

KONGSBERG

Wind Farm Management System



KONGSBERG


200

Presentation overview

- This is KONGSBERG
- Kongsberg Wind Farm Management System (WFMS)
 - Performance Monitoring
 - Wind Farm Control
 - Production Forecast
 - Condition Monitoring
- Kongsberg in Wind

A world class journey

1814 - 2014



THE BEGINNING 1814 - 1890

- *Established 1814 by Poul Steenstrup*
- *One of Norway's first industrialised factories*
- *A knowledge-based business from the start*



WORLD'S BEST 1890 - 1900

- *Innovation at it's heart, international success in it's sights*



MODERN TIMES 1900 - 1945

- *Continual development of the company and brand*
- *Creating new divisions*
- *Investing in our people, fulfilling our potential*



INDUSTRIAL LOCOMOTIVE 1945 - 1960

- *Driving force in the restructuring and development of Norwegian industry*
- *Collaboration with the best to be the best*

A world class journey

1814 - 2014



- *A golden age of innovation at the company*
- *Gaining recognition as a global leader*



- *Creating long-term stability through focusing on core strengths*
- *The creation of a new, publicly listed business – proud of our past, focused on our future*



- *World class solutions to global challenges*



- *Kongsberg Oil & Gas Technologies*
- *Kongsberg Maritime*
- *Kongsberg Defence Systems*
- *Kongsberg Protech Systems*



EXTREME PERFORMANCE FOR EXTREME CONDITIONS

We develop and deliver advanced systems and technology for people working under extreme conditions.

Our solutions ensure efficiency, safety and high performance in operations ranging from deep sea to outer space.

At its core, KONGSBERG integrates advanced technologies into complete solutions

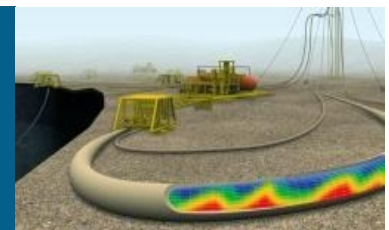
Key core capabilities

- Integrating sensors and software
- Supporting human decision making, precision, safety, security
- Cybernetics, software, signal processing and system engineering
- Project and supplier management

