

Engine emissions and MARPOL Annex VI

Emissions from petroleum products other than marine fuels often contain no more than 10 parts per million (ppm) of sulphur (0.001%), whereas marine bunkers can legally contain up to 50,000 ppm (5%). That is about to change – and dramatically.

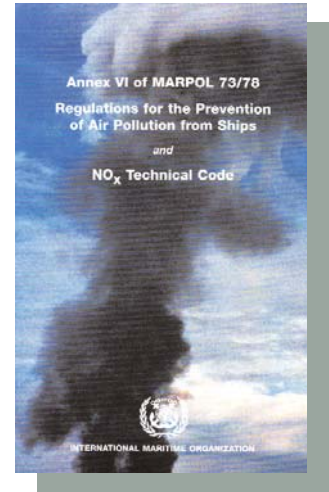
The combustion of marine fuels produces emissions of sulphur dioxide (SO_x) and particulate matter. Nitrogen oxides (NO_x) are also emitted, mainly as a result of incomplete combustion. SO_x, NO_x and particulate matter emissions can damage human health and SO_x also damages the environment and contributes to acidification, which damages ecosystems.

May 2005 saw the entry into force of Annex VI of MARPOL 73/78. The main aims of the Annex

are to reduce emissions from ships of SO_x and NO_x, which are major contributors to 'acid rain' when near land (on the high seas, acid deposition is easily neutralised by the ocean).

The European Parliament has already adopted EU Directive 1999/32/EC in April 2005, which with a few additional requirements is aligned with MARPOL Annex VI including the use of shipboard abatement methods.

The combined effect of these measures has major implications for shipowners, charterers, and bunker suppliers. This *Signals* supplement will look at the new regulations and some of their consequences.



The new regulations



MARPOL Annex VI

Annex VI imposes a global sulphur cap of 4.5% by mass (m/m). This measure alone introduces little practical change, since residual fuel oils generally have a sulphur content below 3%. However, Annex VI also provides for an upper limit of 1.5% m/m sulphur content to apply to all fuel used in designated 'SO_x Emission Control Areas' (SECAs), unless the vessel is equipped with an exhaust gas 'scrubber' or other technology to limit SO_x emissions. Annex VI also covers ozone-depleting substances, but is not concerned with greenhouse gasses.

MARPOL Annex VI will apply to all ships flying the flag of a country that has ratified MARPOL Annex VI, or ships in the territorial waters of such a country. However, there are exceptions to the regulations or parts of the regulations (see page S2). By June this year, 25 countries representing more than 60% of world tonnage (GT) had ratified Annex VI. These countries included Bangladesh, Cyprus, Denmark, Finland, Germany, Greece, Japan, Liberia, Marshall Islands, Norway, Panama, Singapore, Spain, Sweden and the UK.

The current status of convention ratification can be checked at the IMO website: www.imo.org

European Union Directive

The European Union (EU) has also produced regulations imposing restrictions on emissions

from ships and at one stage was considering imposing significantly lower limits than those proposed by MARPOL Annex VI.

However, a compromise was reached between IMO and the European Parliament and the agreed amendments to the EU Sulphur Directive 1999/32/EC were adopted in April 2005. This imposes much lower limits for sulphur emissions for passenger ships and ferries on regular services to or from any EU port from 19 May 2006 and mirrors the requirement for SECAs contained in MARPOL Annex VI.

In addition, an extremely low sulphur limit on fuel will be imposed on vessels berthed in European ports from 2010.

Important dates

Date	Regulatory change
1 January 2000	Ship engines should comply with NO _x Technical Code
13 April 2005	EU Sulphur Directive 1999/32/EC adopted
19 May 2005	MARPOL Annex VI enters into force
19 May 2006	Baltic SO _x Emission Control Area (SECA) enters into force
19 May 2006	Maximum sulphur content of bunker fuel 1.5% for passenger ships to and from EU ports.
22 November 2007	North Sea and English Channel SECA enters into force
13 April 2008	All ships must have obtained an IAPP certificate
1 January 2010	Maximum sulphur content of bunker fuel 0.1% for ships at berths in the EU

Controlling sulphur emissions in a SECA

SOx Emission Control Areas (SECAs) are areas adjacent to coastlines that have been identified as being particularly sensitive to acid rain deposits. The Baltic Sea will be the first SECA to be established, with effect from 19 May 2006, and the English Channel and North Sea will become a SECA in autumn 2007. Other SECAs are currently being proposed.

When a vessel is within a SECA, the sulphur content of all fuel – both residual (heavy fuel oil (HFO)) and distillate (marine diesel oil (MDO)) grades – used on board must not exceed 1.5% m/m.

