Exhaust Gas Recirculation technique makes marine diesel engine IMO Tier III NOX-compliant.

MAN Diesel & Turbo, together with HHI-EMD, the engine and machinery division of Hyundai Heavy Industries, has presented the first IMO Tier III-compliant diesel engine utilising EGR (Exhaust Gas Recirculation). The presentation of the engine took place at HHI-EMD production facilities in Ulsan, South Korea on 9 October 2012 when a group, representing shipyard and shipowners, was invited to an informal presentation of the new engine type – an MAN B&W 6S80ME-C9 with integrated EGR.

The EGR system represents a milestone in Tier III development that enables the engine to meet IMO Tier III NOx regulations, which will be introduced in ECAs (Emission Controlled Areas) from 2016. The new development means that this strict emissions limit can be met without significantly compromising engine performance. In this respect, MAN Diesel & Turbo’s Søren H. Jensen, Vice President and Head of Research & Development, Marine Low Speed, said: “Testing achieved a low penalty, equivalent to 1-3 g/kWh, which is even better than our most optimistic expectations.”

The EGR system was designed, produced and assembled in close cooperation with HHI-EMD, Alfa Laval, Siemens, GEA and Vestas Aircoil. This close cooperation has ultimately resulted in a reliable prototype engine configuration...
Continued from front page

...that MAN Diesel & Turbo states will form the basis for its future low-speed diesel programme.

Søren H. Jensen further stated: "As a promising spin-off benefit, the engine can also run in a fuel-optimised Tier II mode that facilitates an approximate 4 g/kWh fuel-oil consumption reduction at part load." As such, MAN Diesel & Turbo reports that this makes the engine even more efficient than today's high-efficiency Tier II engines during transoceanic operation. This favourable result was accomplished through a combination of sequential turbocharging, turbocharger cut-out and low EGR rates.

The engine will be installed in a Maersk Line C-class container vessel, currently under construction at Hyundai’s shipyard. The ship is due for delivery in the first quarter of 2013 and is bound for service between South East Asia and West Africa. The A.P. Moller – Maersk Group and MAN Diesel & Turbo have agreed to operate the engine 20% of the time in IMO Tier III mode, and to otherwise favour the fuel-optimised Tier II mode with low EGR rate. MAN Diesel & Turbo intends to follow the engine’s performance closely over the next three years in order to gain service experience and further increase the EGR system’s reliability for future engines.

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ME-GI Orders Kickstart New Era of Propulsion

Continued from front page

“...very attractive to our customers.”

Furthermore, the Teekay engines are based on the new ultra-long-stroke G-type concept to deliver an even higher overall propulsion plant efficiency. Previously, the G-type engine has gained the fastest market acceptance of any engine in the MAN B&W portfolio.

The ships will be constructed by Daewoo Shipbuilding & Marine Engineering Co., Ltd. (DSME) of South Korea. Teekay LNG Partners L.P. intends to secure long-term contract employment for both of the vessels on a voyage basis. LNG carriers prior to their delivery in the first half of 2016.

Ole Grane, Senior Vice President Low Speed Sales and Promotions, MAN Diesel & Turbo, said: “Our experience with two-stroke, dual-fuel engines stretches back to the 1990s. With the current developments in fuel prices and multiple customer requests for a solution, the momentum towards the development of a commercial, low-speed dual-fuel engine became unstoppable. We see these orders as a natural culmination, and see the ME-GI as the beginning of a significant new era.”

Hyundai

The new orders have been placed since Hyundai revealed the first, commercial MAN B&W ME-GI engine at a large customer event in Korea on 9 November 2012. The ME-GI is a gas-injection, dual-fuel, low-speed diesel engine that, when acting as main propulsion in LNG carriers or any other type of merchant marine vessel, can burn gaseous fuel (methane, natural gas) with a minimal amount of pilot oil for ignition. The engine subsequently passed its Type Approval Test at the end of November.

The ME-GI engine

Originally unveiled at a major event at MAN Diesel & Turbo’s Copenhagen Diesel Research Centre in May 2011, the ME-GI engine represents the culmination of many years’ work that began in the 1990s with the company’s prototype MC-GI dual-fuel engine that entered service at a power plant in Chiba, near Tokyo, Japan in 1994.

Depending on relative price and availability, as well as environmental considerations, the ME-GI engine gives shipowners and operators the option of using either HFO or gas – predominantly natural gas but also, eventually, LPG.

