Goltens

InService

Goltens Worldwide Newsletter | Issue 01.2013

Minimizing Asset Downtime

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3D scanning, detailed engineering and prefabrication of retrofit kit helps offshore operator meet tight timelines

Goltens helps paradise stay paradise

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Goltens completes challenging crankshaft replacement for Royal Caribbean Cruises with no impact to ship's schedule

President's message

Measuring the value of something you can't see

Downtime. It may be invisible, but it negatively affects every one of our customers in significant ways – from operations hurdles to decreased profitability to reduced peace of mind of both management and technical resources. Goltens prides itself on minimizing asset downtime for our customers by providing innovative technical solutions in a responsive manner with the emphasis on prolonging the lifetime of an asset in a safe manner.

Downtime affects different stakeholders in different ways:

• The most important consideration here is the end customer – a consumer of the power produced by a plant or a company that has the charter on a vessel. While their tolerance for downtime is generally the lowest, their expectation for recovery time is the highest making recovery a race against time.

• The "the middle man" being the captain of a vessel or the plant manager has the overall responsibility for the delivery of a product to the end customer. They generally have to rely on the technical resources deployed whether on a vessel or at a stationary powerplant, and often feel disconnected and powerless when an incident happens depending on their level of technical knowledge.

• The technical resources feel the endless pressure from above to perform magic and restore machinery to production with the wave of a wand. While they are often very knowledgeable, these resources may be out of their depth when it comes to major repairs they're not very familiar with.

But no matter the stakeholder, they all have one thing in common: they want to limit downtime and restore operations ASAP. These are the fundamental challenges any service company and repair provider will face when having to restore a power source back to production after a breakdown.

KEEPING ASSETS OPERATIONAL

At Goltens, we pride ourselves on minimizing asset downtime for our customers through our global presence, prompt response time, and the precise manner in which we approach each and every job.

Across all of our business areas we focus on devising solutions to restore from casualties in the fastest manner possible or find methods to complete jobs without introducing downtime for the vessel or plant.

In this issue of InService, we'll provide a number of examples of how we minimize operational downtime for our customers. With the global economy still on shaky ground in many sectors, keeping assets operational at the lowest cost is critical.

NAVIGATING COMPLIANCE

In Goltens Green Technologies we've built up processes and teams around the globe to help shipowners navigate the complex decision making involved in ballast water treatment regulation compliance.

By performing space studies with 3D laser scanners, we're able to create a baseline for the feasibility of system installation without interrupting normal vessel operations. We can also execute the detailed design and engineering with finite tolerances and fabricate the required piping package and, in many cases, complete the installation of the complete kit so that regular vessel operations may proceed uninhibited.

At Goltens, we pride ourselves on minimizing asset downtime for our customers

COST & TIME EFFICIENT

The sole purpose of our in-situ machining capabilities are to carry out repairs in the most cost and time efficient manner possible. Our ability to mobilize tools to site and perform the most complex machining tasks without requiring disassembly, transport and additional downtime are key to our customers' success. The focus here is to repair damaged machinery and avoid full disassembly and replacement of large machinery items. We are constantly pursuing innovative techniques, like our recently Class approved crankshaft annealing procedure, for repairs that limit the downtime and cost for both owners and insurers.

WORLD-CLASS EXPERTISE

Diesel engine services are the foundation upon which Goltens was built. We've developed global capability in strategic locations around the world to provide customers local access to our expert afloat diesel teams and reconditioning and machine shop services.

ABILITY TO IMPROVISE WHEN TIME IS OF THE ESSENCE

Whether in charge of a vessel at sea powered by its own powerplant, i.e. the diesel engine and its auxiliary machinery, or in charge of a large factory powered by its own stationary powerplant, time will always be of the essence when a mechanical failure suddenly occurs. Goltens has always been known for its ability to enter the scene with the aim to solve the technical problem in the fastest, safest and most economical manner in order to resume normal operation. We believe that our ability to improvise technically even within the most complex scenarios has been crucial and appreciated for the asset operators, our customers.

We're constantly expanding the range of these services to provide our customers the broadest range of specialist services with precise and prompt response. Through preventive maintenance, scheduled overhauls and engine diagnostics we help our customers keep their equipment running in optimal fashion. When the worst occurs and a major casualty results, no one is better positioned globally to respond and get the casualty restored more quickly or cost effectively. |||

Paul Friedberg
President Worldwide Service

Goltens secures worldwide approval

from Germanischer Lloyd for in-situ crankshaft annealing

After years of research and development and successful shop and field trials on the annealing of crankshafts, Goltens was awarded worldwide approval for its repair process from Germanischer Lloyd (GL) in September 2012.

This certification covers the in-situ annealing of medium-speed, four-stroke diesel engine crankshafts and followed a formal review by Germanischer Lloyd of the crankshaft annealing process and related governing documents and procedures.

SAVING CONDEMNED CRANKSHAFTS

The approved procedure reduces hardness in damaged crankshaft journals through annealing (heat treatment) of the crankshaft. The process is specifically targeted at salvaging crankshafts that would otherwise be condemned and require replacement due to the severity of the hardness exceeding engine maker specifications.

After witnessing many needlessly condemned crankshafts, Goltens looked closer at annealing as a safe and repeatable way to minimize downtime, save customers and insurers money, and shorten repair time.

The historical lack of acceptance of annealing crankshafts in the marine market has resulted in millions of dollars in unnecessary downtime, repairs and crankshaft purchases. Therefore Goltens undertook a deliberate process of extensive workshop trials to demonstrate the repeatability of results and the quality of the outcome.

THE ANSWER IS OBVIOUS

"For years, Goltens has been successfully annealing crankshafts in-situ and in our workshops on a wide variety of engine makes and models all over the world," notes Roy Strand, Vice President of Goltens Americas and Europe. "Germanischer Lloyd's global approval of our process provides a significant validation and will go a long way toward making this a broadly understood and accepted repair procedure across the marine sector."

"Our top priority is always to minimize the time and expense of downtime. When the cost and time of an avoidable crankshaft purchase and replacement is compared with the cost and time to anneal and machine the crankshaft in place, the answer is obvious. The repair is dramatically cheaper and faster than the replacement." |||

Shop trial wins Senegal annealing job with Mitsubishi

Goltens was already familiar with the engines at a stationary power plant in Rufisque in western Senegal when Mitsubishi asked the company to inspect one of the nine Mitsubishi 18KU30B generators in operation there. But a shop trial awaited Goltens before it could begin annealing...

Goltens had previously successfully performed in-situ machining at the plant and was very familiar with the engines. An inspection revealed that the 330mm crankpin journal had suffered a bearing failure that had resulted in hardness levels as high as 596 Brinell. Goltens proposed to Mitsubishi to anneal and machine the crankshaft to salvage the shaft within the rated diameter.

DEMONSTRATION OF ANNEALING PROCESS

To evaluate the effectiveness of annealing, Mitsubishi invited Goltens to demonstrate its annealing process on a crankshaft that had been intentionally hardened for the demonstration in its factory in Yokohama, Japan. Goltens technicians traveled to the factory and, following its GL-approved process, demonstrated the effectiveness of annealing to Mitsubishi.

After the successful shop trial, Goltens was engaged to anneal the damaged crankpin and mobilized its technicians, annealing equipment and in-situ crankshaft machining tools to Senegal to conduct the work. Goltens undertook all of the engine preparation required by its process to ensure the operation would not cause any damage to the engine casing from linear expansion of the crankshaft and machined the crankshaft surface free of cracks. The technicians then connected the annealing equipment and performed the heat treatment of the shaft.

After annealing, Goltens took hardness readings and the results were accepted by Mitsubishi. The crankpin was then machined and polished to a finish diameter of 326mm removing only 4mm from the shaft diameter. |||

"Germanischer Lloyd's global approval of our process provides a significant validation and will go a long way toward making this a broadly understood and accepted repair procedure across the marine sector."

Cranking it up a notch

A sample of some crankshafts successfully annealed by Goltens includes:

- BERGEN BRM
- BERGEN KVGS 18G4.2
- BERGEN B35:40-V20AG
- DEUTZ 6SVM640
- DEUTZ TBD645 L6
- DEUTZ 12M640
- GMT 420.12
- MAK 16CM32
- MAK 453
- MAK 551
- MAK 6M453
- MAK 6M552C
- MAK 8M19
- MAK 8M20
- MAK 8M32
- MAK 8M601
- MAN B&W 10V52/55A
- MAN B&W 12V52/55
- MAN B&W 14V40/45A
- MAN B&W 16U28LH-4
- MAN B&W 16V40/54
- MAN B&W 23/30
- MAN B&W 28/33
- MAN B&W 28LH
- MAN B&W 40/54A
- MAN B&W 6L28/32
- MAN B&W 7L40/45
- MAN B&W 8L23/30
- MAN B&W 8L28/32H
- MAN B&W 8L32/40
- MAN B&W 9L 40/54
- MAN B&W 9L28/32
- MAN B&W V9V40/54
- MAN MITSUBISHI 9V40/54
- MIRLEES K6 MAJOR MK3
- MIRRLEES 16KV MAJOR MK II
- MIRRLEES K8 MAJOR
- MITSUBISHI MHI 16KU
- MITSUBISHI 18KU30B
- NIIGATA 16V32 CLX
- NIIGATA 32CX
- PIELSTICK 12VPC2
- PIELSTICK 14VPC4
- PIELSTICK PC18V2.5
- SKL VDS 26/20
- STORK WERKSPOOR 16SWD280
- STORK WERKSPOOR 280/8
- STORK WERKSPOOR 6TM 410
- STORK WERKSPOOR 8TM620
- STORK WERKSPOOR SWD 9FEHD240
- SULZER 12ZV40/48
- SULZER 16ZAV40S
- SULZER AL 25/30
- SULZER 12ZA40S
- WARTSILA 18V46B
- WARTSILA 4R32
- WARTSILA 6L46C
- WARTSILA 9R32
- WARTSILA W18V32
- WARTSILA W18V46

Powerplant in Rufisque, Senegal

Annealing equipment set up on trial shaft in Yokohama

Annealing pads installed on damaged crankpin

In-Situ Machining of the annealed crankpin in progress

The value of an independent opinion and approach

The application of Goltens' GL-approved annealing process salvages a condemned crankshaft for a containership in Turkey avoiding an unnecessary main engine crankshaft replacement.

Goltens was called upon to inspect a crankpin badly damaged by a bearing failure on the containership's MAN 6L48/60 main engine. The company inspected the 415mm-diameter journal, performing magnaflux and hardness tests and checking the run out on the shaft.

It was found that the run out on the shaft was 0.11mm versus a maximum of 0.09mm as allowed by MAN. Hardness values were also as high as 700 Brinell, which was well beyond the maker's limits.

Local grinding was also performed, and it was determined that the cracks did not penetrate below the 5mm undersize — the smallest diameter for which standard undersized bearings were available. Goltens informed the owner that it believed the crankshaft could be saved at -5mm — despite the surface cracking, slight bend and excessive hardness resulting from the casualty — via annealing and peening of the shaft.

Subsequent inspection by the engine maker confirmed the previous findings. However, since MAN does not approve of annealing and peening to reduce hardness and straighten its crankshafts, the shaft was condemned by the maker.