Dynamic positioning and vessel automation



Real time drilling support



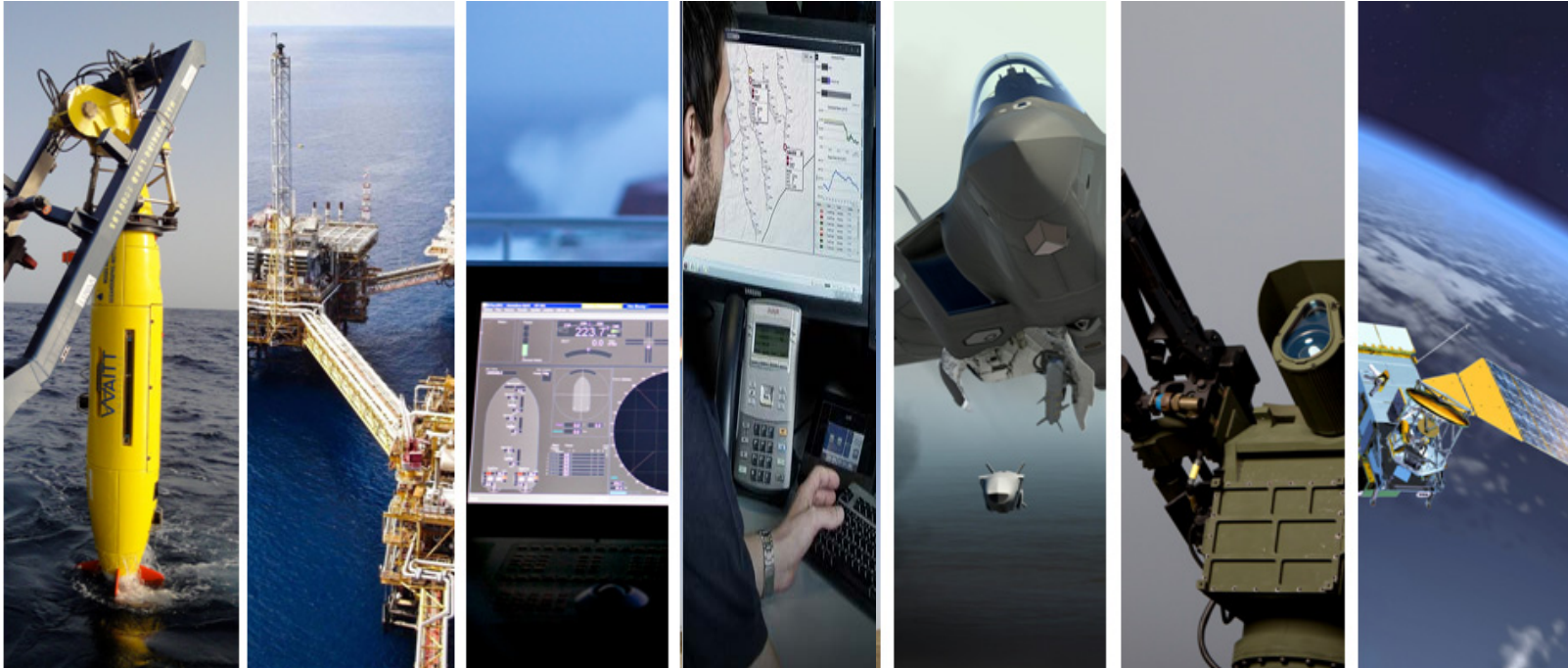
Advanced robots



Command and control systems



International high-tech solutions, from deep sea to outer space



Advanced solutions and applications for the maritime, oil & gas, renewable wind, defence and space industry.

