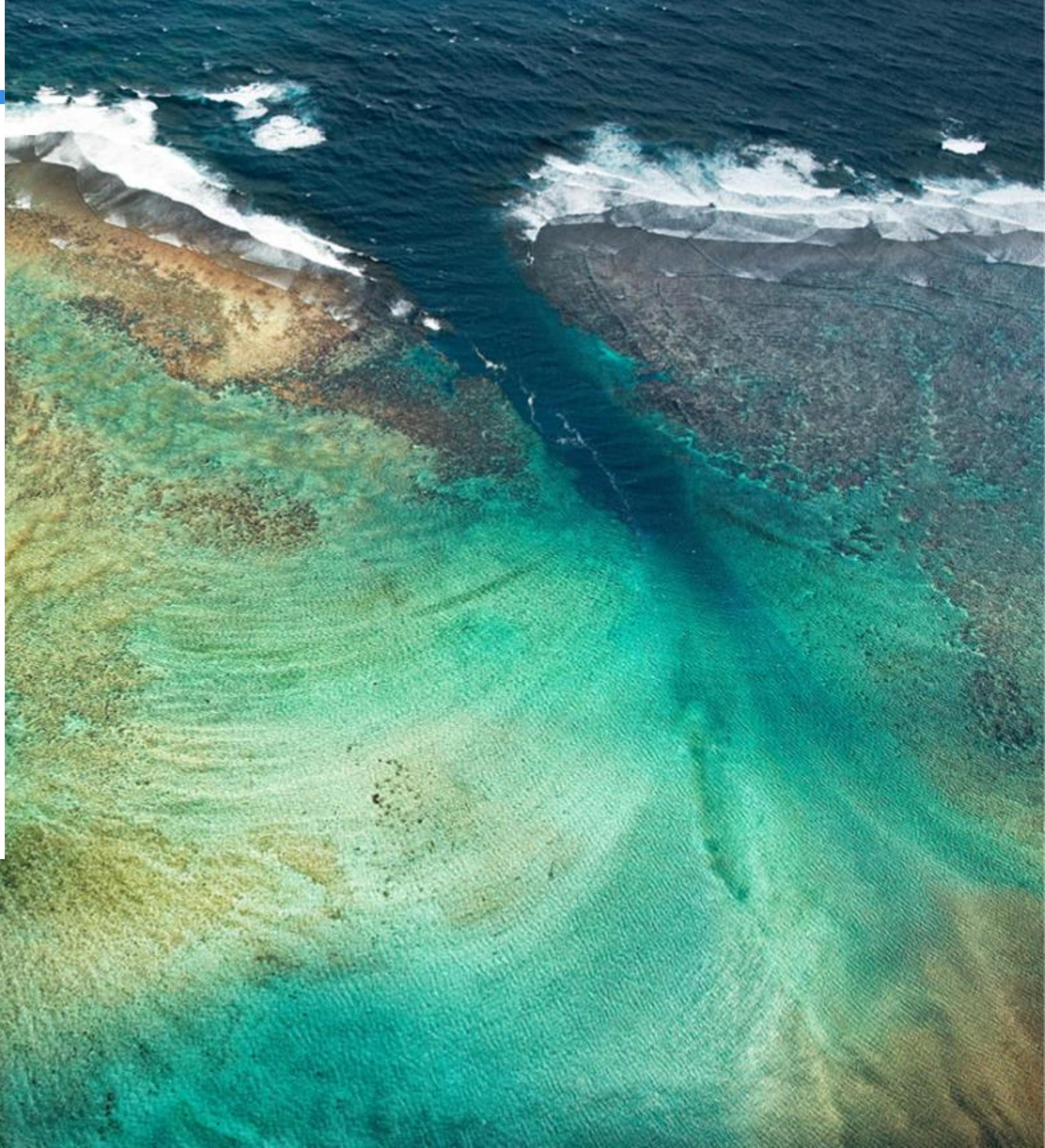
The regulatory framework affecting shipbuilding

Nikolas Vaporis

06 June 2018

Lloyd's Register



Contents

Reduction of GHG emissions from ships

Reduction of GHG emissions from ships

Initial IMO Strategy on Reduction of GHG Emissions from Ships

- MEPC 72 adopted a Resolution on "Initial IMO Strategy on Reduction of GHG Emissions from Ships".

INITIAL IMO STRATEGY ON REDUCTION OF GHG EMISSIONS FROM SHIPS

Contents

Reduction of GHG emissions from ships

Initial IMO Strategy on Reduction of GHG Emissions from Ships

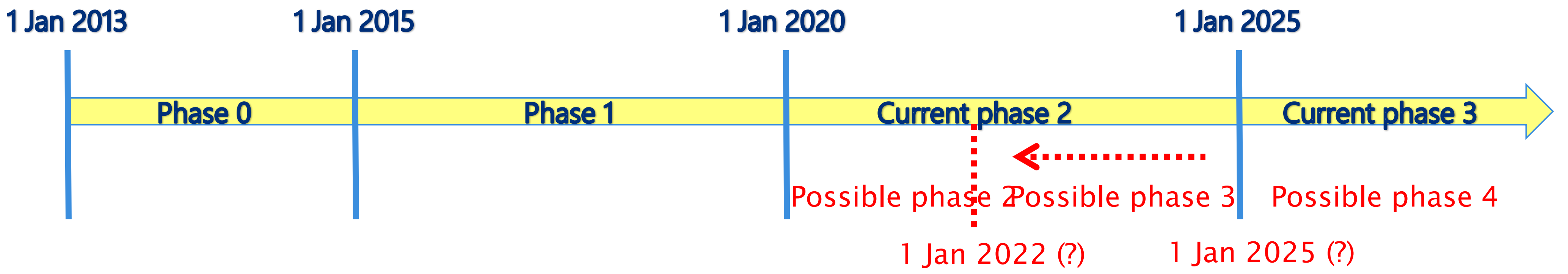
- **Levels of ambition**

Subject to amendment depending on reviews to be conducted by the IMO, the Initial Strategy identifies levels of ambition for the international shipping sector …	
.1	Carbon intensity of the ship to decline through implementation of further phases of the energy efficiency design index (EEDI) for new ships
	to review with the aim to strengthen the energy efficiency design requirements for ships with the percentage improvement for each phase to be determined for each ship type, as appropriate;
.2	Carbon intensity of international shipping to decline
	to reduce CO_2 emissions per transport work, as an average across international shipping, by at least 40% by 2030, pursuing efforts towards 70% by 2050, compared to 2008; and
.3	GHG emissions from international shipping to peak and decline
	to peak GHG emissions from international shipping as soon as possible and to reduce the total annual GHG emissions by at least 50% by 2050 compared to 2008 whilst pursuing efforts towards phasing them out as called for in the Vision as a point on a pathway of CO_2 emissions reduction consistent with the Paris Agreement temperature goals.

