

Laivojen rikkipesurit

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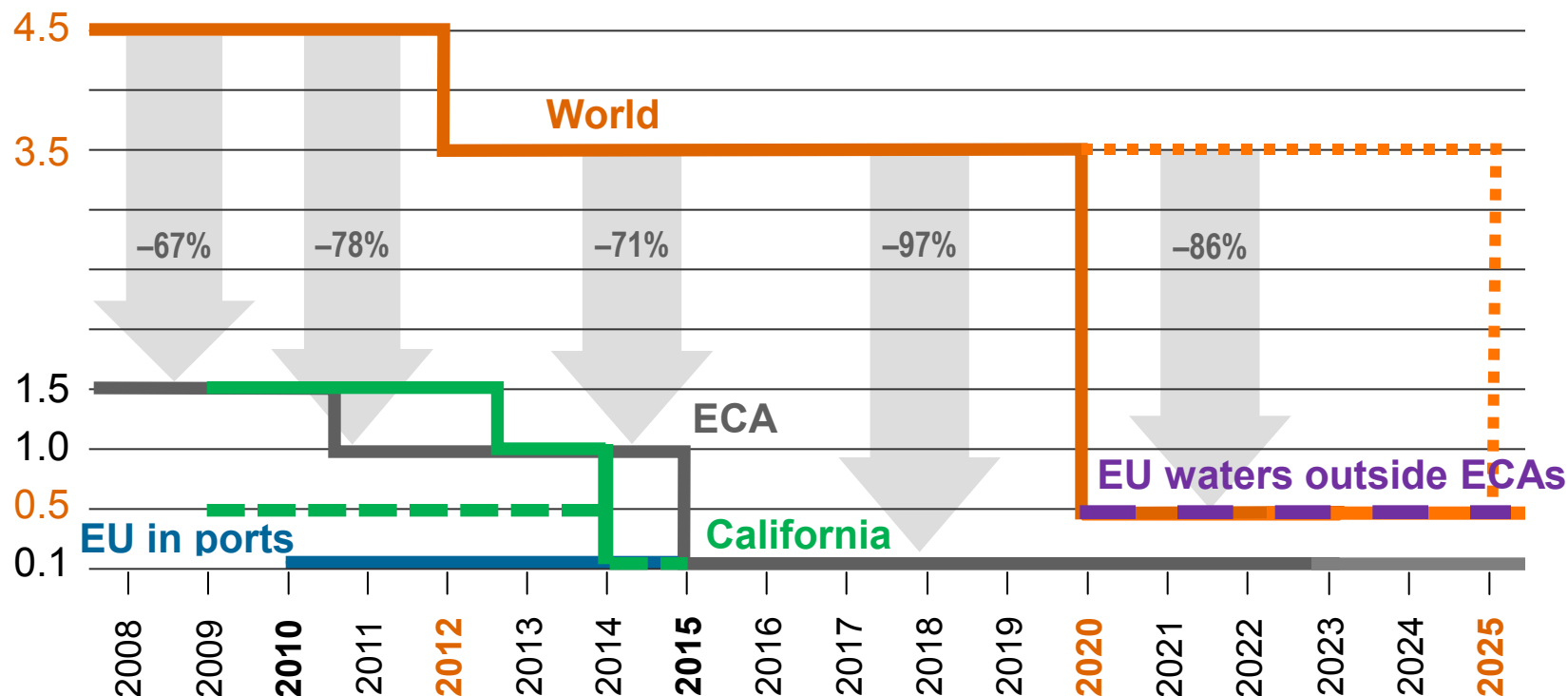
23 January, 2013

Agenda

1. *Legislation*
2. *Economy*
3. *Technologies*
4. *References*

Marine sulphur limits

Sulphur limit (%)



Review of the 0.5% S global limit to be performed in 2018. In case readiness is not deemed to be sufficient by 2020, the introduction of the limit will be postponed to 2025.

Fuel type Not regulated = both HFO and distillate are permitted
Exhaust gas cleaning Permitted alternative under Regulation 4 to achieve any regulated limit
Particulate Matter (PM) No limit values.