- Extreme Performance for Extreme Conditions -

Focus on technology leadership forms the basis for our international growth



Global Top 3

Offshore, merchant shipping applications

Defence systems and applications

Niche oil and gas and subsea technologies

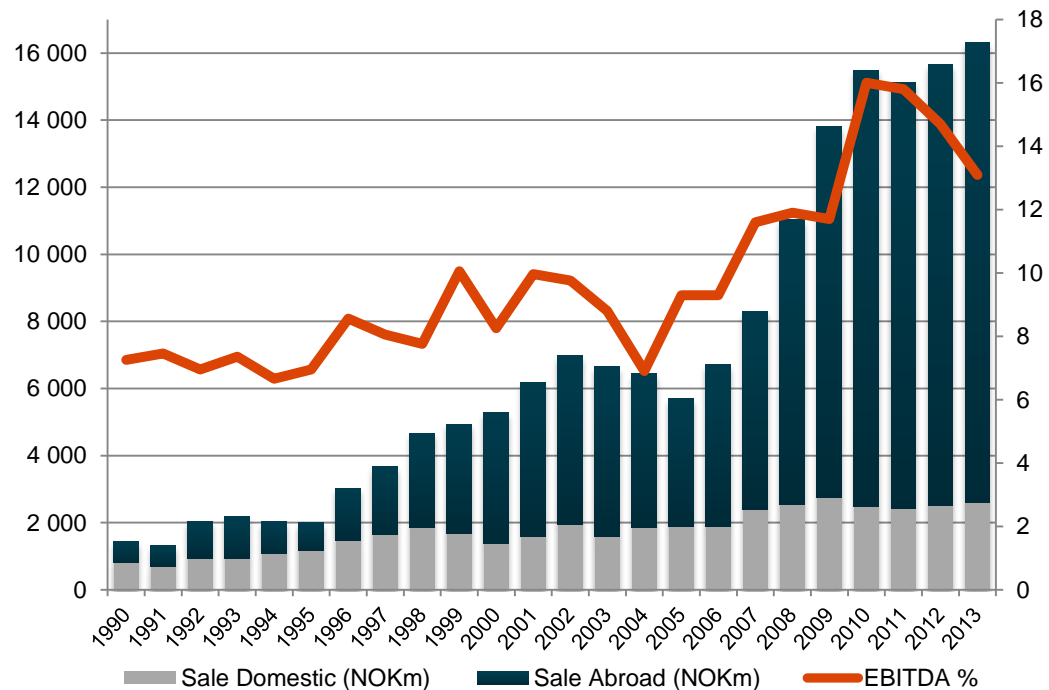
Niche space technologies

Company data (2013 figures)

