Goltens

InService

Goltens Worldwide Newsletter | 2022

Setting the Pace

As the world's marine and power industries move toward cleaner fuels, energy storage and stricter emissions standards, Goltens continues to adapt its service offerings to the latest technologies and set the pace for our customers.

Goltens technicians replacing a Wärtsilä crankshaft for a tanker in India

Page 6

Goltens
Energy Control Solutions (ECS)

Goltens' Energy Control Solutions (ECS) Vertical

Page 3

Goltens launches new vertical to integrate the latest product technologies into energy and power projects across all types of prime movers.

"Green" 2-Stroke Engine Component Reconditioning

Page 12

Environmentally responsible processes drive annual re-use of over 3,000 tonnes of critical components, conserving precious resources.

Engineering and Design Services Go to Next Level

Page 20

Goltens' services widen beyond BWMS and EGCS retrofit design and branch into newbuilding and vessel conversion projects for customers worldwide.

PRESIDENT'S MESSAGE

Two decades of accelerating change with more to come

Sandeep Seth
President
Goltens Worldwide

In more than 20 years with Goltens, I have witnessed significant changes in the technologies and services required by our customers across all the markets we serve.

When I first joined the company, the technologies around power generation and main propulsion were relatively static and there was relatively little focus on how the fuels the industry used, the ballast water we transported from port to port and the technologies we chose impacted the environment and what we could do to limit those impacts. That is not to say companies weren't actively developing innovative solutions and designs to improve efficiency and limit environmental impacts, but the ROI from such investments seldom justified the expense on their own.

Economic drivers from a global recession, the oil-and-gas crisis and increased environmental regulations, both global and regional or country-specific, have all had material impacts on how we think about the future of our business, how we operate our business and what we invest in to ensure that our business models are fit for the future. These and other factors, coupled with rapid technological advancements, present maritime and powerplant operators with more options for deploying capital and what solutions to invest in moving forward.

MARITIME, OFFSHORE AND OIL-AND-GAS SECTORS – RAPIDLY SHIFTING TECHNOLOGIES AND REQUIREMENTS

In the maritime industry, most of these changes are being driven, one way or another, by regulations. The implementation of the Ballast Water Convention and the IMO 2020 sulphur cap were among the first steps to address these two major problems. Now, EEXI and CII present additional challenges for owners as they assess their existing fleets and future newbuilds. These circumstances, coupled with technological developments and the ever-present push to be more efficient and generate increased financial returns, are forging changes in shipping markets at a rate we've never experienced before.

Initial movements from planned to condition-based maintenance now involve the use of remote, real-time monitoring and the leveraging of "big data" to improve maintenance regimes and operational efficiency, reduce manning or perhaps go fully autonomous. Following the shift from HFO to low-sulphur fuels (or alternatively fitting vessels with scrubbers) in 2020, we are now seeing a rapid acceleration of plans for adopting alternative fuels like LNG, hydrogen, methane and ammonia and the introduction of fuel cells, battery storage and hybridized power models. At the same time, EEXI and CII will drive the initial adoption of engine power limitation (EPL) with a longer-term focus on retrofits and newbuilds that will include a wide range of energy-saving devices (ESDs) like sails, hull and propeller modifications and other technologies enabling cleaner and more efficient propulsion systems. All these developments combined will change the face of the marine, offshore and oil-and-gas segments for the better.

STATIONARY POWER AND INDUSTRIAL SECTORS – SLOWER PACE OF CHANGE WITH DELIBERATE MOVEMENT

Within Stationary Power, major investments in green sources of solar and wind energy are accelerating as prices continue to decline and the global movement to combat climate change gains ground. These market dynamics have driven material changes in markets around the world where new fossil-fuel power is largely natural gas. More traditional diesel-powered plants are under increasing pressure to close or adapt.

Within Stationary Power, major investments in green sources of solar and wind energy are accelerating as prices continue to decline and the global movement to combat climate change gains ground.

As a result, Goltens is seeing significant interest from traditional oil-fired plants to convert to dual-fuel operation. Depending on geography, many power producers are facing deadlines to convert or finding they are no longer able to renew their contracts to operate or supply power to the grids. In addition to the transition to gas, operators are looking at alternative methods to meet power requirements through hybridized micro-nets that integrate fossil plants with wind, solar and battery storage to create more environmentally sustainable models. Given the social, economic and political changes that are all gearing away from fossil fuels, there is an imminent need to increase commodity throughput requiring new technological, control and environmental solutions.

AS THE WORLD CHANGES, SO DOES GOLTENS

In response to many of these market drivers and technology changes, at Goltens we have evolved and transformed our portfolio of service offerings, leveraged technologies, increased our physical footprint around the globe and joined forces with strategic partners to adapt to our constantly maturing and increasingly environmentally aware customer bases.

On the engine side, Goltens has undergone a now well-established transformation from a diesel engine-centric service provider to one that can service all makes and models of larger bore, medium- and slow-speed diesel, gas and dual-fuel engines. We are committed to continually adjusting our service portfolios to include alternative-fuel engines and more advanced battery storage devices. In addition, we have broadened our portfolio to provide both Electronically Controlled Engine Services (ECES) and the servicing of hydro, steam and gas turbines. Our-state-of-the-art In-Place Machining capabilities remain fully relevant to these next-generation prime movers.

Goltens took a fortuitous and aggressive step back in 2010 with the introduction of our Green Technologies business, which assists in decarbonization transformation and the control of invasive marine species. Through this highly specialized service unit, Goltens has completed more than 1,000 ballast water and exhaust-gas scrubber projects globally. More currently, and as the ballast water wave begins to subside, our specialized design capabilities are being directed toward newbuild engineering packages, EEXI compliance and CII retrofit design projects all backed by our global capacity to design, prefabricate, project manage and complete turnkey retrofit installations for customers. In addition, we provide a comprehensive suite of consultancy services, including EPL or Shapoli reports, Sea Trial and Class approvals and CDF analysis for vessel integration and vessel performance optimization. Goltens also offers sales and service on emission monitoring systems as well as after-sales services of Ballast Water Treatment Systems (BWMS) and scrubber systems, including ballast water testing.

In addition to these organizational changes, we are also pleased to introduce our Energy Control Solutions (ECS) business, which continues to grow. Expanding on our time-tested position as an expert on engine governors and controls and turbine controls, Goltens has made significant investments in technology, expert technical talent and expanded partnerships, all focused on bringing a more proactive and robust set of solutions to the propulsion and power generation markets. With retrofit and upgrade solutions already well established and in place for hydro-, steam- and gas-turbine plants and diesel, dual-fuel and gas-powered reciprocating engines, we are driving our customers to longer-term, sustainable power and controls solutions utilizing the latest available technologies.

As market dynamics continue to evolve and change, they demonstrate how Goltens continues to be at the leading edge and ready to support your needs regardless of location, fuel type or prime mover.

In this publication, we have compiled what we regard to be an impressive collection of news stories and case studies that we are confident you will find both interesting and informative. As market dynamics continue to evolve and change, they demonstrate how Goltens continues to be at the leading edge and ready to support your needs regardless of location, fuel type or prime mover. As we have been for more than 80 years, Goltens is and remains committed to providing technologically advanced and responsive service solutions anywhere in the world. ■

Goltens

Energy Control Solutions (ECS)

Goltens is a global energy controls solutions provider delivering complex engineering solutions that integrate the latest product technologies into energy and power projects across all types of prime movers.

Further to our world-renowned capability to overhaul and repair prime movers, generators, motors and balance of plant equipment, Goltens has long been a trusted partner for customers all over the world in the mechanical and electronic engine controls space. Powerplant operators and shipowners globally rely on Goltens to perform routine maintenance as well as overhaul these critical control components. With our expanded distribution relationship with Woodward and the addition of our partners, L&S Electric for excitation and SEG for power protection, our focus and scope have increased and Goltens now has a much broader base to provide comprehensive turnkey solutions.

ECS has invested heavily in cutting-edge technology and deep industry expertise to expand the breadth and depth of the solutions we offer and the customers we serve. We now provide full system integration and turnkey solutions to reciprocating diesel, gas and dual-fuel engine plants as well as gas-, steam- and hydropower turbines and centrifugal compressors throughout the world. While routine maintenance and repair is still core to our business, solving complex control, excitation and power management challenges across industry lines is our specialty.

The robust solutions our engineers provide include evaluation and upgrade of governors and actuators, independent overspeed systems, anti-surge compressor systems, complete prime mover safety and monitoring systems, generator protection, AVR/Excitation and power management with HMI, SCADA and balance of plant as required.

Regardless of whether your plant has suffered an unfortunate casualty, you are proactively planning for an upgrade of aging and obsolete equipment or you are planning an expansion of generating capacity, as your reliable partner ECS can help you implement an efficient, technically advanced and supportable solution to your specific challenge. ■

Integrated power solutions

WOODWARD Business Partner

SEG electronics business partner

L&S INTEGRATED SOLUTIONS LEGENDARY SERVICE

Steam/Gas Turbine Turnkey Solutions

- Gas Turbine Governor Control Valves and Shut Off Valves services and upgrades
- Steam Turbine actuator upgrades including mechanical to electronic systems
- Protection, including SIL3 overspeed and TTV systems
- Turbine and Compressor Control system upgrades
- Power Management, Generator and Motor Protection and Excitation systems
- Remote Access for fast and efficient remote field service support

Diesel, Gas and Dual-Fuel Reciprocating Engine Turnkey Solutions

- Mechanical and Electronic Governor systems
- Gas Admission, Wastegate and By-Pass valves
- Ignition, Real-Time Combustion Monitoring with Detonation/Misfire detection systems
- Engine Control, Monitoring and Alarm systems
- Engine Safety systems
- Power Management, Generator Protection and Excitation systems
- Remote Access for fast and efficient remote field service support

Power Solutions

- Protection relays for Motors, Generators and Distribution equipment
- Advanced Excitation Systems (AES)
- Power Management Systems, load sharing and synchronizing
- Low Voltage Switchboard and Motor Control Center
- Load shedding systems to ensure your plant preferences are prioritized during unplanned events
- SCADA systems bringing all the data together in one interface
- Remote Access for fast and efficient remote field service support

Hydropower Turnkey Solutions

- Advanced Excitation Systems (AES)
- Digital governors and HMIs with interconnectivity to other systems
- Governor hydraulic actuation systems including Hydraulic Power Units (HPU) and Main Distribution Valves (MDV)
- Independent overspeed protection system

Goltens secures turbine controls distributorship authorization covering most of continental Africa

Building upon our Woodward engine controls distributorship and RER (Recognized Engine Retrofit) designation for the Middle East and most of Africa secured in 2016, Goltens has also been awarded Woodward's turbine controls distribution and Recognized Turbine Retrofit partner designation for most of Africa.

Goltens' turbine controls-related territories now include Angola, Botswana, Cabo Verde, Comoros, Djibouti, Eritrea, Ethiopia, Ghana, Guinea, Kenya, Lesotho, Liberia, Libya, Madagascar, Mozambique, Namibia, Nigeria, Rwanda, São Tomé and Príncipe, Seychelles, Somalia, South Africa, South Sudan, Sudan, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe. ■

WOODWARD Business Partner

Massive controls upgrade project in Philippines delivers major performance and efficiency improvements for 23 Wärtsilä engines

M3 floating power barge in Philippines

Goltens was engaged to evaluate the current controls configuration on two Therma Mobile Inc. oil-fired floating power barges and propose a solution to both increase the efficiency and reliability of startup and operations while also meeting strict NGCP (National Grid Corporation of the Philippines) regulations for ancillary power load response.

THE CHALLENGE

The company's barge M3 is equipped with 11 Wärtsilä 18V32 engines while its M5 has six Wärtsilä 18V32 and six 12V32 engines. Both barges had slightly different controls configurations but the issues they faced were the same:

- **Engine Hard Start** – Both barges were experiencing intermittent startup problems where in order for the engines to clear the cranking speed, a barge operator needed to manually assist the actuator fuel linkage. This added significantly to engine startup time and slowed down the barges' entire synchronization process.

- **Simultaneous Synchronization** – The existing synchronization relied on a single DEIF synchronizer for each barge controlling the synchronization of all the engines. This resulted in operators only being able to synchronize one engine at a time, dramatically increasing the time to be fully running and synchronized to the grid.

- NGCP Response Requirements – NGCP response targets require that engines must have a Fast Start capability and be able to synchronize to the grid within 15 minutes and load up their offered reserve capacity within an additional 15 minutes. The inefficiencies associated with the existing Engine Hard Start problem and Simultaneous Synchronization challenges made the NGCP time windows difficult to meet. In addition, the NGCP requires frequency deadband and droop functionality, which did not exist in the current configuration.

THE SOLUTIONS

- **Engine Hard Start** – For the M3, Goltens replaced the existing Woodward PG-EG actuators' servo valve boosters and introduced preventive maintenance for the connections between actuator and booster. For the M5, Goltens upgraded all 12 legacy Woodward PGG 58 mechanical hydraulic governors with Woodward PG-EG 58 electrohydraulic actuators and Woodward 2301E digital speed controls.

- **Simultaneous Synchronization** – In addition to the changes made to address the Engine Hard Start issues, Goltens installed Woodward easYgen 3200XT genset controllers on each engine and made modifications to, or disconnected, the existing DEIF synchronizers.

THE RESULTS – FAST STARTUP, SIMULTANEOUS SYNCHRONIZATION AND NGCP REQUIREMENTS MET

The new controls design, which introduced state-of-the-art Woodward product upgrades to the power barges, and the configuration changes implemented met all of the operating requirements. Engine Hard Start challenges were addressed, and synchronization times dropped from a few minutes to less than 20 seconds. All NGCP time requirements for fast start capability and reserve capacity response were met as well as the requirements for deadband and droop. ■

Goltens controls technician monitoring M5 DG unit during commissioning

M3 Commissioning of control panel after upgrade with easYgen 3200XT

Phased Woodward controller upgrades ensure emergency backup power for prominent UAE hospital

Technical management at a well-known hospital in the UAE recognized that the Woodward Gen6000 controllers on their FG Wilson generators were obsolete and no longer supported. System performance and reliability of the ATS system were also a concern due to the hardwired relay logic. The hospital approached Goltens Energy Control Solutions (ECS) to seek a technically sound and supported upgrade for this critical emergency power machinery.

Although not a drop-in replacement, the combination of Woodward easYgen 3200XT and LS5 controllers was an ideal successor to the Gen6000 controller and hardwired relay logic. Goltens presented a plan for a phased upgrade that would ensure continuous and reliable emergency power to the hospital while the controls were being upgraded.

PHASED EXECUTION FOCUSED ON POWER AVAILABILITY

To ensure sufficient emergency power was available to the hospital while the controllers were upgraded, four mobile generators of the same capacity as the gensets were installed to account for the offline generators. The project was broken down into three phases. The first consisted of upgrading the controllers on two of the generators, with the remaining pair to be upgraded in Phase 2. This was a strategic and precautionary measure to ensure the hospital would always have reliable backup emergency power in case of failure. Phase 3 included the upgrade of the ATS system.

PHASE 1: All four generators were tested in operation with the existing controllers to create a baseline which could be compared against the improved performance of the easYgen 3200XT controllers. Once complete, the first two generators were isolated from the bus and the mobile generators were connected. The generator panels were modified to accommodate the easYgen 3200XT and rewiring was completed in parallel to the configuration.

Final loop checks were then carried out and the engines were started without any issues, responding well to the test commands provided from the easYgen controllers. After the initial test, the gensets were taken online and a load was applied to test their response and operation before handing them over and moving to the next phase.

PHASE 2: The remaining two gensets were also upgraded and tested on and off load. Both performed well and responded to commands as intended. As load testing was not advisable due to the critical nature of the power, a load bank test of all four generators was carried out to test the performance of the gensets at peak load before final handover. With all tests successful and the customer satisfied with performance, the gensets were brought online for regular operation.

PHASE 3: The existing ATS system had an old and traditional relay logic to carry out the transfers between transformers and bus couplers. Additionally, using traditional relay logic provides no indication in case of a fault, and so traceability can be extremely difficult and time consuming. If the fault is intermittent and not resolved then that fault can occur anytime in the future, which is huge risk for a hospital installation. This outdated technology was no longer suitable for such a critical application.

Goltens upgraded the old relay logic system with the Woodward LS5 controllers, which are designed for this purpose. The LS5 provides readings such as voltage, frequency and power, and most of all provides error logging for traceability. The upgraded system now allows the user to trace the root cause of problems for rectification.

Fourteen LS5s were provided to retrofit the existing ATS system along with earth leakage monitoring relays on the outgoing feeders. These will provide additional information to the LS5s in case of fault or trips. All the controllers were connected to a central HMI display developed by Goltens that provides an immediate overview of the complete system including data from the easYgen and ATS system. The HMI data is in turn fed into the BMS system for remote monitoring and operation.

