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HYUNDAI BWTS

Ballast Water Treatment System

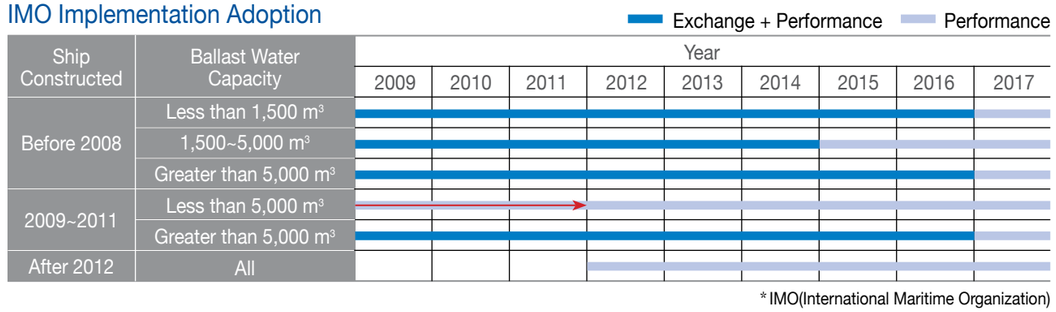
HiBallast & EcoBallast

HYUNDAI HEAVY INDUSTRIES | ENGINE & MACHINERY

K01-118-09 JUL. 2015

BWTS Implementation

IMO Implementation Adoption



* IMO(International Maritime Organization)

Regulation D-2 Ballast Water Treatment Standard

- Less than 10 viable organisms / m^3 for > 50 ㎛
- Less than 10 viable organisms / ㎖ for10 ~ 50 ㎛
- Toxicogenic Vibrio cholerae(01 and 0139) : < 1cfu / 100 ㎖
- Intestinal Enterococci : < 100 cfu / 100 ㎖
- Escherichia coli : < 250 cfu / 100 ㎖

USCG Implementation Schedule (published on 23 March 2012)

	Vessel's Ballast Water Capacity	Date Constructed1	Vassel's Compliance Date
New Vessels	All	On or after 01 Dec 2013	On delivery
Existing Vessels	Less than 1,500 m^3	Before 01 Dec 2013	First scheduled DD after 01 Jan 2016
	1,500-5,000 m^3	Before 01 Dec 2013	First scheduled DD after 01 Jan 2014
	Greater than 5,000 m^3	Before 01 Dec 2013	First scheduled DD after 01 Jan 2016

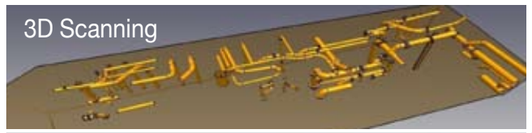
Retrofit

Retrofit Advantages of the HiBallast & EcoBallast

- Well proven & safe process technology
- Low operation & maintenance costs
- Easy installation by Modularized Units
- Short installation period under Floating or Dry Dock
- Two BWTS models available
- Extended definite warranty by HHI

