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EXPERIENCE OF MSC FOR SHIP EXHAUST GAS EMISSION LEVEL MODERATION. COMPANY PERSPECTIVE AND NEEDS

01/12/2017

AGENDA

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1. MSC GROUP - Introduction
2. Background to exhaust gas emission
3. Options for Shipowners
4. Conclusion

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MSC GROUP - INTRODUCTION

THE MSC GROUP

Since 1970, Mr. Gianluigi Aponte has led MSC from its humble one-vessel-operation beginnings, into its current status as a world leader in global container shipping.

The company has seen exponential growth in terms of both volume and fleet capacity, and now serves millions of customers globally, with a much respected 365 day a year operation.

During this time, MSC has made strategic investments into cargo-related businesses including ports, crewing, trucking/railroad and ship management.

CAPTAIN GIANLUIGI APONTE
Group Executive Chairman

DIEGO APONTE
Group President & CEO

ALEXA APONTE VAGO
Group Chief Financial Officer

THE MSC GROUP OF COMPANIES

CARGO DIVISION

msc

TiL
Terminal Investment Limited

MEDLOG
Transport & Logistics

PASSENGER DIVISION

MSC

GNV
GRANDI NAVI VELOCI

SNAV

A TRULY GLOBAL COMPANY

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We bring our customers outstanding global coverage, connecting all of the world's trade centres.

- 480 offices
- 155 countries
- 70,000 staff
- 490 vessels
- 200 routes
- 500 ports of call
- 53 terminals
- 18 million TEU carried annually

MSC CRUISES

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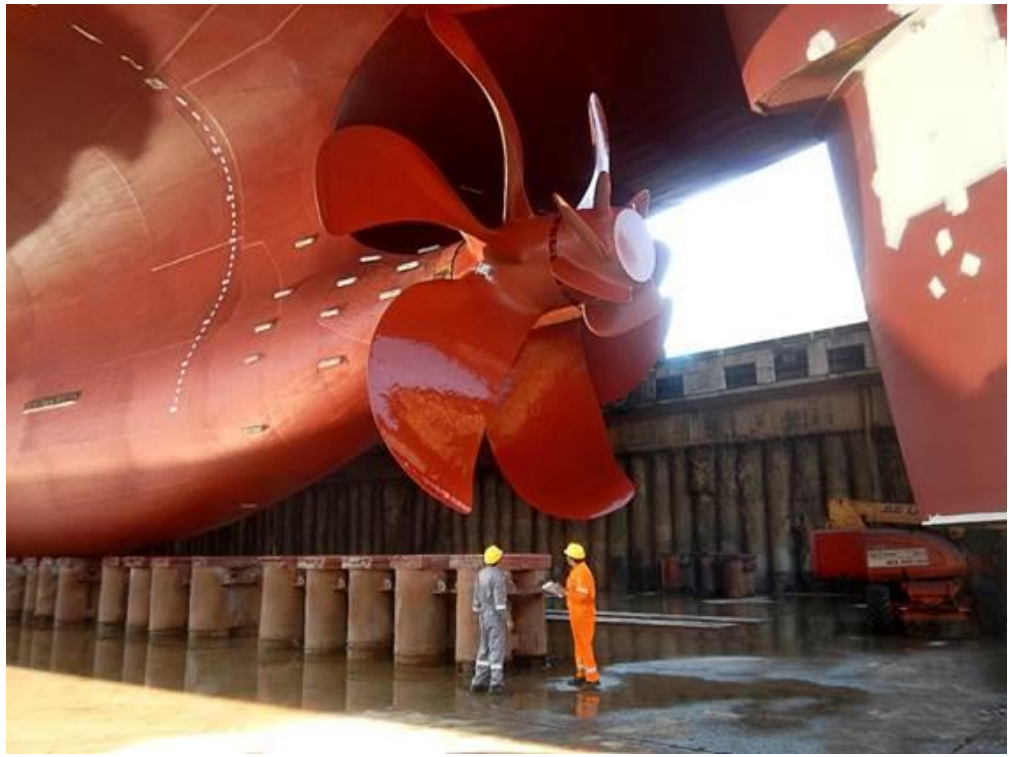
The group reaffirmed its proud heritage and passion for the sea with the formation of MSC Cruises which is today the world's largest privately-owned cruise line.