RESULT

Overall, this complex project was methodically installed and commissioned over the course of a few months. In addition to the precautions inherent in the phased approach and the installation of the mobile generators, the team primarily worked at night, coordinating closely with hospital management and support staff so as not to disturb normal operations. ■

Goltens' 'Smart Box' solution reduces Woodward 3161 and UG8 upgrade time and cost

Having already completed governor upgrades on two P&O Maritime tugs, Goltens was engaged by P&O Maritime FZE to complete a similar upgrade on the tug Sinyar. The 15-year-old vessel, equipped with two Wartsila 9L20 engines, each driving a propeller and a fire pump, were fitted with mechanical Woodward 3161 governors with pneumatic speed setting, shutdown solenoids and start fuel limiter solenoids.

Goltens' controls experts had advised that with the existing Woodward 3161 governors, the fuel system response to engine speed or load changes was suboptimal and generating black smoke during transients. In addition, the existing governors were old, unreliable, reaching end of life and likely to drive increasing repair and spares costs going forward.

P&O Tug Sinyar

Beyond the operational and age limitations, the engines' speed was controlled via a combinator with different operating modes for propulsion and for the fire pump, and this would need to be addressed in the upgrade proposal.

Goltens recommended an upgrade to the UG-25+P3.

SMART BOX IMPLEMENTED

To address the operational requirements, simplify the design and reduce the time required for the retrofit, Goltens again used its Smart Box, which converts the existing 3161 or UG8 engine wiring directly to the UG25+ configuration. Using Smart Box makes the conversion fully plug and play without having to consider additional wiring or complex configurations.

By design, the Smart Box maps all combinations of 3161 & UG governor connections to the respective UG25+P3 terminals. This process dramatically increases the speed and efficiency of the upgrade. The upgrade also eliminates the current to pneumatic converter by using the UG25+P3 electronic governor. The combinator mA speed setting output and shutdown signal input are now directly connected to the UG25+P3 along with redundant power supplies. The start fuel limiter is also now managed within the governor software.

Goltens controls technician installing the Smart Box onboard

RESULT AND RECOMMENDATION

The Smart Box plug-and-play solution reduced the onboard upgrade installation time for the Woodward 3161 governors to the UG25+P3 on the Sinyar to a matter of hours.

Smart Box enables efficient upgrades during any vessel's normal operating routine. ■

Rigging condemned crankshaft from the engine room

Makita MAN 6L35MC main-engine crankshaft replacement minimizes downtime for chem tanker

In-situ inspection leads to comprehensive urgent repair including line boring and sourcing replacement crankshaft

Goltens was engaged to inspect the main-engine crankshaft on a 23-year-old, 11,700-dwt chemical/product tanker anticipating that the crankshaft could be salvaged with in-situ machining. The tanker had suffered major bearing failures on three of its main journals. Inspection revealed major damage to the running surfaces of the main journals that could not be rectified within the OEM's specifications. Goltens therefore recommended replacement of the crankshaft as well as a full inspection of the bedplate for potential replacement.

Line boring of main engine bearing pockets

Laser alignment check of main bearing pockets

DRY-DOCK AND SUPPLY CHALLENGES

The vessel was unable to secure a shipyard berth within a reasonable timeframe and turned to Goltens for support. After numerous potential dry-docking options in Southern India and the broader Middle East were abandoned due to capacity issues, Goltens managed to secure a space alongside at a shipyard on the West Coast of India. The repair would have to be done with the vessel in the water.

Complicating matters further was the long lead time from the OEM for the delivery of a new crankshaft and associated spares required for the repair and rebuild. The customer again turned to Goltens for options. Our trading specialists were able to secure a suitable crankshaft of the same make/model of engine from a vessel heading to the breaker's yard. Once secured, the replacement crankshaft was fully inspected in the presence of Class and cleared for use.

REPAIRS PROGRESS SMOOTHLY

Goltens' team mobilized to the yard complete with the required tooling to place lifting pad eyes and remove obstacles to the rigging of the crankshafts and other larger components. The engine was then fully disassembled with major components transported to Goltens' workshop for overhaul. On board, the in-situ specialists used lasers to check the main bearing pockets for damage and determined that, although the engine required line boring, the bedplate could be salvaged.

While the engine components were being overhauled and the replacement crankshaft transported to site, Goltens completed line boring of the engine now fitted with three replacement bearing caps provided by Goltens in preparation for installation of the crankshaft.

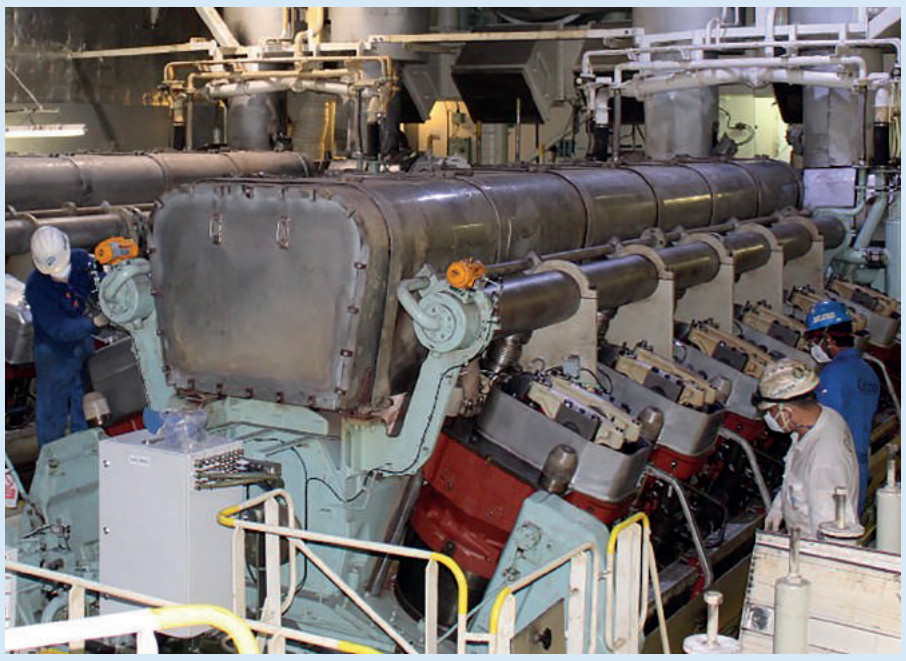
DOWNTIME KEPT TO AN ABSOLUTE MINIMUM

The technicians installed the crankshaft and rebuilt the engine before completing successful sea trials and handing the repaired engine over to the ship's Chief Engineer. Goltens specialists completed this challenging repair with the vessel afloat, supplying the crankshaft and other key components and arranging for an emergency berthing space.

Once again, Goltens completed a major repair while dramatically reducing vessel downtime for the owner. ■

Four Wärtsilä 12V50DF overhauls completed in only 14 days

Tight overhaul schedule met for LNG tanker at Singapore yard



Goltens' Diesel Team disassembling one of the four Wartsila 12V50DF engines in Singapore

Goltens' Diesel Technicians installing one of the fully overhauled cylinder heads

Goltens was engaged by a Singaporean shipyard to undertake an engine overhaul project on a nine-year-old LNG tanker with a very tight timeline. The yard required four Wärtsilä 12V50DF dual-fuel auxiliary engines to be overhauled in only 14 days.

OVERHAUL SCOPE:

- Full inspection and overhaul of 48 cylinder heads (including pressure testing)
- Inspection and overhaul of rocker arm assemblies
- Inspection, calibration and crack test of pistons and connecting rods as per OEM specification
- Calibration and honing of cylinder liners for better engine performance
- Renewal of crank pin bearings and checking of bearing clearances
- Overhauling of fuel injection systems for increased efficiency
- Adjustment of valve tappet clearances
- Renewal of all gas admission valves
- Checking and recording crankshaft deflections

ON TIME WITH EXCELLENT RESULTS

The 18,000-hour overhauls were successfully completed within the 14-day window required by the customer. All engine safety devices were checked and found to be working normally, and a running-in program was carried out as per the maintenance manual. Once completed, the engines were tested up to 100% load and all engine parameters were found to be normal prior to handing the engines over to the vessel's Chief Engineer. ■

End-to-end engine repair for Indonesian gold mine

Wärtsila 18V26 crankshaft replacement and engine overhaul

A leading gold-mining company on the island of Sumbawa had suffered a casualty on one of its 10 Wärtsila 18V26 diesel generators and required a comprehensive repair. The casualty resulted in a condemned crankshaft that needed to be replaced and the customer also required Goltens to complete a full overhaul of the engine.

Goltens' diesel and in-situ machinists performed a detailed site inspection to evaluate the engine and crankshaft condition prior to responding to an open tender. They determined that the crankshaft was beyond salvage with in-place machining and instead proposed replacing it and performing a full overhaul and commissioning of the engine to return it to operation.

Due to the layout of the powerhouse, Goltens' proposal included the design and fabrication of special lifting tools to rotate the engine upside down to facilitate removal and remounting of the crankshaft. After preparing the lifting tools and mobilizing to site, the Goltens team disassembled the engine, removed the crankshaft and completed a full block inspection and laser alignment check on the bearing pockets to ensure that line boring was not required. The new crankshaft was mounted and all engine components, which were thoroughly inspected, measured and overhauled as per OEM specifications, were reinstalled. After completing realignment of the engine and alternator, and calibrating and commissioning the safety devices, operational testing was completed successfully and the engine returned to service. ■

Rotating the engine block to remove damaged crankshaft

Rigging new crankshaft to the engine

'Back from the burn' – mechanical and electrical restoration for fire-damaged containership

Yanmar 6EY26L auxiliary and MAN 7L70MC-C main engine repairs

Fire-damaged containership alongside in Philadelphia

THE CASUALTY

A 13-year-old containership experienced a major shipboard fire in one of its Yanmar 6EY26L auxiliary diesel generators causing significant mechanical and electrical damage to the generator itself, the adjacent generator and the engine space as a whole. The fire caused the vessel to lose all power and the use of the auxiliary boiler and main propulsion for an extended period. Upon power restoration with backup generators, the emergency required starting the MAN 7L70MC-C main engine under cold conditions, operating for approximately 18 hours at slow speed to return to port in Philadelphia.

INSPECTION AND MOBILIZATION

With a long history of restoring shipboard fire damage and as an authorized Yanmar distributor, Goltens was contracted to inspect and repair the damaged Yanmar auxiliary engines and complete extensive repairs to the ship's electrical systems. Goltens was also asked to complete repairs to the main engine, which showed heavy scuffing and scoring on the liners, piston rings and skirts as a result of the cold-start operation.

AUXILIARY ENGINE REPAIRS

The direct and radiant heat of the fire damaged wiring harnesses, cabling, sensors, panels and machinery components on the engine. Goltens disassembled it in full, removing all heads, connecting rods, liners, turbo charger, coolers and auxiliary pumps. Engine components were sent to Goltens' workshop for full inspection and reconditioning where possible.

Goltens' in-situ technicians also polished numerous damaged main and crankpin journals, while the diesel team supplied and replaced damaged camshaft sections. The resilient mounts were all replaced due to fire damage, and the governor and turbo charger cartridge were deemed a total loss and replaced. Goltens rebuilt the engine with a mix of new and reconditioned components and our electrical team replaced all damaged wiring harnesses, cables and sensors on the engine, as well as completing inspections on all alternator cables, stators and excitations systems and completing other extensive electrical repairs throughout the engineering spaces and beyond.

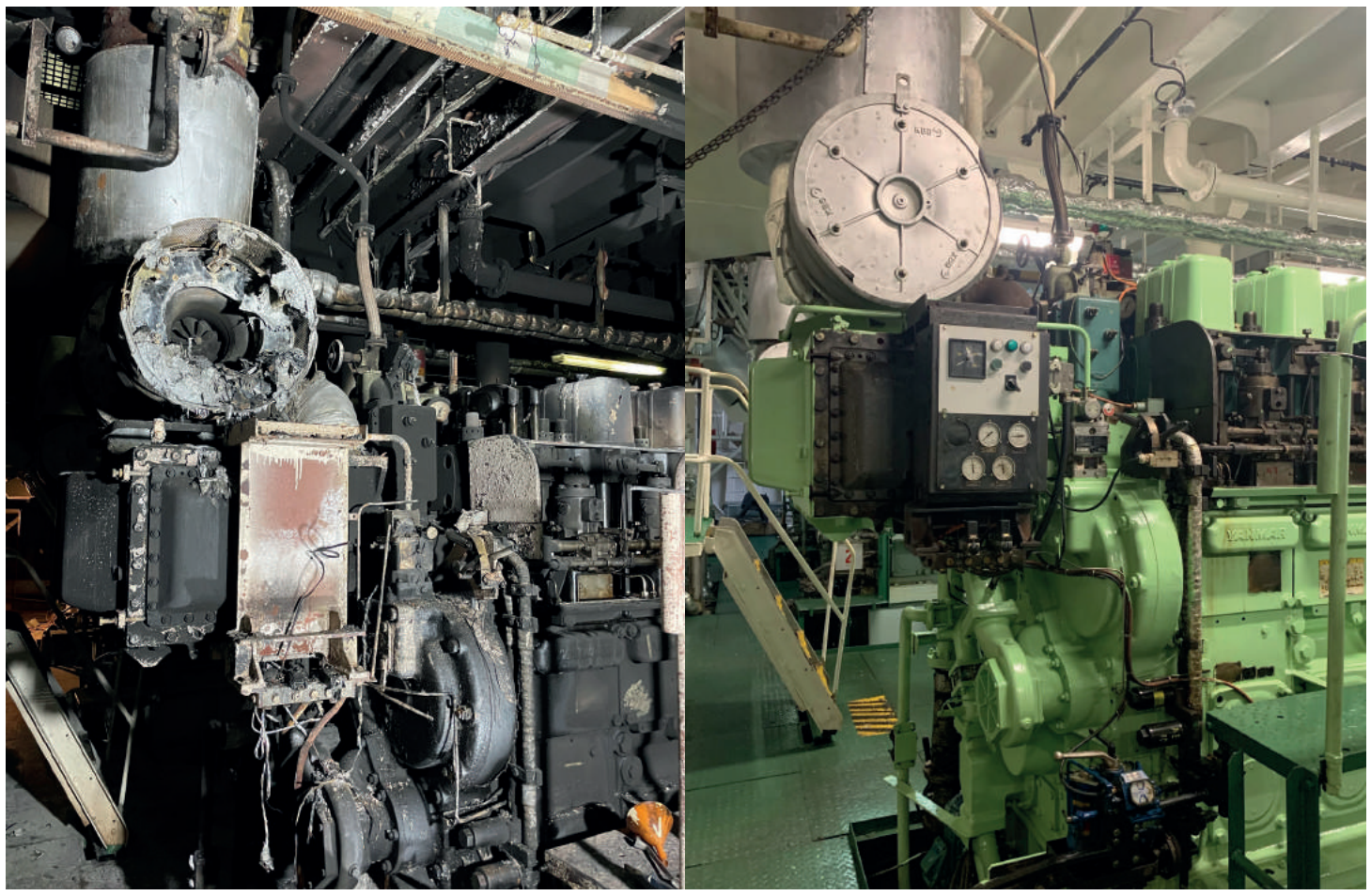
Goltens also performed mechanical and electrical repairs on the engine adjacent to the fire, although this damage was less severe.

MAIN ENGINE REPAIRS

The Goltens team also completed the disassembly of the main engine, and all units were inspected. The engine's cylinder liners were all honed or replaced, and the engine was reassembled with new or reconditioned skirts, crowns, bolts, O-rings and piston rings. Finally, the engine was filled with jacket water and satisfactorily pressure tested.

RESULTS

Goltens' repair work was completed in 46 days, with various components of the repair being completed earlier. All systems and main and auxiliary engines were successfully tested and the vessel returned to service. ■



Before and after photos of fire-damaged Yanmar auxiliary engine

Removal of main engine piston assembly

Liner Diameter Measurement

Increasing focus on 2-stroke liner wear patterns after sulphur emissions cap drives Goltens' investment in highly efficient liner measurement tooling

With emissions control regulations now in effect requiring the use of an exhaust gas scrubber system or the burning of low-sulphur fuel oil to meet emissions criteria, Goltens is seeing ever-increasing demand for liner wear inspections on 2-stroke main engines. Operators running on low-sulphur fuels are aware of the lower lubricity of these blends and the potential inconsistency of the bunkers they take on in various ports around the globe.

