

Siemens Energy Sector

Turbine Condition Monitoring TCM® And Reliability.

Mikkel Maehlsen

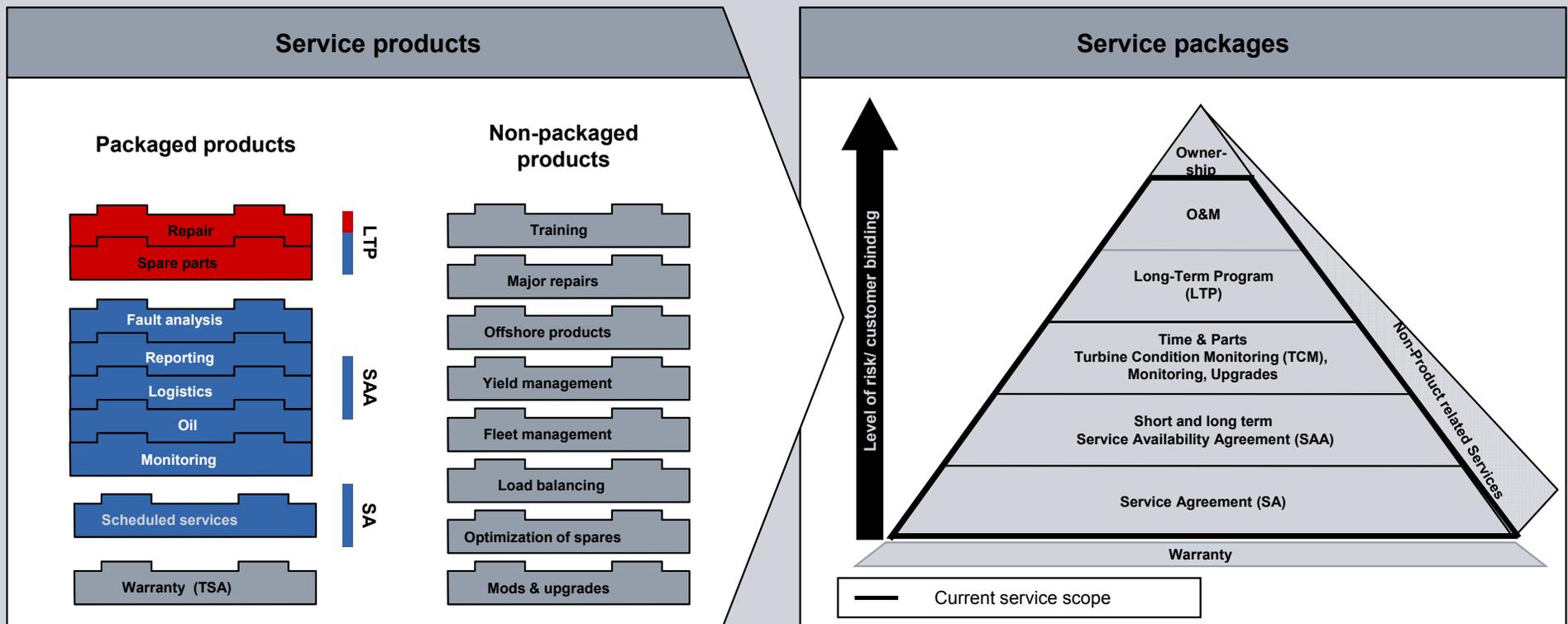
Siemens Service is a global organization with local set up



- Siemens has a global service organization structured to allow for the deployment of the highest qualified personnel on time
- New markets are established with a local presence
- Resources, skills, tooling and experience are transferred locally, to allow for optimized response times

