Hyde GUARDIAN™
Ballast Water Treatment System

Ballast Water Management Regulations and Challenges

SNAME COLLEGIUM

ABS London

October 11, 2011

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With Scientific Input from Dr. David Wright, Co-Chair

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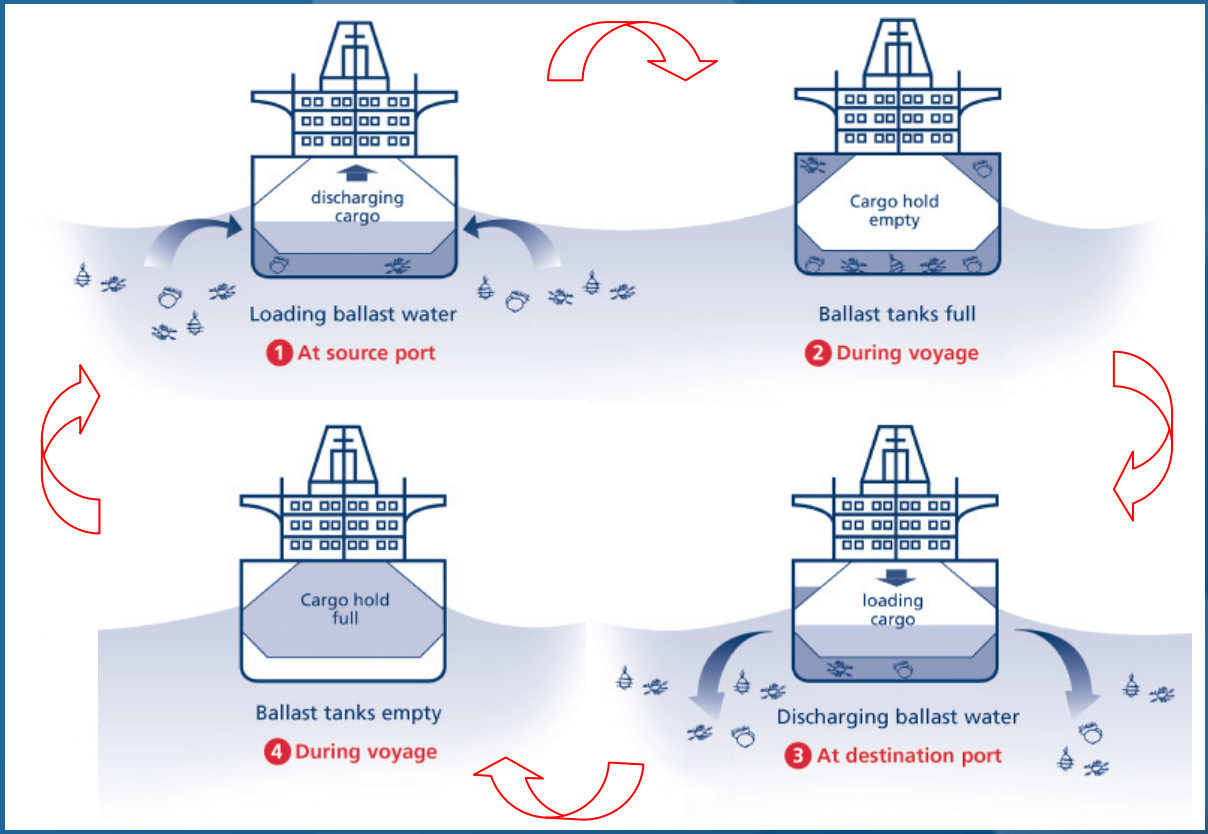
The Issue

Transfer of invasive species by ships' ballast water



Source : IMO GloBallast Program

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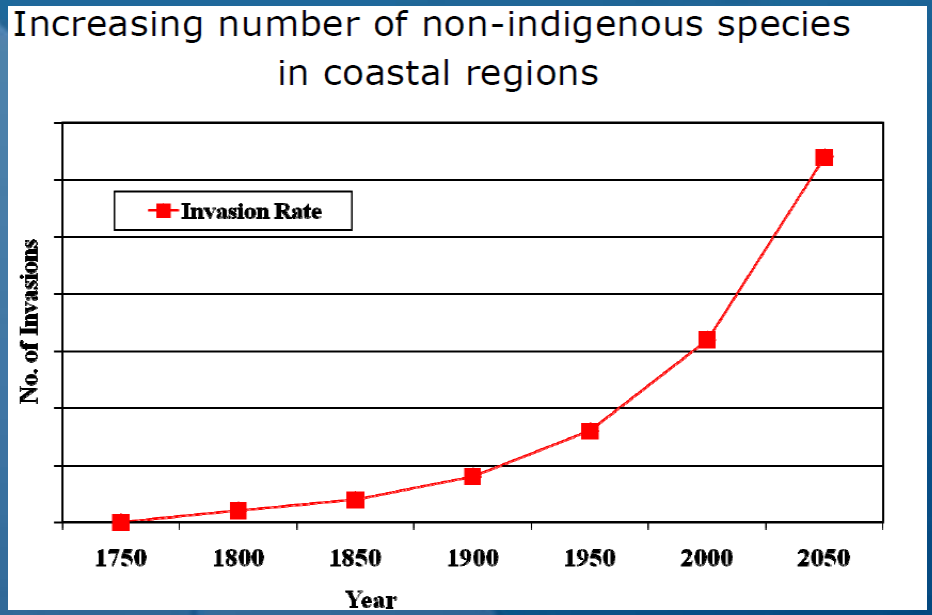
The Issue

