Confitarma Meeting

Rome, Italy
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Environmental Issues

Luiz G. Motta
Director, Technology & Business Development
ABS

Environmental Issues Impacting Shipping & Shipbuilding

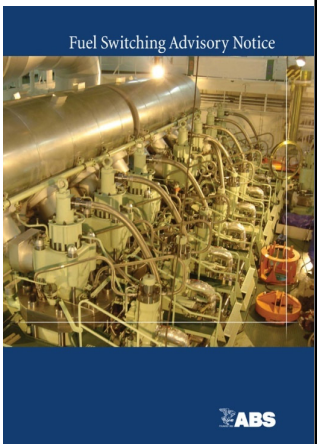
- Regulatory Compliance
  - Emissions – MARPOL Annex VI
  - Ballast Water – BWM Convention
  - Recycling – Recycling Convention
- Energy Efficiency and Carbon Emissions
  - IMO Regulatory Development
  - Industry Initiatives
- Environmentally-friendly designs and operations combine regulatory compliance and energy efficiency
- ABS Guide for Environmental Protection (ENVIRO, ENVIRO+)

Emissions

- Impact of MARPOL Annex VI and Regional Regulations
  - NOx: Engine selection (Tier II, Tier III)
  - SOx: Fuel system design (HFO, LSFO, MDO/MGO)
  - Fuel switching (California, EU ports, ECA)
  - Alternatives:
    - Exhaust gas cleaning systems
    - Alternative fuels and propulsion
    - Cold ironing
- Supplement to the IAPP certificate for operation in emission control areas (ECA) (MEPC60)

Emissions

- ABS Guides
  - Cold Ironing and Alternatives
  - Gas Fueled Power Plants
  - Fuel Cell Powered Ships
  - Hybrid Propulsion
- ABS Advisory
  - Fuel Switching Advisory Notice



MARPOL Annex VI: Regulation 13 – NOx

Ship Constructed (≥1 January)	Application of Requirements	Emission Limits	Compliance at engine's delivery except as below
1990 to 2000 *Retroactive to existing engines*	Engine size > 5000 kW and ≥ 90 liters / cylinder	**Tier I**	1st IAPP Renewal Survey 12 months or more after IMO advised by Admin of a Party of availability (physical and cost) of "*upgrade kit*"
2000 ≤ x <2011	Engine size > 130 kW		Operation outside and within of ECA
2011 ≤ x <2016		**Tier II**	
≥ 2016			Operation outside of ECA
≥ 2016 two exceptions *		**Tier III**	Operation within ECA (2012-2013 - Tech Dev Review)

** L<24m if used for recreational purposes or total power<750kW if unable to achieve due to design limitations*

RPM	Total Weight of NO_2 Emission (g/kWh) < 130	130 ≤ n < 2000	≥ 2000	Relative NO_2 Reduction from Tier I
Tier I	17.0	$45*n^{(-0.2)}$	9.8	Current
Tier II	14.4	$44*n^{(-0.23)}$	7.7	15.5% - 21.8%
Tier III	3.4	$9*n^{(-0.2)}$	2.0	80%

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MARPOL Annex VI: Regulation 14 – SOx

	Global (1 January)		Emission Control Areas (SOx)	
Current Limit (m/m)	**4.5%**		**1.5%**	
Entry Into Force Date	≥ 2012 to < 2020/25*	≥ 2020/25*	≥ 1 July 2010 to < 1 Jan 2015	≥ 1 Jan 2015
Limit (m/m)	3.5% +	0.5% +	1.0% +	0.10% +

* **Note:** Effective year (2020 or 2025) will be decided by 2018
\+ **Note:** Alternative Technology is also acceptable; Exhaust Gas Cleaning Systems

MEPC 60:

Proposal to designate 200nm (1.0%) USA/Canada as ECA (SO_2, NOx, PM) adopted - enter into force 1 Aug 2011 (Current ECAs (SO_2) – Baltic and North Sea)

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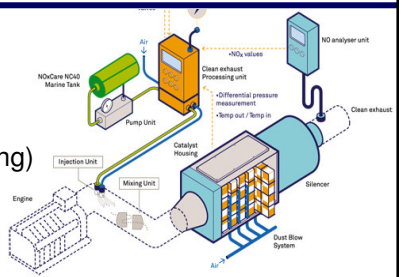
Complying With New Emissions Limits

