X-DF TWO-STROKE ENGINES: OPERATIONAL EFFICIENCY AND FUTURE DEVELOPMENTS

JOIN THE WEBINAR
April 14 @ 2PM SGT
(Middle East and Asia session)
AGENDA:

- X-DF two-stroke engines and future development
- Operational experience of X-DF 2-stroke engines
- Wärtsilä Lifecycle Services
- Live Q&A session

PRESENTED BY:

Jeremy Crossman
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Excellence & Coaching,
Wärtsilä

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General Manager, Head of Global Sales,
WinGD

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WinGD

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General Manager, Agreement Sales,
Wärtsilä
WEBINAR PRACTICALITIES

The webinar is 45 min + up to 15 min Q&A

- High bandwidth Wi-Fi or hardwire is better
- You will be muted when you join
- Questions can be sent with the questions widget in the control panel
- The recording will be shared after the webinar
- Local telephone numbers at own cost (in case audio by telephone)
- Sit back and gain insight!
X-DF Technology and Future Developments

C. Cartalemi
Head of Global Sales
X-DF has Become the Standard of the Industry

A decade of technical developments and commercial successes

Kick-off:
- Concept development
- Rig and one cylinder testing

Full scale engine testing with RT-flex50DF:
- Concept verification
- Performance, automation and component design

Start up of X72DF tech. demonstrator
RT-flex50DF:
- First customer engine deliveries
- Type Approval Test

First large LNGC sea trial, June 2017

X-DF is the standard engine for LNGC (100% MS)
X-DF 2.0 was launched

2011
2012
2013
2014
2015
2016
2017
2020
2021

First sea trial completed
First large-bore production engines

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WinGD X-DF Technology and Future Developments
X-DF Provides the Best CAPEX/OPEX

The best solution for all ship segments

The main merits

- Low gas pressure < 13 bar
  - Simple and reliable gas supply system
  - Simple gas sealing
  - Wide selection of proven compressors / pumps

- Lean-burn ‘Otto’ combustion means IMO Tier III compliance:
  - Without additional equipment (EGR/SCR)
  - Without additional fuel consumption
  - Without compromised component reliability

- Gas mode: Pre-mixed lean-burn ‘Otto’ combustion
- Diesel mode: Diesel process
Improving Combustion Stability

iCER technology

- Extended operating window
- Better lambda control
- Lower fuel consumption
- Lower emissions
iCER Technology

Equipment of iCER - scheme

Gas fuel -> iCER active
Liquid fuel -> iCER inactive

BPV  Back Pressure Valve
EG   Exhaust Gas
SOV  Shut Off Valve
SAC  Scavenge Air Cooler
WMC  Water Mist Catcher
EGC  Exhaust Gas Cooler
PHE  Plate Heat Exchanger
iCER Benefits

Effect on gas combustion

Increase of rate of recirculated exhaust gas

Adjustment of pilot injection timing

Benefits of iCER technology:
- Combustion can be fully controlled and optimised for best gas fuel consumption
- Combustion speed is decreasing for smooth combustion
iCER Benefits

- Reduced **fuel gas consumption**
- Due to the increased compression ratio the **liquid fuel consumption** in diesel mode is reduced as well
- **CH4 emission** (methane slip) reduced by up to 50%
**iCER Technology**

**Gas fuel and diesel fuel consumption – 5X72DF [11400kW / 74 RPM]**

Gas fuel and Diesel fuel consumption reduction on all loads
Highest reduction especially at part loads

**Gas mode [BSGC]**

- 6.4 g/kWh
- 5.6 g/kWh
- 4.4 g/kWh

**Diesel mode [BSFC]**

- 8.1 g/kWh
- 7.1 g/kWh
- 5.7 g/kWh
Emission Improvement from X-DF to X-DF 2.0

Lower CO2
Lower NOx
Low PM

X-DF vs. X-DF 2.0

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WinGD X-DF Technology and Future Developments
iCER Technology

Proposed arrangement on a LNGC - 5X72DF-2.1

1. iCER very close to the engine
2. No adaptation of vessel design required
3. Minimised Engine Room design changes foreseen
4. Arrangement also possible for other vessel types
Thank you

