Operational aspects of a sulphur cap on marine fuels

Executive Summary

The IMO MARPOL Convention Annex VI sets a maximum limit for sulphur content of 4.5 % for marine fuels allowed used onboard ships. Annex VI also defines Sulphur Emission Control Areas (SOxECAs) to be areas with special requirements to use of low sulphur marine fuels where the max sulphur limit is 1,5%. The Baltic Sea was designated a SOxECA in the original protocol. In MARPOL Annex V, Regulation 5 IMO included the English Channel to be part of the North Sea as a special area.

Sulphur level in the air and in the drainage basins of central Europe is stated to be above the acceptable limits by the European Commission. The sulphur levels have to be regulated by means effective for operation and control. The 1999/ 32/ EC Directive regulates the use of fuels in the European areas, but until now except marine use of fuel. As the shipping activities produce a severe part of the critical sulphur emissions in areas of Europe the activity has to be regulated to obtain an emission reduction. An amendment to Directive 1999/ 32, regulating sulphur content of marine fuels is therefore proposed. Regulations regarding the English Channel and the Baltic and North Sea are identical to those specified by IMO. Operational aspects and consequences of the proposal are described in this report.

The European Commission will regulate fuels for use in Europe and make marine fuels with sulphur content limits available according to the requirements in the proposed amendment. The Commission defines fuel grades according to the sulphur content in the fuel in three levels. ISO 8217 specification is usually referred to for fuel purchase, including content of sulphur. But the criteria will in European waters be overruled by the Commissions requirements.

The MARTOB Task 5.2 report “Future availability of LSHFO” indicates that there will be a problem to supply sufficient LSHFO according to the demand for the fuel as a result of introduction of the new regulations. Answers to the questionnaire also show that several ship owners plan to use LSHFO also outside SOxECA. If a noticeably part of the trans-ocean fleet will use LSHFO on a continuous basis, the demand situation could be critical. Passenger ships on regular services to or from EU ports will always have to use LSHFO quality from 1st July 2007. Oil tankers consume fairly large quantities of fuel during un-loading, cargo pumps are normally steam driven from ship’s steam boilers. Daily consumption for a VLCC during un-loading might reach close to 100 tons. But the biggest additional consumption of gas oil compared today will come from auxiliary engines earlier using heavy fuel oil at berth.

A tight supply situation for LSHFO might involve re-blending of current HSHFO with low sulphur products, MDO or other components. This option presents a risk for producing unstable LSHFO bunkers. Dilution of a thermally cracked residue with too high concentration of a paraffinic diluent such as gas oil could result in an unstable fuel. It is consequently necessary to ensure that the aromaticity of any diluent is high enough to keep the asphaltenes dispersed. The addition of catalytically cracked cycle oils is one way of doing this, and so providing an adequate stability reserve. Reduced

stability reserve means that even small changes in external conditions will bring about instability. Two fuels, each stable within themselves, may prove to be incompatible when mixed. The mechanism of incompatibility is similar to that of stability and depends on the chemistry of the blended fuels.

If the tight supply should result in reduced stability for parts of the LSHFO products, the shipping industry will face more frequent operational problems, clogging of fuel separators and filters, fuel coagulation and heavy sludge formation.

Important for the recognition of the results in this report is the Questionnaire developed in the project, and distributed in collaboration with ECSA and the Norwegian Shipowners' Association. Close to thirty ship operators have returned the Questionnaire, together forming a representative volume for most sectors of domestic and international shipping. The answers to the Questionnaire have been applied as basis for assumptions made during the work.

A brief description of fuel systems and their design to handle different fuels are given in the report. A simplified overview model with fuel tanks, process blocks and flow lines are used to describe fuel systems. Answers to the questionnaire show that many ship owners/ operators find that their fuel systems are not adequately arranged to handle dual fuel operation for main or auxiliary engines.

For ships continuing their mono fuel operation within the new legislation, the SOxECA border regulation will represent few consequences. Regarding continuous operation on low sulphur fuel, the study present experience from two vessels with several years operation on such products.