Failure to follow OEM guidelines to correctly adjust the lube oil type and feed rate to account for the change in fuel type can result in accelerated wear patters due to over-lubricating or under-lubricating, resulting in bore polish or liner scuffing. Generally, cold corrosion results from operating at too low an operational temperature or using oil with too low a Base Number (BN), and Bore Polish results from over-lubrication use of oils with too high a BN. Both conditions result in accelerated wear and lead to liner scuffing.

MASSIVE INCREASE IN INSPECTION EFFICIENCY

Traditionally, liner inspections were completed by disassembling the unit inclusive of cylinder head, piston, piston rod and liner. The process was time consuming, required a team of technicians and limited the number of liners that could be inspected in a given day. In response to the growing demand, and to introduce higher efficiencies to the inspections, Goltens has invested globally in Liner Diameter Measurement (LDM) tooling. With LDM, Goltens is now able to undertake inspection of all liners on a 2-stroke main engine in a single day without disassembly of a single unit, and produce highly accurate reports to indicate cylinder liner wear, remaining life of the liner, ovality and any clover leafing present.

ACCURATE MEASUREMENT ENABLES CONFIDENT DECISIONS

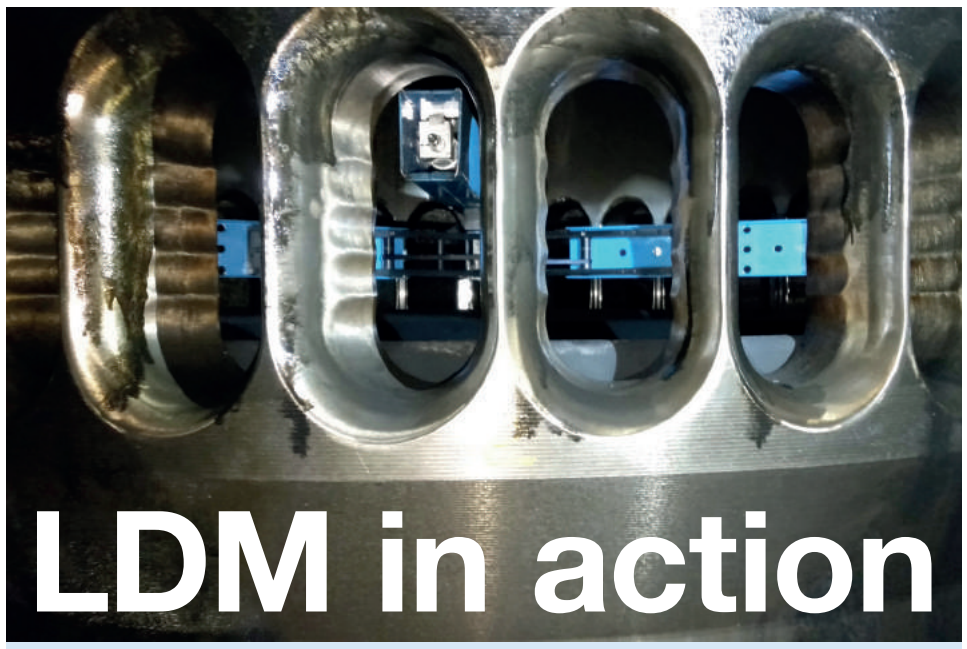
The results provide operators with a highly accurate picture of the condition of their liners and allow them to proactively plan for replacement, corrective action or to continue to operate confidently in the knowledge that their liners are aging properly. In addition to preventing unexpected off-hire periods due to unexpected failure, operators are able to use the data to determine which liners are to be replaced during upcoming yard periods, and arrange for purchase and transport in the most economical manner. Goltens is currently engaging with certain customers who are planning to perform LDM checks on their entire fleet on a periodic basis as part of proactive condition-monitoring programs.

With LDM, Goltens is now able to undertake inspection of all liners on a 2-stroke main engine in a single day without disassembly of a single unit.

Goltens stations in Singapore, China, Dubai, Rotterdam, Houston and Miami are all capable of delivering this service. ■

The LDM measurement process is simple:

- Calibrate the system
- Put piston in its lowest position
- Attach piston height measurement device to piston underside
- Place measurement device on top of piston
- Move piston to desired position and carry out the predefined number of diameter readings
- Move piston to next position and measure diameters again
- Continue until finished
- Evaluate measured data in handheld terminal or transmit measurement data to a PC for evaluation, storage or reporting



LDM in action

LDM installed on top of piston

Validation of liner wear limits after main engine unit suffers blow-by on worn Wärtsilä 6RT-FLEX82C cylinder liner

Goltens' technician installing and configuring LDM equipment

The crew of a nine-year-old container ship, equipped with a Wärtsilä 6RT-FLEX82C main engine, observed exhaust gas blow-by on cylinder No. 5 during normal operation and could not increase the load above 35%. The cylinder liner had 22,452 running hours and the crew suspected it was excessively worn and needed to be replaced.

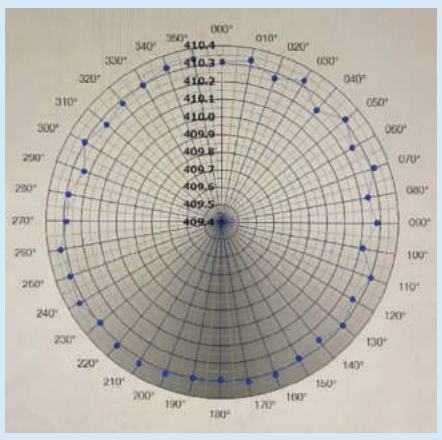
The customer requested Goltens to attend and replace the cylinder liner with an onboard spare and to evaluate units No. 2 and No. 4, which had very similar running hours. The vessel was scheduled to enter dry dock later that year and the customer wanted to verify the cylinder liner wear and deformation alongside its regular scavenge port inspections.

Goltens deployed its technicians with LDM (Liner Diameter Measurement) tooling. LDM allows for precise measurement of liners without the traditional labor-intensive process of removing cylinder covers and piston assemblies to do a manual measurement. With the LDM, Goltens is able to complete the measurement of an entire 2-stroke engine's liners in a single day.

LDM INSPECTION RESULTS

Unlike unit No. 5, the cylinder liners in No. 2 and No. 4 were found to be in good condition. The maximum cylinder wear level was measured at 0.92mm on unit No. 2 and 0.87mm on unit No. 4. These measurements were well below the maximum allowable wear limits of 5.75mm.

The average liner wear rate on these two liners was found to be quite low at 0.038mm/1,000 hours and .041mm/1,000 hours, respectively. Goltens advised that if the current wear rate were sustained, the liner life should exceed 80,000 running hours. ■



Cloverleaf graph of liner wear pattern

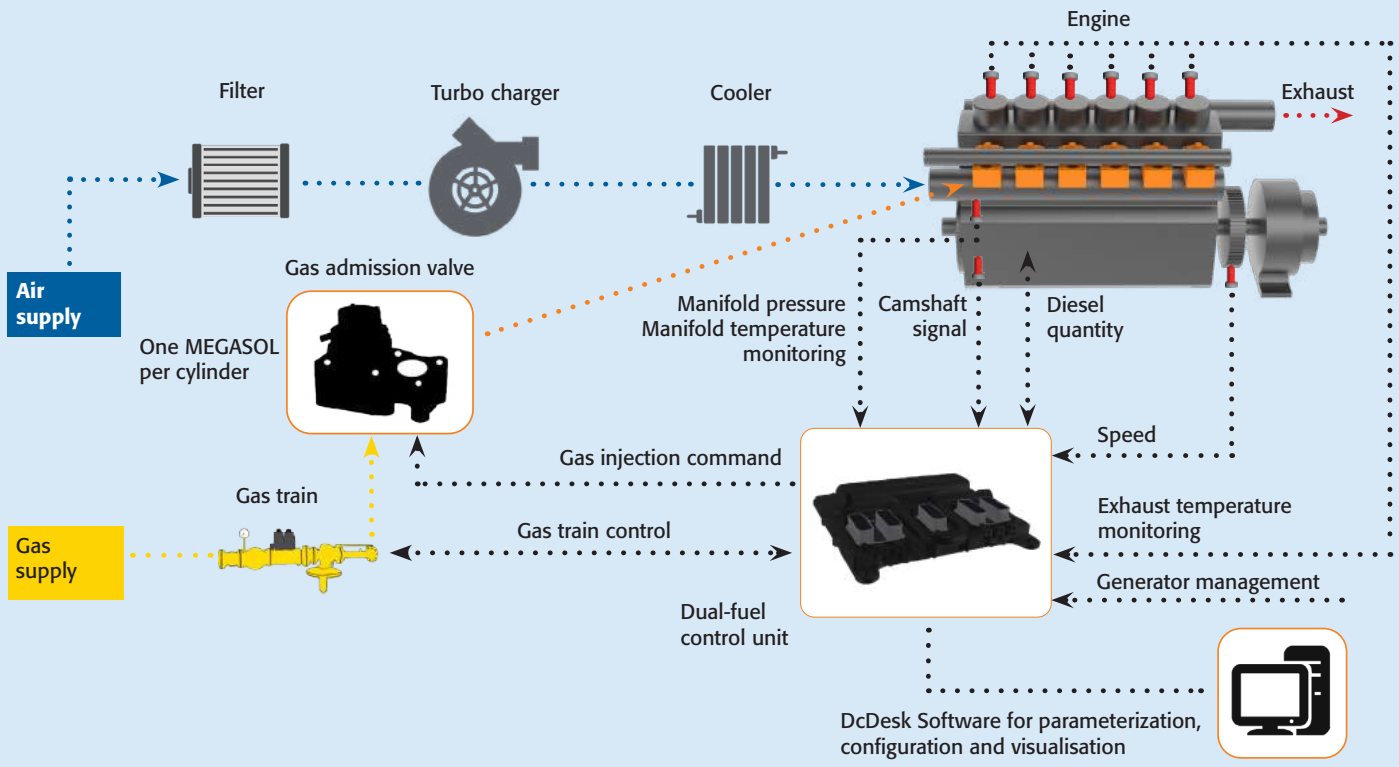
Dual-Fuel Conversions

Goltens lands CAT 3616 retrofit contract for fast ferry in South America

Goltens Miami secured the dual-fuel conversion of the first of four Caterpillar 3616 engines for a 30-year-old, 156-dwt fast ferry operating in South America. Goltens is leading the project supported by components and engineering supplied by Heinzmann GmbH. It is scheduled to be delivered in the second half of 2022.

The solution will enable the ferry operator to run a gas/diesel ratio of 70:30 at approximately 85% of its 4,792kW rated output with the option to run at full power in diesel mode. The resulting solution will reduce GHG emissions and provide the owner with fuel choice flexibility. Evaluation of the proposed solution also provides the opportunity for significant savings in fuel costs.

The first converted engine is planned to be trialed on a test bed to verify all the required operating parameters are met before being installed on the ferry and subsequent conversion of the other three engines onboard. ■



Goltens teams up with Marine Motor Service GmbH in North America

A powerful combination of high-quality parts and services presents a compelling alternative to the engine makers

Goltens' stations in the U.S. have executed an exclusive distribution agreement with German parts manufacturer Marine Motor Service GmbH (MMS). The agreement covers the U.S. and Canada and enables Goltens to offer MMS' expansive parts portfolio to the stationary power market.

"MMS has an excellent reputation and track record providing some of the highest-quality parts to the marketplace and we are thrilled to be able to partner and represent them in North America. MMS has been supplying marine and powerplant customers around the world successfully for decades, but at present it is their gas engine and dual-fuel engine parts that we find most interesting as we strengthen our position within this market segment," says Roy Strand, Goltens' Chief Operating Officer. "The combination of our two companies' strengths provides customers with a cost-effective and powerful independent parts and service alternative to the engine makers," he adds.

MMS supplies parts suitable for use in large-bore, medium-speed 4-stroke diesel, gas and dual-fuel engines manufactured by Wärtsilä, Caterpillar MaK, MAN B&W, HHI, SKL, Pielstick, Stork and Sulzer from their ISO certified facilities in Germany. ■

MARINE MOTOR SERVICE GmbH

Electronic-Controlled Engine Services (ECES)

The maintenance of electronic engine controls requires a deep understanding of engine control logic, the interface of each function and working condition requirements of the system. Goltens' service teams have complete knowledge of modern electronic diesel engines and can provide comprehensive overhaul solutions for your vessels.

With extensive experience and advanced testing technology, Goltens provides high-quality electronic engine control overhaul onboard vessels and FIVA/HPS pump bench test services to minimize downtime and extend engine lifecycle.

Goltens has provided these services to more than 150 vessels, overhauling more than 200 FIVA valves and 125 HPS pumps.

Main service areas supported include:

Goltens engineer servicing Alpha lubricator

FIVA valve on test bench

HCU (HYDRAULIC CYLINDER UNITS)

- Overhaul FIVA valve units, exhaust valve actuator and fuel oil pressure booster
- Overhaul cylinder lubricator system
- Overhaul accumulator and refill with nitrogen
- Function test of FIVA valve

Overhauling pneumatic system

MECHANICAL AND PNEUMATIC SYSTEM

- Check gear tooth condition
- Check and retighten the chain
- Overhaul pneumatic valves
- Overhaul main starting valve
- Function test of pneumatic valve system

Servicing engine-driven and start-up pumps

HPS (HYDRAULIC POWER SUPPLY)

- Inspection of auto flushing filter for hydraulic system
- Replacement of hydraulic hose and seal ring
- Overhaul engine-driven pump and startup pump
- Overhaul accumulator and refill with nitrogen
- Check hydraulic pressure buildup time and hydraulic decay time
- Replacement and readjustment of accumulator block relief valve

Inspecting angle encoder

ELECTRONIC CONTROL SYSTEM (ECS)

- Check junction box connection and all cabling
- Check insulation of ECS system
- Check interlock switches and transmitters
- Binding checks all cables
- Check ECS parameter and performance curve
- Re-calibration on ECR and LOP
- Check alarm history in event log on MOP
- Check PMI and Cocos EDS system
- Check ethernet system for monitoring system

Goltens Miami and Goltens Houston awarded OEM-equivalence by U.S. Navy's Military Sealift Command (MSC)

OEM equivalence for MAN, Wärtsilä, Sulzer, Stork Werkspoor, Bergen and MaK marine diesel engines

An MSC Engineering Evaluation Team has completed the review of Goltens' application to be considered qualified to provide OEM-equivalent maintenance and repair services on MSC ships. Goltens was deemed to have met the requirements that govern the "procurement of items critical to safety and the modification, repair and overhaul of those items assigned to Military Sealift Command vessels". The OEM-equivalent qualification covers MAN, Wärtsilä, Sulzer, Stork Werkspoor, Bergen and MaK marine diesel engine maintenance and repair services on MSC vessels.

The MSC operates roughly 125 civilian-crewed vessels that provide ocean transportation to the Department of Defense. The vessels replenish U.S. Navy ships, conduct specialized missions, strategically preposition combat cargo at sea and move military cargo and supplies used by deployed U.S. forces and coalition partners around the world. ■

The appearance of U.S. Department of Defense (DoD) visual information does not imply or constitute DoD endorsement.

Reduce, Reuse, Recondition

Goltens helps support war on waste by extending engine life cycles

Reconditioning of White Metal Bearings

Each year Goltens' stations recondition an average of over three million kilograms of critical 2-stroke engine components, dramatically reducing the environment impact of engine operations by extending component life cycles.

As the world's economies and major maritime and power corporations look for ways to limit the negative impacts of their operations on the global environment, the long-proven process of reconditioning core engine components is being looked at from a fresh angle. Reconditioning of piston crowns, connecting rods, exhaust valves and other major 2-stroke engine components has traditionally been viewed as an economical approach to engine operation and maintenance, but with the increasing focus on reducing carbon footprints, the environmental benefits of reusing components as opposed to consuming new ones are clear.

WASTE REDUCTION

Reusing and returning components to an original specification affects multiple areas. The raw material required to manufacture new components is avoided, while the material removed as part of reconditioning is recycled. The amount of raw material required to deliver a 'like new' component pales in comparison to that of manufacturing a new one. Furthermore, reconditioning processes have been streamlined to reduce waste and to ensure environmental impacts are kept to an absolute minimum.

Goltens' workshop facility in Singapore

Machining of 2-stroke cylinder cover on CNC vertical lathe

2-stroke chroming facility in Singapore

ENVIRONMENTALLY SOUND PROCESSES

Goltens has worked with local authorities and leading equipment manufacturers to ensure that all our processes comply with, or exceed, all required environmental regulations. When it comes to chromium – chroming is a necessary part of the process for most piston crowns as well as the stems of some valve spindles – Goltens works to eliminate harmful environmental impacts through rigid adherence to regulations and the use of the latest exhaust scrubber technologies. As newer, cleaner solutions become feasible, Goltens is working aggressively to incorporate them into our business.

