Recent Application on Regulation for Ballast Water Treatment in Ship Design

General

- It is estimated that shipping transfers abt. 10 billion tones of ballast water each year around the world

- The invasion of foreign species through ship's ballast water is a world-wide economical and ecological threat

The IMO Convention

- The International Maritime Organization (IMO) and other international bodies to take action to address the transfer of harmful organisms by ship's ballast water.

- On February 13, 2004, IMO adopted a **new convention** (Control and Management of Ship's Ballast Water and Sediment) in which ballast water exchange and/or ballast water treatment will be required on all vessels operating on routes with potential invasion risks.

Ballast Water Management procedures

1. Ballast Water Exchange Standard

(Regulation **D-1**)

-- Tentative Measures until comply with D-2

2. Ballast Water Performance (treatment) Standard

(Regulation **D-2**)--- Ballast Water should be treated

-- Not come into force yet

At the moment most new ships are following D-1 standard

Ballast Water Exchange

D-1 Standard

1. Sequential method

--- 95% of Ballast water from ballast tank discharge to overboard then filling clean deep sea water to the tank one by one.

---Limited by ship's stability

---For some kinds of ship, this method can't be used, such as container vessel, multi-purpose vessel, RoRo vessel and PCTC vessel etc.

Ballast Water Exchange
D-1 Standard

2. Flow through (Over flow) Method

---Pumping through at least 3 times clean deep sea water to replace ballast water in ballast tanks

---This technique is not effective in removing organisms from ballast water.

- **There are some limitation in both methods**

The problem for D-1 Standard

- Otherwise, the Ballast Water which is replaced from ship to deep sea itself contribute to the wider dispersal of harmful species, and that island states located ‘down-stream’ of mid-ocean in Ballast Water Exchanging areas may be in particular risk from this practice
- It is therefore **extremely important** to develop the effective ballast water treatment methods as soon as possible, in order to replace Ballast Water Exchange (D-1)

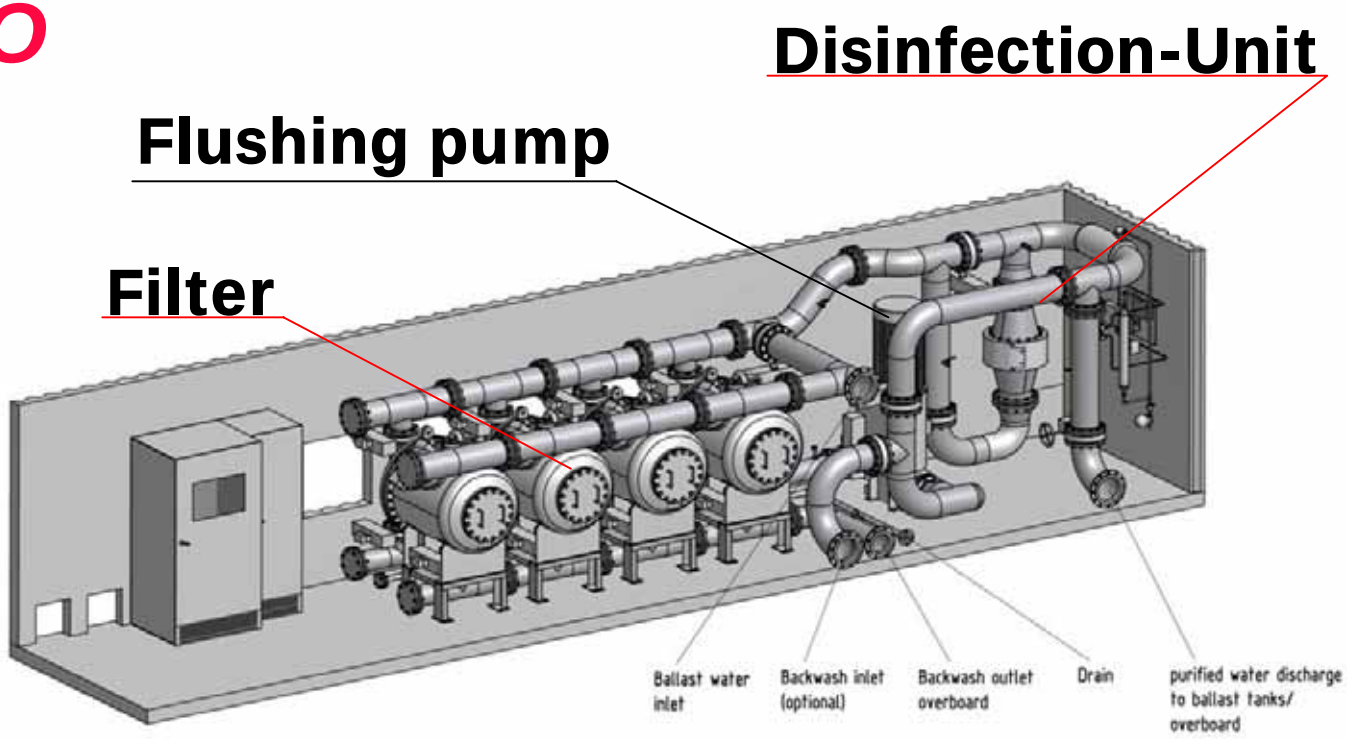
Ballast Water treatment (D-2)

- **The technology for ballast water treatment**

1. Mechanical treatment methods
   such as filtration and separation
2. Physical treatment methods
   such as sterilization by ozone, inert gases, oxidation, ultra-violet light, electric currents and heat treatment
3. Chemical treatment methods
   such as adding biocides to ballast water to kill organisms
4. Various combinations of the above

