MACHINE HEALTH ASSESSMENT SYSTEM (M-HAS)

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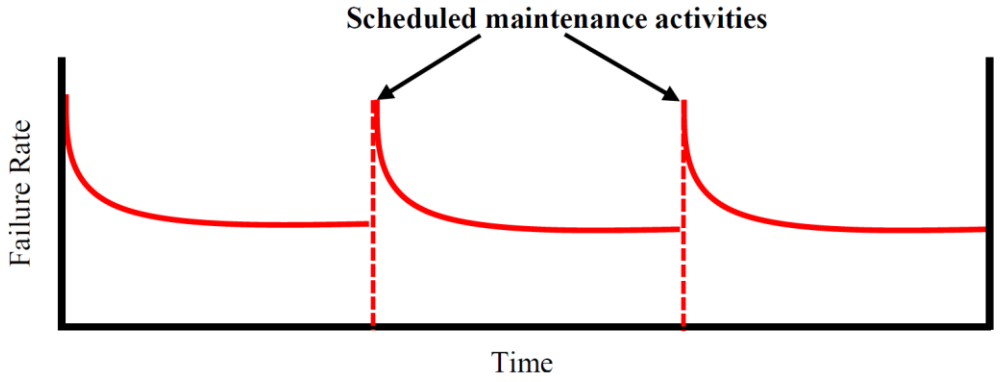
Overview

- Moving from periodic to condition-based maintenance (CBM)
- Overview of Turner Iceni's M-HAS
- Examples of M-HAS at work
- How can M-HAS promote a circular economy

Moving from periodic to condition-based maintenance

Periodic Maintenance

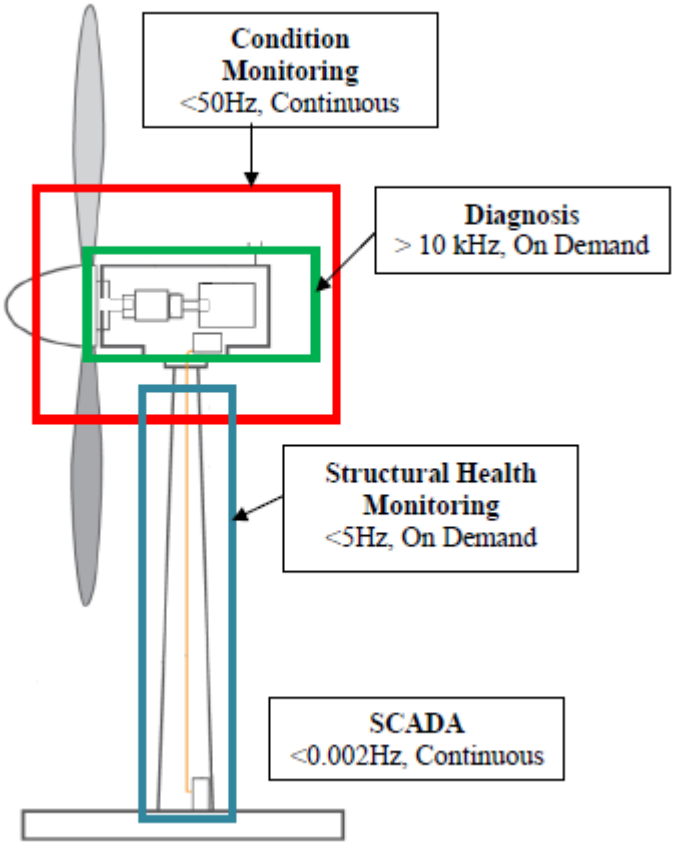
- Good when condition closely related to time & duty
- Justifiable for high cost of failure
- Maintenance can be carried out unnecessarily
- Does not allow manifesting faults to be identified at an early stage



Moving from periodic to condition-based maintenance

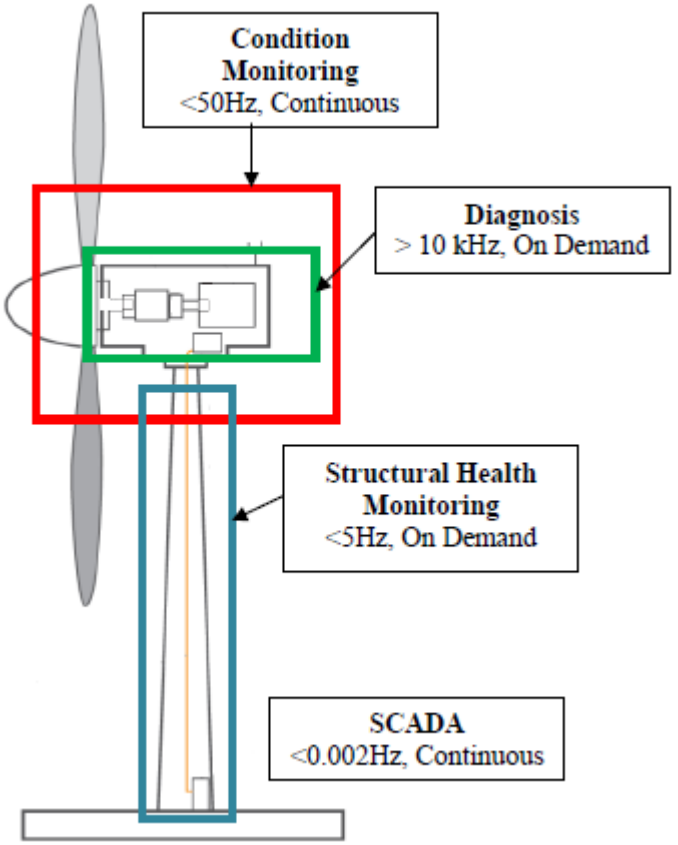
Condition-based Maintenance

- Use of sensors to monitor machine health
- Maintenance only carried out when necessary
- Optimised O&M scheduling
- Avoidance of major failures