THE DECISION

At that point Goltens was instructed to machine the crankshaft to -4mm and to evaluate the condition of the shaft. It was determined that the hard spots did not lessen – in fact, they became worse. All of the surface cracks were removed, with the exception of a few that could be locally ground and not exceed the -5mm target. Goltens was now confident that they could salvage the crankshaft at -5mm.

Due to the excessive hardness on the journal and the requirement to peen the shaft to straighten it, Goltens worked closely with Germanischer Lloyd (GL) to gain approval for a slight modification to its GL-approved process. The owner then gave Goltens the order to proceed with the annealing and peening of the shaft to restore it to the required tolerances. The process modification helped improve the effectiveness of the annealing procedure, which would be key in reaching the 350 Brinell upper limit set by the maker.

THE REPAIR

Goltens mobilized its annealing equipment while engine preparations were being carried out. To ensure that no ancillary engine damage occurred from the linear expansion of the crankshaft or the heat from the annealing itself, Goltens instructed the owner to ensure that the flywheel, gear wheel and other vulnerable components were removed prior to starting the process.

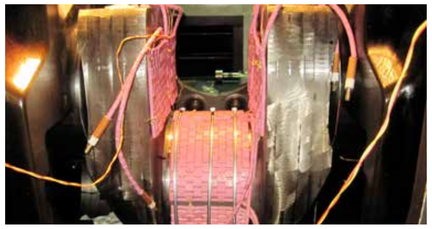
Project facts:
MAN 6L48/60 Annealing

Ship Type: Containership
Journal Diameter Pre-Machining: 415mm
Final Journal Diameter: 410mm
Max Hardness Pre-Annealing: ~700 HB
Max Hardness Post- Annealing: <300HB

NO LENGTHY DOWNTIME, NO LARGE EXPENSE

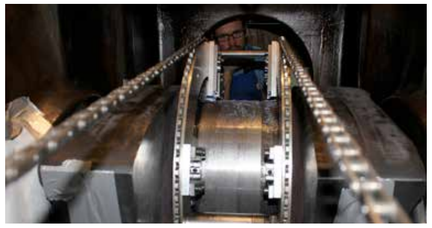
Once preparations were taken care of, Goltens completed the annealing of the crankpin and subsequent testing showed that the hardness had been successfully reduced to below 300 Brinell. The shaft was then carefully peened and the straightness of the shaft was restored. Goltens then set up its single-point cutting tools, finish machined the journal to -5mm and then machine polished it to its finished surface.

Final inspections were then completed and measurements were taken and verified by both owner and class. Upon installation of the undersized bearing and completion of additional required work, the engine could be restored to operation. And all of this without the lengthy downtime and large expense of an unnecessary crankshaft replacement…



Annealing equipment mounted on damaged crankpin

Installation of ceramic tile heating blankets for annealing

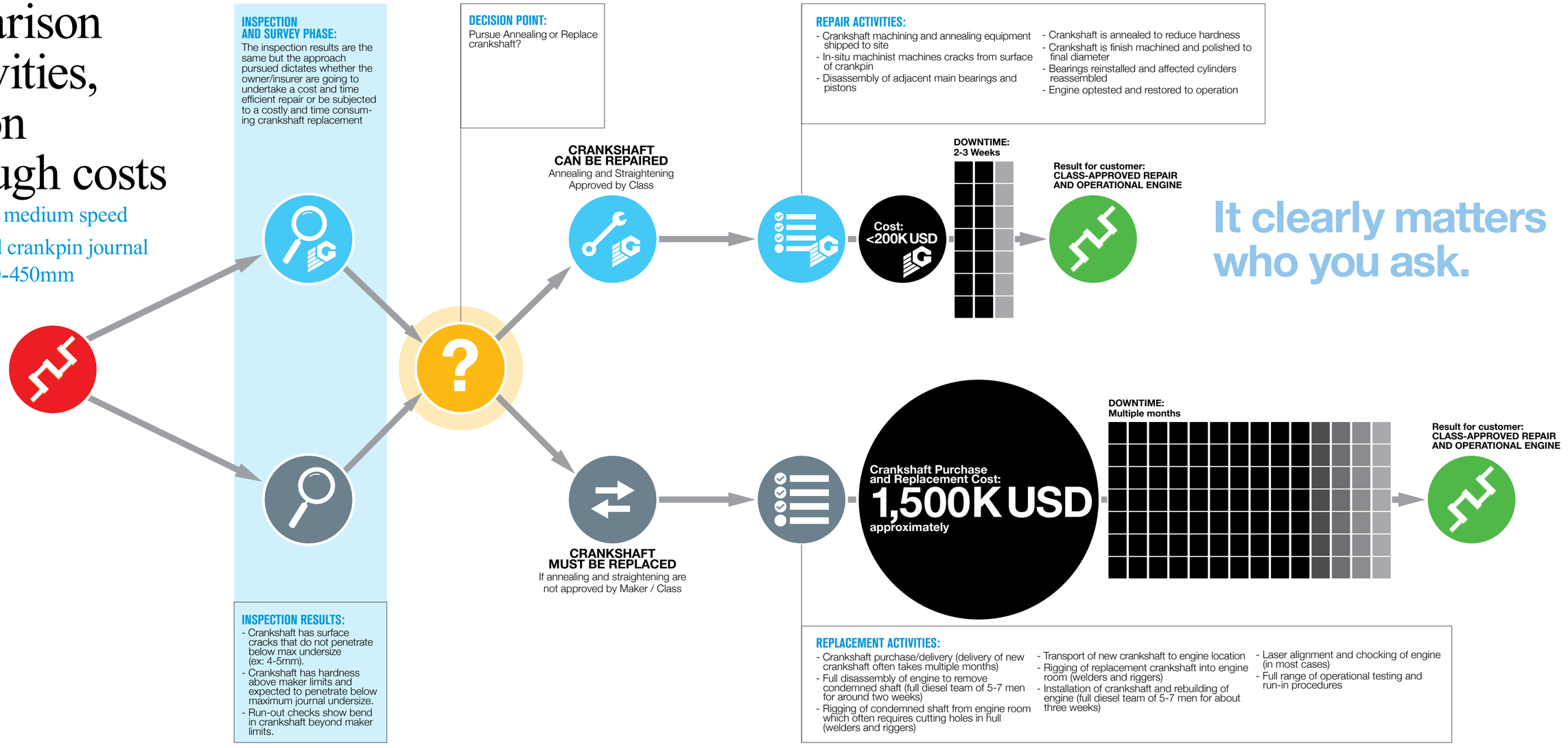


Post Annealing machining of the crankpin journal

Checking deflection at -3mm (high hardness areas visible on center and right side of crankpin journal)

Comparison of activities, duration and rough costs

for a 6-cylinder medium speed with a damaged crankpin journal diameter of 400-450mm



It clearly matters who you ask.

Hydropower 2.0

The basic techniques used in hydropower maintenance and repair services are no mystery to Goltens' global network of workshops. And by being a leading repair specialist in a sophisticated hydropower market like Norway, Goltens is able to follow and utilize the latest technology and tools in this area as well.

Given the massive hydropower infrastructure investments in Norway in recent years, Goltens Oslo has ramped up its investments in tooling and skilled hydroelectric equipment maintenance personnel accordingly. The workshop now has a range of equipment to serve clients all over Norway. This includes a 2,200-mm diameter milling machine. It's so large, in fact, that it arrived through the roof of the Oslo workshop by way of a 200-ton crane.

ADJUSTMENTS TO THE ONE-THOUSANDTH OF A MILLIMETER

In close cooperation with some of the biggest names in generators (Alstom and Voith) and generators (Andritz Hydro and Rainpower), Goltens plays a key role in maintaining hydropower shafts, bearings and a range of parts connecting turbine to generator.

"We make sure that worn parts are restored to their original performance," explains Goltens Oslo Managing Director Finn Moe. "Specialized skills and machining equipment with extremely high accuracy are needed to ensure lubrication in these critical parts. Gliding surfaces are machined by one-thousandth of a millimeter to allow lubrication oil to quickly form a thin film that separates metal from metal every single time the shaft rotates." The weight lifted by the oil film might be up to 200-400 tons.

NEW MARKET, NEW PATTERNS

The challenges don't stop there, however. Indeed, many power stations were designed to produce electricity 24 hours a day and, in the old days, they were stopped only a few times per year for maintenance.

Today's market works in a much more sophisticated way. The power grid allows for a vast number of producers – small and large – to act together. As the spot price varies a producer may find it attractive to start and stop the turbines several times a day.

This setup has created an entirely new operational pattern, and would have left much of the equipment obsolete if it had not been possible to modify it. By modifying some parts, Goltens is able to change the lubrication and prepare old equipment for the new usage patterns. The prolonged lifetime of the asset and the ability to produce power at peak prices is a very attractive combination for the power stations.

SIDE BY SIDE

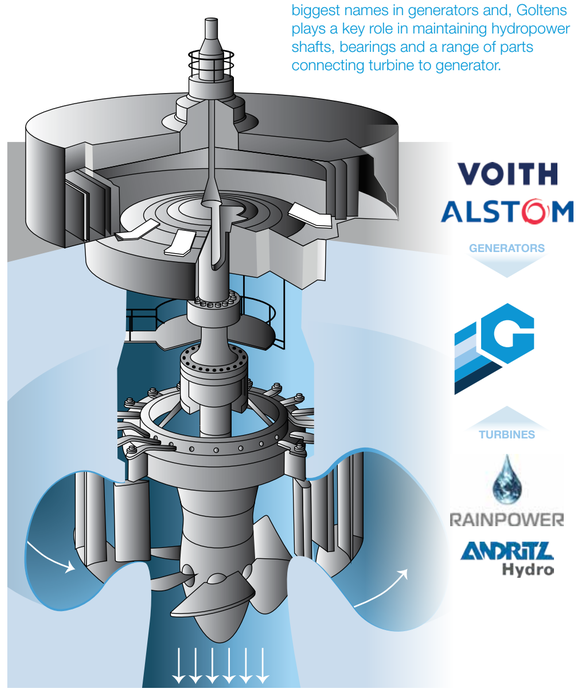
130 TWh of electricity is produced in Norway per year by over 700 hydroelectric power stations, some of them over 100 years old. Moe explains that new power stations are built to run side by side with older stations, since there is little efficiency to be gained from replacing old stations that can be restored.

And with such a large number of older stations, there are always a number of hydropower jobs on Goltens Oslo's docket. |||

WATCH A VIDEO USING THE QR CODE
(or at www.goltens.com/hydropower)

Specialized skills and machining equipment with extremely high accuracy are needed when adjustments to the one-thousandth of a millimeter are made to hydropower station parts

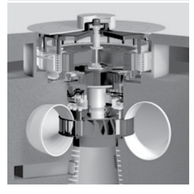
In close cooperation with some of the biggest names in generators and, Goltens plays a key role in maintaining hydropower shafts, bearings and a range of parts connecting turbine to generator.

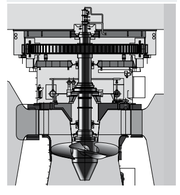


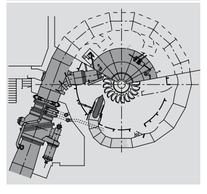
Francis turbines are used primarily for medium heads up to 600 m and large flows. Their special hydraulic characteristics enable relatively high-speed compact units, right up to the highest power outputs.