SOx Emission Control Areas

IMO SOx Emissions Control Areas are geographically defined areas where ships must limit their SOx emissions.

SOx ECAs

- Baltic Sea
- North Sea + English Channel
- North America
- US Caribbean area



North American SECA and NECA

Fuel sulphur limit applicable 12 months after entry into force of SECA, as per Regulation 14.7 of revised Marpol Annex VI.

North American SO_x and NO_x Emission Control Area.

- IMO adoption 2010, entry into force 1 August 2011, applicable 1 August 2012.
- 200 miles from coast.
- Fuel Sulphur: 1.00 % 1 August 2012, 0.10 % 1 January 2015, all ships.
- NO_x: Tier III (Tier I minus 80 %) 2016, newbuildings.

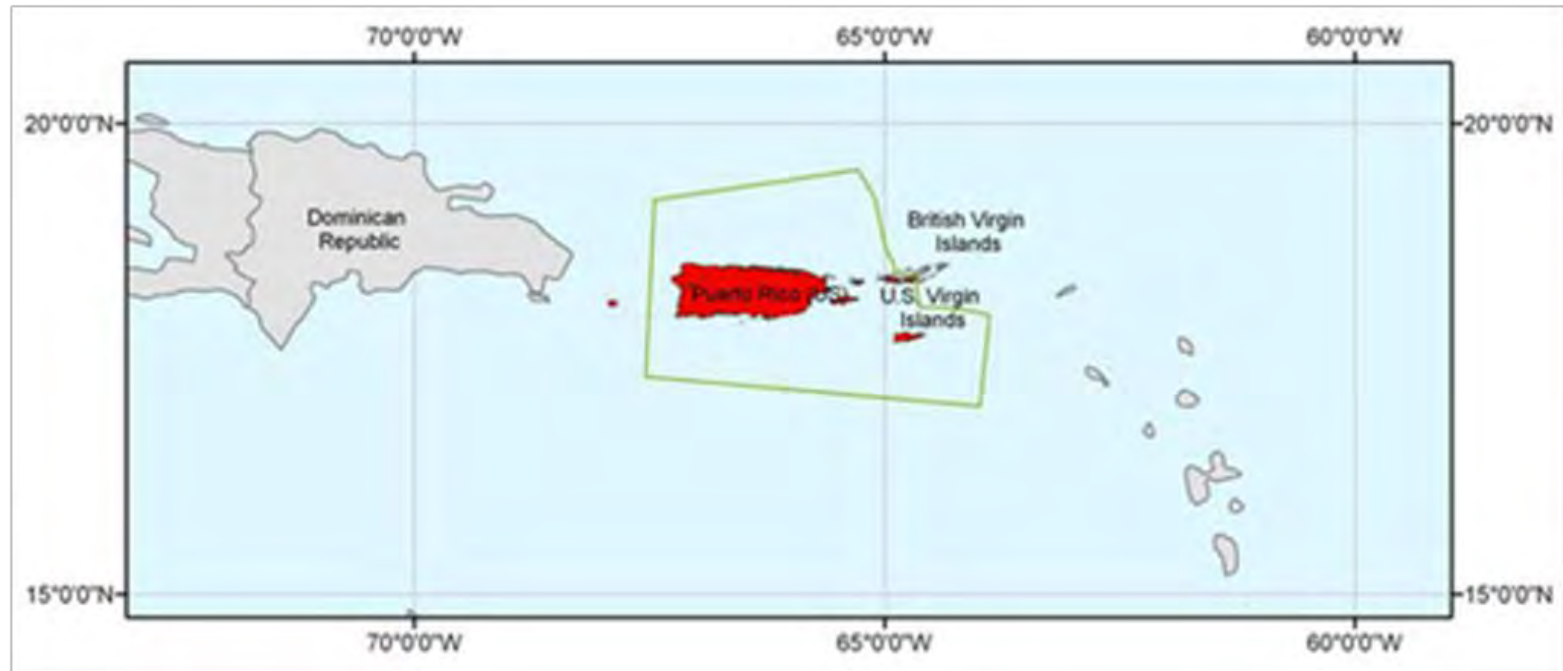


Caribbean SECA and NECA

Fuel sulphur limit applicable 12 months after entry into force of SECA, as per Regulation 14.7 of revised Marpol Annex VI.

