Changing times

Simon Brown of W R Systems looks at how the maritime industry is evolving under the raft of new emissions regulations

These are interesting times in the world of vessels' emissions: many new regulations are entering into force over the next few years and this complex maze of seemingly individual requirements is challenging even the most proficient vessel operator.

From a personal viewpoint, being a 'Brit' but having recently changed companies to a medium-sized American corporation, this geographical change has provided me with a whole new perspective on this fascinating subject.

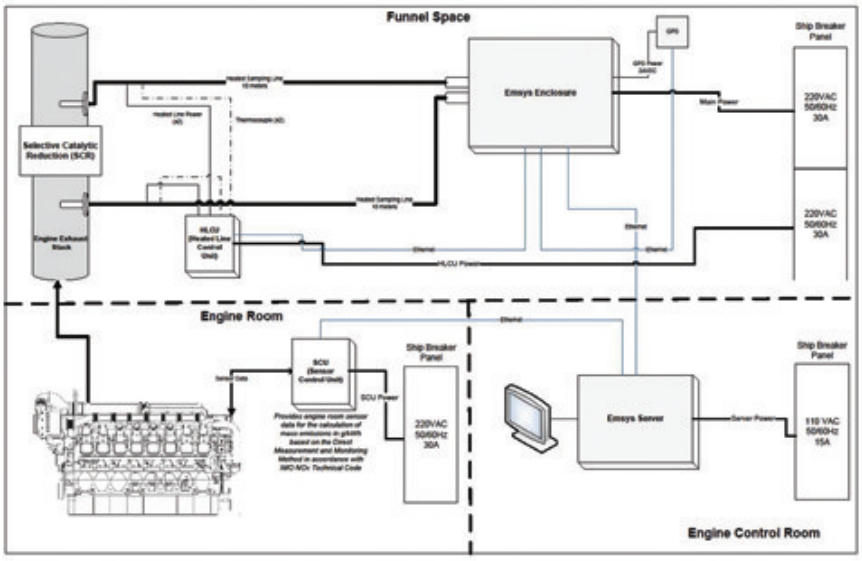
The revisions of the **International Maritime Organization's** (**IMO**) *MARPOL* Annex VI were meant to deliver the maritime industry a unified 'roadmap' regarding global requirements for air emissions compliance up until 2020. However, many localised regulations and environmental initiatives have appeared subsequently to create confusion and uncertainty.

Until recently, the use of 'scrubbers' was seen as a complex, expensive, and untried high-risk technology. However, volatility in the world oil market, high prices of marine diesel and gasoil combined with the potential scarcity of the required fuels in Emission Control Areas (ECAs) had prompted a significant increase in the scrubber market activity. Various companies are now actively engaging in onboard trials, and the first commercial scrubbers are now in construction at shipyards in the Far East. The United States, although reluctant at first, seems to be embracing this challenge with an open mind.

From a nitrous oxide (NOx) viewpoint, Tier III will bite in 2016. However, engine builders and technology providers are hard at work developing the various technological solutions to meet the significantly reduced NOx limits. Unfortunately, to coin a commonly used phrase, there is no 'silver bullet' for NOx. Depending on the vessel's trading pattern, engine type, and geographic location, the solution or technology required will probably differ widely. With the exception of vessels operating solely on liquefied natural gas (LNG), the industry must strive to reduce emissions on the current engines and boilers and available fuels.

The **IMO Bulk Liquids & Gases** (**BLG**) committee has been developing its *Guidelines for Selective Catalytic Reduction systems* (*SCRs*) for over two years. This is one technology for reducing NOx, but it is not suitable for every application. The engine builders are actively developing 'in-engine' solutions to the applications. Each of these approaches will have a cost, whether in capital outlay, maintenance, or fuel penalties.

Having been relatively late to ratify Annex VI, the US maritime industry has had less time than its European counterparts to become adjusted to its requirements. Until ratification, vessels were using a voluntary scheme to meet the requirements of Annex VI. Now, these vessels are implementing their *International Air Pollution Prevention* (*IAPP*) and *Engine International Air Pollution Prevention* (*EIAPP*) certificates for the first time. This is creating many challenges for vessel operators.