7 493 employees

76 % revenues from outside Norway

More than 25 countries



We genuinely believe that our strong, value based culture drives our business performance

WORLD CLASS

— THROUGH PEOPLE, TECHNOLOGY AND DEDICATION

DETERMINED

What we start, we finish.
We do not give in

INNOVATIVE

We relentlessly pursue
improvements, new ideas
and new solutions

COLLABORATIVE

We collaborate as individuals
and as an organization

RELIABLE

We are reliable people.
We are responsible
citizens.

World Wide Life Cycle Support

- KM - equipment on more than 17 000 vessels – comprehensive service network
- KONGSBERG's life cycle services is a **key differentiator in the market**



Kongsberg Maritime's "follow the sun" support centers, located in Norway, Singapore and New Orleans, ensure service 24/7 around the globe



Kongsberg Maritime

- Efficient and safe operations at sea



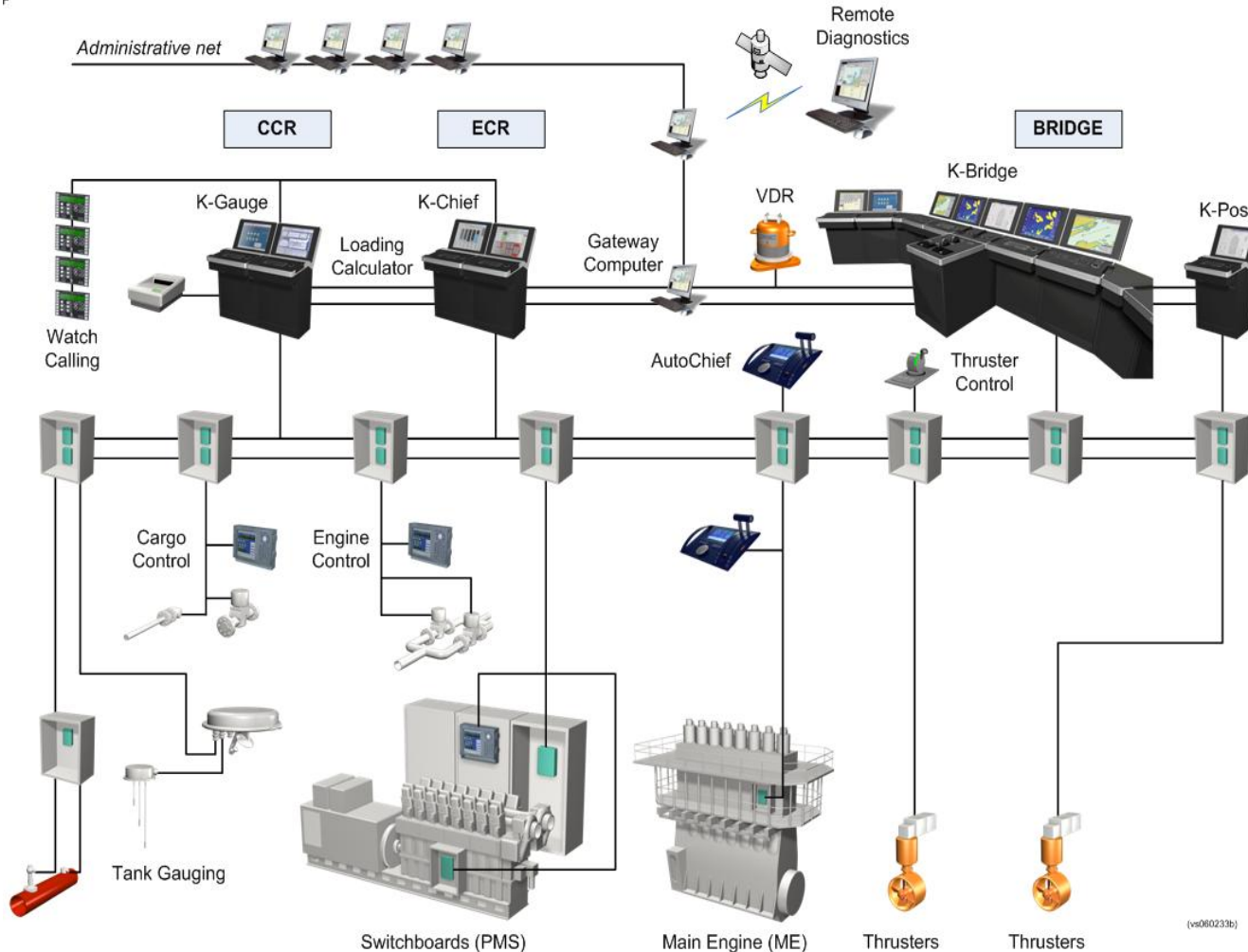
Kongsberg Maritime

- Offshore – Merchant Marine – Subsea
- 55 offices in 18 countries
- 4258 employees (2013)
- Revenues MNOK 8 264 (2013)
- Installed on more than 17,000 vessels
- Dynamic positioning, navigation, automation, simulation, seabed surveying and fisheries

System integrator – Full picture

Kongsberg Maritime

”The Full Picture” for Maritime and Offshore applications
To be extended to Wind Power applications



(vs060233b)



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Kongsberg Wind Farm Management System



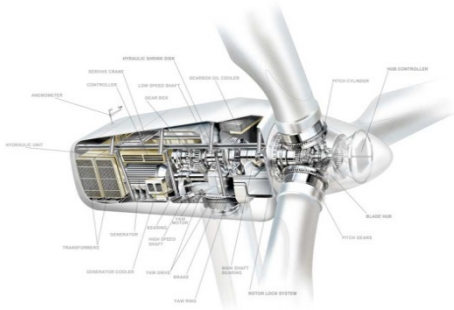
KONGSBERG

Condition Monitoring

Production Forecasting

Wind Farm Control

Performance Monitoring



TOTALITY

5-8% reduction in CoE through our new Wind Farm Management System

Setting the new standard for wind farm control and optimization
Providing insights in how your wind farm operates in one complete tool