Caribbean SOx and NOx Emission Control Area.

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Scrubber documentation during certification

SECP

SHIP NAME

Main engine

Auxiliary engines

Oil-fired boilers

Ref. to statutory documents

Procedure for compliance

By shipowner, shipyard, contractor

Approved by Administration

SECC (A)

Scrubber

Make, type, serial number

ETM number

By Administration

***Scheme A and B unless
otherwise stated***

“Exhaust Gas Declaration”

Engine

- Make, type, power, rpm

- Exhaust gas data (e.g. EIAPP cert.)

*By engine maker or designer **

Approved by Administration

“Flue Gas Declaration”

Oil-fired boiler

- Make, type, capacity, pressure

- Flue gas data

*By boiler maker or designer **

Approved by Administration

ETM

ETM number

Make, type, serial number

Capacity

SOx-reduction (A)

Installation requirements

Operational requirements

Maintenance requirements (A)

Survey procedures

Wash water characteristics

By manufacturer

Approved by Administration

OMM

Instrumentation issues

Gas and water monitoring

Device list (sensors, analysers)

Device positions

Service requirements

Maintenance, calibration

Survey procedures

By manufacturer

Approved by Administration

EGC Record Book

Log book for service and
maintenance as per ETM &
OMM.

Possibly in vessel PMS.

By manufacturer

Form approved by Administration

** Or another
competent party*

Survey Schemes*:

Survey schemes for exhaust gas emission compliance:

Item	Scheme A	Scheme B
Performance measurement campaign	Yes	No
Monitoring of sulphur emissions	(Daily)	Continuous
Monitoring of process parameters: <ul style="list-style-type: none">•Scrubbing water flow•Scrubbing water pressure•Scrubbing water pH•Exhaust gas pressure, scrubber inlet•Exhaust gas pressure differential•Exhaust gas temperature, scrubber inlet•Exhaust gas temperature, scrubber outlet•Combustion unit load	Continuous	Daily

Survey schemes for water discharge compliance are identical under Scheme A and B.

* Details in Resolution MEPC.184(59)

Surveying Bodies:

-Flag state: Initial, Annual, Intermediate and Renewal Surveys

-Port state: Occasional Surveys

Wärtsilä Scrubber Safety Concept approved by DNV, LR, BV and GL

Technical safety approved.

SAFETY CONCEPT FOR SO_x SCRUBBER MARINE INSTALLATION

DOCUMENT NUMBER: R.1257.1

REVISION: D
April 18, 2008



REVISION HISTORY

REV.	DATE	DESCRIPTION
0	16.11.2006	First new revision
A	30.11.2006	Updated with team comments
B-PREL	25.9.2007	GRP scrubber part modified
B	2.10.2007	Wärtsilä and Metso comments updated
C	9.10.2007	Comments from Project Meeting 8.10.
D	18.4.2008	Pipe integration, fan, automation etc

