

# WÄRTSILÄ DYNAMIC MAINTENANCE PLANNING (DMP) AND CONDITION BASED MAINTENANCE (CBM)

# Condition monitoring, Dynamic Maintenance Planning and Condition Based Maintenance

## Condition Monitoring (CM)

Remote monitoring of equipment parameters and operational data. Supports operators in maintaining and optimising equipment original performance.

## Dynamic Maintenance Planning (DMP)

Enables fine-tuning of operating parameters and adjustments of maintenance intervals for main components.

## Condition Based Maintenance (CBM)

Optimises the availability, reliability and performance of installed equipment. Part of Wärtsilä's Dynamic Maintenance Planning concept.



- Wärtsilä CBM allows entering into DMP, which enables need based engine maintenance
- DMP enables fine-tuning of operating parameters and adjustments of maintenance intervals for main components
- **DMP assists in meeting the technical, economical and environmental performance targets of an installation**
- Wärtsilä CBM and DMP is part of Wärtsilä agreement having true goal to increase engine availability, reliability and efficiency

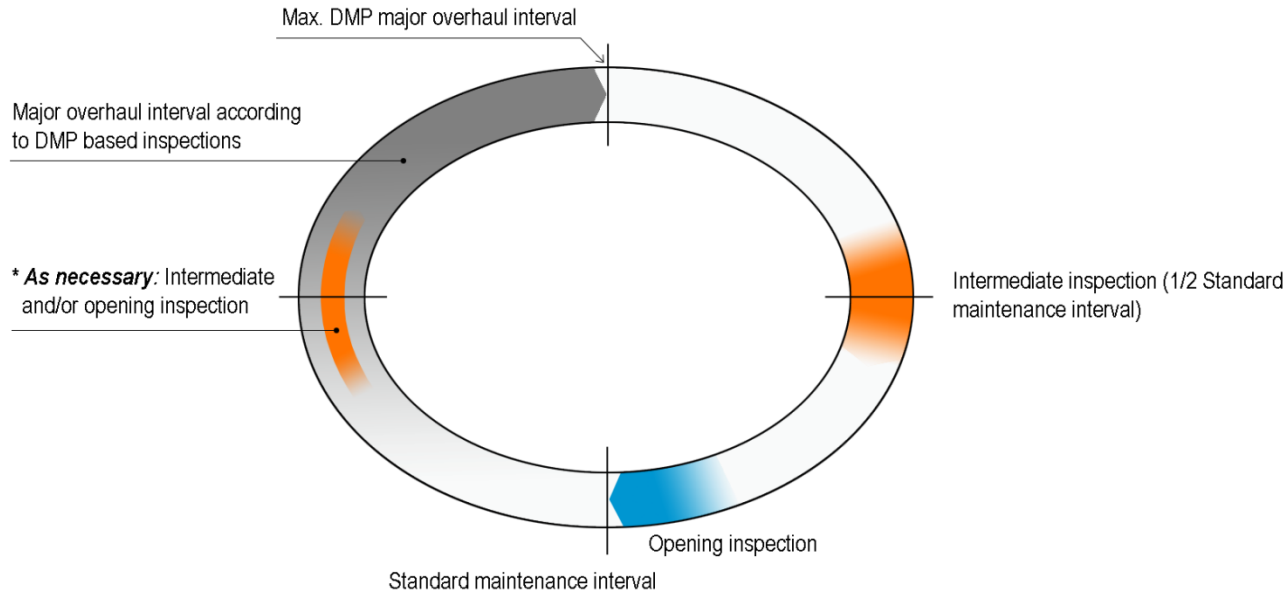
# DMP Concept

DMP solution assist in meeting the technical, economical and environmental performance targets of an installation.

The DMP solution enables fine-tuning of operating parameters and adjustments of maintenance intervals for main components.