Moving from periodic to condition-based maintenance

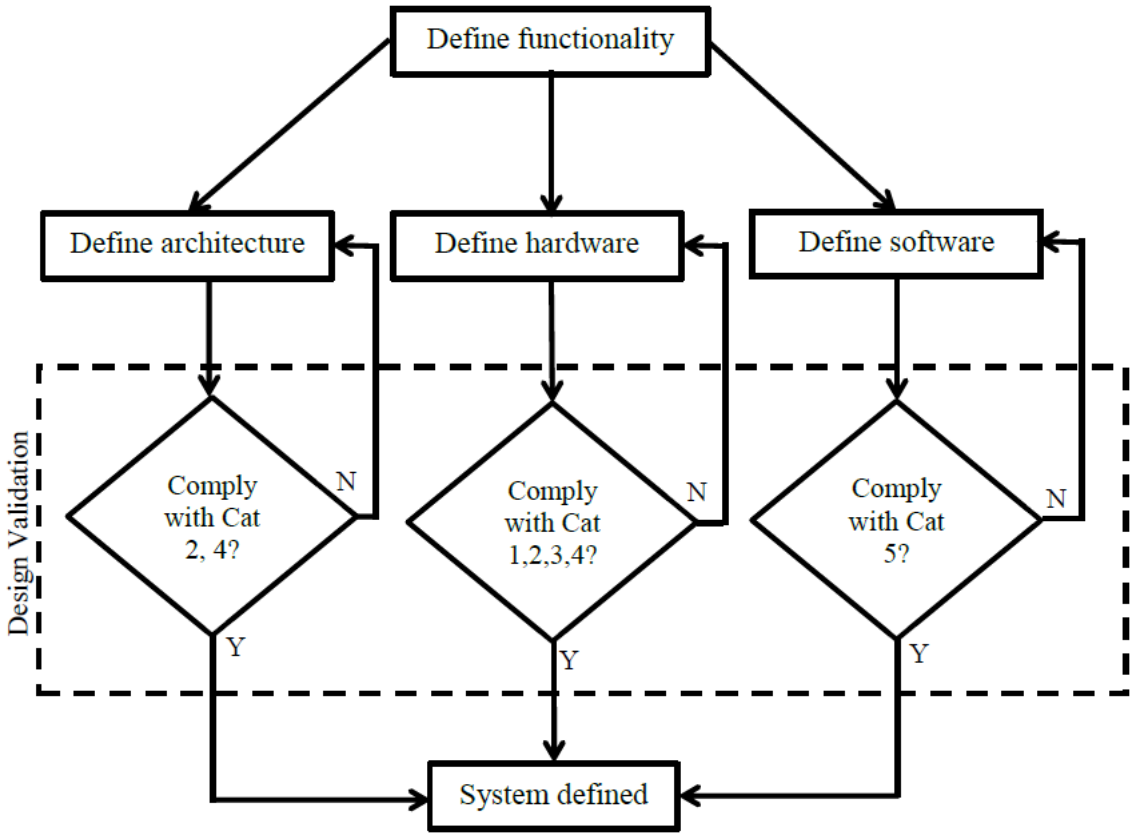
In reality operators are using a combination of periodic and condition based maintenance



Designing CMS Correctly

Categories of robustness:

- Weather
- Operational
- Personnel handling
- Electrical signal
- System software



What is M-HAS?

- Low cost condition monitoring system
- Can be retrofitted to any turbine
- Free standing or integrated with SCADA
- Cloud-based data storage and display
- Real-time and offline analysis
- Automatic alarming