Furthermore, the ME-GI engine represents a highly efficient, flexible, propulsion-plant solution that is retrofittable for all existing ME engines.

About TOTE

TOTE Inc. is one of the United States leading marine transportation companies. TOTE Inc.’s marine subsidiaries include the well-known TOTE: Shipholding Inc., Totem Ocean Trailer Express and Sea Star Line, which provide regular marine transportation for general cargo between the continental United States and Alaska and Puerto Rico. TOTE Inc. is a wholly-owned subsidiary of Saltchuk Resources, Inc., a family owned, Seattle, Washington-based holding company of freight transportation and petroleum distribution companies.

About Teekay

Teekay LNG Partners L.P. is a publicly-traded master limited partnership formed by Teekay Corporation – the US aerospace and defense company – NASSCO has designed and built ships in San Diego’s industrial corridor since 1963 and has locations on both the U.S. west and east coasts. The company specializes in the design, construction and repair of auxiliary and support ships for the U.S. Navy, as well as oil tankers and dry cargo carriers for commercial markets.

Greek Shipowner Sees the Advantage of Employing Fuel-Sharing Mode

LNG carriers employing 51/60DF engines are first reference in important segment

MAN Diesel & Turbo has won the contract to supply the engines for two Greek LNG carriers (LNGCs). The installation of the MAN 51/60DF dual-fuel engines aboard the newbuildings represents an important first such reference in this segment.

The new order covers 2 × 9L51/60DF + 2 × 8L51/60DF engines, a total of 34 MW installed power per vessel. Each engine is IMO Tier II compliant in diesel mode with lower exhaust-gas emissions in gas mode than IMO Tier III stipulates – fuel-sharing mode will be applied to each unit.

Greek customer

The customer is Athens-based Alphagas Tankers and Freighters Inter- national Ltd. Both newbuildings will be built at MAN Diesel & Turbo’s Augsburg plant in Germany.

Fuel-sharing mode

The order is the first LNGC newbuilding globally with fuel-sharing capability. The company’s LNG sales team, based in Augsburg, Germany, has promoted this special feature since 2009 with a special focus on LNG carrier applications. To optimise the carriers’ fuel flexibility in fuel-sharing mode, the dual-fuel engines are capable of burning both gaseous and liquid fuels simultaneously. This will prove especially beneficial during ballast voyages where the volume of generated, natural boil-off gas is significantly lower than on a laden voyage.
DieselFacts received an exclusive tour around the massive ship from Lars Blicher, General Manager & Director of Danish company Swire Blue Ocean A/S.

Swire Blue Ocean provides services to the offshore wind industry and its newest vessel, the state-of-the-art Pacific Orca, was christened in October in Copenhagen. Built in Korea by Samsung over 1½ years, the 8 x MAN 9L27/38 GenSets for diesel-electric propulsion were built by Doosan. The subsequent trip from Korea to Denmark took 80 days.

Pacific Orca is the world’s most modern WIV with an overall length of 160.9 m, a breadth of 49.0 m, and a speed of 13.0 knots. The ship is designed to transport up to 12 x 3.6 MW disassembled offshore windmills and its main crane has a maximal capacity of 1,200 tons.

Lars Blicher told DieselFacts: “The engines are hugely important as we have to be able to rely on them. They are diesel-electrics so, if any fail, we have others to take over. We opted to put identical engines in the ship to make life easier when it comes to spare parts and maintenance.”

He continued: “There is a lot of redundancy in the engines and, in our experience, MAN engines are very reliable and easy to work with. We are delighted to have MAN engines on board our vessel.”

Blicher also said: “It is a 3rd generation ship for the wind turbine industry, but also works in the oil and gas sector where we have to decommission platforms in the North Sea. Our unique selling point is the large weather window we have. The crane can work in up to 20-metre-per-second winds and the ship can manoeuvre in 2.5-metre waves. This means that, when other vessels have to give up, we can sail out to the site and be ready. So we are much more efficient.”

Safety is enhanced through a 6-leg design that allows the vessel to remain stable in the event of a leg penetrating the seabed during operations. With a large cargo area and high capacity deck loading, the vessel offers great flexibility in the carriage and installation of wind turbines and foundations of all types and sizes.