ballast water treatment plant

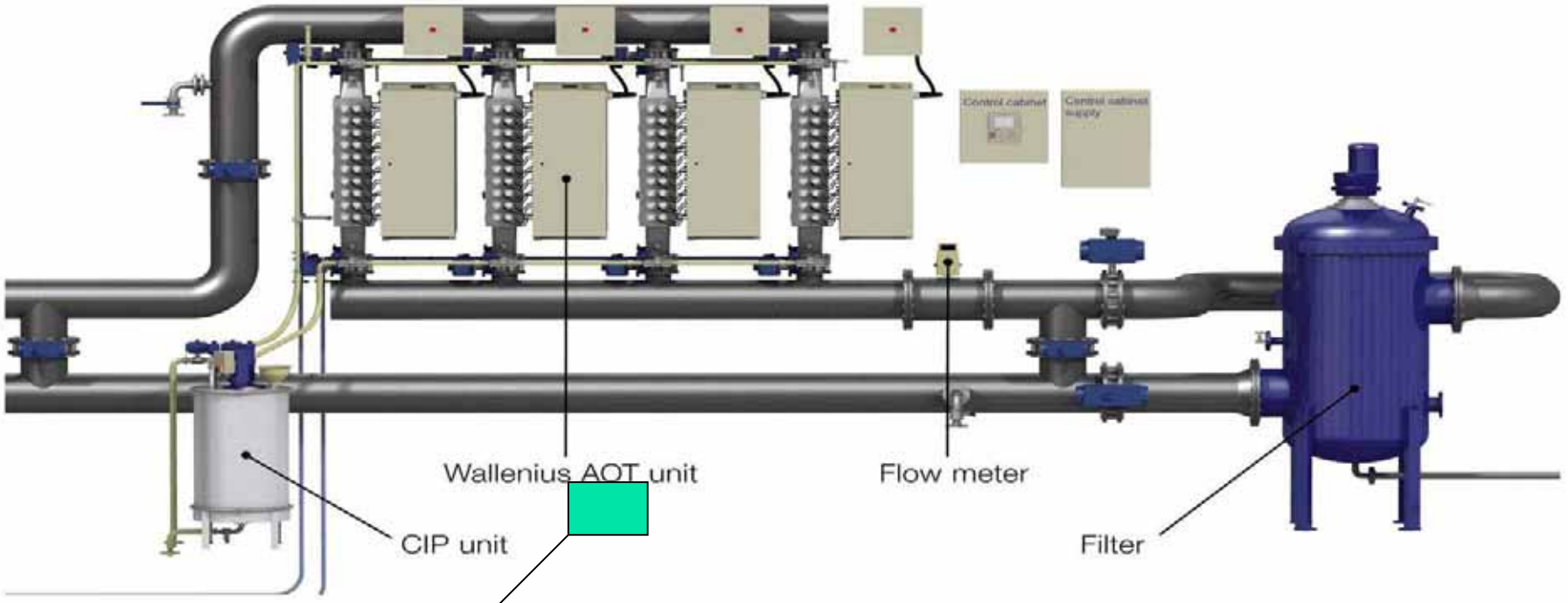
RWO



CleanBallast! SYSTEMS

ballast water treatment plant

PureBallast System



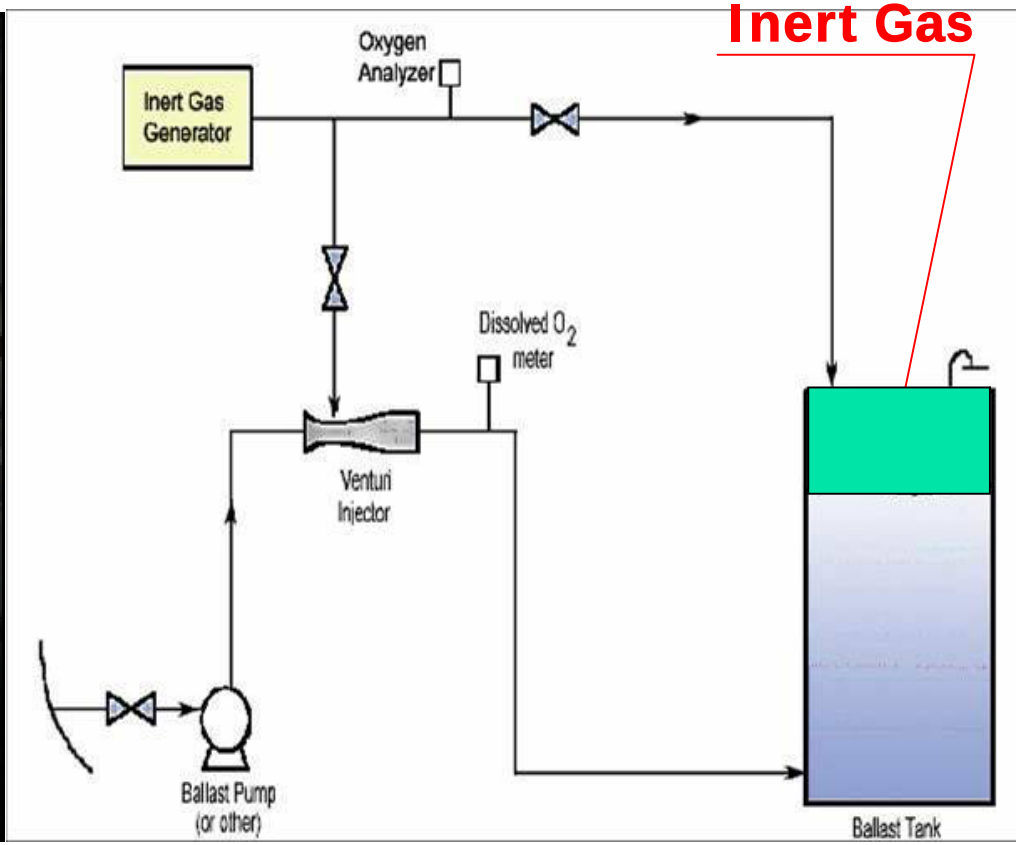
Draft installation of a PureBallast system for 1000 m³/h

Advanced Oxidation Technology

ballast water treatment plant

Gas Super-saturation

NEI



ballast water treatment plant

BOLLFILTER

Ballast Water Performance (D-2)

Application date of D-2

The date of ship construct	Ballast water Capacity (m3)	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Before 2009	1500~ 5000							→			
	≤1500 or ≥5000									→	
In or after 2009	≤ 5000				→						
Between 2009 to 2011	≥5000									→	
in or after 2012					→						

Only BW treatment allowed

Ballast Water Performance (D-2)

Acc. to International Conventions, the application of D-2 come into force:

- **12 months after** ratification by **30 States** and Whose fleets not less than **35%** of world merchant shipping tonnage.
- *Now It is ratified by **14 States** which occupies **3.55%** world shipping tonnage. So the application date **will be delay** about 2-3 years*.
- Some **Ship Owner have required** to install the B.W. treatment system on the new ships

Question to Designer:

How to *install*

the B.W. treatment system

The problems of ballast water treatment for ship design

1. **No many ballast water treatment systems can be selected.**
   ---Up to now, abt.15 systems are developed or under development
   ---But only 3 systems have been approved by Administration/Class
2. **Consideration of the treatment capacity and the size of equipment**
   --- Generally the engine room space is limited, so the equipment size is very important

The problem of ballast water treatment for ship design

3. More electric power consumption

--- Because of additional equipment such as back flushing pump, Disinfection-Unit, AOT Unit etc.