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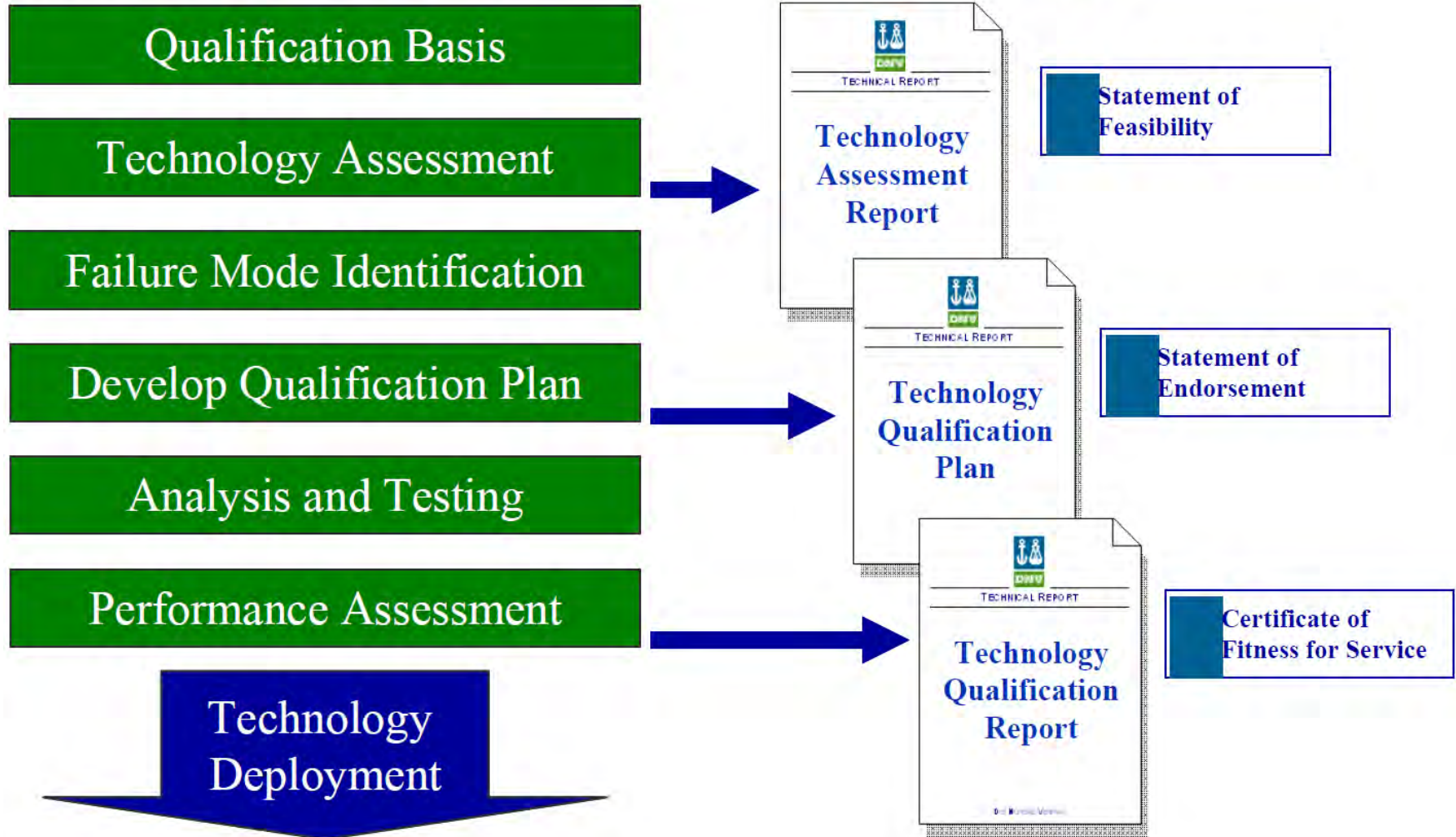


Classification Society Involvement

1. Roles of classification societies in scrubber projects:
 - Safety related technical approval (all projects)
 - Marpol approval (when authorized to act on behalf of the flag Administration)
 - Risk assessment (in selected projects, when requested to act as advisor)
2. Some class societies have published scrubber related rules
3. Some class societies are expected to publish scrubber related rules soon
4. Cooperation between class societies and Exhaust Gas Cleaning System Association (EGCSA)