Studies show that the rate of introduction of invasive species associated with ships' ballast water is rising faster and faster.

- *Larger and faster ships*
- *Expansion of ports in new locations.*



Source : IMO GloBallast






Source : IMO GloBallast

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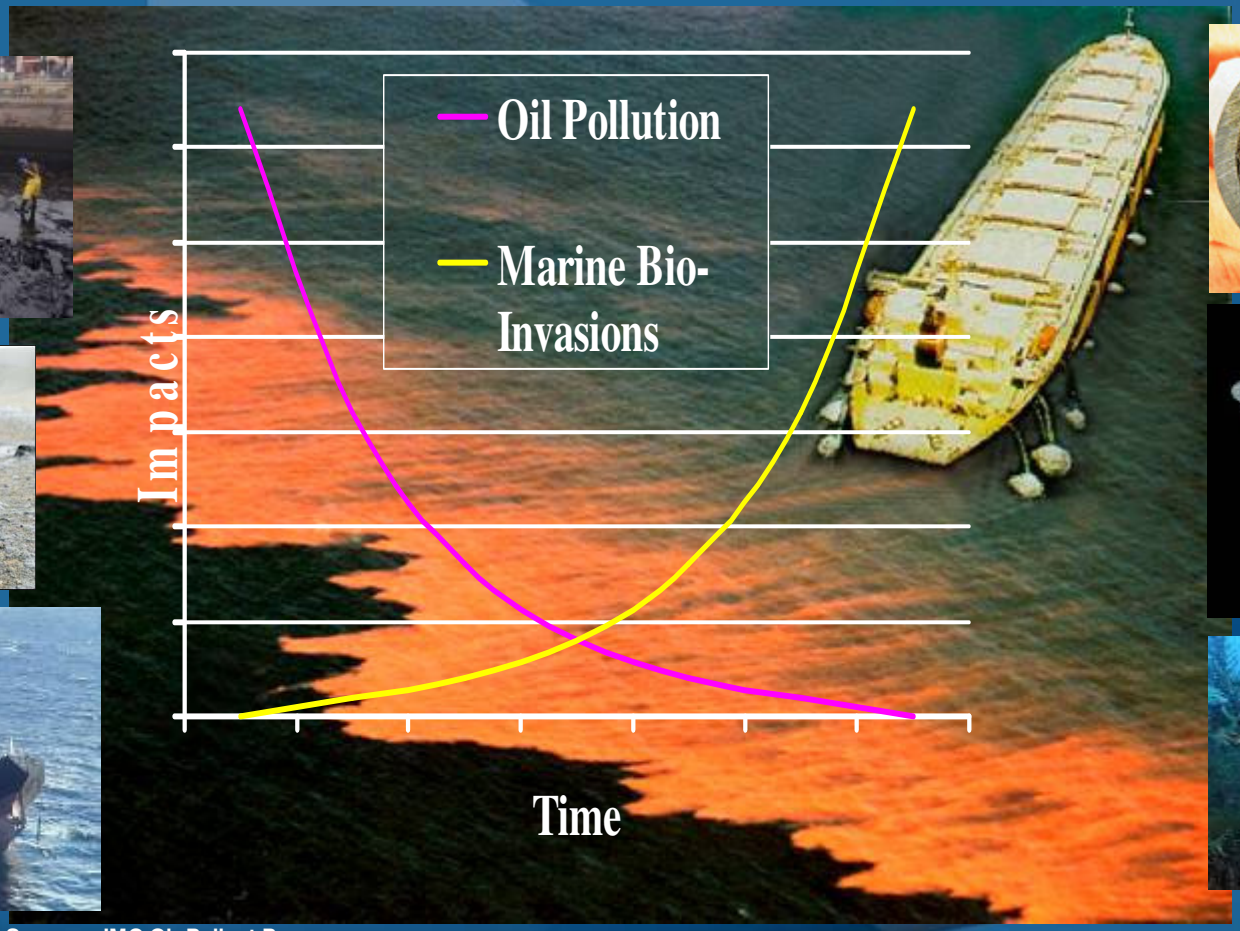
Compare *Impact* over time
oil pollution -vs- marine bio-invasions