Winterthur Gas & Diesel Ltd.
Switzerland
www.wingd.com
WinGD X-DF
Update Service Experience &
Outlook on X72DF Upgrade

Adrian Siegfried
GM Customer Support
14/04/2021
DF Fleet Figures

Quickly increasing in numbers.. in the assembly shop

- A number of engine manufacturers have gained significant experience and routine in production as well as testing of X-DF engines:
  - 27 sets RT-flex50DF (in China, Japan and Korea)
  - 6 sets X52DF (in Korea and Japan)
  - 33 sets X62DF (in Korea)
  - >150 sets X72DF (in Korea and China)
  - 12 sets X92DF (in China)

- Type Approval Testing (TAT) done on RT-flex50DF, X52DF X62DF, X72DF and X92DF (incl. new control system).

- First X40DF engine passed FAT in China.

- First X82DF engine ongoing R&D testing in China.
DF Fleet Figures

Quickly increasing in numbers.. and in operation

• Locations: China, Turkey and Korea
• Ship types:
  • 15,000 dwt Chemical Tanker
  • 14,000 dwt Asphalt Carrier
  • 7000PCTC with 8X52DF
  • 123k Shuttle Tanker with 7X52DF
  • 180,000 m$^3$ LNGC with 2 x 6X62DF
  • 174’000 m$^3$ LNGC with 2 x 5X72DF
  • 115k Ice class (crude) Tankers with 7X62DF
  • 115k Crude oil Tanker with 6X62DF
  • 180k Bulk carriers with 5X72DF
  • 22k TEU ULCC with 12X92DF
• Engine types: RT-flex50DF, X52DF, X62DF, X72DF, X92DF
• More than 100 engines in service (March 2021) – with >1 million rhrs
DF Service Experience Update

- Update on piston running
- Update on Jacket Cooling water system
- Service overhaul feedback - Key component TBOs
- Recent Service letters
Root causes of cylinder scuffing

A limited number of piston running incidents occurred in 2019 and early 2020 on mid-bore DF engines.

Although root-cause investigations showed many contributing factors, the following were considered to have the most significant influence:

- **Breakdown of lubrication oil film due to water ingress** into the cylinder. -> Resolved with improved pre-chamber fixation method.
- **Cylinder lubrication deposit** leading to restricted freedom of the piston rings. -> Resolved with new cylinder oil formulations and updates on documentation (follow below QR code).
- **High cylinder liner wall temperatures** affecting the behaviour of the cylinder lubrication -> Resolved with enhanced cooling system efficiency

Today piston running is very stable (again) on the X62DF/X72DF engines, with other X-DF engines showing excellent conditions from the beginning.
Increased Liner Wall Temperature

**Internal cooling water leakages on X62/72DF**

**Investigation, Mitigation & Design Upgrade**

**Correct Water Guide Jacket alignment**

- Venting instruction SL004-1 (Jan 2019), and updated SL0004-2 released (Sept 2020).

**Removing air bubbles in cooling circuit**

- Air separators introduced as new standard on X62/X72DF (Nov 2018).

**Fixation of the Water Guide Jacket improved**


**Newbuilding JCW ‘Uniflow’ solution introduced** (adapting X62B and X72B concept) for X62/72DF engines

- Simplification of system and enhanced reliability.
- Some projects also receive JCW Uniflow ‘Retrofit’ upgrades -> Enhanced cooling efficiency with increased flow rate in liner cooling bores for existing engines (see sketch on the right).

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The introduction of the JCW uniflow retrofit solution was found to greatly improve the on-board situation and resulted in LWTs reduced by up to 15 °C at high engine loads on certain ships.
X52DF Service Feedback

Check up on first X52DF after 6000hrs – good condition of key components

Six X52DF engines are in service today with up to 6000 running hours, powering Shuttle Tankers (with DPS mode) and 1 PCTC (Car Carriers).