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The requirement to operate engines within the settings detailed in the Engine Technical File may not have been followed for the past few years – the use of NOx influencing components with fully traceable IMO part numbers may have been unintentionally overlooked, rendering these engines potentially out of compliance. Vessel managers and superintendents have been frantically tracing documentation trails back over many years to provide the necessary framework and history required to satisfy the US flag. In some cases, the issue of an EIAPP certificate may not even be possible under the traditional route. This could lead to a very lengthy and costly process to ensure the vessel meets the compliance requirements.

Recently, the **United States Coast Guard** (**USCG**) has issued guidance to its inspectors regarding Port State Inspection procedures. These differ slightly depending on whether the vessel is US flagged or internationally registered. Strict guidance on the extent of the vessel/engine examination has been issued which follows the IMO Guidelines for Port State Inspections. However, the USCG has specifically detailed which infringements would be cause to 'detain' the vessel. It is likely the US Port State Inspections could be more rigorous than with some other MARPOL ratified countries given the USCG's past history of environmental thoroughness.

The **US Environmental Protection Agency** (**EPA**) is responsible for approval of IAPP, EIAPP, and Engine Technical Files. However, there is a big crossover regarding regulations, as the EPA has been enforcing strict 'national' rules for marine engines for many years. Unfortunately, the compliance documentation required is not identical. This area becomes particularly complex where vessels require connection to the sea bed or shore-based installation. In these cases, once connected to the seabed, the vessels become regarded as a 'stationary source' and required to comply with the applicable *US Code of Federal Regulations Title 40* (*40CFR*) regulations. This presents a huge challenge to operators because when the vessel is 'off the buoy', it then must comply under MARPOL. In these cases, working with the EPA is mandatory and usually involves complex mechanisms calculating total emissions and ensuring specific emissions limits are not exceeded. A detailed 'quality assurance' file must be prepared and approved by the EPA and regular audits of data collection/measurement system integrity are mandated.

Given the pressure from the regulators, some innovative owners are choosing to become 'over-compliant' by operating their vessels to higher standards than the regulatory limits. This is done for many reasons: charterer's requirements, corporate social responsibility (CSR) initiatives, making the vessel 'more attractive' to their customers, and differentiating themselves environmentally from their competitors. All of these initiatives could involve a significant increase in the vessels' operating costs. It is my personal experience that no two owners have the same environmental 'drivers'.

Given the aforementioned, owners are now looking for a more holistic solution to their requirements. This is why the use of emissions monitoring systems (EMS) for engines and boilers has now started to increasingly be identified as a solution to some, or all, of these compliance challenges. I have personally been involved in developing and promoting the use of EMS technology for many years. At the outset, fearmongers claimed that if you actually measured your emissions, you were likely to be 'out of compliance' – whereas when using the traditional 'Parameter Check Method', ignorance was bliss and compliance would never be questioned.

The plethora of emission control devices which will appear in the next few years and the requirement to switch these on/off depending on whether a vessel is in an ECA mean that monitoring is now actively being promoted by regulators. In order to meet some of the various NOx, sulphur oxide (SOx), carbon dioxide (CO_2), and particulate matter (PM) regulations, EMS has now become the only acceptable solution. It is anticipated that when Tier III NOx limits are introduced in 2016, vessels will be mandated to provide some form of monitoring at the 'end of the funnel' whilst in ECAs to ensure the NOx reduction systems are functioning as designed.

So, where is the EMS market heading? From a purely personal viewpoint, necessity and opportunity dictates commercial development. The original EMS market offerings around the ratification of Annex VI in 2005 were based mostly on land-based technology, proven over decades in power stations and large emissions generating plants. However, the take-up of the technology was fairly small and nearly all for niche application as opposed to mandatory compliance. These systems tended to be cumbersome and extremely maintenance intensive. The already over-worked ship's crew had to adjust to more complex equipment, with the associated operation and maintenance requirements. It was obvious that the technology needed significant development to meet the unique requirements of the maritime community.