Qualification Work Process

DNV deliverables



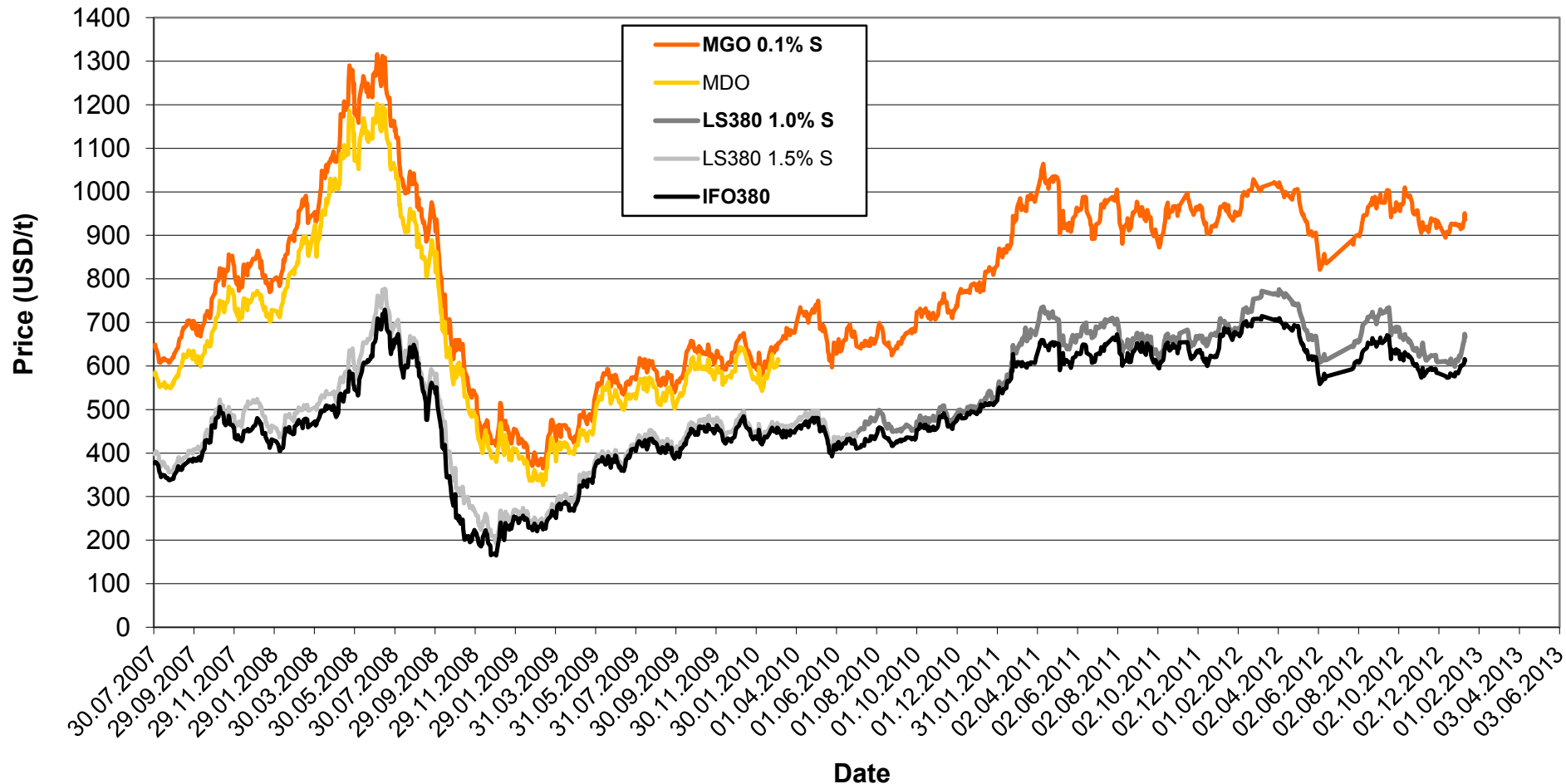
This work is at an advanced stage

Fuel prices, Rotterdam

$\Delta = 140 \dots 700 \text{ \$}/\text{ton}$
MGO - HFO

Updated 14 January, 2013

Fuel prices (Rotterdam)