GLOBAL OPERATION WITH 3,000 TONNES OF IMPACT

While all of Goltens' workshops globally recondition 4-stroke engine components like cylinder heads, connecting rods and other pieces, our stations in Rotterdam, Dubai, Shanghai and Singapore specialize in, and have invested heavily in, reconditioning processes for 2-stroke engine components, which are the largest in terms of raw material required and environmental impacts. Overall, Goltens reconditions an average of 1,400 two-stroke pistons, 1,550 exhaust valve spindles, 1,130 valve seats, 300 piston skirts and 300 cylinder covers per year along with hundreds of other components. Assigning an average weight to each of these components, there is an estimated reuse of over three million kilograms/three thousand tonnes per year of steel that is not sent to scrap and does not need to be mined and processed to make new components.

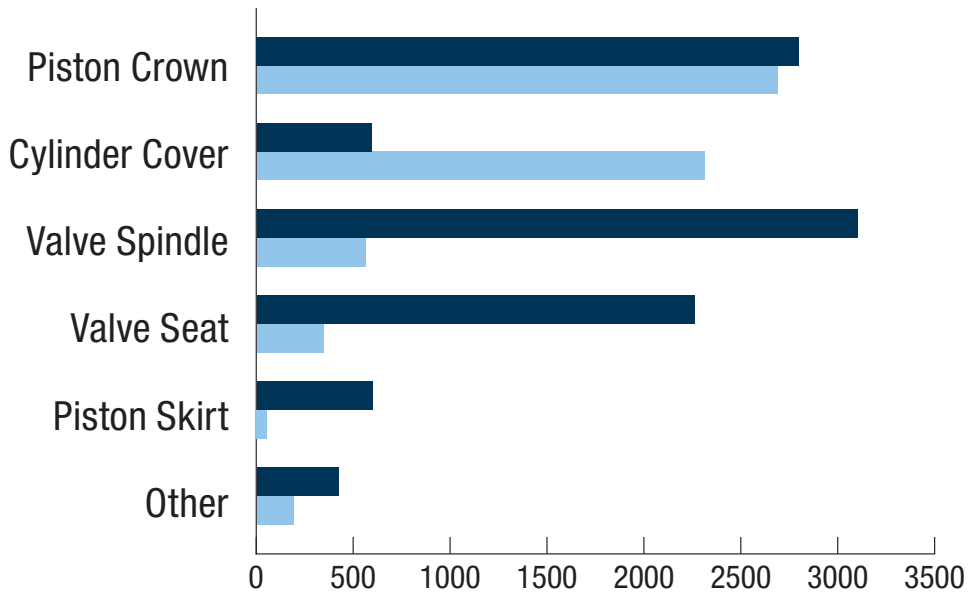
WHAT ABOUT QUALITY?

Over our 80-plus years of service to the market, Goltens has reconditioned countless components for the maritime and power industries. Adherence to tight, ISO-controlled and marine Class-certified processes has resulted in a near zero defect rate and the confident expectation of our customers of a second (or third) full life cycle for the component. Every component delivered by Goltens follows the exacting standards of the OEM without unnecessary consumption of raw materials associated with a new component.

WHAT ABOUT COST?

In general, reconditioning has been viewed as economical by the market when the price to recondition the piece is 50% or less than the price of new one. Substantial investments in CNC tooling, supply chain management, process reengineering and quality controls have enabled Goltens to continue to offer this invaluable service at competitive rates that meet this price sensitive criteria and limit the impacts of large-bore diesel engines on the environment. ■

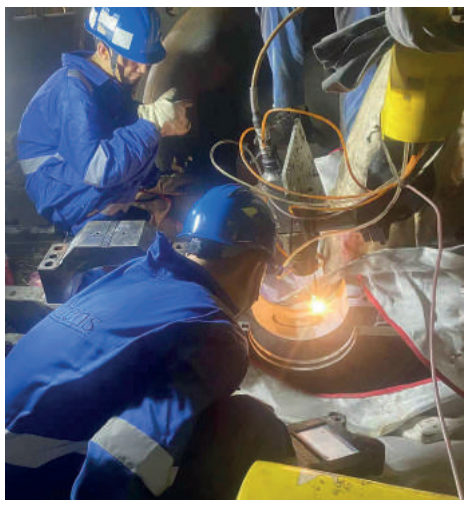
2020-2021 Reconditioned 2-Stroke Components and Weight



Remetalling

Restoring equipment to original dimensions

Goltens is globally known for our ability to remove metal to complete high-tolerance repairs of damaged surfaces, but did you know we can also add it back?



IN-SITU RECONDITIONING OF SLIDE BEARING HOUSING OF LARGE MULTI-AXIS AIR COMPRESSOR IN CHINA

A large chemical plant with an annual production output of 1.5 million tonnes was undergoing an overhaul when the operator discovered that the main bearing on its air compressor had severely overheated. With large orders pending, minimizing downtime for the machinery was critical. The equipment OEM contacted Goltens and after inspection, Goltens mobilized in-situ laser cladding and line boring tooling to the site. Goltens performed in-situ grinding of the damaged surface, laser clad the bearing housing and line bored the 280mm bearing housing with a tolerance of 0.02-0.03mm. With an original plan to complete in seven days, Goltens worked multi-shift to complete the job in only four days.

LASER CLADDING RESTORES BULKER'S WORN STEERING GEAR TO ORIGINAL DIMENSIONS

A bulk carrier undergoing dry-dock repairs discovered that the steering gear inner housing and rotor were badly worn and required a creative repair. After inspection, Goltens proposed to machine the worn surfaces, perform laser cladding to restore the worn material, machine the surfaces back to original OEM dimensions and reassemble the components. Goltens' specialists completed the work in only four days before it was reinstalled and successfully tested.

THERMAL SPRAYING SOLUTION RESTORES POLYESTER PLANT AGITATOR SHAFT

A polyester plant planning a maintenance shutdown suspected that polyester reactor agitator shaft was damaged. Goltens inspected the shaft journal and found excessive ovality and deep scoring and scratches on the running surface. Complicating the repair, the customer required the journal's original diameter to be restored. Goltens pre-machined the 285mm diameter journal removing 3.3mm to clear it of scoring and any surface cracks. The journal was then remetalled using thermal spray and finish-machined and honed to the required diameter and roughness.

LASER CLADDING AND JOURNAL MACHINING SALVAGES SLURRY PUMP SHAFT FOR MINE

A mining company suffered a major bearing seizure on the crankpin of a slurry pump shaft resulting in hardness levels as high as 397 HB and heat cracks on the pin surface. Goltens offered a solution to machine the pin to undersize, but the pump maker required the pin diameter at original specification. Goltens proposed an alternative repair solution using laser cladding to rebuild the crankpin diameter and machine it back to its original size and tolerance. The crankpin was machined to 2mm undersize to clear all heat cracks and inspected again by MPI. Once satisfied, the cracks and hardness were removed from the surface, the crankpin was clad with 3mm Inconel 625 material, machined, honed and polished to final diameter before being checked with Leica Laser Tracker.

LASER CLADDING SOLUTION RETURNS STEEL PLANT'S PILGER MILL TO OPERATION

One of the world's largest steel and non-ferrous metal equipment manufacturers was having one of its cold pilger mills repaired when issues with the gearbox bearing housing were discovered. Instead of boring to oversize and installing an oversized bearing, the customer required the repair to return the housing to its original dimensions. Goltens mobilized laser cladding and line boring equipment and specialists, laser clad the bearing housings and line bored the housings after they were realigned to achieve the required dimensions. ■

Reconditioning White Metal Bearings

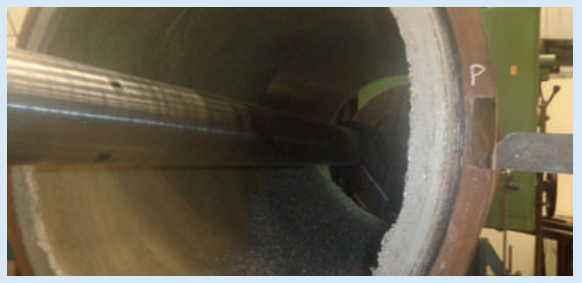
Goltens was an early pioneer in developing proprietary centrifugal casting machinery to meet the highest tolerances and quickly repair and recondition bearings. Centrifugal casting, where the bearing is spun while the babbitt material is poured, is a significantly better process with much improved results versus a poured cast bearing. The spinning results in increased pressure and ensures that babbitt is free of impurities, gases and imperfections. This ability to repair large-diameter stern tubes, crankshaft and other journal bearings with precision and speed is something our customers have to come to rely on. The reconditioning process works as follows:

Step 1: The damaged/worn bearing material is melted off the bearing surface with high-temperature torches.

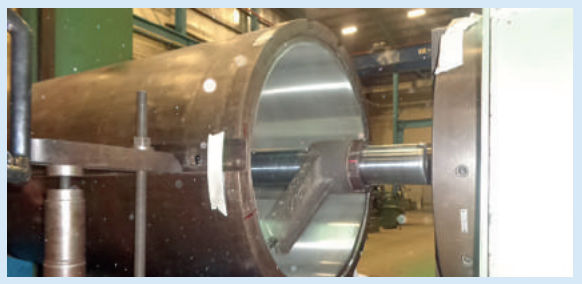
Step 2: The surface is then prepared with a Hoyt tinning compound to ensure proper adhesion of the white metal bearing material to the bearing shell.

Step 3: Hoyt 11R grade white metal ingots are then melted in preparation for pouring.

Step 4: The bearing shell is prepared for centrifugal casting and mounted on the casting machine. Melted white metal is then poured into the spinning, preheated casing.



Step 5: The centrifugal cast bearing is then mounted and aligned on the horizontal mill for rough machining of the bearing surface.



Step 6: The stern tube is finish-machined to the required diameter and surface roughness.

Step 7: The bonding of the white metal is verified using ultrasonic testing prior to final calibration checks on the bearing measurements prior to delivery back to the end-customer for installation.

Continued Expansion in T

Goltens' mechanical and in-situ machining skills do not relate solely to reciprocating engines. Our specialists are regularly called upon by end-customers and turbine OEMs to bring their specialized mechanical and high-precision in-place machining services and tooling to bear on steam-, gas- and hydropower turbines all over the world.

LINE BORING SOLUTION FOR GE FRAME 9 GAS TURBINE
Having previously successfully completed line boring repairs for the customer, Goltens was once again brought in to resolve clearance issues discovered between the rotor and casing on a 1.019MW GE Frame 9 gas turbine. The turbine unit had issues with the clearance between rotor and casing being too small and required Goltens' assistance to complete the machining to the required dimension. Goltens completed the complex, high-precision line boring of the casing to repair HP stages 2-9 and IP stages 1 and 2 within the required timelines.

LINE BORING AND HONING OF BOLT HOLES BETWEEN TURBINE AND GENERATORS
A leading IPP approached Goltens with an urgent requirement to correct the misalignment of their coupling connection bolts in a GE Frame 9 gas turbine, which had deformation due to thermal expansion. The misalignment was impeding completion on an ongoing overhaul and return to power production. Goltens' technicians prepared the special tools and completed line boring and honing of a total of 44 bolt holes.

SLIP RING MACHINING
Goltens deployed its in-situ machining tools and technicians to Tanjung Priok Power Station in Indonesia to repair worn slip rings that were making contact with the carbon brush on a Mitsubishi MB-H turbine generator.

HYDROPOWER TURBINE COVER MACHINING
The turbine OEM approached Goltens to make machining modifications to one of their turbines to support the installation of a turbine cover with a new design. To support this, Goltens was required to customize its tooling to machine six holes of 72mm diameter through a thickness of 32mm in the overhead. Goltens completed the machining by drilling the holes with stepped diameters until the required size was met.

n Turbine Repair Services

STEAM TURBINE SHAFT MACHINING
Goltens' in-situ machining experts were brought in to repair a turbine shaft on a newbuild steam-turbine generator damaged during trial operations in Europe. The shaft journal surface was repaired and subsequent operational trials were successful.

GAS TURBINE AIRFLOW IMPROVEMENT
Goltens was engaged by the OEM to support a combustion airflow intake improvement project on an aging gas turbine at a power plant in China. This involved the in-situ machining of two new holes into the intake housing, which was difficult due to the angle of the housing and the hardness of the material to be cut. The job was completed with two shifts in three days.

TURBINE RESIDUAL LIFE ANALYSIS
Goltens' turbine experts and NDT specialists performed a complete assessment of an Escher Wyss 5MW steam turbine that had been in operation for over 50 years at an oil-processing facility. The assessment included dye penetrant, ultrasonic, magnetic particle and metallographic (RPL) testing of all the turbine components. The results of the inspection concluded the turbine could be safely operated for another five years.

STEAM TURBINE ROTOR SHAFT MACHINING
Goltens' in-situ machinists rectified damage to the 200mm-diameter shaft of a steam-turbine powerplant. The team managed to complete the urgent repair removing only 0.5mm from the plant's 10MW Shandong Jinan turbine shaft and completed the job in only four days.

SEAT RING GROOVE MACHINING
To accelerate the planned upgrade of a 15MW steam turbine in China, the manufacturer decided to perform the work on site instead of transporting all components to their workshop. Goltens' in-situ team was contacted to undertake the machining modifications to the turbine's seat ring grooves using a specially modified version of our line boring tooling to machine the 1.5-meter diameter. ■

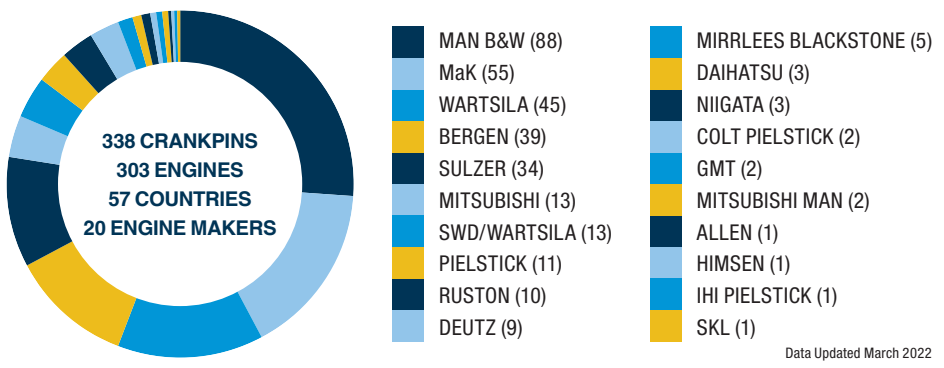
Crankshaft Annealing – Goltens successfully salvages over 300 4-stroke engine crankshafts around the world

Our proven process saves operators millions on crankshaft replacements and limits asset downtime

Historically, shipowners and powerplant operators experiencing crankshaft casualties resulting in excessive hardness had two options: replace the crankshaft or machine below the hardness. The first option results in major expense and downtime and the second, if successful, in major reduction of the journal diameter potentially limiting the crankshaft's serviceable life.

Since receiving marine Class approval for our crankshaft annealing process in 2012, Goltens' stations around the world have been salvaging badly damaged crankshafts for customers all over the world. Once looked down upon as a non-standard or unapproved repair by the major OEMs, Goltens has brought crankshaft annealing forward as a well-proven, repeatable process that returns crankshafts to service with the absolute minimum amount of material removed and extending life expectancy.

Goltens' annealing process continues to save owners millions of dollars in avoided and unnecessary crankshaft replacements and countless days of avoidable downtime every year. ■



Crankshaft annealing saves money and minimizes downtime for Caribbean powerplant

Having previously been forced to replace a Wärtsilä crankshaft and incur all the costs and related downtime, the plant operator learned that engaging Goltens and its alternative crankshaft repair methods pays off in multiple ways.

Machining the surface cracks from the damaged journal

Ceramic annealing tiles being installed on crankpin

The 78.5MW powerplant, with eight Wärtsilä W18V46 and two 18V32 engines commissioned in 2015, experienced a significant bearing failure on one of its engines. The uncontrolled cooling related to the shutdown introduced excessive hardness in one of the crankpin journals. Having previously commissioned another company to replace a crankshaft following a failure, the operator contacted Goltens to inquire if this crankshaft could be salvaged to avoid the downtime and excessive cost associated with a replacement.