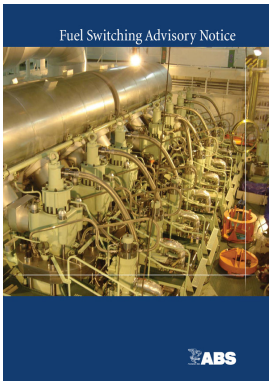
- SOx emission reduction
  - Internal engine modifications (30-70% reduction)
  - Exhaust Gas Cleaning (Scrubbing) (90-99% reduction)
  - Switch from HFO to MDO (40% reduction w/1.5% MDO) (80% reduction w/0.5% MDO)



- NOx emission reduction technologies
  - Internal engine modifications (30-70% reduction)
  - Water Injection/Humid Air Engine (65-85% reduction)
  - Exhaust Gas Recirculation (30-70% reduction)
  - Selective Catalytic Reduction, SCR (90-95% reduction)

Fuel Switching Concerns

- Engines/Boilers
  - Low viscosity and lubricity of low sulfur fuel
  - Incompatible lubricating oil
  - Energy generated per unit volume of fuel
  - Incompatibility of high sulfur and low sulfur fuels
  - Sudden change in fuel temperature
- Boilers
  - Additional combustion controls needed
    - Flame scanners
    - Pre and post-purge
- ABS Fuel Switching Advisory Notice
- ABS Notes:
  - Use of Low Sulfur Marine Fuel for Main and Auxiliary Diesel Engines
  - Use of Low Sulfur Marine Fuel for Boilers



Equipment Modification

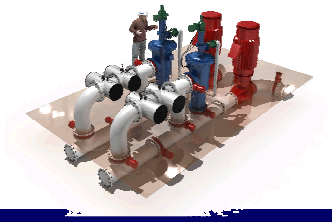
- Modifications to engines, boilers, associated fuel supply and control systems are to be reviewed by ABS
  - Assessment of operation with low sulfur fuel
  - Manufacturer's advice regarding fuel switching procedures
  - Original Equipment Manufacturer (OEM) or entity recognized by OEM to be employed to carry out the design modifications

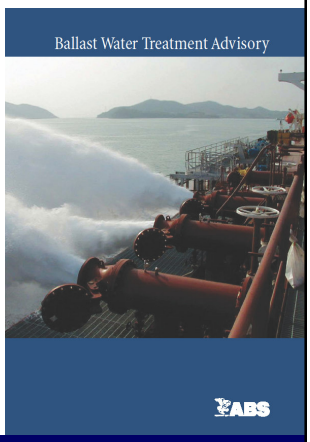
Ballast Water Convention

- International Regulatory Status (IMO)
  - BWM Convention enters into force 12 months after ratification by 30 States with 35% world's GT
  - As of 31 July 2010, 26 governments (24.4% GT) ratified the Convention:
    - Albania, Antigua and Barbuda, Barbados, Brazil, Canada, Cook Islands, Croatia, Egypt, France, Kenya, Kiribati, Republic of Korea, Liberia, Maldives, Marshall Islands, Mexico, the Netherlands, Nigeria, Norway, Saint Kitts and Nevis, Sierra Leone, South Africa, Spain, Sweden, Syrian Arab Republic and Tuvalu

Ballast Water Treatment Systems

- Selection of BWT technology and system dependent on the vessel type and service and will impact
  - Space requirement
  - Power requirement
  - Ballast tank and pipe corrosion
  - Hazardous area installation for tankers
- **ABS Guides for BWM and BWT**
- **ABS BWT Advisory Notice**





BWM Convention: Implementation

- **D-1** = **exchange** standard **D-2** = **treatment** standard
- Implementation: ships of signatory flag States/all ships in jurisdictional waters of signatory States