TURNER M-HAS
MACHINE HEALTH ASSESSMENT SYSTEM

Overview of M-HAS

Wear Metals in Oil

Oil Condition

Vibration Levels

Other Sensors

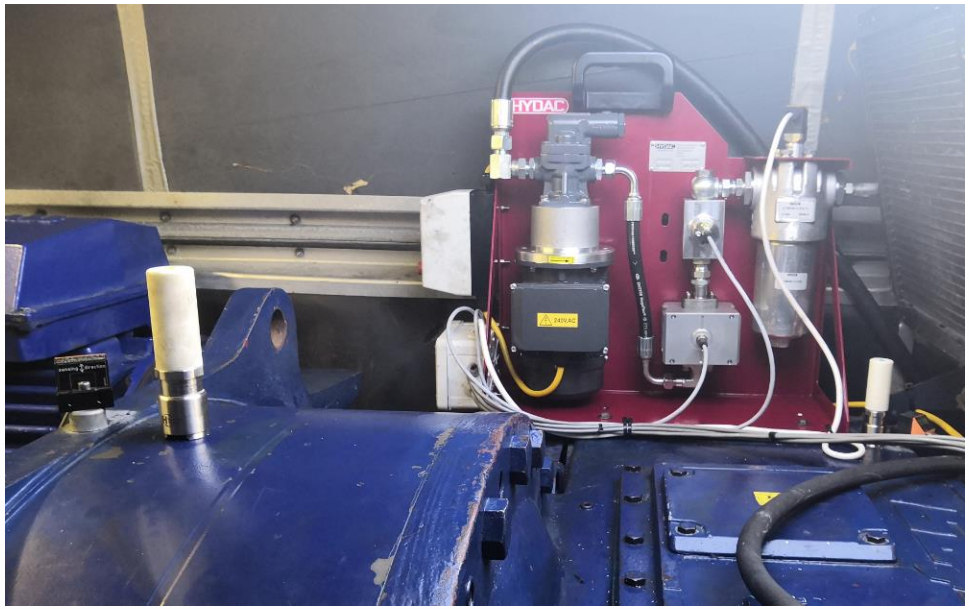
M-HAS collects data at a cloud server

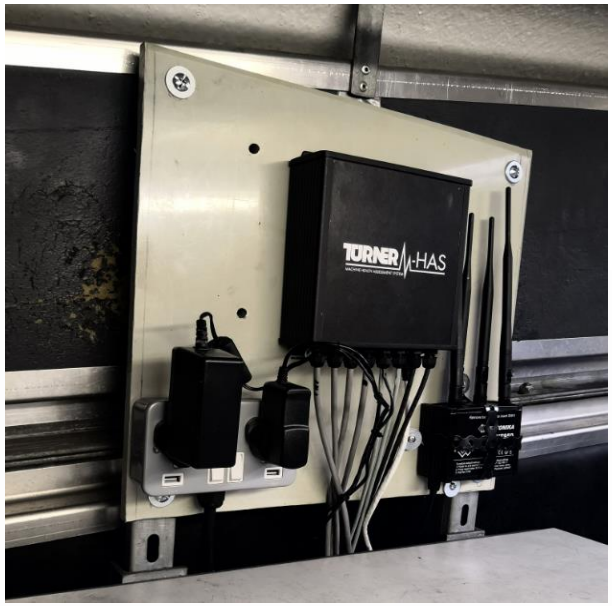
M-HAS Data Collection Module (DCM)

Web Interface
www.turnerm-has.com

Data is typically sent at a rate of 5 data points every half hour to the cloud server. The site updates every half hour.