- **Youngest fleet in the world** with 12 vessels at sea.
- With **11 new mega-ships on order** through an industry unprecedented €9 billion, 10-year investment plan.

ENVIRONEMENTAL PERFORMANCE

- Retrofitting programme over 256 vessels: estimated reduction of 2 mio tons of CO_2/year
  - New bulb design
  - Controllable pitch propeller modifications with attached boss fin caps resulting in approx. 14% fuel savings
- Shore Power Supply (SPS) systems – 30% of MSC's fleet is SPS-equipped
- Advanced antifouling coating systems
- Ballast water management system – 114 MSC vessels ready, remaining fleet by end 2017
- MSC Oscar and MSC London classes – EEOI of 7
- MSC fully supports the Hong Kong Convention



1. BACKGROUND TO EXHAUST GAS EMISSION

SOURCE OF EMISSION ON A CONTAINER SHIP

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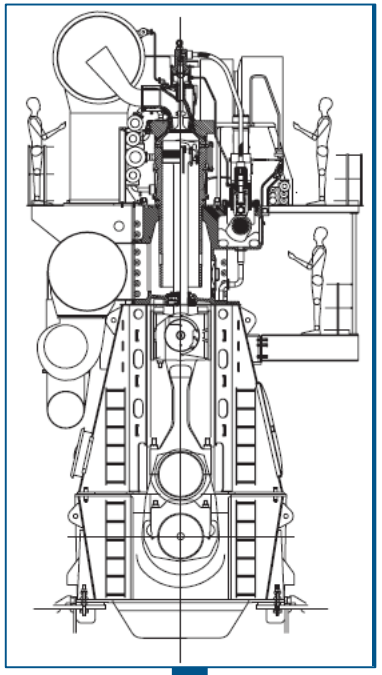
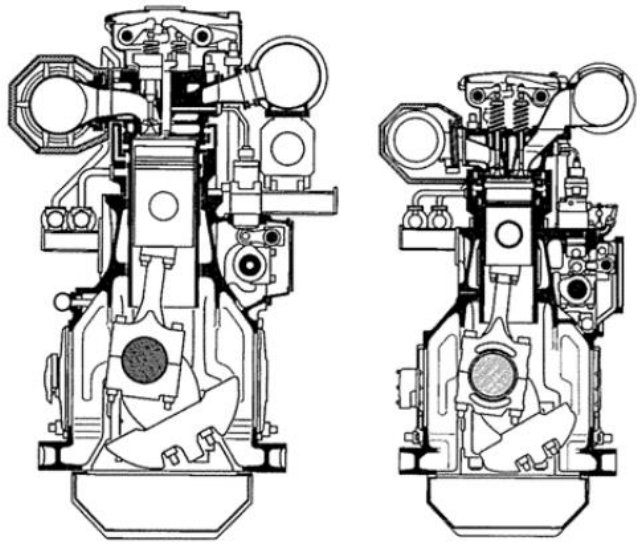
AUXILIARY BOILER

