



Predictive Maintenance

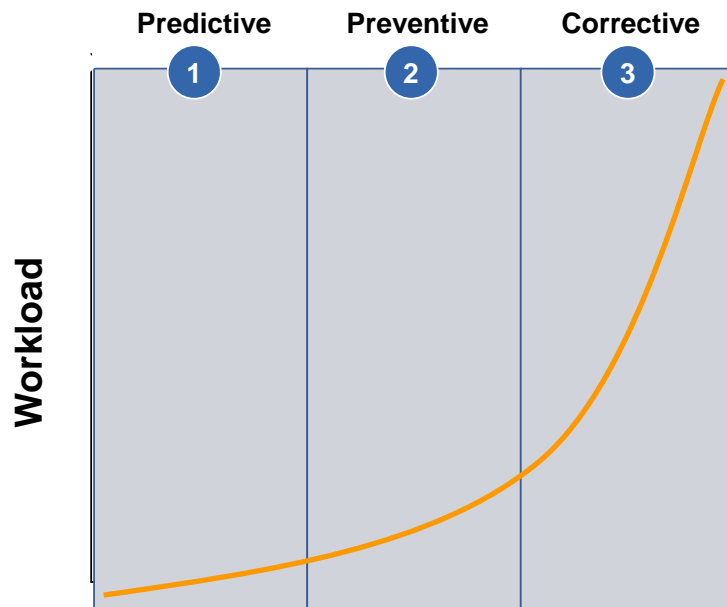
Winterwind 2011,

Umeå, February 9 – 10th 2011

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Typical maintenance strategy focuses on preventing, but mostly on correcting problems

Unscheduled Service curve



- 1 Maintenance carried out following a forecast derived from analysis and evaluation of significant parameters of the degradation of the system or component.
- 2 Maintenance carried out at predetermined intervals or according to prescribed criteria, intended to reduce the probability of failure or the degradation of the system or component.
- 3 Maintenance carried out after fault recognition to bring the system or specific component into original operating condition.

Predictive Maintenance



Detection of possible defect origin, consequently predicting when a potential failure can occur

- Scheduled service is optimised, reducing unscheduled turbine visits
- Minimised visits and minimised risk of deteriorated main components means, less cost
- Optimal power generation, positively affecting production output
- Allows long window for resolve due to early identification

Predictive Maintenance

What is the Diagnostic Center

Based on the complex CRO_DA_C operational and turbine experience database, including 10,000+ turbine data interfaces (TDIs)

Predictive: Model based monitoring uses intelligent models to translate collected data to predict the possible fault origin.