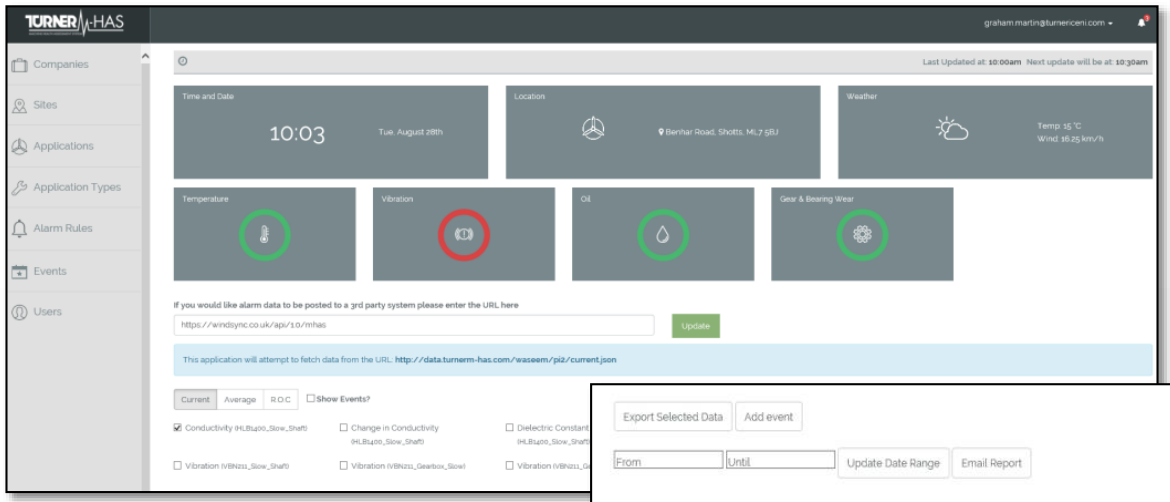
Installed M-HAS Instrumentation

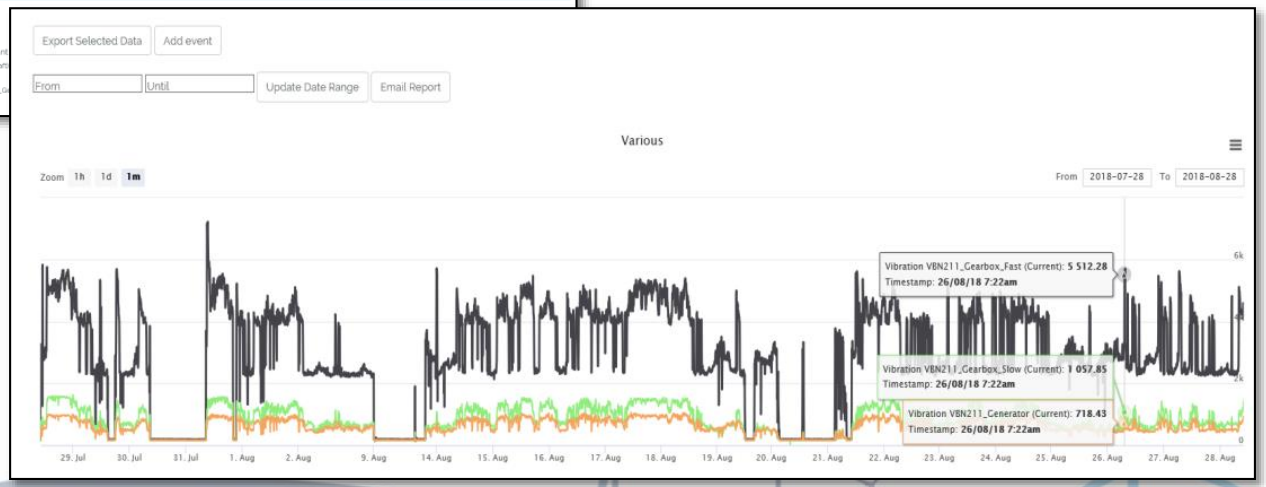




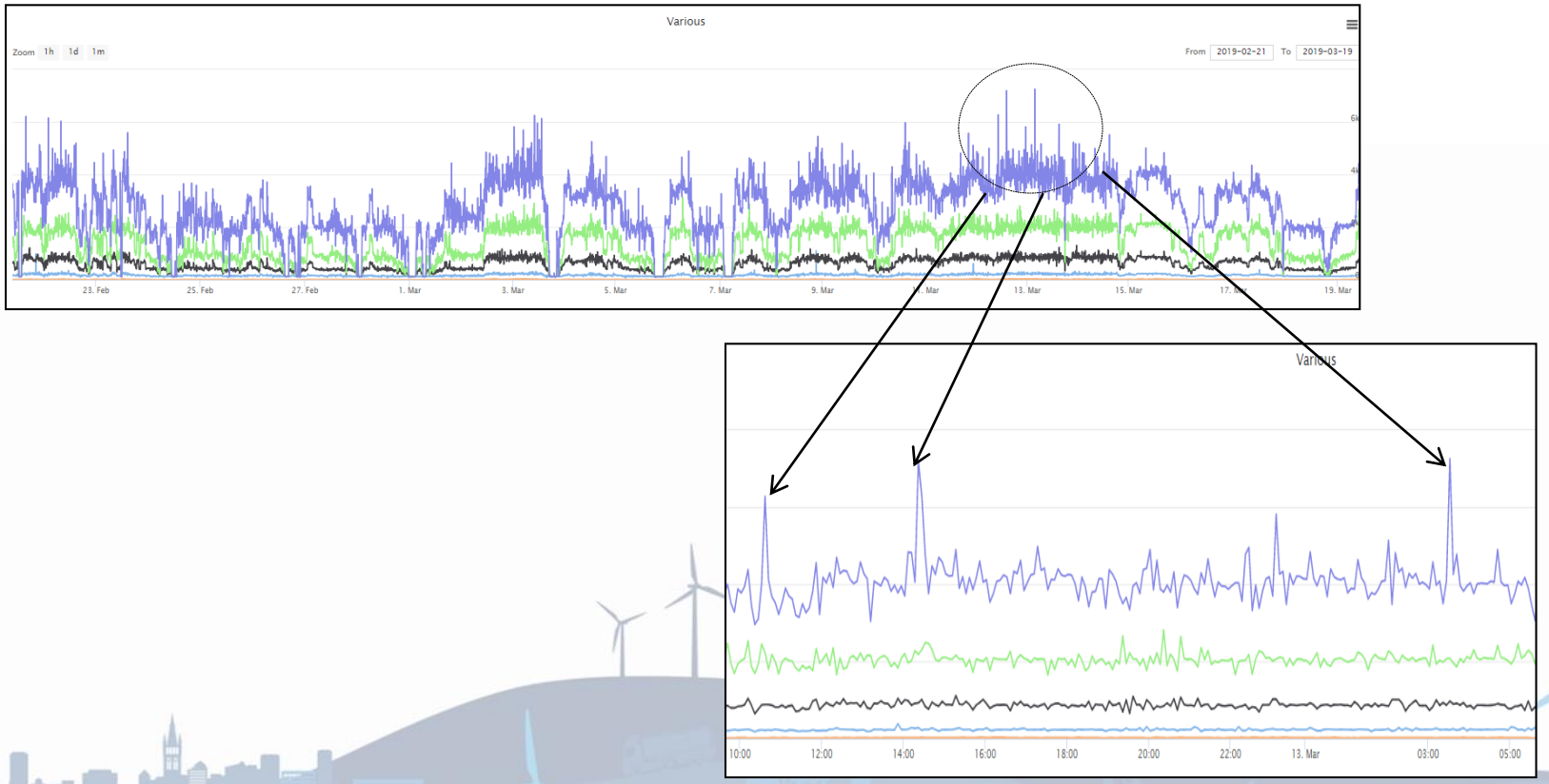
Vestas V47 Example

M-HAS Web Interface

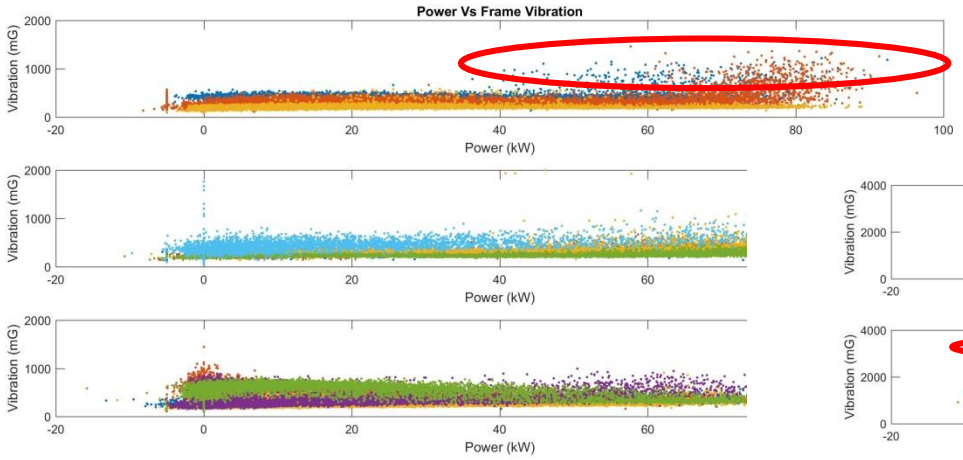