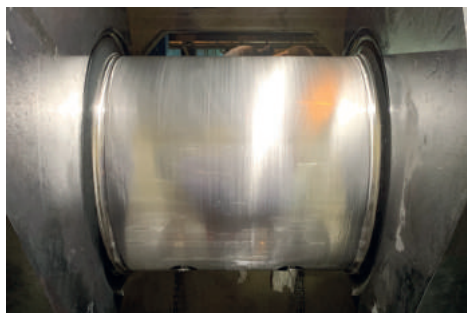
DAMAGE INSPECTION AND REPAIR RECOMMENDATIONS

Goltens presented its repair method then inspected the crankshaft and determined that it could definitely be salvaged through annealing and machining. Our experts were also confident that we could significantly limit the amount of material removed from the journal and extend the potential life of the crankshaft. While the hardness was high, with spots between 460HB and 580HB (normal hardness levels are ~320HB), Goltens noted that they could salvage the crankshaft and remove only 4mm from the shaft. Machining away the journal surface to get below the hardness is sometimes a possibility but this generally results in the removal of uneccessary diameter and limits the potential life of the shaft. If the machining required to remove the hardness exceeded the rated diameter (10mm) of the shaft, it would be a total loss.

ANNEALING AND MACHINING REPAIR

Goltens mobilized tooling and in-situ specialists to site and machined the crankpin surface until it was clear of surface cracks. Once completed, the annealing tiles and insulation materials were put in place. In conjunction with the other preps, Goltens removed the adjacent main bearings and the engine's flywheel and installed gauges to monitor the linear expansion of the shaft to ensure the significant heat introduced did not pose a risk to the block or adjacent journals.

The computer-controlled heating and cooling process, which brought the journal above 600˚C and gradually lowered the temperature to ambient, reduced the hardness to 320HB, which was well within the maker's tolerances. Once annealing was completed, Goltens mounted the cutting and honing tooling and finished the crankpin at (4.00mm) with a surface roughness of less than 0.20Ra. The process successfully avoided another costly and uneccesary crankshaft replacement for the plant. ■



Fully repaired Wärtsilä 32 crankpin

Checking residual hardness after crankpin annealing and cooling

Dual crankshaft machinists in action

Goltens succeeds in dramatically reducing downtime

When faced with multi-journal crankshaft casualties and compressed timelines, sometimes it is best to double the resources applied.

With major investments made over the years in developing our proprietary and market-leading crankshaft cutting tools, Goltens has already reduced the time required to repair a damaged crankpin by up to half versus traditional crankshaft grinding methods. This by itself is an incredible improvement, but sometimes “fast” just isn’t “fast enough”.

Regardless of whether the engine’s application is merchant, naval or power generation, the pressure on operators to reduce downtime is always extreme. As a result of our investments in tooling and a deep bench of in-situ machining specialists, Goltens has the flexibility to be creative in our solutions to further accelerate repairs. Sometimes, when multiple crankpins are damaged, we have the capacity to double up the resources applied and complete two journals simultaneously.

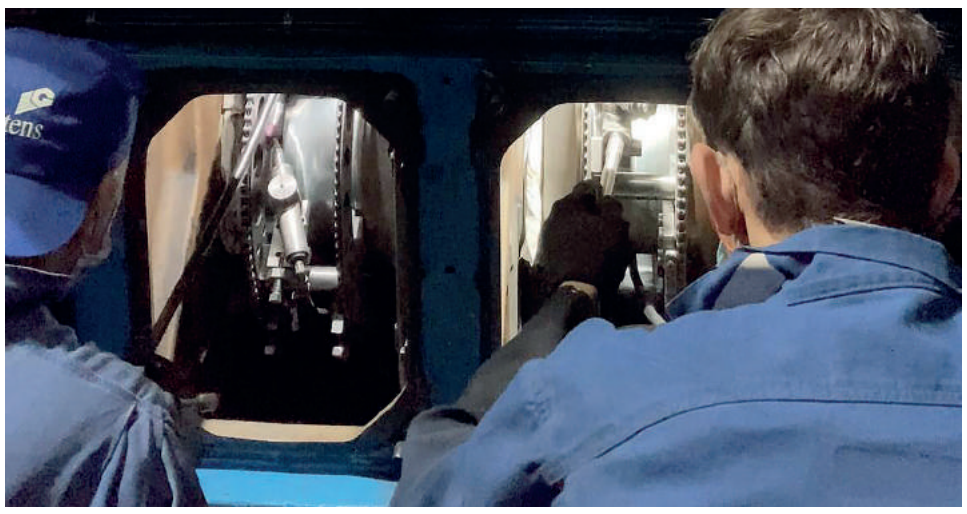
Below are a few recent multi-journal projects undertaken by Goltens’ machining experts around the globe:

FIVE WÄRTSILÄ 6L32 CRANKPINS IN EIGHT DAYS

Goltens’ three-man team of in-situ machinists completed the machining repair of five Wärtsilä crankpins on a 14-year-old containership in only eight days, removing 0.5mm from each crankpin. This repair would normally have required 14 days to complete. Work was completed on a U.S. voyage between Newark and Miami.

5 PIELSTICK 10PC4.2V CRANKPINS FOR USNS BENAVIDEZ

Goltens was engaged by the engine OEM to repair five crankpins on a RoRo Vehicle carrier operated by the U.S. Military Sealift Command (MSC). Deploying two sets of machining equipment and technicians, Goltens completed the removal of 1.0mm from each journal along with finish-polishing in only 10 days.



16 WÄRTSILÄ 8L26A CRANKPINS FOR VESSEL IN DRYDOCK IN PORTUGAL

After excessive wear was found on all crankpin journals on two Wärtsilä 8L26A engines during a drydocking, Goltens’ crankshaft machinists were engaged to machine all the crankpins. To speed the process, the team machined 2 crankpins at a time, removing 1.0mm from the diameter of each. Goltens also completed polishing of 3 main journals and completed the total job in 28 days. ■

In-situ metal stitching salvages another badly damaged engine block

Another costly and time-consuming block replacement was avoided with Goltens' metal stitching repairs, once again minimizing asset downtime for the customer.

An 11-year-old containership suffered a major casualty on one of its Yanmar 6EY26L auxiliary engines resulting in pieces of the connecting rod breaking through the crankcase wall causing extensive damage. The connecting rod bolts on one of the cylinders gave way and resulted in a substantial hole above the inspection door.

In view of how operationally disruptive and very expensive a block replacement would be, the owner contacted Goltens to inspect the damage and determine if the block could be salvaged.

INSPECTION AND REPAIR PLANNING

Goltens inspected the block and determined the hole in the block, as well as other damage found in the lower liner landing surfaces, could be repaired. Unfortunately, none of the pieces of the block were substantial enough to be stitched together.

For the lower liner landing surface, line boring that area and inserting an oversized sleeve was proposed. For the inspection door damage, Goltens proposed the fabrication of a cast insert that could be metal stitched into the block for a permanent repair. Goltens created a 3D model of the insert and mobilized tools and technicians to complete the repairs.

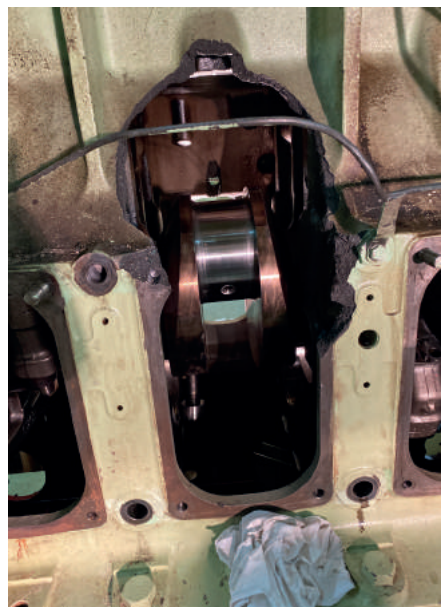
METAL STITCHING

Goltens’ specialists cropped out a clean area to match the shape and dimensions of the modeled insert while the insert was fabricated to match the 3D model. The insert was positioned and held in place with temporary stiffeners. Using a jig, the holes for the stitching pins were drilled and tapped and stitching pins installed to draw the sides of the cracked surfaces together. To reinforce the repair to the surface’s original strength, locks were then inserted, drilling and tapping with precision jigs, such that the locks were inserted into place perpendicular to the cracks.

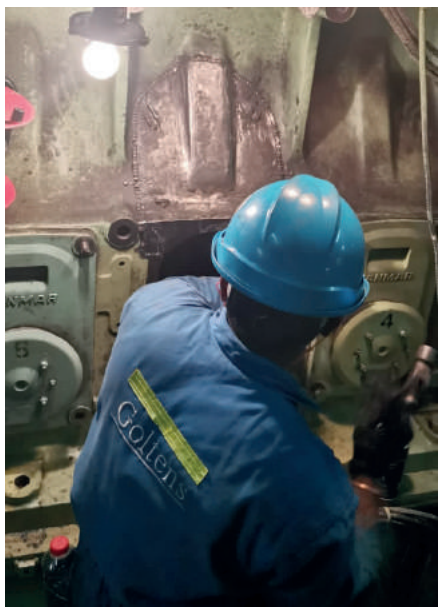
FINAL STEPS

To restore the surface to its original condition, the stitched surface was peened and ground level to the adjacent block surface. Once completed, die penetrant testing was completed across the entire surface to ensure no cracks remained and the repair was complete.

As a final step, holes for the crankcase door were tapped with a magnetic drilling machine and the repaired surface painted. The engine was then put through satisfactory operational trials at full load. ■



Damaged section of engine block from conrod failure



Stitching and locking complete, peening in process

Die penetrant crack test of repaired surfaces

Metal stitched area after painting

Line Boring – a critical piece of Goltens' in-situ machining portfolio

Goltens undertakes all manner of line boring services whether for engine repair, supporting shipyard newbuild and repair functions or for general industrial applications.

Goltens uses purpose-built line boring equipment that enables our machinists to handle line boring requirements up to 10 meters in length, with a wide variety of straight bore and tapered bore diameters depending on the requirements of the job. Main bearing pockets, lower liner landing surfaces, stern tubes, turbine casings, rudder stocks and other requirements are all routine work for our machining specialists and tooling.

Below are two recent jobs performed for different powerplant operators in the Dominican Republic:

Goltens' specialists boring two lower liner landings at the same time

Line boring tooling mounted on the cylinder head studs

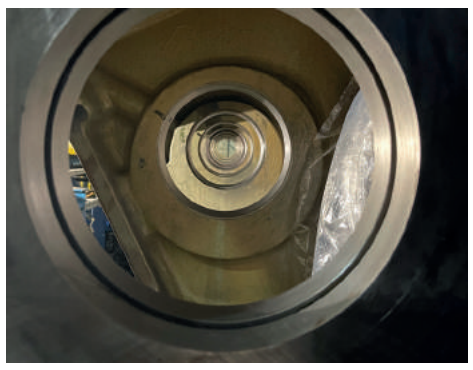
DOUBLE BORING SET-UP DRAMATICALLY REDUCES DOWNTIME FOR WÄRTSILÄ 18V50DF ENGINE

Goltens was approached by a powerplant operator to solve a problem with one of their Wärtsilä 18V50DF engines. All 18 cylinders had worn lower liner landing surfaces allowing cooling jacket water to leak past some of the liners. Goltens proposed to bore the lower liner landings to oversize, install ring inserts and finish-machine to the original diameter. To limit engine downtime, Goltens deployed two sets of boring tooling specially modified to mount quickly and accurately on the cylinder head studs of the engine. Four technicians were deployed so that two liner landings could be machined at the same time.

For each of the eighteen 572mm bores, Goltens machined 20mm from the diameter and mounted ring inserts into the oversized bore using liquid nitrogen. Once shrink-fit in place in accordance with OEM specifications, Goltens finish-machined the interior diameter of the inserts to the original 572mm and test fit the liners.

CAMSHAFT LINE BORING REPAIR ON WÄRTSILÄ W16V32 ENGINE

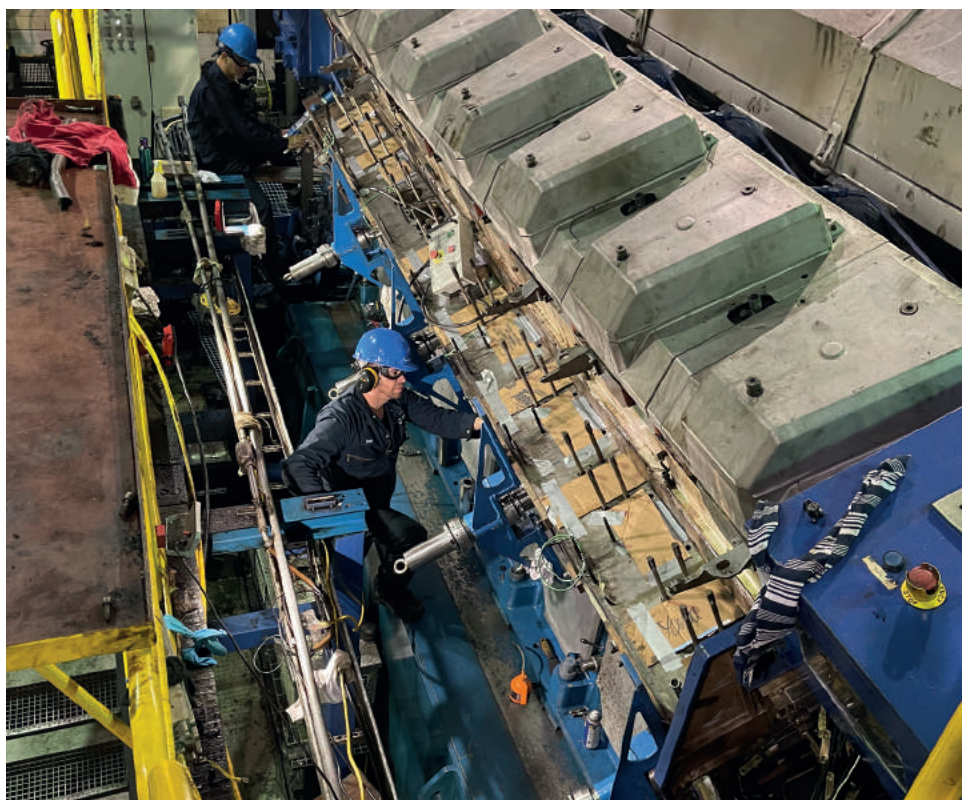
A powerplant reported camshaft bearing issues on bearing pocket No. 5 on one of it Wärtsilä W16V32 engines. Goltens inspected the engine and found significant discoloration in the bearing pocket consistent with a loss of lubrication resulting in overheating. A subsequent laser check on all the bearing pockets to check the line showed high deviation between all of the bearing pockets. Based on the findings, Goltens recommended line boring all the camshaft bearing pockets to get a new center of circle and to fit oversized bushings once complete.



Finished camshaft bore after machining

Goltens set up its line boring tooling along the full length of the engine, with special-purpose brackets and bearings for the bar placed between the bearing pockets. Using the new center of circle references from the laser, Goltens machined 10.00mm from the diameter of the bearing pockets and installed new oversized bushings (manufactured in Goltens' workshop) with liquid nitrogen, Loctite and set screws before performing machining of a final finish 1.00mm from the pockets. ■

Laser check on camshaft bearing pocket bore alignment



Line boring equipment installed on all camshaft bearing pockets

$$EEXI = \frac{\prod_{j=1}^{n} f_j \cdot \left(\sum_{i=1}^{n_{ME}} P_{me}(i) \cdot C_{FME}(i) \cdot SFC_{ME}(i) \right) + \left(P_{AE} \cdot C_{FAE} \cdot SFC_{AE} \right) + \left(\left(\prod_{j=1}^{n} f_j \cdot \sum_{i=1}^{n_{PTI}} P_{PTI}(i) - \sum_{i=1}^{n_{eff}} f_{eff}(i) \cdot P_{AE\_eff}(i) \right) \cdot C_{FAE} \cdot SFC_{AE} \right) - \left(\sum_{i=1}^{n_{eff}} f_{eff}(i) \cdot P_{eff}(i) \cdot C_{FME} \cdot SFC_{ME} \right)}{f_i \cdot f_c \cdot f_l \cdot Capacity \cdot f_w \cdot V_{ref} \cdot f_m}$$

Decarbonization Solutions / EEXI Retrofits

Goltens is here to help as your trusted environmental compliance partner

As a leading pioneer in green technology retrofits for the marine industry, Goltens introduced efficient, cost-effective solutions for shipowners seeking to comply with ballast water and sulphur emissions regulations. With the EEXI (Energy Efficiency Existing Ship Index) coming into force on 1 January 2023, shipowners are once again faced with the possible need to retrofit for compliance. Goltens offers a comprehensive EEXI compliance package of solutions and support to help navigate these regulations and comply with its requirements. Services we offer include:

EEXI COMPLIANCE CALCULATOR

To support shipowners, Goltens has developed a free portal (www.eexicalculator.com) featuring a digital self-service tool that owners can use to enter details for each of their vessels, determine an indicative EEXI and learn whether the ship is compliant or requires further action.

EEXI TECHNICAL FILE PREPARATION AND CLASS APPROVAL

Once your EEXI is determined, Goltens can prepare your vessel's EEXI technical file and work through the required Class approvals.