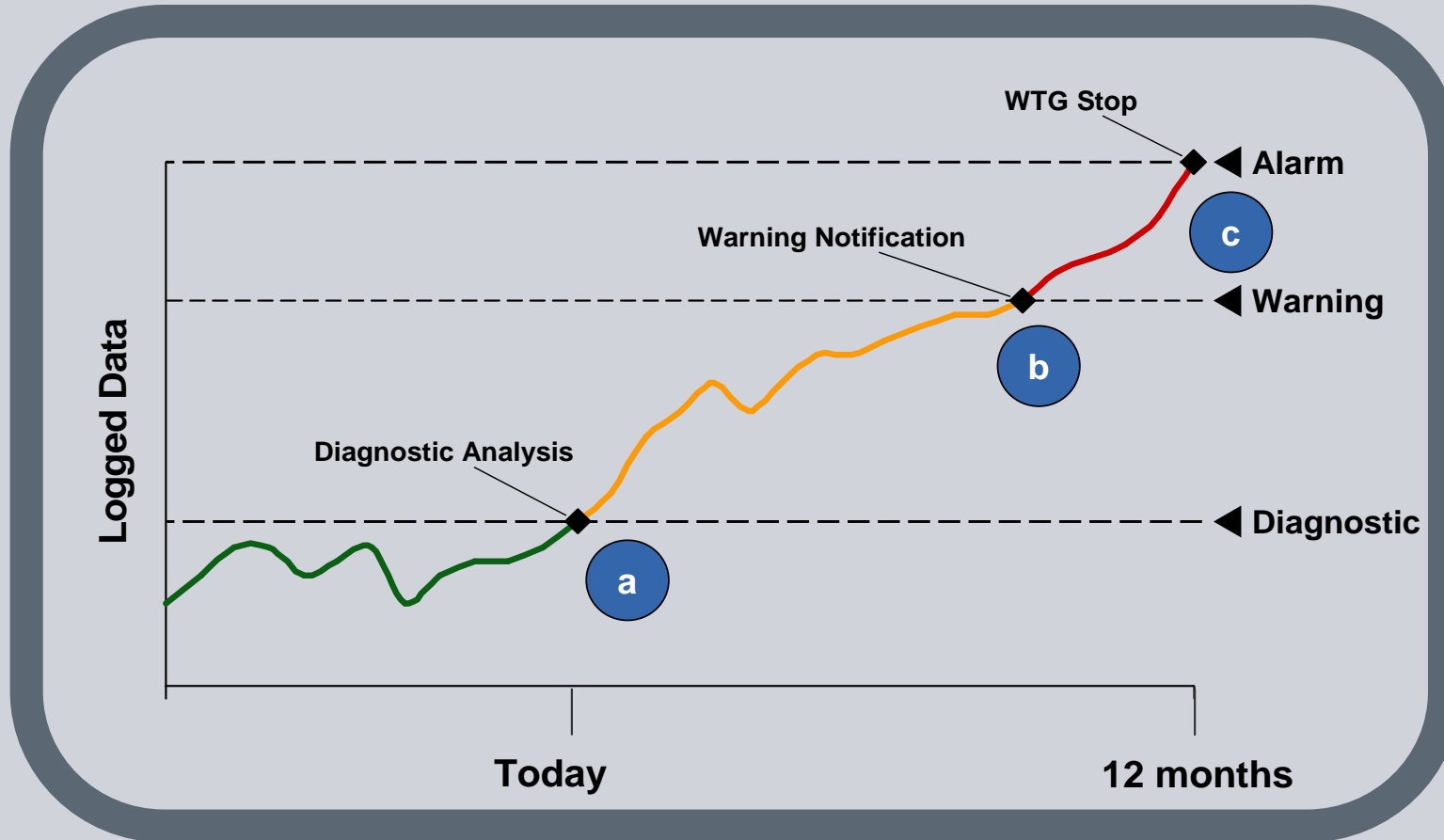
Preventive: Siemens condition monitoring system monitors and collects data from components via sophisticated sensors. Warning notifications are produced at the slightest vibration deviations. CRO_DA_C is consulted to analyze turbine data.

Corrective: Remote data analysis (RDA) analyzes data collected from SCADA and the Siemens condition monitoring systems. Technicians are prepared for strategic dispatch.