4. High price

--- The price of the new equipment is very high, because it takes huge money and time in research and development.

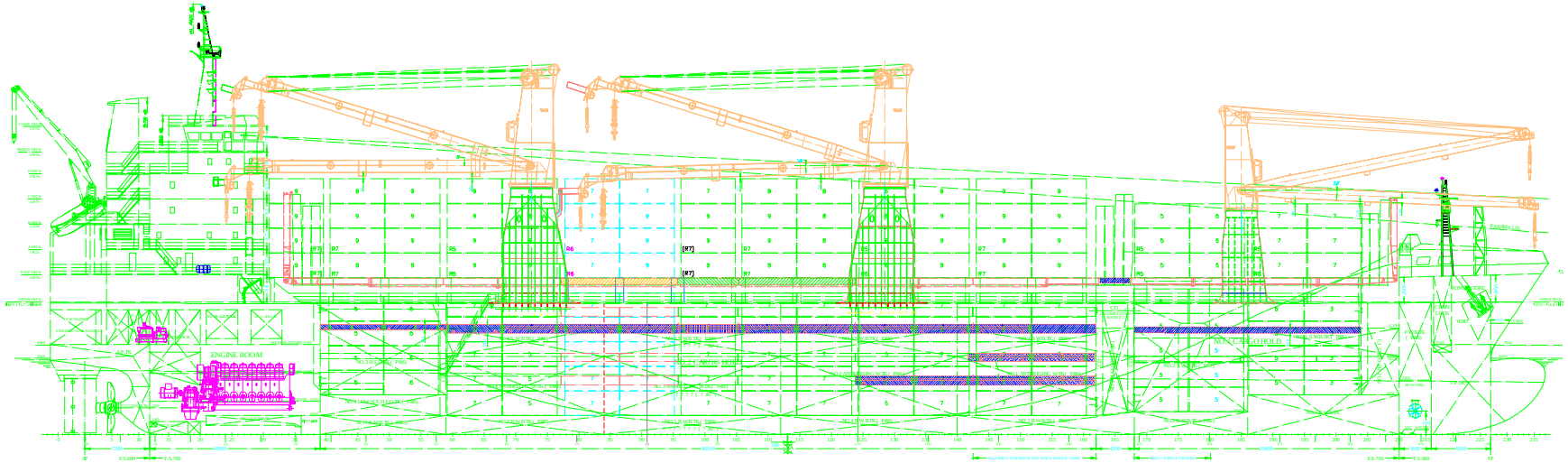
--- After more and more BW treatment plants used in the ship building, the price will be reduced.

Application of Ballast Water Treatment in Ship Design

Example

19100DWT MULTI-PURPOSE VESSEL

19100DWT MULTI-PURPOSE VESSEL



19100DWT MULTI-PURPOSE VESSEL

PRINCIPAL PARTICULARS

Length overall	abt. 166.00 m
Breadth	22.90 m
Depth	13.90 m
draught (Scantling)	9.50 m
Capacity of water ballast tanks	**9650** m3
Application Date for D-2 standard	**2017**

It is Owner's requirement to install BW treatment plant

19100DWT MULTI-PURPOSE VESSEL

Reason:

- The new regulation will be come into force in the future for all ships

  ---It is easier to install the B.W. treatment system for new vessel than the existing vessel
- The vessel will be navigated in the special area that is very dirty

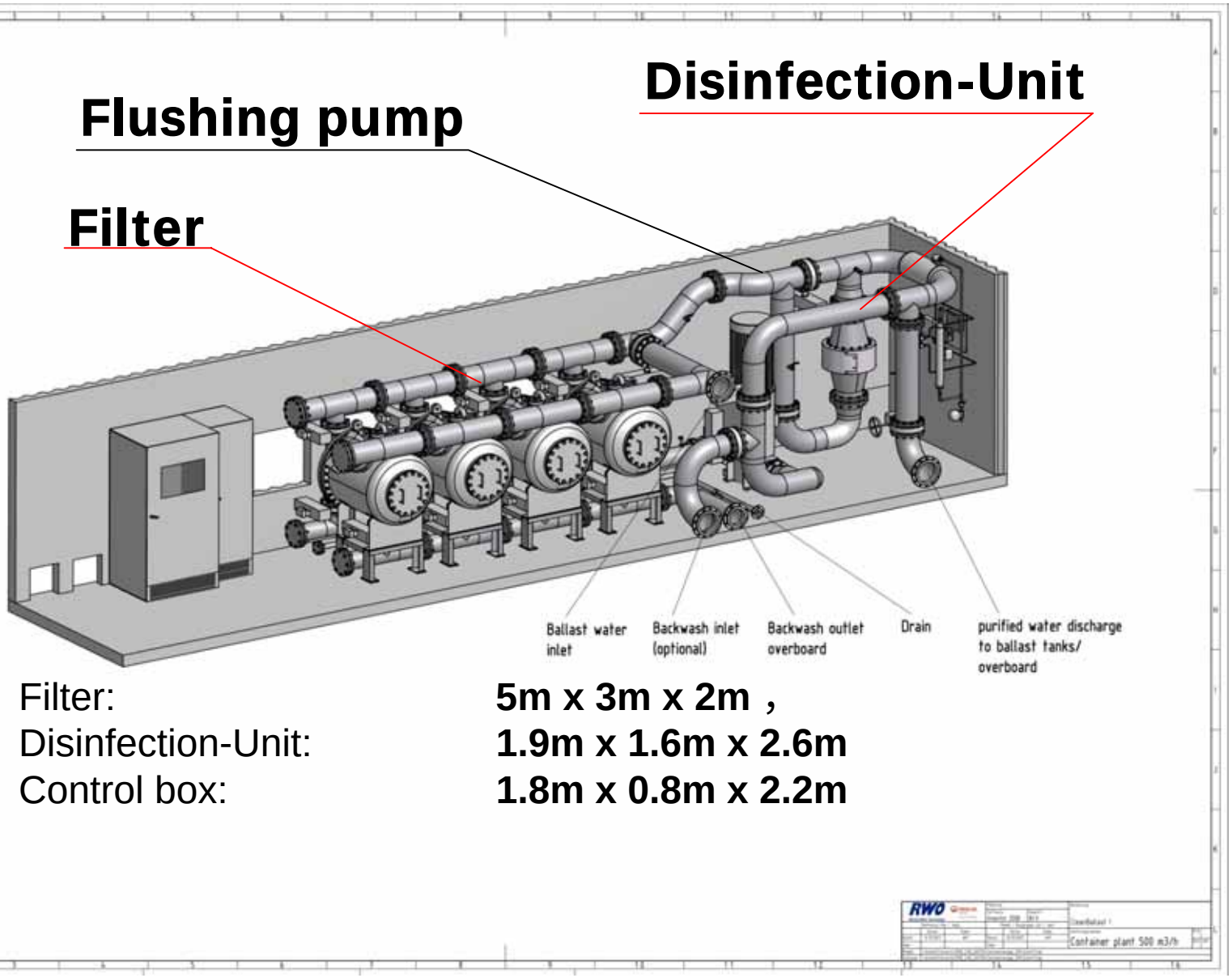
  --- Where there are a lot of mud and sand in the ballast water as well as organisms

