Introduction to IMO and overview of MARPOL Annex VI framework

Seminar on the regulation and reduction of air emissions from ships

Bangkok, Thailand
27 June 2019
Content

• Context: shipping essential to the world
• Introduction to IMO, structure and decision-making process
• Brief overview of the MARPOL Convention and its Annexes
• MARPOL Annex VI framework
• Main aspects of SOx, NOx and GHG emissions control
Context: shipping essential to the world
Shipping essential to the world

• Over 80% of global trade by volume and more than 70% of its value carried on board ships (dry bulk, oil & gas, manufactured goods, etc.)
• Shipping underpins global economy, international trade and development

10.7 billion tons transported by ships in 2017 (+ 4% compared to 2016, fastest growth in five years)

Developing countries continue to account for most global seaborne trade flows, both in terms of exports (60% of world merchandise loaded) and imports (63% of world merchandise unloaded).

Source: Review of maritime transport 2018 – UNCTAD, October 2018
Shipping essential to the world

- World seaborne trade projected to grow annually by 3.8% between 2018 and 2023 (with rapid growth for container and dry bulk ships, tanker volumes to grow at a slower pace)

However, UNCTAD identifies uncertainties derived from geopolitical, economic and trade policy risks.

Source: Review of maritime transport 2018 – UNCTAD, October 2018
Introduction to IMO, structure and decision-making process
The International Maritime Organization (IMO)

Shipping = international activity => need to be governed by common international standards and not conflicting/varying individual national standards

IMO = specialized agency of the UN
- IMO Convention was adopted in 1948
- In 2019: 174 Member States + 3 associated members
- 81 consultative NGOs; 64 IGOs

“Safe, secure and efficient shipping on cleaner oceans”

- IMO develops and maintains a comprehensive regulatory framework for shipping
- IMO addresses safety, environmental, legal matters, technical co-operation, security and the efficiency of shipping
- IMO developed and adopted more than 50 mandatory instruments and over 1,000 rules and guidelines
The purposes of the Organization are:
- To provide **machinery for cooperation among Governments in the field of governmental regulation** and practices relating to technical matters of all kinds affecting shipping engaged in international trade;
- to encourage and facilitate the general adoption of the highest practicable **standards** in matters concerning the maritime safety, **efficiency of navigation and prevention and control of marine pollution from ships**; [...].

• Functioning of IMO relies on **contributions** made by all Member States (e.g. proposals, information, technical papers, reports, etc.) and their **participation** in the meetings (approximately 30 weeks of sessions per year)

• Best efforts are made to reach decisions by consensus
The structure of IMO

Assembly

Council

- Maritime Safety Committee (MSC)
- Marine Environment Protection Committee (MEPC)
- Legal Committee (LEG)
- Facilitation Committee (FAL)
- Technical Cooperation Committee (TC)

Sub-Committees: HTW, III, NCSR, PPR, SDC, SSE, CCC

(PPR = Pollution Prevention and Response)

Intersessional Working Groups (ex: ESPH, GHG, etc.)
The structure of IMO

Assembly

• Highest Governing Body of the Organization
• Consists of all 174 Member States
• Meets once every two years in regular sessions (31st session from 25 November to 4 December 2019)
• Responsible for approving work programme and determining financial arrangements
• Elects the Council members

Council

• Consists of 40 Member States in 3 categories which serve a term of 2 years (China, Indonesia, Malaysia, Philippines, Singapore and Thailand are IMO Council members)
• Executive Organ of IMO. Responsible, under the Assembly, for supervising IMO’s work
• Coordinates activities of the IMO organs
• Considers IMO draft work programme and budget estimates (submits them to Assembly)
• Receives reports/proposals of Committees and submits to Assembly with comments and recommendations as appropriate
• Appoints Secretary-General, subject to approval of Assembly
Set-up

IMO also welcomes participation of:

- Representatives from UN and its specialized agencies (e.g. ILO, WTO, UNFCCC, …)
- Observers from inter-governmental organizations (e.g. IHO, EC, …)
- Observers from non-governmental organizations in consultative status (e.g. ISO, IACS, ICS, etc.)
Mr. Kitack Lim (Republic of Korea)

Elected as IMO Secretary-General by the 114th session of the IMO Council in June 2015 for a four-year period beginning 1 January 2016.