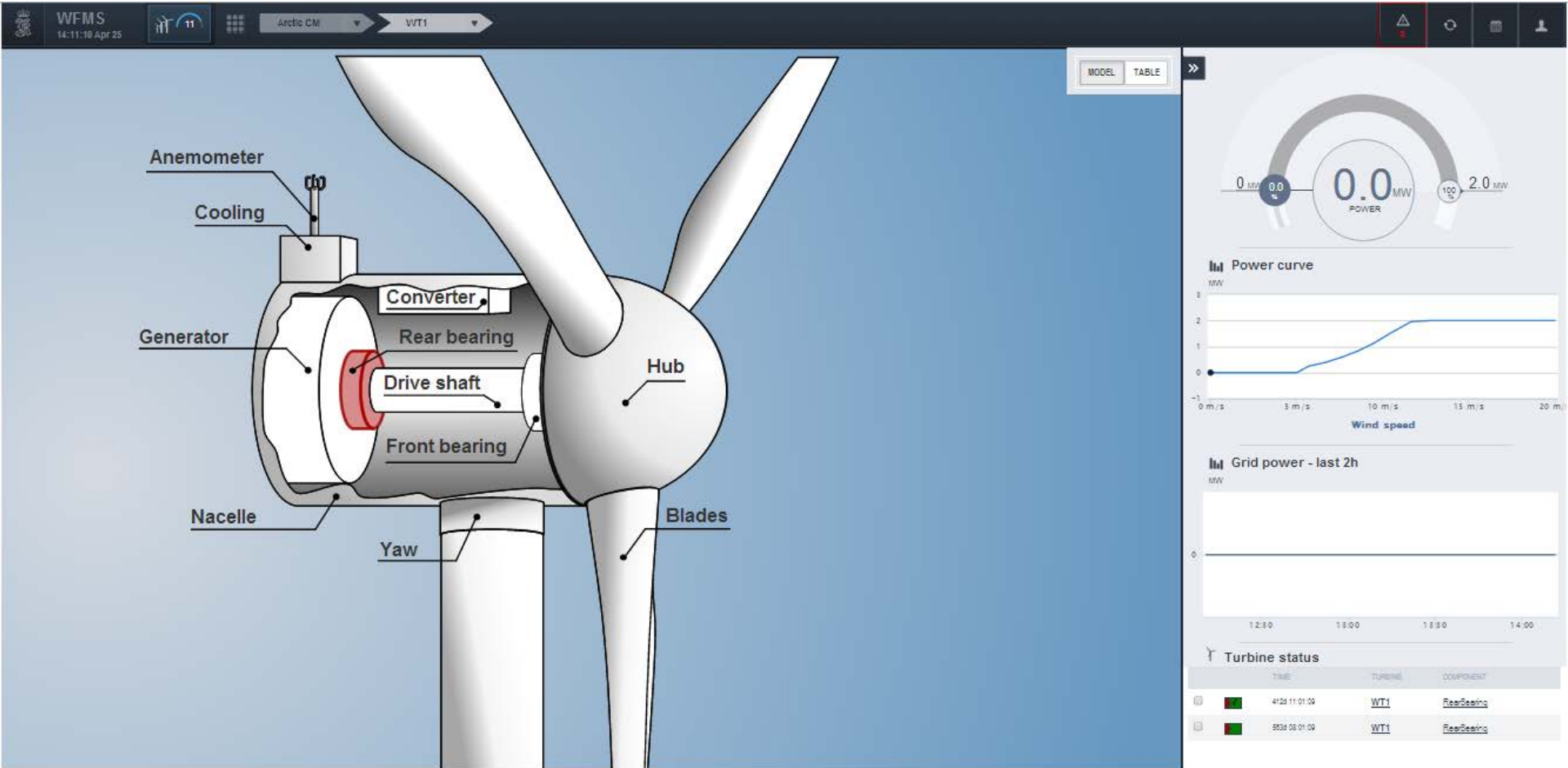
Performance Monitoring

- COLLECTS AND MONITOR ALL KPI'S OF THE WIND FARM IN ONE SIMPLE TOOL
 - Reporting
- GIVES AN OVERVIEW OF THE WIND FARM PERFORMANCE
 - Power curves
 - Pitch angle..
- PROVIDES AN HANDY TOOL WHERE CUSTOMERS CAN DO THEIR OWN ANALYZES
 - Faults – lost production
 - Inefficiency – lost of production
 - Benchmarking..