A detailed field follow up inspection on the first X52DF from Feb 2021 confirmed excellent conditions:

- Piston rings in spotless condition (2 ring pack)
- Little deposits on piston crown and ring grooves
- Original honing marks on cylinder liners visible

Other ‘new’ features:

- iGPR: Working excellent, no issues experienced.
- LVOC (Liquified Volatile Organic Compounds) system under commissioning on 7X52DF Shuttle Tankers.
X92DF Service Feedback

6 vessels currently in operation

- No major issues on engine design encountered.
- Piston running resolved with latest design improvements (validated through extensive R&D testing on testbed)
- iGPR system working flawless
- WiCE control system: Very good service experience since delivery, no major issues faced. Some specific alarms added to the system to improve engine monitoring based on first service feedback.
- WinGD closely following up fleet.
X-DF Service Feedback

After 21’000 rhrs on first X62DF – Intermediate survey after 3 years in operation

- Excellent piston running behaviour.
- Wear down on cylinder liners measured ‘0’ – original honing marks partly still visible after 3 years in operation; theoretical lifetime cylinder liners: >300krhrs.
- Gas Admission Valves (GAV): Excellent condition; lapping of valve seats done, now ready for the next 3 years of operation.
- Pilot Fuel Injectors: Excellent operation confirmed, TBO/lifetime extended from 8000 to 12’000 running hours in a first step; clear potential to further stretch the TBO interval in the future.
- Main fuel injector: Aging of nozzle tip over time due to thermal exposure (gas mode operation) identified, picture various across DF fleet. Current TBO (8000~12’000hrs) remains valid at present.
Service Letters

Quick solutions based on field findings

Several service letters were recently released - based on field experience – to ensure proper support of the running fleet:

- **SL0015-1** (Feb 2020) – Pre-chamber fixation upgrade for DF engines
- **SL0009-1** (July 2020) – Slow steaming recommendations
- **SL0025** (Aug 2020) – Control parameter upgrade L’Orange injectors
- **SL0016** (Sept 2020) – Operating iCAT system with one grade cylinder oil
- **SL0004-2** (Sept 2020) – Upgrade on JCW systems X62/72DF
- **SL0027** (Feb 2021) – Main injector potential cross contamination (X62/72/DF)
- **SL0018-1** (Feb 2021) – Lubricants for WinGD engines
DF Service Experience - Status Today

After >1 Million rhrs in the total of X-DF fleet

- X-DF engines are running well overall. More than 100 DF engines are in service, with longest running hours achieved being >26'000hrs.

- X-DF fleet is rapidly increasing: First X52DFs entered service in spring 2020 and the X92DF (CMA-CGM ULCC) fleet rose to 6 ships in operation today.

- RT-flex50DF/X52DF/X62DF and X72DF experienced problems systematically resolved and solutions applied to all X-DF designs.

- WinGD closely following X-DF fleet to further enhance customers satisfaction, and decreasing OPEX as the engines gain more running hours.
Supporting the Operating Fleet

Joint efforts for common customers

• WinGD works closely with its Service Partners, Wärtsilä (and CMS) for service attendance within the engines warranty period.

• Organising repairs / spare parts to be completed in time is important. Minimise downtime for a vessel, and minimise operators potential losses.

• Equally or even more important – especially in COVID’19 times as experience showed – is timely remote support. Helping a customer / a vessel via remote can save time and cost, and in many cases, issues can be resolved within a short time, so that the vessel can continue its voyage.

• With remote Support, WinGD’s Operation team is working very closely with Wärtsilä’s Technical Support team (with its 24/7 capabilities) together. The common target: Provide a customer/vessel in need of swift support regardless of time and time zone.
The New X72DF: Powering the Next Generation of LNG-fuelled Ships

Adrian Siegfried
GM Customer Support
14/04/2021
Upgrading the Well Established X72DF

Reasoning and summary in a nutshell

WinGD has launched four new variations of the X72DF engine for better adaptation in several ship applications, with the target to reduce the investment and operational costs while keeping the emissions at the lowest possible levels. The new X72DF-1.1 and X72DF-1.2 (non-iCER) engines offer:

- WiCE – the most modern engine control system
- WiDE – real time engine performance and predictive maintenance analysis system
- Optimized production costs / reduced ancillary system capacity
- Design of components based on proven design principles
- Improvements / lessons learned from service/field implemented
- More compact - reduced engine length (-x.2 engine)
- Taken over: X-DF low-pressure dual-fuel technology with low base cost, and low energy demanding fuel gas supply system
- Interface readiness to the optional X-DF 2.0 iCER Technology -> Engines then being named X72DF-2.1 and X72DF-2.2
X72DF-x.1 and X72DF-x.2 Engines

Target market

The target market was until now mainly LNG carriers. With the growing demand for Tier III compliant propulsion solutions and the increasing availability of gas as a fuel, the application range extends to Tankers, Bulk carriers and Container vessels.