MAIN ENGINE



AUXILIARY ENGINES



EXHAUST GASES

EXHAUST GASES - CHEMICAL COMPONENTS

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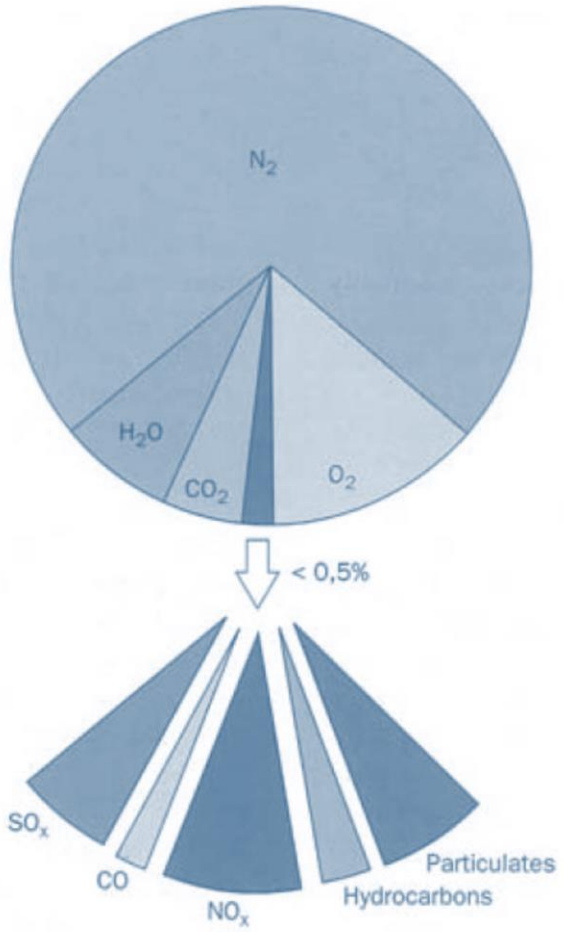
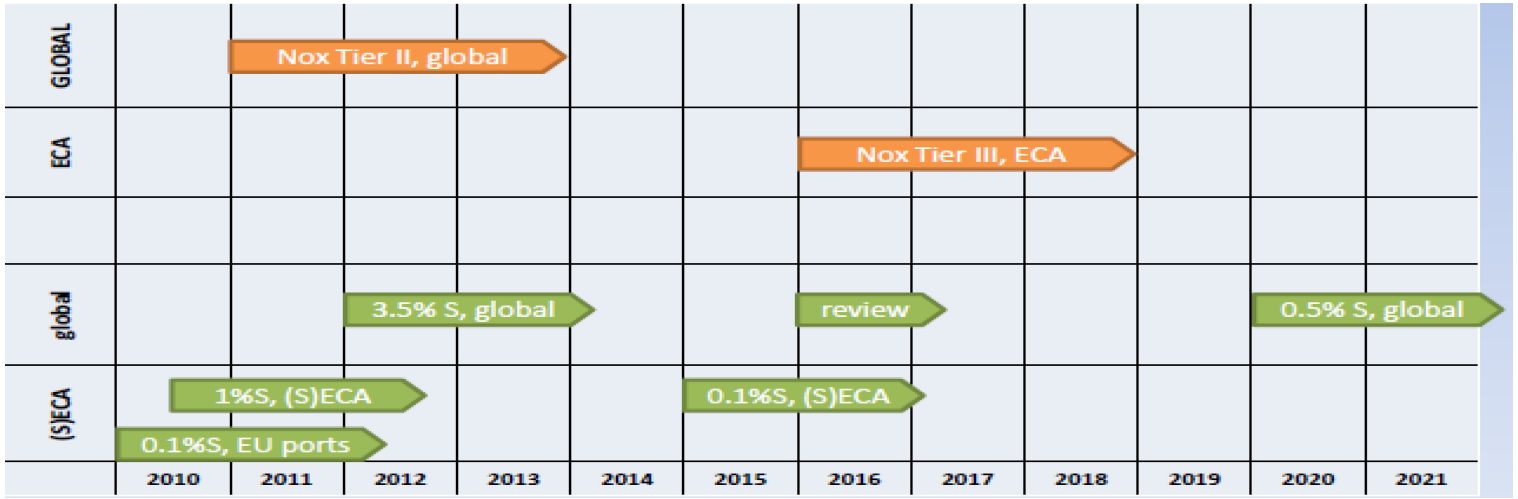


NON TOXIC
CO2 – Carbon Dioxide
N2 – Nitrogen
H2O – Water (In vapor form)
O2 – Oxigen

TOXIC and POLLUTANT
NOx – Nitrogen oxides
SOx – Sulfur oxides
CO – Carbon Monoxide
HC – Hydrocarbons
Particulates

Major air pollutant and significant impacts upon human and environment health

TIMELINE OF AIR EMISSION REGULATIONS AND GOVERNING LEGISLATION



Governing Body	LEGISLATION
IMO - SOx	MARPOL Annex VI
IMO - Scrubbers	Resolution MEPC.259(68)
EU	2012/33/EU
US EPA	Vessel General Permit – VGP
California Air Resources Board - CARB	