Pacific Orca has an operations crew of 25-30, but the ship can accommodate up to 111 persons on board, each with an individual cabin and en suite facilities. The unique vessel is propelled using four 3.4 MW azimuth stern thrusters. It has no rudder but is instead equipped with two bow thrusters and two bow-tunnel thrusters, each providing 2.2 MW in power, that give the ship a unique manoeuvrability.

Swire Blue Ocean
With a long history of successful marine and engineering operations and a strong focus on the environment, Swire Blue Ocean provides premium level services to the offshore wind industry. Its innovative vessels, combined with a long-standing reputation as a provider of high quality, reliable and safe offshore support services, efficiently installs offshore wind turbines.

Download the DieselFacts App on your tablet and get access to extra Pacific Orca material including video and many more photos.
US Oil Major Places Order for Ultra-Efficient Tier III-Compliant Engines

Chevron Corporation orders G-type units with integrated exhaust gas recirculation

G-type engines with integrated EGR system offer both high efficiency and low NOx emissions.

MAN Diesel & Turbo has received an order from Chevron Corporation, the American multinational energy company, for two lighter新building newbuildings with each vessel to be powered by an MAN B&W 6G70ME-C9.2 prime mover. The newbuildings will each use an MAN Diesel & Turbo EGR (Exhaust Gas Recirculation) system to help their ME-C prime movers meet Tier III emission standards well in advance of requirements coming into effect. The engines will also retain the ability to switch to Tier II operation when outside the ECA (Environmental Control Area).

MAN Diesel & Turbo states that the engine for the first vessel has a delivery date in December 2012, with the second due in early 2014 and the vessels due for delivery in 2014. Chevron has also ordered 1 x MAN 8L27/38 + 2 x MAN 7L25/31 gensets for each vessel. Doosan Engine will construct both gensets and G-type engines at its works in Korea.

Exhaust gas reduction

Generally, ships use HFO as fuel, which contains sulphur and forms NOx and SOx during combustion. Generally, ships use HFO as fuel, which contains sulphur and forms NOx and SOx during combustion. Exhaust gas reduction works in Korea.

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Investigation of Ice Classed Ships

A new paper by Birger Jacobsen, Senior Two-Stroke Research Engineer

Ice Classes and Requirements

Ships with an ice class have a strengthened hull to enable them to navigate through sea ice. Depending on the class, sea chests, i.e. the openings in the hull for seawater intake, have to be properly arranged in order to avoid blocking up with ice. Most of the stronger classes require several forms of rudder and propeller protection, and strengthened propeller tips are often required. Different ice classes and types exist depending on the classification societies, but the ice class most often referred to is the Finnish-Swedish ice class:

<table>
<thead>
<tr>
<th>Ice class</th>
<th>Ice thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A Super</td>
<td>1.0 m and a 0.1 m thick consolidated layer of ice</td>
</tr>
<tr>
<td>1A</td>
<td>1.0 m</td>
</tr>
<tr>
<td>1B</td>
<td>0.8 m</td>
</tr>
<tr>
<td>1C</td>
<td>0.6 m</td>
</tr>
</tbody>
</table>

Temperature Restrictions and Load-Up Procedures of MAN B&W Two-Stroke Engine

In order to protect the engine against cold corrosion attacks on the cylinder liners, some minimum temperature restrictions and load-up procedures have to be considered before starting the engine.

Recommended start of engine at normal very low engine load operation

Fixed pitch propellers

Normally, a minimum engine jacket water temperature of 50°C is recommended before the engine may be started and run up gradually up to 50%, and then slowly from 50% to 75% of specified MCR load (SMCR power) over 30 minutes.

For running-up between 75% and 100% of SMCR power, it is recommended that the load be increased slowly over a period of 60 minutes.

Recommended start of engine at normal very low engine load operation

For engines running most of the time at 10% to 40% engine load, an extra slow load-up procedure is recommended compared with the load-up procedures described above.

Preheating during stand-by periods

During short stays in ports (i.e. less than 4-5 days), it is recommended to keep the engine preheated with the purpose being to prevent temperature variations in the engine structure and corresponding variations in thermal expansions, and thus the risk of leakages.

A standard preheater system with a built-in preheater is shown in Fig. 2.

Design Recommendations of MAN B&W Two-stroke Main Engine for Operation at Extremely Low Air Temperature

When a standard ambient temperature matched main engine on a ship operates under arctic conditions with low turbocharger air intake temperatures, the density of the air will be too high. As a result, the scavenging pressure and the compression pressure, and the maximum firing pressure will be too high.