The new engines present a “drop-in” solution for the successful X72DF engine.
## X72DF-x.1 and X72DF-x.2 Engines

### Engine power / speed range

<table>
<thead>
<tr>
<th></th>
<th>X72DF</th>
<th>X72DF-1.1 / X72DF-2.1</th>
<th>X72DF-1.2 / X72DF-2.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power/cyl. R1 (kW)</td>
<td>3225</td>
<td>3225</td>
<td>2600</td>
</tr>
<tr>
<td>Power/cyl. R4</td>
<td>2080</td>
<td>2080</td>
<td>2080</td>
</tr>
<tr>
<td>Speed R1 (rpm)</td>
<td>89</td>
<td>89</td>
<td>79</td>
</tr>
<tr>
<td>Speed R3/R4 (rpm)</td>
<td>69</td>
<td>69</td>
<td>69</td>
</tr>
<tr>
<td>Bore (mm)</td>
<td>720</td>
<td>720</td>
<td>720</td>
</tr>
<tr>
<td>Stroke (mm)</td>
<td>3086</td>
<td>3086</td>
<td>3086</td>
</tr>
<tr>
<td>MEP (bar)</td>
<td>17.3</td>
<td>17.3</td>
<td>15.7</td>
</tr>
<tr>
<td>Pmax (bar)</td>
<td>200</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Cyl. config.</td>
<td>5-8</td>
<td>5-8 (*)</td>
<td>5-6</td>
</tr>
</tbody>
</table>

* The iCER version X72DF-2.1 is available as 5-7 cylinder execution
## X72DF-1.1 and X72DF-1.2 Engines
### Design details and naming

<table>
<thead>
<tr>
<th></th>
<th>X72DF-1.1</th>
<th>X72DF-1.2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bedplate</strong></td>
<td>Flexible girders (*)</td>
<td>Shortened bedplate; Flexible girders</td>
</tr>
<tr>
<td><strong>Crankshaft</strong></td>
<td>FCV4 standard execution</td>
<td>FCV5, lighter and shorter execution</td>
</tr>
<tr>
<td><strong>Engine control</strong></td>
<td>WiCE</td>
<td>WiCE</td>
</tr>
<tr>
<td><strong>Supply unit</strong></td>
<td>Standard supply unit X72DF</td>
<td>Compact supply unit from X62-S2.0</td>
</tr>
</tbody>
</table>

* The ‘flexible’ main bearing girder follows the latest WinGD design concept; e.g. it is a more flexible support which reduces main bearing edge loading aside from a lighter construction.
### X72DF-2.1 and X72DF-2.2 Engines Featuring iCER

#### Design details and naming

<table>
<thead>
<tr>
<th></th>
<th>X72DF-2.1</th>
<th>X72DF-2.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cylinder</td>
<td>5-7 Cylinder</td>
<td>5-6 Cylinder</td>
</tr>
<tr>
<td>Bedplate</td>
<td>Flexible girders</td>
<td>Shortened bedplate; Flexible girders</td>
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</tr>
<tr>
<td>Supply unit</td>
<td>Standard supply unit X72DF</td>
<td>Small supply unit X62-S2.0</td>
</tr>
<tr>
<td>iCER</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>
X72DF-x.1/-x.2 Main Features

Design changes

Engine management
- WiCE implementation
- Rail unit box as X72-B

Conrod, Crosshead, Guide shoe
- Weight reduction in clarification

«X62-S» Supply unit
- Smaller supply unit with smaller gear train and pumps

Bedplate
Flexible girders
New foundation bolt concept

Shortened thrust bearing section

Hot parts
- Slightly Increased CR (iCER)
- New pre-chamber design
- New piston design

Piping and platforms
- Pipe connection and reinforcements for iCER
- Slightly increased outlines

Scavenging
- New cooler «C» design (reduced water flow)
- Scavenging more towards FE
- GTD Data (April ‘21)