Source : IMO GloBallast Program

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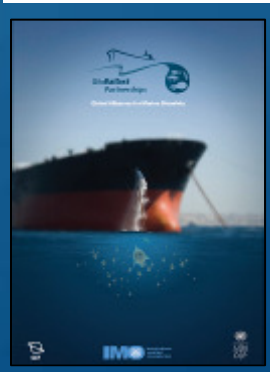
IMO BWM Convention

- In February 2004, IMO adopted the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWMC).
- BWMC sets a framework for national governments to implement new legislation.
- Entry into force of this Convention → Needs 30 countries and 35% of World Gross Tonnage. Ratification expected in late 2011. Comes into force 12 months later.

Currently 30 countries representing >26.4% have signed.

- Shipping companies that must comply with the convention are encouraged by IMO to install Type Approved Ballast Water Treatment Systems (BWTS) on their ships.



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IMO BWMC Timetable

Existing Vessels Ballast Water Cap. (m3)		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	20...
< 1500 *OR* > 5000	A	Exchange or Treat (D1 or D2)							TREAT (D2)				
1500 to 5000	A	Exchange or Treat (D1 or D2)					TREAT (D2)						
New Vessels **BW Cap. (m3)**	**BUILD YEAR**												
> 5000	2009 - 2011	Exchange or Treat (D1 or D2)							TREAT (D2)				
> 5000 m3	2012 →							TREAT (D2)					
< 5000 m3	2009 →	*)	Exchange or Treat (D1 or D2)					TREAT (D2)					
< 5000 m3	2010 →	**)		TREAT (D2)									

A = shall comply, NOT later than the first intermediate or renewal survey, whichever occures first, after the anniversary date in the year of compliance with the D-2 standard.

*) MEPC.57 postponed requirement to second annual survey or latest by the end of 2011.

**) MEPC.59 reccommends to Administrations to start fitting ships with BWMS technology.

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Regional Enforcement

Some Countries have Implemented National Regulations Related to BWM Prior to the BWMC Coming Into Force:

- Australia
- Brazil
- Canada
- Norway
- Israel
- ROPME SEA AREA
- Ukraine
- USA – Federal and State

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North America
USCG Proposed BWM Regulations

USCG Proposed Rulemaking (Public Comment Period over 12/4/09)

- **"Phase One" BWDS – Consistent with IMO D2.**
- **Implementation Schedule – Starting 2012**
- **Practicability Review Process – Proposed 2013 and every 2 years after. Review to determine if a more strict discharge standard is practicable and what level standard.**
- **"Phase Two" BWDS – Potentially 1000 x Phase One.**
- **Grandfathering for systems installed to comply with Phase One standard – Proposed 5 years.**
- **USCG Approval for BWT systems – Details of Approval Process and proposed Equivalency to credible IMO Type Approvals.**