Mr. Kitack Lim was nominated for re-election as secretary-general of the International Maritime Organization. His second term will start on 1 January 2020, subject to the approval of the IMO Assembly in December 2019.
How is IMO funded?

- **Membership charges** (Member States pay charges based inter alia on registered tonnage)
  
  ⇒ Top three contributors for 2014: Panama, Liberia and Marshall Islands
  
  ⇒ Voting rights are not linked to the level of financial contribution

- **Voluntary contributions** from Member States, governmental agencies, intergovernmental bodies (EU, etc.) and other public, private and non-governmental sources (IPIECA, etc.)

- Some projects are funded by UN or its specialized agencies (e.g. GEF, UNDP)

- For most technical assistance programs, **countries** provide donations (ITCP, trust funds, etc.)

- **Commercial activities** (including publications, catering and conference services)
Legislative map

IMO Instruments

- Pollution Response
  - Intervention and OPRC Conventions and Protocols
- Pollution Control
  - MARPOL, London, BWM, AFS, Hong Kong
- Safety
  - SOLAS
  - COLREG
  - STCW
  - LL
  - SAR
- Compensation
  - Civil Liability (and the associated IOPC Fund Conventions)
- Universal Conventions
  - Vienna, Montreal, Stockholm, UNFCC, etc.

Regional Agreements

Regional Laws

NATIONAL LEGISLATION
Video: historical perspective on IMO achievements

https://www.youtube.com/watch?v=TZyYNTMx9Do
Brief overview of the MARPOL Convention and its Annexes
Sources of Pollution from Ships

Exhaust Gases (SOx, NOx, GHG, etc.) from
- main and auxiliary engines
- boilers
- incinerators

Emissions of Freon/Halon gases

Evaporation from cargo (VOCs)

Oil spills

Loss by accidents – ship cargoes & life

Bilge-water disposal/ tank washing

Emissions from paint solutions

Sewage & Garbage

Loss of cargo

Loss by accidents – ship cargoes & life

Ballast water discharge

© Damen shipyards
International Convention for the Prevention of Pollution from Ships (MARPOL)

- **MARPOL Convention** = main international convention covering prevention of operational or accidental pollution of the marine environment by ships

<table>
<thead>
<tr>
<th>Annexes I &amp; II</th>
<th>Annex III</th>
<th>Annex IV</th>
<th>Annex V</th>
<th>Annex VI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Oil and Noxious Liquid Substances</strong></td>
<td><strong>Harmful Substances Carried at Sea in Packaged Form</strong></td>
<td><strong>Sewage from Ships</strong></td>
<td><strong>Garbage from Ships</strong></td>
<td><strong>Air Pollution from Ships</strong></td>
</tr>
<tr>
<td>In Force</td>
<td>In Force</td>
<td>In Force</td>
<td>In Force</td>
<td>In Force</td>
</tr>
<tr>
<td>152 Parties</td>
<td>139 Parties</td>
<td>132 Parties</td>
<td>145 Parties</td>
<td>93 Parties</td>
</tr>
<tr>
<td>99% of World Tonnage</td>
<td>98% of World Tonnage</td>
<td>90% of World Tonnage</td>
<td>98% of World Tonnage</td>
<td>96% of World Tonnage</td>
</tr>
</tbody>
</table>
International Convention for the Prevention of Pollution from Ships (MARPOL)

- **Annex I – regulations for the Prevention of Pollution by Oil**
  - Entered into force on 2 October 1983
  - Covers prevention of pollution by oil (operational + accidental)
  - The 1992 amendments to Annex I made it mandatory for new oil tankers to have double hulls

- **Annex II - Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk**
  - Entered into force on 2 October 1983
  - Details the discharge criteria and measures for the control of pollution by noxious liquid substances carried in bulk; (abt. 250 substances).
  - Discharge of their residues is allowed only to reception facilities
International Convention for the Prevention of Pollution from Ships (MARPOL)

• **Annex III – Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form**
  - Entered into force on 1 July 1992
  - Contains general requirements for the issuing of detailed standards on packing, marking, labelling, documentation, stowage, quantity limitations, exceptions and notifications.
  - “harmful substances” = marine pollutants in the International Maritime Dangerous Goods Code (IMDG Code)