DMP consists of:

- Remote Condition Monitoring service
- Site audits and intermediate / opening inspections
- Maintenance planning service



\* Depending on the operating conditions and results from previous inspection

# DMP Concept

## Remote condition monitoring

CBM collected data



## Operating crew reporting

Fuel/ Lube oil analysis  
Extended condition monitoring



## Site audit and inspections

Execution of inspections  
Report findings




## Maintenance Planning

- CBM reports
- Measurements based on analysis update
  - Work cards
  - Spares scheduling
- Workforce scheduling
  - Logistics and coordination report
  - Recommendations actions needed

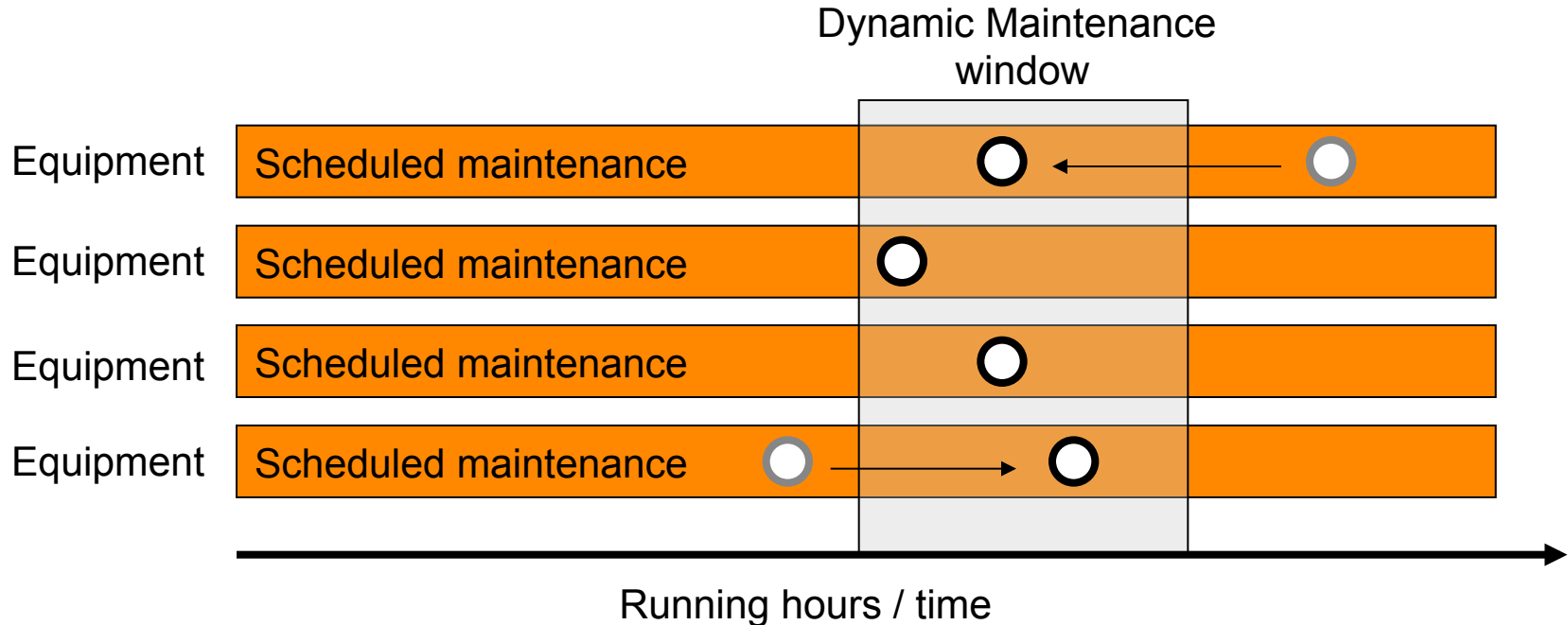


Online Report



Work orders

# DMP Schedule

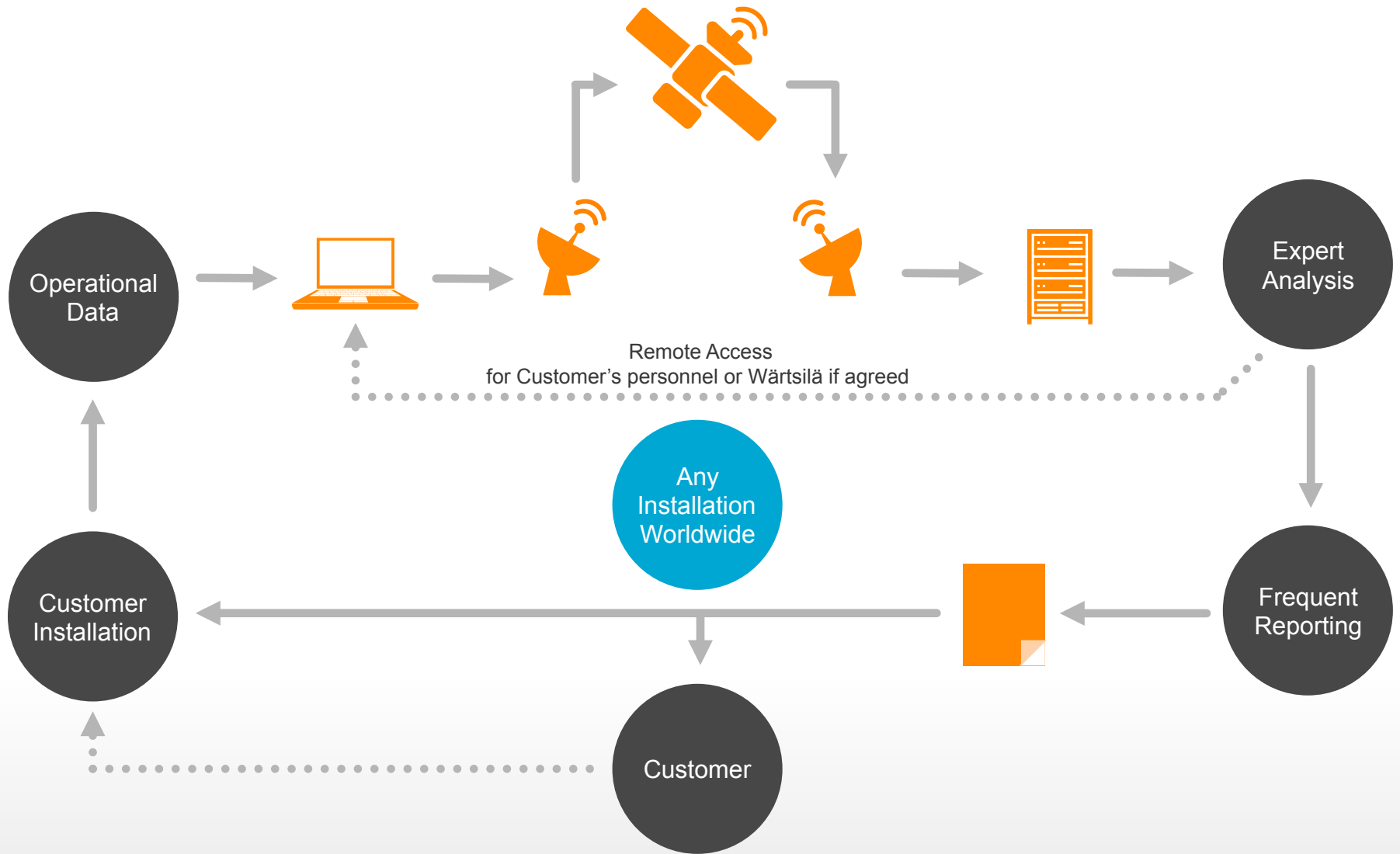


Conventional equipment maintenance means scheduled preventive maintenance routines strictly based on equipment running hours. So it is not always possible to match various schedules in the best way, which in turn can affect operational availability.

In contrast, predicting the actual condition of the equipment makes it possible to regroup the maintenance of equipment and systems in a maintenance window so that it also fits in with other business factors.