Availability and cost issues

It is anticipated that initially there may be problems with the availability of low-sulphur heavy fuel oil (LSHFO), both in quantity and geographically. For example the nearest current suppliers to the Baltic are in Singapore, and their quantities are limited. Members are advised to plan well ahead to obtain suitable bunker fuel.

It is also anticipated that there will be a low-sulphur fuel cost premium. This is currently reported to be US\$10 to US\$50 a tonne and the demand situation nearer the SECA implementation date could raise it to between US\$30 and US\$70 a tonne.

After prolonged use of low-sulphur fuel, an acid or alkaline situation can build up in the engine that may cause accelerated wear. If prolonged use of

low-sulphur fuel is anticipated then it may be possible to use a different grade of engine lubricating oil to compensate.

Dual pipe and tank systems

Many industry advisors are contemplating a minimum of two separate pipe and tank systems, one for standard 4.5% sulphur fuel and other for low-sulphur fuel, and it may be possible for many ships to achieve this without major modification.

The procedure for changing from 4.5% fuel to low-sulphur fuel prior to entering a SECA must not compromise navigational safety. Vessels will have to allow sufficient time for the fuel oil service system to be flushed of all fuels exceeding 1.5% sulphur content prior to entering a SECA. Detailed records must be kept of the time and position of the vessel when changeover procedures are completed.

Alternatives to low-sulphur fuel

Alternatives may be available that allow ships to comply with the emissions regulations in SECAs, without using low-sulphur bunkers. Three such alternatives that have been reported are exhaust gas cleaning, blending and emissions trading.

Exhaust gas cleaning

Once the technology is developed, exhaust gas cleaning (EGC) systems may be a good option for ships operating mainly in SECAs with the additional benefit of EGC also controlling NOx

emissions. The IMO has not yet published its requirements for EGC, but in the meantime studies are being carried out into the practicalities of installing and operating such 'scrubbers'.

EGC systems will not be practicable for many vessels because of the space required to install the equipment and the capital outlay, which is likely to discourage their use save in recently built tonnage or newbuildings. The cost of retro-fitting a gas scrubber may be in the region of US\$500,000.

Blending

Reports seem to suggest that blending HFO with MDO could be a popular option of achieving 1.5% sulphur content. There may be no need for dual pipe and tank systems but there may be a need for more MDO capacity on board the ship. Fuel costs might be more expensive than LSHFO but for ships with little trading in SECAs, it could still be a cost-effective option.

Emissions trading

In the context of SOx emission control, the idea of emissions trading appears to be at the moment simply a proposal for future discussion. One suggestion is that there might be a monthly 'quota' of emissions for a fleet of ships and, provided the fleet emission total for the month is within the quota, the fleet will have complied – ships with lower emissions gain credits that offset ships with higher emissions.

When does MARPOL Annex VI not apply?

There are exceptions to the regulations or parts of the regulations. These include the following:

- Emissions that result from efforts to save life at sea or secure the safety of the ship
- Emissions that result from damage to the ship or its equipment, provided of course that all steps are taken to limit the emissions and that the action causing the damage was not reckless or done with intent
- Ships trading solely within their own flag State waters are also exempt, provided the Administration applies alternative measures
- Nitrogen oxide (NOx) emission controls do not apply to diesel engines with a power output less than 130 kW (about 175 hp) nor to emergency or lifeboat engines.

Only ships over 400 GT will be surveyed to ensure that they comply with Annex VI and only those ships over 400 GT that sail to other IMO member States will need to carry certification.

Sulphur oxide emissions

From 19 May 2005, the sulphur content of bunker fuel on board must not exceed 4.5% at any time. The International Bunker Industry Association advises that the current world average sulphur content in bunker grade fuel oil is between 2.7% and 3.0% by mass (m/m), so there should be no problem for ships to comply with this requirement.

However, Members are advised to check with their bunker suppliers that the sulphur content is below this limit before taking bunkers.

Within a SOx Emission Control Area (SECA), the bunker fuel in use must have a sulphur content of less than 1.5%. The first SECA – the Baltic Sea – comes into effect from 19 May 2006 and at the moment the only other SECA designated by IMO is the North Sea and English Channel, which comes into effect on 22 November 2007.

Members can obtain more information about bunker fuel content from the International Bunker Industry Association website: www.ibia.net

NOx Technical Code

Nitrogen oxide (NOx) emissions are to be limited by Annex VI Regulation 13 and the NOx Technical Code. The IMO issued interim guidelines in November 1998 for the application of the NOx Technical Code, which stated that ships should comply with the Code from 1 January 2000.