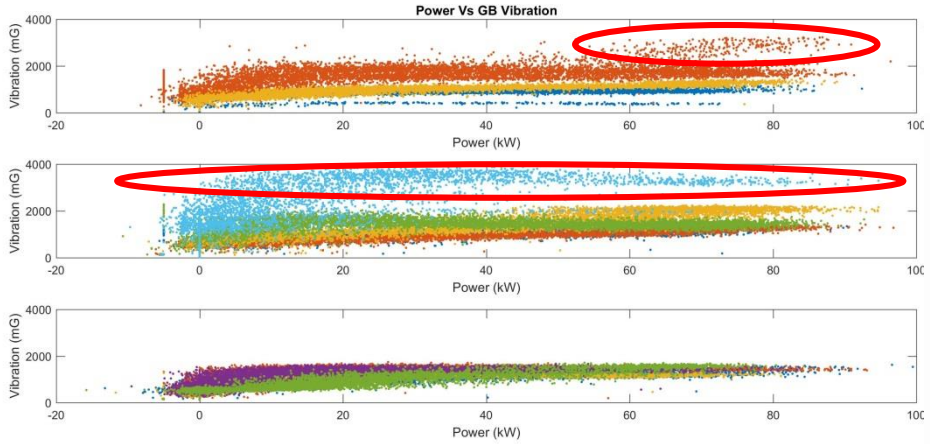


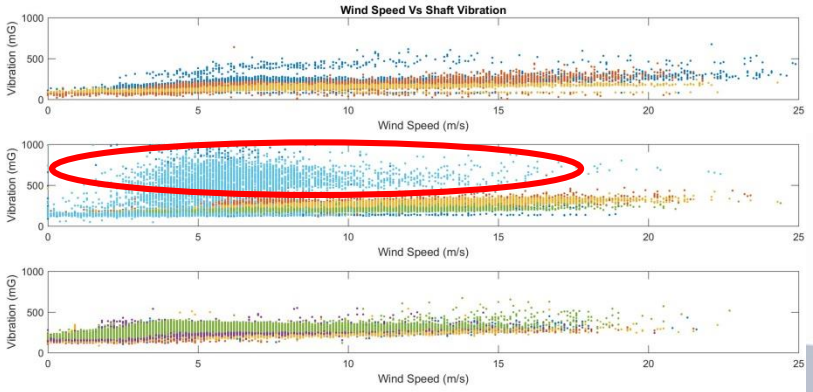
M-HAS Fault Detection



M-HAS Fault Detection



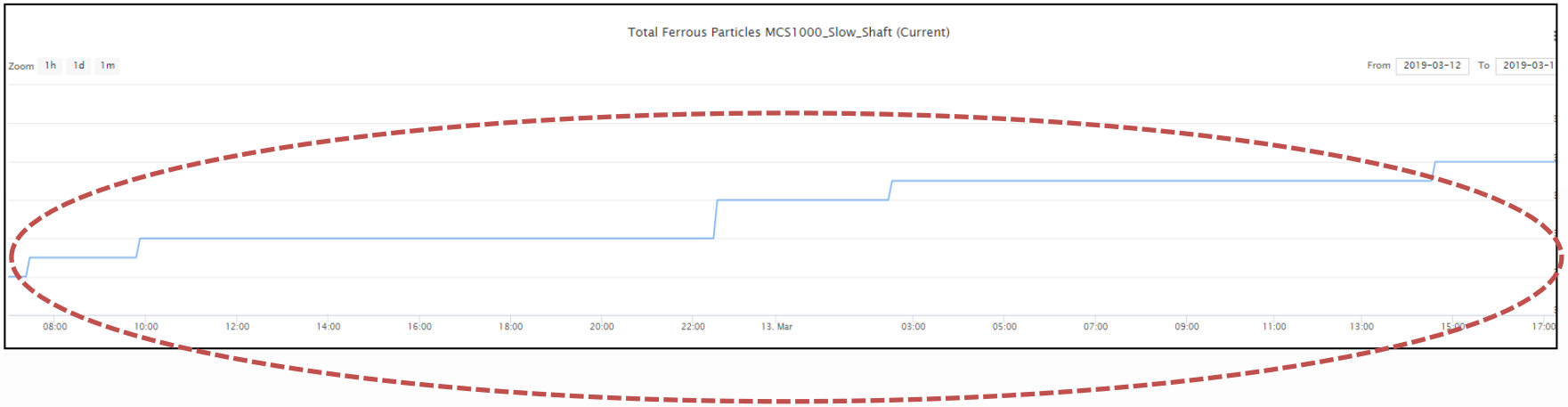




- Cracked bedplate
- Lightning rod failure
- Braking failure
- Gearbox faults
- Hub slip