The technical file must be approved and the International Energy Efficiency Certificate re-issued by your flag administration or recognized organization (RO) at the ship's first annual survey after 1 January 2023 at the latest.

EEXI COMPLIANCE/RETROFIT SOLUTIONS AND ADVISORY SERVICES

In the event that a vessel is not EEXI compliant, Goltens' technical experts and design engineers will be able to analyze and advise on potential solutions to comply, and execute engineering and design to retrofit the ship in the least invasive manner possible. These services can result in a feasibility study that evaluates EEXI improvement options.

If you are struggling with how to evaluate your EEXI compliance rating or what steps you can take to become compliant, reach out to a Goltens' expert today and start your journey to EEXI compliance and decarbonization. There are many more ways to comply with EEXI than just using Engine Power Limitation.

Get in touch with us and see what's the best solution for your vessel. ■

IMO-compliant commissioning testing of Ballast Water Management Systems (BWMS)

Effective from 1 June 2022, regulation E-1 of the Ballast Water Management Convention will enter into force requiring all vessels fitted with the IMO D-2 discharge standard.

To support shipowners globally, Goltens' stations offer Class-approved, onboard indicative testing and reporting at select major ports around the world completed in compliance with BWM.2/ Circ.70/Rev.1, 'Guidance for the commissioning testing of ballast water management systems'. The momentum has been building; in the first four months of 2022, our stations in Asia have completed IMO D2 commissioning tests for more than 50 vessels operating in the region, with many more expected in the coming months. Goltens is in discussions with numerous major owners and managers about fleet agreements to provide this testing at strategic locations around the world.

OBJECTIVE OF BWMS COMMISSIONING TESTING

Commissioning testing is required to demonstrate that the particular type-approved BWMS installed onboard the vessel is performing as designed by demonstrating that its mechanical, physical, chemical and biological processes are working properly. Note that commissioning testing is not performed to validate the system design. The respective BWMS designs should have been validated during the respective type-approval process and will already have been demonstrated to comply with the IMO D-2 discharge standards.

QUALIFIED TESTING PROVIDERS

The required testing must be performed independently to the satisfaction of vessel's flag state administration. The testing is not within the scope of standard supplier commissioning, however the BWMS supplier can support the process by arranging or facilitating third-party independent testing. With years of BWMS retrofit experience and hundreds of installations completed, shipowners can confidently engage Goltens' highly experienced engineers to conduct this testing.

BWMS TESTING PROCESS

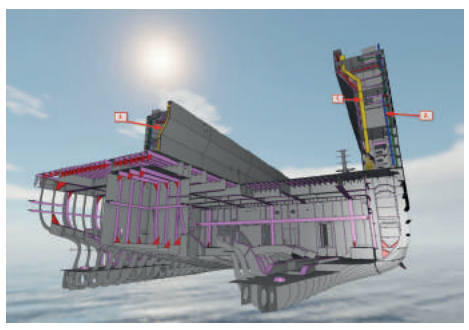
The guidance shown in the infographic (right) indicates that system testing should be conducted using local ambient water regardless of the challenges this water may present, and regardless of it being within or outside the original system design limitations. ■

Goltens' Engineering Services go far beyond b

Our talented team of design engineers tackle much larger and more co

With over 1,000 compliance retrofit projects completed over the last 10-plus years, Goltens' name has become synonymous with helping shipowners comply with environmental regulations in the least intrusive and most efficient manner. While many customers have experienced Goltens' design engineering services related to such ballast water and emissions projects, what many may not realize is that we also have deep expertise in vessel design and conversion. Here are two recent projects we have completed:

Render of the vessel design



3D model showing optimized pipe routing for most efficient and easy installation with long pipe lengths, as shown in the photo

Vessel during construction

WIND-ASSISTED GREEN CARGO VESSEL *MV CANOPÉE*

Jifmar Guyana, a marine contractor with headquarters in Aix-en-Provence, France, developed a wind-assisted RO-RO cargo vessel for the Ariane Group to transport its Ariane 6 rocket parts from Europe to Guyana. The 121-meter, 4,700-dwt vessel *Canopée* is designed and built by Neptune Marine Projects in Leek, Netherlands.

MAJOR PROJECT CONTRIBUTOR

Goltens' design team was honored to be a part of the design team for this unique and groundbreaking vessel, the very first cargo vessel equipped with four wingsails called OceanWings. The OceanWings system will enable the vessel to significantly reduce its fuel consumption. Goltens' scope included the mechanical engineering and part of the outfitting of the technical spaces, routing of all ship's pipelines, and the delivery of the equipment and appendages.

DESIGN PROCESS MAXIMIZES YARD OPERATIONS AND CONSTRUCTION EFFICIENCY

Through close coordination with the owner and the shipyard, Goltens created 3D Cadmatic models for the technical spaces, including the propulsion and alignment arrangement. Our focus was on delivering a practical layout optimized for efficient daily operations and maintenance of the systems. Using 3D software and the accompanying viewer made full oversight of the actual arrangement, service space, walking areas, etc., much easier for the owner and the shipyard.

The technical systems packages included complete diagrams with parts lists and relevant calculations for systems capacities. Foundation drawings were made for the delivered equipment. Furthermore, the delivered designs optimized the routing of the lines for low-cost production and piping installation. Performing the piping and construction engineering at the same time saved significant time at the yard as installation was simplified by cutting penetration holes beforehand instead of doing this on site. All Class approvals and communication were handled by Goltens, with the vessel scheduled for final delivery to the owner by the end of 2022.

***MV Canopée* during construction at the yard in Szczecin, Poland (April 2022)**

Goltens' engineers delivered the following as part of the project:

- 18 P&IDs with part lists
- 86 different pieces of equipment
- 1,069 appendages
- Routing of 4,200-meter pipelines
- Approximately 3,500 isometric drawings of the individual pipe spools
- 30 arrangement drawings
- 165 outfitting section, tank arrangement and system drawings
- 64 foundation drawings

nd ballast water and scrubber retrofit services

re complex projects from newbuild design to vessel conversions

OSV SK728 prior to conversion

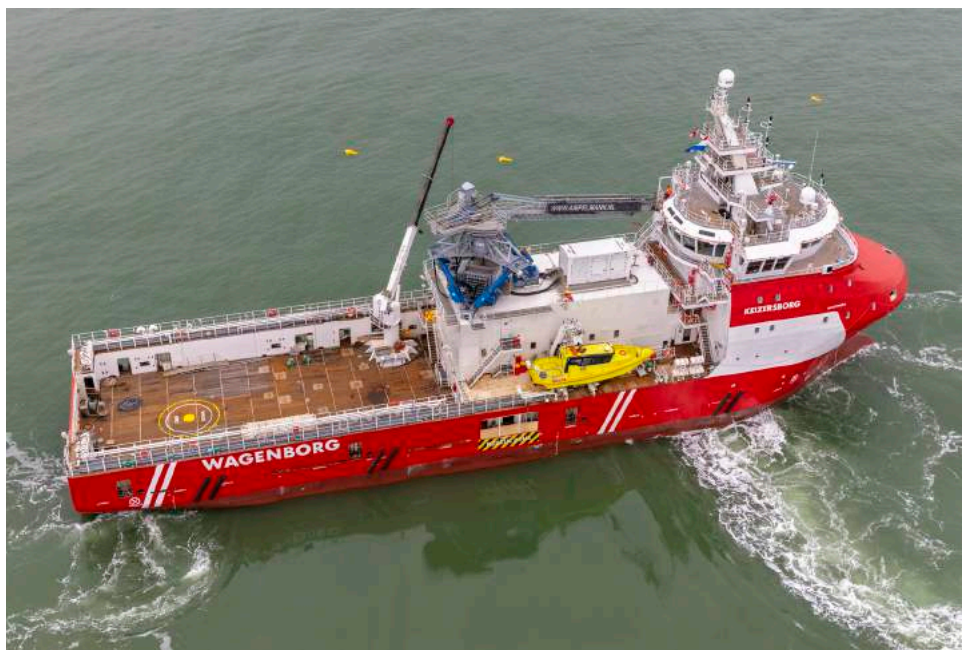
SUPPLY VESSEL CONVERTED TO DUAL-PURPOSE SERVICE SHIP

The SK728 was originally delivered in 2018 by Wuhu Shipyard in China as an Offshore Supply Vessel (OSV) with a total lenght of 79.2 meters. The vessel subsequently changed ownership and a decision was made to convert it to a dual-purpose Walk to Work Service (W2W) and Emergency Response & Rescue Vessel (ERRV).

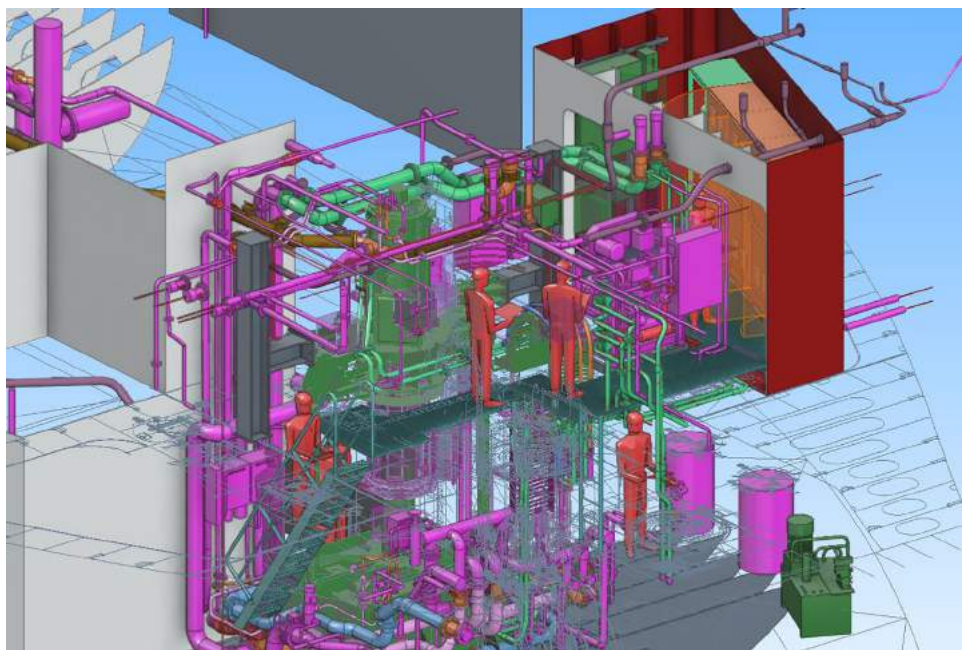
GOLTENS LEADS CONVERSION MANAGEMENT

As part of the project, Goltens was selected to deliver engineering and design as well as project management oversight at the shipyard in the Dutch port of Delfzijl. The project involved new accommodation for 60 people, lifeboats installed both port and starboard, as well as the installation of various new components and other modifications. These included an Ampelman motion compensated gangway system, conversion of the liquid cargo system to enable dynamic draft adjustment during rescue operations and retractable bow thrusters for DP2 certification.

To accommodate the new components, it was necessary to reorganize the equipment in the technical spaces. By using 3D laser scanning, Goltens' design enabled the prefabrication of many parts and components outside of the vessel making the conversion much more efficient. The ship, named *Keizerborg*, has been commissioned and delivered and is fully deployable. ■



Dual-purpose EERV and W2W vessel *Keizerborg*

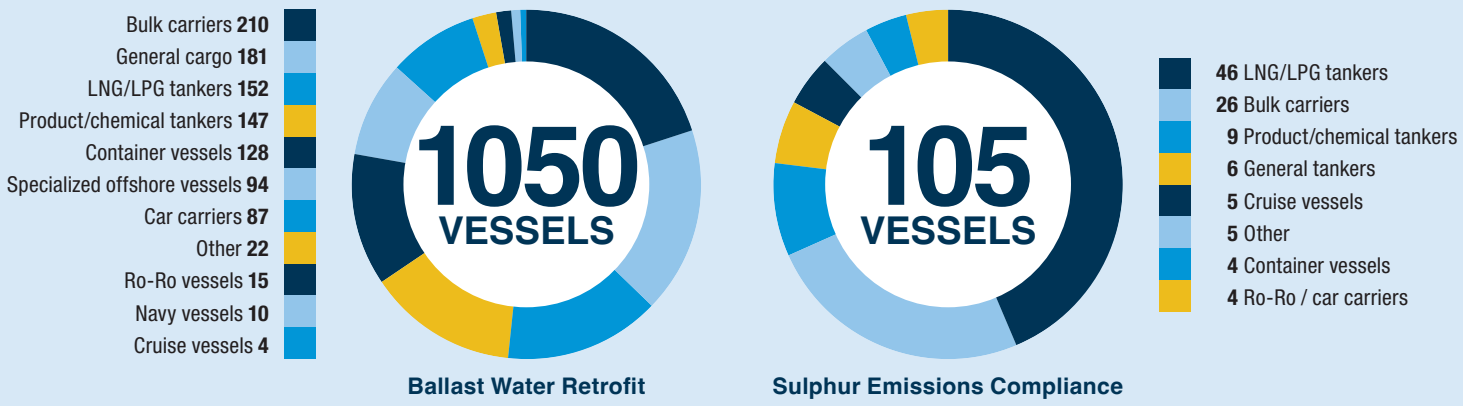


3D Rendering of engineering model for *Keizerborg*

The BWMS retrofit bottleneck has finally arrived

Still have ships to retrofit with a Ballast Water Treatment System (BWMS)? Goltens can help get you on track.

Goltens has been projecting a retrofit bottleneck in the design and installation of BWMS for years. Due to delays in the date of the Ballast Water Convention enforcement, COVID-19 extensions and various other factors, the bottleneck failed to appear as more time was granted to comply with the regulations. Now, with all vessels requiring full compliance by their second IOPP survey after the convention entered into force, the final compliance deadline is rapidly approaching in September 2024. The bottleneck appears to be finally materializing.



Ballast Water Retrofit **Sulphur Emissions Compliance**

As of June 2021, there were roughly 35,000 trading vessels reported to have not yet completed the retrofitting of a BWMS. Doing the basic math, this equates to 875 vessels per month that need to be retrofitted before the deadline. Further exacerbating the problem are supply-chain issues resulting from COVID-19 as well as regional conflicts that are making the on-demand supply of systems much more challenging.

GOLTENS IS UNIQUELY QUALIFIED

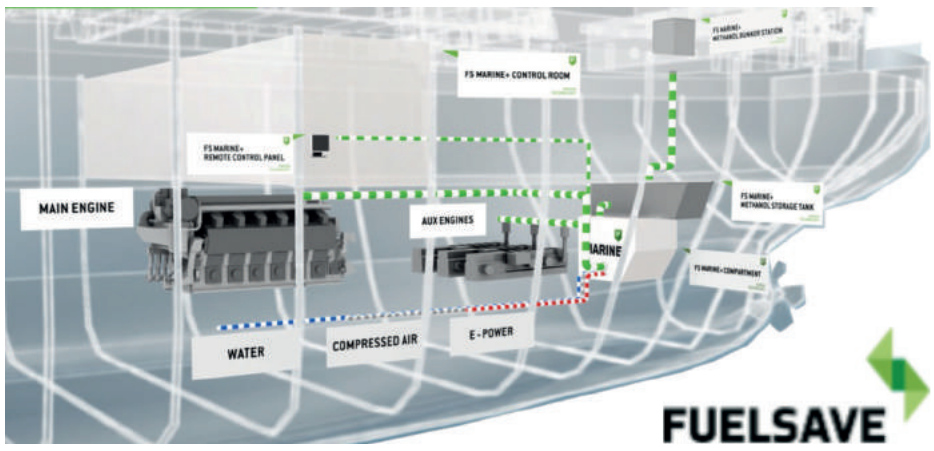
With more than 1,000 compliance retrofit projects completed or in process and a global network in 15 countries, Goltens is unmatched in its experience and uniquely qualified and positioned to support shipowners with 3D scanning, modeling, design, prefabrication and installation of BWMS.

A RANGE OF SUPPORT LEVELS

With time running short, Goltens continues to offer cost-effective, flexible solutions that meet each owner's unique requirements. We can engage with varying degrees of involvement and costs to help in the push to compliance. Projects can be tailored to include Goltens' support on a case-by-case basis with prefabrication, installation, project management oversight and even system commissioning and testing. ■

Goltens and FuelSave GmbH sign LOI to pursue global agreements related to OpEx savings and emissions reduction retrofit solutions

Goltens Worldwide and German technology company FuelSave GmbH have signed a letter of intent (LOI) to pursue non-exclusive agreements related to Goltens promoting the sale of, and performing retrofit design engineering, installation, commissioning and after sales service of, FuelSave's patented FS MARINE+ product.