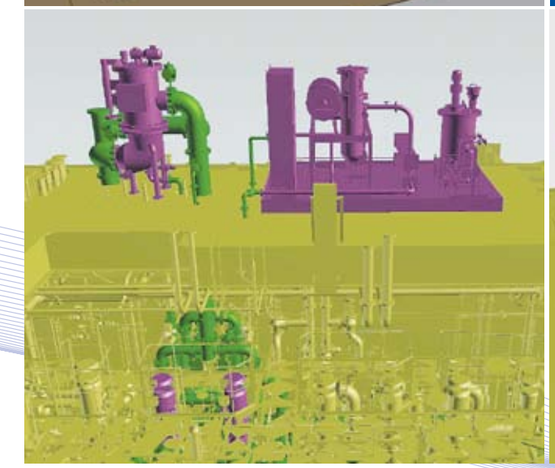
Task Procedures for Retrofit Vessels

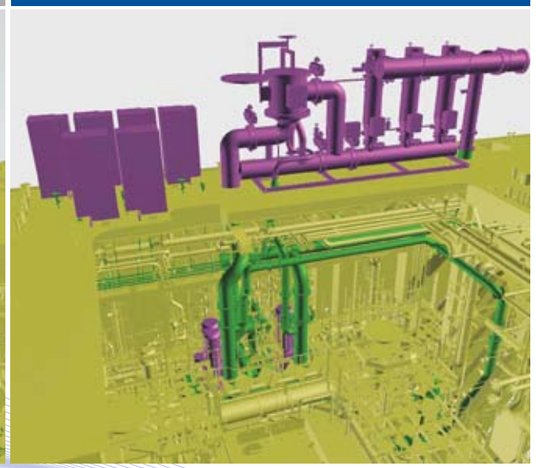
Primary equipment arrangement using P&ID and the relevant drawing ▶ Survey and scanning onsite ▶ Recompose and reproduce piping lines to be installed with existing pipes ▶ Approval process ▶ Installation and Commissioning



Faster

Easier



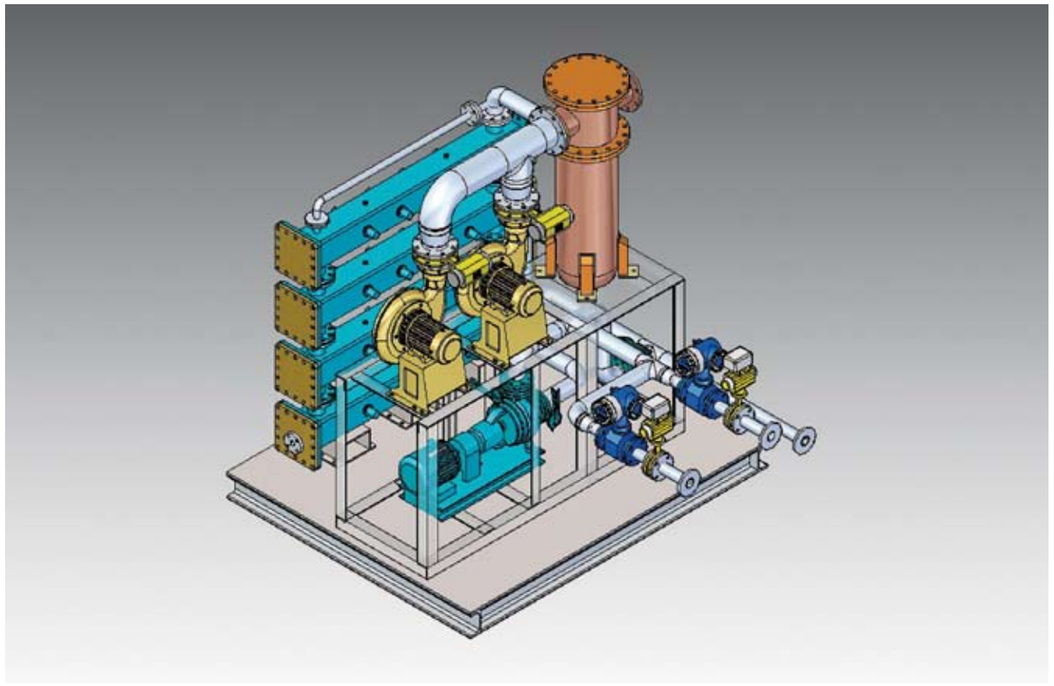


HiBallast

IMO Final Approval : July, 2011
Government Type Approval : Nov., 2011
USCG AMS : June, 2013
DNV's Safety Assessment : May, 2013
LR's General Design Approval : Jan., 2014
USCG Type Approval : 2018(expected)