  --- When the vessel navigate in that area for a few years, there are many sediment in the ballast tanks

  --- To be cleaning it

Acc. to the owner's special requirements we select **RWO CleanBallast! SYSTEMS** in this vessel

RWO CleanBallast! SYSTEMS



Filter:	**5m x 3m x 2m ,**
Disinfection-Unit:	**1.9m x 1.6m x 2.6m**
Control box:	**1.8m x 0.8m x 2.2m**

19100DWT MULTI-PURPOSE VESSEL

- **Characteristic:**

Big filter with Flushing pump

- Big filter---- means good filtration performance, but Big size and high discharge resistance (Pressure loss)

- Flushing pump----If the pressure difference between filter's inlet and outlet is higher than a certain value, the flushing pump will be automatic started to back washing the filter to keep filter cleaning.

- **So it is suitable for ship in dirty area**.

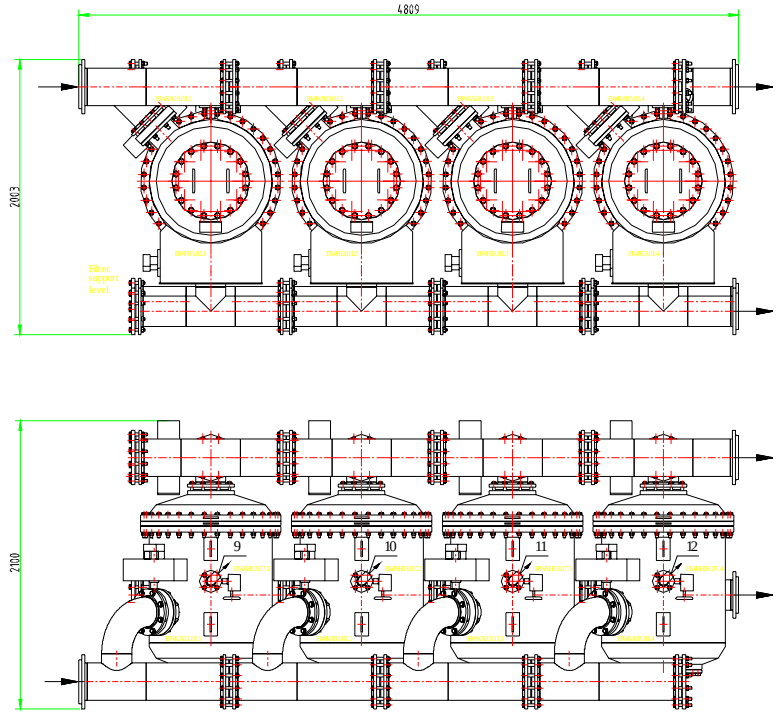
19100DWT MULTI-PURPOSE VESSEL

PRINCIPAL PARTICULARS ***for RWO*** **CleanBallast! SYSTEMS**

Number:	**2 sets**
Capacity:	350m3/h (each)
Filter	**2 sets**
Flushing pump	**2 sets**
▪ Capacity:	360 m3/h (each)
▪ Delivery pressure:	0.60 MPa
▪ Electric power consumption:	110 kW (each)
Disinfection-Unit	**2 sets**
▪ Electric power consumption:	20kW (each)
Total electric power consumption:	**abt. 130kWx2=260kW**
Pressure loss:	**0.08** MPa
Total price:	**One million USD**