Reduction of GHG emissions from ships (Related to EEDI)

Under discussion
(To be completed in MEPC 74)

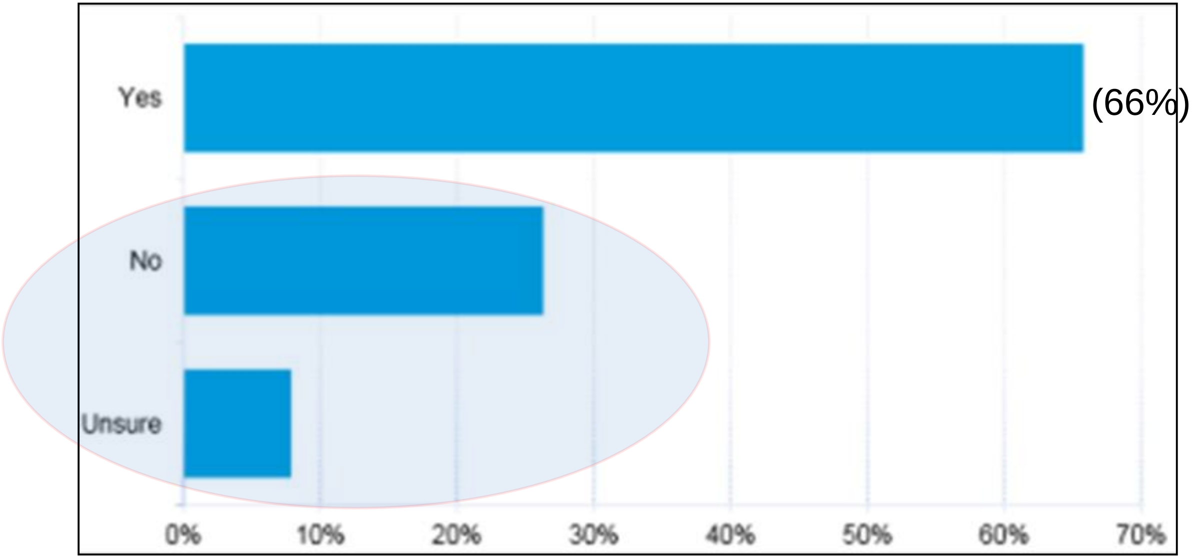
- Further review of EEDI – beyond phase 2
  - MEPC 70 agreed that the aforementioned review should be finalized in time for adoption of the necessary amendments to MARPOL Annex VI with a view to early implementation of phase 3 in 2022 and, if agreed, introduction of phase 4 as soon as possible.



Air pollution (SOx Control)

The 2020 Global Sulphur Limit

Do you expect the IMO global emission regulations to become enforceable as planned as from 2020?



(Source: Drewry Maritime Research (08 Apr 2018))

There is still uncertainty among shipowners …

IMO Frequently Asked Questions

The 2020 global sulphur limit

- **Can this date be changed?**

The date is set in the MARPOL treaty. So it can only be changed by an amendment to the MARPOL Annex VI. This would require a proposal for an amendment to be put forward by a Member State that is a Party to Annex VI, that proposal then circulated and finally adopted by MEPC. An amendment to MARPOL is required to be circulated for a minimum of six months prior to adoption and then can only enter into force a minimum of 16 months after adoption.

Given that Parties to MARPOL Annex VI decided in October 2016 to implement the 2020 date, it is not anticipated that such a proposal would be forthcoming.

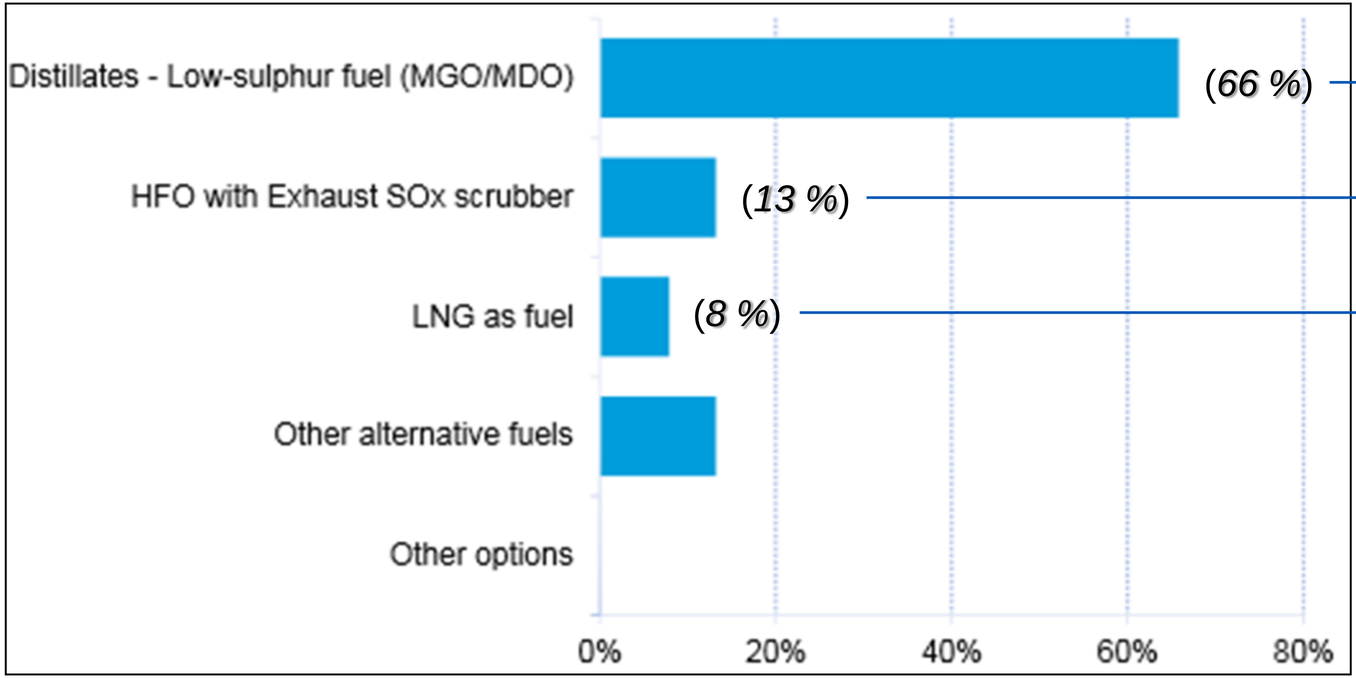
- **So can there be a delay in implementation?**

No, legally, there can be no change in the 1 January 2020 implementation date, as it is too late now to amend the date and for any revised date to enter into force before 1 January 2020.

However, IMO Member States will work in the relevant IMO technical bodies to address any issues that might arise with regards to ensuring consistent implementation.