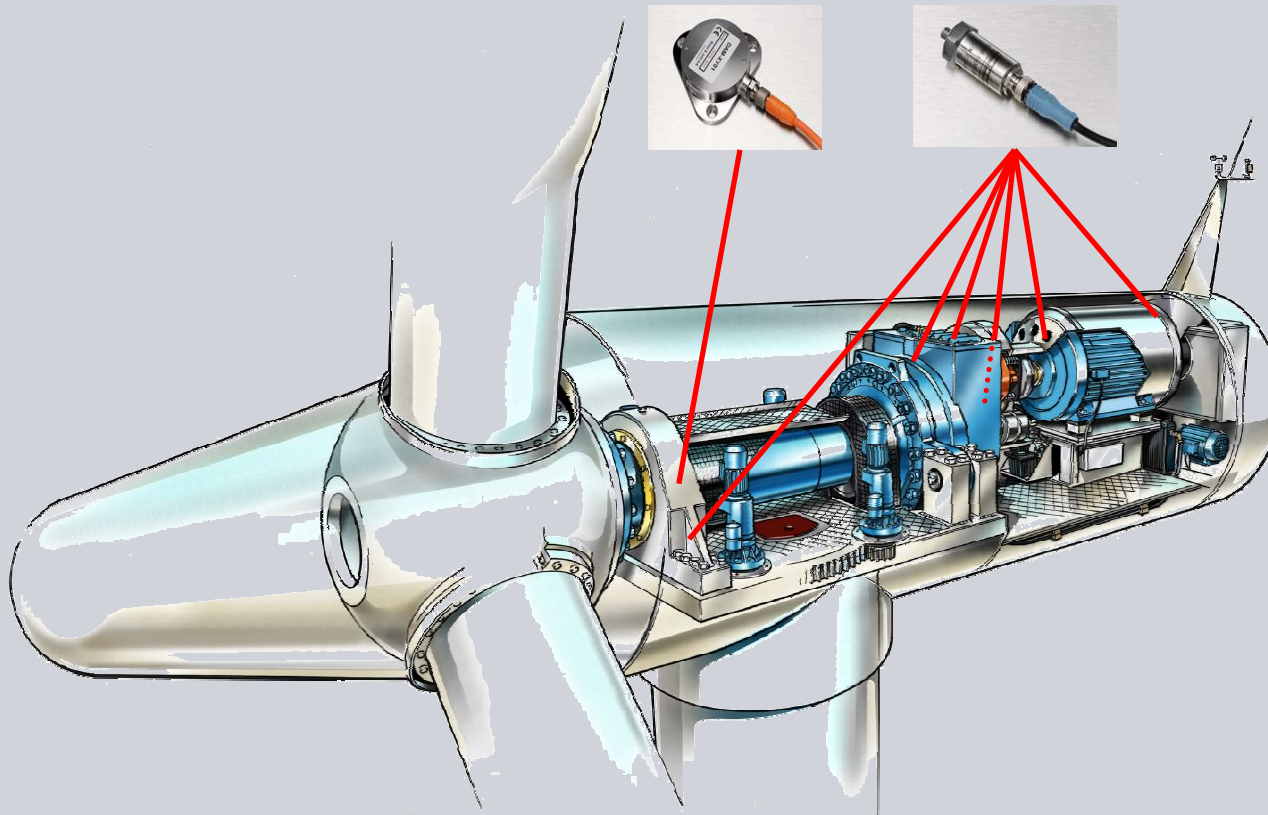
Customer Benefits

- Optimization of turbine reliability
- Enhanced response times
- Power generation and profitability
- Onshore and offshore environments