- Wärtsilä has more than 10 years of experience in engine condition monitoring with various type of diesel and gas engines
- The engines operational data is collected during normal operation and evaluated by experienced Wärtsilä engine superintendents with Wärtsilä dedicated engine based evaluation tool.
- The data collection is done automatically and does not put additional work to ship crew or plant personnel
- The engine condition evaluation results are reported monthly basis with operation data, notifications and advices

# CBM Way of working





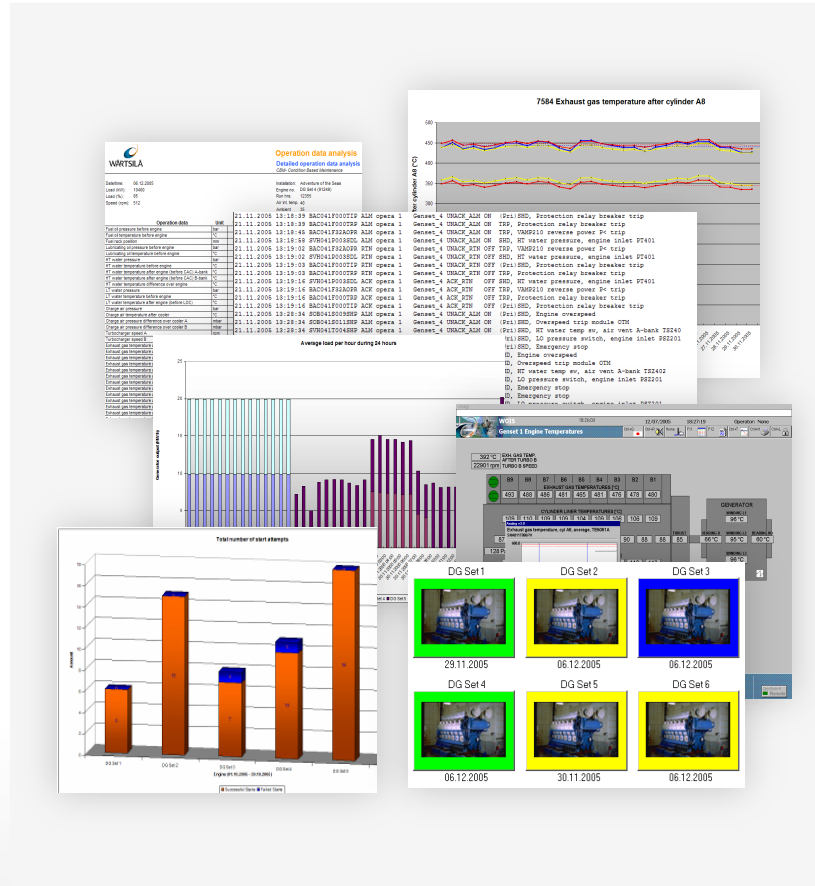
# CBM Reporting

## CBM Analysing and Feed back

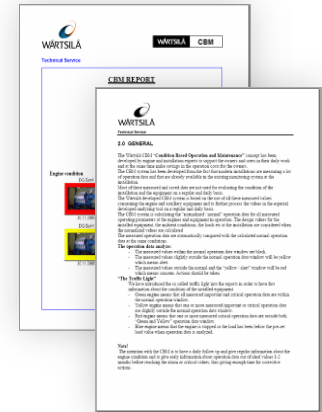


CBM  
Database

- Ideal reference values
- Remote monitoring
- Condition feed back
- Predictions
- Production reports
- Special analysis
- Alarm log analysis
- Etc.