Kaplan turbines are used primarily for lower heads up to 50m and larger flows. Some of the largest in the world are Kaplan turbines with an output of up to 200 MW and runner diameters of up to 10.5 m.

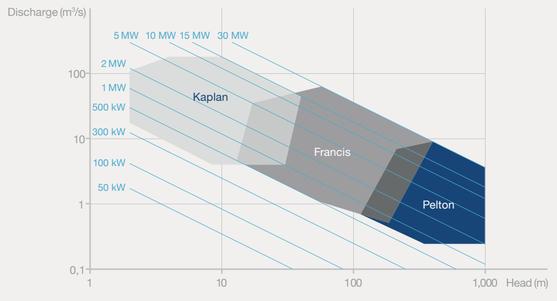
Pelton turbines are used when there is a high head of water, 50-1000 meters. It consists of a Pelton Wheel which is mounted directly onto the generator and rotates in a casing which has no pressure of water and is open to atmospheric pressure.



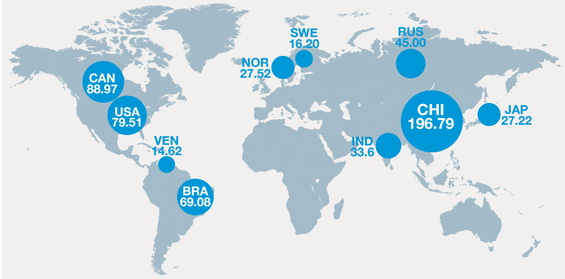




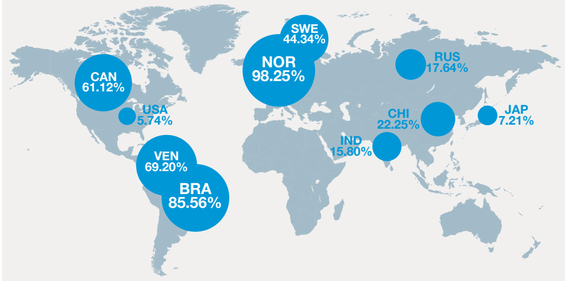
RANGE OF APPLICATION



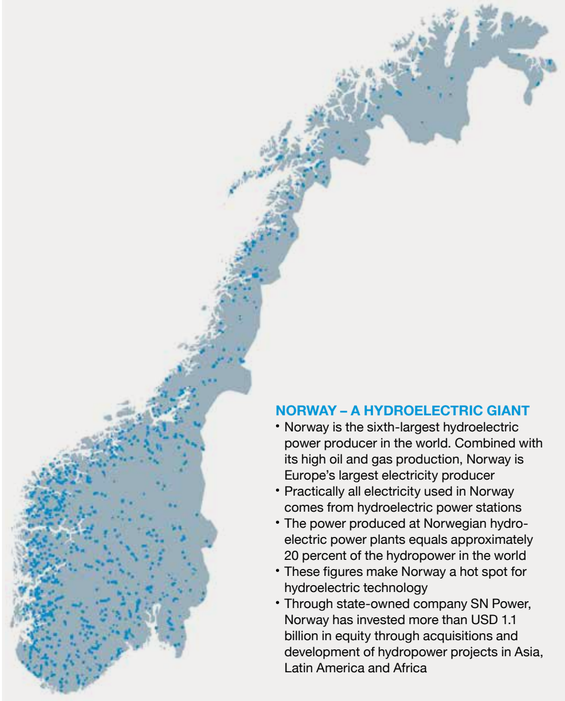
10 LARGEST HYDROELECTRIC PRODUCERS AS PER INSTALLED CAPACITY (GW)



10 LARGEST HYDROELECTRIC PRODUCERS AS PER PERCENTAGE OF TOTAL CAPACITY



THE SPECIFICITY OF NORWAY: DISTRIBUTION OF HYDROELECTRIC PLANTS



NORWAY – A HYDROELECTRIC GIANT

- Norway is the sixth-largest hydroelectric power producer in the world. Combined with its high oil and gas production, Norway is Europe's largest electricity producer
- Practically all electricity used in Norway comes from hydroelectric power stations
- The power produced at Norwegian hydroelectric power plants equals approximately 20 percent of the hydropower in the world
- These figures make Norway a hot spot for hydroelectric technology
- Through state-owned company SN Power, Norway has invested more than USD 1.1 billion in equity through acquisitions and development of hydropower projects in Asia, Latin America and Africa

Goltens Green Technologies goes global

As the world's shipowners wrestle with the decision on how and when to press forward with investments in ballast water treatment systems, Goltens Green Technologies continues to ramp up its capability to support customers around the globe.

The U.S. ballast water regulations that went into effect in June 2012 certainly increased the sense of urgency for many owners with vessels calling the United States. Coupled with the almost inevitable ratification of the IMO treaty on ballast water treatment, this has created a landscape where some must comply and others are still wrestling with compliance preparations.

Responding to requirements from proactive shipowners around the world, Goltens has expanded its capabilities from its original Green Technologies center in Groningen, The Netherlands, to include all regions within the Goltens network.

Due to a growing level of activity, Goltens has invested heavily in additional 3D laser scanning equipment, processing software and dedicated technical resources in the United States, Norway, Singapore, China and the Middle East. Additionally, Goltens Green Technologies has established a steering committee and technical teams from across the regions to make certain that the methodology and approach are formalized and standardized – ensuring a consistent quality delivery anywhere in the world.

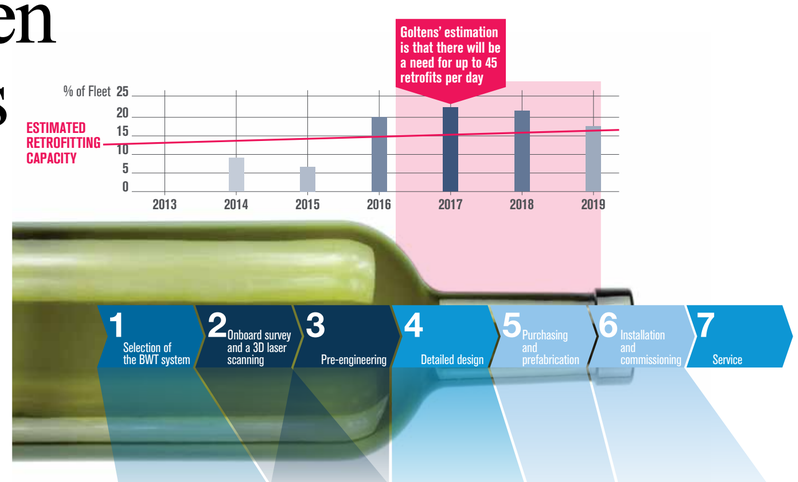
THOUGHT LEADERSHIP & OWNER RESPONSE

Goltens Green Technologies continues to be at the forefront of the ballast water treatment discussion, and is a sought-after and active participant in user groups and conferences around the world.

In the last year alone, Goltens Green has spoken at:

- HME conference Rotterdam (January 2012)
- RoRo shipping conference, Copenhagen (February 2012)
- ImarEst Ballast Water Technology Conference, London (February 2012)
- BWM Tech North America in Miami (October 2012)
- Ballast Water Treatment Technology Conference, Houston (November 2012)
- BWM Tech (Informa/Lloyds List) in London (December 2012)
- Green Shipping Technology Conference Hamburg (March 2013)
- Ballast Water Treatment Technology Conference Singapore (April 2013)
- IMaREST Ballast Water Technology Conference, London, (May 2013)

Through these speaking engagements, Goltens Green has found many owners eager to learn about its retrofit approach. Large fleet owners are especially concerned with the logistical and financial challenges of getting their vessels ready in time. This sense of urgency has already resulted in a number of fleet agreements with Goltens for scanning, design and retrofit services. Goltens Green Technologies now has an order book with over 70 retrofit installations – ranging from initial studies to turn-key installations during normal operation of the vessel. |||



Type of vessel	Type and Size of system (m³/hr)	3D Laser Scanning & System Modeling	Detailed Engineering Design	Purchasing & prefabrication	Installation Supervision	System Installation
Cement carrier	UV system, 334		✓	✓	✓	✓
Bulk carrier	Combined system, 2000		✓		✓	Shipyard
Bulk carrier	Different systems, 1200	✓				
PSV	UV system, 334	✓	✓			Shipyard
PSV	UV system, 167	✓	✓	✓	✓	✓
PSV	UV system, 334	✓	✓		✓	Shipyard
PSV	UV system, 334	✓	✓	✓	✓	✓
PSV	UV system, 334	✓	✓	✓	✓	✓
Container vessel	UV system, 1000	✓				
Bulk carrier	Electrolysis, 5000	✓				
PSV	UV systems, 2 x 167	✓	✓	✓	✓	✓
PSV	UV systems, 1 x 167	✓	✓	On Order	On Order	On Order
Bulk carrier	UV system, 2000	✓	✓		Shipyard	Shipyard
PSV	UV system, 167	✓	On Order			
PSV	UV system, 167	✓				
PSV	UV system, 167	✓				
PSV	UV system, 334	✓	✓	✓	✓	✓
PSV	UV system, 334	On Order	On Order		TBD	TBD
PSV	UV system, 334	✓	✓	✓	TBD	TBD
Bulk carrier	UV system, 2000	On Order	On Order		TBD	Shipyard
Bulk carrier	UV system, 2000	✓	On Order		TBD	Shipyard
Bulk carrier	UV system, 2000	✓	On Order		TBD	Shipyard
Bulk carrier	UV system, 2000	✓	On Order		TBD	Shipyard
Bulk carrier	UV system, 2000	✓	✓		TBD	Shipyard
Bulk carrier	UV system, 2000	✓	On Order		TBD	Shipyard
Bulk carrier	UV system, 2000	✓	On Order		TBD	Shipyard
Bulk carrier	UV system, 2000	On Order	On Order		TBD	Shipyard
Bulk carrier	UV system, 2000	On Order	On Order		TBD	Shipyard
Bulk carrier	UV system, 2000	✓	On Order		TBD	Shipyard
Bulk carrier	UV system, 2000	✓	On Order		TBD	Shipyard
Bulk carrier	UV system, 2000	On Order	On Order		TBD	Shipyard
Bulk carrier	UV system, 2000	✓	✓			Shipyard
Bulk carrier	UV system, 2000	✓	On Order		TBD	Shipyard
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Bulk carrier	UV system, 2000	✓	On Order		TBD	Shipyard
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Bulk carrier	UV system, 2000	✓	On Order		TBD	Shipyard
Bulk carrier	UV system, 2000	✓	On Order		TBD	Shipyard
Bulk carrier	UV system, 2000	✓	On Order		TBD	Shipyard
Bulk carrier	UV system, 2000	✓	On Order		TBD	Shipyard
Car carrier	UV system, 150	✓	✓			
Bulk carrier	Advanced Oxidizing, 5000	✓				
Roro vessel /ferry	UV system, 500	✓				
Roro vessel /ferry	UV system, 500	✓				
80 mtr Yacht	- -	✓				
PSV	UV system, 2 x 150	✓	✓			
PSV	UV system, 2 x 150	✓	✓			
PSV	UV system, 334	✓	✓			
Pipe laying vessel	UV system, 500	✓	✓	✓	✓	Shipyard
Bulk carrier	Electrolysis, 5000	✓	Quoted			
Bulk carrier	- -	✓				
Tanker	Electrolysis/Ozon, 2000	✓	✓		✓	Shipyard
Tanker	Electrolysis/Ozon, 2000	✓	On Order		On Order	Shipyard
Classic Yacht	- -	✓				
Motoryacht	- -	✓				
OSV	UV system, 150	✓	On Order		On Order	On Order
OSV	UV system, 150	✓	On Order		On Order	On Order
Chemical tanker	- -	✓	✓		TBD	Shipyard
Ferry	- -	✓				
Ferry	- -	✓				
PSV	UV system, 150	✓				

Beating the bottleneck

By planning ballast water treatment (BWT) system installation ahead of time, companies can gain peace of mind, save money, avoid additional dry docking periods, spread their investment, and beat the bottleneck set to arise after the IMO BWT convention passes. Just ask Saga Shipholding…

Saga Shipholding – the open-hatch carrier subsidiary of Nippon Yusen Kaisha (NYK)—has anticipated the arrival of the treatment convention since 2010, and has planned accordingly.