Diagnostic analysis is conducted proactively, prior to Warning notifications



Turbine Conditioning Monitoring



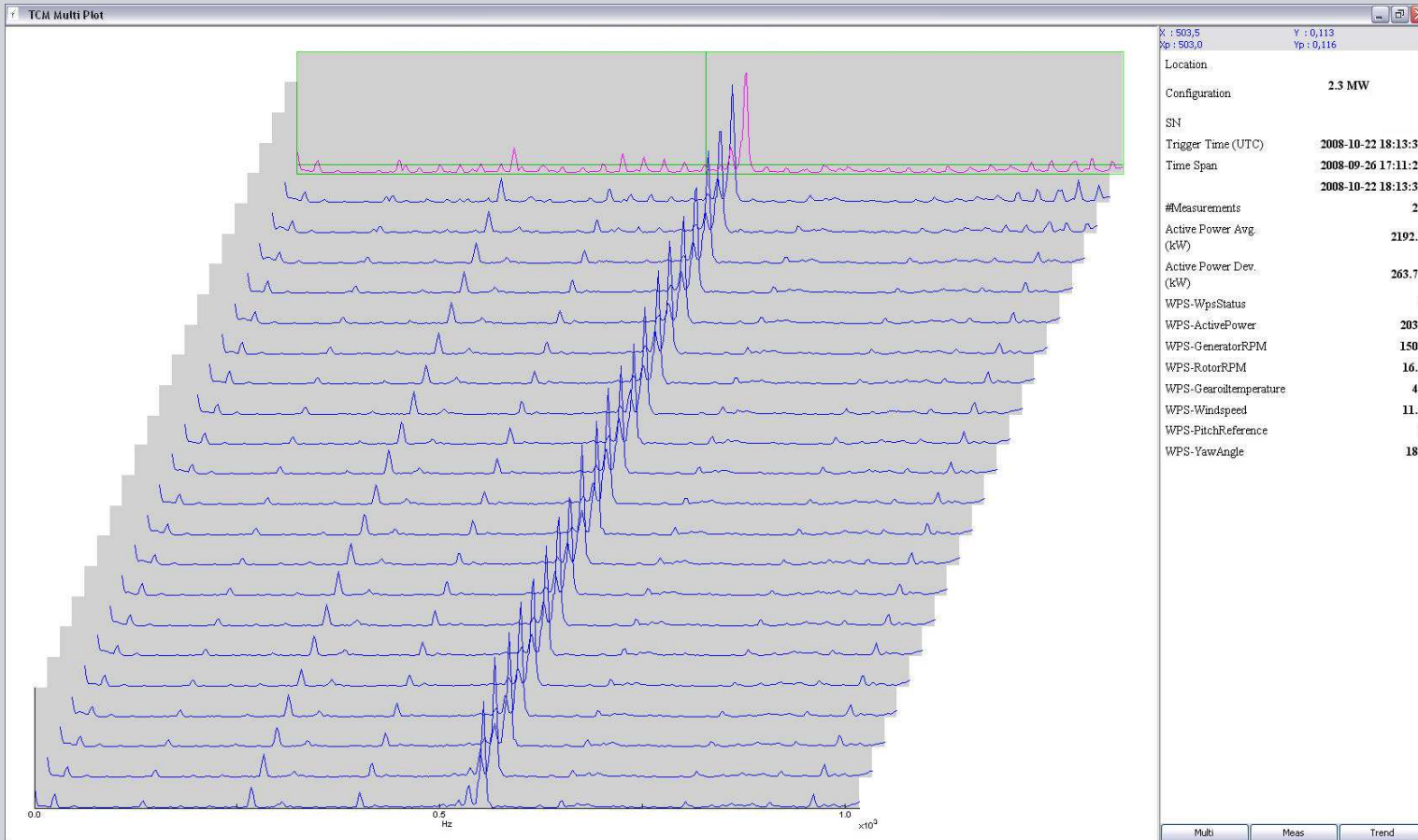
Accelerometers

Main bearing: 2

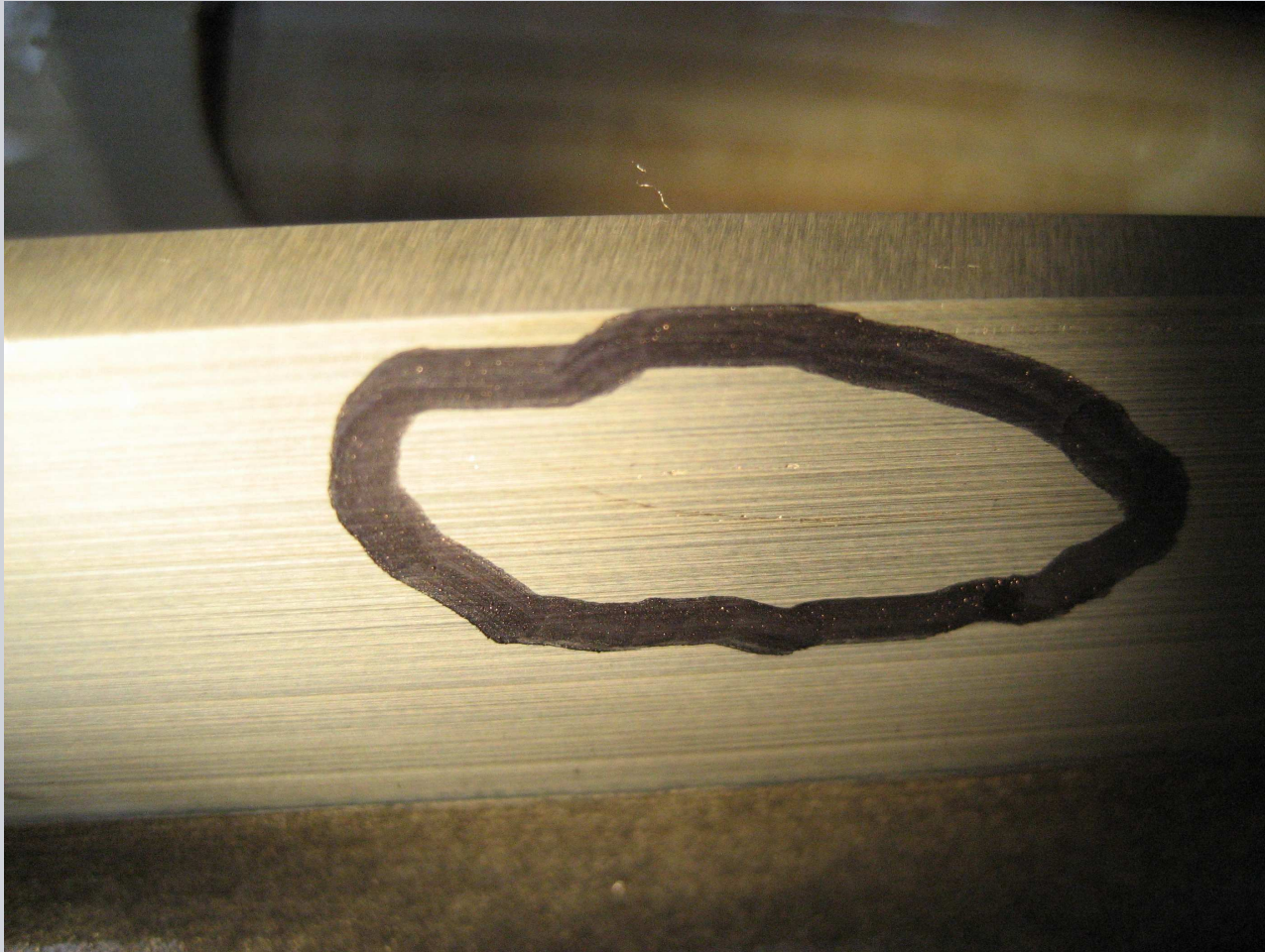
Gear: 3

Generator: 2

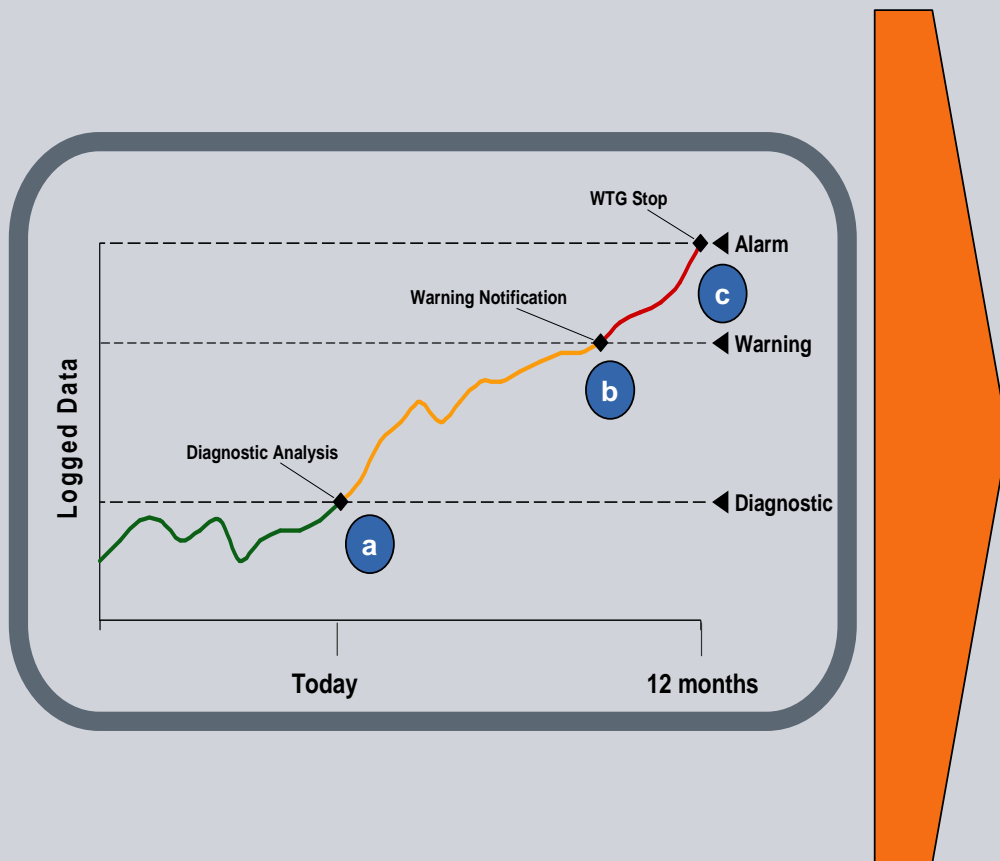
Damage example - Waterfall



Damage Example Picture of RC



Predictive Maintenance



- a**

 - Diagnostic data and Siemens condition monitoring vibration patterns are analyzed