• **Annex IV - Prevention of Pollution by Sewage from Ships**
  - Entered into force on 27 September 2003
  - Discharge of sewage into the sea is prohibited (except with sewage treatment plant or when the ship is discharging comminuted and-disinfected sewage)
International Convention for the Prevention of Pollution from Ships (MARPOL)

- **Annex V – Prevention of Pollution by Garbage from Ships**
  - Entered into force on 31 December 1988
  - Deals with different types of garbage and specifies the distances from land and the manner in which they may be disposed of; the most important feature of the Annex is the complete ban imposed on the disposal into the sea of all forms of plastics.

- **Annex VI – Prevention of Air Pollution from Ships**
  - Local air pollutants (SO\textsubscript{x}, PM, NO\textsubscript{x})
  - Ozone Depleting Substances
  - Volatile Organic Compounds
  - Incinerators
  - Energy Efficiency of Ships
Chapter 3: control of emissions from ships

- Ozone Depleting Substances
- Nitrogen Oxides (NOx)
- Sulphur Oxides (SOx) and PM
- Volatile Organic Compounds (VOCs)
- Shipboard incineration & reception facilities
- Fuel oil availability and quality

Chapter 4: regulations on energy efficiency for ships

- EEDI
- SEEMP and data collection and reporting
MARPOL Annex VI framework
Shipping air emissions and its impacts

Figure 8.1 Schematic diagram of the overall impacts of emissions from the shipping sector on climate change (from Lee et al., 2009a)
Why regulate shipping emissions? Impact on human health and the environment

Annual average contribution of shipping to PM$_{2.5}$ concentrations (micrograms/m$^3$)
Concentration increases from ships range up to 2 μg per cubic meter (μg/m$^3$) and occur primarily over oceans and coastal regions.
Ratification of MARPOL Annex VI

- Air Pollution Conference 1997 adopted the Protocol of 1997 to amend the MARPOL Convention, adding a new Annex VI entitled “Regulations for the Prevention of Air Pollution from Ships”
- Number of Contracting States: 93 (as of 21 May 2019)
- The combined merchant fleets of which constitute approximately 96.68% of the gross tonnage of the world’s merchant fleet
- Entry into force in the Country 3 months after the date of deposit of the instrument of ratification
Why become a Party to MARPOL Annex VI?

- Governments may wish to become Parties to MARPOL Annex VI as result of:
  - Marine environmental concerns for waters under their jurisdiction
  - Air quality concerns as they affect populations or land areas under their jurisdiction
  - Benefits to their shipowners (worldwide acceptance of ships)
  - Benefits to their ports (means to control pollution)
  - Concern for worldwide environment

- Parties to MARPOL have the **obligation** not to discharge harmful substances into the sea or to control the discharge of pollutants to the atmosphere

- But they in return have the **privilege** of not being polluted by other Parties (if they are, and the pollution occurs within their territorial waters, they can prosecute)
MARPOL Annex VI – Regulations

Chapter 1 - General

Application Reg.1
Definitions Reg.2
Exceptions and exemptions Reg.3
Equivalents Reg.4

Chapter 2 - Survey, Certification and Means of Control

Surveys Reg.5
Issue or endorsement of certificates Reg.6
Issue of a certificate by another Party Reg.7
Form of certificates Reg.8
Duration and validity of certificates Reg.9
Port state control and operational requirements Reg.10
Detection of violations and enforcement Reg.11
### MARPOL Annex VI – Regulations

**Chapter 3 - Requirements for Control of Emissions**

- Ozone-depleting substances  
  - Reg.12
- Nitrogen oxides (NO\textsubscript{x})  
  - Reg.13
- Sulphur oxides (SO\textsubscript{x}) and Particulate Matter (PM)  
  - Reg.14
- Volatile organic compounds (VOC)  
  - Reg.15
- Shipboard incineration  
  - Reg.16
- Reception facilities  
  - Reg.17
- Fuel oil availability and quality  
  - Reg.18
Chapter 4 - Energy Efficiency Regulations

Application Reg.19
Attained EEDI Reg.20
Required EEDI Reg.21
SEEMP Reg.22
DCS (Data Collection System) Reg.22A
Technical cooperation and technology transfer Reg.23