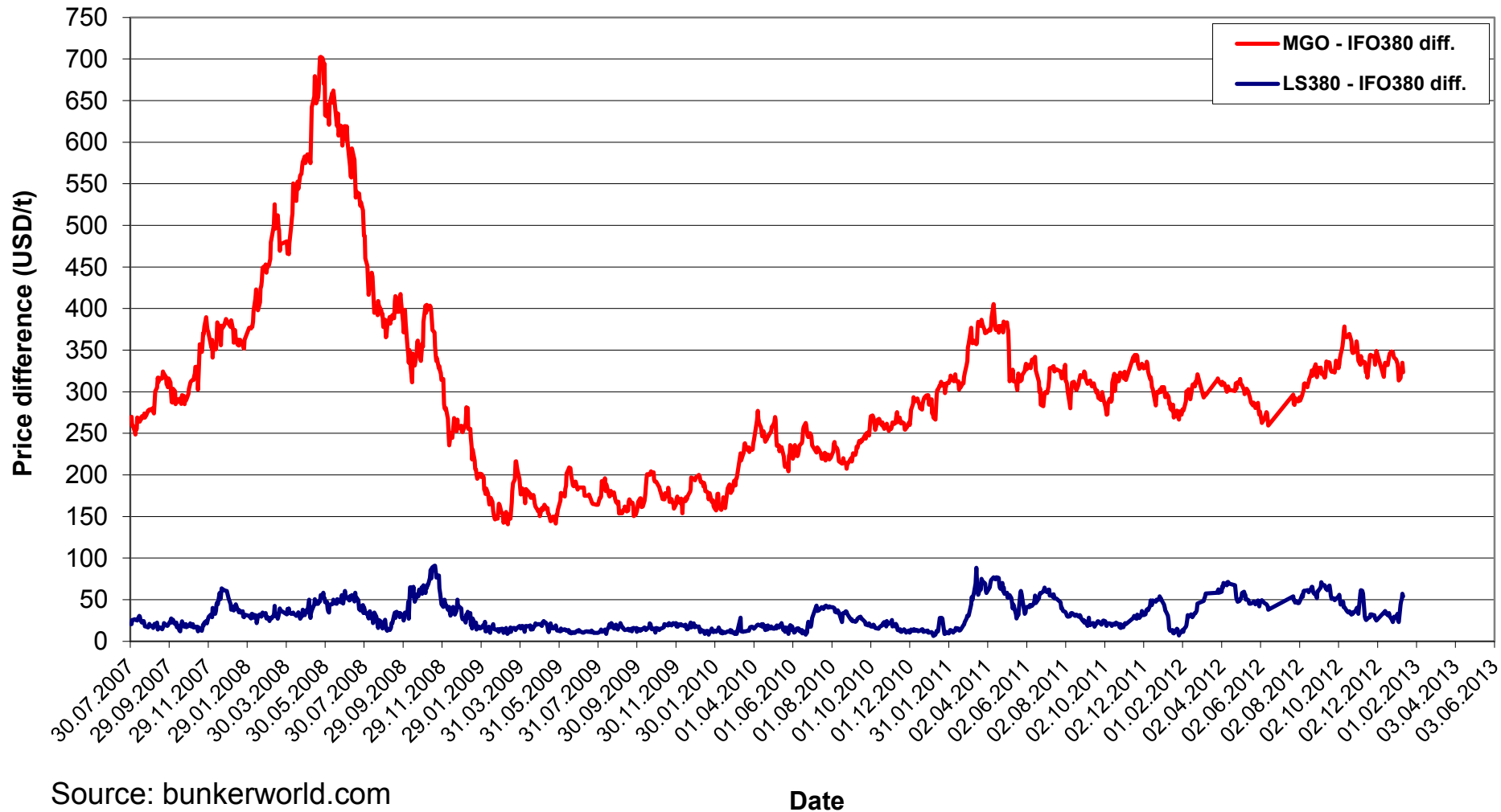
Source: bunkerworld.com

Fuel prices, Rotterdam

$\Delta = 140 \dots 700$ \$/ton
MGO - HFO

Updated 14 January, 2013

Fuel price differences (Rotterdam)



Source: bunkerworld.com

Date

Ship Fuel Costs

*System delivery cost (not including installation)