In order to prevent such excessive pressures under low ambient air temperature conditions, the turbocharger air inlet temperature should be kept as low as possible. Furthermore, the scavenging air coolant (cooling water) temperature should be kept as low as possible and the engine power in service should be reduced.

Main precautions for extremely low air temperature operation, arctic exhaust gas bypass

With a load-dependent arctic exhaust gas bypass system (standard MAN Diesel & Turbo recommended for extreme low air temperature operation), as shown in Fig. 2, part of the exhaust gas bypasses the turbocharger turbine, giving less energy to the compressor, thus reducing the air supply and scavenging air pressure to the engine.

Ships with ice class notation

For ships with the Finnish-Swedish ice class notation 1C, 1B, 1A and even 1A super or similar, most MAN B&W two-stroke diesel engines meet the ice class demands, i.e. there will normally be no changes to the main engines. This again means that the standard thrust bearings for most of the MAN B&W two-stroke engines are sufficient.

The Extended Main Engine Load Diagram

A controllable pitch propeller (CP propeller) may, with advantage, be applied for high ice classed ships. However, because of the high efficiency and simplicity, a fixed pitch propeller (FP propeller) may often be preferred for low ice classes.

When a ship with fixed pitch propeller is operating in normal sea service, it will in general be operating around the design propeller curve 6, as shown in the standard load diagram in Fig. 3.

FP propeller and no ice ramming

For ships with special operating conditions, like occasionally operating in thick ice, it would be an advantage during normal operation conditions to be able to operate the propeller/main engine as much as possible close to line 6, but in ice situations with heavy running propeller inside the torque/speed limit, line 4.

For ships occasionally operating in heavy ice, the increase of the operating speed range between line 6 and line 4 of the standard load diagram may be carried out as shown in Fig. 4 for the extended load diagram for speed derated engine with increased light running.

CP propeller and ice ramming

When a ship with CP propeller is operating under ice ramming conditions, the running point on the combinatorial curve of the CP propeller (could be on line 6) will suddenly change because of the ice ramming and move to the left in the load diagram. The reason is that there is some reaction time in

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Fig. 1: Preheating of jacket cooling water system

Fig. 2: Standard load dependent low ambient air temperature arctic exhaust gas bypass system

Fig. 3: Standard MAN B&W two-stroke engine load diagram

---
changing the CP propeller pitch. For such running conditions, the extended load diagram shown in Fig. 4 may also be useful for the main engine operation.

Ice Class Demands for Propeller Type and Main Engine Power Output

Propulsion advantages with CP propeller

Normally, and also valid for low ice classes, FP propellers are installed in merchant ships because of their simplicity and high efficiency. The propellers are cast in one block, and therefore the position of the blades, and hence the propeller pitch, is once and for all fixed with a given pitch that cannot be changed in operation. This means that when operating in, for example, heavy weather and ice, the propeller performance curve will be very heavy reduced speed for same power. Compared to the FP propeller, for the CP propeller, the position of the blades, and thereby the propeller pitch, can be controlled to avoid heavy running and overload of the main engine. Therefore, CP propellers can, with advantage, be applied both for moderate ice classes as well as for very strong ice classes.

Required minimum propulsion power output

When sailing in ice with a bulk carrier or a tanker, the ship has to be ice classed for the given operating need of trading in coastal states with seasonal or year round ice-covered sea. Besides the safety of the hull structure under operation in ice, the minimum required propulsion power for breaking the ice has to be met. Existing ships with conventional main engines

Based on the average bulk carriers and tankers before 2007, the minimum power demand, according to theformula of the Finnish-Swedish ice classed ships, class 1A Super, 1A, 1B and 1C, has been estimated, see Fig. 5. In general, the lowest ice classes, 1B and 1C can – powerwise – almost always be met.

Future ships with modern main engines

In the Finnish-Swedish ice class formula, the needed installed propulsion power is inversely proportional to the propeller diameter, i.e. the larger the propeller is, the lower the needed power will be. Modern ships of the future may be installed with a highly efficient propeller, i.e. with a 10-12% larger propeller diameter. This means a lower optimum propeller speed, and an ultra-long-stroke MAN B&W two-stroke main engine of the G-type to be installed, involving an about 5-8% higher total efficiency.