Chapter 5 - Verification of compliance (III Code and mandatory IMO Audit Scheme)

Application Reg.24
Verification of compliance Reg.25
Regulation 1 - Application

1. The provisions of Annex VI shall apply to all ships, except where expressly provided otherwise in Regulations 3, 5, 6, 13, 15, 16, 18, 19, 20, 21, 22 and 22A of this Annex

- When suffering damage to ship or equipment
- When saving life at sea
- When securing safety of ship
- Ship trials for research
- Ships smaller than certain size
- Certain ship size and ship types based on specific regulations
Typical terms that are defined:

- **Emission control area** means an area where the adoption of special mandatory measures … is required to control NO\(_x\) or SO\(_x\) and particulate matter or all three types of emissions …

- **Fuel oil** means any fuel delivered to and intended for combustion … including gas, distillate and residual fuels

- **NO\(_x\) Technical Code** means the Technical Code on Control of Emission of Nitrogen Oxides from Marine Diesel Engines …
Regulation 3 - Exceptions and Exemptions

General

1. Regulations of this Annex shall not apply to:
   .1 any emission necessary for the purpose of securing the safety of a ship or saving life at sea; or
   .2 any emission resulting from damage to a ship or its equipment:
      .2.1 provided that all reasonable precautions have been taken after the occurrence of the damage …; and
      .2.2 except if the owner or the master acted either with intent to cause damage, or …

Trials for Ship Emission Reduction and Control Technology Research

Emissions from Sea-bed Mineral Activities

3.1. Emissions directly arising from the exploration, exploitation and associated offshore processing of sea-bed mineral resources …
Regulation 4 – Equivalents

1. The Administration of a Party may allow any .. apparatus .. or compliance methods used as an alternative if such .. appliances or compliance methods are at least as effective as that required by this Annex, ....

2. The Administration of a Party which allows such an alternative ..... shall communicate to the Organization for circulation to the Parties the particulars thereof, for their information and appropriate action ...

Notifications from Parties are available through the IMO Global Integrated Shipping Information System (GISIS)

http://gisis.imo.org/Public/
Regulation 5 – Surveys and inspections for MARPOL Annex VI
Survey guidelines under the Harmonized System of Survey and
Classification (HSSC), 2017 (resolution A.1120(30))

• Initial survey – A complete inspection of all the items concerning the
  particular certificate before the ship is put into service.

• Renewal survey – As similar as the periodical survey but consequently
  results in issuing a new certificate.

• Intermediate survey – Inspection of some items relating to the
  certificates.

• Annual survey – General reviewing of the items related to particular
  certificates to ascertain the fact that they have been maintained and
  remained as per certificates.
Regulation 6 – Issue or Endorsement of Certificates

1. An **International Air Pollution Prevention (IAPP) Certificate** shall be issued, after an initial or renewal survey ..., to:

   a. any ship of 400 gross tonnage and above engaged in voyages to ports or offshore terminals under the jurisdiction of other Parties; and
   b. platforms and drilling rigs engaged in voyages to waters under the sovereignty or jurisdiction of other Parties.

2. An **International Energy Efficiency (IEE) Certificate** shall be issued, after an initial survey....

3. Such certificates shall be issued or endorsed either by Administration or RO. In every case, **the Administration assumes full responsibility** for certificate.

4. Upon receipt of reported data pursuant to regulation 22A.3 => issuance of a **Statement of Compliance** related to fuel oil consumption
Regulation 7 – Issue of a Certificate by another Party

1. A Party may, at the request of the Administration, survey a ship and, ...shall issue or authorize the issuance of relevant Certificates ...

2. A Copy of certificates and a copy of the survey report shall be transmitted to the requesting Administration.

3. A certificate so issued shall contain a statement to the effect that it has been issued at the request of the Administration and it shall have the same force ...