EXISTING AND FUTURE EMISSION CONTROL AREAS

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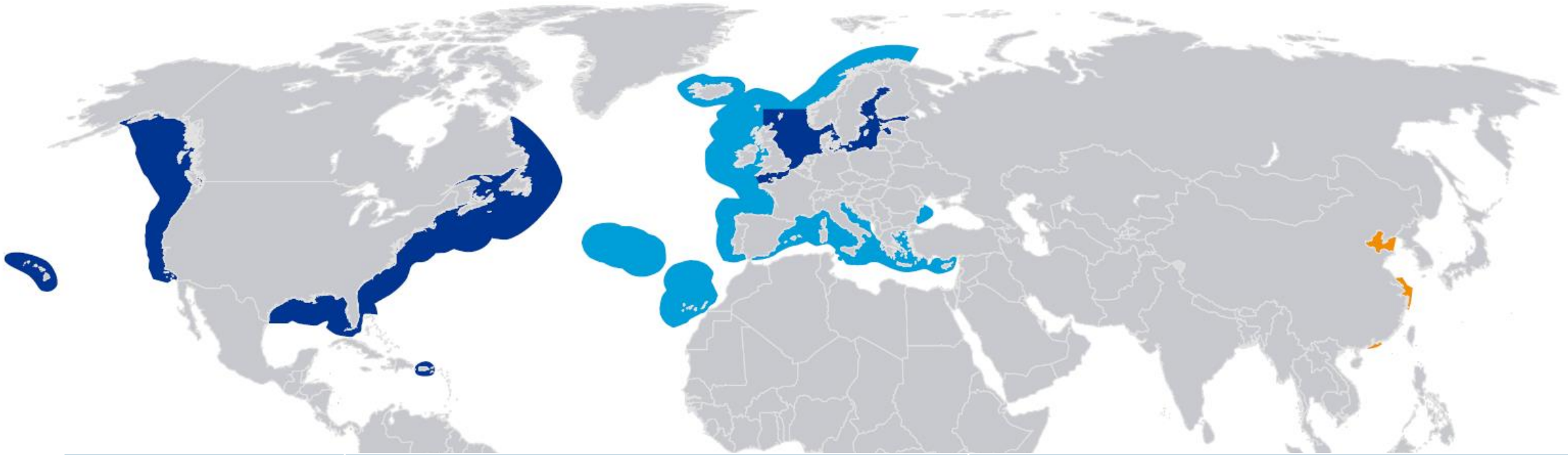

Area	Sulphur limit – Today Situation	Sulphur limit – 2020 ONWARDS SITUATION
Global	3.5%	0.5%
US and EU ECA	0.1%	0.1%
EU Waters	0.1% - Only at berth	0.1%
Hong Kong - China	0.5% - Only at berth	0.5% *

2. OPTIONS FOR SHIPOWNERS

OPTIONS AVAILABLE TO SHIPOWNERS FOR MEETING 0.5%S FUEL COMLIANCE

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1. Hybrid or Distillate marine fuels :	• **S**everal suppliers have developed new low-sulphur 'hybrid' fuels. • Price difference between low and high sulphur fuel is around US$ 190/mt presently, but expected to increase to USD 300/mt based on industry forecasts.
2. Scrubbers:	• Cleaning of exhaust gas reduces sulphur (SO2) and particulate emissions from ship engines, generators, and boilers. Ship Exhaust Gas Scrubber enables ships to meet sulphur emission limits as required by IMO MARPOL Annex VI regulations without switching to low-sulphur fuel.
3. Switch to LNG as fuel:	• Requires major modification for retrofit existing vessels. Not feasible as a retrofit project except for certain trade like if a ship is exclusively trading in Baltic area. At present limited infrastructure for LNG bunkering remains a big challenge.
4. New technologies:	• SO2 removal from exhaust streams with separate treatments is being tested presently in laboratories. • Fuel desulfurization feasibility • Hidrogen Fuel's cell, combined with battery technlogy • Outcome can be known only in few years from now but is not guaranteed.