FS MARINE+ is designed to reduce fuel consumption of marine diesel-powered engines and auxiliary systems, thereby significantly reducing emissions. As the world's first onboard hydrogen generator and injection solution with gas and liquid injection mechanisms and processes, the solution has been proven both in the lab and the field. It has also passed various risk assessments and FMEAs (failure mode and effects analyses) with different OEMs and HAZIDs (hazard identification studies) with various class societies.

"With the EEXI and CII regulations coming into force, our customers are looking for alternative retrofit solutions that reduce primary fuel consumption and harmful emissions and air pollution while offering an interesting ROI in their compliance investments. FuelSave aims to provide these benefits with FS MARINE+," said Roy Strand, Goltens' Chief Operating Officer.

ADVANCED FLEXIBLE DESIGN

The system is designed for easy installation/retrofitting and can be implemented as a containerized module on deck or below deck where space is available. FuelSave also delivered the world's first retrofittable, Class-approved methanol storage tank. A smart-controlled hydrogen syngas generator and injector combine a proprietary gas injection with other efficiency enhancement processes, including a specific water-methanol injection enabling cleaner, cooler combustion leading to less fuel burn and emissions. FS MARINE+ is scalable allowing up to six engines or boilers to be connected to a single unit.

CLIMATE AND OPEX BENEFITS

FuelSave aims to provide FS MARINE+ with investment payback guaranteed within the five-year warranty period. Beyond its emissions and fuel savings, FuelSave's real-world and lab trials also show that the system promotes reduced maintenance and repair costs due to less soot and deposits thanks to the cleaner burn and therefore longer lube oil lifetimes and lower wear and tear on the engine. The system was validated in 2.5 years without a single incident, with satisfied customer reference and appreciation letters as well as third-party reports available from one of Europe's largest heavy lift crane ships. FuelSave subsequently signed its first USD 5M contract to equip six ships. The next two installations will be deployed in DP3 pipelayer and drillship applications in the offshore segment. ■

Goltens Worldwide signs sales and service agreement for Emsys Maritime's Continuous Emissions Monitoring System (CEMS)

Goltens' stations around the world are now able to offer a CEMS solution specifically designed for demanding marine and offshore applications, as forward-thinking owners proactively look for ways to measure their current emissions levels and the effectiveness of mitigation efforts to reduce their climate footprint.

Amid increased focus on greenhouse gas (GHG) emissions and new regulations related to EEXI and CII, UK-based Emsys Maritime Ltd has appointed Goltens as an authorized sales, installation, commissioning and after-sales service partner for its Emsys-iS Marine Emissions Monitor and Emsys-PM Smoke Density Monitor products.

The Emsys-iS system, with its calibration-free quantum cascade laser technology, was designed to provide the industry with a smaller, more flexible analyzer. It can be applied on a wide variety of vessels, both those fitted with selective catalytic reduction (SCR) systems and exhaust gas cleaning systems (EGCS) and those without emissions control equipment installed. The Emsys-PM system additionally provides a simple, low-cost cross-stack sensor that captures both smoke density and particulate matter (PM) measurements to give a complete emissions picture.

IMPRESSIVE INSTALLED BASE AND PRODUCT CAPABILITIES

Emsys boasts a broad customer base of leading merchant shipping, cruise, shipyard and offshore oil-and-gas operators including Carnival Corporation, Disney Cruise Lines, Samsung Heavy Industries, Fincantieri and some of the world's largest offshore drilling contractors. Emsys' products are currently installed on more than 200 vessels with a significant orderbook in the newbuild and retrofit markets. While other CEMS solutions have been adapted from more forgiving shore-based industrial applications, the compact design and robust hardware configuration of the Emsys products are tailor-made for tough marine and offshore environments.

Emsys-iS has become the market-leading emissions monitoring package for reporting methane slip and total emissions from marine and offshore applications. Whether reporting emissions for ESG (Environmental, Social and Governance) purposes or for regulatory compliance, the patented (US and EU patents) and type-approved (by ABS, DNV and the Korean Register of Shipping) technology has all the accreditations necessary to meet customer-specific requirements. Emsys' Analytics V1.0 environmental reporting package integrates directly into the vessel providing the most accurate reporting of all measured pollutants/GHGs on a per-voyage or timeframe basis. With off-ship transmission and remote diagnostics, it provides a one-stop, high-reliability solution for operators' emissions monitoring needs. Typical monitored GHG include CO2, CH4 and N2O, with traditional pollutants including NOx, SO2, CO, NH3, smoke density and PM available as standard.

A WELL-MATCHED COMBINATION

"Goltens is the ideal partner, with an excellent reputation as a service provider. Their global footprint allows us to offer installation, commissioning and after-sales service in major ports around the world, while their experience in consulting with customers regarding environmental solutions and retrofitting those solutions is top notch," said Emsys Maritime Managing Director Simon Brown.

The Emsys-iS and Emsys-PM systems are ideal where space is tight and measurement needs to be fast and is required across multiple stacks with a single instrument. ■

Weatherdeck installation of Emsys-iS

Emsys used for SCR emissions performance testing at a major yard during sea trials

Emsys
emissions monitoring for ships

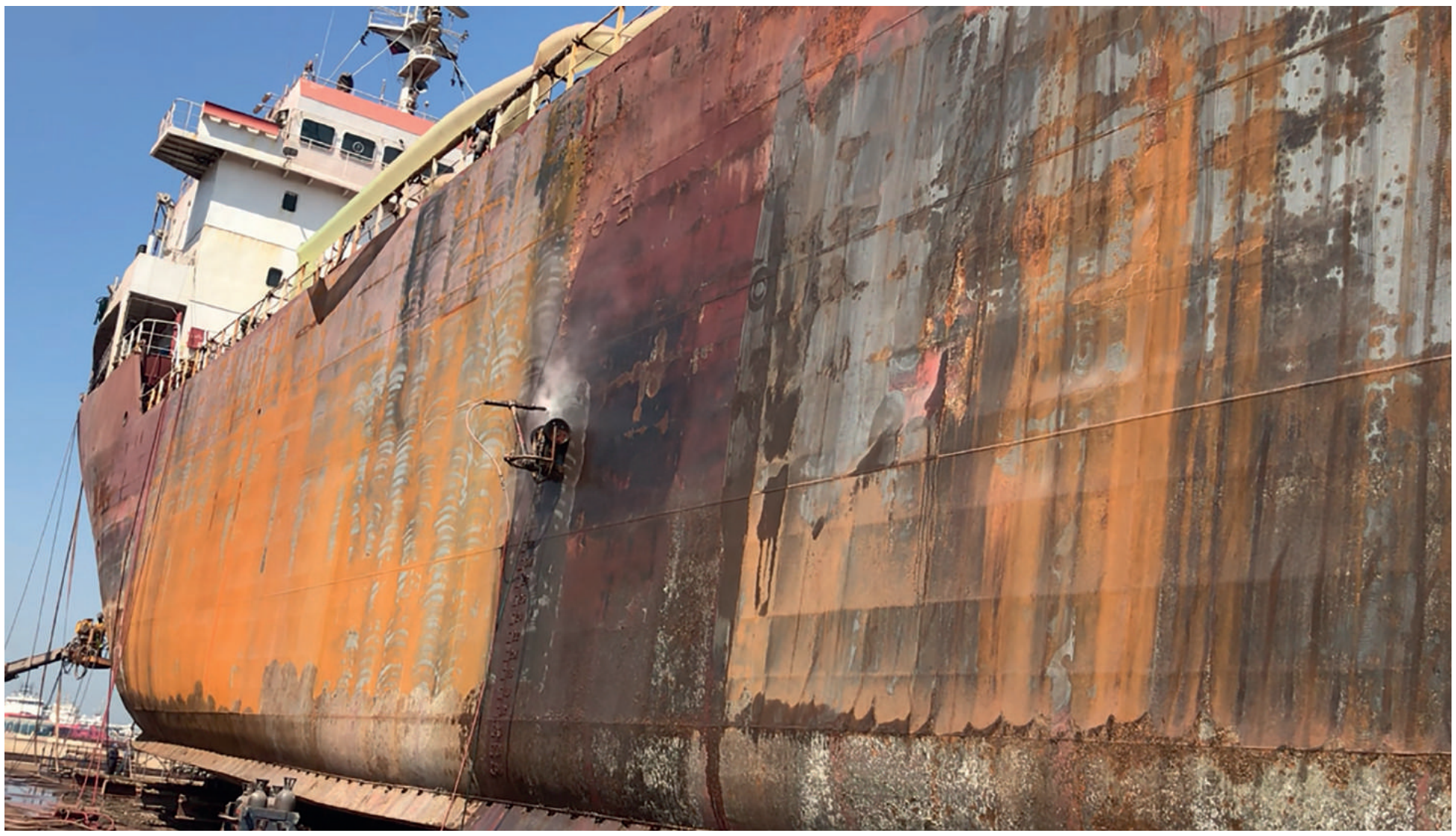
Post scrubber emission monitoring probe installed on newbuild cruise ship

EMSYS-iS Key Features and Qualifications

- Single unit monitors 4 stacks expandable to 8
- Can monitor NOx (NO + NO2), CO2, SO2, CO, CH4, H20 and NH3
- Compact design/small footprint for easy installation (only 800mm x 600mm x 300mm deep)
- Proven across Cruise, Container, Bulk Carrier, General Cargo, LNG & LPG Carrier, Shuttle Tanker, Crude Oil Tanker and Drillship applications
- High ambient operating temperature (55oC) allows siting in engine room/funnel space with no AC requirements
- IP56 option allows for siting on weather deck if required
- Integration to vessel automation systems and performance software systems via MODBUS with off-ship data transfer capability

Robotic Hydroblasting

– efficiency and lower environmental impact for dry docking



Robotic blasting equipment in action on a hull

Due to urgent charter requirements, Goltens Dubai was tasked with completing the dry docking of a 15-year-old Oil Products Tanker in only 15 days. The unique activities involved in the docking scope made meeting this timeline a challenge. In addition to the normal blasting and painting, the installation of a Ballast Water Treatment System (BWMS) and major overhauls of main propulsion gearbox, thruster and shafting were also included in the scope.

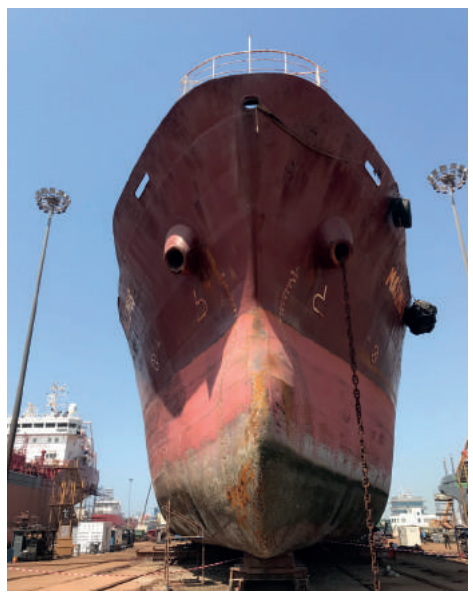
INCREASED EFFICIENCY WITH REDUCED ENVIRONMENTAL IMPACT

The 115-meter tanker required blasting and painting of 4,474M2 of vertical and horizontal surfaces on the hull. To meet the compressed timeline and large surface area requirements, Goltens introduced robotic blasting to complete the blasting in only four days compared to conventional blasting which would have required seven to eight days.

In addition to shortening the timeline, use of the robotic blaster reduced fuel consumption by a full two-thirds. Robotic blasting can cover 200-250M2 per day compared to the 40-50 M2 achieved with manual blasting with the same quality. To achieve the same outcome, multiple teams with multiple machines would have to be applied along with cherry pickers or scaffolding for access. In addition to reduced fuel consumption and increased efficiency, the process used less water, less labor and less equipment hire. Lastly, the robot collects most of the particulate matter and dirt generated by the blasting, further limiting the environmental impacts.

TIGHT TIMELINE MET WITH ALL REQUIREMENTS COMPLETE

Goltens Dubai's experienced, cross-functional team delivered the vessel to the owner on time with the full scope completed. In addition to the compressed blasting and painting scope, the BWMS was installed with piping prefabricated and galvanized by Goltens and successfully tested/commissioned with the support of the OEM. All mechanical work on the thruster and shafting was completed successfully as well as the overhaul of the main engine gearbox with modifications made to the shaft output flange to improve future maintenance accessibility. ■



Vessel prior to painting

Vessel after painting completed

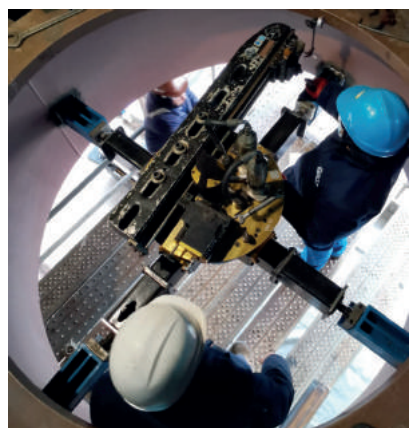
Specialized Shipyard S

When shipyards face major challenges during newbuild or dry-docking repair operations, ca

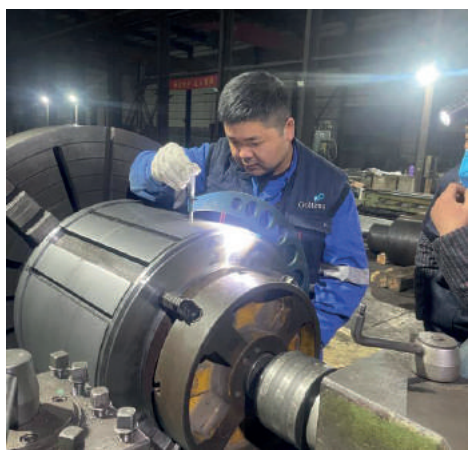
Shipyards rely on Goltens specialists for their ability to diagnose the root cause of a problem and apply their knowledge and experience to solve those issues quickly and with precision. Here is a selection of typical projects Goltens has recently completed for shipyard customers all over the world:

CHINA: HIGH-PRECISION IN-PLACE MACHINING ON STERN TUBE HOUSING
Goltens completed high-precision in-situ machining on two stern tube housings for an ice-class expedition cruise vessel in China. The work included line boring of port and starboard forward and aft stern tubes, forward and aft seal landing surfaces and realignment of the intermediate stern tube bushes prior to chockfasting.

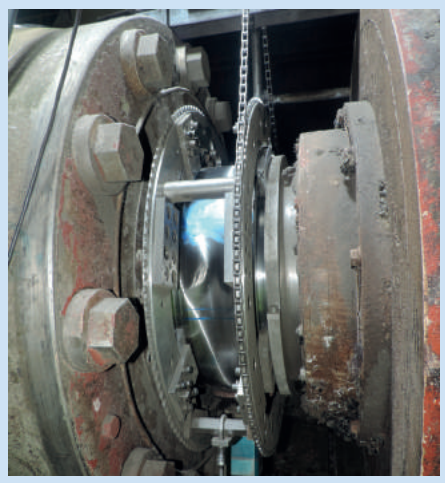
NEW JERSEY: SHAFT SEAL LINER REMOVAL FOR THE USNS *RED CLOUD*
Goltens was engaged to inspect and make a proposal for the removal of a damaged shaft seal liner on one of the U.S. Military Sealift Command (MSC)'s large, medium-speed RoRo ships. Due to limited space, Goltens fabricated special tools and brackets and repurposed one of their milling machines to carefully mill across the outside liner surface to delicately split the liner without damaging the propeller shaft surface.



AZERBAIJAN: FLANGE FACING AND BORING PROPULSION THRUSTER FOUNDATION SEATS
Goltens' in-place machinists were engaged as part of a vessel newbuild project in Baku. The vessel's thruster foundation seats required facing and the inside diameters required boring. Goltens removed roughly 12mm off the flange faces to meet the required thickness and bored the 50mm-thick inside diameter to a final measurement of 1.76 meters. Goltens achieved a flatness on the flanges of less than 0.08mm and a surface roughness less than 3Ra.



CHINA: DRY-DOCK SHAFT INSPECTION LEADS TO CORRECTIVE ACTIONS
During dry-dock inspection of the shafting of a 10-year-old bulk carrier in Zhoushan, Goltens found scoring on the shaft journal and white metal from the stern tube bearing and measurements outside of the required operating parameters. To ensure the shafting system was in perfect working order upon leaving the dock, Goltens completed polishing of the shaft journals and intermediate shaft, roughness and hardness checks, stern tube bearing calibration, laser alignment and boring of the stern tube bearing housing and machining of the outside diameter of the stern tube bearing.