"We carried out a planning process from 2010 through 2012 in which we evaluated the ballast water treatment system types available—mechanical, chemical and ultraviolet disinfection," says Saga Shipholding Technical Manager Nils Otto Bjørhovde. "We found that the ultraviolet system made the most sense for us. From there, we chose three suppliers to take part in a tender process, and Optimarin ending out winning the contract to retrofit all of our vessels."

TIME OF THE ESSENCE

The contract covered complete BWT systems—including installation, engineering and service agreements—for 24 sophisticated open-hatch bulk carriers. It also built in another important element: time.

"We will carry out the first retrofitting of one of our vessels in China in mid-May. Our plan of action is to retrofit all of our vessels with BWT systems from now through 2016," says Bjørhovde.

The first vessel is not dry docking due to BWT installation. In fact, Saga has planned in advance to avoid such issues. All vessels will be retrofitted during their regularly scheduled dry dockings. Therefore there will be no schedule delays or differentiations as a result of the BWT system retrofits.

"This is the main reason for starting early. We can carry out BWT system installations on 6-8 vessels per year from now through 2016," Bjørhovde says. "Our belief is that it will become much more expensive the closer one gets to future BWT regulation installation deadlines. This is in regards to both the equipment itself and the fact that you'd then have to dry dock purely to carry out a retrofit."

AN EASY DECISION

Optimarin brought Goltens in as its engineering partner on the fleet agreement—and Saga was pleased with this.

"We knew Goltens as a trusted partner from other jobs, so we were happy for them to get on board here. When you add in their competitive prices, all of this made it an easy decision for us," says Bjørhovde.

He said that Goltens' 3D laser scanning of Saga's fleet was also a large selling point when carrying out retrofits with sister vessels. "Not only does the scanning create huge cost advantages, but it also makes it so much easier when working with all of the smaller details when carrying out prefabrication." |||

Nils Otto Bjørhovde, Saga Shipholding Technical Manager

Planning ahead

1 Selection of the BWT system
2 Onboard survey and a 3D laser scanning
3 Pre-engineering
4 Detailed design
5 Purchasing and prefabrication
6 Installation and commissioning
7 Service

As Saga shows, it pays to plan ahead. Goltens Green Technologies confirms that this is the optimum way to move forward. "If shipowners make a fleet agreement and spread out ballast water retrofitting from now until 2016, both suppliers and companies like Goltens would be willing to make this long-term commitment for a good price," says Business Development Manager Jurrien Baretta.

"If suppliers and retrofitters can spread out the work, they know how many people they need to hire to get the work done, have some transparency in their orderbooks, and can actually offer a good price," she continues.

"If all of the work has to take place at the last minute—and people have to be moved from other jobs to complete the tasks in time—then companies will be much less willing to negotiate."

Goltens Green Technologies' seven-step approach—the Proper Prior Planning approach—serves as a helpful system for all shipowners looking to embark on ballast water treatment (BWT) system installation. Here's a closer look at the steps:

1. SELECTION OF THE BWT SYSTEM

Take a closer look at your vessels and their requirements, the ballast water options on the market, and make a short list. Some of the main considerations for shipowners to take into account should include ballasting capacity, availability of power, installation space, and whether the vessel will sail in salt or fresh water—as some BWT systems have issues with the latter. The system should be type approved—otherwise it will not receive class approval.

"Goltens can help fleet owners evaluate their short lists—by looking through test results, giving advice regarding what to expect from certain systems, and ship type requirements," says Baretta.

2. ONBOARD SURVEY AND 3D LASER SCAN

After a shipowner has shortlisted a number of BWT systems, Goltens Green Technologies experts go onboard the vessel to evaluate the space and perform a 3D laser scan to find the best way to fit the system. A laser scan will reveal any obstacles in the way of piping installation and help determine the most feasible solution.

"Laser scans mean that you don't have to carry out ship design work for each sister vessel in the process. Therefore, each following vessel will have a cheaper process than the first vessel that was 3D scanned," says Baretta.

3. PRE-ENGINEERING

At this stage the BWT system shortlist will be further refined. Some systems may be removed because they will not fit or because it might be too complicated to get the piping in. When the owner makes a final system choice, the detailed engineering work begins.

4. DETAILED DESIGN

The next step is preparing the detailed production drawing of the piping, foundations and any constructions that may be needed. Goltens Green Technologies will get the drawings approved by class prior to moving further. This can take a few months.

5. PURCHASING AND PREFABRICATION

It is important to bear in mind that purchasing a BWT system includes a lead time of six months or more. Assorted ancillary materials are included in the purchasing to ensure there are no delays once installation commences.

6. INSTALLATION AND COMMISSIONING

The supplier will need to come onboard and complete the commissioning of the system, and the classification society will need to survey the system for the final approval. If planned properly in advance, installations can take place during regularly scheduled dry docks. Certain installations can be done without adding new overboard connections, and in these cases, dry docking isn't necessary at all.

7. SERVICE

This is probably the most critical long-term step. Goltens' service stations will provide ongoing support and service to your BWT systems worldwide.

ALL OR PART OF THE PROCESS

No matter how far along a company is in its BWT system installation process, Goltens can help. The company can carry out all or part of the work. "We're willing to help shipowners carry out the entire process from A to Z, but are also happy to assist if they only need help with specific parts of the process—like laser scanning or engineering. We know that superintendents are extremely busy, and we are willing to help wherever it's needed," Baretta concludes. |||

Stationary power plant assistance. Anytime, anywhere.

Dealing with engine maintenance and unexpected casualties is hard enough, but when the nearest airport is hours away and there are no local repair companies the challenges become even more daunting. Thankfully, this is where Goltens comes in.

Stationary power plant operators around the world are faced with challenges shipowners are not. These power plants tend to be far away from the main power grids, and serve as critical sources of electrical power for production at remote mines and factories as well as remote communities.

Unlike in busy global ports – where access to quality service companies is generally not a problem – there is very often no local service at all, let alone specialist service, available in these areas. As such, these operators are exposed to a greater risk of downtime due to accessibility or even the willingness of some service providers to travel to these locations.

As Goltens has executed its strategy to expand its services beyond its traditional marine focus over the past decade, it has found these customers very receptive to an independent alternative. One that is focused on fast response time, high-quality service and, even more importantly, presenting repair options rather than merely replacement.

This market has expanded for Goltens, as stationary plant operators around the world now rely on the company for everything from the supply of engine and auxiliary spares, routine maintenance and overhaul to the more time-sensitive casualty response service that Goltens is famous for.

These operators have come to learn that, provided Goltens can ensure the safety of its specialists, there is really nowhere in the world that Goltens will not travel to support a customer. Over the past year alone, Goltens has been at locations ranging from isolated plants north of the Arctic Circle to remote production plants deep in the jungle and remote island plants – providing all types of parts supply and service.

The following stories and graphic provide even more detail on the lengths that Goltens will go to satisfy its customers – anytime and anywhere. |||

WORK IN STATIONARY POWER PLANTS:

1. **Alaska, USA (Wartsila 16V32)** Performed in-situ machining and standard overhaul on multiple engines
2. **New York, USA (DeutzTBG632)** Performed engine and generator overhaul for a large shopping center
3. **Mexico (Wartsila W18V32)** In-situ machining of crankpin after bearing failure at Mexican paper mill
4. **Florida, USA (Pielstick 18V2.2)** Machined and sleeved generator shaft in-situ, installed new bearing and aligned generator at power plant
5. **Freeport, Bahamas (Mitsubishi UEC60LSII)** Performed reconditioning of piston crowns, cylinder heads, piston rods and spindles and seats
6. **Port Au Prince, Haiti (Wartsila 16SW280)** In-situ annealing and machining of damaged crankpins
7. **San Salvador, El Salvador (MaK 16CM32)** In-situ annealing and machining of crankpin after bearing failure
8. **Roatan, Honduras (Wartsila 12SW280 & 8SW280)** Annealing and machining of crankpin and replacement of crankshaft on second engine
9. **Nicaragua (MaK 16CM32)** In-situ annealing and finish machining of damaged crankpin after bearing failure at powerplant
10. **Panama (General Electric Turbine)** In-situ machining of damaged turbine shaft
11. **French Guiana (Pielstick 16PC2)** After bearing failure, machining and polishing of crankpin journal to restore engine
12. **Ecuador (Wartsila W16V26)** In-situ annealing and machining of damaged crankpins
13. **Iquique, Chile (Wartsila 18V32)** Supply of engine spares and turbo overhauls for remote mine
14. **The Netherlands (Enterprice HVA 16C-4)** Complete engine overhaul on stationary gas engine after major breakdown at power plant
15. **Porto, Portugal (Mitsubishi 18KU30A)** In-situ machining of 10mm from badly damaged crankpin
16. **Consuegra, Spain (Bergen BV20)** In-situ annealing and machining of damaged crankpin journal
17. **Rufisque, Senegal (Mitsubishi 18KU30B)** In-situ annealing and machining of damaged crankpin journal
18. **Corsica, France (Sulzer RND90)** Machined one crankpin on large stationary diesel. Crankpin was out of tolerance due to wear
19. **Bologna, Italy (Rolls Royce Bergen KVGS18 G4.2)** Saved crankshaft from being condemned with in-situ annealing, machining and polishing of crankpin
20. **Lesbos, Greece (GMT A420.12)** In-situ crankshaft machining to restore damaged journal after bearing failure
21. **Beirut, Lebanon (MAN B&W 9L52/55B)** Complete rebuild of engine and recasting of foundation at power plant
22. **Raniyah, Saudi Arabia (Deutz BV 16M 640)** In-situ machining of damaged crankpin after bearing failure at a power plant
23. **Dar Es Salaam, Tanzania (Wartsila 18V38)** Performed planned maintenance overhauls on five engines, and will complete the other five on schedule
24. **Ras Al Khaima, UAE (MAN 9L 58/64)** Full engine overhaul during shutdown of the cement plant. Completed within 10 days
25. **Faislabad, Pakistan (Wartsila NOHAB 16V25)** In-situ machining of two crankpins damaged by bearing failures at a textile factory
26. **Lahore, Pakistan (Mitsubishi 18VKU30A)** Machined crankpin to 10mm undersize as a result of significant damage from bearing failure at a power plant
27. **India (Bergen B35/40V16 Gas Engine)** In-situ machining of crankpin with bad scoring and surface cracks
28. **Bangladesh (Sulzer 14ZAV40S)** Performed In-situ machining of damaged crankpin after bearing failure
29. **Tibet, China (Sulzer 8ZAV40S)** In-situ machining of damaged crankpin journal after bearing failure
30. **Aceh, Indonesia (MaK8M453AK)** After not operating for more than a year, Goltens rehabilitated the engine and put it back into service
31. **Singapore (MWM TBDG441BV12)** Goltens performed in-situ line boring and crankshaft inspection due to a damaged main bearing pocket
32. **Lombok Island, Indonesia (SEMT Pielstick 12PC2.5)** Performed engine overhaul and in-situ machining of damaged crankpin
33. **Brunei (Mirlees Blackstone K6Major MK3)** In-situ annealing, machining of damaged crankpin after bearing failure
34. **Philippines (Sulzer 16VZAV40S)** In-situ machining of damaged crankpin after bearing failure
35. **Jayapura - Papua, Indonesia (SWD 6TM410)** In-situ machining of damaged crankpin after bearing failure

Helping hand to Nicaraguan power plant

When the company that began the job was unable to effectively mobilize tools and technicians to remove the high hardness discovered in the crankpin, Goltens received the call from CENSA in Nicaragua to take over the repair of a damaged MaK 16CM32 engine.