NOx emissions are related to the power output of the engine. Engine manufacturers will have built the emission-control requirements into engines fitted from January 2000 and will also have NOx Technical Code compliant modifications for existing engines. NOx emissions control can also be managed by fitting the engine with an exhaust gas cleaning (EGC) system or other approved method to keep emissions within limits.

It is important that Members check with their engine manufacturers that engines comply with the NOx Technical Code (see 'How to show you comply').

How to show you comply

International Air Pollution Prevention Certificate (IAPP)

From 19 May 2005 or the next scheduled dry-docking, all ships of 400 GT or over on international voyages will require an International Air Pollution Prevention Certificate (IAPP).

However, only countries that have ratified MARPOL Annex VI can issue IAPP certificates. The certificate will be valid for a period of five years and, prior to issue, there will be an initial survey followed by intermediate and periodic surveys as specified by the flag State. The certificate will be accompanied by a Supplement known as the Record of Construction and Equipment. Accidents or defects that have or may have affected the capability of the ship to comply with Annex VI must be reported to the authority issuing the IAPP.

Engine International Air Pollution Prevention Certificate (EIAPP)

The NOx Technical Code states that each engine to which the regulations apply must be issued with an Engine International Air Pollution Prevention Certificate (EIAPP) to prove compliance. This is issued by the ship's flag State. Ships from a flag State that has not yet ratified MARPOL Annex VI should obtain a Statement of Compliance with the NOx Technical Code from their flag State.

For an engine that is not certified, Members must apply to the manufacturer to confirm that the engine is compliant with the NOx Technical Code, with or without modification. Engine manufacturers will be able to provide the EIAPP issued by a recognised organisation for that engine type and the technical file for the engine.

If the engine is not Code compliant, the engine manufacturer can arrange for the engine certification and produce an approved technical file before the next scheduled dry-dock survey.

A sample Statement of Compliance is contained in Marine Guidance Note (MGN) 142, which can be downloaded from the United Kingdom MCA website: www.mca.gov.uk

Record keeping

Both Annex VI and the EU Sulphur Directive contain detailed provisions for documenting the sulphur content of fuel supplies and also require bunker suppliers to certify that the fuel supplied is in conformity with the relevant limits and with Regulation 18(1) of the Annex.

Vessels will have to retain bunker delivery notes (see below) onboard for three years and samples for at least 12 months. The samples, which should be collected in accordance with the guidelines set out in IMO Resolution MEPC.96(47), are in addition to the commercial samples generally

provided for verification purposes. Port State control will check a vessel's bunker delivery notes against the records made at the port where the bunkers were supplied.

The vessel's Oil Record Book should show that any low-sulphur fuel has been stored separately from higher-sulphur fuel. The logbook should record that low-sulphur fuel was in use prior to entering a SECA and that the change over back to higher-sulphur fuel did not commence until after leaving the SECA.



Guidelines for port State control inspections

The IMO has issued draft Resolution MEPC (53) containing guidelines for inspections related to MARPOL Annex VI. Both the Paris MOU and Tokyo MOU port State control regions have indicated they will implement the guidelines.

The guidelines define what will constitute 'clear grounds' to conduct a detailed survey and lists the deficiencies that would warrant detention of a ship. These include:

- no IAPP or EIAPP Certificates or technical files (see above)
- having a non-compliant NOx diesel engine
- having fuel on board with sulphur content exceeding 4.5%
- non-compliance with SECA requirements (not applicable until May 2006)
- having a non-compliant incinerator
- master or crew not familiar with procedures or equipment.

The guidelines can be viewed on the NewsNet pages of the Association's website: www.nepia.com

Bunker delivery notes

To control the supply of bunkers in countries that have ratified MARPOL Annex VI, all bunker fuel oil taken by a ship must be accompanied by a bunker delivery note. The details on the note must include:

- name and IMO number of ship
- port
- date of commencement of delivery
- address details of supplier
- product name
- quantity
- density at 15°C
- sulphur content
- signed declaration by supplier that sulphur content is less than 4.5% or 1.5% as required and the fuel is within the specification defined in MARPOL Annex VI Reg. 18 (1)

- be accompanied by a representative sample of the fuel oil sealed and signed by the supplier.

The bunker delivery note must be kept on board for inspection for a period of three years and the sample must be kept on board for 12 months or until the fuel has been used, whichever is the greater.

The administration or a designated authority in each country supplying bunkers will maintain a register of local suppliers of fuel oil and ensure that the registered suppliers:

- provide a bunker delivery note as per Annex VI Appendix V
- keep a copy of the bunker delivery note for at least three years from the date of issue
- provide a representative sample.

The European alternative

The European Parliament adopted its own emissions regulations on 13 April 2005 in the form of the EU Sulphur Directive 1999/32/EC, including amendments from COM(2002) 595.