HYUNDAI
Ballast Water Treatment System (BWTS)
Explosion Proof Type Available

HiBallast Overview



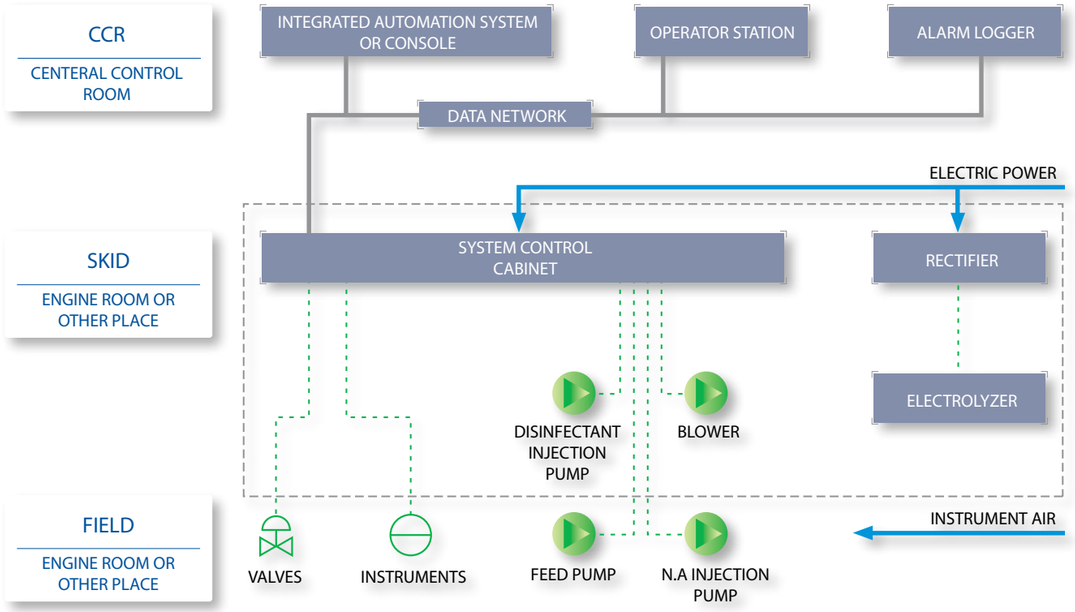
Design Standards

Description *Model*	Flow Capacity *m^3 / hr*	Electrolysis System Unit Dimensions *L x W x H (mm)*	Filter Unit Dimensions *L x W x H (mm)*	Weight (wet) *kg*	Required Power *kW*
HiB-300	300	2000 × 2200 × 2300	570 × 570 × 1805	1700	15
HiB-500	500	2000 x 2200 x 2300	570 x 570 x 2010	1700	25
HiB-700	700	2000 x 2200 x 2300	670 x 670 x 2190	2000	35
HiB-1000	1000	2500 x 2400 x 2400	780 x 780 x 2130	2700	50
HiB-1500	1500	2500 x 2500 x 2400	900 x 900 x 2420	3800	75
HiB-2000	2000	2500 x 2500 x 2400	900 x 900 x 2420	5000	100
HiB-3000	3000	3000 x 2800 x 2600	1120 x 1120 x 2610	6500	150
HiB-4000	4000	3000 x 2800 x 2600	1230 x 1230 x 2660	8200	200
HiB-5000	5000	3500 x 2800 x 2800	1230 x 1230 x 2660	8800	250
HiB-6000	6000	3500 x 2800 x 2800	1410 x 1410 x 3500	9300	300
HiB-8000	8000	4000 x 2800 x 3000	1630 x 1630 x 3650	9700	400

Main Features

Easy Installation	• No changes of the existing ship design • Space-saving installation by modularized design, well suitable for retrofit
Automatic Operation	• Feedback control of each unit with Human Machine Interface • Automatic and manual operation • Automatic TRC(Treatment Rated Capacity) control
Economic Operating Cost	• Low fuel cost by low power consumption • Long lifetime of electrodes
Convenient Maintenance & A/S	• Modular type system • Easy replacement by engineer / ship crew • Global support and worldwide A/S network
Main Application	• Any type vessel including Oil Tanker, Container, LNG & LPG Carrier • Ballast water capacity : 75 ~ 10,000 m³/hr