Goltens mobilized its annealing equipment, single-point cutting tools and in-situ machinists to the site and took over the job.

As the crankpin had already been machined down to 278.5mm, pre-machining was not required prior to annealing. Goltens verified that the crankpin was free of surface cracks and performed a hardness mapping of the crankpin. Hardness values over 500 hB (hardness Brinell) were discovered in spots around the crankpin surface, well above the manufacturer's acceptable limits.

Goltens installed the annealing equipment and performed the annealing process, after which the hardness values were brought to within acceptable parameters and the crankpin was finish machined and honed to a final diameter of 278mm.

SINGLE TEAM MOBILIZED

Goltens was able to mobilize a single in-situ machining team capable of performing the crankshaft machining and annealing. This saved the customer unnecessary downtime and costs associated with the waiting for the mobilization of multiple teams.

The crankshaft was restored to operational status with only 0.5mm additional material removed from the crankshaft diameter. The finished crankshaft was within maker specifications and the engine was returned to operation. |||

Annealing equipment setup on damaged crankpin

Goltens Service Engineer adjusting settings on annealing equipment

Post Annealing hardness testing

Post Annealing crankpin machining

Major overhauls of generators in Tanzania

When Goltens signed a service agreement with Independent Power Tanzania (IPTL) for the overhaul of 10 Wartsila 18V38 engines, the main challenge was to carry out the extensive 36,000-hour overhaul scope within the timeline committed to.

The Tanzania plant had a limited window available for the completion of the maintenance during the planned engine/plant shutdown. To accomplish this, Goltens deployed a team of a diesel supervisor, an electro and automation specialist, and four mechanics to complete the work following the maker's defined scope within the 30 days allotted per engine.

Goltens disassembled the engine and completed an inspection of the shaft and a change out of the main bearings. The inspection of all subcomponents and the upper and lower liner landing surfaces revealed that some wear had occurred. This required in-situ machining of both surfaces on some cylinders and the insertion of prefabricated rings to renew the sealing surface. Thankfully Goltens had anticipated the possibility of this situation beforehand, and had brought its in-situ machining tools and the required ring inserts to the site.

Removal of big end bearing housing

BACK IN OPERATION IN TIME

In the end, Goltens completed the overhaul within the agreed timeline and completed full operational testing of the engines prior to handing it back over to IPTL for return to operation. |||

Calibration checks on big end bearing housing

Installation of cylinder head

In demand in Indonesia

An independent power producer in Aceh, Indonesia entrusted Goltens to carry out general overhaul of their seven genset units in serial fashion. The job needed to be timely and accurate, as electricity production could not be disrupted to avoid a shortage of supply to the public grid.

Prior to the job execution, one diesel engineer was dispatched to ensure the completeness of spare parts and take initial performance of the gensets.

Goltens then carried out repairs which included a general overhaul of the diesel engines per the maker's guidelines, reconditioning of the turbochargers, overhaul and calibration of the speed governors, overhaul of engine components, reconditioning and calibration of fuel injection pumps and injectors at the workshop, renewal of the cylinder liners, and engine commissioning and reliability testing, among other repairs.

SEAMLESS COORDINATION

Goltens completed the job within the agreed time frame – eight days per engine - not exceeding a total of 60 days for seven units. Seamless coordination between the diesel service team at the site and Goltens' workshop service team yielded high-quality results that were recognized and appreciated by the customer. |||

Securing turbocharger in place after overhaul

Test running/commissioning of engine

7 Engine plant in Indonesia

Cleaning of block liner bore

Minimizing offshore sector downtime – where time truly is money

With day rates for some deepwater rigs over $500,000, large jack-up rigs around $150,000 and offshore intervention and large capacity anchor-handling vessels in some regions around $70,000, it's easy to see that, in the offshore sector, repair speed and accuracy is even more important than repair cost (reference chart to the right comparing vessel/rig rates servicing the oil and gas industry with merchant vessel day rates). This is mainly because of the cost of the assets employed to produce the oil and gas, but also because of the large cost of downtime and its direct effect on the revenue stream from an oil and gas field.

In many places around the world, the offshore environment is harsh and dangerous and lives are at risk. Therefore, there is a requirement for the most sophisticated vessels with the most advanced station keeping systems with redundant high power capability which drives the day rates to a totally different level than merchant fleet rates. Hence, precision becomes key and tolerance for error is minimal and when you add these facts to the extremely lucrative hire rates, it puts great pressure on vessel and rig managers to maintain 100% asset availability.

SUPPORTING OFFSHORE'S UNIQUE REQUIREMENTS

Goltens has positioned itself to support offshore's unique requirements — whether the needs entail ballast water treatment systems, diesel engine services or in-situ machining.

GREEN TECHNOLOGIES

Given that the installation of ballast water treatment (BWT) systems is a non-payback investment and offshore vessel day rates are so high, Goltens Green Technologies' approach to BWT retrofits is to complete the process with the least interruption to vessel operation possible. In fact, in some cases there is no downtime at all.

Green Tech utilizes 3D scanning, which can generally be done in less than a day while the vessel is still in operation. Vessel owners can then utilize this 3D output to help them make BWT system decisions. Once the decision is made, Goltens can move forward with detailed design and engineering, as well as fabrication of the piping and connections. In many cases the pre-fabricated piping system can be loaded onboard the vessel and installation completed while the vessel is still in operation.

This approach has been so successful that Green Tech has signed fleet agreements with a number of shipowners and is in the midst of completing even more deals.

DIESEL ENGINE SERVICES

Regardless of the location of a platform or vessel, Goltens has the ability to deploy its diesel teams to site quickly to perform routine maintenance, diagnose and troubleshoot, or to restore from a casualty. The Energy Exeter case study in this section provides a perfect example of the extensive diesel engine work the company can carry out on a rig.

IN-SITU MACHINING SERVICES

Goltens' on-site/in-place repairs to damaged equipment are provided quickly and with minimal downtime whether onboard active rigs and vessels or at newbuild and repair yards around the globe. See the separate article in this section for recent examples of Goltens' in-situ machining support. |||

Preparing Energy Exerter for Black Sea relocation

In December 2012 Prime Point Holdings of Singapore awarded Goltens the order for the inspection, complete overhaul, operational testing and preservation of three 2500KVA Wartsila 12V22MD diesel generator sets, one 750KVA Baudouin 12P15 diesel generator set, two 6-cylinder Caterpillar 3406C diesel crane engines, and all related auxiliary systems onboard the Energy Exerter, a 31-year-old self-elevating cantilever jack-up oil rig.

In addition to the complete refurbishment of the onboard generators, the Energy Exerter project scope being undertaken by the yard was huge. The rig was disassembled into eight separate pieces and prepared for shipment to Burgas, Bulgaria and reassembly in the Black Sea later on in the year. After shipment, a total of 7.5 km of welding will need to be carried out to reassemble the parts into a well-functioning rig again.

CLOSE COORDINATION ON ENGINES

As the rig's power requirements exceeded available shore power at times, Goltens coordinated closely with the customer and had to be flexible in how the engines were taken off line and ensure that they were brought back into service on schedule.

Goltens performed inspections of all engines and dismantled and overhauled all components prior to reassembly. Parts were either overhauled on site in the yard or were transferred to Goltens' nearby workshop in Rotterdam for overhaul. Additionally, Goltens in-situ machinists polished all crankpin and main journals as part of the overhaul and rebuild process.

PRESERVATION FOR SHIPMENT

To prepare for the long gap between overhaul and commissioning after transport to the Black Sea, Goltens also undertook measures to preserve the condition of the newly overhauled auxiliary systems, isolated the engine exhaust systems and took preservation measures on each of the engines.

STREAMLINED WORK, SIGNIFICANT COST SAVINGS

Goltens completed all facets of the work scope on time to the satisfaction of the customer. The company's ability to handle all aspects of the project avoided multiple contractors, and the ability to overhaul the engines onboard and avoid major item removal from the rig allowed the customer to realize significant cost savings.

Goltens diesel technicians will travel to Burgas in the fourth quarter of 2013 to commission and test all systems prior to Energy Exerter being put back into service for the next phase of its lifecycle. |||

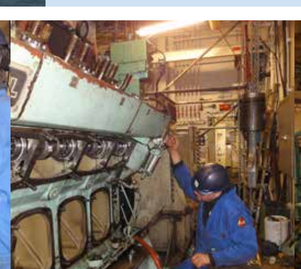
Project facts: Energy Exerter

Rig Type: Self-Elevating Cantilever Jack Up
Rated Water Depth: 300ft
Drilling Depth: 25,000 ft
Year built: 1982

DIESEL ENGINES:
- Wartsila 12V22MD (3 units) / 2,500KVA
- Baudouin 12P15 (1 unit) / 750KVA
- Caterpillar 3406C (2 units) / 345KVA

AUXILIARY SYSTEMS:
Generators, Cooling water system, Hydraulic systems, Exchangers, Mud pumps, Fuel systems, Hydraulic systems, Safety systems, Exhaust Isolation

Reassembly of one of the overhauled pistons and connecting rods



Rotating the engine to its correct position

One of the completely overhauled and fully tested Wartsila engines type 12V22MD

DAY RATE IN USD FOR VARIOUS VESSEL TYPES AND OFFSHORE SEGMENTS (2010-2012)

SOURCES: CLARKSON'S "OVERVIEW OF THE OFFSHORE SUPPLY VESSEL INDUSTRY" AND RS PLATOU'S GLOBAL SUPPORT VESSEL MONTHLY (Feb 2013) AND THE PLATOU REPORT

Minimizing downtime with offshore in-situ machining

Goltens' global reach and ability to respond make it the clear choice for in-situ machining services when equipment is down and production is on the line.

Whether it's a problem on an FPSO, deepwater drilling platform, specialized OSV, jack-up rig or any other type of offshore platform, Goltens responds with qualified, certified technicians to address the challenge and restore the casualty in a precise, safe and swift manner. Offshore operators know that downtime equals lost revenues and when it occurs, they demand a fast and expert response from a company that is qualified to respond.

These operators also know that when production is on the line, it is not how close you are to the problem that matters. It's how you respond and how capable the team is that comes onboard to solve the problem. The company has to have offshore-certified resources ready to go and be able to respond on a moment's notice.

