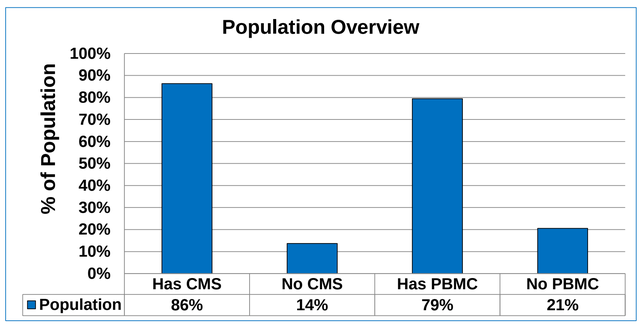
- Manufacturers offer performance guarantees on maintenance contracts
- Guarantee availability levels or production levels
- Usually covers preventative and corrective maintenance
- Maintenance work is the full responsibility of the manufacturer
- CMS are utilised in these maintenance contracts for both preventative and corrective maintenance



Analysed Population Overview

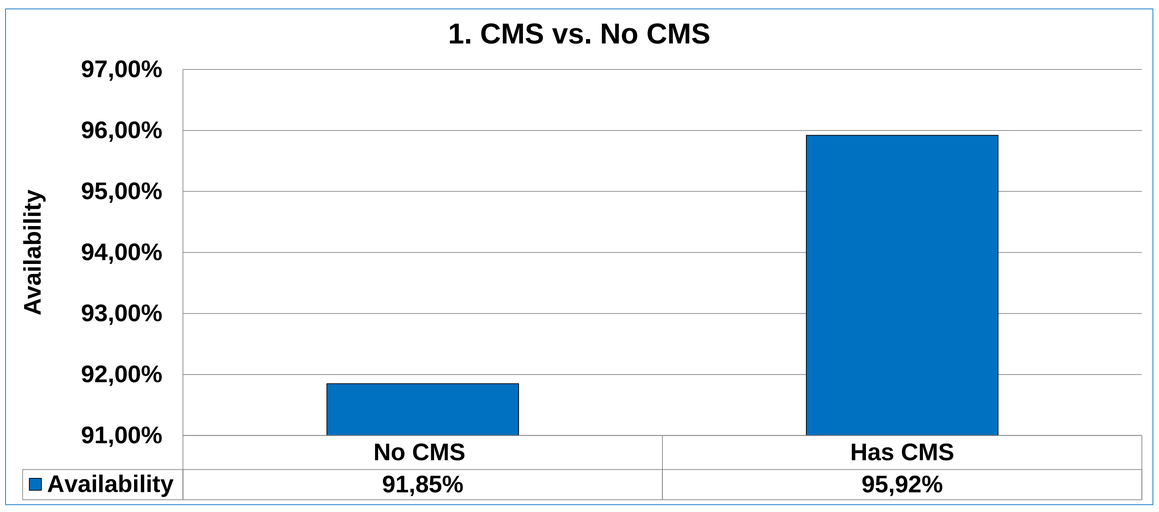
- Population builds up to between 400 – 500 offshore wind turbines
- From between 7-12 offshore wind farms
- Wind farms operating for between 3 – 9 years
- Modern multi MW turbines between 1.5 and 4 MW
- Gear driven induction generator type turbines with different power ratings

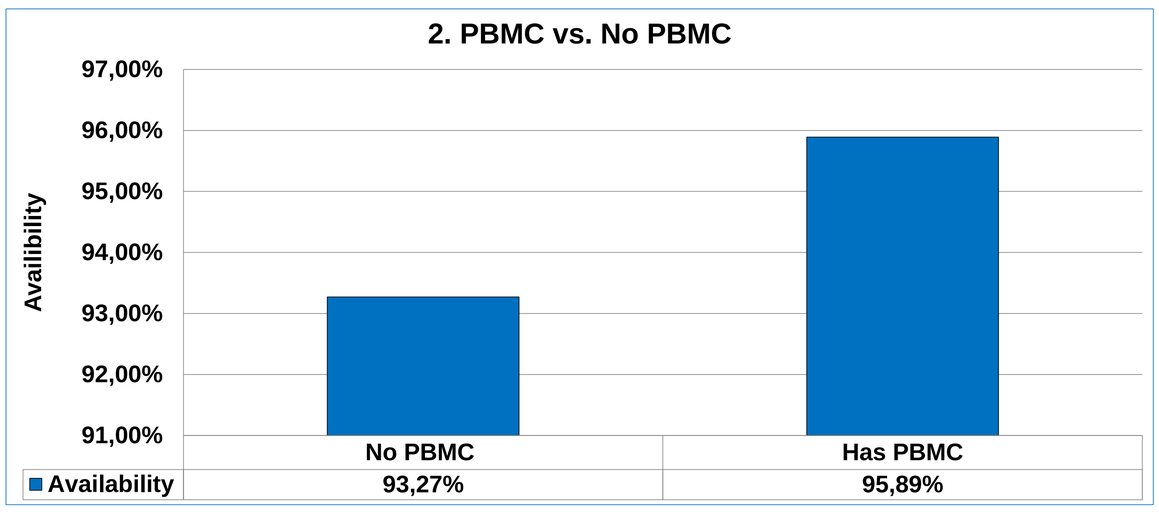




Results

In the following graphs availability is defined as the time the turbines were available and ready to operate divided by the time total in the period





- No CMS and No PBMC populations are closer to shore
- No CMS and No PBMC populations are older
- No CMS and No PBMC populations have a lower rated power on average
- No CMS and No PBMC populations have a lower mean wind speed
- No CMS and No PBMC populations have a lower failure rate

- No CMS has 4% lower availability to the population with CMS
- No PBMC has 2.58% lower availability to the population with PBMCs
- 4% availability = ~£47,500 per year for an average offshore wind turbine
- 2.58% availability = ~£30,000 per year for an average offshore wind turbine
- Based on energy from an average offshore wind turbine from EWEA factsheet

Discussion and Conclusions

1. The “No CMS” population has a lower failure rate than the CMS population, however the availability is also lower in the NO CMS population. This means that downtime must be higher. As the no CMS population is closer to shore the higher down time is not due to travel time so must be a result of other factors. One of the factors could be the CMS allowing for better maintenance planning which in turn leads to shorter downtimes and higher availability for turbines with CMS.
2. Similar conclusions can also be drawn for PBMCs. As the “No PBMC” population has a lower failure rate and is closer to shore the lower availability can only be explained by longer lead and repair times. These longer repair and lead times in comparison to the “Has PBMC” population could be due to the manufactures being faster at repairing the turbines that they will have to pay downtime compensation for.
3. Based on the analysis of this population there is a business case for a CMS on an average offshore wind turbine if it costs less than ~£47,500 per year.
4. Based on the analysis of this population there is a business case for a PBMC on an average offshore wind turbine if its additional cost is less than ~£30,000 per turbine per year.

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