4. No IAPP / IEE Certificate shall be issued to a ship which is entitled to fly the flag of a State which is not a Party.
Survey and certificates summary

- All ships of ≥ 400 gross tonnage
- Fixed or floating platforms (drilling rigs)
- Floating craft and submersibles

≥ 5,000 gross tonnage

Chapter 3
International Air Pollution Prevention (IAPP) Certificate

Chapter 4
DCS Statement of Compliance
International Energy Efficiency (IEE) Certificate
Subject to Initial, annual, intermediate and renewal surveys

Subject to Initial, annual, intermediate and renewal surveys
Regulation 8 – Form of Certificates

The IAPP Certificate and its Supplement* shall be drawn up in a form corresponding to the model given in appendix I to this Annex

Guidance on the Supplement to the IAPP Certificate (MEPC.1/Circ.849)
Regulation 9 – Duration and Validity of Certificates (1/2)

1. An IAPP Certificate shall be issued for a period specified by the Administration, which shall not exceed five years.

2. **Renewal** of the certificate:

   .1 when the renewal survey is completed within three months before the expiry date, the new certificate shall be valid .......... to a date not exceeding five years from the date of expiry of the existing certificate;

   .2 when the renewal survey is completed after the expiry date of the existing certificate, the new certificate shall be valid from the date of the renewal survey to a date not exceeding five years from expiry date of existing one.
Regulation 9 – Duration and Validity of Certificates (2/2)

.3 when the renewal survey is completed more than three months before the expiry date of the existing certificate, the new certificate shall be valid from the date of completion of the renewal survey to a date not exceeding five years from the date of completion of the renewal survey.

.4 If a renewal survey has been completed and a new certificate cannot be issued … before the expiry date of the existing one, the person or organization authorized by the Administration may endorse the existing certificate…
Regulation 10 – Port State Control on Operational Requirements

1. A ship, when in a port or an offshore terminal under the jurisdiction of another Party, is subject to inspection by officers duly authorized by such Party where there are clear grounds for believing that the master or crew are not familiar with essential shipboard procedures relating to prevention of pollution from ships.

2. The Party shall take such steps as to ensure that the ship shall not sail until the situation has been brought to order in accordance with the requirements of this Annex.
Regulation 11 – Detection of Violations and Enforcement

1. Parties shall co-operate in the detection of violations and the enforcement of the provisions of this Annex ….

2. A ship to which this Annex applies may, in any port or offshore terminal of a Party, be subject to inspection by officers appointed or authorized by that Party …

3. Any Party shall furnish to the Administration evidence, if any, that the ship has emitted any of the substances covered by this Annex in violation of the provisions of this Annex.

4. Upon receiving such evidence, the Administration so informed shall investigate the matter ….. that sufficient evidence is available to enable proceedings to be brought in respect of the alleged violation, it shall cause such proceedings to be taken in accordance with its law as soon as possible.

And other aspects …..
Main aspects of SOx, NOx and GHG emissions control
(under MARPOL Annex VI, Chapters 3 and 4)
How is SO\textsubscript{x} produced and what is its impact?

- SO\textsubscript{x} is normally Sulphur dioxide (SO\textsubscript{2}) and to some extent Sulphur trioxide (SO\textsubscript{3})
- SO\textsubscript{x} is produced from combustion (oxidation) of sulphur contained in most fuel-oil
- **SO\textsubscript{x} causes:**
  - acid rain
  - sea and soil acidification
  - human health issues
  - A study on the human health impacts of SO\textsubscript{x} emissions from ships, submitted to MEPC by Finland in 2016 estimated that by not reducing the SO\textsubscript{x} limit for ships from 2020, the air pollution from ships would contribute to more than 570,000 additional premature deaths worldwide between 2020-2025.
- PM (Particulate Matter) is produced due to incomplete combustion of fuel.
- Level of PM is dependent on fuel sulphur level.

\[\Rightarrow \text{reduction of fuel sulphur will reduce SO}_{x} \text{ but also PM}\]
Sulphur content of fuel oil used on board ships (Regulation 14 of MARPOL Annex VI)

- **Non-ECA**
  - 01/10/2012: 3.50%
  - 01/1/2015: 1.50%
  - 01/1/2020: 0.10%

- **ECA**
  - 01/7/2010: 1.50%
  - 01/1/2015: 1.00%
  - 01/1/2020: 0.50%

**Review of fuel oil availability (2016)**
SOx emissions will be discussed into more details later…
What is NO\textsubscript{x}  