Control System Configuration

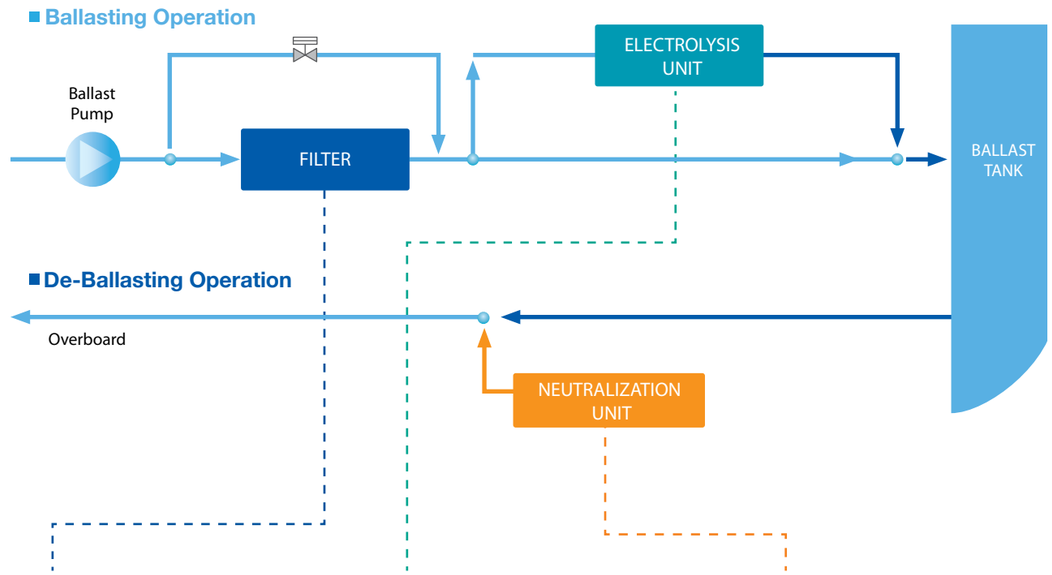


How HiBallast works?

HiBallast is a disinfection system by electrolysis of sea water

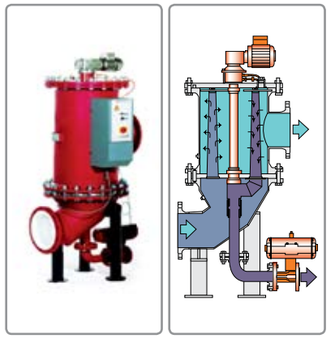
- Components : filter, Electrolysis Unit, Neutralization Unit, TRO Sensing Unit
- Required seawater capacity for electrolysis : only 1% of total ballast capacity
- Disinfectants : Sodium Hypochlorite
- Neutralizing agent : Sodium Thiosulfate
- Safety first : No harmful to human & vessel, No dangerous by H_2 gas separation, No risk to ballast tank coating

Process Configuration



REMOVE

Particles or organisms larger than 50㎛



DISINFECT

Produce disinfectant to kill virus, pathogenic bacteria and other organisms smaller than 50㎛