Fuel prices are prices in Rotterdam

Case 1: 31.08.2010

Case 2: August 2008

Case 3: May 2008

Cost comparison for 25 years

Total engine power: 10 MW

Annual fuel consumption: 9800 ton/a

Annual average load: 69%

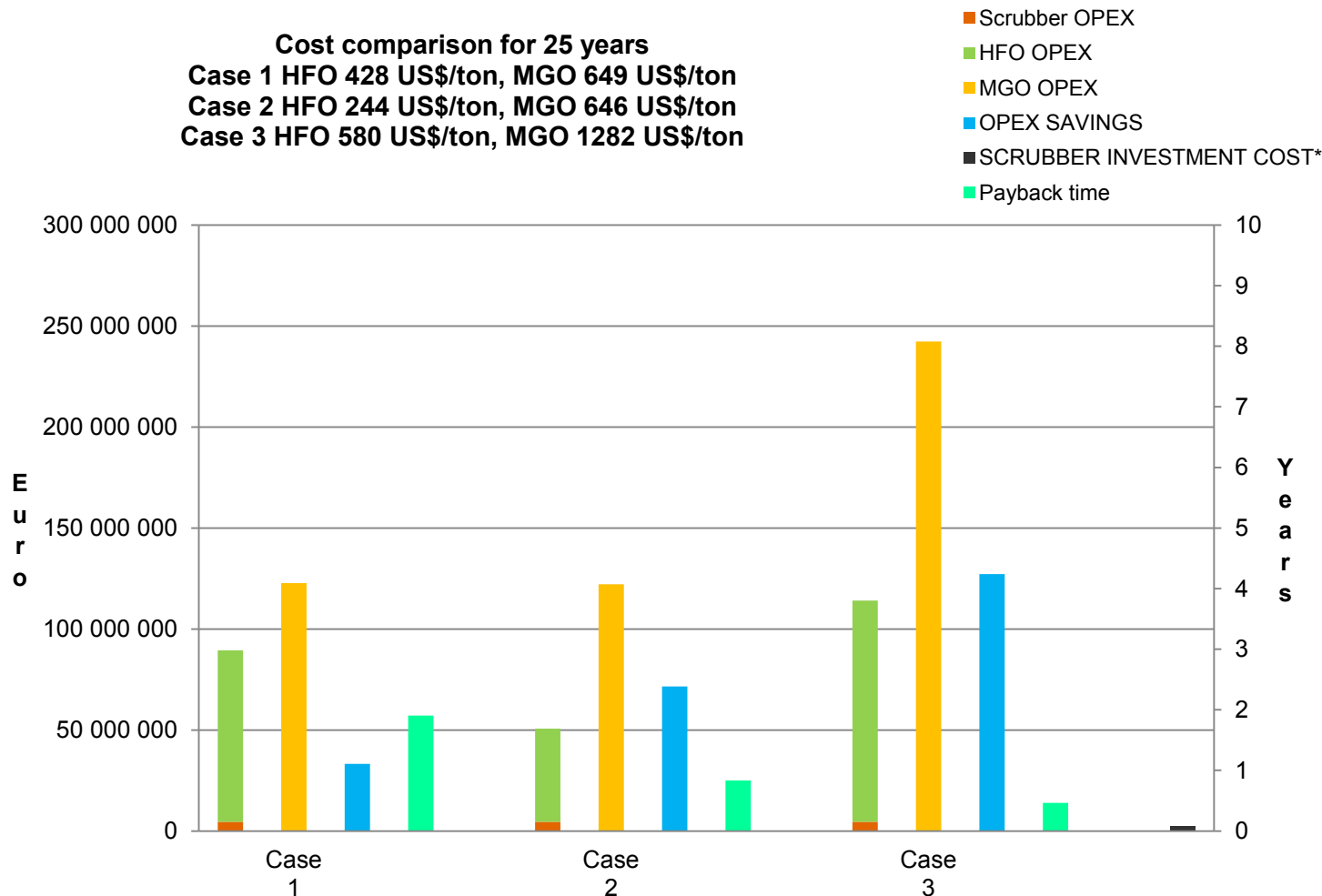
Interest rate for NPV calculations: 5.0%