- Sensor failure
- Bad placement
- Sensors disconnected/swapped round

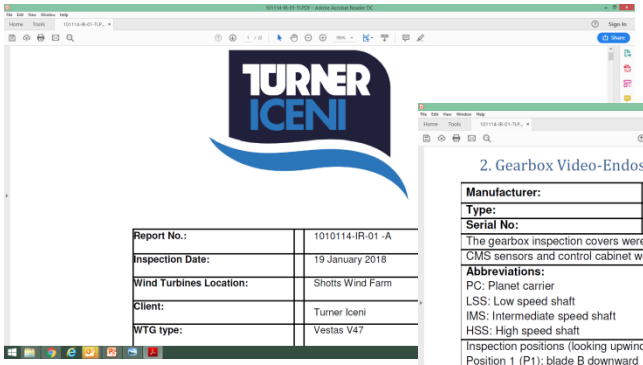
Online Oil Analysis



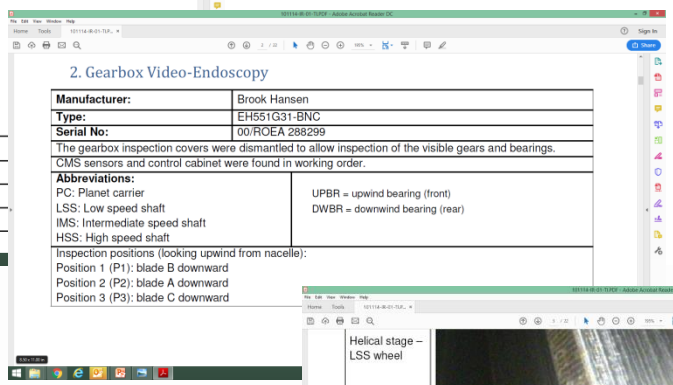
54 particles

Real time analysis of the wear metal measurement showing an increase in ferrous material.

M-HAS Reporting

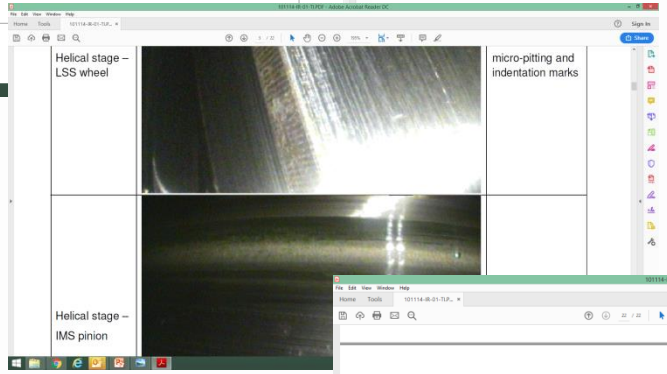


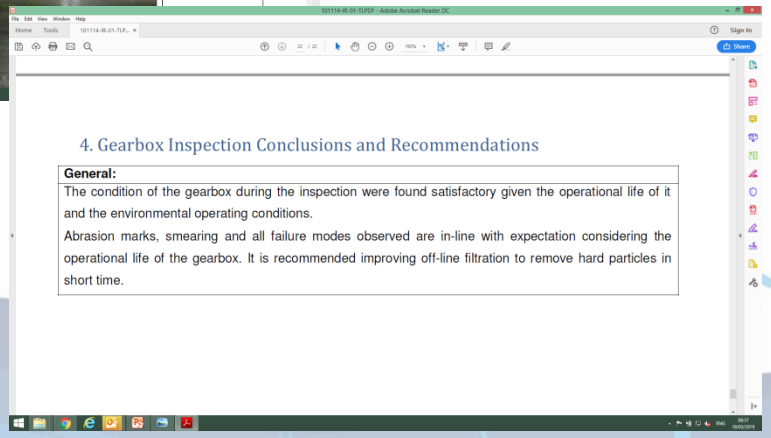
Report No.:	1010114-IR-01 -A
Inspection Date:	19 January 2018
Wind Turbines Location:	Shotts Wind Farm
Client:	Turner Iceni
WTG type:	Vestas V47



2. Gearbox Video-Endoscopy

Manufacturer:	Brook Hansen
Type:	EH551G31-BNC
Serial No:	00/ROEA 288299
The gearbox inspection covers were dismantled to allow inspection of the visible gears and bearings.	
CMS sensors and control cabinet were found in working order.	
Abbreviations: PC: Planet carrier LSS: Low speed shaft IMS: Intermediate speed shaft HSS: High speed shaft	UPBR = upwind bearing (front) DWBR = downwind bearing (rear)
Inspection positions (looking upwind from nacelle): Position 1 (P1): blade B downward Position 2 (P2): blade A downward Position 3 (P3): blade C downward	