Offshore customers all over the globe rely on Goltens' in-situ machining capabilities. Some of the company's recent jobs in this area include laser alignment and chocking of deck equipment and turbines, diesel engine crankshaft machining, XY milling, metal stitching of damaged engine blocks and time-critical flange facing.

In the last year, Goltens in-situ technicians have been onboard all types of offshore rigs and vessels in major production locations in the North Sea, Persian Gulf, Gulf of Mexico, Brazilian basins, West African oil fields and key locations across Southeast and Far East Asia. Details on a few of these recent jobs follow below:

In-Situ machining and alignment onboard Offshore Supply Vessel
Goltens attended Farstad Shipping's offshore anchor handling supply vessel Bos Turquesa in Brazil to investigate and troubleshoot recurrent premature main bearing failures on its #1 and #4 Bergen B32:40 L6P main engines. The investigation revealed that a previous repair attempt by another company did not address the alignment issues and that the previous bearing repair on the main bearing was poorly performed. Goltens machined the main journal for use with an undersized bearing and realigned and chocked the engines, resolving the problem and returning the engine to service.

Goltens technicians installing chain-driven rings to rotate the shaft during main journal machining

Goltens restores major crankshaft damage to offshore vessel in South America
Goltens mobilized tools and technicians to inspect and repair a MaK 8M32C engine onboard an offshore vessel in South America. The vessel had experienced a casualty resulting in damage to all main journals and crankpins. Goltens deployed two teams of in-situ machinists to work around the clock to machine all of the crankpins and main journals and restore the offshore vessel's engine to service in the minimum amount of time.

Goltens grinds damaged crankpin journal fillet radius in-situ

Critical In-Situ Machining onboard FPSO in west Africa
Goltens was asked to carry out an inspection and, if required, be ready to conduct in-place machining to repair the 14-inch diameter, Techlok flange connector for the riser connection onboard the FPSO Kwame Nkumrah in Ghana, west Africa. Goltens' team repaired the flange, restoring it to maker's tolerance within a single work shift. The repair removed all mechanical damage from the riser movement and restored the equipment to operation without further delay.

Emergent In-Situ Machining solution keeps new build offshore vessel on schedule
During the final construction and commissioning of wind carrier vessel Bold Tern in the Lamprell Yard in Jebel Ali, vessel owners Fred Olsen noticed the jacking cylinders for the legs were being damaged during actuation by the scraper ring which had been installed to remove debris from the cylinder. With no time for full disassembly of the cylinders, Goltens installed a split frame orbital cutting machine onto the jacking cylinder and inverted the tool post ninety degrees and installed modified tooling. Goltens removed a small section of the hydraulic jack body to allow the scraper ring to be removed intact for analysis. The job required precision so as not to damage the jacking cylinder during rotation and also not to cut too far into the hydraulic jack body, but just enough to remove the retaining ring and allow the scraper ring to be removed.

Tight timeline met on Offshore BWT retrofit

A major subsea and oil and gas company gave Goltens an advanced 3D laser scanning, engineering design and associated piping order in November 2012 for one of its vessels. Given that all prep work needed to be finished ahead of the scheduled drydock in January 2013, time was of the absolute essence…

An advanced pipe-laying vessel was to have an Optimarin OBS ballast water treatment (BWT) system installed during its drydock, and therefore needed all scanning, design and prefabrication completed ahead of time.

Goltens Green Technologies experts joined the vessel in Invergordon, Scotland on December 4 to complete the one-day scanning of the engine room space where the system was to be installed. Seventeen days later, Goltens delivered the complete engineering package to the owner and began the prefabrication of all required piping and components to install the system.

The vessel went into a Dutch drydock during the second week of January and Goltens delivered the prefabricated piping to the shipyard. Installation work was completed under Goltens' supervision – with the project status reported to the vessel superintendent daily, and progress and actions discussed with the relevant parties during morning meetings to keep the project on track.

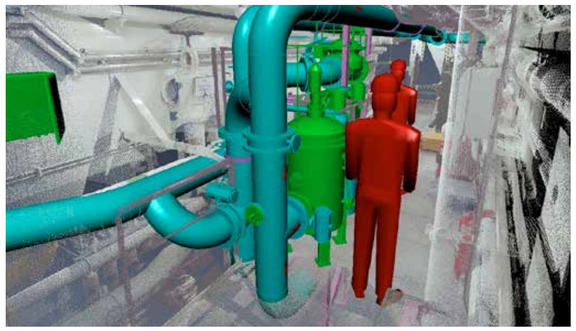
WRAPPED IN A MONTH

Due to the large scope of the scheduled drydocking, working efficiently with all parties involved was a challenge. However, the project was completed on schedule and did not result in any delays in the vessel's departure from the yard. The total piping and electrical installation project, including commissioning, took four weeks to complete. |||

Project Facts: BWT Retrofit

Vessel type: Advanced Pipe Laying Vessel
Ballast flowrate: 500 m3/hr
Total ballast capacity: 5,746 m3
Ballast treatment system:
Optimarin OBS 500 m3/hr

Performing 3D Laser scanning onboard vessel in Invergordon, Scotland



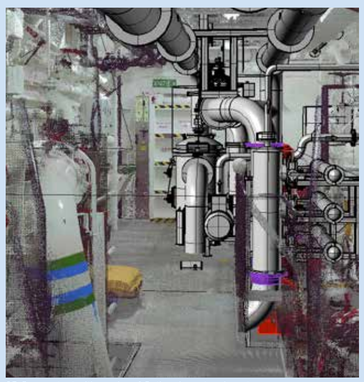
3D scanning results with Optimarin system overlay on scan

Optimarin System installed onboard

Performance of commissioning inspection by Goltens Green Technologies

JOB PROGRESSION SEQUENCE – PRE-SCAN/SYSTEM OVERLAY ON SCAN/INSTALLED

Photo of space scanned for installation



3D Scan output with overlay of Optimarin system layout

Optimarin System installed onboard

Goltens helps paradise stay paradise

Careful planning and execution allows for uninterrupted operation onboard Royal Caribbean cruise ship

The last thing over 2,000 cruise passengers want to be reminded of when vacationing in Royal Caribbean paradise is irritating signs of everyday life. You know, things like delays and repairs. So when Royal Caribbean contacted Goltens to see whether a crankshaft replacement could be undertaken mid-cruise without interruptions, Goltens knew there was a lot riding on its response…

Royal Caribbean Cruises Ltd. contacted Goltens Singapore after one of its vessel's five Wartsila 12V46 main engines suffered a main bearing failure. The cracks found were deeper than the maximum allowed undersize by the engine maker, requiring a replacement of the crankshaft. It was also discovered that during the main bearing failure a lot of heat was transferred to the bearing saddle, causing it to collapse. As a result, in-situ line boring of the main bearing pockets was also required to restore the engine back to running condition.

Goltens mobilized one of its most experienced Repair Managers to conduct an inspection during a port call in China to evaluate the logistics for the repair and options for onloading the replacement shaft.

CRITICAL EVALUATION

Goltens performed an on-site inspection, reviewed AutoCAD drawings of the engine room, and overlaid the dimensions of the 9-meter/15-ton replacement crankshaft along the potential route. The evaluation showed that there would be just enough space to shift the crankshaft between the forward and aft engine rooms via the watertight door with only a few centimeters of clearance without cutting the door. This evaluation was critical, as the watertight door would have needed to be 100% restored prior to sailing and the 10-hour port stay in Singapore was not long enough to complete all required work.

Complicating matters, the engine room was located 80 meters from the service/cargo entrance where the replacement crankshaft would be loaded onboard. This alleyway is critical to the efficient transfer of provisions and luggage to the vessel's roughly 2,500 passengers and crew. With only a 10-hour port call, completing the transfer of the crankshaft without interrupting these critical transfers or interrupting the movement of the vessel was a logistical nightmare. It was a situation that required extremely precise timing and execution.

The offloading of the condemned crankshaft was not as critical, as it could be cut into smaller sections and offloaded more easily without time constraints via the watertight door in Singapore.

RACE AGAINST TIME

After the proposed process was reviewed by Royal Caribbean's class – Det Norske Veritas (DNV) – and Royal Caribbean accepted the proposal, Goltens mobilized to complete the repair as quickly as possible.

Careful preparation work was then carried out. This included removal of a portion of the overhead ceiling in the aft engine room and all piping and cabling to allow for access from the service alleyway one deck above the aft engine room before the rigging operation commenced.

The operation to onload the new crankshaft started from shoreside in Singapore at 0800 hours, and the crankshaft was transferred onboard via the provision doors at 0900 hours. Now the race was on to get the crankshaft shifted 80 meters in the service alleyway as quickly and safely as possible – as the passengers had started to board and all luggage had to be shifted in the same alleyway. Two hours later the crankshaft was in place 80 meters inside the vessel, and the luggage and provision movement could start at the scheduled time.

As the vessel could not sail with open holes in the alleyway deck, the deck cutting and lifting operation had to be completed at the next port of call, a 12-hour stay in Port Klang, Malaysia.

As soon as the vessel reached port, Goltens' welders cut the access hole in the deck and began the rigging operation to lower the 15-ton crankshaft into the engine room. Once the crankshaft was lowered, the hole was immediately welded shut and quality checked, and the vessel sailed on time. This operation went smoothly and the new crankshaft was soon hanging over the engine where it would be installed. (Continued on next page)

Project facts: Crankshaft Replacement

Type of vessel: Cruise vessel
Equipment maker: Wartsila
Model: 12V46
Length of crankshaft: 9 meters
Weight of crankshaft: 15 metric tons
No. of main engines: 5

Rigging of condemned crankshaft from the engine room

IN-SITU LINE BORING, INSTALLATION & REBUILD

Goltens carried out in-situ line boring of the damaged main bearing pocket in parallel. A new undersize saddle was supplied and installed in the engine and machined back to its original size. This action meant that all main bearings stayed the standard size and eliminated the need for special bearings.

Once the crankshaft was installed, all clearances were checked and found satisfactory, and the engine was rebuilt. All auxiliary equipment had been fully overhauled by the vessel crew and Goltens technicians. As part of the rebuild Goltens also replaced the original rubber cushion mountings with a newer, improved spring mounting design. After alignment was carried out, the engine was ready for operational testing.

(Continued on next page)

Rigging of replacement crankshaft onboard during port call in Singapore

Preparing crankshaft for transport down passageway via skid

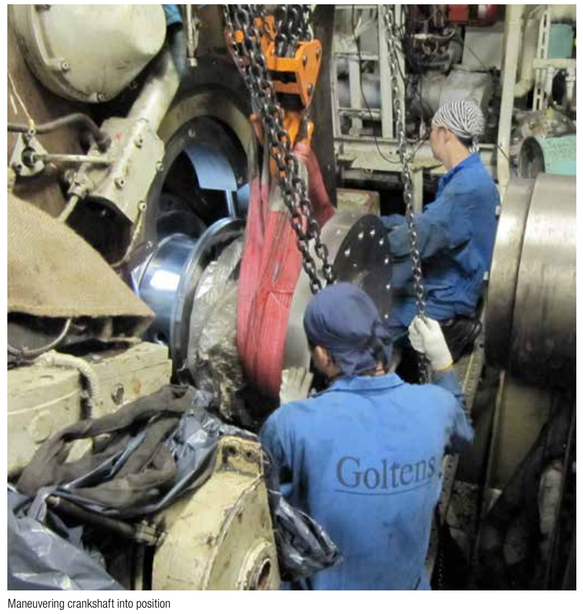
Transfer of replacement crankshaft down 80 meter passageway

MAKING THE IMPOSSIBLE POSSIBLE

A performance test and tune-up test was completed by Goltens technicians. All 12 cylinders were adjusted such that all exhaust temperatures and peak pressures were in perfect balance and the vessel was able to take the engine back in operation within the agreed project time. The entire process was completed to Royal Caribbean's and DNV's satisfaction – and there was no interruption to the vessel's schedule or disruption to its passengers.