NEUTRALIZE

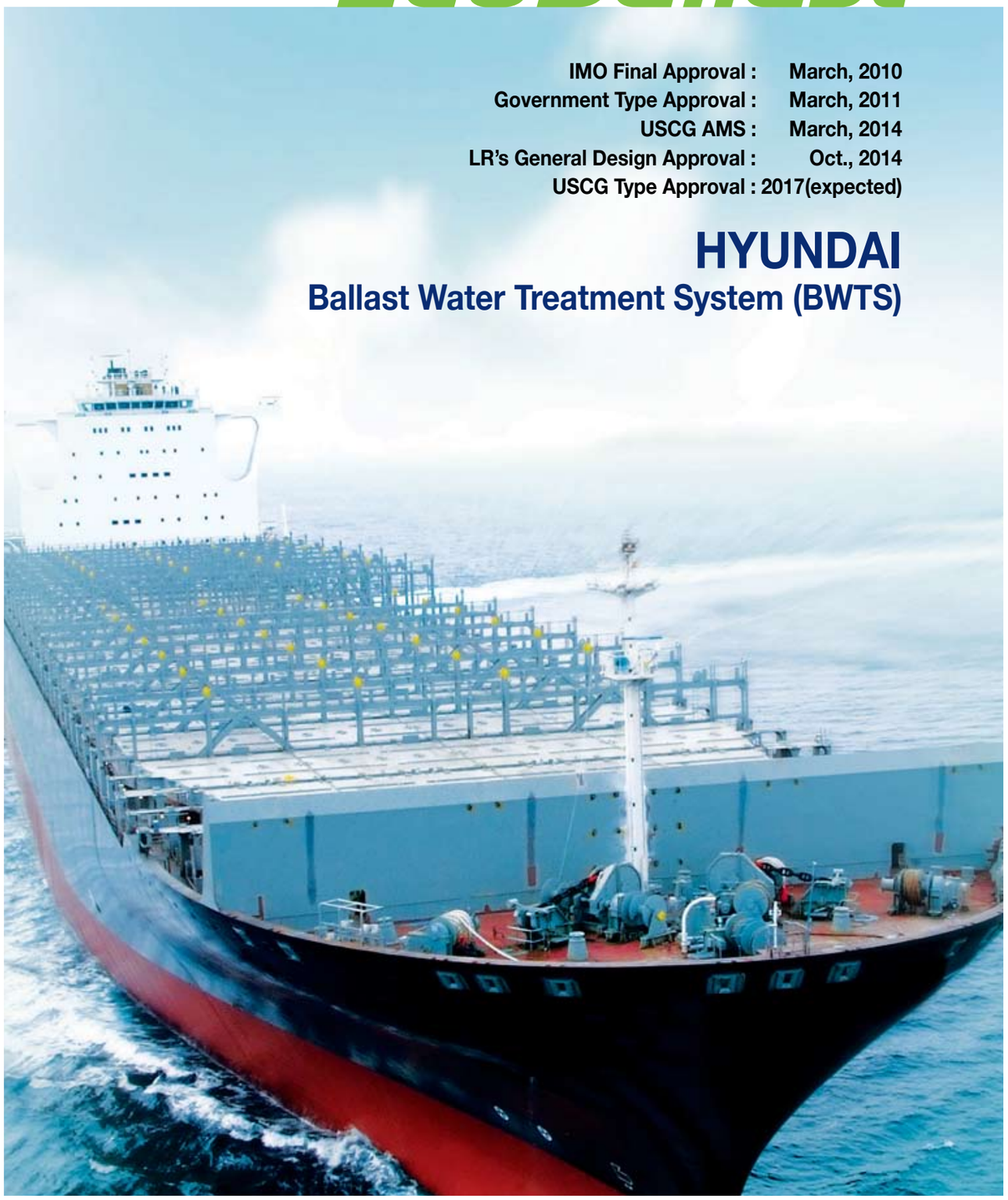
In deballasting the solution of sodium thiosulfate is used to convert any remaining residual oxidants into stable reduced form such as chloride and bromide.

In deballasting operation, the system needs to be neutralized prior to the discharge with neutralization agent to avoid environmental damage of the sea water.

EcoBallast

IMO Final Approval : March, 2010
Government Type Approval : March, 2011
USCG AMS : March, 2014
LR's General Design Approval : Oct., 2014
USCG Type Approval : 2017(expected)

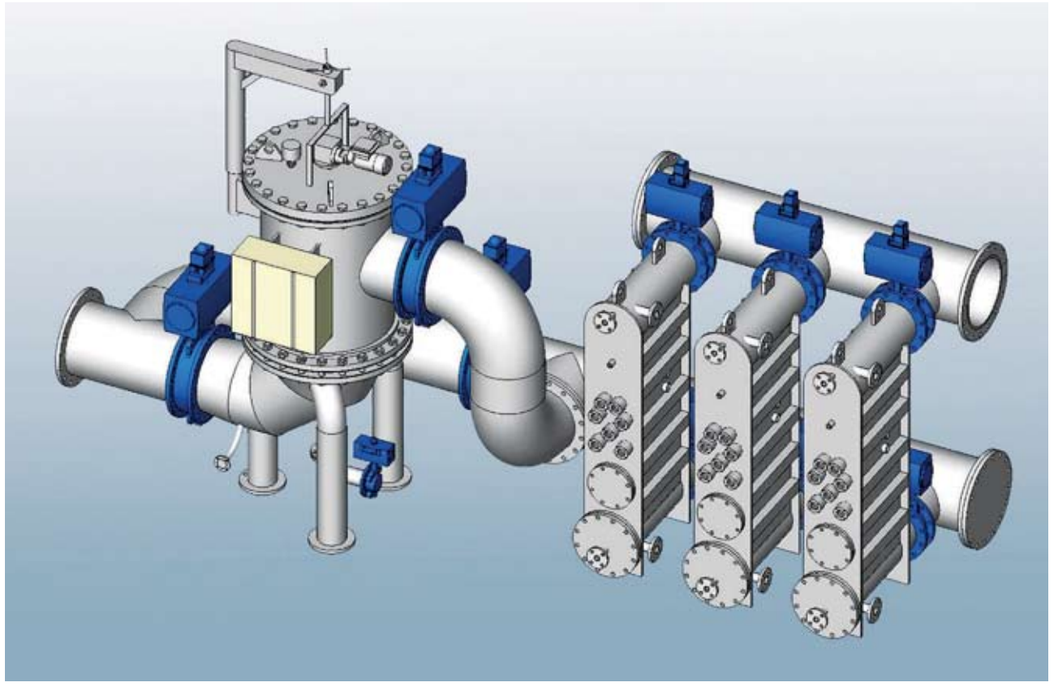
HYUNDAI
Ballast Water Treatment System (BWTS)