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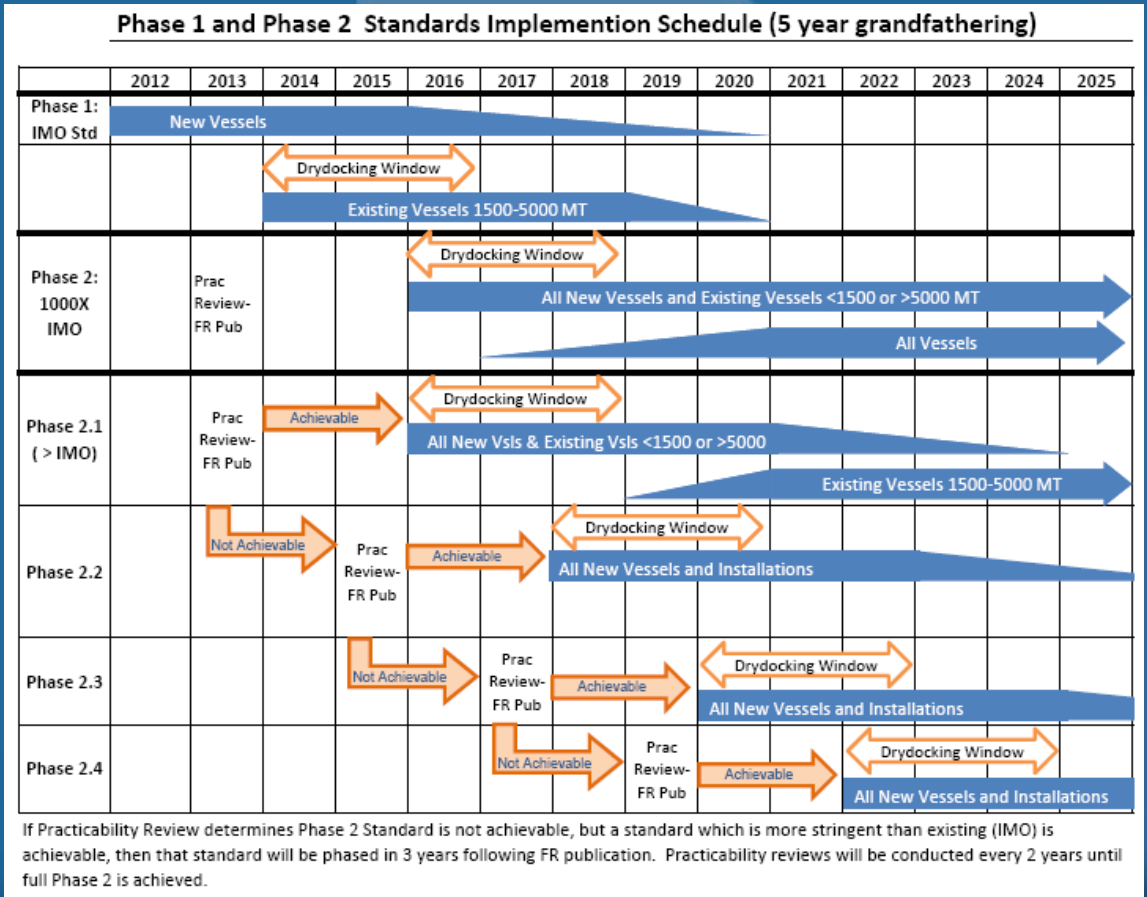
North America
USCG BWM Regulations



Note that the USCG indicates in their Draft Programmatic Environmental Impact Statement (DPEIS) that they prefer the Phase One standard (same as IMO D2).

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Port State Control Enforcement Challenges

An Estimated 70,000 Ships will be Regulated

Strict Enforcement would Require Testing Each Ship Each Time it Discharges BW

A Tiered Approach is Required:

- Self Monitoring and Reporting
- Risk Assessments
- Occasional Spot Checks
- Full Testing Only for Historical Offenders

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Current Initiatives to resolve these issues

Recent comprehensive reports on these issues include:

• 2010 European Maritime Safety Administration (EMSA) Report (concentration on analytical methodologies). EMSA-led BLG Correspondence Group and major report to be published in BLG16

•2010 U.K. report under auspices of International Council for Exploration of the Sea (emphasis on sampling issues).

•U.S. Coast Guard/U.S. EPA/National Academy of Sciences (focus on ETV protocols)

•Strategies referred to here are under development in the IMO Flag State Implementation (FSI) sub-committee.

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The Size of the World Commercial Fleet

- Estimated 70,000 commercial vessels will install on-board BWTS before 2020

- Perhaps 10,000 units per year (or 30 installations per day) for multiple years

- Once all existing ships are in compliance, (2020?), only newly-built ships will require the installation of BWTS, so global BWTS markets will then shrink to around 2,000 ships per year (five or so installations per day).

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Issues concerning international standards

- Certification (performance) testing is seen as a 'blue-print' for compliance testing, at least in its most comprehensive form.
- Therefore, any residual ambiguities, particularly as related to worldwide interpretation of the BWM standard, could have implications for eventual compliance testing.
- Article 7 of the Convention states that a vessel *"should not be unduly delayed by the application of an extended survey process"*
- Therefore, it is important that any compliance testing follow a recognizable common standard with an expected time scale.

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Sampling Issues

•Continuous time-integrated sampling of ballast water throughout a discharge event can provide statistically sound estimates of organism abundances *(Miller et al. 2011).*

•However, logistical and time constraints (e.g. a short turnaround time, relatively small ballast discharge) lead to questions about the volume required for true representative sample of the ballast water aboard the vessel. For rare organisms larger samples are equated with greater precision associated with organism counts.

•"Too small" samples may underestimate the number of live organisms in a discharged ballast water sample, especially relevant with respect to the D-2 discharge standard. What about sample error associated with multiple counts? "should *every replicate count* be at or below the D-2 standard, or can a BWMS be considered compliant if the *mean* of the replicates meets the standard?"