Low Load Operation and Servo-ice Optimisation of MAN B&W Two-stroke Main Engines

An ice classed ship with high ice class has a relatively high demand to the SMCR power (max. power) caused by the extra power margin needed for sailing in ice. However, most of the time, the ship will normally be operating in ice-free areas involving that the main engine in normal sea service may operate at low load. Therefore, in such cases a low load optimisation of the main engine might be a good idea.

Fuel consumption and optimisation possibilities

NOx regulations place a limit on the SFOC on two-stroke engines. In general, NOx emissions will increase if SFOC is decreased and vice versa. In the standard configuration, the engines are optimised close to the IMO NOx limit, and, therefore, NOx emissions may not be further increased. The IMO NOx limit is given as a weighted average of the NOx emission at 25, 50, 75 and 100% load. This relationship can be utilised to tilt the SFOC profile over the load range. This means that SFOC can be reduced at part load or load at the expense of a higher SFOC in the high load range without exceeding the IMO NOx limit.

Only high-load optimisation is available for engines with conventional efficiency turbochargers (66% instead of 67%) and non-adjustable maximum firing pressure at part load (MC engines without VIT). Optimisation of SFOC in the part-load (50-85%) or low-load (25-70%) range requires the application of a tuning method. Furthermore, a turbocharger cut-out method is available for SFOC reduction at part low load operation.

Propulsion Systems Applied and Example

Ice classes without ramming

For ice classed ships anticipated to be without ice ramming, the standard diesel-mechanical propulsion systems for merchant ships can be applied, i.e. with Controllable Pitch propeller (CP propeller) or with Fixed Pitch propeller (FP propeller) directly coupled to an MAN B&W two-stroke main engine, see Fig. 6 and Example

Ice classes with ramming

The ramming on ice may involve occasional high torque on the propulsion system and, therefore, the diesel-electric system with CP propeller may often be preferred, as the electric motor is suitable for high torque deviations, see Fig. 7. However, such a propulsion system has a lower efficiency (11-12%) compared with a propulsion system with CP propeller directly coupled to an MAN B&W two-stroke engine. Therefore, as the major time in ship operation is often in normal sea service without ice, alternative to the conventional diesel-electric propulsion system might be preferred.

This is a heavily abridged version of a much more detailed paper with the same title and is available from MAN Diesel & Turbo upon request.

Download the DieselFacts App on your tablet and get access to video interview with the author of the paper. 
Order Book Reflects Growing Interest

Ultra-long-stroke G-type engine series with unprecedented high efficiency continues to attract market attention

MAN Diesel & Turbo has released the largest such facilities in the People's Republic of China.

The six MAN B&W G70ME-C9.2 engines are all destined for 186,300 dwt Capesize bulk carriers and will be manufactured by CSSC-MES Diesel Co. Ltd. (CMD), the Chinese engine manufacturer. The first of the six engines is scheduled for delivery in December 2013 with the remaining five due in 2014. The vessels will all be built at Shanghai Waigaoqiao Shipyard (SWS), one of the largest such facilities in China.

Comparison

MAN Diesel & Turbo has released figures comparing the performances of a G70ME-C9.2 type and a 6G70ME-C8.2 type aboard a Capesize bulk carrier – the latter engine represents a traditional choice for such a vessel. Results show that the G-type engine makes a significant 6.5% saving in comparison to the S-engine, of which 4.5% stemmed from the improved propeller efficiency – which is a consequence of the lower rpm and 2.0% from the actual engine. The table below contrasts the most important values for the S- and G-type engines.

The G-type programme MAN Diesel & Turbo’s G-type programme entered the market in October 2010 with the entry of the G60ME-C9 model. MAN Diesel & Turbo subsequently expanded the ultra-long-stroke programme in May 2011 with the addition of G70ME-C9, G80ME-C9, G60ME-B9, G45ME-B9 and G40ME-B9 models. The G-types have designs that follow the principles of the large-bore, Mark 9 engine series that MAN Diesel & Turbo introduced in 2006. Their longer stroke reduces engine speed, thereby paving the way for ship designs with unprecedented high efficiency.

G-type background

Tankers and bulk carriers have traditionally used MAN B&W S-type engines with their long stroke and low engine speed as prime movers, while larger container vessels have tended to use the shorter-stroke K-type with its higher engine speed. Larger container vessels, in recent years, have also been specified with S800ME-C9 and S900ME-C8 engines because of the opportunity they offer to employ larger propeller diameters. Following efficiency optimisation trends in the market, MAN Diesel & Turbo has also thoroughly evaluated the possibility of using even larger propellers and thereby engines with even lower speeds for the propulsion of tankers and bulk carriers.