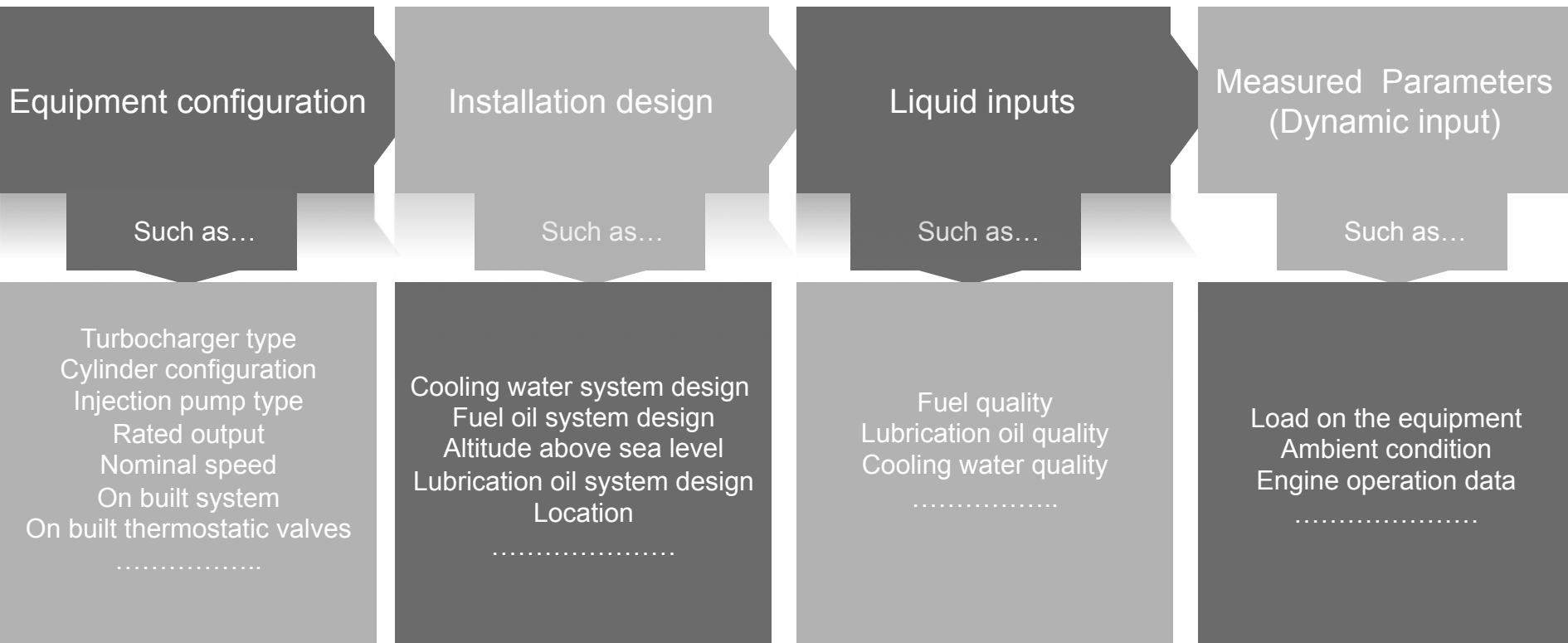


## CBM Report



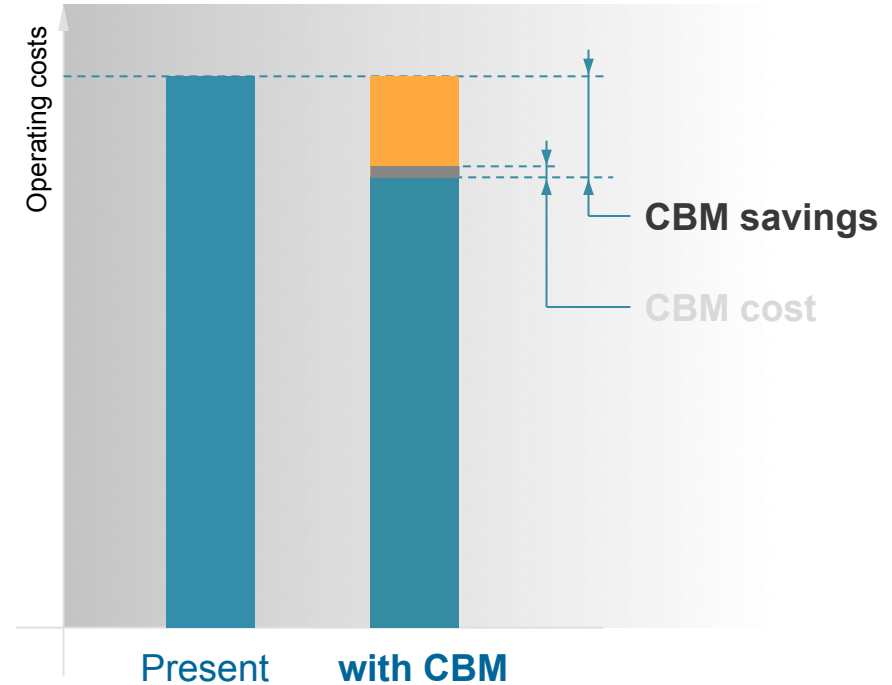
# How the engine health is determined?