•There is a case for indicative analyses that clearly indicate a gross violation of the D-2 standard, whereupon a decision needs to be made on whether the vessel should stop discharge, at least pending detailed analysis. Clarification is still required as to criteria needed for suspension of discharge:

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Analytical Issues.

Methods available comprise:

- Indirect, e.g. Residual Oxidant Concentration Indirect autonomous measurements that could include particulate profile analysis and surrogate indicators of disinfection efficacy, e.g., total residual oxidant [TRO] and/or oxidation reduction potential [ORP] sensors for chlorine and ozone treatments; dissolved oxygen and/or pH sensors for deoxygenation treatments; and radiometers or measures of power output + water transmittance for UV treatments.
- Indicative/Indirect measures of abundances of live organisms may also be collected autonomously, or by inspectors, for indications of clear non-compliance (e.g., vital stains + flow cytometry, ATP kits, in situ PAM fluorometry*).*
- Direct measurement, which is directly comparable to the D-2 standard

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USA and Singapore - Examples of Logistical Difficulties related to compliance assessment.

United States. **Primary logistical problem would be coverage required to serve their 49 major ports separated by hundreds or thousands of miles, including the Great Lakes and Hawaii.**

Singapore. **Receives > 70,000 commercial vessels/ year in a single port, not including barges, tugs, ferries and passenger vessels; an average >190 vessels per day.** ***(This is a comparatively efficient port. The average turnaround time for ships in Singapore is between 6-8h, whereas in other ports, it may take more than 10 times as long for a similar type of vessel).***

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Conclusions.

It will be difficult to effectively use detailed analyses of every aspect of the D-2 standard for all but an extremely small percentage of ships entering port due to:

1. Limited available, qualified testing personnel for real-time testing in hundreds/thousands of ports worldwide. Coverage would not be possible for full compliance testing of representative samples to the current standard, and
2. Time constraints relating to test procedures (few-several days) and to vessel turnaround time in port (few hours-few days). In many cases, full compliance information would not be available before the vessel is due to leave port.

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Recommendations

A tiered approach to assessment, recognizing that it will not be feasible to test more than a fraction of the world fleet at any given time. The proposed solution entails the use of reporting, inspections, and testing, involving a phased series of steps that increase the likelihood of detecting non-compliance, but also involve an increase in resources and logistical challenges.

Such a strategy would identify the most obvious cases of non-compliance, based on the rationale that it is much easier and cheaper to detect clear non-compliance than it is to identify full compliance, bearing in mind the sampling and analytical effort involved.

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Port State Control Enforcement Challenges Questions?

Port State Control inspections - what challenges are owners and operators facing?

How does an operator comply with the requirements of the BWM Convention?

What will PSC be looking for? What will they check?

What problems/penalties could be faced by ship operators as a result of PSC inspections?

What can an operator do to mitigate potential problems/penalties?

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Answers?

The ability of the Administrations, through the Port State Control process, to effectively verify compliance with the Convention will depend on the precision and reliability of data obtained on use and performance of BWMS. While any penalties for non compliance will come under the purview of the laws and requirements of individual countries, any process that streamlines and normalizes compliance testing will result in a more even application of the Convention worldwide. Ship operators will also welcome a common and understandable approach by port State control (PSC) in verifying compliance with the Convention.

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USCG STEP

STEP (Ship Technical Evaluation Program)

PURPOSE

Provide a mechanism for BWMS manufacturers to partner with vessel owners to encourage installation of treatment systems on board operating vessels.

USCG gets performance data. Owner gets grand-fathering protection

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North America
USCG STEP

Considerations for Shipowners:

- Vessels accepted into STEP are permitted to use the system for the life of the ship / life of the system for purposes of U. S. regulations and IMO in USCG controlled waters.
- Fleet applications into STEP are now being accepted, although the STEP resources are limited and selections are CG driven.
- Responsibility for application, installation and testing falls on the vessel owners.
- Systems which are unsafe or in substantial non-compliance must be removed

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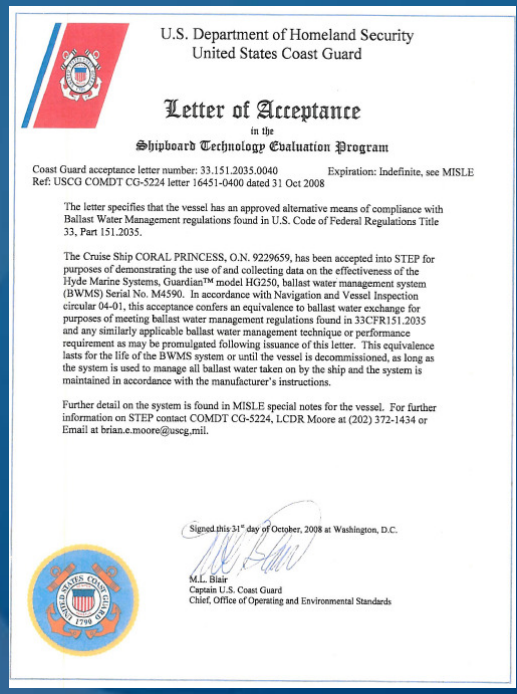
North America
USCG STEP