Options for Ship Owners

How do you intend to ensure emission compliance for your existing fleet?



when looking at compliance for newbuilding projects …

37 % (LSFO)

21 % (SOx Scrubber)

24 % (LNG)

(Source: Drewry Maritime Research (08 Apr 2018))

Options for Ship Owners

Solution	Method	Pros	Cons	Likelihood
Do Nothing i.e. switch to distillate fuel in 2020	• Lower fuel sulphur content (including blended fuel)	• Safe • Proven • Limited technology investment needed	• Higher fuel cost • Fuel availability uncertain	• Considered to be the most likely option for majority of vessels
Alternative Fuels e.g. LNG	• Switch to using less polluting fuels	• LNG: very low NOx, SOx and PM • c.20% reduction in CO_2 emissions • Cost competitive fuel	• Retrofit complex and expensive • Technology is costly • Fuel availability uncertain - bunkering infrastructure limited • Cargo capacity	• Retrofits of existing ships unlikely • Approaching 10% of orderbook with LNG as fuel • Mainly LNG carriers/ Ferries/ Cruise – uptake likely to be much slower in volume sectors • Certain owners looking at other fuels including LPG
Exhaust Gas Cleaning Systems /SOx Scrubbers	• Open Loop: exhaust gases mix with seawater, forms sulphuric acid which is then neutralised by the alkaline components in seawater and discharged overboard • Closed Loop: gases are cleaned with seawater mixed with caustic soda. • Hybrid: capable of using both methods.	• SOx emissions reduced by more than 90% • PM emissions reduced by 60-90% • Enables continued use of cheaper HFO	• Significant investment/ payback period • Additional operational costs associated with catalyst, increased power and disposal of sludge • Issues with wash water discharge • Long term availability of low cost HFO	• Some uptake in orderbook but many owners unlikely to make CAPEX commitment (at least pre-2020).

(Source: Clackson Research, Environmental and Regulatory Update, Presentation to Shipbuilding Forecast Club(March 2018))

LNG as an alternative fuel

Pros

- SOx reduction of abt. 100 %
- NOx reduction of up to 80-90 %
- CO_2 reduction of 10-20 %
- Reduction of particulates
- Positive impact on EEDI
- Clean burning => less maintenance
- Chartering preference
- Second-hand value
- Better crew retention

Cons

- "New" technology as primary fuel
- Manoeuvre./low load on compliant fuel
- Possible methane slip
- May cause loss of cargo space
- Increased newbuilding/retrofit cost
- Availability of LNG
- Possible time constraints for bunkering
- Investment in crew training
- LNG price uncertainty

IGF Code (ships contracted on or after 1 January 2017 or delivered on or after 1 January 2021)

Lloyd's Register Rules for the Classification of Natural Gas Fuelled Ships

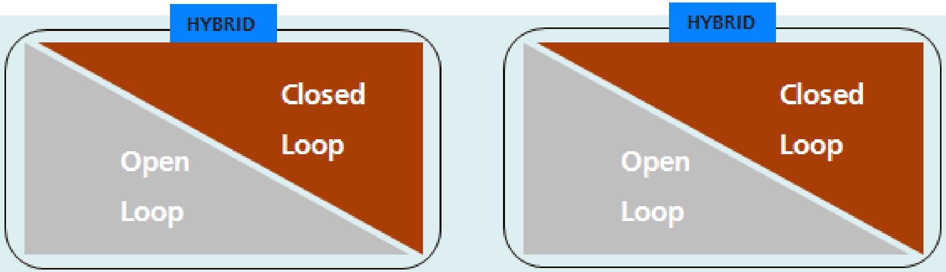
SOx Scrubber

- Fuel prices make exhaust gas cleaning attractive. There are two technologies capable of cleaning exhaust gas;

Scheme A *Scheme B*

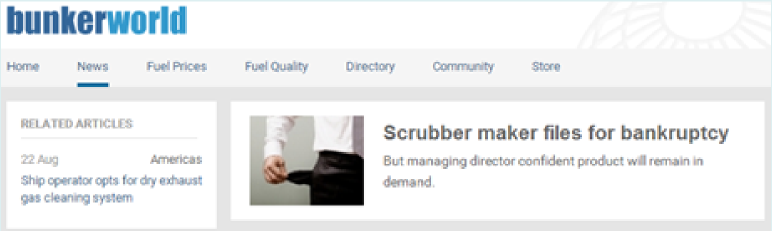
Wet Scrubber

Aqueous Chemical Reaction



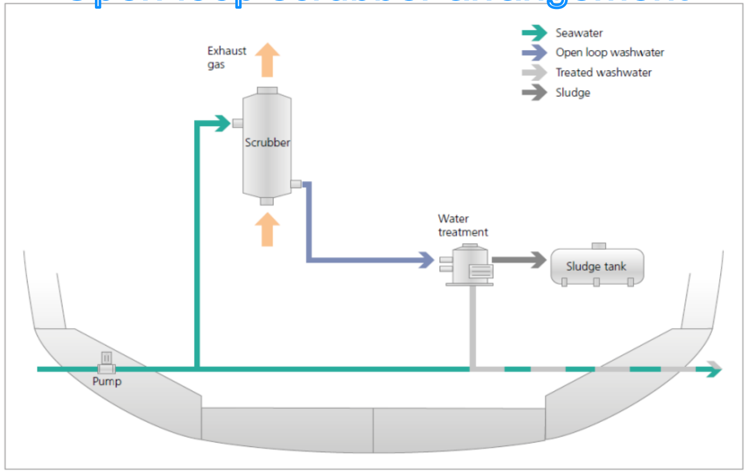
Dry Scrubber

Dry Chemical Reaction (calcium hydroxide)

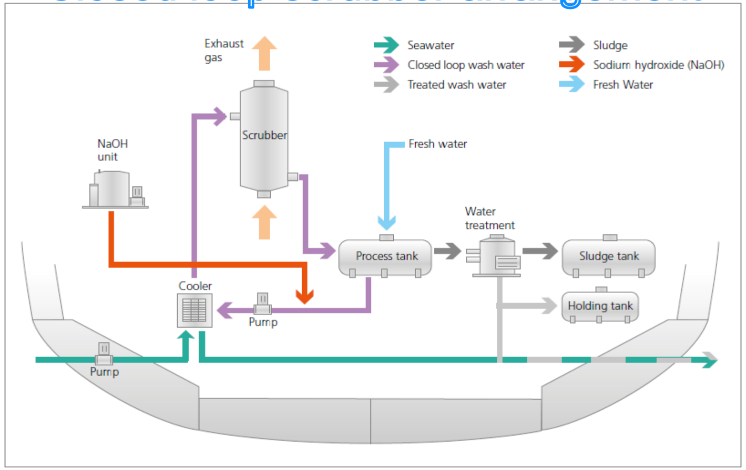


Wet exhaust gas scrubbers

Open loop scrubber arrangement



Closed loop scrubber arrangement



- Exhaust gas passed through water curtain
- Open and/or closed loop systems
- May present significant size and weight issues
- Requires a water treatment plant
- Significant energy consumption
- May not be compatible with SCR systems
- Possible **discharge restrictions** for **open loop** in certain territorial waters

Air pollution (NOx Control)

NOx Emission Control Requirements

NOx emission control requirements(Reg.13 of MARPOL Annex VI)

- Applicable to each marine diesel engine with a power output of more than 130 kW installed on a ship

n = rated engine speed (crankshaft RPM)	Tier I	Tier II	Tier III
	1 January 2000 ≤ K/L < 1 January 2011	1 January 2011 ≤ K/L	1 January 2016 ≤ K/L
n < 130 rpm	17.0 g/kWh	14.4 g/kWh	3.4 g/kWh
130 rpm ≤ n < 2000 rpm	$45.0 \times n^{(-0.2)}$ g/kWh	$44.0 \times n^{(-0.23)}$ g/kWh	$9 * n^{(-0.2)}$ g/kWh
2000 rpm ≤ n	9.8 g/kWh	7.7 g/kWh	2.0 g/kWh