The fuel is one of the most significant aspects of environmental impact defined in Wallenius Wilhelmsen's extensive environmental programme. As a part of that programme the Wallenius Lines owned PCTC (Pure Car and Truck Carrier) TURANDOT has been running on Marine Diesel Oil, MDO, from January 1998 until December 2001. The bunker specification was DMB quality but with a Sulphur content of less than 1%. By this the SO2 emissions were reduced by 75% compared to the sister vessel TITUS operating on HFO 380 cSt. This is in line with the company's long term target to reduce SO2 emissions by operating on fuel containing less than 1.5% S by the end of 2003. Fuel consumption was reduced by at least 5% thanks to the higher heat value and less heating of fuel tanks.

Findings from the work onboard indicate that savings from fully utilized MDO operation corresponds to an price difference of about 20 USD/mt compared to ordinary 380cST HFO. The most important savings are from crew reduction, fairway fees and cylinder oil consumption. Due to regulations regarding safety crew, the crew reduction is not utilized on TURANDOT. The savings in work could also be used to reduce the cost of external services, e.g. onboard trucks, hydraulics and electric motors.

Problems with sludge have occurred two times. This might be because the DMB quality of MDO is an intermediate product that is normally not delivered in such large quantities as when bunkering TURANDOT. A test with RMG 35 fuel with a sulphur content of less than 1% was not successful. It was impossible to process the fuel in the separator and consequently not possible to use for running the engine. This was

probably due to the fact it was a blended product. The bunkering was made in December 2002 and resulted in big problems onboard. In spite the fact that the product fulfilled the RMG 35 standard it was not possible to use as fuel.

The proposed amendment to Dir. 1999/32 states that at berth it will be prohibited to use fuel with a content of sulphur above 0.2%. This will require vessels to carry gas oil, a quality not normally used onboard. Trans-ocean vessels might experience problems purchasing such low sulphur gas oil in international ports, hence it might be necessary to await entering European port. As some vessels are not allowed to carry out bunkering operations while loading or discharging, this will delay the loading operations. If the vessels have to change over to MGO at berth or in the harbour area there are increased risks for black outs. A black out is of course much more critical if the vessel is under manoeuvring in harbour and not at berth.

Trunk engines designed for HFO will more frequent operate on MGO. Experience must be collected to ensure that safe operation is obtained. Reference is made to MARTOB Task 5.3 report "Technical Implications for Machinery and Systems Operating on Low-Sulphur Marine Fuels".

The case studies from dual fuel operation reveal that no firm general conclusion on best practice can be made with respect to change in operational procedures for dual fuel operation. The main reasons for this are that the trading pattern of the vessel, and the space available for fuel system modifications will heavily influence the operator's decision.

The optimal solution from an operational point of view, considering both safety and extent of new operational procedures, is to have dual fuel storage and fuel pre-treatment systems for high and low sulphur fuel qualities.

For ships in inter continental trade, change over from HSHFO to LSHFO is a viable option due to few visits each year to the SOxECA. Long hauls and few visits will provide a sufficient time window to properly plan and execute change over from HSHFO to LSHFO, without significantly increasing the risk for stop of engines.

For ships with more frequent visits in the SOxECA, change over between HSHFO and LSHFO is not recommended unless the ship has two separate fuel pre-treatment systems, due to the complicated change over operational procedures and increased risk for stop of engines.

The study is not able to establish general cost estimates on the economic impact for any ship operating in a SOxECA, although case study results are presented. In the work it is however provided presentations on how a ship owner may estimate and consider best solution with respect to economic impact of new regulations.

Two important areas of further work have been identified from the case studies:

- More experience feedback should be collected on dual fuel operation to gain increased knowledge on potential safety and operational problems experienced with change over between HFO and LSHFO.
- Operational procedures should be carefully established and approved by administrations for those who will operate on more than one fuel quality and with change over between different fuel qualities upon entering a SOxECA.