Hyde Marine & USCG STEP

2008 - ***Coral Princess*** **(Retrofit in 2003) is the first ship accepted into US Coast Guard STEP Program. The** ***Coral Princess*** **is allowed to discharge properly treated ballast water in U.S. waters for the life of the ship! Over 8 years of reliable operation.**



U.S. Department of Homeland Security
United States Coast Guard

Letter of Acceptance
in the
Shipboard Technology Evaluation Program

Coast Guard acceptance letter number: 33.151.2035.0040 Expiration: Indefinite, see MISLE
Ref: USCG COMDT CG-5224 letter 16451-0400 dated 31 Oct 2008

The letter specifies that the vessel has an approved alternative means of compliance with Ballast Water Management regulations found in U.S. Code of Federal Regulations Title 33, Part 151.2035.

The Cruise Ship CORAL PRINCESS, O.N. 9229659, has been accepted into STEP for purposes of demonstrating the use of and collecting data on the effectiveness of the Hyde Marine Systems, Guardian™ model HG250, ballast water management system (BWMS) Serial No. M4590. In accordance with Navigation and Vessel Inspection circular 04-01, this acceptance confers an equivalence to ballast water exchange for purposes of meeting ballast water management regulations found in 33CFR151.2035 and any similarly applicable ballast water management technique or performance requirement as may be promulgated following issuance of this letter. This equivalence lasts for the life of the BWMS system or until the vessel is decommissioned, as long as the system is used to manage all ballast water taken on by the ship and the system is maintained in accordance with the manufacturer's instructions.

Further detail on the system is found in MISLE special notes for the vessel. For further information on STEP contact COMDT CG-5224, LCDR Moore at (202) 372-1434 or Email at brian.e.moore@uscg.mil.

Signed this 31st day of October, 2008 at Washington, D.C.

M.L. Blair
Captain U.S. Coast Guard
Chief, Office of Operating and Environmental Standards

2010 - **Celebrity** ***Mercury*** **(Retrofit with Hyde GUARDIAN® in 2006) is accepted into USCG STEP Program. Ship renamed** ***Mein Schiff 2*** **In 2010 now operated from Germany.**

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Hyde Ballast Water History

Since 1996, Hyde Marine has been a pioneer in the development of effective Ballast Water Management Technology Solutions.

1996 – 2002. Land Based Testing and 5 Shipboard installations

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Hyde Ballast Water History

Hyde Ballast Water Treatment Technology improved based on lessons learned and shipboard experience. Hyde GUARDIAN® installed on Coral Princess June 2003.

2003 – 2008 Coral Princess, Celebrity Mercury,
Royal Navy QE Class Aircraft Carriers (2 ships – 3 systems each ship)

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Hyde Ballast Water History

2008 - *Coral Princess* is the first ship accepted into US Coast Guard STEP program.

April 29, 2009 - Hyde GUARDIAN® receives IMO Type Approved from MCA (UK National Administration) through Lloyds Register.

2010 – First BWT Engineering Type Approval received From ABS. Approval also received from LR, RS and BV and applied for from DNV, GL and other major Class Societies

IMO Type Approval:

Type Approval Certificate No.
MCA 0900032, 29 April 2009.

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Hyde GUARDIAN®

The *Proven*, Simple, Safe and Effective Solution

Fully automated, two-stage process:

1st Stage - Auto-backflush depth filtration

2nd Stage - UV disinfection

The Hyde GUARDIAN® uses *no chemicals or active substances in the treatment process or for maintenance!*