Ballast Cpty (m^3)	Build Date	*First Intermediate or Renewal Survey, whichever occurs first, after the anniversary date of delivery in the respective year								
		2009	2010	2011	2012	2013	2014	2015	2016	2017
<1,500	< 2009	D-1 or D-2								D-2 *
	in 2009	Note: D-1; D-2 by 2nd Annual but not beyond 31 Dec. 2011 or EIF, whichever is later								
	>2009	D-2 (at delivery or EIF, whichever is later)								
≥1,500 or ≤5,000	< 2009	D-1 or D-2						D-2 *		
	in 2009	Note: D-1; D-2 by 2nd Annual but not beyond 31 Dec. 2011 or EIF, whichever is later								
	>2009	D-2 (at delivery or EIF, whichever is later)								
>5,000	< 2012	D-1 or D-2								D-2 *
	≥ 2012	N/A			D-2 (at delivery or EIF, whichever is later)					

Note: Signatory States may not invoke delayed D-2 enforcement permitted by A.1005(25)
Entry Into Force (EIF) date

Recycling

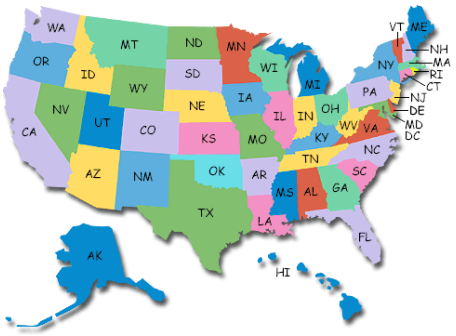
- **International Convention for the Safe and Environmentally Sound Recycling of Ships**
  - Entry into Force requires ratification by States with GT and States with recycling capacity and will take some time
  - Convention requires:
    - Inventory of hazardous materials
    - Approval of recycling facilities
    - Approval of ship for recycling
  - Optional early compliance
  - ABS Ship Recycling Guide update

Environmental Issues

Foreign Vessels Operating in US

Foreign Vessels Operating in US

- Many US states have additional, or separate, requirements for pollution prevention, most notably Air and various Water Discharge provisions for ballast, bilge, treated sewage.
- The USCG does not enforce these, nor interprets these requirements, please maintain contact with local shipping agents for specific requirements and points of contact for questions.



MARPOL Annex VI: Air Pollution

- Entered into force for US in January, 9 2009
- Requirement for Int'l Air Pollution Prevention (IAPP) Certificate (Engine IAPP)
- Requirement for Technical Files
- Requirement for Type Approval Certificate for incinerators installed after 1 Jan 2000
- Requirement for Bunker Delivery Notes (3 years)
- Requirement for Verification of Samples retained on board (12 months)

Regional NOx Emission Requirements

- US EPA Regulations
  - For vessels flagged or registered in the US
  - Applies to diesel engines on ocean-going vessels
  - For 2004 and later model year marine diesel engines, in addition to Annex VI Reg 13 NOx requirements, engines are also required to meet EPA emission regulations
    - 40 CFR Part 94 (Cat 1,2,3 engines)
    - CFR Part 1042 (Cat 1,2 engines) – engines of new and existing vessel utilized for emergency application to meet min Tier 2 emission standard

Category	Engine	Limits	Effective Date
Category 1	Engines up to 7L per cylinder (above 50hp)	Tier 1 limits – same as Tier 1 limits in Annex VI Tier 2/3/4 limits – differ from Tier 2/3 limits in Annex VI; dependent on displacement, max engine power and model year of engine	Tier 1 – 1 Jan 2004 Tier 2 – phase in from 2008 Tier 3 – phase in from 2009 Tier 4 – phase in from 2014
Category 2	Engines from 7-30L per cylinder		
Category 3	Engines above 30L per cylinder	Tier 1/2/3 limits – same as limits in Tier 1/2/3 limits Annex VI	Tier 1 – 1 Jan 2004 Tier 2 – 1 Jan 2011 Tier 3 – 1 Jan 2016

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Regional SOx Emission Requirements

- California Air Resources Board (CARB) Regulations
  - Applies to all types of marine fuels used by ships in California waters within 24 nm of the California baseline
  - Applies to both main and auxiliary engines
  - Applies to auxiliary boilers, but not main propulsion boilers