19100DWT MULTI-PURPOSE VESSEL

Filter

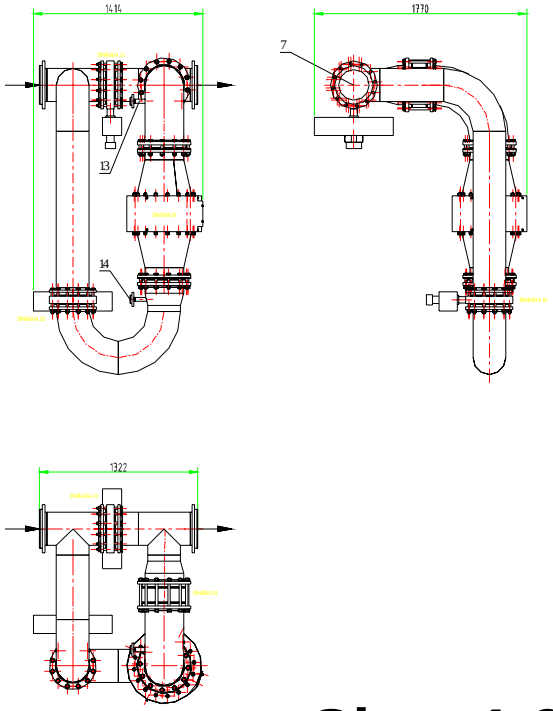


Size: 5m x 3m x 2m

RWO

19100DWT MULTI-PURPOSE VESSEL

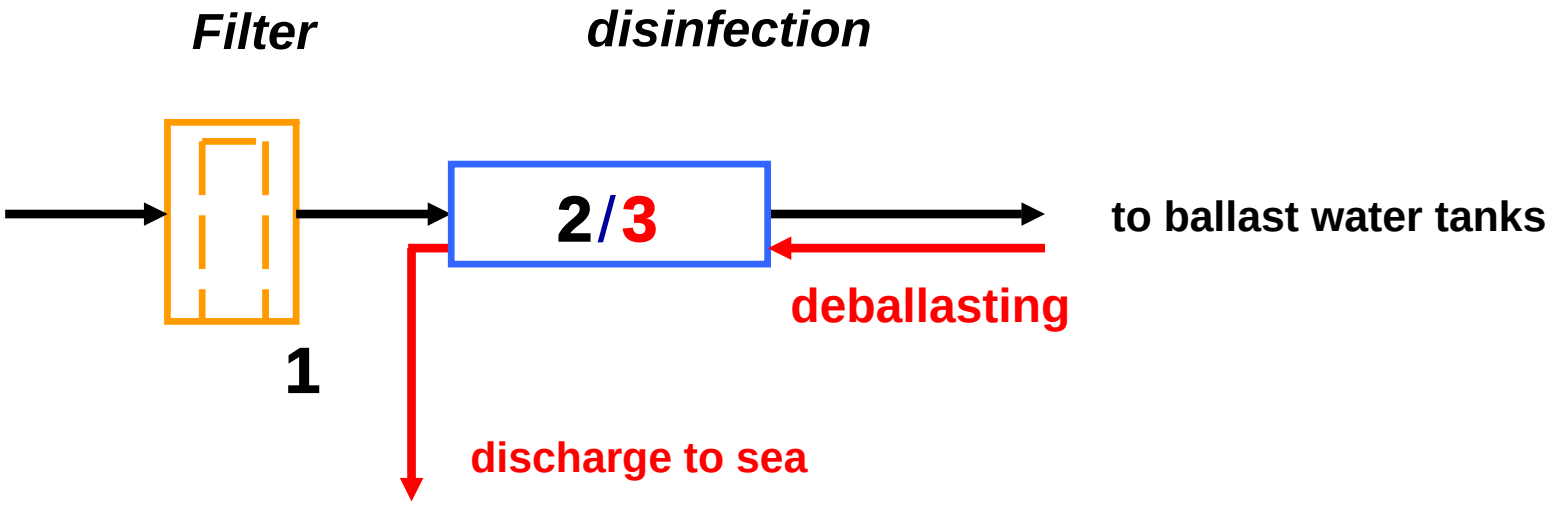
Disinfection-Unit



Size: 1.9m x 1.6m x 2.6m

RWO

Conception



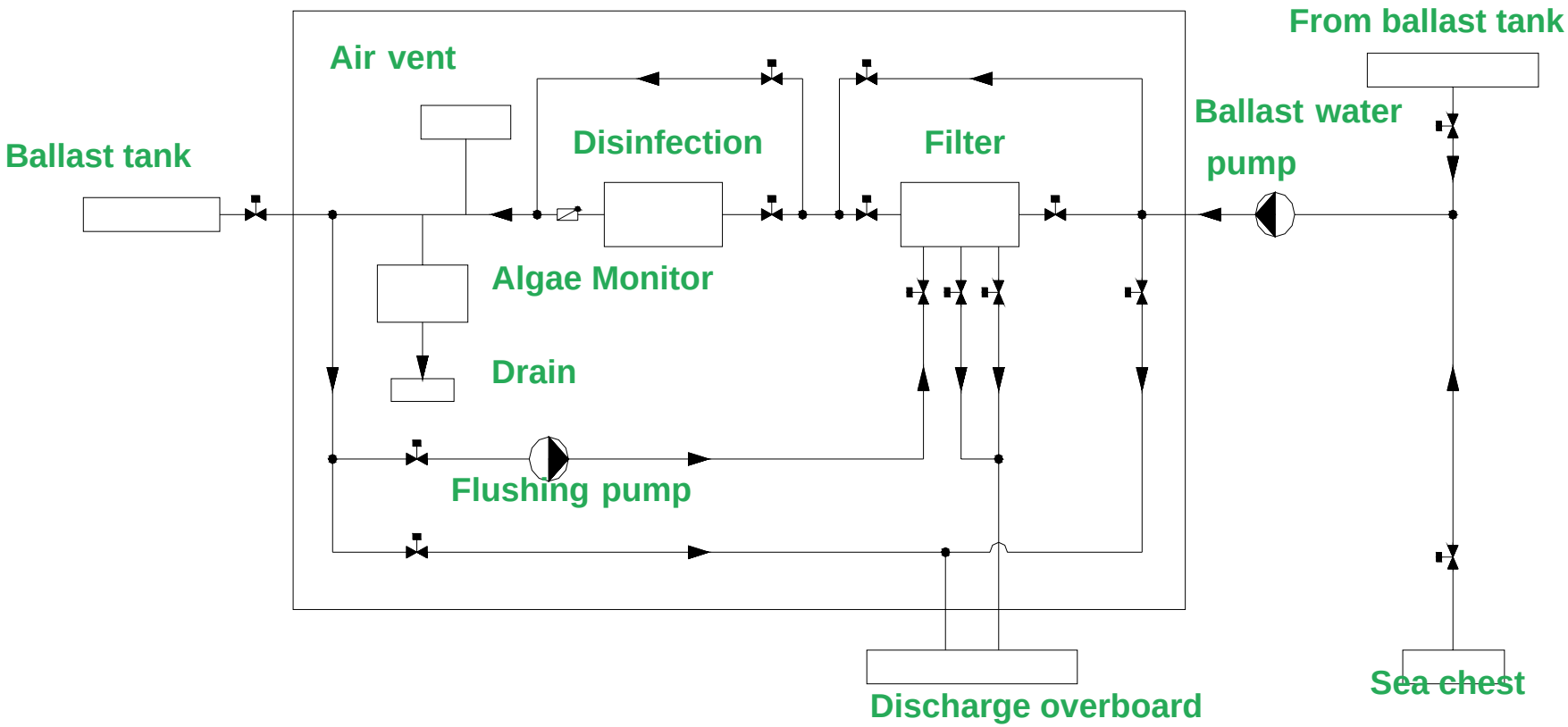
1. Mechanical filtration to remove suspended solids, sediments and certain organisms during ballasting