- NOx refers to oxides of nitrogen including NO\textsubscript{2} and NO

- Formed in the process of fuel combustion where O\textsubscript{2} and N\textsubscript{2} meet at high temperature

- The higher the temperature (and longer the exposure time at high temp.), the more NO\textsubscript{x} is formed

- In engines, the higher the temperature, the more efficient the engine is; thus more NO\textsubscript{x} produced

- Marine engines are most efficient engines and also produce highest NO\textsubscript{x} compared to other types of engines and combustion systems

- NO\textsubscript{x} from other sources (e.g. boilers, dual fuel engines, gas turbines, ) are relatively small due to their type of combustion
Impact of NO$_x$

- NO$_x$ is a reactive gas, at the presence of sunlight
- NO$_x$ contributes to ground-level ozone formation
- NO$_x$ contributes to smog formation.
- Causes health problem; in particular on respiratory system
- Additionally, NO$_x$ contributes to global warming and acid rain

**Photochemical smog:**

Chemical reaction of NOx and VOC in the atmosphere together with PM and water vapour, which leaves airborne particles and ground-level ozone
### Regulation 13 NO$_x$ - Application

<table>
<thead>
<tr>
<th>Applies to</th>
<th>Marine diesel engines with a power output more than 130 kW</th>
<th>installed on a ship constructed on or after 1 January 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applies to</td>
<td>Marine diesel engines with a power output more than 130 kW</td>
<td>undergone a <strong>major conversion</strong> on or after 1 January 2000</td>
</tr>
<tr>
<td>Applies to</td>
<td>Marine diesel engines with an Approved Method</td>
<td>Installed on a ship constructed on or between 1 Jan 1990 to 31 Dec 1999</td>
</tr>
</tbody>
</table>

**Not applicable to**
- Emergency marine diesel engines
- Marine diesel engines installed on lifeboats
- Any device or equipment intended to be used solely in case of emergency
- Engines on ships only engaged in domestic voyages can be made subject to alternative NO$_x$ control measure or exempted if pre-19 May 2005
Regulation 13 - NOx emission limits

<table>
<thead>
<tr>
<th>Tier</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier I</td>
<td>Constructed on or after 1 Jan. 2000</td>
</tr>
<tr>
<td>Tier II</td>
<td>Constructed on or after 1 Jan. 2011</td>
</tr>
<tr>
<td>Tier III</td>
<td>Applied in ECAs&lt;br&gt;- Constructed on or after 1 Jan. 2016*&lt;br&gt;- Constructed on or after 1 Jan. 2021**</td>
</tr>
</tbody>
</table>

* North American and US Caribbean Sea Area ECA
** Baltic and North Sea ECAs

20% reduction
80% reduction

Rated engine speed (rpm)

NOx emission limit (g/kWh)
Tier III
Emission Control Areas (ECAs) for NO\textsubscript{X} emission control

North American ECA

Reg. 13.5.1:

Tier III controls apply only to the specified ships while operating in ECAs established to limit further the NO\textsubscript{X} emissions. These are:

- North America ECA + US Caribbean ECA for ships constructed on or after 1 January 2016
- Baltic Sea and North Sea ECA from 1 January 2021.

Applies to newly constructed ships after such dates.
North Sea and Baltic Sea ECA NOx

- MEPC 70 approved North Sea and Baltic Sea as an ECA-NOx and adopted at MEPC 71 in July 2017 – entered into force on 1 January 2019

- Tier III NOx emission limit will apply to engine installed on ships constructed on or after 1 January 2021 and operating in North Sea and Baltic Sea
Pre-2000 engines
Regulation 13 – Approved methods

Ships constructed - 1 Jan 1990 to 31 Dec 1999:

• Required to fit an “approved method” to enable the engine to meet Tier I NO\textsubscript{X} emission limits
• IMO to be notified of approved method
• The approved method to be installed at first renewal survey 12 months after IMO notified the “method” is approved
Regulation 13 - Approved Method examples

MEPC.1/Circ.845 (List of Notifications from Administrations, as of July 2014)