California Air Resources Board (CARB)			
Fuel	**Grade**	**% S**	**Effective Date**
Marine Gas Oil	DMA	1.5	1 Jul 2009
Marine Diesel Oil	DMB	0.5	1 Jul 2009
Marine Gas Oil	DMA	0.1	1 Jan 2012
	DMB		

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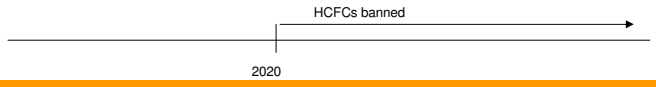
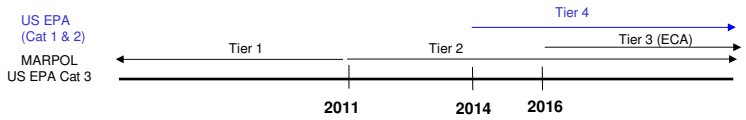
Summary

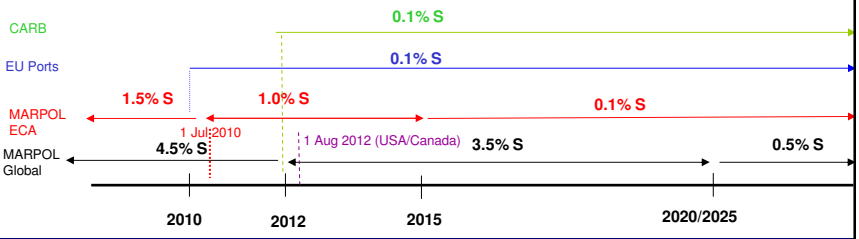
Ozone Depleting Substances



NOx



SOx



MARPOL Annex IV: Marine Sanitation Devices

- US is not signatory to MARPOL Annex IV
- All ships must comply with US regulations in 33 CFR 159 and have a USCG Approved Marine Sanitation Device, or as an alternative, comply with MARPOL Annex IV as evidenced by an International Sewage Pollution Prevention Certificate
- USCG recognizes foreign-manufactured Sewage Systems in compliance with Annex IV (as amended by MEPC.2(VI) or MEPC.159(55)) as compliant with US regulations provided the system is in proper operation
- Reference: USCG Navigation and Vessel Inspection Circular (NVIC) 1-09
- US EPA: proposal to ban all sewage discharges from large cruise ships and most other large ocean-going ships to the marine waters along California's entire coastline

EPA VGP & NPDES

United States Environmental Protection Agency (EPA)
National Pollutant Discharge Elimination System (NPDES)

VESSEL GENERAL PERMIT FOR DISCHARGES INCIDENTAL TO THE NORMAL OPERATION OF VESSELS (VGP)

- VGP Compliance required from 6 Feb 2009, including Alaska and Hawaii
- Compliance with inspections, training, record keeping and reporting requirements as of 19 Feb 2009
- Applies to all commercial vessels (L > 79 ft) when operating within US waters (3 nm territorial sea)
- National in scope – States may have more stringent requirements

EPA VGP Structure

- Part 1 – Coverage under the Permit
- Part 2 – Effluent Limits and Related Requirements
- Part 3 – Corrective Actions
- Part 4 – Inspections, Monitoring, Reporting, and Recordkeeping
- Part 5 – Vessel Class-specific Requirements
- Part 6 – State 401 Certification Conditions
- Appendices

Coverage Under the Permit

- Notice of Intent (NOI) required to receive permit coverage
  - Required for vessels ≥ 300 gt or with ballast capacity ≥ 8 cu.m
  - NOI by 19 Sept 2009
  - New vessels NOI no later than 30 days before vessel discharge into the waters subject to the permit
  - Information on EPA's electronic Notice of Intent (eNOI) http://cfpub.epa.gov/npdes/vessels/enoi.cfm

- One-time permit report between 30-36 months after obtaining permit coverage

Effluent Limits for Discharge Categories

- Deck Washdown and Runoff
- Bilgewater
- Ballast Water[1]
- Anti-Fouling Hull Coatings
- Aqueous Film Forming Foam
- Boiler/Economizer Blowdown
- Cathodic Protection
- Chain Locker Effluent
- Controllable Pitch Propeller Hydraulic Fluid
- Distillation and Reverse Osmosis Brine
- Elevator Pit Effluent
- Firemain Systems
- Freshwater Layup
- Gas Turbine Wash Water