One reason for the new Directive is that many vessels nowadays do not need to change over to diesel for manoeuvring and powering generators, with the result that they could continue burning high viscosity heavy fuel containing up to 4.5% sulphur in EU waters. The requirements in the Directive are aligned with Annex VI, apart from some additional requirements that are more stringent.

- The maximum allowed sulphur limit for fuel will be 1.5% for all passenger ships on regular services to and from EU ports from 19 May 2006.
- The maximum allowed sulphur limit for fuel will be 0.1% for ships at berths in EU ports (if berthed more than two hours) from 1 January 2010. This amendment will eliminate the possibility of using HFO or heavy MDO in port.

These requirements do not apply to emissions for safety of life at sea purposes or resulting from accidental damage, provided all steps are taken to limit the extent of the emissions and the damage was not caused recklessly or with intent.

The compromise means that EU member nations can choose whether to ratify MARPOL Annex VI or EU Sulphur Directive 1999/32/EC.

Finally, the EU is going to submit a report to the IMO by 2008 about additional amendments relating to SECAs, which will designate additional SECAs through the IMO and possibly reduce the sulphur limit in SECAs down to 0.5%. It will also consider alternative or complementary measures, including economic instruments such as emissions trading.

Operational considerations

Sampling

Quite a few bunker suppliers' general terms and conditions stipulate that samples are to be taken from the barge's hose connection. Owners (or time charterers) are advised to reject such a condition before stemming bunkers on the grounds that it is contrary to the guidelines in IMO Resolution MEPC.96(47), which both Annex VI and EU Sulphur Directive 1999/32/EC require to be observed.

Ship's lines and tanks

Very few vessels have existing tanks designed to hold two different grades of distillate fuels (1.5% and 0.1% sulphur) and one grade of residual fuel (4.5% sulphur). It may be difficult to alter the total available tank space onboard so owners may have to consider changing existing tanks and duplicating pipework to provide segregated 4.5% and 1.5% systems.

Engine performance and maintenance

The change over from heavy fuel oil (HFO) to low-sulphur marine diesel or gas oil (MGO) will inevitably have operational consequences on main and auxiliary engines designed to operate on residual fuels. Such consequences may include increased fuel-pump leakage, with consequential reduction in generating capacity, effects on engine timing and loss of lubricity.

The change-over from high-viscosity HFO heated to 100°–150°C to low-viscosity MGO at 40°C can cause severe thermal shock, an increased risk of loss of power and damage to fuel systems. Engine manufacturers have advised that the switch will require a 20 to 60 minute change-over procedure to avoid problems with fuel pumps and injectors resulting from rapid changes in temperature. Any shortcut could lead to temporary engine failure.



Courtesy of Ronald Woehrn

In main engines, two different lube oils with different base numbers may need to be carried to allow for operating for extended periods on low-sulphur fuels. Owners will clearly need to consult closely with engine manufacturers in preparing appropriate directives for chief engineers to limit ignition and combustion problems.

Commercial and legal considerations

Problems may arise where the charterparty gives the charterer the option to nominate discharge port(s) out of one or more wide geographic ranges after the vessel has left the port of loading. This is common in the oil or grain trades, where the cargo may be re-sold several times while afloat.

The vessel may have to change course to find compliant fuel to enable it to reach and enter an EU destination or a port in, or requiring transit through, a SOx Emission Control Area (SECA). In such a case, the owner will be looking to recover additional freight and increased bunker costs and should therefore prepare to include an appropriate clause to this effect.

With regard to time charters, disputes may arise concerning the charterer's entitlement to order the

vessel to a SECA without having first provided compliant bunkers. BIMCO has drafted a fuel sulphur content clause for time charter parties. Its aim is to ensure that time charterers supply fuel of whatever specification may be required in emission control zones in which the vessel trades and to indemnify owners in respect of any failure to comply.

Considerable expense for owners

It will be up to owners, however, to ensure continued compliance with the usual time charterparty warranty that the vessel is 'in a thoroughly efficient state in hull, machinery and equipment for and during the service'. If a vessel is to remain attractive in a competitive chartering

market, owners may need to incur considerable expense in retrofitting additional bunker and lube-oil tanks, so as to maximise its ability and flexibility to trade in SECAs. Owners will also need to invest time in revising on-board procedures and training engine-room personnel.

Enforcement of the new EU Directive will be the responsibility of port State control in member States. It remains to be seen whether a vessel burning non-compliant fuel will be prevented from loading or discharging cargo, or whether cargo operations will be allowed to proceed against payment of an appropriate penalty. The Directive mentions the need for 'effective sampling and dissuasive penalties'.

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