Such vessels may be more compatible with propellers with larger diameters than current designs, and facilitate higher efficiencies following adaptation of the aft-hull design to accommodate a larger propeller. It is estimated that such new designs offer potential fuel-consumption savings of some 4-7%, and a similar reduction in CO2 emissions. Simultaneously, the engine itself can achieve a high thermodynamic efficiency using the latest engine process parameters and design features.

Gas Turbine Deal for Brazilian Offshore Platforms

South American hub clinches significant contract extension with Petrobras Brasiliero energy group.

MAN Diesel & Turbo SE, the leading international manufacturer of large-bore diesel engines and turbomachinery, has concluded a long-term service agreement with the Brazilian energy group Petrobras Brasiliero (Petrobras) for the maintenance, repair and operational support of 20 MAN THM gas turbine trains on four offshore platforms in the crude oil and natural gas exploration area off the north-east coast of Rio de Janeiro. The agreement spans five years and is the second extension of this service contract, which was originally signed in 2002. The value of the agreement is 150 million euro.

The gas turbines drive ten gas compressors and ten generators on the Petrobras platforms Cheme 1 and 2, Garopua and Pampo situated 150 kilometres off the Brazilian coast in the Campos Basin, where around 80 per cent of Brazil’s crude oil and natural gas production are located. The service agreement includes technical support for the operation of systems, regular maintenance work, any repairs that are required as well as spare parts and their logistics. Besides the core components turbine, compressor and generator, the contract also covers all auxiliary equipment as well as the control system.

The service from MAN Diesel & Turbo meets the particular requirements of the oil and gas business: round-the-clock availability 365 days a year, rapid response times to maintain operations and compliance with exacting safety and environmental requirements. “The further extension of the service agreement confirms our excellent collaboration with Petrobras and represents a key reference on the Brazilian oil and gas market,” says Dr. René Umlauf, CEO of MAN Diesel & Turbo. “We are absolutely delighted to be a highly trusted partner of many years’ standing to Petrobras.”

MAN Diesel & Turbo operates over 100 service stations worldwide under the MAN PrimeServ brand, including stations in the Brazilian cities of Rio de Janeiro, Manaus, Macae, Petrópolis and Salvador.
MAN Diesel & Turbo’s PrimeServ division in Frederikshavn has, in close cooperation with shipowner and constructional engineering company NCC, performed a propulsion equipment upgrade for the ‘M/V Baltic’ – a 900 m³ sand and gravel dredger.

In connection with a fleet energy-optimising project, NCC contacted MAN PrimeServ at the beginning of 2012 with an enquiry regarding upgrade possibilities for an existing vessel’s propeller and nozzle. NCC has a fleet of five ships and was, as a starting point, interested in the upgrade of the Baltic. The vessel, which was built in 1983, had – during many years of operation – suffered from propeller and aft-ship vibrations resulting in high noise levels in the accommodation. Eventually, the nozzle broke loose from the hull.

In January 2012, the PrimeServ retrofit department in Frederikshavn entered a dialogue with NCC Chief Superintendent, John Jeppesen, on the design of new propeller blades and a new, customised propeller nozzle – with the priority being increased propulsion efficiency and fuel savings. The propeller-blade design chosen was a medium-skew blade profile for ducted operation with an MAN Alpha AHT nozzle – customised with a length/diameter ratio of 0.5. The new nozzle and blades were installed in April 2012 while the vessel was docked at Svendborg Shipyard, Denmark.

The ship has been in operation with the new propulsion equipment since April and the feedback from the Chief Engineer and the operational crew clearly indicates a much improved performance. Chief Superintendent Jeppesen confirms: “The measured fuel consumption reduction is 14% and the noise level in the accommodation is reduced by 10 dB together with an effective reduction of vibrations. Also, the ship’s manoeuvrability in harbours has been improved.”

The financial aspect of the project has also proved very attractive for NCC with an estimated payback time of just 1½ years.