[1] Incorporates USCG's mandatory BWM and BW exchange standard

Effluent Limits for Discharge Categories

- Graywater
- Motor Gasoline and Compensating Discharge
- Non-Oily Machinery Waste
- Refrigeration and Air Condensate Discharge
- Seawater Cooling Overboard Discharge
- Seawater Piping Biofouling Prevention
- Sonar Dome Discharge
- Stern Tube Oily Discharge
- Small Boat Engine Wet Exhaust
- Underwater Ship Husbandry Discharges
- Welldeck Discharges
- Graywater Mixed with Sewage from Vessels
- Exhaust Gas Scrubber Washwater Discharge

Additional Information

- Available at: www.epa.gov/npdes/vessels

Update on BWM in US Waters

- Current jurisdictions for BWM in the US
  - USCG regulations
    - 33 CFR Part 151 Subparts “C” and “D” under Non-indigenous Aquatic Nuisance Prevention and Control Act (NANPCA) and National Invasive Species Act (NISA)
  - EPA regulations
    - VGP under Clean Water Act (CWA)
  - States legislation/regulations

USCG BWM Regulations, Summary

- **Applicability:** All vessels operating in US waters or bound to US ports
- **Exemptions:** - Crude oil tanker in coastwise trade
  - Vessel operating within one COTP zone
  - Vessel on innocent passage
- **Documentation:**
  - Maintain BWM plan
  - Report 24-hours before arrival
  - Maintain records on board for two years
- **Exchange ballast water:**
  - ≥ 200 nm offshore (> 2000 m for limited areas)
- **Good operational practices:**
  - Remove tank sediments
  - Rinse anchors/lockers
  - Minimize uptake near dredging operations
  - Train personnel
- **Penalties:**
  - Knowing-violation is class C felony
  - Civil penalty not > $27,500/day of continuous violation

USCG's Shipboard Technology Evaluation Program (STEP)

- A USCG program available to all US and foreign flag vessels
- To facilitate development of effective BW treatment technologies through experimental systems
- To create more options for vessel owners seeking alternatives to BW exchange
- Grant equivalency to future BW discharge standard regulations while the proto-type system operates satisfactorily
- As of January 2010, four vessels are enrolled and two vessels are being reviewed for STEP
- Two of enrolled vessels are equipped with BWMS developed by "Ecochlor Inc", one with Hyde Marine system and the remaining one with "BalPure" system

USCG BW Discharge Standard (NPRM)

	Plankton		Bacteria / Virus	Bacteria		
Technical description	Large Organisms (> 50 µm)	Small Organisms (> 10 µm & ≤ 50 µm)	Very Small Organisms (≤ 10 µm)	Toxicogenic Vibrio cholerae (O1 & O139)	Escherichia coli	Intestinal enterococci
Phase One	< 10 per m^3	< 10 per ml	N/A	<1 cfu per 100 ml	<250 cfu per 100 ml	<100 cfu per 100 ml
Phase Two	< 1 per 100 m^3	< 1 per 100 ml	< 1000 bacterial cells AND < 10,000 viruses per 100 ml	<1 cfu per 100 ml	<126 cfu per 100 ml	<33 cfu per 100 ml