EcoBallast

EcoBallast Overview

EcoBallast system installed in engine room (3D Modeling)



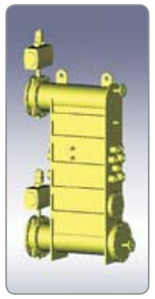
Design Standardsa

Description *Model*	Flow Capacity *m^3 / hr*	UV Reactor Unit Dimensions *L x W x H (mm)*	Filter Unit Dimensions *L x W x H (mm)*	Weight (wet) *kg*	Required Power *kW*
Eco-350	350	400 × 1100 × 1800	880 × 865 × 2220	1400	34
Eco-750	750	600 x 1100 x 1850	1250 x 1100 x 2430	2655	68
Eco-1000	1000	1700 x 1100 x 1800	1250 x 1100 x 2430	3405	102
Eco-1500	1500	1500 x 1100 x 1850	1525 x 1310 x 2630	4410	137
Eco-1800	1800	3000 x 1100 x 1800	1500 x 1470 x 2640	6340	171
Eco-2100	2100	2400 x 1100 x 1850	1500 x 1470 x 2640	6290	205

Main Features

Filter

- High performance
- Small footprint
- Full automation
- Easy maintenance
- Low maintenance cost

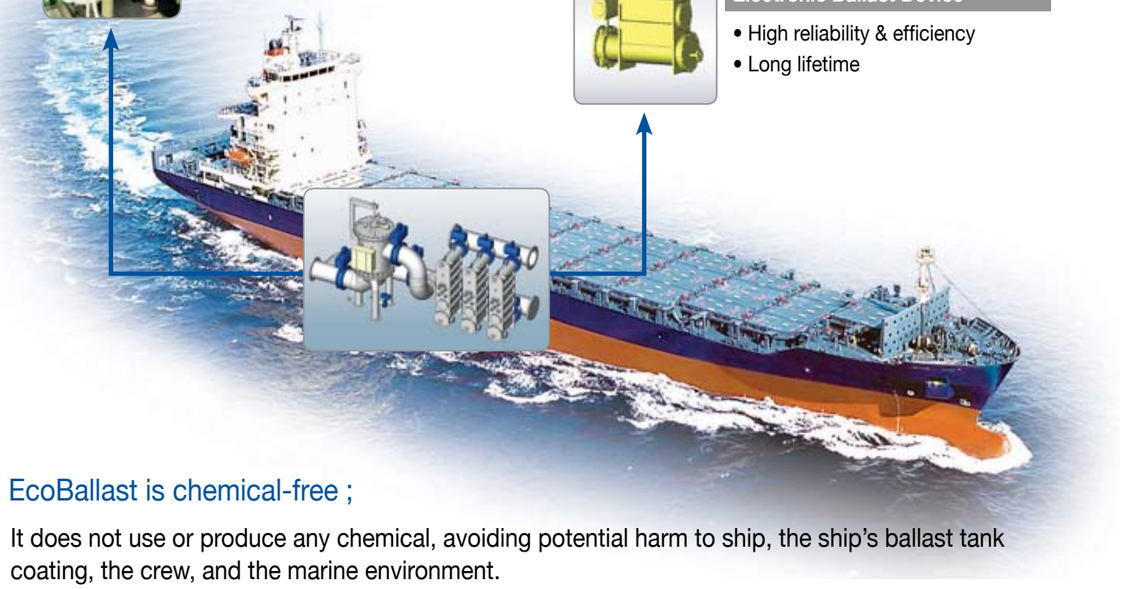


UV Reactor

- High efficiency
- Unique & robust design
- Automatic TRC (Treatment Rated Capacity) control