 - Service technicians given special tasks to correct possible defect origin
 - Minimal or no effect on turbine performance

- b**

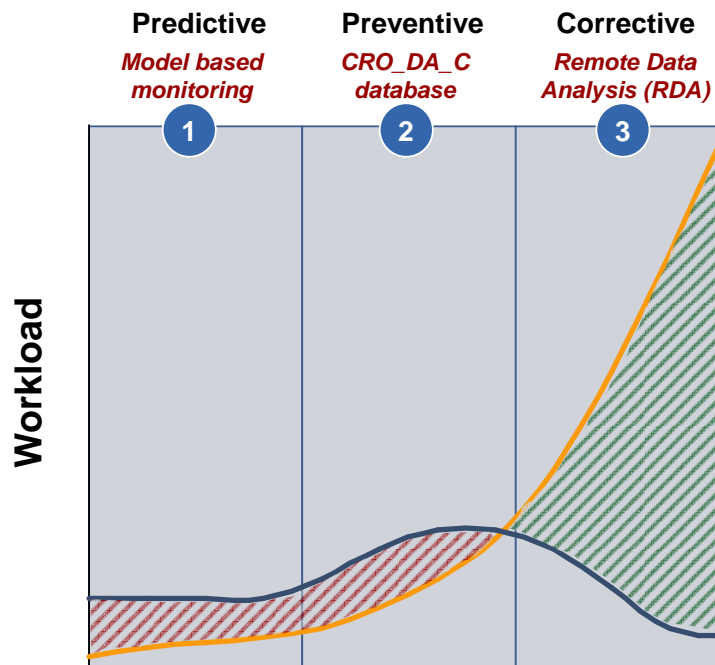
 - Defect developed, causing warning through remote monitoring
 - Alarm management or Siemens condition monitoring vibration patterns are analyzed
 - Service technicians given unscheduled service tasks
 - Effect on turbine performance and risk for turbine stop is high

- c**

 - Defect has caused an alarm, resulting in immediate turbine stop
 - Corrective action is taken to solve problem

Predictive and preventative investment saves valuable resources by optimizing downtime

Unscheduled Service curve



Targeted Work Load Curve

Optimization of maintenance strategy through integration of preventive and predictive maintenance resulting in optimized downtime and operating expenditure



Cost savings



Work load investment