Performance Standards Comparison

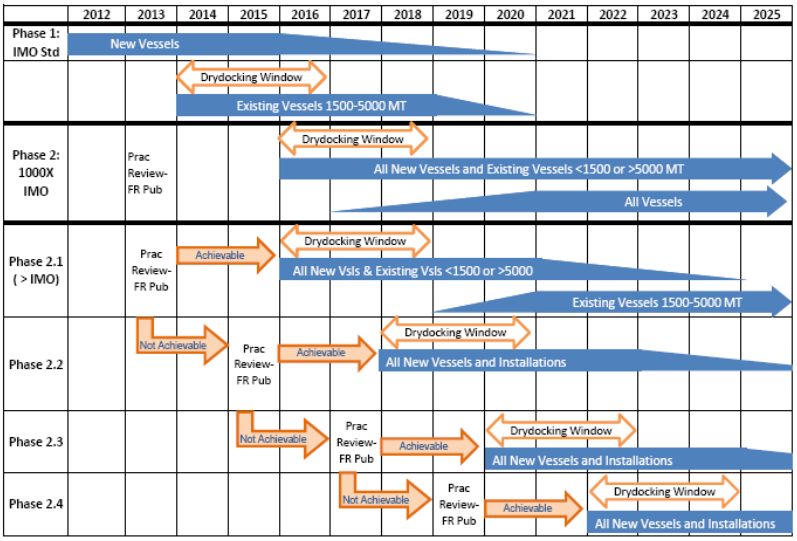
		IMO	California		New York		Great Lakes		USCG Phase 1	USCG Phase 2
Implementation year		**2010**	**2010**	**2020**	**2012**	**2013**	**2012**	**2016**	**2012**	**2016**
Applicability		**New**	**New**	**All**	**All**	**New**	**New**	**All**	**New**	**New**
Organisms > 50 µm	per m3	< 10	0	0	< 0.1	0	< 10	< 10	< 10	< 0.01
Organisms 10 – 50 µm	per milliliter (ml)	< 10	< 0.01	0	< 0.1	< 0.01	< 10	< 10	< 10	< 0.01
Escherichia coli	cfu per 100 ml	< 250	< 126	0	< 126	< 126	< 250	< 250	< 250	< 126
Intestinal enterococci	cfu per 100 ml	< 100	< 33	0	< 33	< 33	< 100	< 100	< 100	< 33
Toxicogenic Vibrio cholera	cfu per 100 ml	< 1	< 1	0	< 1	< 1	N/A	N/A	< 1	< 1
Notes			1	4	2	1	3			1

Note 1: Additional standard of less than 1,000 bacteria per 100 ml and less than 10,000 viruses per 100 ml
Note 2: This standard is the same as that of the US Federal Bills introduced during the Bush Administrations
Note 3: Great Lakes States adopting these standards include Illinois, Indiana, Minnesota and Ohio
Note 4: Zero means no detectable living organisms in the discharged water

Implementation Schedule

		Phase 1		Phase 2	
Vessel category	BW capa. (m3)	Construction date	Compliance date	Construction date	Compliance date
New vessels	All	On or after 1 Jan 2012	On delivery	On or after 1 Jan 2016	On delivery
Existing vessels	< 1,500	Before 1 Jan 2012	1st drydocking after 1 Jan 2016	Before 1 Jan 2016	1st drydocking after 1 Jan 2016 or 5 years after installation of BWMS meeting phase 1 standard, whichever is later
	1,500 – 5,000		1st drydocking after 1 Jan 2014		
	> 5,000		1st drydocking after 1 Jan 2016		

Implementation Schedule of BWDS



Note: Five-year grandfathering is granted for implementation of Phase 2 standard

Source: USCG Presentation on NPRM of BWDS for Public Meetings

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Practicability Review (PR)

- At least 3 years before implementation of Phase 2, USCG is to publish the results of PR on:
  - Practicability to implement Phase 2 standard on a predetermined schedule
  - Availability of testing protocols to verify compliance
- If PR finds no systems can meet the entire Phase 2 standard, but a significant improvement over Phase 1 (IMO equivalent) is achievable, then USCG will propose intermediate standards and their associated timeline
- PR will be conducted every 2 years until full Phase 2 standard is achieved

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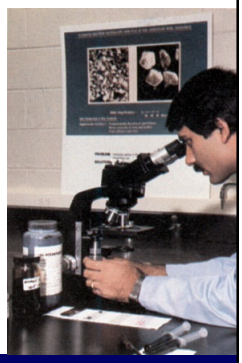
BWM Standard Approval

- Proposed approval requirements are based on:
  - EPA's Environmental Technology Verification (ETV) Program
  - G8 Guidelines under BWMC 2004 (similar procedure but more stringent requirements ex. shipboard tests for a 12 month period vs. 6 month)
  - Existing USCG requirements for equipment installed on board vessels
- All approval tests and evaluations shall be conducted by Independent Laboratories in the US with oversight by USCG and EPA
- Biocides used in BWMS may require independent registration by EPA under the Federal Insecticides, Fungicide, and Rodenticide Act (FIFRA)