Crankshaft
- Shortened
- Lighter execution FCV5

WinGD X-DF Technology and Future Developments
Thank you

Propelling shipping towards a greener future

Winterthur Gas & Diesel Ltd.
Switzerland
www.wingd.com
WÄRTSILÄ
LIFECYCLE SOLUTIONS

JÖRGEN NAAIJER
GENERAL MANAGER, AGREEMENTS
CONTENT

01  Co-operation with WinGD
02  Marine market landscape
03  Improve your business performance and competitiveness
04  Wärtsilä Lifecycle solutions
05  Customers' reference
A STRONG LONG-TERM PARTNERSHIP TO PROVIDE
UNMATCHED MAIN PROPULSION POWER TECHNOLOGY AND LIFECYCLE SERVICES
TO THE GLOBAL MERCHANT SHIPPING INDUSTRY
THE MARITIME INDUSTRY IS UNDER PRESSURE

SHORT TERM
- Vessel contracting
- Fleet utilisation & earnings

TODAY’S CHOICES HAVE A LONG-TERM IMPACT
- Increasing technology complexity
- Importance of fuel flexibility growing
- Environmental compliance
CUSTOMERS’ CHALLENGES

DRIVING PROFITABLE BUSINESS
- Asset availability and operational reliability to avoid unexpected downtime
- Optimised energy efficiency and long-term cost predictability
- Adopting new ways of working and business models

ADOPTING NEW TECHNOLOGIES
- Knowledge and application of new technologies and access to needed skills
- Securing a contemporary and competitive fleet
- Managing assets on system level and system updates

ENVIRONMENTAL COMPLIANCE
- Keeping up with new legislation and regulations
- Understanding the business impact of new regulations
- Financing new environmental technology and modernisations
OUR SHARED GOAL IS TO

Increase your earnings with improved asset performance

Improve your profitability with efficient operations and maintenance

Mitigate your risks with sustainable operations and predictable costs
# IMPROVE YOUR BUSINESS PERFORMANCE AND COMPETITIVENESS

## Increase earnings

**IMPROVED ASSET AVAILABILITY**
- Guaranteed operational efficiency and uptime
- Holistic and efficient fleet management
- Optimising vessel performance and installations on system level
- Managing new and old technology, helping to renew ageing fleet
- Leading with sustainable and digital technologies and innovations

## Increase profitability

**OPTIMISED OPERATIONS AND MAINTENANCE**
- Lifecycle management and long-term planning
- Guidance, trouble-shooting, tuning and expert support
- Real time asset optimisation and diagnostics through cloud connectivity
- Improved asset availability and system reliability with maintenance management

## Mitigate risks

**SUSTAINABLE AND PREDICTABLE OPERATIONS**
- Risk and reward sharing financing models
- Guaranteed performance based on agreed target levels
- Ensured safety and cyber security
- Optimised engine fluids: engines, propulsion and emission monitoring
- Improved and maintained energy efficiency and lower fuel costs
- Compliance with new legislation and regulations and understanding of the business impact
PARTNERING FOR CARE-FREE LIFECYCLE OPERATIONS

WÄRTSILÄ GUARANTEED ASSET PERFORMANCE | ENSURED FLEET PERFORMANCE AND BETTER EARNINGS

WÄRTSILÄ OPTIMISED MAINTENANCE | IMPROVED OPERATIONAL RELIABILITY

>700 SHIPS HAVE A WÄRTSILÄ LIFECYCLE SOLUTION

94% OF CUSTOMERS RENEW THEIR LIFECYCLE AGREEMENTS

90% OF ISSUES SOLVED REMOTELY

70% REDUCTION OF UNSCHEDULED MAINTENANCE COSTS
WÄRTSILÄ GUARANTEED ASSET PERFORMANCE

The Guaranteed asset performance ensures the operational reliability, performance and availability of your assets. Quantifiable performance targets are mutually agreed based on your business needs, and Wärtsilä then guarantees that those targets will be reached and maintained.

BENEFITS

• Guaranteed operational efficiency and availability
• Consistently maintained asset performance
• Predictive maintenance tailored for your operations
• Cost predictability and guaranteed service levels
• Advanced support from our Expertise Centres enabled by Expert Insight
• Financing models that share risk and reward
WÄRTSILÄ OPTIMISED MAINTENANCE

The Optimised maintenance improves long-term cost predictability and availability by data driven dynamic maintenance planning and scheduling maintenance procedures to suit your business operations. We help you to optimise maintenance intervals according to actual needs to prevent any unexpected downtime. Our Expertise Centres support you proactively, whenever and wherever needed.