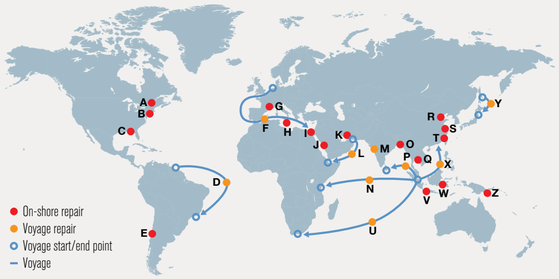
"Our team has accomplished an impressive task here. The internal logistics involved in getting the crankshafts in and out of the engine room on a cruise vessel mid-voyage with over 2,000 passengers onboard is immense. After 20 years in ship repair, I'm still impressed by how our riggers and mechanics manage to accomplish what seems to be impossible at first glance," says Goltens Singapore Managing Director BC Chua. |||

Rigging replacement shaft into engine room via hole cut in passageway floor



Maneuvering crankshaft into position

A SMALL SAMPLE OF RECENT CRANKSHAFT REMOVAL AND REPLACEMENT WORK PERFORMED BY GOLTENS GLOBALLY



A. Montreal, Canada
Yanmar 6N 280L - Performed laser alignment of bearing pockets and installed crankshaft and reassembled engine.

B. New York, USA
MaK 6M551AK - after a con rod failure and catastrophic failure to the bedplate, Goltens disassembled the engine, removed the crankshaft and damaged bedplate and replaced the bedplate and reinstalled the crankshaft.

C. Alabama, USA
Daihatsu 8PS-26H - After lube oil failure, crankshaft on bulk carrier required replacement. Disassembled engine, replaced crankshaft, rebuilt engine and restored to operation.

D. Trinidad to Brazil
ABC 6 BDXC720–100A - Voyage repair consisting of replacement of engine bedplate and crankshaft and reassembly of engine.

E. Chile
Yanmar 6ZL-UT - Performed crankshaft change, lineboring and complete overhauls on 3 Yanmar 6ZL-UT engines. Sourced all parts and completed all service.

F. Germany to Suez
MAN 6L23/30H - Voyage repair to replace 2 crankshafts onboard the same vessel. Damage caused by extreme wear/ovality.

G. Marseille, France
MAN 6L23/30H - Crankshaft rejected due to excessive wear on the crankpins. Crankshaft replaced with new one and engine rebuilt.

H. Malta
DEUTZ RBV12M350 - After catastrophic bearing failures on main engine, Goltens removed crankshaft, line bored the engine, replaced the crankshaft and rebuilt and op-tested the engine.

I. Port Suez, Egypt
MaK 6M601 - Goltens disassembled engine, removed crankshaft, line bored engine and reinstalled crankshaft and reassembled the engine.

J. Jeddah, Saudi Arabia
MAN V6 40/54 - Goltens disassembled engine, removed crankshaft, line bored engine and reinstalled crankshaft and reassembled the engine.

K. Dubai
MaK 12M43C - Goltens removed crankshaft, polished journals and reassembled engine after main engine room flooding.

L. UAE to Djibouti
Sulzer 6AL 25 - Crankshaft condemned due to severe crankpin damage. Goltens removed/replaced crankshaft and rebuilt engine during voyage.

M. Mumbai, India
MAN B&W 5L 23/30 - Goltens reconditioned damaged crankshaft in the workshop and completed crankshaft replacement and engine rebuild on voyage.

N. Singapore to Mombasa, Kenya
Yanmar M220AL-SN - Voyage repair to replace crankshaft, bedplate and engine block.

O. Bangladesh
Wartsila 18V46GD - Goltens supplied replacement block, retrofitted for Dual Fuel operation and rebuilt engine after polishing crankshaft. Completed full rebuild.

P. Singapore to Sri Lanka
Yanmar M220 ALSN - Voyage repair. Replacement of crankshaft, alignment of main bearing pockets and rebuilding engine.

Q. Thailand
B&W 6L 23/30H - Crankshaft replacement, alignment check of main bearing pockets and rebuild of engine.

R. Tianjin, China
MAN B&W 6L27/38 - Removed and replaced damaged crankshaft. Completed rebuild and commissioning of the engine.

S. COSCO Lianyuangang, China
YANMAR 6M200AL - Crankshaft scrapped due to deep cracks on main journals. Goltens replaced crankshaft,reassembled and aligned and chocked engine.

T. Zhoushan, China
YANMAR 6M18AL - After connecting rod failure, Goltens removed and replaced condemned crankshaft and rebuilt the engine.

U. Singapore to Cape Town
Wartsila 6R32D - Voyage repair consisting of crankshaft removal, line boring of engine main bearing pockets, installation of crankshaft and reassembly.

V. Tanjung Priok, Jakarta
Daihatsu 6PKT16 - Goltens removed crankshaft, repaired in workshop and reinstalled and assembled engine.

W. Balikpapan, Indonesia
Mirrlees Blackstone ESL 16MK-2 - Replaced crankshaft after major casualty due to lube oil contamination.

X. Singapore to China
Wartsila 6L20 - Voyage repair. Goltens replaced the damaged crankshaft and reassembled the damaged engine.

Y. Sakhalin, Russia to Muroran, Japan
Bergen B32 40L9A - Performed crankshaft replacement, laser alignment of main bearing pockets and rebuilding of engine.

Z. Port Moresby, Papua New Guinea
MAN B&W 6L 23/30H - Removed and replaced A/E engine crankshaft and rebuild engine supported by ship's crew.

Shipyard Services – responding fast and meeting deadlines

When companies think about where Goltens works, stationary power plants, offshore platforms and shipboard engine rooms most often come to mind. Therefore, the magnitude and breadth of services provided directly to shipyards and customers during their shipyard periods may come as something of a surprise…

In the shipyards, missed deadlines and deliveries cost owners and yards time and money. Goltens' continuous focus is on providing an expert and rapid response to help customers solve both known challenges and unforeseen problems on time and on budget.

Goltens has long-standing relationships with shipyards all over the world – ranging from long-term, informal arrangements to formal joint ventures and resident contractor arrangements. Yards around the globe call Goltens daily to provide support in diesel services, large and small-scale in-situ machining services, laser alignment and chocking, as well as reconditioning of critical parts like stern tubes and other bearings.

Goltens' ability to respond and to solve challenging technical challenges outside the norm for these very capable yards makes it an indispensible resource. Additionally, close working relationships with yards all over the world often enables customers to engage Goltens directly for specialist services inside the yard when the yard is unable to perform them directly. |||

4.7M Thruster Flange Machining

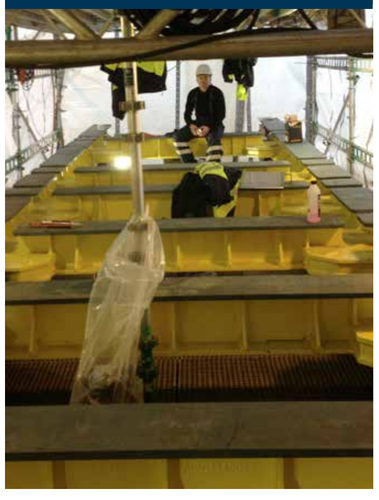
Goltens performed large scale flange facing on 2 - 6 Megawatt stern tube thrusters on the cable laying vessel, Lewek Constellation. The job was completed at the TriYard Shipyard in Vietnam. The job was completed ahead of time with a job process approved by class. The end result was within the tolerances set by the yard and the Thruster supplier.

Assembly and Installation of Helideck Pancake

In collaboration with Marine Aluminium AS, one of the world's leading companies within engineering, design and fabrication of aluminium structures and products for the offshore and shipbuilding industry, Goltens recently completed the assembly and installation of a helideck pancake onboard the conversion vessel ARV3 in one of the Singapore shipyards.

ITW Chockfast Foundation installation onboard Jackup Rig

Goltens completed the design and fabrication of a 13,000mm X 400mm Skid foundation for a crane onboard a Norwegian Jack Up Oil Rig undergoing a refit in a shipyard on the west coast of Norway. The completed foundation was installed using ITW Chockfast and was capable of withstanding a total load of more than 100 Tons.



Line boring 1.27M Propeller Thurster Housings

Goltens' In-Situ team was asked to complete line boring on 6 propeller thruster housings in Jurong to an oversize diameter of 1.27M. Goltens modified its boring tools for the job and laser aligned the tooling to ensure the tight tolerances were achieved and accurate. The job was completed on time and within the specified tolerances to the full satisfaction of the customer.

Emergent Repairs to a Damaged Rudder Stock

During a scheduled 5 year drydocking of the bulk carrier Lilian Z at Chengxi Shipyard, abnormal wear and scraping was observed on the 500mm diameter rudder stock. The damage required immediate repair to keep the drydocking schedule and Goltens completed the emergent job in only 2 days to keep the shipyard schedule on track.

SOME EXAMPLES OF GOLTENS' SHIPYARD RELATIONSHIPS INCLUDE:

ASRY SHIPYARD (BAHRAIN)
Agreement with Goltens Bahrain for presence and exclusivity for all diesel-related work

DUBAI MARITIME CITY/DUBAI DRY DOCKS (DUBAI)
Memorandum of Understanding for cooperation on service delivery

AL FATTAN SHIP INDUSTRIES (TAWEELAH, ABU DHABI)
Joint venture partner for operation of shipyard

JEDDAH SHIPYARD (WESTERN PROVINCE, SAUDI ARABIA)
Memorandum of Understanding for execution of diesel and mechanical works through which, Goltens Red Sea has a presence inside the shipyard.

DAMMAM SHIPYARD (EASTERN PROVINCE, SAUDI ARABIA)
Memorandum of Understanding and good working relationship with the shipyard for execution of diesel and mechanical works

YIULIAN DOCKYARDS (GUANGDONG, CHINA)
Resident contractor for a broad range of diesel engine repair and reconditioning, and the full range of Goltens' in-situ machining services

SHANGHAI SHIPYARD (SHANGHAI, CHINA)
Service agreement for diesel engine repair and reconditioning, all of Goltens in-situ machining services, and the supply and service associated with alignment and chocking

WESTERN INDIA SHIPYARD LTD (GOA, INDIA)
Memorandum of Understanding signed as specialized, in-situ and diesel automation service provider

PIPAVAV DEFENSE AND OFFSHORE ENGINEERING (RAJULA, INDIA)
Resident contractor in newbuilding activities. Memorandum of Understanding signed for repair activities

Stern Tube Boring in Jeddah Shipyard

Goltens was asked to perform stern tube boring onboard the Mahabbah, a 240,550 DWT Passenger/Ro-Ro vessel, in Jeddah Shipyard in Saudi Arabia to rectify long-term shaft vibration issues. Goltens fabricated the required mounting brackets to mount the line boring tools and bored the three 1.8, 1.4 and 0.75 meter sections over a length of about 18 meters to the required diameters between 460-464mm.

