PTI SYSTEM FOR SLOW SPEED 2-STROKE MAIN ENGINES WITHOUT GEARBOX

BACKGROUND
Cargo owners, charterers and the public more and more focus on safety, including the safe operation of the main propulsion. A main propulsion failure may cause catastrophic costs with salvage and disastrous environment consequences.

The installation of emergency propulsion in a ship fitted with a slow running diesel main engine is a complex issue. This is due to the high power, the high torque and low RPM, both in normal and emergency mode. Realizing that slow speed diesel engines propel the majority of the world’s tonnage the new and innovative method of emergency propulsion developed represents a significant step in decreasing the risk of pollution catastrophes, salvage operations etc. Faced with the requirement of emergency propulsion for a series of Panamax LR1 Ice 1A tankers the need for innovation was imminent as there was no other commercial solution available. Marinvest Engineering decided to go for an in-house solution.

THE RESULT
Today four Panamax tankers have been fitted with Disconnector and hydraulic PTI drive in the years 2006-2008, The power used, is 2300 kW per ship. A speed of 10 knots has been achieved repeatedly. The hydraulic power is taken from the power pack already provided for cargo handling. Estimates show full manoeuvrability in winds of 17 m/s and wave height 3,5 m for a Panamax tanker with a 2400 kW emergency power input.

The Marinvest Emergency Propulsion System works with both electrical or hydraulic power and for all sizes of shaft diameters. The Disconnector is class approved (DNV) as part of the shafting.
The Advantages are:

- Eliminates the need to install twin main engines for the purpose of increasing operational safety – a major cost reduction.
- Improves safety as a “Take me home” device in case of a main engine breakdown.
- Much lower risk for environmental damages.
- Allows for main engine maintenance while at a tanker terminal
- Insurance cost reductions due to less risk in general and less risk of a salvage situation.

THE DESIGN

The system basically consists of two parts. A Disconnector. The generation and transmission of the emergency power itself is ship specific, depending on auxiliary systems etc. One particular solution is described in more detail.

DISCONNECTOR

The Disconnector is the heart of the system. It is a cylindrical unit of relatively small size: a diameter of approximately double the shaft diameter and a length approximately three times the shaft diameter. It is part of the shafting system and does not require any ship foundation. The disconnector is shown in the picture and schematic drawing below.

One end has a flange connection (# 1 in the drawing) to the intermediate shaft flange. This flange connection has an axial play of 4-5 mm. The flange bolts (# 2) serve only to provide an axial force across the flanges and have no part in the transmission of shaft torque. The bolts therefore have a radial play in the flange, allowing them to be removed by hand as soon as the bolt tension has been released. This is an important time saving feature as compared with fitted bolts The bolts are tensioned by means of a conventional hydraulic nut system, common to all the bolts for quick release.
Between the flanges is a set of radial dowels (#3), recessed into each of the mating flanges to nearly 50% of their diameter. In normal operation and with tensioned flange bolts the dowels will absorb the shaft torque in shear. The dowels are easily removed when the bolt tension has been relieved. When the dowels and the flange bolts have been removed the mating flanges and shafts are free to rotate relative each other.

The intermediate shaft protrudes into the disconnector at a reduced diameter and has a disc bolted to its end face. On each side of the disc is fitted a spherical bearing (#4), sized to absorb the propeller thrust, in the forward and aft directions.

**EMERGENCY POWER INPUT (PTI)**

The propulsive power may, depending on available auxiliary power on board, be electrical or hydraulic. If hydraulic power can be made available separately or from other installations on board, such as with ships having large side thrusters or a hydraulic cargo pumping system it is natural to use hydraulic drive for the emergency propulsion. In the following is described such the system as installed in the Marinvest Class Panamax tankers:

Available hydraulic power is 2600 kW, delivered at 270 bar from the cargo pumping system. It was found that application of high torque/low-RPM hydraulic motors was the attractive technical/economical solution as compared with low torque/high-RPM hydraulic motors with gear. Emergency drive was selected at 63 RPM with a 1:1 drive from four high torque hydraulic motors to the shafting. Trials have demonstrated a speed of above 10 knots under emergency power only.

Aft of the disconnector there is a drum with four sprocket wheels. A quadruple chain drive transfers the hydraulic motor torques to the intermediate shaft. In normal ship’s service the sprocket drum is resting in a cradle. There is a flange on the intermediate shaft provided with banana shaped bolt holes. A flange on the sprocket drum therefore can be bolted to the intermediate shaft in any angular position. The torque from the sprocket drum will be transmitted to the shaft by means of friction flange contact.
The picture and drawing above shows the physical arrangement on board the vessel. There is a manoeuvring stand close to the hydraulic motors. The hydraulic valves are servo operated and governed from a computer with local input as well as input from the bridge. The operation of the hydraulic system is straightforward with built in ramps for controlled start and stop of the system.

An electric drive may be built similar to the hydraulic drive described above. Depending on power and RPM the torque may be transferred by means of chains, ribbed belts, a gear or even friction to a wheel on the intermediate shaft.

The Disconnector is Class approved (DNV) as part of the shafting. The ship-specific emergency power input is in the Class approval process.

THE DELIVERY
Marinvest Engineering delivers a turnkey solution from engineering, construction to commissioning and training.

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