2. Disinfection to reduce the number of organisms before filling ballast water tanks

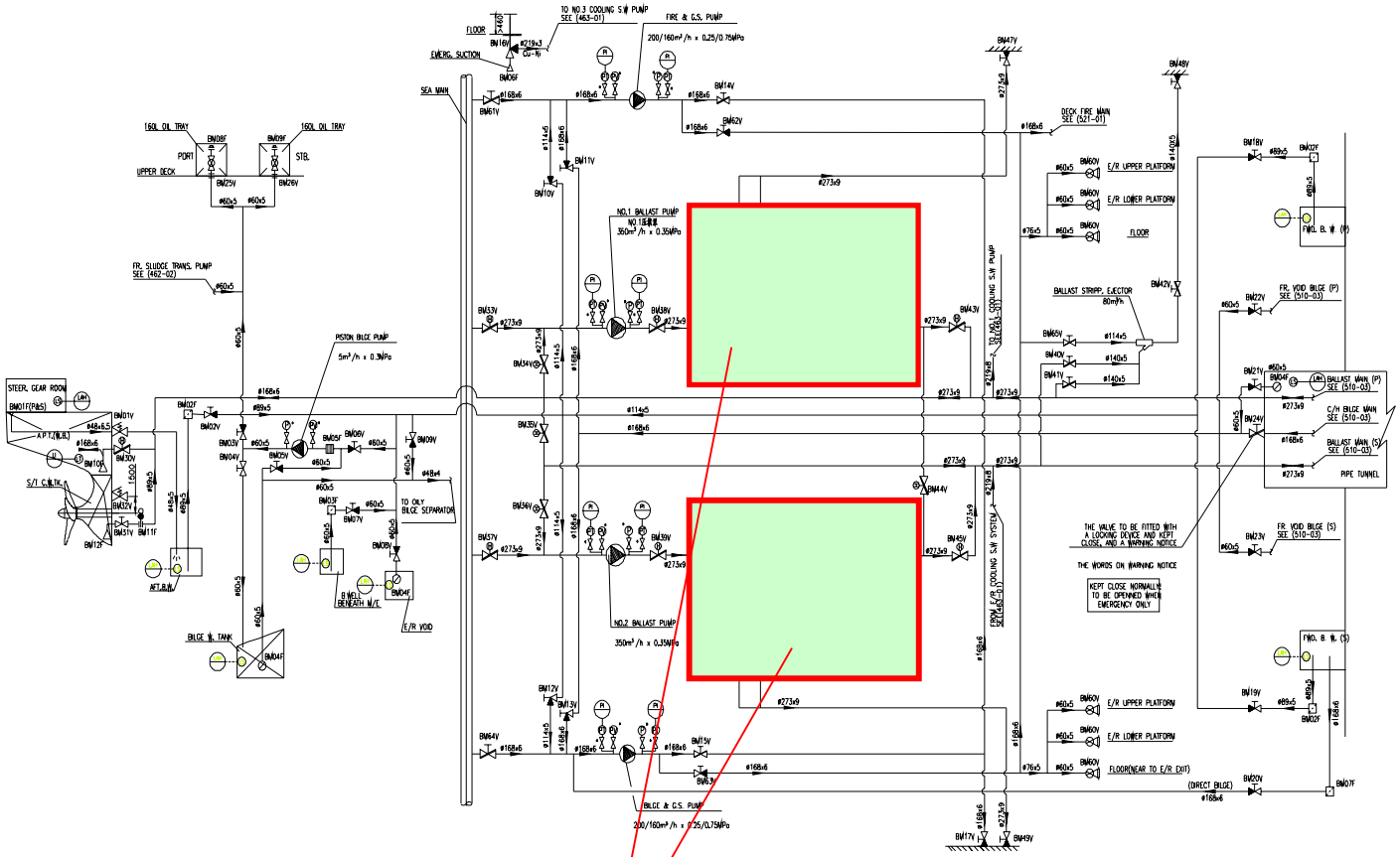
3. Second disinfection to reduce the number of organisms according to the future Performance Standard D2 at ballast water discharge