USNS Soderman (T-AKR-317) Propeller Shaft Seal Liner Machining

Goltens was contracted by Boston Ship Repair to conduct in-situ machining of two worn propeller shaft seal liners on the USNS Soderman. Goltens machined and polished the 850mm diameter shafts in-place within maker tolerances for the seals avoiding the incredibly time consuming and expensive requirement to remove the shafts for repairs.

Main Engine and Gear Box Repairs in Chinese Yard

During shipyard period in China, Goltens undertook an extensive scope of work onboard the tanker Golden Ambrosia. All work was completed in a tight schedule of 22 days and included: STBD main engine & gear box overhaul and crankshaft removal, crankshaft inspection and machining, laser alignment and line boring, alignment and chocking of engine, rebuild and commissioning of engine, remetalling of intermediate shaft bearing and journal polishing and laser alingment of stern tube.

CJ-70 Jack Case Fixation System Machining

Over a period of one month, Goltens completed an extensive X-Y-Z milling, Flange Facing and Laser Alignment project at a shipyard in Singapore. Goltens was contracted to support the shipyard in the construction of the CJ-70 Jack Case Fixation System on a new build jack up oil rig at the yard. Goltens milled 8 port and starboard foundations (3.9M x 100mm) and 8 vertical flanges (450mm x 150mm)

An important player in Gulf shipbuilding and repair

Al Fattan Goltens Ship Building and Repair -LLC in Abu Dhabi aims to help cover the growing shipbuilding and repair service needs in the Gulf Cooperation Council. The recently constructed 75-meter landing craft for the United Arab Emirates (UAE) Navy is a perfect example of Al Fattan Goltens' capabilities.

Al Fattan Goltens has been up and running for two years in Al Sadr port in Taweelah, Abu Dhabi, and has a workforce of around 150 skilled people. During this time the yard has completed several refits for the UAE Navy as well as newbuilding projects. The largest of these projects by far is the 75-meter landing craft new building delivered to the Abu Dhabi Naval Foreces in May 2013.

The vessel will be used as a supply/support vessel, and comes complete with a fully operational hospital deck. This deck includes an operating room, burn unit, procedure room, laboratory, sterile room, pharmacy, ward with nine beds and accommodations for all medical staff.

The vessel is also equipped with an elevator from the main deck to helideck for the smooth departure of injured personnel, and has the facility to deliver other equipment and supplies from its six cargo holds with the use of two 8- x 14-meter telescopic cranes.

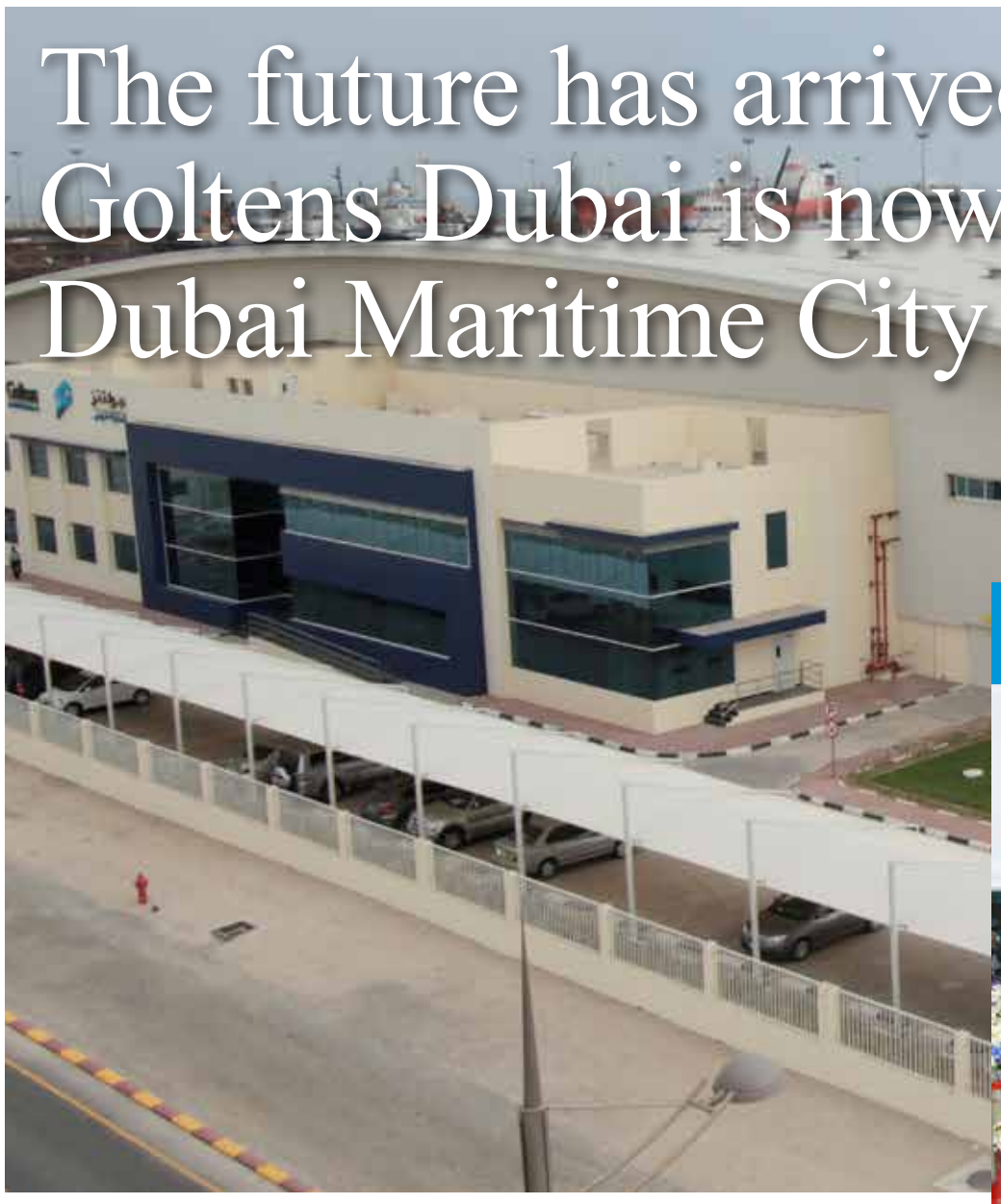
Al Fattan Goltens Joint Venture's main yard has an area of over 300,000 square meters and multiple lengths of berths. The facility and its skilled staff have the capability of delivering complete vessel designs, engineering and manufacturing. This means that Al Fattan can satisfy the needs of marine customers in the areas of newbuilds, conversions and repairs.

With the continuous advancement in computer-based technology, Al Fattan has been able to utilize new software tools to optimize designs, test structures, produce detailed 3D engineering drawings, and accurately predict vessel performance. |||

Afloat barge launch of the Al Shareeah (75 meter Roll on-Roll Off Landing craft)

Bridge control of the Al Shareeah Landing Craft

The future has arrived – Goltens Dubai is now in Dubai Maritime City



Ribbon cutting during Opening Ceremony on 2nd May 2013 by Chairman Dry Docks World and Maritime World Mr Khamis Buamim, Norwegian Ambassador to the UAE Ms Åse Bjerke, one of the Goltens owners Mr Truls Golten, Goltens local sponsor Mr Saeed Kamda and Goltens Worldwide President Mr Paul Friedberg

Goltens Dubai's relocation to Dubai Maritime City (DMC) – one of the world's largest dry docking facilities for offshore service and small cargo vessels – means that the company is now offering its full range of workshop and docking services in a more efficient and responsive manner.

The state-of-the-art, purpose-built facility includes 10,000 square meters of workshops, 1,500 square meters of offices, and around 10,000 square meters of open yard to the rear of the site adjacent to the ship transfer area. Relocation of the business from Al Jadaf to DMC commenced in early March 2013 and was largely completed by the end of April.

AT THE HEART OF THE DOCKING MARKET

"It has been a huge task to relocate 80 staff, 280 workers, 14 workshops and several hundred pieces of equipment a few kilometers down the road while trying to maintain business as usual. This is not the sort of thing one does every day so it was a new experience for all of us," says Goltens Worldwide Services President Paul Friedberg.

"We are delighted with the new facility and the benefits this brings to our business and our customers in the region. It has been enormously satisfying to be given a clean sheet of paper to custom design a facility that greatly enhances our operations and more than meets the needs and desires of our customers going forward. We are now placed at the heart of the docking market in UAE where we can better serve our docking and afloat customers, as well as be closer to Drydocks World – already a major customer and one which we see as key to our future success in the region."

Goltens has already carried out 60 dockings in DMC, and is looking to increase docking activity in the new location to augment its already well-established and respected diesel, mechanical, electrical, reconditioning, and in-situ machining capabilities. The new facility also offers state-of-the-art warehousing for its parts and lubricant trading activities, as well as storage and control of customer assets. |||

Organizational changes strengthen strategic focus

The Goltens Worldwide management organization is undergoing structural changes, with the goal of sustaining recent strategic implementation success in the diesel and in-situ areas and company growth in new and existing markets.

MIDDLE EAST

Tom Boyle has taken the position as Managing Director of Goltens Dubai Services and Vice President Goltens UAE from 1 January 2013. Boyle spent almost six years managing Goltens Singapore and Goltens South East Asia, and was instrumental in developing Goltens' businesses in Vietnam and in the Philippines. He will now focus on developing Goltens UAE from the new facility in Dubai Maritime City.

SOUTH EAST AND FAR EAST ASIA

Sandeep Seth was appointed Vice President Goltens Asia as of 1 October 2012 with operational, financial and business development responsibility for all of the Goltens business units in South East and Far East Asia, including India.

B.C. Chua was promoted to the position of Goltens Singapore Managing Director with effect from 1 October 2012 and reports to Goltens Asia Vice President Sandeep Seth. Chua has worked at Goltens for the last 12 years and for the last three years has served as Goltens Singapore's Sales and Marketing Director.

Michael Madely has been promoted to the position of Goltens China Managing Director – with responsibility for both repair and trading activities – from 1 April 2013. Madely has been responsible for Goltens Vietnam business and operations development after the opening of the new facility at the end of 2009.

Truong Doan Thoai has been promoted to Goltens Vietnam General Manager and will develop this business unit in Vung Tau. Thoai has worked as Goltens Vietnam Operations Manager since the opening of the facility in 2009.

EUROPE AND AMERICAS

Roy Strand was appointed as Vice President Goltens Europe on 1 August 2012 in addition to his current responsibilities as Vice President Goltens Americas. Strand is also the spearhead for coordination and execution of the Goltens group's global in-situ machining strategy.

GOLTENS WORLDWIDE ADVISORY BOARD

Maarten Jeronimus, Managing Director or Goltens Rotterdam BV, has been appointed by the Board of Directors as a member of Goltens Worldwide Advisory Board which is responsible for charting the formulation and execution of the company's global strategy.

"We are confident that this reorganized structure will result in an enhanced focus on quality and customer service, improved operational efficiency and continued worldwide growth and business development," says Paul Friedberg, President Goltens Worldwide Services.