<table>
<thead>
<tr>
<th>Date of notification</th>
<th>Administration</th>
<th>Engine type</th>
<th>Manufacture</th>
<th>Type of approved method</th>
<th>MCR per cylinder (kW/cyl)</th>
<th>Rated speed (rpm)</th>
<th>IMO Circular No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 October 2010</td>
<td>Denmark</td>
<td>S70MC</td>
<td>MAN B&amp;W</td>
<td>Fuel nozzle</td>
<td>2,530 – 2,810</td>
<td>81 – 91</td>
<td>MEPC.1/Circ.738</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RTA52</td>
<td>Wärtsilä Swiss Ltd.</td>
<td>NOx optimized injection timing</td>
<td>-</td>
<td>-</td>
<td>MEPC.1/Circ.743</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RTA52U</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>RTA58T</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>RTA62</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>RTA62U</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>RTA72</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>RTA72U</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>RTA84C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>RTA84CU</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>RTA84M</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>RTA84T-B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>RTA96C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 February 2011</td>
<td>Germany</td>
<td>S70MC</td>
<td>MAN B&amp;W</td>
<td>Fuel nozzle</td>
<td>2,250 – 2,810</td>
<td>81 – 91</td>
<td>MEPC.1/Circ.764</td>
</tr>
<tr>
<td>11 August 2011</td>
<td>Denmark</td>
<td>S70MC</td>
<td>MAN B&amp;W</td>
<td>Fuel nozzle</td>
<td>1,160 – 1,430</td>
<td>114 – 127</td>
<td>MEPC.1/Circ.765</td>
</tr>
<tr>
<td>5 October 2011</td>
<td>Denmark</td>
<td>S60MC</td>
<td>MAN B&amp;W</td>
<td>Fuel nozzle</td>
<td>1,650 – 2,040</td>
<td>94 – 105</td>
<td>MEPC.1/Circ.770</td>
</tr>
<tr>
<td>4 June 2014</td>
<td>Denmark</td>
<td>L50MC</td>
<td>MAN B&amp;W</td>
<td>Fuel nozzle</td>
<td>1,075 – 1,330</td>
<td>133 – 148</td>
<td>MEPC.1/Circ.837</td>
</tr>
</tbody>
</table>

Any up-to-date information will be available on: http://gisis.imo.org/Public/
Regulation 13 (NO$_x$) – Engine certification (pre-installation certification on test bed)

- Test bed exhaust emission measurement

- NO$_x$ Technical File
  - Information on components, settings, operating values & adjustments to maintain NO$_x$ emissions within allowable limits

- Issue of Engine International Air Pollution Prevention (EIAPP) Certificate or statement of compliance for an engine
  - Issued for applicable engines
  - Valid for the engines life (unless major conversion)
Regulation 13 (NO$_x$) - Onboard NO$_x$ verification methods (post-installation)

Verification methods (NO$_x$ Technical Code Chapter 6)

- **Engine Parameter Check method** in accordance with 6.2 to verify that an engine’s component, setting and operating values have not deviated from the specifications in the engine’s NOx Technical File.

- **Simplified Measurement method** in accordance with 6.3; (Complicated and expensive). Confirmation test of NO$_x$ emissions to be within the limits of respective emissions measured on the test bed.

- **Direct Measurement and Monitoring method** in accordance with 6.4. Direct measurement of the exhaust flow by flow nozzle or equivalent metering system; difficulties in terms of direct gaseous flow measurement; potential errors.
Summary
NO$_x$ Certificates (Ships >400 GT)

• Required for diesel engine with output more than 130 kW on ships keel laid on or after 1 January 2000.

• Or for pre-2000 ships with Approved Method.

• Or major conversions of engines after this date.

• Certification according to NO$_x$ Technical Code 2008 from 1 July 2010 → EIAPP certificate

• Tiers I, II and II are applicable. Tier III only applicable in ECA-NOx.
CO$_2$ concentrations

The world’s challenge: increasing CO$_2$ concentrations in the atmosphere

400 ppm exceeded for the first time in April 2015

Source: IPCC
Current and projected GHG emissions from international shipping

- In 2012, international shipping CO₂ emissions were estimated to be 796 million tonnes accounting for 2.2% of global CO₂ emissions.

- By 2050, CO₂ emissions from international shipping could grow by between 50% and 250%, depending on future economic growth and energy developments.

- Demand is the key driver for growth.