- Ships (keel-laid on or after **1 January 2016**) operating in **the North American area** or **the U.S. Caribbean Sea area**
- Ships (keel-laid on or after **1 January 2021**) operating in **the Baltic Sea** or **the North Sea (including English Channel)**

Options for Ship Owners

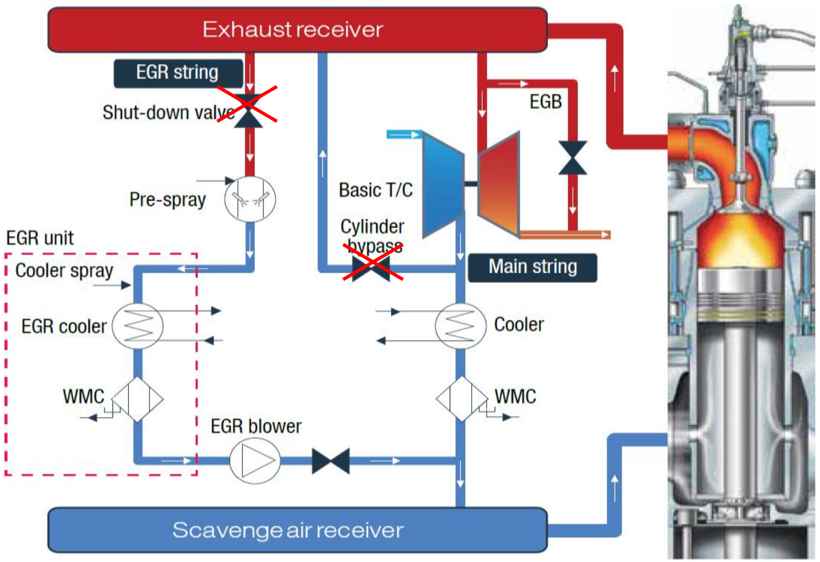
Solution	Method	Pros	Cons
Selective Catalytic Reduction (SCR)	• Use of urea and catalyst, which is added to the exhaust gas system	• Effective for most engine load range • Larger reference base • More widely tested by owners, especially in Norway	• High capital cost • Regular urea resupply • Not suitable for low engine load • Space for urea tank required • Ongoing cost of purchasing chemical agents
Exhaust Gas Recirculation (EGR)	• Recirculation of cooled exhaust gas into the charge air, to be used again in the combustion process	• Space saving • Low operating expenditure	• Reduced engine efficiency • High initial investment, retrofits are particularly expensive • Caustic soda required • Disposal of wash water and sludge • May not reduce emissions enough to comply with tier II limit without changes in engine operation or type of fuel used
LNG Fuel	• Lean-burn natural gas engines	• No SOx emission • Particulate matter and CO2 reduction • Competitive fuel cost	• High LNG conversion cost • LNG bunkering facility limited • Reduce of cargo space onboard • May not itself be enough to meet Tier III limits

(Source: Clackson Research, Environmental and Regulatory Update, Presentation to Shipbuilding Forecast Club(March 2018))