BWMS Approval

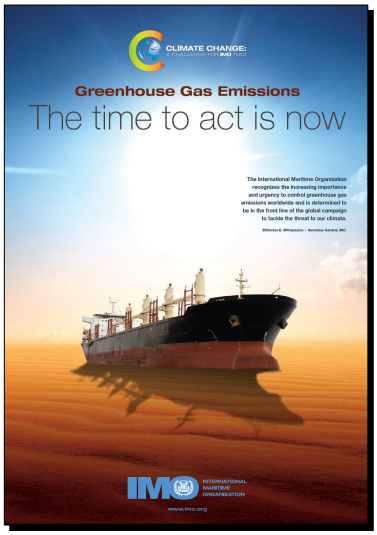
- The USCG will consider "Equivalency Determinations for BWMS" or "Equivalent Approval Procedures" for:
  - BWMS that has been approved by a foreign administration
  - BWMS that has successfully been used in a prototype experimental treatment system program that included tests onboard a vessel under normal shipping operations
  - BWMS for which a manufacturer has already conducted a substantial amount of land-based and/or shipboard testing independent of the requirements of the NPRM for BWDS.

Specific USCG's Questions from NPRM

- Is it feasible to apply Phase 1 standard to all existing vessels by 2014?
- Is a grandfather clause necessary? If so, is 5-year period enough?
- What are the costs to purchase, install, operate/maintain and replace BWMS that can meet more stringent than Phase 1 or IMO BWMC?
- Is there a technology system that can be scalable or modified to meet multiple stringency standards after being installed?
- What are additional costs for vessels to upgrade the BWMS from Phase 1 to Phase 2?
- What BWMS is sufficient to safeguard against invasion of NIS (non-indigenous species) into US waters via ships' BW?

Energy Efficiency & Carbon Emissions

- **IMO regulatory** development under pressure from EU and possible developments by UNFCCC
- **Balancing the need** to show results with proper review of the proposed measures
- **Unresolved issue** – Common but Differentiated Responsibilities vs. No More Favorable Treatment



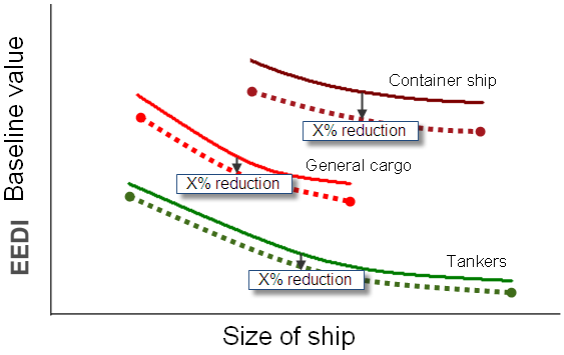
Energy Efficiency & Carbon Emissions

MEPC60

- **Draft amendment** to MARPOL Annex VI making the Energy Efficiency Design Index (EEDI) and Ship Energy Efficiency Management Plan (SEEMP) mandatory
- **Establish Expert Group** on GHG Market Based Measures (MBM)
- **Many considered** the time used for technical discussion on EEDI evaluation inadequate

Energy Efficiency Design Index (EEDI)

- Application to **new ships**
- **Required EEDI** is obtained as X% reduction from the **Baseline**, equally applied for all ship types
- Baseline is based on a regression analysis of historical data
- Proposed baselines do not represent ships in each size category[1]

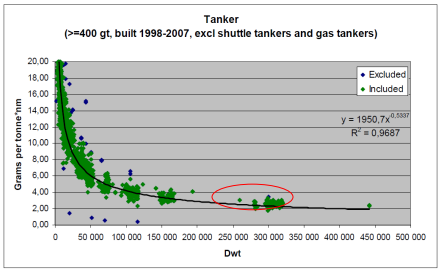


[1]ABS/HEC Study: Evaluation of the EEDI Baseline for Tankers Containerships and LNG Carriers

Energy Efficiency Design Index (EEDI)