SYSTEM DRAWING

RWO

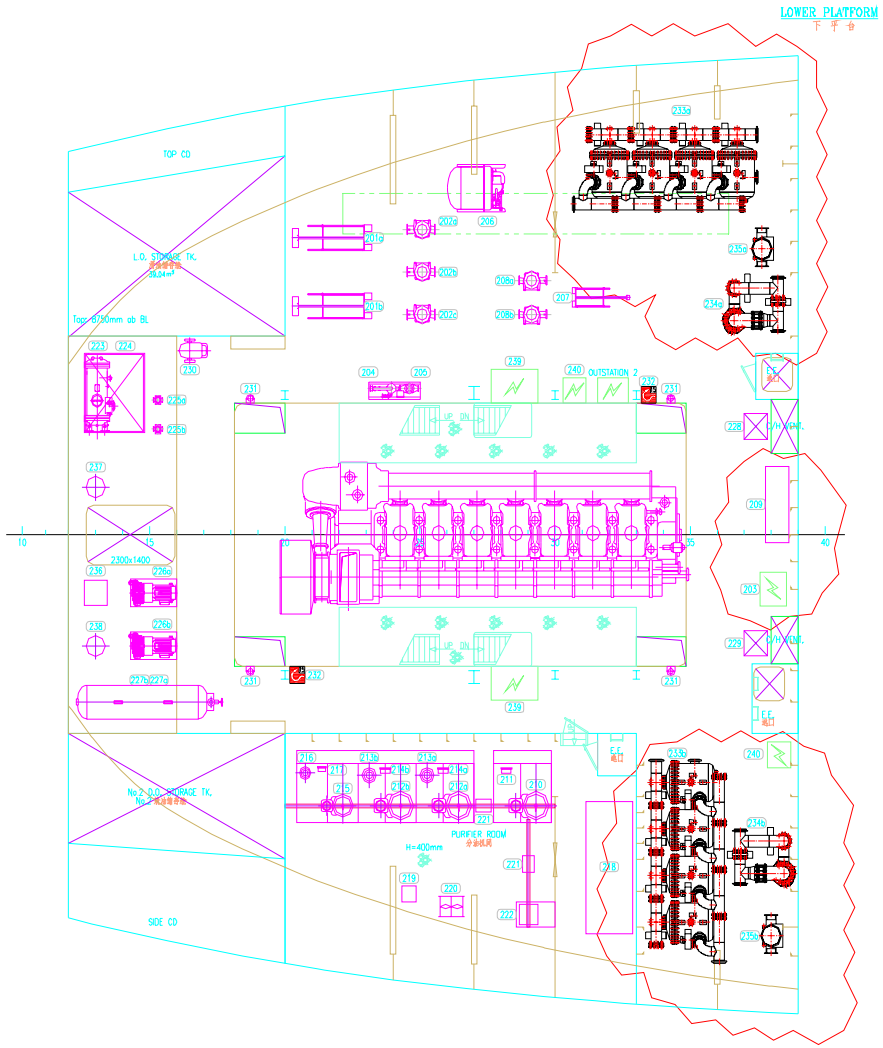


SYSTEM DRAWING



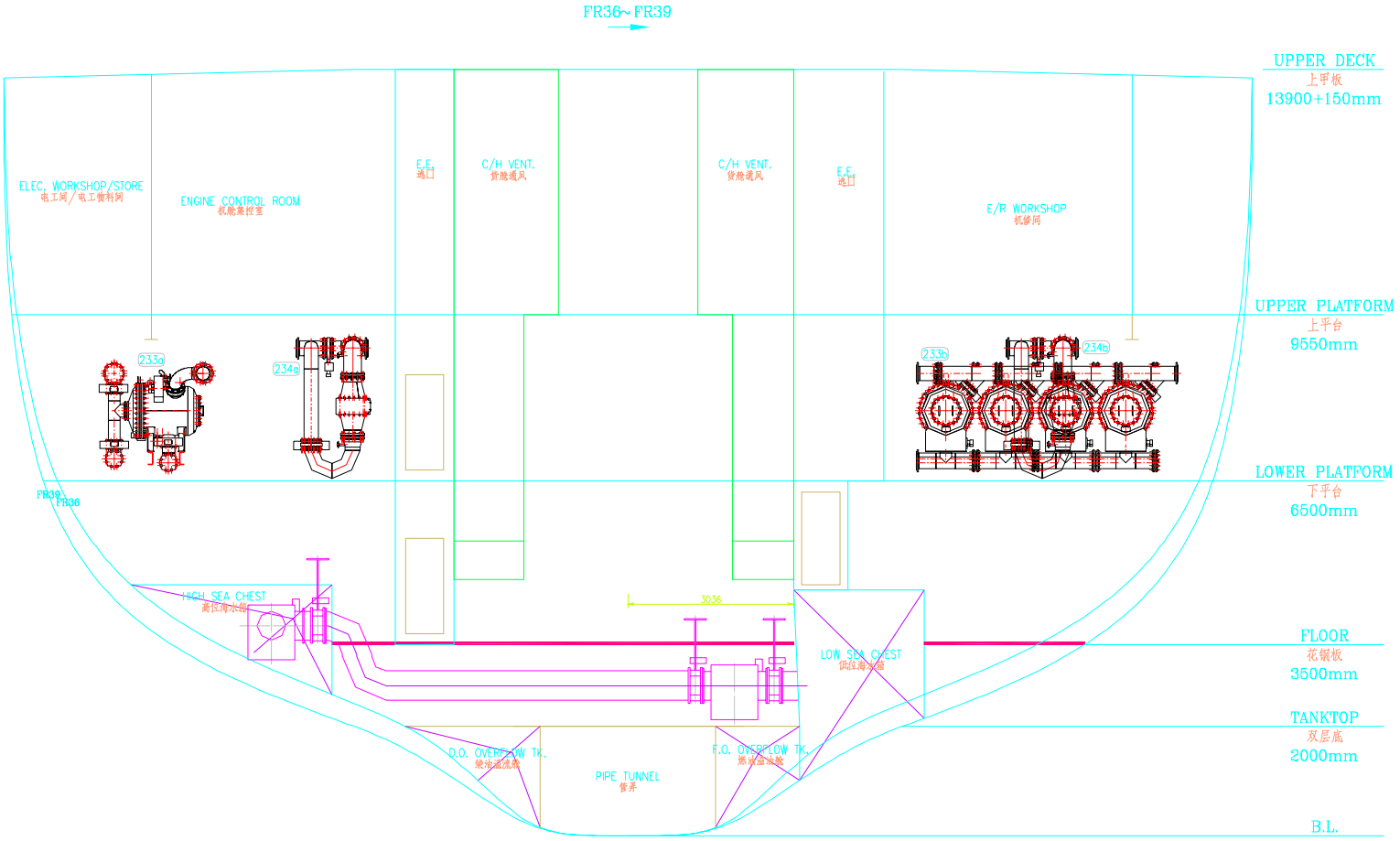
Ballast water treatment

ENGINE ROOM LAYOUT



19100DWT MPV

ENGINE ROOM LAYOUT



19100DWT MPV

The consideration of using ballast water treatment in ship design

- The **suitable capacity** of total ballast water in ship
- **Using permanent ballast** for some kind of ships in order to reduce the quantity of water ballast.

  --- For container vessel, Ro-Ro vessel, PCTC Vessel etc.

  at loading condition, part of ballast water is used to increase the stability. So we can use permanent ballast instead of this part of ballast water. Otherwise, the specific gravity of permanent ballast (steel，iron，stone and concrete etc.) is heavier than sea water. It's better for ship's stability.

The consideration of using ballast water treatment in ship design

- Find **suitable space** for install B.W. treatment equipment

  ---specially for existing vessel

- The **suitable capacity** of ballast pump and Ballasting /de-ballasting **time**

  ---for designing, the capacity of BW treatment plant should be minimized because it is related to the engine room space, electric power consumption, and the equipment price etc.

  So the ballast pump capacity may be reduced and Ballasting /de-ballasting **time** may be longer than before

Ozone Treatment Plant

On the superstructure

Inert Gas treatment plant

NEI

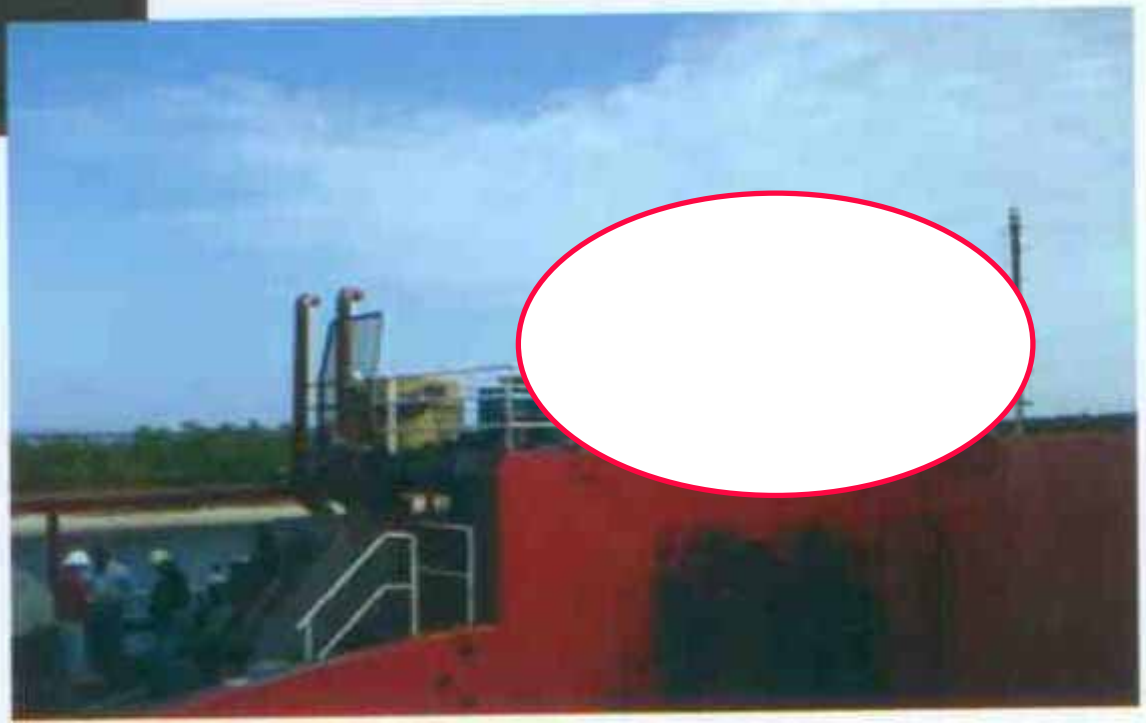
- 12" Diameter Venturis in Machinery Space
- 2,500 m3/hr Inert Gas Generator