My company, **WRSystems**, is based on the US East Coast. Having generated an enviable reputation in the United States regarding product development and through-life support of marine navigation and communication technology, outside the United States, we are relatively unknown. Three years ago, the company identified a market opportunity in the emissions measurement area, and the design of a simple, robust, sensor-based EMS was seen as a vehicle for generating the same enviable reputation in the global commercial maritime market.

From the outset, it was decided not to become another analyser supplier; this would definitely not meet the company's core objectives. WRSystems has extensive experience in sensor integration and this background led the development team to identify two essential requirements. The first is the need for the emissions sensor to be maintenance and calibration free. The second is for the system to measure PM, identified as one of the most important emissions components due to its well-publicised health implications.

The *Emsys* system has been developed and tested over a two-year period. Firstly, the emissions sensing technology was identified,

with *Quantum Cascade Lasers* (*QCL*) being seen as capable of overcoming nearly all of the technology drawbacks of the current crop of *Chemiluminescent* (*CLD*) and *Non-dispersive Infra-Red* (*NDIR*) analysers. It has the unique ability to measure four gases in one pass, which allows NOx to be measured as NO and NO_2 individual components. This overcame one drawback of the traditional technology which required a high-cost, consumable 'NOx converter' to convert the NO_2 to NO, thus allowing the single gas (NO) analyser to measure NOx. Secondly, we have the calibration issue. Analysers were developed for the laboratory – and although ruggedised versions have since evolved, they are essentially still the same technology. Temperature changes and vibration require these systems to be continually reset through zero and span adjustments.

This 'drift' results in inaccurate measurements, but more importantly requires the use of expensive calibration gas to bring the analyser back into the required accuracy. Specialist calibration gas is not always available in every port and is a 'hazardous air cargo', which makes it a very expensive consumable item.

WRSystems identified that mitigation of this issue would take the EMS technology forward a generation. The QCL sensor within Emsys is calibration-free, only requiring the mandatory calibration checks necessary within MARPOL or the vessel's air permit. More importantly, it does not drift with temperature and vibration.

The PM sensor was another critical consideration. Measuring PM usually required an instrument in each exhaust uptake. These instruments tend to be optical and get dirty easily which makes them very high maintenance.

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WRSystems took the approach to measure the PM 'outside the stack' in a specialist optical chamber that meets *EPA PS-1* standards. This meant that only one PM sensor was necessary for up to 10 exhaust stacks. The exhaust gas is extracted from the relevant stack and maintained in such a manner that keeps the PM in the same condition as at the sample point in the exhaust stack. Onboard tests were undertaken to prove the technology and the system is unique in having ABS Type Approval for measuring PM. WRSystems is currently patenting this technology.

Low maintenance, quick installation

Other key precepts of the design were low maintenance, quick installation, high accuracy, and mission critical reliability. WRSystems believes all of these points have been achieved in developing Emsys as truly 'second generation technology'. The comprehensive suite of ABS Type Approvals and MED approval allows the system to meet the requirements of all current and future identified regulations. The system has also undergone approval from the EPA in a critical 'air permit' application, proving that the industry is receptive to new ideas and ground-breaking technology.

Commercial orders

Within the first six months of its launch, Emsys has generated its first commercial orders from four important sectors of the maritime market: exhaust gas cleaning systems, cruise ships, oil and gas exploration, and container ships. These contracts are a testament to an industry under pressure looking for reliable solutions, rather than the traditional lowest price compliance option. The level of commercial activity we are currently experiencing leads me to be cautiously optimistic that we have 'resonated' at the correct frequency with maritime community.

Rising to the challenges

To conclude this article with a personal view on where the industry in heading, I think the maritime community has always risen to the challenges ahead, and these new environmental regulations are no exception. The industry has highly visionary leaders and genuinely passionate entrepreneurs ready to take up the challenges set by the regulators and, more importantly, the shipowners. The 'organic' nature of environmental compliance during the next few years will inevitably require many changes to perceived thinking. Companies such as WRSystems and its peers will be aiming to deliver the solutions to meet these highly challenging requirements.