Ref: Third IMO GHG Study 2014
Energy efficiency regulations for ships

- Chapter 4 added to MARPOL Annex VI (regulations 19 to 23) in 2011
- Entered into force on 1 January 2013
- First ever mandatory global energy efficiency standard for international shipping

RESOLUTION MEPC.203(62)

Adopted on 15 July 2011


(Inclusion of regulations on energy efficiency for ships in MARPOL Annex VI)

THE MARINE ENVIRONMENT PROTECTION COMMITTEE,

RECALLING Article 38(a) of the Convention on the International Maritime Organization concerning the functions of the Marine Environment Protection Committee (the Committee) conferred upon it by international conventions for the prevention and control of marine pollution,
Energy efficiency regulations for ships

- Apply to internationally trading ships of ≥ 400 GT
- Make mandatory:
  - **Energy Efficiency Design Index (EEDI)** for new ships (Reg. 20 and 21)
  - **Ship Energy Efficiency Management Plan (SEEMP)** for all ships (Reg. 22)
  - **Collection and reporting of ship fuel oil consumption data (Data collection system)** (Reg. 22A)

- DCS applies to ships 5,000 GT and above = ships responsible for 85% of GHG emissions from international shipping

Mandatory from 2013
Mandatory from 2013
Mandatory 1st collection year 2019
Energy efficiency regulations for ships

**EEDI**

Energy Efficiency Design Index
Performance of the hardware (ship)

\[
\text{EEDI} = \frac{\text{FOC} \times C}{\text{Capacity} \times V_s}
\]

**EEOI**

Energy Efficiency Operational Indicator
Performance improvement by the effort in operation

\[
\text{EEOI} = \frac{\text{Fuel (ave.)} \times C}{\text{Cargo} \times \text{Distance}}
\]

- Speed control, weather routing, well maintenance, optimum trim and draft etc.

**SEEMP**

Ship Energy Efficiency Management Plan
Projected CO₂ emissions reduction from EEDI and SEEMP

- Document MEPC 63/INF.2 provides estimated CO₂ emissions reduction from the introduction of EEDI and SEEMP, based on a study from LR and DNV:
  - Compared with Business as Usual (BAU), EEDI is expected to generate an annual reduction of between 600 million and 1,000 million tonnes of CO₂ in 2050.
  - Compared with Business as Usual (BAU), SEEMP is expected to generate an annual reduction of between 103 million and 325 million tonnes of CO₂ by 2050.
  - The estimated reductions in CO₂ emissions, for combined EEDI and SEEMP, from the world fleet translate into a significant annual fuel cost saving of about US$50 billion in 2020 and about US$200 billion by 2030.
  - Despite the significant CO₂ emission reduction potential resulting from EEDI and SEEMP regulations, an absolute reduction in total CO₂ emissions for shipping from the 2010 level appears not to be feasible using these two measures alone.
Important IMO Achievements on Climate Change

Norway proposes to establish an emission target for international shipping
March 2004 (MEPC 51)

MARPOL requirements on energy efficiency enters into force
January 2013

Amendments to MARPOL Annex VI adopted – the data collection system for fuel oil consumption of ships
MEPC 70 (Oct 2016)

Roadmap for developing an IMO Strategy on GHG emissions reduction – agreed
MEPC 70 (Oct 2016)

Amendments to MARPOL Annex VI – the data collection system for fuel oil consumption of ships entered into force
March 2018

1997
- The IMO mandate on GHG emissions established through the 1997 MARPOL Conference Resolution 8 on “CO2 emissions from ships”
  Sept 1997

2003
- Resolution A.963(23) "IMO Policies and Practices related to the Reduction of Greenhouse Gas Emissions from Ships"
  Dec 2003

2004
- Amendments to MARPOL Annex VI – to include requirements on energy efficiency
  Adopted through a vote
  July 2011 (MEPC 62)

2011
- Tony De Brum (MI): Proposal to establish a GHG emission reduction target for international shipping consistent with keeping global warming below 1.5°C
  MEPC 68 May 2015

2013
- IMO Strategy on Reduction of GHG emissions from ships – Adopted
  April 2018 (MEPC 72)

2015 2016 2017 2018
WORLD MARITIME DAY 2019

EMPOWERING WOMEN
IN THE MARITIME COMMUNITY