In the double bottom

on low wing tank

Inert Gas treatment plant

- TECO *Pat Cantrell*
- 40,000 DWT Bulker
- Trades US Gulf and East Coast
- 2 x 1,000 m3/hr Pumps
- Double-Bottom and Lower Wing Tanks



NEI

filtration treatment plant

6.18 Ø750 DN300

500 m³/h 50µ

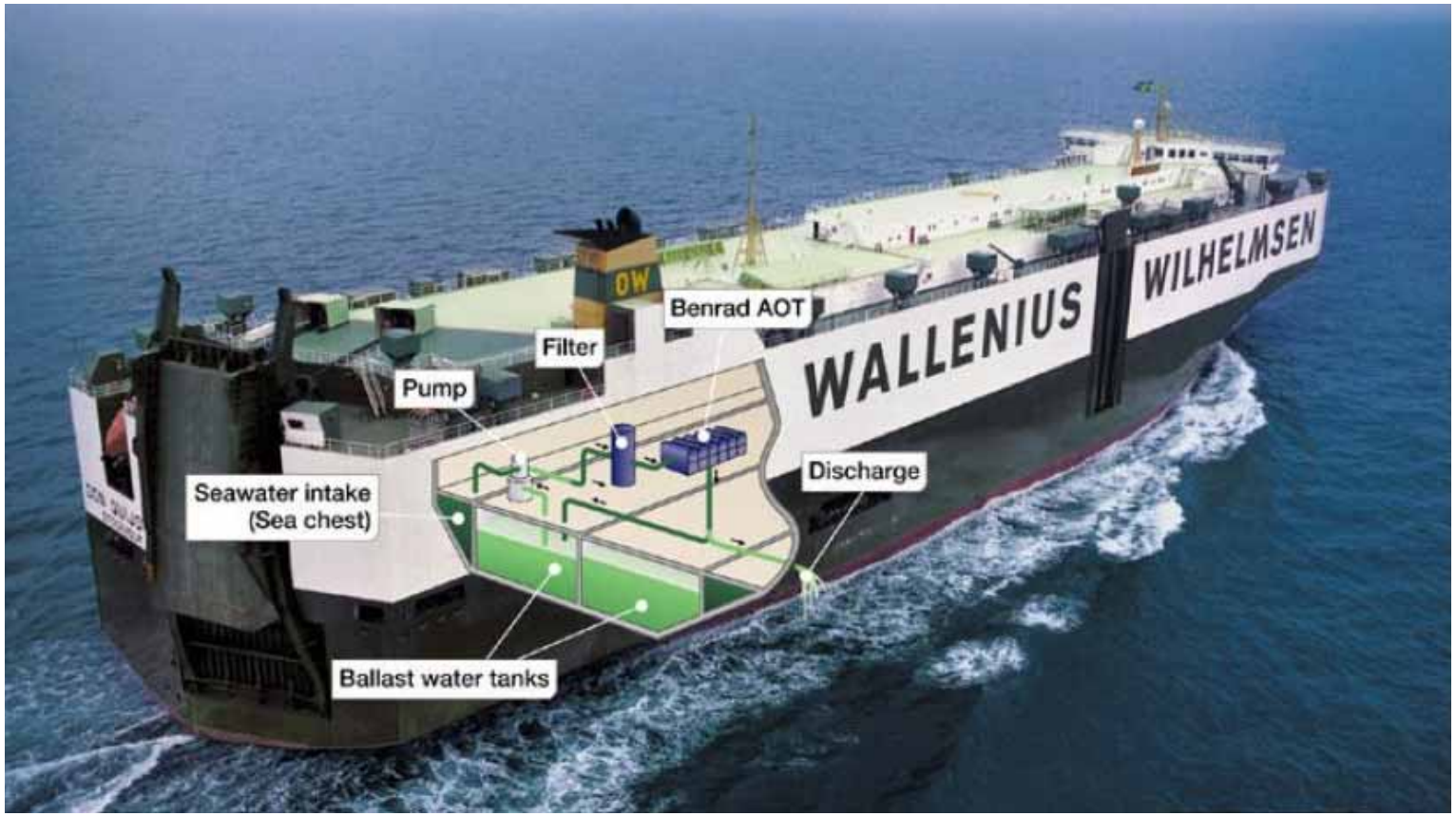
In operation 2005

In the engine room

filtration treatment plant

In the engine room

Filtration and Oxidation Treatment plant



Filtration and Oxidation Treatment plant

Filter

6.18 Ø750
DN400

500 m³/h 50µ

In operation
2003

In the engine room

Filtration and Oxidation Treatment plant

The Benrad **AOT** (Advanced Oxidation Technology) unit

In the engine room

The consideration of using ballast water treatment in ship design

- The pump **delivery pressure increase**

  --- Because of additional discharging resistance

  --- For new design ship, there is no problem, but for existing vessels, the original pump delivery pressure will be not enough for installing some kinds of BW treatment plant that has high additional resistance in the system. So the original ballast pumps should be replaced or other kinds of BW treatment plant with no high discharging resistance to be selected

- **More electric power consumption**

  ---The power of Aux. engine may be increased

  --- It is a big problem for existing vessels

CONCLUSION

- *The above mentioned is only one example in our ship design process*
- *There are many other different problems for different kinds of B.W. Treatment system. So we need study and develop these systems in the ship design to comply with the new regulation*
- *We hope more and more Ballast Water Treatment plant will be approved by Administration or Class and can be used on ship*
- *In the future, the Ballast Water Treatment plant will be easier to install on ship*


THANKS