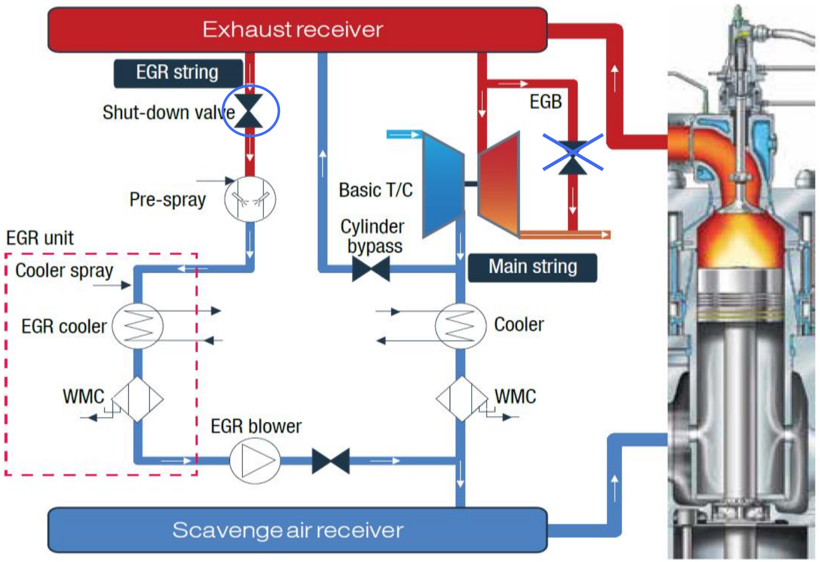
EGR – Working Principle

e.g. EGR with bypass

Tier II Mode

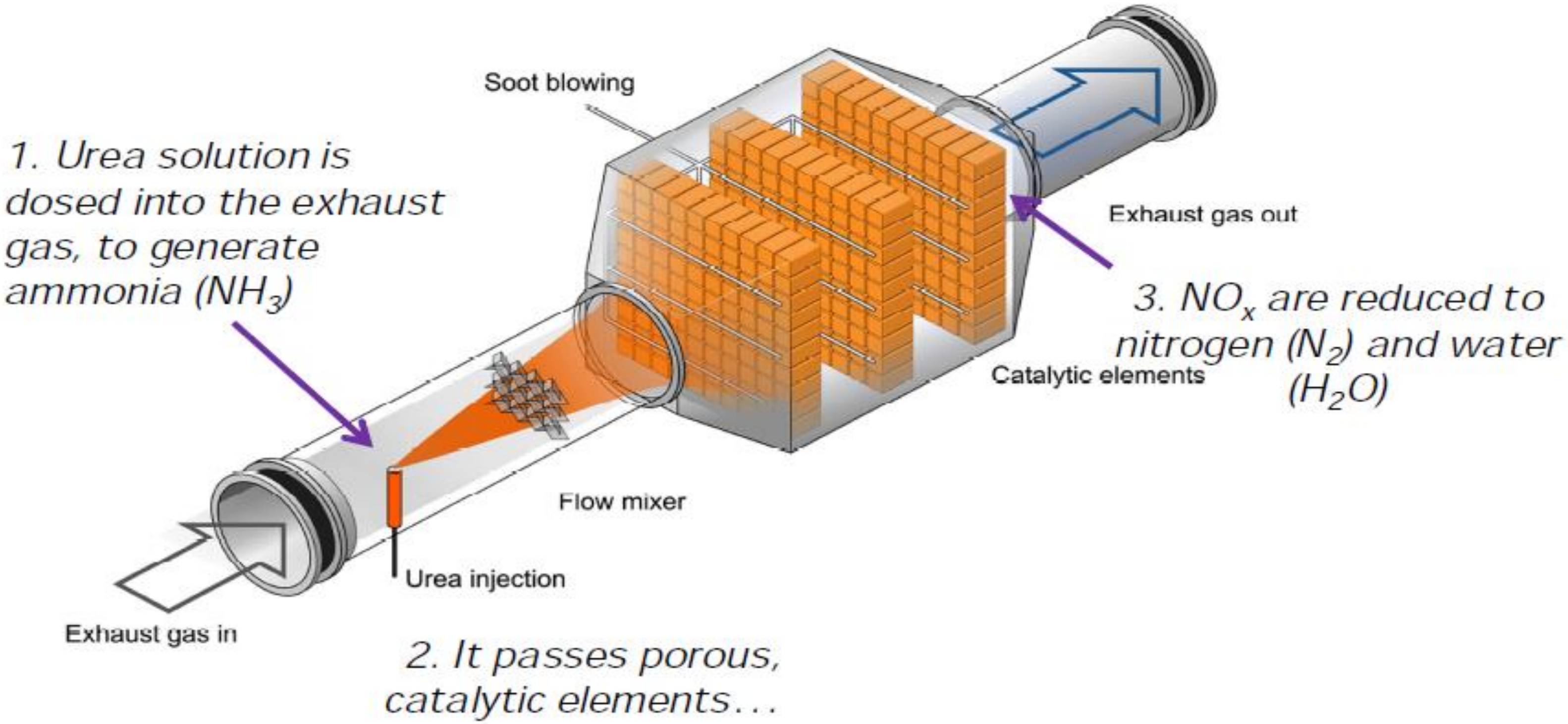


Tier III Mode



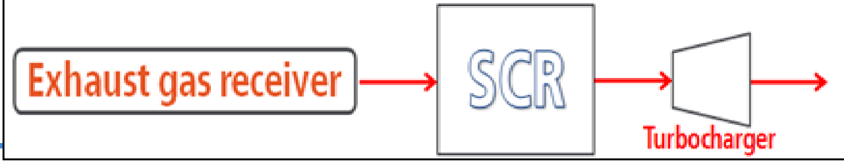
(Image courtesy of MAN Diesel & Turbo)

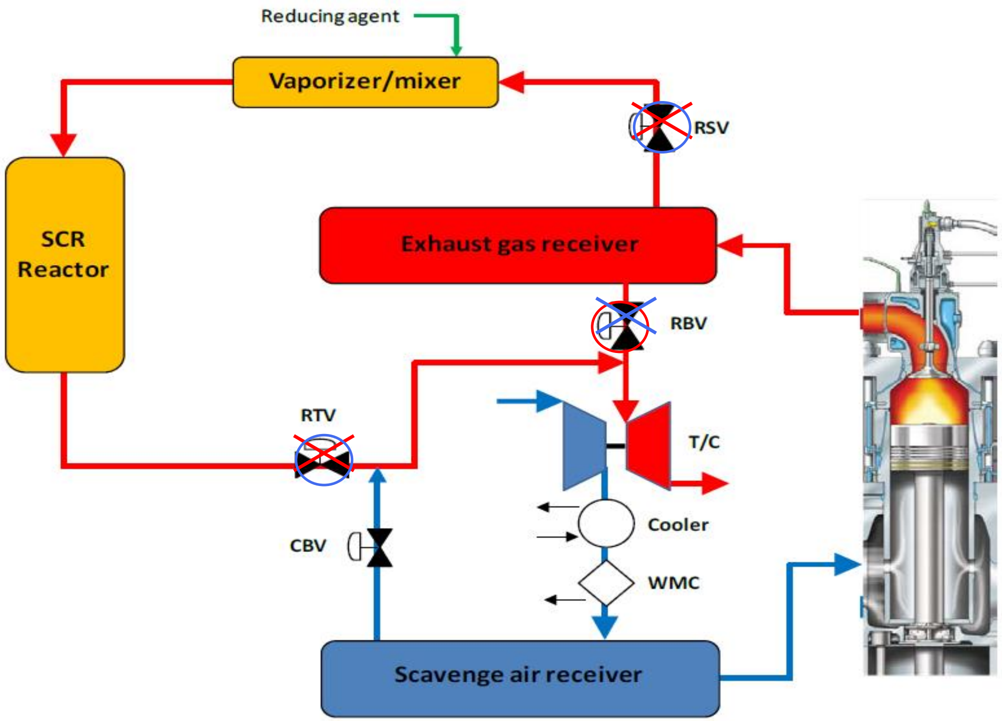
SCR – Working Principle

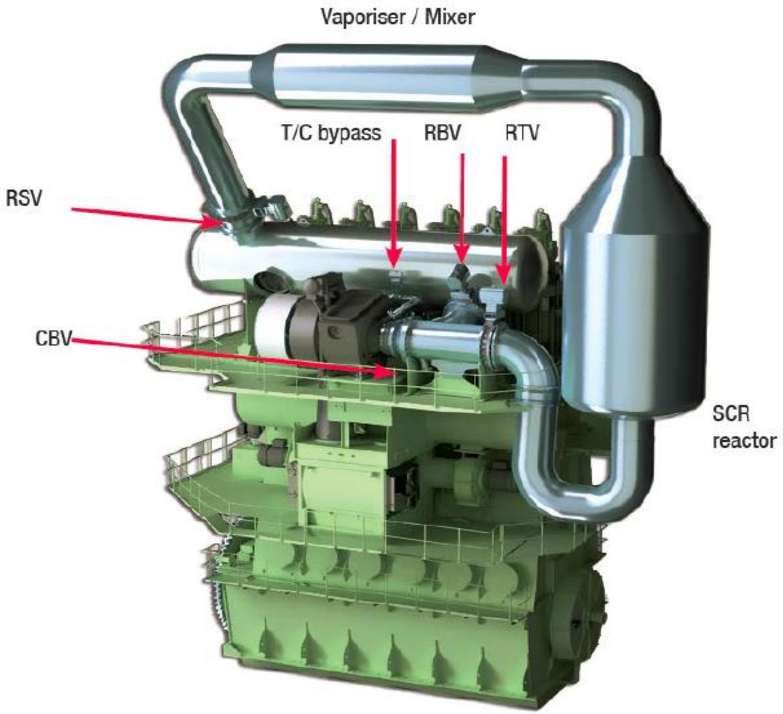


(Image courtesy of Winterthur Gas & Diesel)

HP SCR (High Pressure SCR)