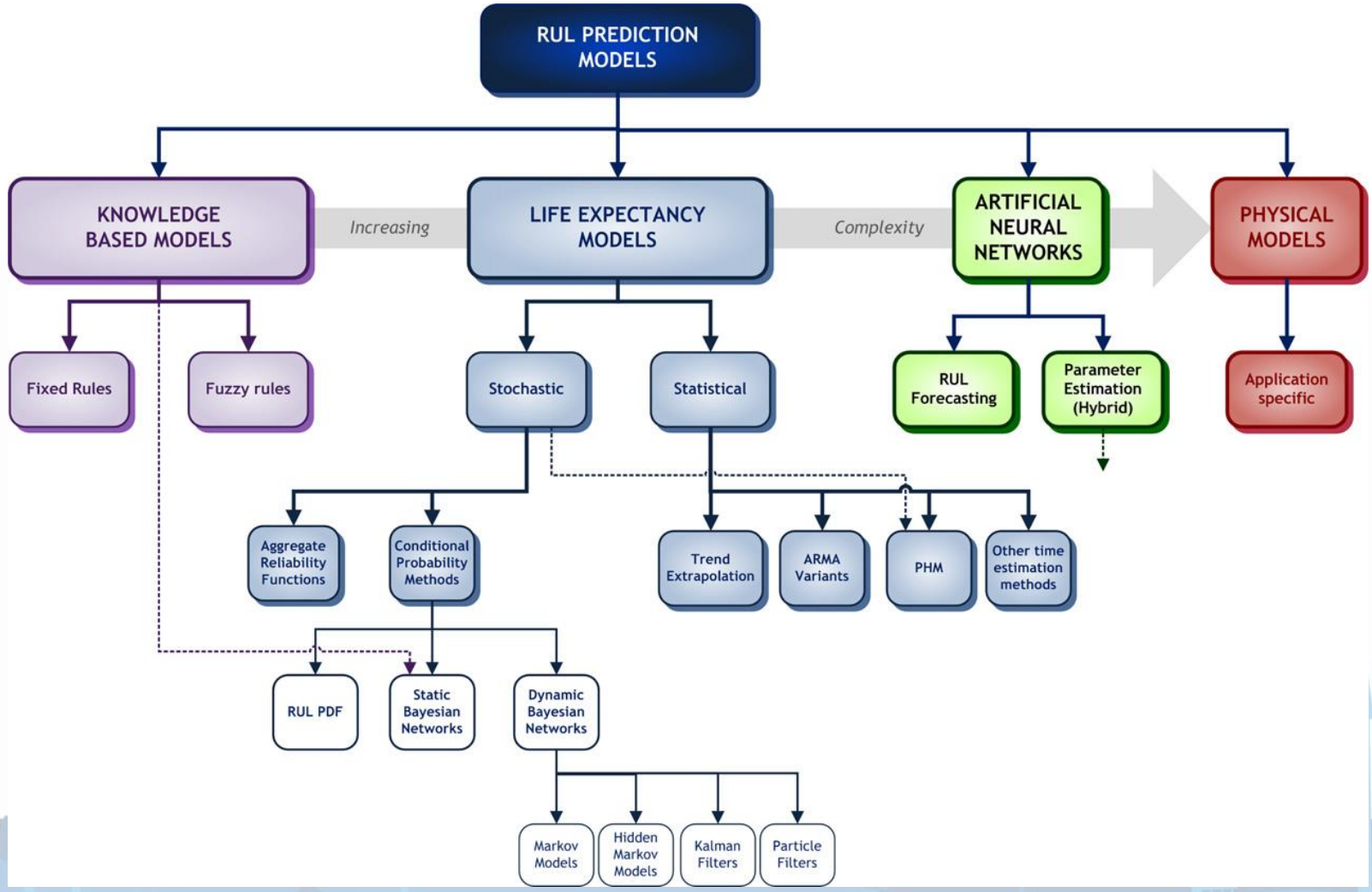
4. Gearbox Inspection Conclusions and Recommendations

General: The condition of the gearbox during the inspection were found satisfactory given the operational life of it and the environmental operating conditions. Abrasion marks, smearing and all failure modes observed are in-line with expectation considering the operational life of the gearbox. It is recommended improving off-line filtration to remove hard particles in short time.

M-HAS system indicates the requirement for an inspection.

The inspection would state requirements for further servicing and possibly a requirement for a replacement bearing or gearbox

Remaining Useful Life Prediction



Sikorska JZ, Hodkiewicz M, Ma L. Prognostic modelling options for remaining useful life estimation by industry. Mech Syst Signal Process 2011;25:1803–36. http://dx.doi.org/10.1016/j.ymssp.2010.11.018.