The engine key operation data is continuously collected and combined with other relevant data. Comprehensive good quality condition evaluation is combination of high accuracy measurements, operation data and co-operation



# Benefits - CBM Targets

- Reduce the fuel oil consumption and emissions with about 2-5%
- Avoid unplanned stops with 60-90%
- Increase the total availability with 5 – 20%
- → Keep your installation always at ideal running condition



# Benefits of DMP and CBM

- Improved reliability, no unexpected down time
- Improved availability, overhauls need and operation scheduled basis with minor operation interruption
- High level of engine efficiency, no increased fuel consumption

# CBM References

More than 520 marine and power plant installations, over 2240 engines are connected to Wärtsilä CBM.



# Reliable oil drilling through dynamic maintenance planning

- Continuous monitoring improves security onboard the rigs



*Engines and thrusters are the heart and lungs of an oil rig and it is of utmost importance for our operations that they function well. The five-year service agreement, with an option for five more, shows that we are thinking long-term about our co-operation with Wärtsilä.*

**Magnar Fagerbakke**  
Vice President, Marketing & Contract  
COSL Drilling Europe AS



## The Challenge

- Customer's installations needed to be up and running with minimum downtime
- A total of 18 engines and 18 thrusters needed to be taken care of
- Monthly time-limit to guarantee minimum downtime.
- Needed to be able to detect possible failures in advance

## Solution

- Tailor-made maintenance agreement to keep the installations productive
- Dynamic maintenance planning to minimize downtime
- Sensors monitoring the installations' condition

## Results

- Improved planning of the operation and maintenance
- Less downtime and longer service intervals
- Improved security onboard the rigs
- Less resources onboard when analysis is done onshore

# Agreement lets RCL focus on their core business

- The agreement between RCL and Wärtsilä is based on mutual trust and long-term commitment



*The core of this agreement is that Wärtsilä will take care of the maintenance that needs to be done on the ship engines so that we can concentrate on our core business, which is looking after cruise guests.*

**Harri Kulovaara**  
Executive Vice President, Maritime  
Royal Caribbean Cruises Ltd.



## The Challenge

- The most extensive maintenance and technical support partnership Wärtsilä has ever formed with a marine customer
- Maintenance planning must be carefully and systematically planned to ensure that the cruise ships can keep sailing and generate income
- Finding new ways to reduce and optimize fuel consumption.

## Solution

- Maintenance support agreement covering 29 cruise ships, 118 Wärtsilä engines with a total output of approximately 1400 MW
- Extensive use of Wärtsilä's Condition Based Maintenance (CBM) engine monitoring systems, enabling performance monitoring of individual engines online anywhere in the world.

## Results

- Customer able to concentrate on his core business
- Better maintenance planning leading to a higher ship utilization rate and thus more income
- Improved fuel economy
- Freeing up resources in house to concentrate on other important issues

# Wärtsilä's Service Agreements



## Supply Agreements

- Manpower
- Spare Parts
- Workshops
- Online Solutions



## Technical Management

- Dynamic Maint<sup>ce</sup> Planning
- Risk Evaluation
- Inspection
- Training and competences
- Planning support



## Maintenance Agreements

- Manpower & Parts
- Performance Guarantee
- Global Coordination & Supply



## Asset Management

- Operations & Maintenance
- Part Crew
- Equipment
- Installation







# WÄRTSILÄ

Thank you!