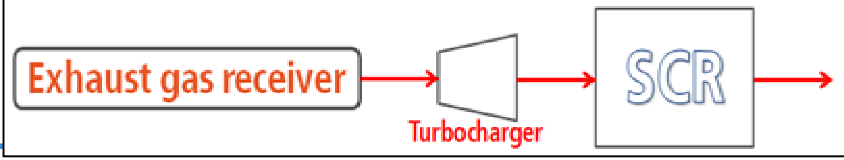


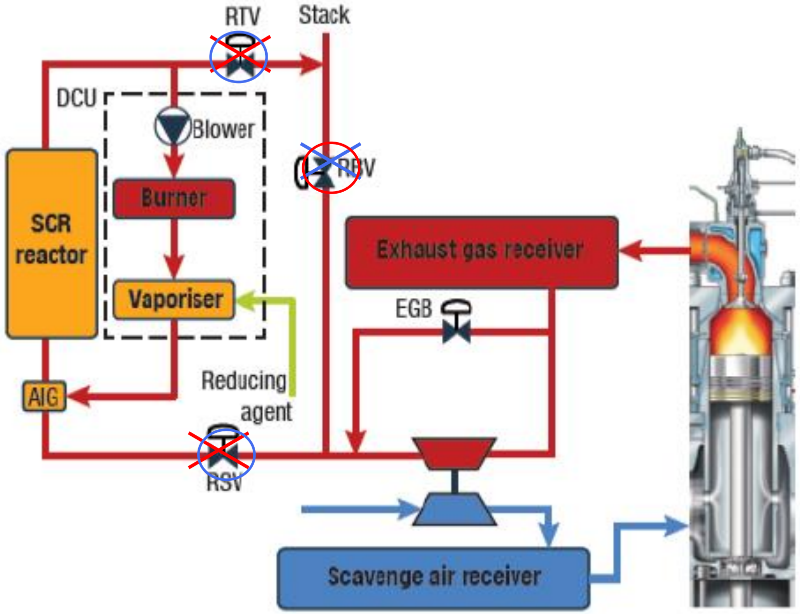


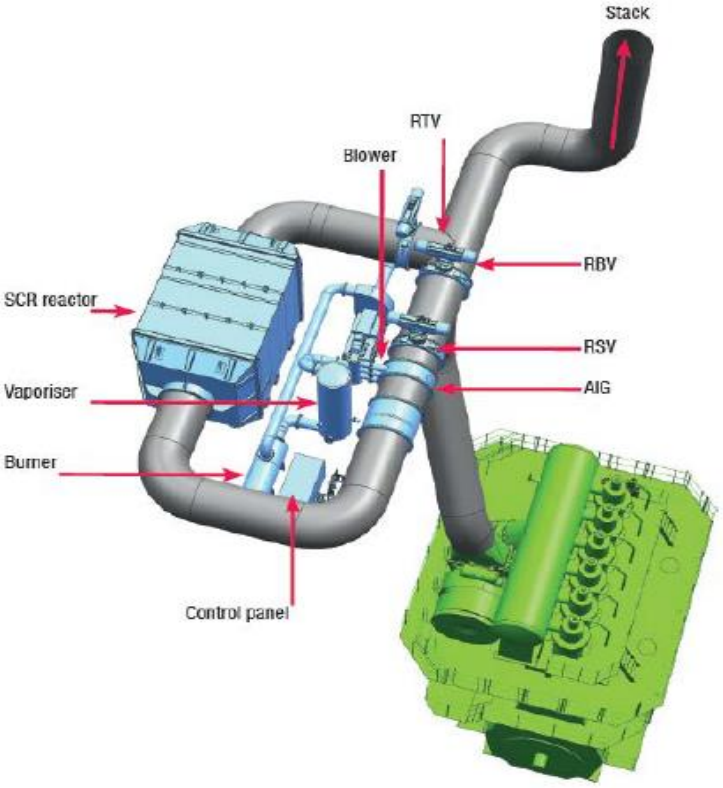


(Image courtesy of MAN Diesel & Turbo)

LP SCR (Low Pressure SCR)







(Image courtesy of MAN Diesel & Turbo)

Ballast Water Management

Application of BWMS Code (The same as that of Res.MEPC.279(70)(2016 Guidelines (G

Timeline

28 October 2018

28 October 2020

2 years

Approved on or after 28 Oct. 2018

New system approvals

System Type Approval

System Installation

Installed on or after 28 Oct. 2020

New **installation** onboard ships

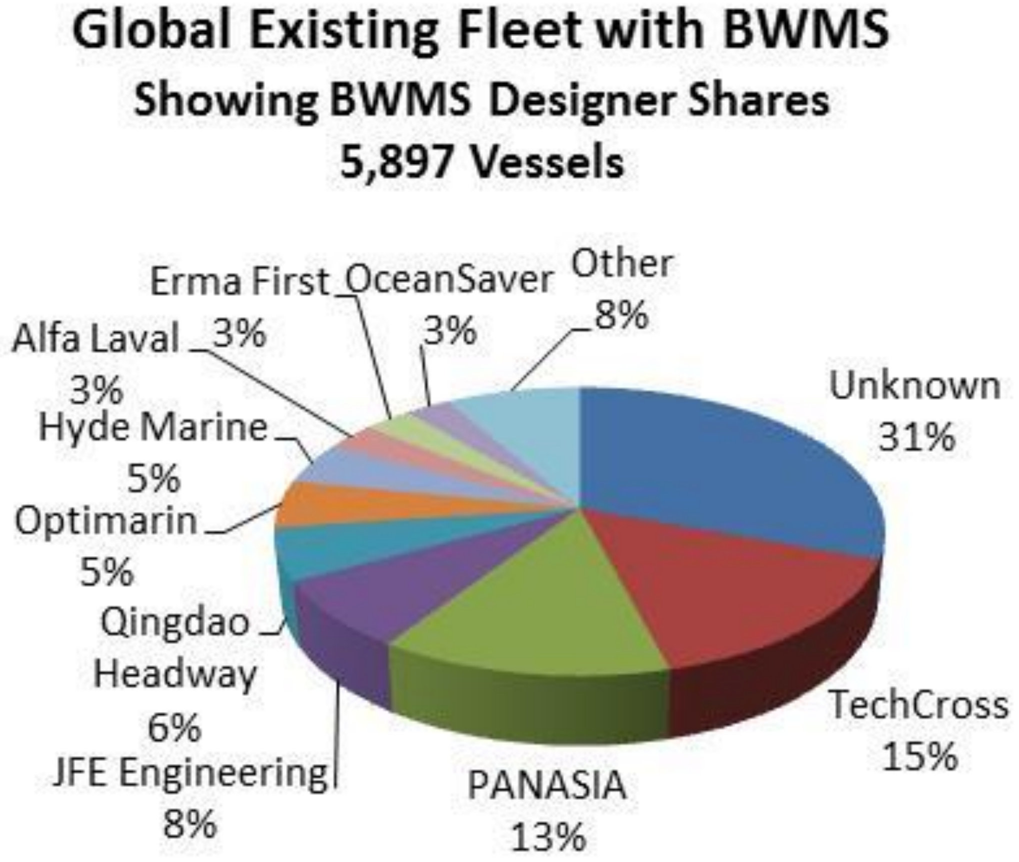
MSC.1/Circ.1221 (Validity of type approval certification for marine products)

The Type Approval Certificate itself has no influence on the operational validity of existing BWMS accepted and installed on board a ship and which were manufactured during the period of validity of the relevant Type Approval Certificate

Installation date

- **Contractual date of delivery of BWMS**; or
- In the absence of the contractual date of delivery, **actual date of delivery of BWMS**.

