Technical implications for machinery and systems operating on low sulphur fuels.

Executive Summary

The objective of the task was to assess technical and operational constrains in application of low sulphur fuels.

Based on diesel engine design, theory of tribology and service experience the possibilities of applying multiple fuel and/or lube oil systems have been evaluated.

As demonstrated in theory by the tribology of cylinder lubrication, and also supported by service experience, it is important to maintain a balance between the fuel sulphur content and the base number of the oil lubricating the cylinder liner. In this way, the influx of alkalinity to the combustion space can be balanced with the sulphur content of the fuel. Combined with engine design factors, this balance must be controlled to ensure a small amount of corrosion in the cylinder liner(s). This is known as controlled corrosive wear – which is a desired situation.

Due to a number of other factors influencing cylinder lubrication – fuel/lube oil performance, chemical, mechanical and thermal aspects of lubrication – the base number/fuel sulphur balance in itself is generally a prerequisite, but never a guarantee for satisfactory cylinder lubrication.

The engine running duration very much influences the need for a balanced BN/S ratio, and it is a general rule that the longer the duration, the more important is the BN/S balance.

Owing to the diversified fuel oil system designs in service and being implemented, it could be an idea to handle/run on at least two different cylinder lube oils. The use of electronic lubricators seems promising in the effort to maintain a balanced BN/S ratio. Multiple cylinder lube oil systems is another possibility, maybe in combination with electronic lubricators for optimal flexibility.

Principal dual fuel system alternatives have been laid out. The possibility of abandoning the unifuel concept for certain ship types has been mentioned. The fuel change-over procedures for diesel engines running two and four stroke cycles have been outlined.

The time required for changing completely from one fuel to another fuel containing less than 1.5% S has been estimated using the so-called sulphur battery. This change-over period can be very long – well above 100 hours. In most of the calculated cases, the change-over period is considerably longer than the period used for dimensioning the fuel oil system's settling and/or service tanks up to three or five times longer.

Owing to quite different change-over periods, depending on fuel oil system layout and vessel trading pattern, some engines will have to operate almost entirely on low-sulphur fuel while others may benefit from a dual fuel system. This could induce a relative distortion of vessel running costs.

Depending on the vessel type and trading pattern in and outside the SECA zones, this might/might not induce a requirement for multiple (dual) fuel and lube oil systems. The major issues involved are:

- Fuel oil incompatibility
- Fuel change-over issues
- Base number – sulphur balance: Acid/Alkalinity
- Duration of fuel change-over – the 'Sulphur Battery'

The present work cannot conclude decisively on these issues, but only outline possible solutions and not recommend one in particular. Future service experience will demonstrate the necessity. A close watch on engine condition should be observed in connection with more frequent change-over between varying HFO sulphur contents.