- Objective to stimulate innovation and technical development
- Speed limit for the seas?
  - Speed reduction "easiest" way to improve the index
  - Different from "slow steaming"
- Not sensitive to changes in steel weight[1]

$$\frac{\text{Engine power x SFC x CF}}{\text{Capacity x Speed}}$$



[1]ABS/HEC Study:Influence of Design Parameters on the EEDI

Ship Energy Efficiency Management Plan (SEEMP)

- Approach to monitor, manage and improve energy efficiency of a ship's operation
- Best practices for fuel-efficient operations of ships
- Company-specific: integral element of a broader company's environmental management system
- Ship-specific, preferably
- Four-steps: planning, implementation, monitoring and self-evaluation/improvement
- Examples of energy efficiency measures: weather routing, trim adjustment, hull and propeller cleaning intervals
- Performance monitoring tools available at various levels of complexity

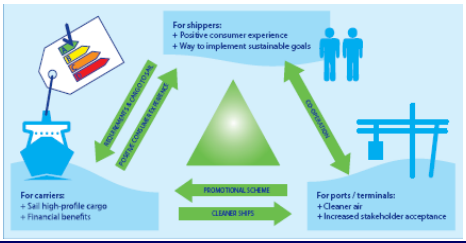
Market-based Measures

- Bunker levy
- Emission trading
- Baseline and credit system based on EEDI
- Regional schemes possible[1]

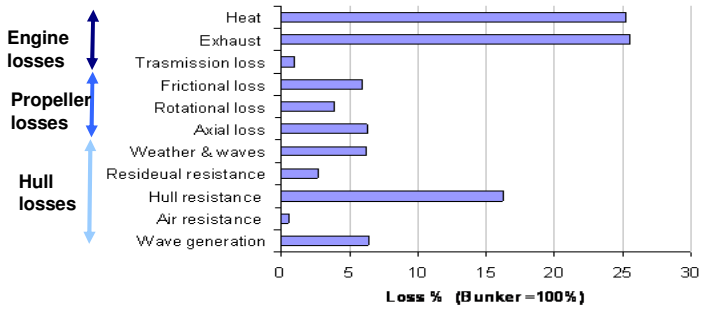
1 CE Delft report for EU DG Env concludes that the cap-and trade scheme for maritime and the emissions tax are best for reducing CO_2 emissions of maritime transport. (Ref. Delft, Dec 2009, Tender DG Env, C3/ATA/2008/0016)

Examples of Industry Initiatives

- Industry workshops on GHG Reduction
- Rating and assessment schemes
  - WPCI Environmental Ship Index
  - Rightship Environmental Rating
  - SNAME Marine Vessel Environmental Assessment
- Charter requirements/guidelines
  - TMSA Element 10
- Virtual arrival
  - OCIMF/Intertanko
- Company initiatives



Energy Efficiency



Engine
- λ Improving engine fuel efficiency
- λ Waste heat recovery
- λ Low load operations
- λ Engine de-rating

Propeller
- λ Propeller optimization
- λ Cleaning

Hull
- Hull shape optimization
- Anti-fouling coatings/cleaning
- Air bubble lubrication
- Weather routing/Trim optimization

Alternative energy source
- Gas
- Renewable energy
- Shore power

Eco-friendly & Energy Efficient Ships

Engine Room discharges
bilge water; oily water; waste oil, accidental bunker discharge, cooling water, seepage thru machinery seals

Engine and combustion emissions
SOx, NOx, PM, CO2

Discharges from accommodations
Sewage; gray water; garbage disposal; refrigerant leakages

Cargo-related discharges
oil; chemical; tank washing; accidental discharges; cargo in packaged form; vapor emission

Ballast water discharges
transfer of harmful non-indigenous marine species

Deck discharges
Cargo residue
Deck cleaning/washing
Anchor and chain washing

Hull coating
anti-fouling coating

Ship recycling
safety and pollution to recycling facilities

Bio-fouling
transfer of non-indigenous marine species

Other
Underwater noise
Collision with whales
Emission during fire
Shipbuilding and ship repair facilities

CO2 emission reduction
Ships' energy efficiency (design and operational)
CO2 reduction market-based measures

Note: Blue categories addressed by **ENVIRO** and **ENVIRO+** notations

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