Ballast Water Treatment Systems



(Source: Clarkson's Research, March 2018)

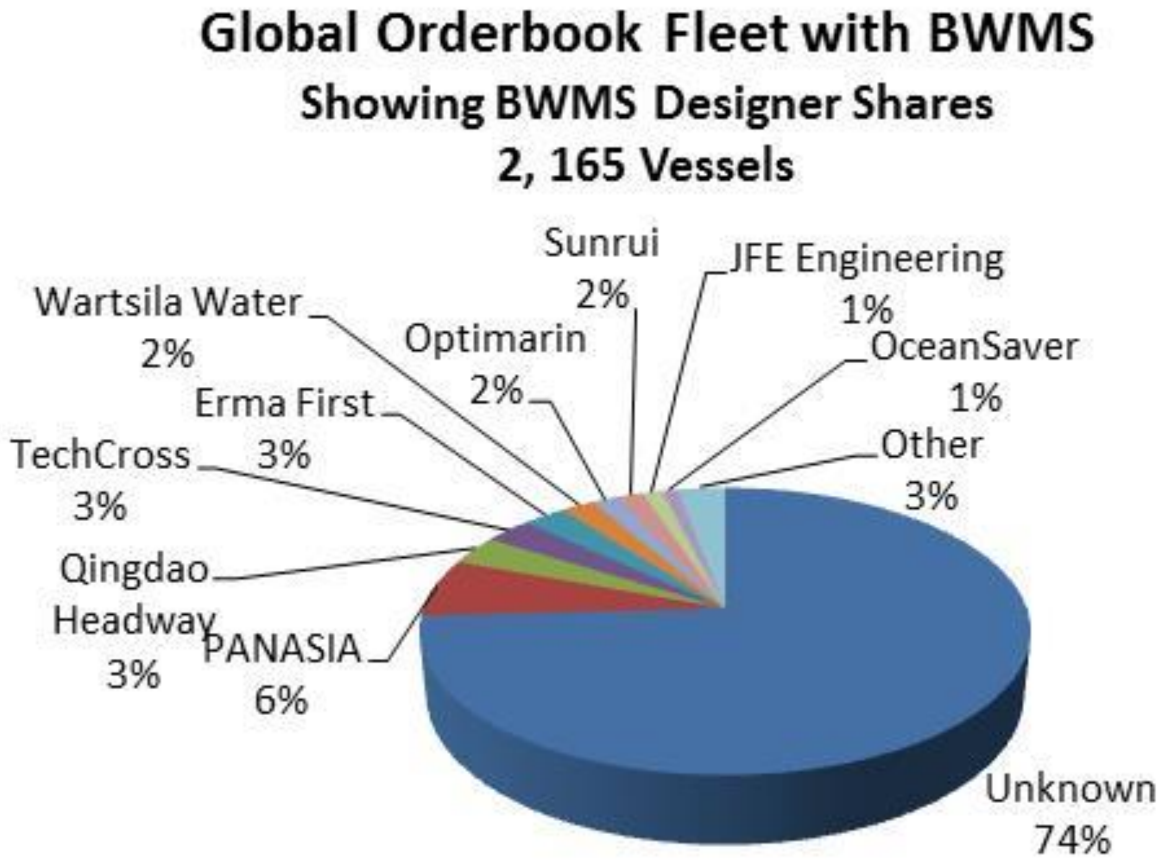
USCG approved BWTSs

Manufacturer (Country)
Optimarin (Norway)
Alfa Laval (Sweden)
TeamTec OceanSaver AS (Norway)
Sunrui (China)
Ecochlor, Inc. (USA)
Erma First (Greece)

Those under review

Manufacturer (Country)
Samsung Heavy Industries Co., Ltd (Republic of Korea)
Techcross, Inc. (Republic of Korea)
De Nora (USA)
BIO-UV Group (France)
JFE Engineering Corporation (Japan)
Panasia Co., Ltd. (Republic of Korea)
Wärtsilä Water Systems, Ltd. (England)
Headway Technology Co., Ltd. (People's Republic of China)

Ballast Water Treatment Systems



(Source: Clarkson's Research, March 2018)

USCG approved BWTSs (As of 11 May 2018)

Marine Safety Center
BWMS Type Approval Status

Approved						
Initial Application Received	**Manufacturer (Country)**	**Model**	**Independent Lab**	**System Type**	**Approved Range**	**Certificate Issued* (Amended)**
20 Sep 2016	Optimarin (Norway)	OBS/OBS Ex	DNV GL	Filtration + UV	167 – 3,000 m^3/h	02 Dec 2016 (03 Nov 2017)
21 Sep 2016	Alfa Laval (Sweden)	Pure Ballast 3	DNV GL	Filtration + UV	150 – 3,000 m^3/h	23 Dec 2016 (21 Dec 2017)
23 Sep 2016	TeamTec OceanSaver AS (Norway)	OceanSaver MK II	DNV GL	Filtration + Electrodialysis	200 – 7,200 m^3/h	23 Dec 2016 (18 Oct 2017)
24 Jan 2017	Sunrui (China)	BalClor	DNV GL	Filtration + Electrolysis	50 – 8,500 m^3/h	06 Jun 2017 (05 Jan 2018)
31 Mar 2017	Ecochlor, Inc. (USA)	Ecochlor BWTS	DNV GL	Filtration + Chemical Injection	500 – 16,200 m^3/h	10 Aug 2017
02 May 2017	Erma First (Greece)	Erma First FIT	Lloyds Register	Filtration + Electrolysis	100 – 3,740 m^3/h	18 Oct 2017

*Some manufacturers have requested multiple amendments to their Type Approval Certificates. The first date is the date when the original certificate was issued, and the date in parentheses is the date of the current amendment. Copies of Type Approval Certificates can be found at http://www.dco.uscg.mil/msc/Ballast-Water/TACs/, or by visiting the USCG Approved Equipment List at: http://cgmix.uscg.mil/Equipment/Default.aspx

USCG approved BWTSs (Under Review (As of 11 May 2018))