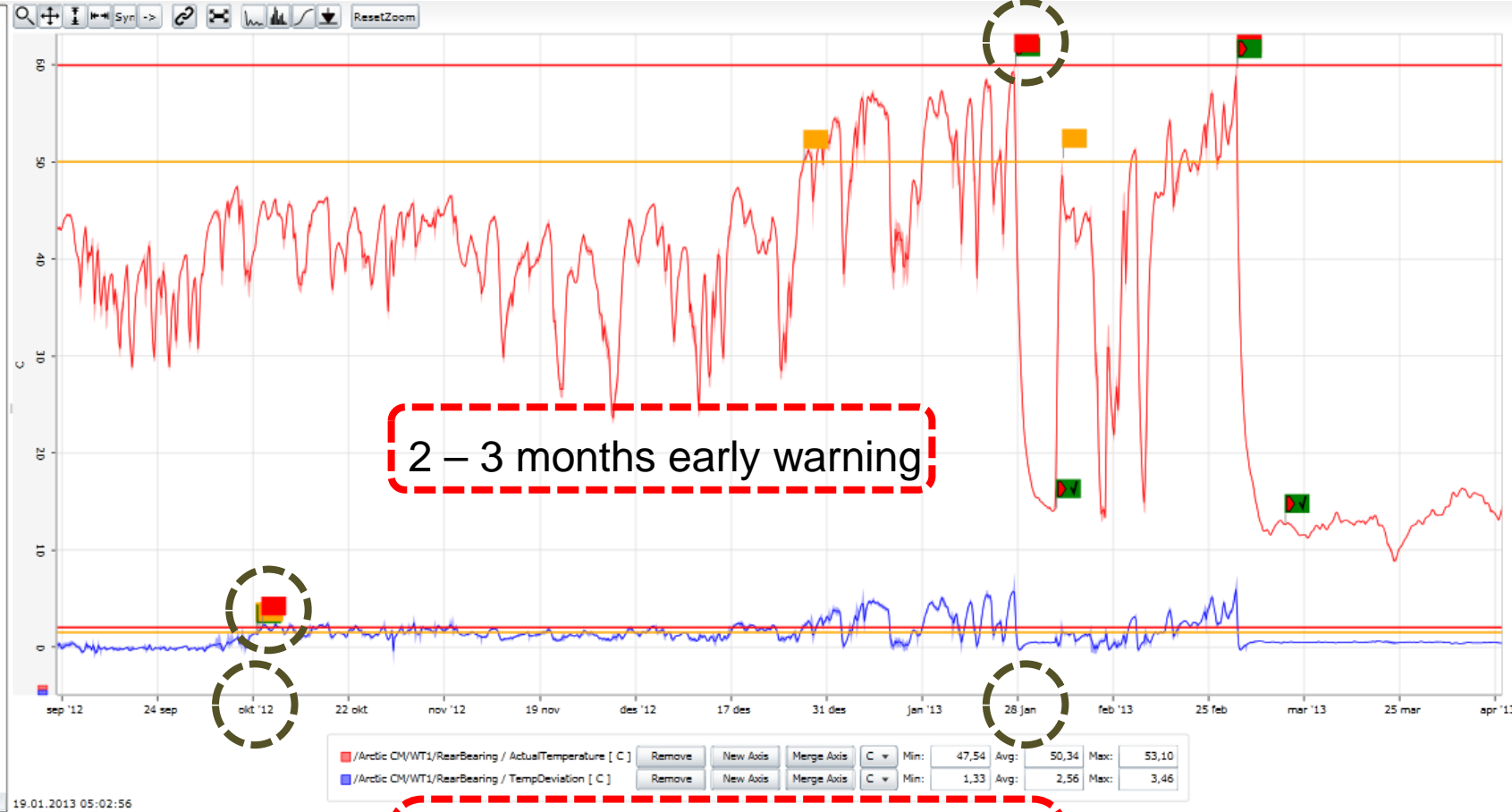
Condition Monitoring – analysing tool





Condition Monitoring – analysing tool

- CM
- '1
- Blade
- Hub
- DriveShaft
- FrontBearing
- RearBearing
 - ActualTemperature
 - EstimatedNormalTemperature
 - TempDeviation
- Generator
- Converter
- Cooling
- Yaw
- Anemometer
- Nacelle
- State
- '2
- '3
- '4
- ks
- sea OPT