Electronic Ballast Device

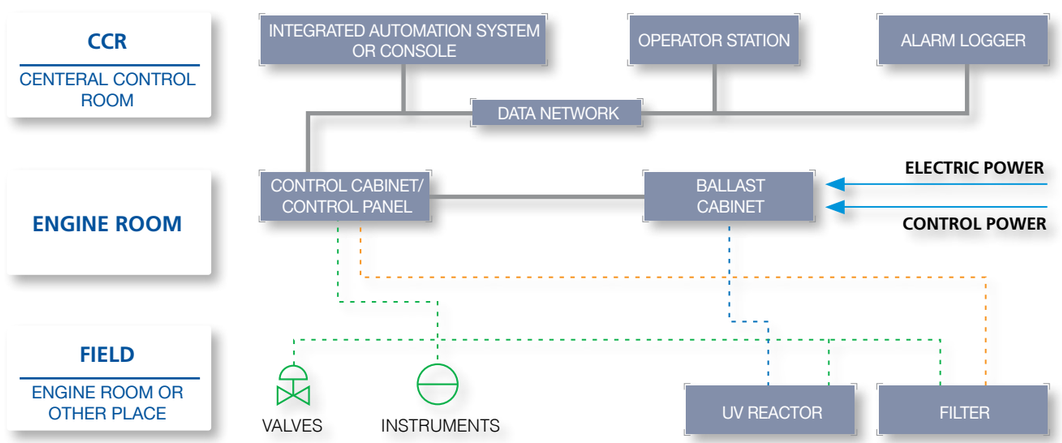
- High reliability & efficiency
- Long lifetime



EcoBallast is chemical-free ;

It does not use or produce any chemical, avoiding potential harm to ship, the ship's ballast tank coating, the crew, and the marine environment.

Control System Configuration

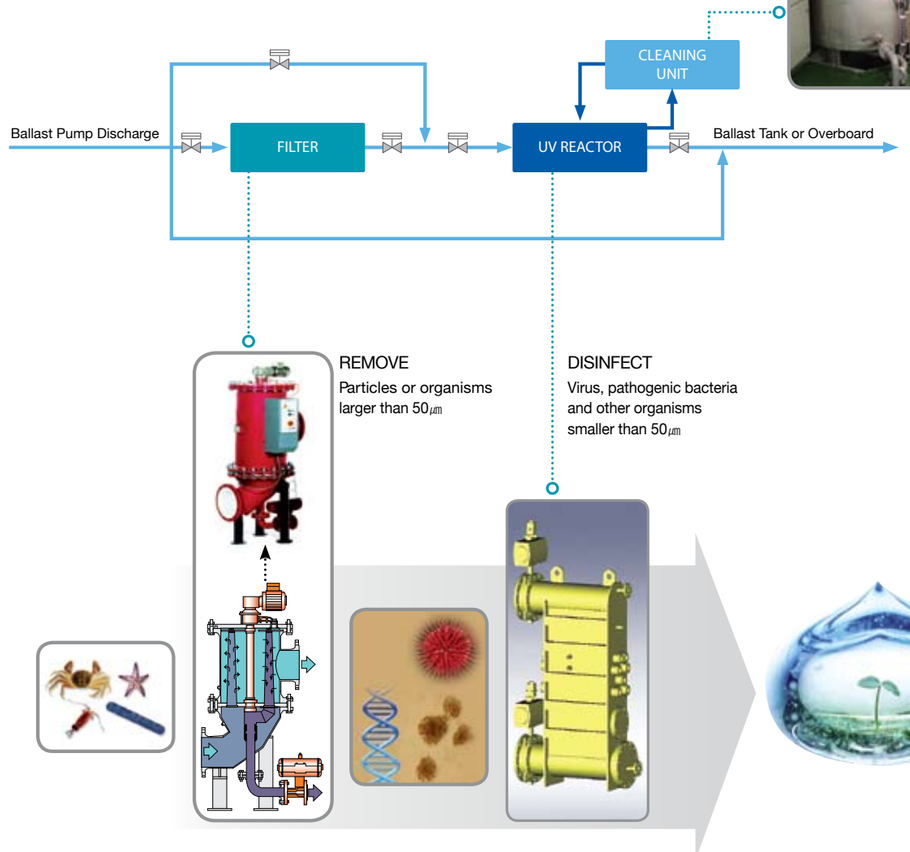


How EcoBallast works?