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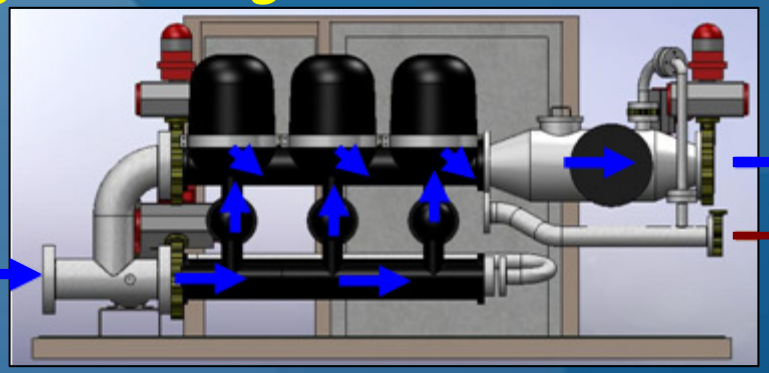
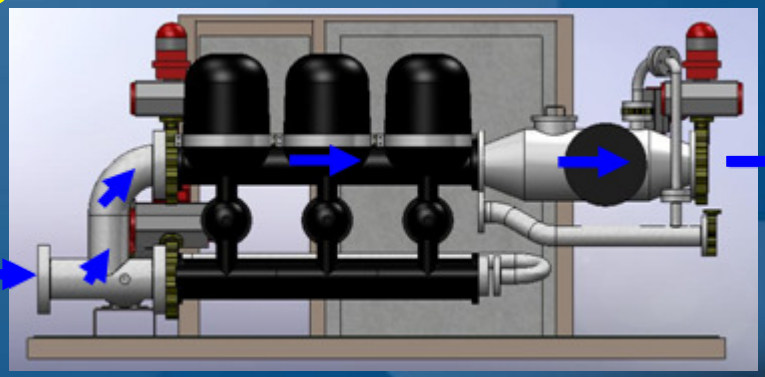
Hyde GUARDIAN® Treatment Process

Hyde GUARDIAN® operates automatically, behind the scenes, during both ballasting and de-ballasting operations.

During Ballasting



During De-Ballast



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Hyde Ballast Water History

2010 - Hyde receives first orders for Ex Proof systems for Suez Max tankers from leading Korean Shipyard for major Greek owner.

Hyde has received orders for over 150 Hyde GUARDIAN® Systems for more than 100 ships With Capacities ranging from 60 to 5450 m3/hr per ship.

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Ballast Water Treatment Solutions

Two main technical approaches:

A Chemical-based Solution

[using Active Substance. Approval according to IMO Resolution MEPC 126(53). Basic and Final Approval according to (G9) and then testing and Type Approval according to (G8)]

A Chemical-Free System Solution

[using no Active Substance. Basic and Final (G9) not required. Testing and Type Approval and according to (G8) and IMO Resolution MEPC 125(53)]

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Ballast Water Treatment Solutions

Most BWM Solutions include two stage process:

Stage 1) Physical Liquid-Solid Separation. To reduce sediment and remove larger organisms. (screen filter, disk filter)

Important to note that even chemical-based treatment options need this first stage, due to the organisms' natural defenses!

Stage 2) Disinfection. To kill or inactivate the smaller organisms:

Physical (UV, cavitation, deoxygenation, etc.)

Chemical (AOT, chlorine, Ozone, Chlorine Dioxide, etc.)

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SELECTION OF A SYSTEM FOR RETROFIT

- Established Technology Supplier
- Proven Reliability & Type Approval
- Suitability for Use with Existing Ballast System & Ballast Pumps
- Design for Adaptability – Modular Components – Installation Flexibility
- Supplier Experience – Lessons Learned from Early Retrofits
- Working Closely with Advisors and Class
- Special Considerations for Special Ship Types – Large Flow rates, Hazardous Locations

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INSTALLATION CHALLENGES

- What is my BW pump(s) capacity [m3/h]?
- Available Pressure from existing pump?
- Number of BWMS units needed?
- Are there stripping pumps or eductors?
- Power Consumption of the BWMS?
- Available space for Equipment?
- What will be the optimal BW piping arrangement?
- Access to get the BWMS into the machinery space?
- Is a dry-docking needed to install?
- Can I integrate the BWMS into the ballast control system?
- If chemicals are required, where do I install tanks?
- What is the purchase cost (CAPEX) of BWMS?

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SPECIAL CONSIDERATIONS FOR RETROFIT PROJECTS

- Vessel Inspection, data collection, review of installation goals and constraints.
- Piping connection schematic and drawings showing tie in points to existing ship systems for Class review/approval
- Identify location for treatment system.
- Develop final arrangement drawings of the equipment and piping to meet owner and class requirements.
- Ship's electrical and control system modifications and wiring
- Material estimates: pipe runs, foundations, and cable
- Assistance during installation.