2 – 3 months early warning

Inspect rear bearing
 Change grease
 Avoid unrepairable fault

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Wind Farm Control

INCREASED PRODUCTION BY DYNAMIC FARM OPTIMIZER

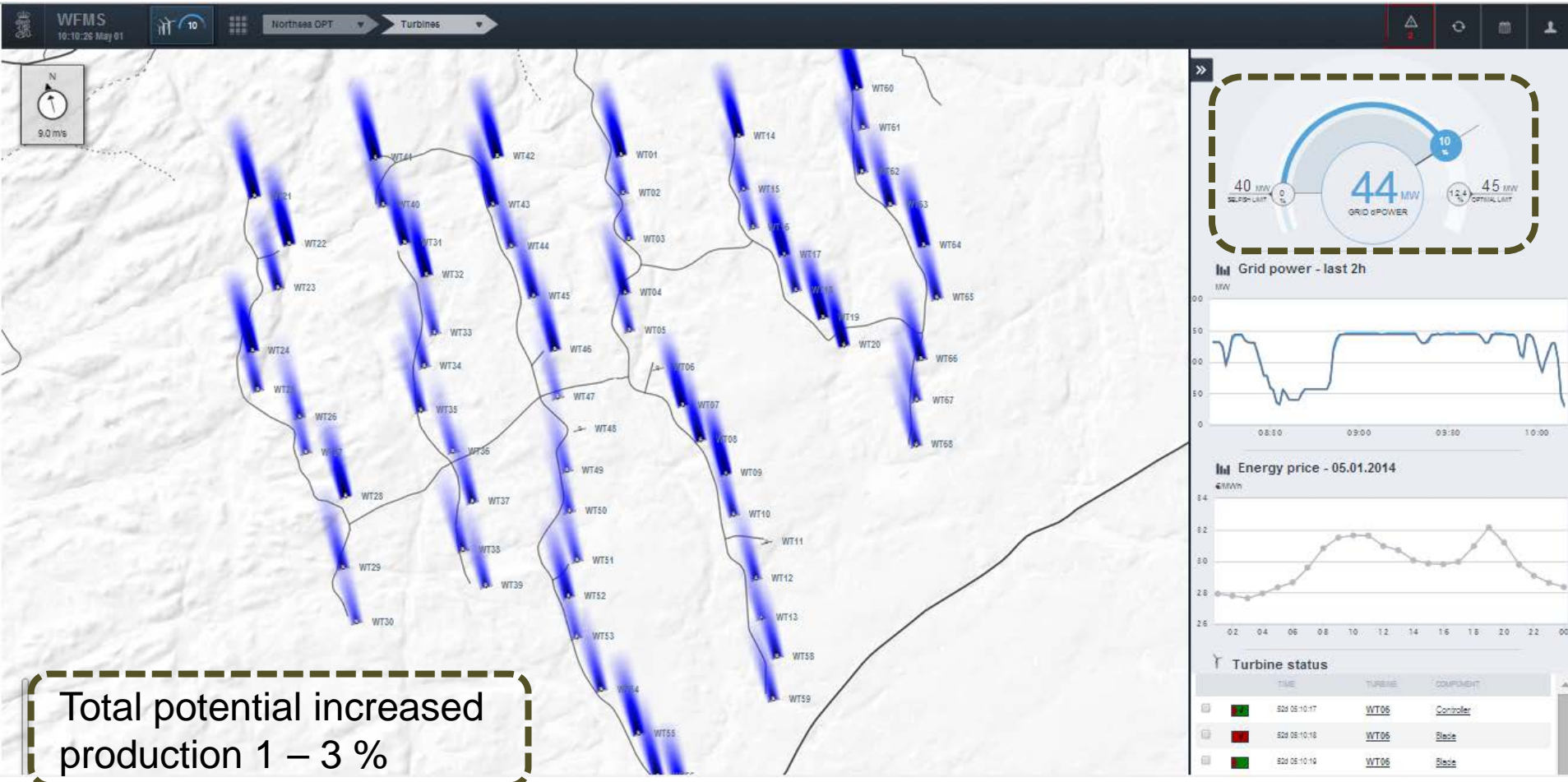
- Individual set points for each turbine based on:
 - *Actual wind condition*
 - *Turbine state/condition*

REDUCED TURBINE WEAR

- Balancing of loads
- Load mitigation
- Reduced turbulence wear



Wind Farm Control – Production optimiser





Production Forecasting

IMPROVED PRODUCTION FORECASTING

- Reduced imbalance cost
- 48 hours predictions
- Integration of WFC, CM and PF in one system

IMPROVED MAINTENANCE FORECASTING

- Predictions of maintenance weather windows
- Minimize production losses due to maintenance stops



Photo: Vattenfall



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KONGSBERG Onshore/Offshore Wind