GREECE: RECTIFYING PORT AND STARBOARD SHAFT SEALS
Deep scoring was discovered on a fast ferry's leaking Simplex seal liners during dry docking in Piraeus. Goltens was engaged to rectify the damaged journal surfaces on the port and starboard seal liners. Our team of three in-situ machining experts completed the machining of the 670mm journals in only four days.

l Support Services

ns, calling Goltens to solve the problem is always a good choice

GREECE: PRECISION ALIGNMENT AND INSTALLATION OF TWO MaK 8M32C ENGINES

A leading IPP approached Goltens with Goltens' specialists were engaged to complete the alignment of replacement engines on a 30-year-old ferry. After foundation preparations and engine rigging were completed by the shipyard, Goltens jacked the engine to set the correct axial alignment, completed thermal growth calculations, laser aligned and moved the engine to final position before drilling foundation and fitted bolt holes and collision chocks welded in place. After final alignment checks and crankshaft deflections, the engines were chocked in place and fitted bolts were installed along with Vulkan couplings.

CHINA: LINE BORING AND FLANGE FACING RESOLVES SHAFT ALIGNMENT ISSUE

A 12-year-old containership undergoing dry docking at a Chinese shipyard discovered the coupling bolts for the flywheel and intermediate shaft had elongated and worn to an oval shape creating 0.5mm clearance between the flywheel and intermediate shaft landing surfaces. Working 24 hours a day, Goltens' specialists used magnesium rods to remove the bolts, completed flange facing on the 1.27-meter damaged mating surfaces and adjusted the shaft alignment before boring the 22 coupling holes to oversize.

TEXAS: COMPREHENSIVE ALIGNMENT AND CHOCKFASTING FOR NEWBUILD CONTAINERSHIP IN BROWNSVILLE, TEXAS

As the authorized distributor for ITW Performance Polymers' Chockfast Orange® compound, Goltens' specialists were brought in to finalize the installation of a Doosan MAN 7S80ME-C engine and chock other equipment for a new build containership at a shipyard in Brownsville. The work scope covered the chocking of main engine in accordance with OEM guidance. In addition to the main engine, Goltens chocked the stern tube, auxiliary engines, steering gear, intermediate pedestal bearings and deck winches.

SAUDI ARABIA: CPP AND GEARBOX REFURBISHMENT

Goltens was contracted by one of the world's largest offshore operators to overhaul the controllable pitch propeller (CPP) and CPP gearbox while their offshore service vessel was in dry dock in Dammam. Goltens' mechanical experts removed the rudder and propeller shaft from the vessel and disassembled the major components. They then completed calibration of the components, replacement of hub bearing bushes and overhaul of the CPP gearbox before reassembly, reinstallation of the rudder and successful sea trial. ■

Goltens' Alternator Reconditioning and Electrical Repair

An often-overlooked capability!

Goltens' capabilities related to alternator repair, motor rewinding and field electrical work is often overshadowed by our global recognition as a mechanical services expert focused on generator and engine repairs. Most customers associate Goltens with the mechanical services, machining and automation and controls side of power generation, but we also have a comprehensive electrical service and repair capability in many parts of the world.

Beyond Goltens' well-recognized automation and controls capabilities, our stations carry out routine maintenance and challenging casualty repairs on large and mid-sized alternators, as well as general electrical repairs and repairs and retrofits on switchgear for marine and stationary power customers throughout the world. Goltens is flexible in terms of where these repairs take place – they can be completed at Goltens' purpose-built facilities or on site if the size and weight of the piece makes it more economical. Many customers find comfort in the fact that Goltens can provide a turnkey solution for both the mechanical and electrical aspects of their power generation requirements.

Below is a small cross-section of electrical projects undertaken by Goltens:

SAUDI ARABIA: SKL 8VDS 29/24 AL-2 ALTERNATOR REPAIR AFTER AUXILIARY ENGINE OVERSPEED ON A CONTAINERSHIP

During a generator overspeed caused by a governor malfunction, rotor balance weight bolts from the 1,600kW alternator broke off and damaged the cooling fan blades. After detailed inspection, Goltens overhauled the damaged alternator (including full cleaning, varnishing and baking of rotor and stator), dynamically balanced the rotor, repaired damages to the yoke and cooling fan, rebuilt the unit and installed it back onboard.

Cleaned and varnished main stator

Dynamic balance of main rotor

SEYCHELLES: REWINDING OF DAMAGED STATOR

After onsite inspection of the generator that had failed due to an electrical fault, Goltens determined that the main stator winding was damaged. Given the size and location of the alternator, Goltens proposed to undertake the large task on site and mobilized a stator winding kit and expert electrical resources to complete the task. After complete cleaning and diagramming of the stator, new coils were installed and connected with new temperature sensors and the stator was varnished, baked and returned to service after IR, PI and HI Pot tests were completed.

Rewinding of main stator

Stator afer completion of winding

WEST AFRICA: WÄRTSILÄ 18V50DF-ABB 11KV 50HZ 20777KVA ALTERNATOR REWINDING

After providing in-place machining and annealing services to repair one of their 13 Wärtsilä 18V50DF dual-fuel generating sets, an IPP in West Africa contacted Goltens to repair one of their damaged 57-ton alternators. As the OEM was only offering a new replacement alternator to solve the problem, Goltens undertook the repair in a more cost-effective manner, replacing the partially damaged core and completing rewinding.

Lamination core being replaced

Main stator being rewound

CHINA: FULL OVERHAUL OF SIEMENS ALTERNATOR FOR CONTAINERSHIP

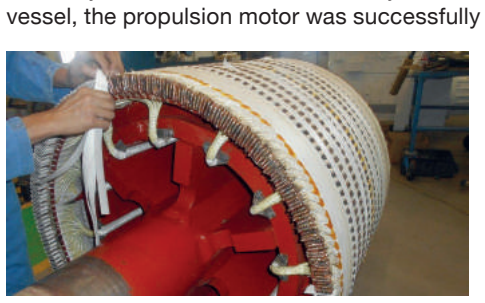
Goltens China was engaged by a containership during a shipyard period to inspect and repair a Siemens 1FC6 1,475 KVA alternator. A detailed technical inspection revealed that the alternator failure required a full rewinding of the rotor and the stator. Goltens' electrical technicians rewound the rotor and the stator, replaced required sensors, insulated and baked the components, dynamically balanced and tested the alternator before returning it to the vessel for service.

Main stator after cleaning

Main rotor being rewound

UAE: PORT-SIDE MAIN PROPULSION DC MOTOR REPAIR – REWIND 750V 4,700HP 4,900AMPS

When the port side, main propulsion DC motor of cable-laying vessel failed, Goltens was called in for inspection, damage evaluation and quotation for repair. Goltens supplied and replaced the commutator, rewound the main rotor and overhauled the stator. The motor was then fully assembled and successfully tested in the workshop. Once reinstalled onboard the vessel, the propulsion motor was successfully tested at full load during a two-day sea trial.



New winding in progress

Fitting new armature

NIGERIA: TURNKEY SWITCHGEAR AND BUS BAR UPGRADE AND RETROFIT FOR OIL PRODUCTION PLATFORM

Goltens' electricians were deployed to the *Marc Lorenceau*, an oil rig converted to production platform off the coast of Nigeria, to address recurrent electrical problems. The 41-year-old rig's switchgear and controls had been malfunctioning and the bus bar breakers were overheating due to capacity constraints. Goltens provided a turnkey retrofit solution to upgrade and retrofit the switchgear and bus bars and supplied all required material (breakers, bus bars, power management and protection relays and Woodward governors and controls). ■

Technician installing new components

On-site bus bar fabrication

Goltens aquires Marintech Ship Repair BV and forms Goltens Maritime Services BV

Years of close cooperation leads to acquisition and increased service presence and offerings in the port of Rotterdam.

After years of cooperation between the two companies, Goltens Rotterdam acquired Marintech Ship Repair BV in January of 2022 and the company was renamed Goltens Maritime Services BV. The addition of the company's service capabilities and its relocation to Rotterdam's Greenport provides Goltens with a strong presence and broader range of services directly in the Port of Rotterdam.

The company's services fully complement Goltens Rotterdam's extensive capabilities and, with a direct presence in the port with 1,152 m2 of well-equipped workshop facilities and reliable access to 1,800 meters of quay facilities with cranage, Goltens is ideally positioned to meet our customers' urgent and routine requirements for afloat repairs and services. ■

Strategic location in the center of Rotterdam Port

Representative 24/7 services provided by Goltens Maritime Services BV include:

- Common repairs and maintenance from anchor to rudder
- 3D scanning with basic and detail engineering
- Piping in steel and all alloys as well as composite pipe GRE/GRVE and thermoplastics
- Surveys, supervision, retrofit and modifications
- Installation of Ballast Water Treatment Systems (BWMS) and scrubber installations
- Repair and modifications to scrubber piping and scrubber units
- Class-certified fabrication of LNG short-distance pieces in stainless steel
- Fabrication of strainers in steel and composite
- Electrical and hydraulic troubleshooting
- Ship and hull cleaning
- Services with riding squads in foreign ports

Part of Goltens Maritime Services' team at the new facility

Goltens Abu Dhabi – customer focus and capability development pay off

Goltens diesel technicians complete overhauls on two Deutz MWM engines in the Goltens Abu Dhabi Workshop

Goltens mechanical technicians overhaul one of two winch gearboxes for a cutter suction dredger. The team also completed full overhauls of a cutter drive gearbox, two dredge pump drive gearboxes, one main generator gearbox and and one ladder pump gearbox.

Goltens Abu Dhabi has come a long way since it was established as a sales outpost in 2017. Now located in an 800M2 Workshop with 150M2 of office space in the busy Mussafah Industrial Area, Goltens Abu Dhabi over the past five years has become a preferred, reliable, high-quality repair partner for a number of high-profile customers in the region.

EXPANDING CAPABILITIES

Like other stations, Goltens Abu Dhabi offers slow- and medium-speed engine services, mechanical equipment repair and shop machining leveraging in-house teams of experienced service engineers and skilled technicians. It has also embedded itself as an independent alternative for repair and maintenance of high-speed engines from OEMs such as CAT, Cummins, Mitsubishi and Yanmar. With investments in computerized tooling, the branch can repair electronically controlled engines including fine-tuning of fuel injection systems.

The team has also established a strong market presence in the repair and maintenance of mechanical equipment such as gearboxes, compressors and pumps. Goltens' expertise in gearboxes ranges from simple single-step reduction gearboxes to more complex reverse-reduction gearboxes using various clutching technologies for single or multiple inputs/outputs on dredgers and offshore vessels.

BUILDING TRUST WITH KEY CLIENTS

A testament to Goltens Abu Dhabi's growing reputation in the market is our agreement with the shipping arm of Abu Dhabi National Oil Co (ADNOC) for the fleetwide maintenance of their GE engines. This is in addition to service work on other OEM engines in their large fleet.

Goltens Abu Dhabi also recently completed a single-source three-year service agreement with the region's largest dredging company for repair and maintenance of heavy-duty gearboxes from different makers.

A STRATEGY FOR CONTINUED GROWTH

Goltens Abu Dhabi is maintaining its unwavering customer focus and solution-oriented approach by developing strong service capabilities in the Turbo Equipment MRO (Maintain-Repair-Overhaul) and Instrumentation & Controls domains, which can be offered to customers across oil-and-gas and other industrial sectors. Today, the branch is already a preferred technical service partner to some of the biggest turbo equipment manufacturers and independent service providers. ■

GOLTENS WORLDWIDE NETWORK

Goltens Miami
10125 USA Today Way
Miramar, Florida 33025
USA
+1 305 576 4410
miami@goltens.com

Goltens Houston
7214 Clinton Drive
Houston TX 77020
USA
+1 713 487 4900
houston@goltens.com

Goltens Rotterdam
Lorentzweg 29
3208 LJ Spijkenisse
The Netherlands
+31 181 465100
rotterdam@goltens.com

Goltens Maritime Services
Pastoriestraat 1
3195 HT Pernis Rotterdam
The Netherlands
+31 10 3225430
gms.rotterdam@goltens.com

Goltens Green Technologies
Kapteynlaan 15
9351 VG Leek
The Netherlands
+31 50 3050230
green@goltens.com

Goltens UK
Suite F5, Clyde View
Riverside Business Park
22 Pottery Street
Greenock, UK, PA15 2UZ
+44 1475 744655
uk@goltens.com

Goltens Dubai
Dubai Maritime City – Ship Docking Yard
PO Box 2811
Dubai
UAE
+971 4 437 6555
dubai@goltens.com

Goltens Fujairah
Plot No.33
Inside Port of Fujairah
P.O. Box 2501
Fujaira
UAE
+971 9 2281899
fujairah@goltens.com

Goltens Abu Dhabi
P.O. Box 93297
Shed 3 Block 8, Plot 9, Sector 44
Mussafah Industrial Area
Abu Dhabi
UAE
+971 2 5558439
abudhabi@goltens.com

Goltens Bahrain
PO Box 50268
Dry Dock Hwy
Al Hidd
Bahrain
+973 17672135 / 17466145
bahrain@goltens.com

Goltens Red Sea Saudi Arabia
Opposite King Faisal Naval Base
Al Khumrah Road
PO Box 22709
Jeddah 21481
Saudi Arabia
+966 12 6363007 / +966 12 6377309
goltensredsea@goltens.com

Goltens India – Mumbai
A -183, TTC Industrial Area
MIDC, Khairane
Thane – Belapur Road Navi
Mumbai – Maharashtra 400 705
+91 9136105582 / 83 / 84 / 85
india@goltens.com

Goltens India – Chennai
K16, 8th Street
Ambattur Industrial Estate
Landmark: Wavin Bus Stop
Ambattur
Chennai
Tamil Nadu 600 058
+91 44 42610066
chennaioffice@goltens.com

Goltens India – Vizag
Plot No. 121, D-Block, Village Vadlapudi
Auto Nagar, G.V.M.C.
Vishakhapatnam (AP) 530012
+891 2533120
gw.vizag@goltens.com

Goltens India – Kolkata
Regus Arcadia
3rd & 4th Floor, Arcadia Centre
Premise No 31
Dr. Ambedkar Saran
Kolkata: 700046
+91 33 66376637
india@goltens.com

Goltens Singapore
No. 6A Benoi Road
Singapore 629881
+65 686 15220
singapore@goltens.com

Goltens China – Shanghai
Block No.5, No.533 Yuanzhong Road
Nanhui Industrial Zone
Nanhui District
Shanghai 201300
China
+86 21 5818 6628
china@goltens.com

Goltens China – Guangzhou
Rm. 105, No 20, Four Hectares
Industrial Road
Miaotou
Huangpu District
Guangzhou 510730
China
+86 20 8208 8729
china@goltens.com

Goltens China – Dalian
Room 1108, Jinlian International Building
No.155 Youhao Road, Zhongshan District
Dalian, 116001
China
+86 411 8230 0582
china@goltens.com

Goltens China – Zhoushan
Jinwangjiao Hotel, Ground Floor
No.2 Sanba Road, Liu Heng Island
Zhoushan 316131, Zhejiang
China
+86 177 4086 2373
china@goltens.com

Goltens China – Yiulian Dockyards Office
Mawan Avenue North
Qianhai, Nanshan
District Shenzhen
Guangdong 518054
China
+86 138 165 8310
china@goltens.com

Goltens Korea
Room 1003
ACE Hightec 21
1470 U-Dong
Haeundae – Gu
Busan, Korea 4805
+82 51 744 8000
korea@goltens.com

Goltens Vietnam
Street No.12 Dong Xuyen
Industrial Zone
Rach Dua Ward
Vung Tau City
Vietnam
+84 64 3 616272
vietnam@goltens.com

Goltens Japan
25-3.5-Chome
Shimbasi Minato-Ku
Tokyo, Japan
+813-3433-0017
japan@goltens.com

Goltens Indonesia – Jakarta
Jl Danau Sunter
Barat Blok A1/1
Sunter Agung
Jakarta Utara 14350
Indonesia
+62 21 6408091
jakarta@goltens.com

Goltens Indonesia – Balikpapan
Panin Tower 8th Floor
Grand Sudirman Balikpapan
Jl. Jend. Sudirman No. 7
Balikpapan – 76114
+62 542 886 3343
jakarta@goltens.com

Goltens Philippines
Unit 17A Berthaphil Compound 1
Jose Abad Santos Avenue
Clark Freeport Zone
Pampanga 2023
+63 2 8584 4750 / +63 45 499 3045
philippines@goltens.com

Goltens Worldwide – Executive Offices
1903 Atlantic Avenue
Building C, Second Floor, Suite 4
Manasquan
NJ 08736
USA
+1 732 223 2030
worldwide@goltens.com

Goltens Worldwide – Executive Offices
91 Tanglin Road
Unit 04-05
Singapore
247918
+65 9828 1366
sandeep.seth@goltens.com