EcoBallast is a ultra violet disinfection system

- Components : Filter, UV Reactor, CIP (Cleaning In Place) Unit
- Disinfectants : UV-C light
- Eco-friendly disinfection process
- Safety first : No harmful to human & vessel

Process Configuration



The ballast water is treated during ballasting and once again during de-ballasting.

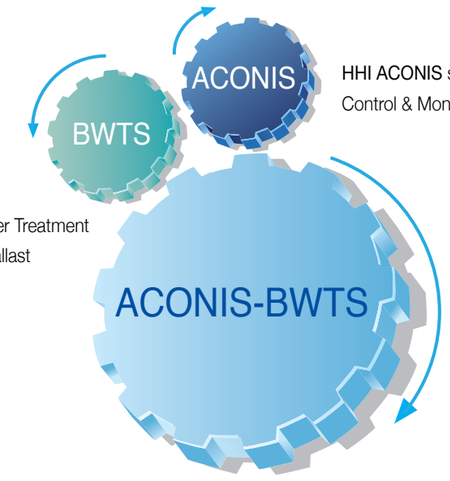
Controller

Key Advantages of the HiBallast & EcoBallast

- Makes ONE Controller
- Provides Smart Ship Solution
- Unique BWTS Controller with ICMS(Integrated Control & Monitoring System) among BWTS makers

ACONIS-BWTS

Robust → Reliable → Simple → User Friendly → Approved



HHI ACONIS stands for ICMS(Integrated Control & Monitoring System) of Vessel

HHI BWTS stands for Ballast Water Treatment System, named HiBallast & EcoBallast

USCG AMS

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

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PC based Ballast Water Control System (Option)

The system is based on modern communication and software technology for ballast water control.

Draught and Tank Level Monitoring
- Draughts, Trim, List at perpendiculars and draught marks
- Tank contents (Level, Volume, Weight and Fill Percent)
- Visual alarm with user definable range

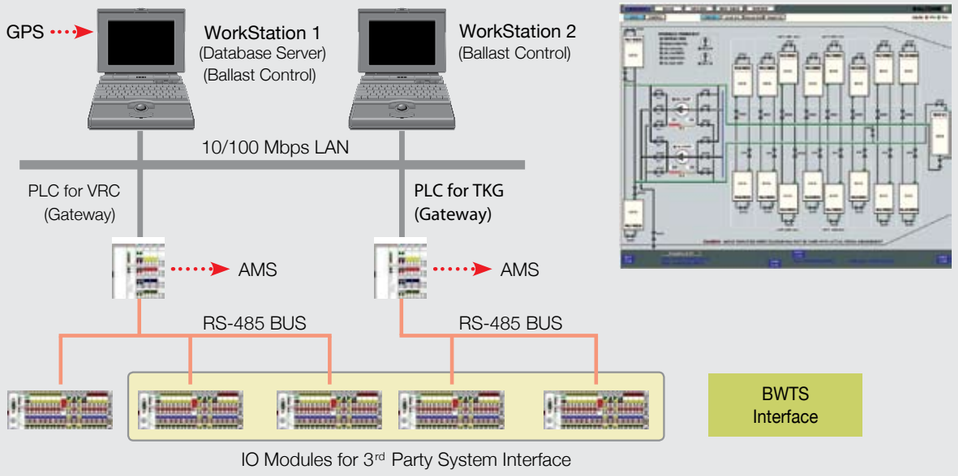
Remote Valve & Pump Control
- Valve status (Open, Close, Position, Move and Alarm)
- Pump pressure, load current and status (Remote, Run, Stop and Alarm)
- Individual control for pump and valve
- Group control for pump and valves (Pre-selected or Tank based)
- Auto/Manual operation trip (Draught / Trim / List and Pump abnormal pressure)

Interface with Ballast Water Treatment System
- Integrated monitoring on the program

Automatic Trace and Log Ballast Water Handling Status
- Trace ballast water movement and target tank (Load and Discharge)
- Log GPS position and time when handling event occurs
- Log tank name and handling amount of ballast water
- Log treatment system operation status while ballast water moves

Ballast Water Handling Report Generation
- User definable report generation with more narrative data record

Typical Schematic Diagram



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