Service offerings/packages

Definition of service products and service packages



1) Excluding grid codes

Source: SWP Service

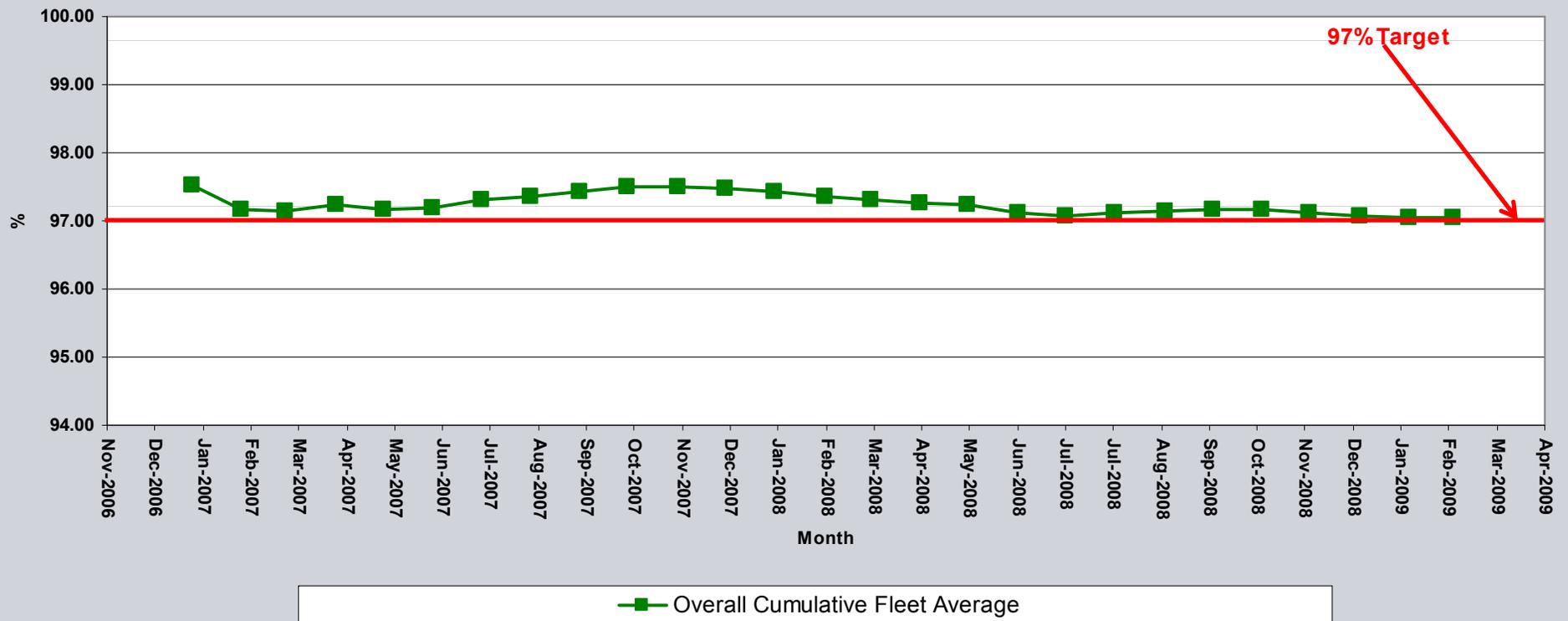
Service key performance indicators (KPI)

Key values of SWP Service

1	Safety		Accident-free performance is our highest priority
2	Quality		We aim for error free processes, procedures, reporting and continuous improvement
3	Responsiveness		Our goal is on time delivery of information, proposals, technical support, products & services to meet customer requirements
4	Customer satisfaction		We aim for a safe working environment where everyone strives for quality and responsiveness
5	Business results		With satisfied customers, we will achieve our business results

Regional availability statistics

Region Americas Production Availability Statistics



TCM® condition monitoring can increase production/availability

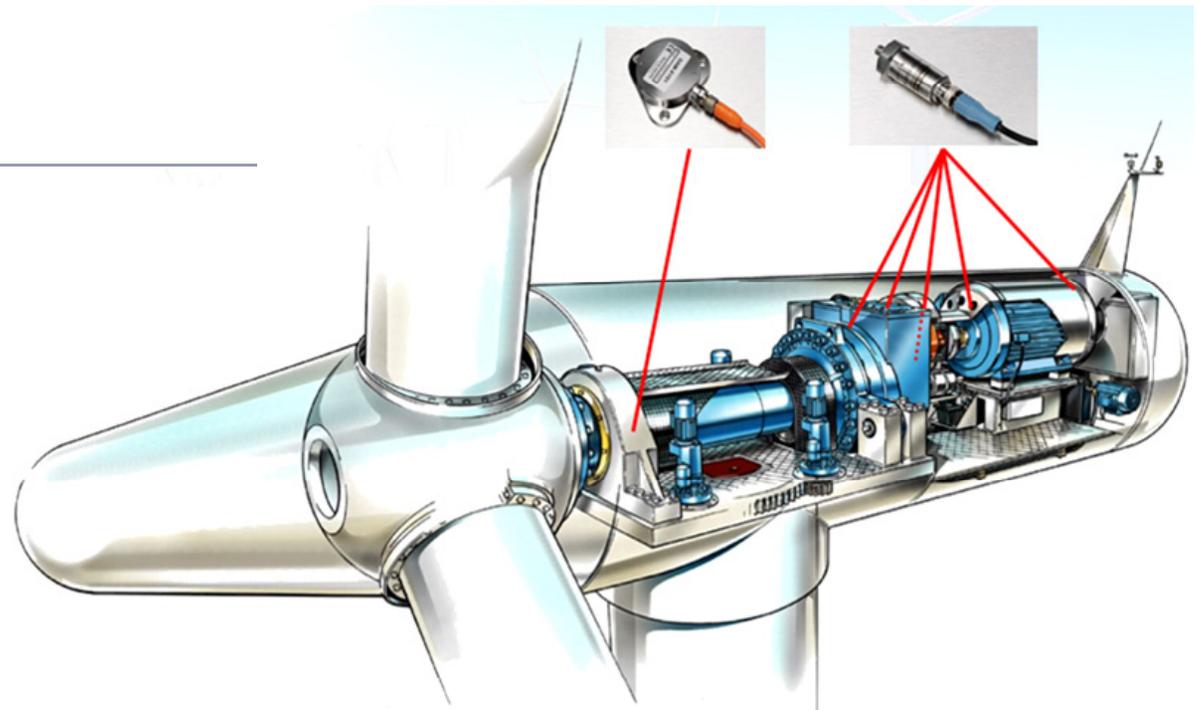
- **Allows for optimized planning of service work, which can reduce service cost**
- **Better planning of service work can reduce down-time**
- **Allows for preventive repair of components before fatal breakdown**
- **Increased possibilities for further technical development**
- **Allows for continuous monitoring**