Marine Safety Center
BWMS Type Approval Status

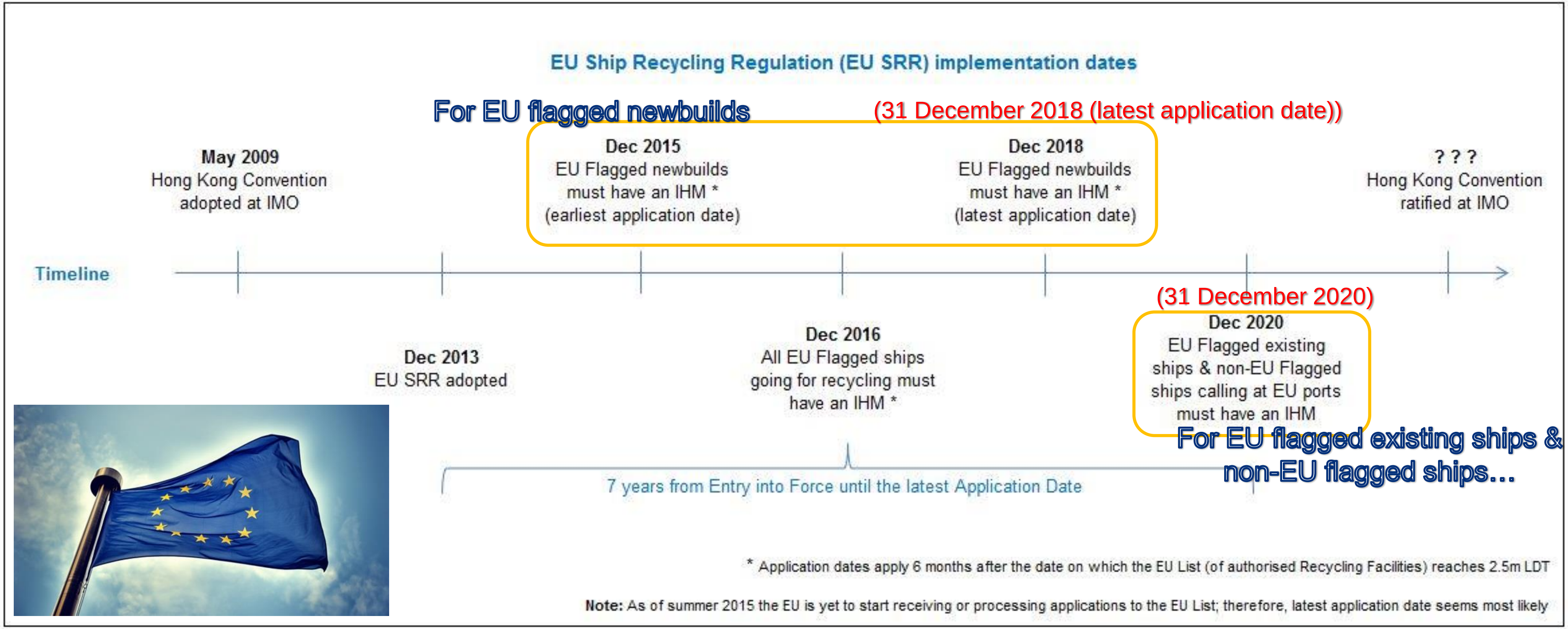
Under Review						
Application Received	**Manufacturer (Country)**	**Model**	**Independent Lab**	**System Type**	**Capacity**	**Certificate Issued* (Amended)**
28 Sep 2017	Samsung Heavy Industries Co., Ltd (Republic of Korea)	Purimar BWMS	Korean Register	Filtration + Electrolysis	250 – 10,000 m^3/h	Pending
31 Oct 2017	Techcross, Inc. (Republic of Korea)	Electro-Cleen System	Korean Register	Electrolysis	150 – 12,000 m^3/h	Pending
03 Mar 2018	De Nora (USA)	BALPURE	Lloyds Register	Filtration + Electrolysis	400 – 7,500 m^3/h	Pending
12 Mar 2018	BIO-UV Group (France)	BIO-SEA B	DNV GL	Filtration + UV	55 – 1,400 m^3/h	Pending
13 Mar 2018	Erma First (Greece)	Erma First FIT	Lloyds Register	Filtration + Electrolysis	100 – 3,740 m^3/h	18 Oct 2017 (Pending)
16 Mar 2018	Alfa Laval (Sweden)	Pure Ballast 3	DNV GL	Filtration + UV	150 – 3,000 m^3/h	23 Dec 2016 (21 Dec 2017)
22 Mar 2018	Optimarin (Norway)	OBS/OBS Ex	DNV GL	Filtration + UV	167 – 3,000 m^3/h	02 Dec 2016 (03 Nov 2017)
29 Mar 2018	JFE Engineering Corporation (Japan)	BallastAce	Control Union	Filtration + Chemical Dosing	500 – 3,500 m^3/h	Pending
30 Mar 2018	Panasia Co., Ltd. (Republic of Korea)	GloEn-Patrol	DNV GL	Filtration + UV	50 – 6,000 m^3/h	Pending
09 Apr 2018	Wärtsilä Water Systems, Ltd. (England)	Aquarius EC	DNV GL	Filtration + Electrolysis	250 – 4,000 m^3/h	Pending
09 May 2018	Headway Technology Co., Ltd. (People's Republic of China)	OceanGuard	DNV GL	Filtration + Electrolysis	65 – 5,200 m^3/h	Pending

*Some manufacturers have requested multiple amendments to their Type Approval Certificates. The first date is the date when the original certificate was issued, and the date in parentheses is the date of the current amendment. Copies of Type Approval Certificates can be found at http://www.dco.uscg.mil/msc/Ballast-Water/TACs/, or by visiting the USCG Approved Equipment List at: http://cgmix.uscg.mil/Equipment/Default.aspx

EU Ship Recycling Regulation (No.1257/2013)

Lloyd's Register

EU SRR(Ship Recycling Regulation) (No.1257/2013)



In November 2016, EMSA, the European Maritime Safety Agency, published a Best Practice Guidance on the Inventory of Hazardous Materials…

EU SRR (No.1257/2013)

PFOS (Annex I)

Newbuild		Existing	
EU Flag	**Non-EU Flag**	**EU Flag**	**Non-EU Flag**
✓ • Table A / Annex I prohibited on new installations	X • Not applicable for ships flying the flag of a third country. • Newbuilds are an existing ship when they enter EU ports.	✓ • Upon Entry into force the IHM should identify at least Table A / Annex I hazards (EU SRR Article 5[2])	X • Not applicable for ships flying the flag of a third country. • Installation whilst in EU port or anchorage is restricted (EU SRR Article 12 [2])

HBCDD (Annex II)

Newbuild		Existing	
EU Flag	**Non-EU Flag**	**EU Flag**	**Non-EU Flag**
✓ • Table B / Annex II & should be identified (Article 5[1]). • Eliminated from use - Stockholm Convention. • EC 1907/2006 requires ban from 21/08/2015.	X • Table B / Annex II & should be identified as far as practicable (Article 5[2]).	X • Table B / Annex II & should be identified as far as practicable (Article 5[2]).	X • Table B / Annex II & should be identified as far as practicable (Article 5[2]).

EU SRR, Annex I – PFOS

Structure / Equipment	Component
Firefighting equipment	Firefighting foams of the type AFFF (Aqueous Film Forming Foams). Typical on a range of ship types but specifically those; – carrying inflammable fluids – with a helicopter deck
Machinery Rooms	AFFF typically stored in one tank serving a main system, potentially with additional smaller and separate devices (for example 20 litres). – Concentration of PFOS normally lay within 0.017-0.037 kg/litre foam. – Total on-board volumes range between 100 – 10,000 litres
Throughout vessel	Hydraulic fluids
	Cable sheath
	Coatings
	Adhesives

EU SRR, Annex II – HBCDD

Structure / Equipment	Component
Liquefied Gas Tanks	Expanded polystyrene (EPS) used for cryogenic insulation
Thermal Insulation boards	Foam materials
Rubber and plastic materials	Cable Sheaths
	PVC flooring
	Gaskets
	Seals
Switch boards	Switch plug cover
	Polymer material of switch board
Electrical extension cover	
Flooring materials	
Coatings	Paint

Thank you

Please contact:

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Lloyd’s Register Marine & Offshore