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The Vital Role that Naval Architects & Marine Engineers Can Play

- Advise ship owners, Ship Managers and Installers in the evaluation and selection of appropriate BWM solutions.
- Support of preliminary inspection
- Engineering services in all phases of the project.
- Assist in the development of Budget and Installation Objectives
- Develop drawings of the to meet owner and class requirements.
- Optimum power generation and management
- Class/Flag Approval

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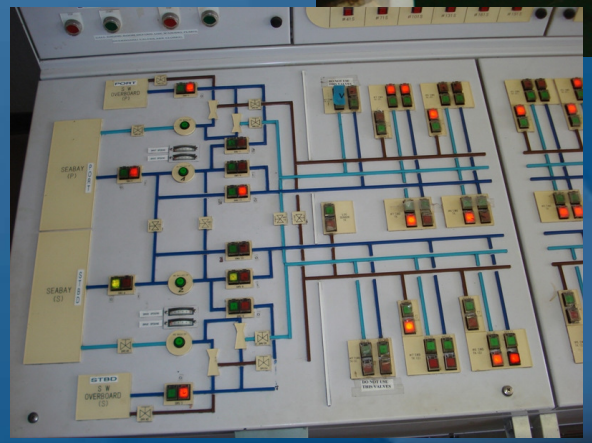
LESSONS LEARNED - EXPERIENCE



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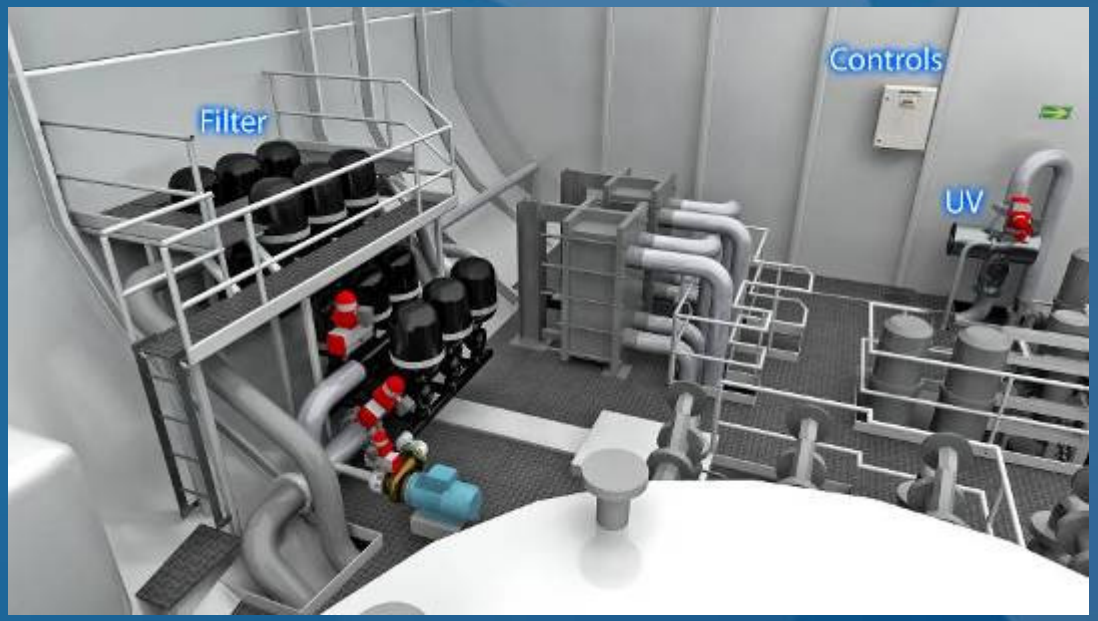
Modular Components
Fast and Easy Installation

Modular design allows great flexiblility to install in crowded machinery spaces of existing ships.



The UV, filter modules, and electric panels can be **brought into the ship without cutting access through hull or deck.**

System components can be **separated** and located in different parts of the ship **to fit.**

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Modular Components
Fast and Easy Installation

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Ballast Water Treatment System

Superflow Installation on Suexmax COT New Builds

2 x 2500 m^3/hr
Hyde Guardian®
Installation with
Ex Proof Design

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Ballast Water Treatment System

Superflow Installation on Suexmax COT New Builds

Ex Proof UV Units
Pump Room
Installation

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OPERATIONAL CHALLENGES

- What is the operating cost (OPEX) of the BWMS?
- Does the BWT affect vessel operation & turn-around time?
- Maintenance intervals and downtime?
- Any specialized training of crew and officers?

- Does the system operate in all water salinity? Need to carry sea water or brine?
- If chemical, what safety and logistical considerations to purchase, transport and store chemical?
- How to ensure active substance is fully neutralized and no chemical is discharged?

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All ship owners will need to comply with upcoming BWM regulations...

but selecting a *safe, practical, robust,* and ***RELIABLE*** ballast water management solution should be *highest priority!*

Hyde Marine's philosophy has been to take the simplest and most direct technical approach in design and selection of components to deliver the most reliable ballast water management system on the market.

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Thank you!

www.hydemarine.com