Measurement points in a 2.3-MW nacelle

Location of sensors

- Main Bearing: 1
- Gearbox: 3
- Generator: 2



Component descriptions within the nacelle

X/Y Module



M – System Computer

ICP Module



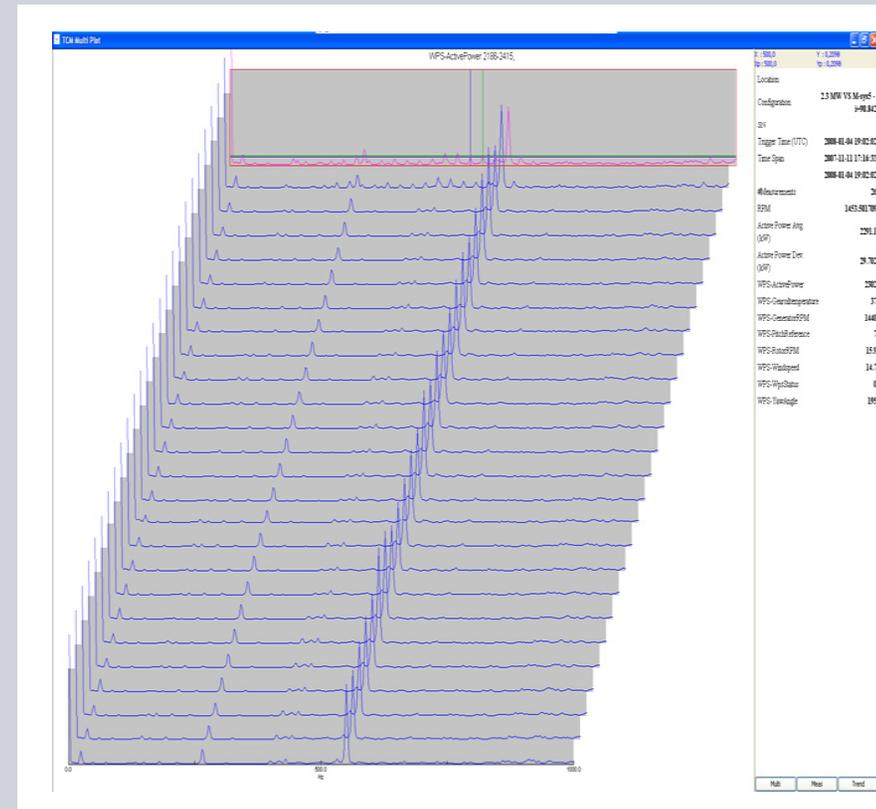
Frequency Response 0 -1kHz



Frequency Response 2Hz -10kHz

TCM® service from Siemens

- Illustration indicates waterfall plot from the TCM® database
- Plot peak indicates a frequency change deviating from the base line
- When detected, the turbine will shut down and a visual inspection is planned
- The frequency of this development is loaded into the TCM® system, and all turbines globally should benefit from the findings.



TCM® allows for real-time data of turbine performance

- Subsequent findings validate TCM® indication
- Crack visually detected, allowing for preventive maintenance to be performed prior to unit failure
- 24/7 continuous monitoring
- Globally acquired data is analyzed for continued improvement



Advanced turbine monitoring system operating worldwide

- **TCM® system is an integrated component in large Siemens wind turbines**
- **Currently operating in more than 2,000 turbines worldwide**
- **Allows for preventive maintenance rather than forced maintenance**
- **Standard on 2.3-MW and 3.6-MW Siemens wind turbine fleet**
- **“Learning system” that allows for data analysis, which may be promptly applied to all TCM®-equipped turbines in the Siemens worldwide fleet**