EXISTING OPTIONS – PROS AND CONS

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	Pros	Cons
1. CHANGE TO MGO or HFO(LOW SULFUR): ***Run full time on Marine Gas Oil or Low Sulfur Heavy Fuel Oil***	• Most convenient • Small Investment in retrofit of plant	• Very High Operating cost • Availability not guaranteed • Operational Issues of main engine if run continuously on MGO
2. CONVERT TO LNG: ***Retrofit Main engine to Run on Gas***	• Meets compliance and also meets future Nox regulation for new ships	• Very High Capex • Limited availability • Limited Operational experience • LNG Bunkering challenges
3. USE EXHAUST GAS CLEANING: ***Install Scrubbers***	• Works with High % S Fuel • Easy Operation and easy availability • Lowest lifecycle cost	• High Capex but ROI based on current HFO and MGO price differential is ranging from 1.5 ~ 3 years

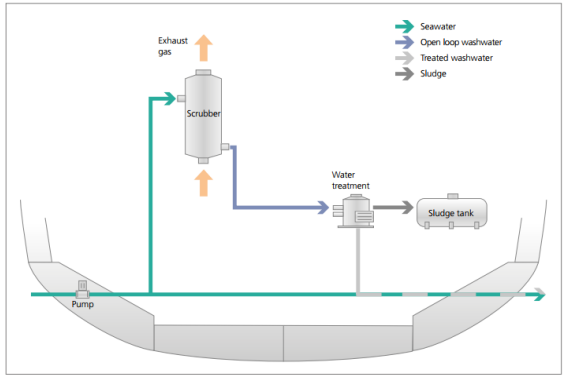
WET SCRUBBING SYSTEM AND THE 3 MOST COMMON TYPES

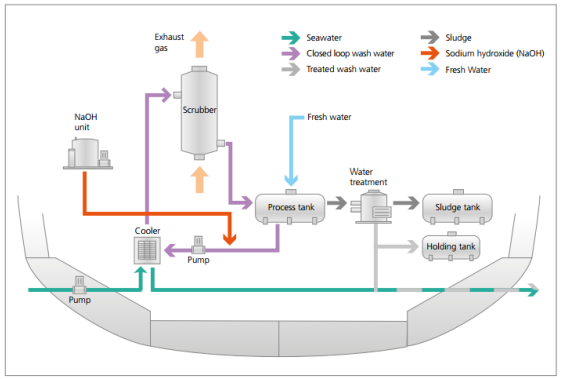
- Simple, robust and effective technique with the first application being at the Battersea power station in London in the 1930s. Mainly 3 types:

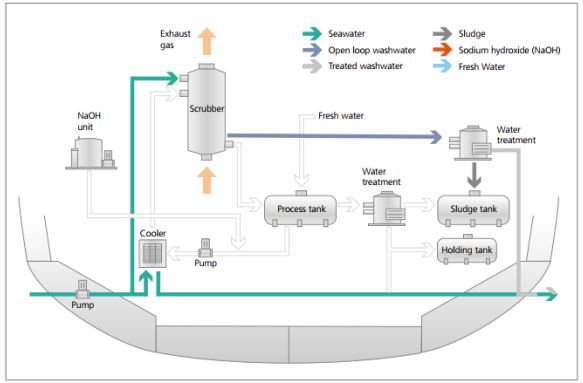
OPEN LOOP systems, which use seawater to treat the exhaust gas

CLOSED LOOP systems, which use fresh water with the addition of an alkaline chemical to treat the exhaust gas

HYBRID systems, which can operate in both open loop and closed loop modes and provides maximum flexibility of operations







ENVIRONMENTAL IMPACTS OF WASHWATER

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Following gaseous emissions of SOx and NOx; given that exhaust gas cleaning will remove the overwhelming majority of SOx from exhaust gas, **this will greatly reduce acidic precipitation**.

The environmental impact of washwater discharge has been studied in a number of technical papers. These have primarily focused on the effects of washwater acidity, reflecting concerns about ocean acidification. **Various papers have found the effects of washwater discharge on ocean acidification to be negligible.**

A study by University College London found that acidic jets discharged into an alkaline environment, as per **washwater discharges from exhaust gas cleaning systems, can be safely absorbed by the sea with a negligible effect on acidification.**

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CONCLUSION

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