

## **Marine Industry Challenges**

In many ways the shipping industry is facing unprecedented times with an uncertain economic climate, rising fuel prices and a shortage of manpower. The additional pressure of rapidly tightening regulation together with increasing environmental demands from charterers and the public, mean that ship operators have challenging and imminent decisions to make. In order for ships and their operators to remain both competitive and compliant, engines and associated equipment are changing and new ways of working are being employed. Whatever the advances in technology or process, it is paramount that solutions are safe, cost effective and deliver robust performance.

Whilst there is currently much talk of Liquefied Natural Gas as a new fuel for shipping, residual and distillate fuels based on the petroleum refining process are still shipping's main energy source. Although the mix of alternatives including LNG will no doubt develop when and where the financial incentives and supply chain capability are in place, the predominance of fossil fuel oils appears set to continue for the foreseeable future.

The overarching regulations for the prevention of air pollution from ships are contained within IMO's revised MARPOL Annex VI. There are also a plethora of regional, national and local regulations which not only enact Annex VI but also in many cases place further restrictions on ships' fuels and emissions. Annex VI places controls on emissions of nitrogen oxides (NO<sub>x</sub>) and sulphur oxides (SO<sub>x</sub>) and allows the use of abatement systems. Although greenhouse gases such as carbon dioxide and methane are not currently covered by Annex VI, energy efficiency and the reduction of CO<sub>2</sub> emissions through improvements in ship design and operation are the subject of much debate at IMO. Methane is twenty times more effective in trapping heat in the atmosphere than CO<sub>2</sub> and although IMO has yet to complete guidelines for the use of LNG as a fuel there is an environmental responsibility to ensure 'methane slip' from the leakage of unburned gas into the atmosphere is properly controlled.

## **The Role of Marine Emissions Monitoring**

Continuous Emissions Monitoring is a tool that enables ships and offshore rigs to be competitive, compliant and environmentally responsible.

There are numerous factors that have to be taken into account when deciding how to comply with SO<sub>x</sub> regulations, but ultimately ship operators have a limited choice - use fuel of the correct sulphur content or fit exhaust gas cleaning systems i.e. scrubbers and continue to use high sulphur fuel.

Robust Continuous Emissions Monitoring systems capable of measuring down to the equivalent of 0.1% sulphur fuel are key for compliance with SO<sub>x</sub> regulations. The majority of scrubber manufacturers have chosen to use the approved method of continuously measuring the SO<sub>2</sub>/CO<sub>2</sub> ratio of scrubbed exhaust gas to confirm the performance of their system. Compliance must be demonstrable at any load point during engine or boiler operation. In situ

analysers mounted directly onto the exhaust offer advantages over extractive systems that draw exhaust into a single remote analyser in a time-share arrangement. With the latter leaks can occur and there is potential for lags and gaps in emissions data.

Using fuel of the required sulphur content will remain an option. All indications are that residual fuel will continue to be used outside of Emission Control Areas and that refiners will not invest in desulphurisation down to the very low levels required in ECAs from 2015. Unless a vessel is changed to low sulphur fuel for all operations, fuel switching will be required on ECA entry and exit until at least 2020 to 2025.

Non-compliance can be very costly, with both heavy fines and detentions possible. Emissions monitoring provides assurance that fuels have been changed in a timely manner and compliance is ongoing.

There is demand for fuel-efficient and NO<sub>x</sub> compliant engines driven by high fuel prices and regulation. The NO<sub>x</sub> Technical Code allows the direct measurement and monitoring of NO<sub>x</sub> and various engine-operating parameters to confirm compliance with MARPOL Annex VI. This removes the need for intrusive engine inspections.

Whilst at-engine techniques are able to meet current NO<sub>x</sub> emission limits, it appears that the very low levels required in ECAs from 2016 can only be met by using exhaust after-treatment in the form of selective catalytic reduction or exhaust gas recirculation. Alternatively LNG could be used as NO<sub>x</sub> emissions are reduced by 80% when compared with traditional fuel oils.

IMO has not yet finalised regulations for confirming the performance of NO<sub>x</sub> after-treatment systems, however US EPA requires Continuous Emissions Monitoring systems to be employed on large engines with NO<sub>x</sub> control technologies that can be turned on-off. It is also important to control selective catalytic reduction systems so that ammonia slip is minimised. Here enhanced feedback can be provided by continuous monitoring of NO<sub>x</sub> emissions.

Industry wide use of LNG faces many challenges and perhaps it may only be used on smaller ships operating exclusively in ECAs where there are financial incentives and a substantial investment in supply infrastructure. In addition to much reduced NO<sub>x</sub>, this fuel offers benefits of near zero SO<sub>x</sub> and lower CO<sub>2</sub> emissions, however as a powerful greenhouse gas methane entering the environment from leaks and incomplete combustion can negate the benefits of CO<sub>2</sub> reduction. Emissions monitoring systems can measure methane emissions from unburned fuel and offer the potential for combustion control.

Emissions monitoring of NO<sub>x</sub>, CO<sub>2</sub>, carbon monoxide and non-methane hydrocarbons can facilitate combustion optimisation in diesel engines, whilst CO<sub>2</sub> monitoring is a tool for the measurement and improvement of efficiency. It is also ideally suited for use with financial instruments if adopted by the industry and its regulators.