The MAN Alpha propeller and aft-ship portfolio

MAN Alpha propellers cover a power range from 4 to 40 MW with fixed pitch and controllable pitch propellers in four and five-bladed executions. The propellers are designed and optimised for a vast number of vessels of different design and applications, from cargo vessels, ferries, cruise ships, offshore vessels, tugs and work boats to fishery and navy vessels. Previous examples of high-end MAN Alpha propeller installations include some of the world’s largest dredgers – Cristobal Colon and Leiv Eiriksson, both 46,000 m³ and with the dredging capacity to a water depth of 150 m – operated by Jan de Nul. Another notable reference is the world’s largest RoPax ferry – the 78,300 bhp ‘M/F Tanit’ – recently started in service for CTN between Marseille and Tunis. To date, the MAN Alpha brand has produced more than 7,000 propellers since the first Alpha CP Propeller design was supplied in 1902 and patented in 1903. MAN Diesel & Turbo deploys the latest advanced design tools, including Computational Fluid Dynamics, Finite Element Methods and Topology Optimisation in the development of its propellers and cooperates with the world’s leading test tanks and research institutes to verify results.

About NCC

One of the leading construction and property development companies in the Nordic region, NCC develops and builds residential and commercial properties, industrial facilities and public buildings, roads, civil engineering structures and other types of infrastructure. NCC also offers input materials used in construction, such as aggregates and asphalt, and provides paving and road services. The NCC Group had sales of SEK 53 billion in 2011, and has approximately 17,500 employees. The group’s shipping company has a fleet of five sand and gravel dredgers, with loading capacities ranging from 340 m³ to 1,350 m³. Three of the vessels are ISM and ISPS certified. Collectively, the NCC fleet dredges some two million tonnes of raw material annually.

NCC Chief Superintendent, John Jeppesen

The M/V Baltic pictured in drydock during the propeller blade and nozzle upgrade job in Svendborg
Reintroducing the 32/44K Engine

A.2 version features conventional injection system to optimise GenSet application

MAN introduced the first 32-bore (32/40) engine in 1997 with over 1,588 such GenSets produced thus far. Most of these are 6- and 7-cylinder engines representing power outputs of 2,880 to 3,500 kW.

The original cylinder output has risen from 440 to 500 kW, while the current version meets IMO Tier II regulations. Thermodynamic calculations show that an increase of the stroke and firing pressure promises a higher output at lower specific fuel consumption.

The first improved engine was introduced in 2007 as a 32/44CR A.1, configured with a common rail injection system. To get a GenSet-optimised engine, MAN Diesel & Turbo is introducing the 32/44K A.2 engine with a conventional injection system. The Factory Acceptance Test of the first, licensee-built, serial engine is expected during 2013.

Optimisation of the GenSet Application

The 32/44K A.2’s engine structure and GenSet components are based on the reliable and robust design of the 32/40CD. The turbocharger matching as well as the valve timing at part load is optimised for low specific fuel consumption, Fig. 2. This results in remarkable fuel savings in the range from 40% to 75% MCR.

One of the mean key performance indicators for optimised GenSets is a high capability for dynamic load response. The 32/44K A.2 engine shows a reasonable faster dynamic load response by optimised rotor inertia and higher speed of the turbocharger at part load. The well-known GenSet design with a common base frame enables an easy installation of the whole GenSet. Due to its similarity with 32/40 GenSets’ major dimensions and connecting points, it is easy to adapt the 32/44K A.2 to engine room designs made for 32/40 GenSets.

Features

Variable valve timing

The new 32/44K engine is able to operate with different valve timings. The switching of the valve timing takes place automatically at a certain load point defined in the engine control system.

Variable injection timing

The injection timing enables the adjustment of a higher firing pressure at part load, which results in a lower fuel consumption. Simply, in order to get acceptable operating data such as firing pressure and exhaust gas temperature at full load, the injection time is adjusted accordingly.

Bore/stroke 320/440 mm

The stroke of 32/44K is enlarged by 40 mm in order to achieve a perfect combustion-chamber shape at TDC. There is also the possibility of realising a higher compression ratio of 17:1 in order to keep the distance between the piston crown and cylinder head, which has a direct effect on the specific fuel oil consumption.

Fig. 2: Calculated specific fuel consumption – 32/44 K A.2 vs 32/40CD

Fig. 1: The 6L32/44K GenSet. The “K” suffix signifies the “conventional” injection system
**Firing pressure 230 bar**

The 32/44K is reinforced at several points in order to achieve an increased firing pressure of 230 bar. Especially the crank drive is improved. The piston skirt is made of forged steel. Thanks to the high firing pressure, it was possible to increase the specific output, although the engine has this low specific fuel consumption.