BENEFITS

- Predictive maintenance tailored for your operations
- Guaranteed maintenance costs and service levels
- Operational support from our Expertise Centres
- Proactive advice and enhanced reliability with Expert Insight
- Online access to your operational data with detailed insights
REMOTE OPERATIONAL SUPPORT – 24/7 ON CALL – DECREASES DOWNTIME THROUGH FASTER ISSUES RESOLVING

In 2020, based on data from 54 LNG carriers...

- LNG REMOTE OPERATIONAL SUPPORT CASES IN 2020:
  - LNG DAY-RATE: 80 000 €
  - 1 100

- 90% OF CASES CAN BE SOLVED REMOTELY

- CUSTOMER AVOIDED OFFHIRE CONVERTED TO EUROS
  - 8.8M€
DECREASED ANNUAL COSTS OF UNSCHEDULED MAINTENANCE WITH EXPERT INSIGHT

In 2020, based on data from 54 LNG carriers...

<table>
<thead>
<tr>
<th>Unscheduled Maintenance in 2019:</th>
<th>Unscheduled Maintenance in 2020:</th>
</tr>
</thead>
<tbody>
<tr>
<td>100,000 €</td>
<td>30,000 €</td>
</tr>
</tbody>
</table>

70% Reduction

CUSTOMERS AVOIDED UNSCHEDULED MAINTENANCE COST OF: 3.8M€
ENHANCED RELIABILITY THROUGH PROACTIVE EARLY DETECTION

In 2020, based on fleet of 54 LNG carriers

DECREASE IN UNPLANNED DOWNTIME
50% OF CASES
i.e. Downtime days were reduced

DOWNTIME IN 2019
3 days

DOWNTIME IN 2020
1.5 day

LNG DAY RATE
80 000 €

EQUALS APPROXIMATELY INCREASE OF REVENUE PER VESSEL OF
120 000 €
i.e. 6.48M€ for all 54 LNG carriers

In 2020, based on fleet of 54 LNG carriers

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120 000 €
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>700 MARINE ASSETS HAVE A WÄRTSILÄ LIFECYCLE SOLUTION

**MERCHANT**
- LNG Carrier
- Container Vessel
- Bulk Carrier
- RoRo Vessel
- Tankers
- Car Carrier
- General Cargo Vessel

**CRUISE & FERRY**
- Passenger & Cargo Vessel
- Cruise Vessel
- Ferry
- High Speed Passenger Vessel

**OFFSHORE, OIL&GAS**
- Offshore support Vessel
- FPSO
- FSRU
- FLNG Plant
- FSO
- Fixed Production Platform
- Semi-submersible rigs

**SPECIAL, OTHER**
- Dredgers
- Tugs
- Icebreaker
- Cable layer
- Fishing Vessel
- Navy
- Other service vessels
Due to us having many installed engines, this is an effective solution that brings peace of mind with regards to maintenance planning and execution. Also, maintenance budgeting is now risk-free. In this way, we can avoid unpleasant cashflow surprises.

We place a huge value on the safe delivery of services, so for us any other scenario is unacceptable. It is imperative that the right spares are onboard a vessel at the right time.

In most cases, we have been able to achieve savings thanks to postponing maintenance and aligning it with the major repair activities of other vessels.

Kostas Karathanos
Innovation & Technology Manager
Gaslog Ltd.

Loukas Kavouras
Fleet Manager
Gaslog Ltd.
It takes the right mix of planning, policy and business skills to get five year price stability, increase engine performance and make forward planning easier. Through the agreement we have experienced these benefits.

For us, a one-stop solution to ship maintenance and performance optimisation is the key, while still keeping overall costs in check. In evaluating the alternatives, we realised the benefits of renewing the maintenance agreement for another five years.

With this agreement in place, we are able to free up our office staff and ship crew so that they can focus on their core work, instead of the more laborious procurement process.

**Mikko Varpio**
Technical Manager
OSM Ship Management Finland Oy
THANK YOU!

WIN GD

WÄRTSILÄ