M-HAS and the Circular Economy

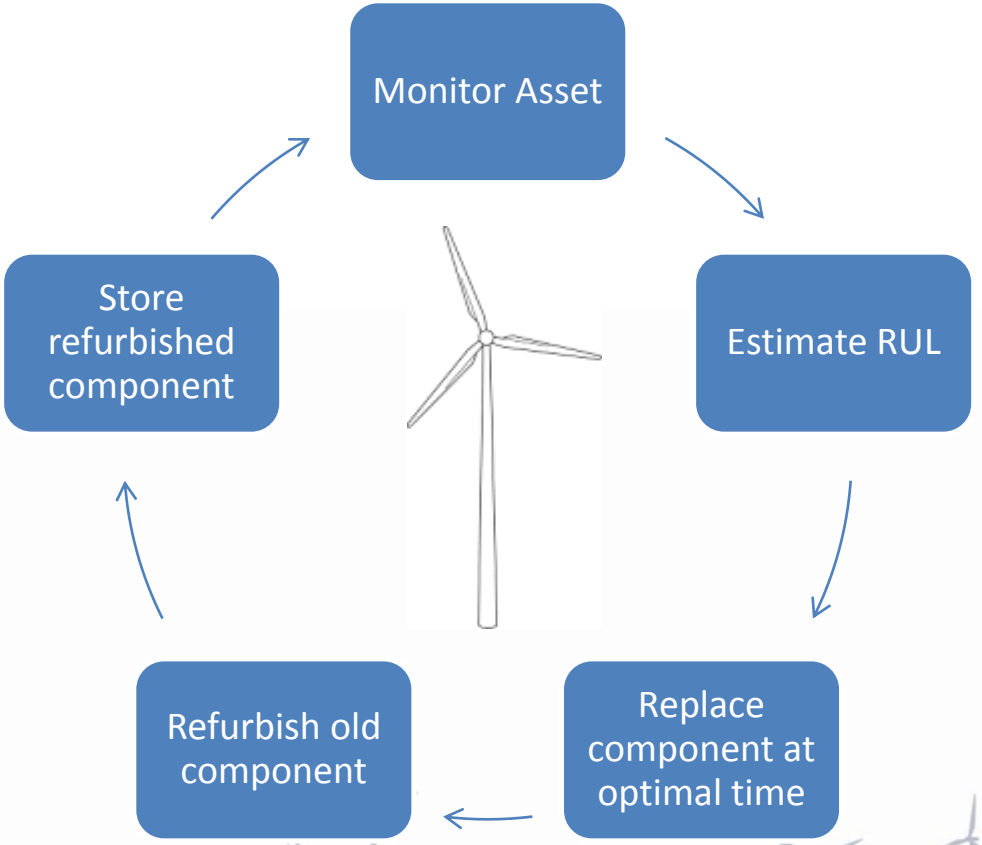
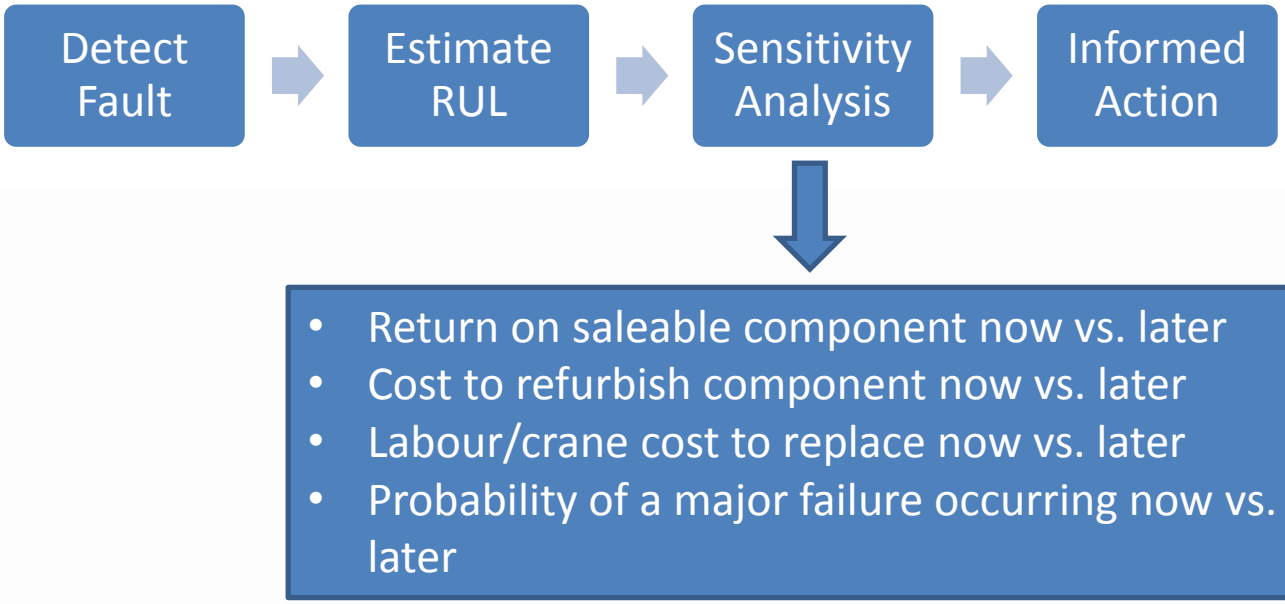


Image: sweetclipart.com

M-HAS and the Circular Economy



Summary

- M-HAS is a low cost condition monitoring system
- Allows optimised maintenance scheduling and avoidance of major failures
- Allows for more informed procurement decisions to be made
- Allows components to be removed before they are beyond repair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