**Waste gate**

The 32/44K A.2 engine is equipped with a waste gate that opens only above 90% load. Hence the engine can be operated with higher charge air pressure at part load. This improves engine efficiency and ensures low soot emission at part load.

**TCR turbocharger**

Miller timing requires a good TC efficiency at a high TC pressure ratio. This is fulfilled with the new TCR for the 32/44K where the actual compressor ratio is 4.8 bar. The turbocharger is a completely new design, see Fig. 3, and offers a remarkably high pressure ratio at full load and maintains the good performance at part load, see Fig. 4.

**Automation**

MAN Diesel & Turbo’s own, well-proven SaCoSone product family was adapted for the 32/44 engine and the 32/44 automation system consists of a control unit, a local operating panel and an auxiliary cabinet. The new variable valve timing (VVT) system is controlled by the auxiliary cabinet.

**Relation to the 32/40 and New Parts**

Apart from piping and cabling, approximately 70% of the engine parts are similar to the well-known 32/40 engine. As with the 32/40, the new 32/44K engine has two camshafts: one for the injection timing and one for the valve timing. The cylinder head and the crankcase are also nearly identical. The footprint is identical to the one of the 32/40 engine.

Completely new, but proven on the 32/44CR engine are:
- Turbocharger unit
- Power train
- Variable valve timing
- SaCoSone
- Variable injection timing
- The fuel pumps.

**GenSet Design**

The GenSet equipped with 32/44K A.2 will have the same width as with the 32/40 engine. The length will increase slightly due to the higher power output (estimation ~300 mm). The design with engine and alternator assembled rigidly on a common bed frame, allows quick and easy assembly times. The GenSet is mounted resiliently on the ship, there are only minor requirements to the foundation at the ship. This enables a higher flexibility of the position on board.

**Future Prospects**

The next version of the 32/40K engine will be an adaption to propulsion operation for FPP and CPP. This will be the ideal engine for small ships operating often on Chinese rivers. This engine is open for all new developments regarding the TCR product line.

This is an extract from a lengthier technical paper and is freely available from MAN Diesel & Turbo upon request.
On July 18th, 2012 MAN Diesel & Turbo Operations Pakistan Ltd. completed a 10th successive 18,000-hour engine maintenance at Atlas Power Ltd. Pakistan.

The maintenance work began in September 2011 with the first engine and proceeded in accordance with the Government of Pakistan dispatch programme, which allowed just one engine to be out of commission per month during the planned, 11 month maintenance period.

Extensive planning and preparation was required to perform the 18,000 hour maintenance activities for eleven MAN 18V48/60 engines to the highest level of quality while, simultaneously, minimising the service outage time to maximise plant availability and power generation sales for Atlas Power. On average, each engine’s maintenance could be completed in fourteen offline days – comfortably within the time permitted for the planned service.

A maintenance crew of sixteen mechanical and electrical engineers, mechanics, and cleaners worked in two shifts during the fourteen-day period to ensure the genset and associated auxiliary system were returned to service in accordance with the planned outage window.

One of the major risk factors during such time-compressed service was the quality of the work, especially that on the cylinder heads. This was mitigated by making available a full set of cylinder heads and implementing a philosophy of ‘replace then refurbish’ when cycling the parts through each successive engine maintenance. Refurbishment could be conducted and completed in a less stressful environment once the engine returned to operation.

Each serviced engine underwent major maintenance on all piston rings, honing of liners, overhaul of the complete cylinder heads, inspections and cleaning of vital engine components and a full turbocharger service. In addition to the engine maintenance work, the generator and major auxiliary equipment such as the exhaust gas boiler, LO coolers, separator and radiator coolers were all serviced within the same permitted engine outage time.

It was planned to execute the 18,000 running hour service of the eleventh unit during the final three months of 2012, assuming in the meantime that the genset had been processed as forecast.

About PrimeServ O&M

In 2009 MAN Power Management was awarded a ten years operations and maintenance contract for the 225 MW diesel-fired Atlas Power Ltd. power plant, located near Lahore, Pakistan. The power plant built by MAN Diesel & Turbo went into service in 2009 and consists of eleven MAN 18V48/60B engines and one steam turbine utilising the waste heat of the engine exhaust gases. MAN Power Management was integrated into MAN’s after sales-division – MAN PrimeServ – in May 2012.

Scenes from the Atlas Power maintenance project including a site view and a photograph of the engine hall that features eleven MAN 18V48/60 engines.