Fuel price inflation rate: 4.8% (1980-2010 average)

Currency rate: 1.27 US\$/€

NaOH 50%: 200€/ton

Cost comparison for 25 years
Case 1 HFO 428 US\$/ton, MGO 649 US\$/ton
Case 2 HFO 244 US\$/ton, MGO 646 US\$/ton
Case 3 HFO 580 US\$/ton, MGO 1282 US\$/ton



SOx scrubbing technology

The Ship Power Supplier

Scrubbing plant needed for removing sulphur oxides (SOx) from the exhaust gases of marine diesel engines and oil-fired boilers.

The product development covers scrubber design, performance, lifetime and economy, corrosion, scaling, the effect of scrubbing equipment on engine performance, installation requirements, discharge water criteria, ecological impact, sludge handling, exhaust plume quality, noise, chemicals, certification etc.

Target segments

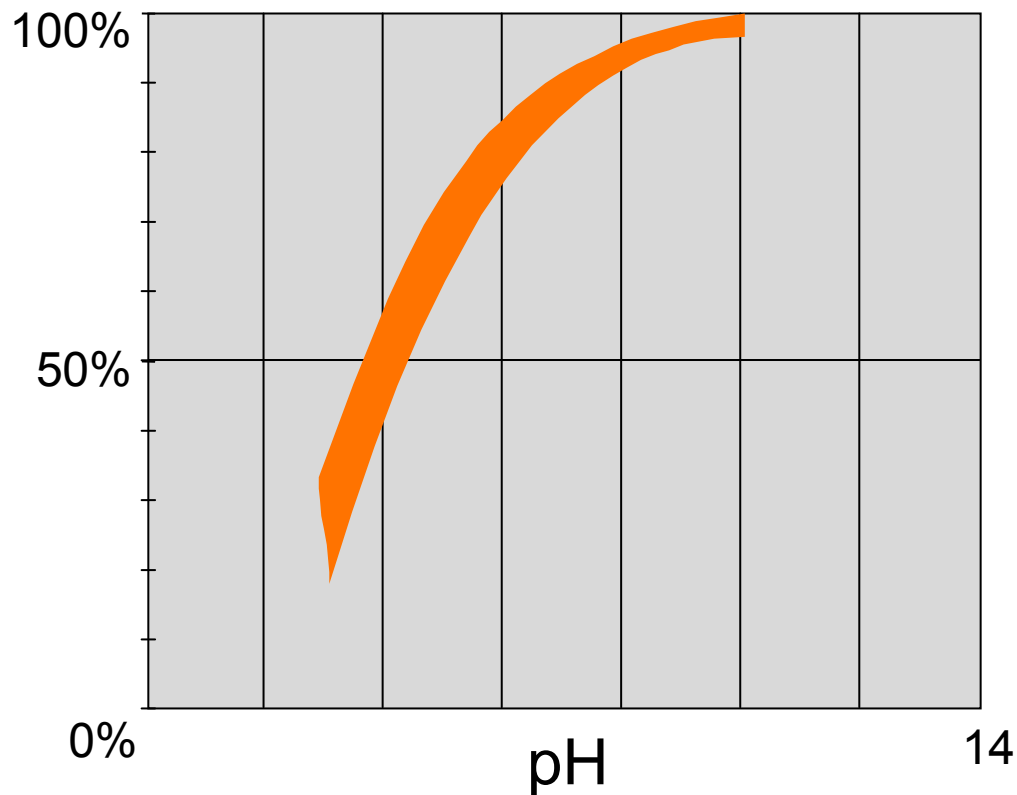
- *New buildings and retrofit installations.*
- *Diesel engines and oil-fired boilers.*
- *Two-stroke and four-stroke engines.*
- *Main and auxiliary engines.*
- *Any engine brand.*

Sulphur reduction versus water PH

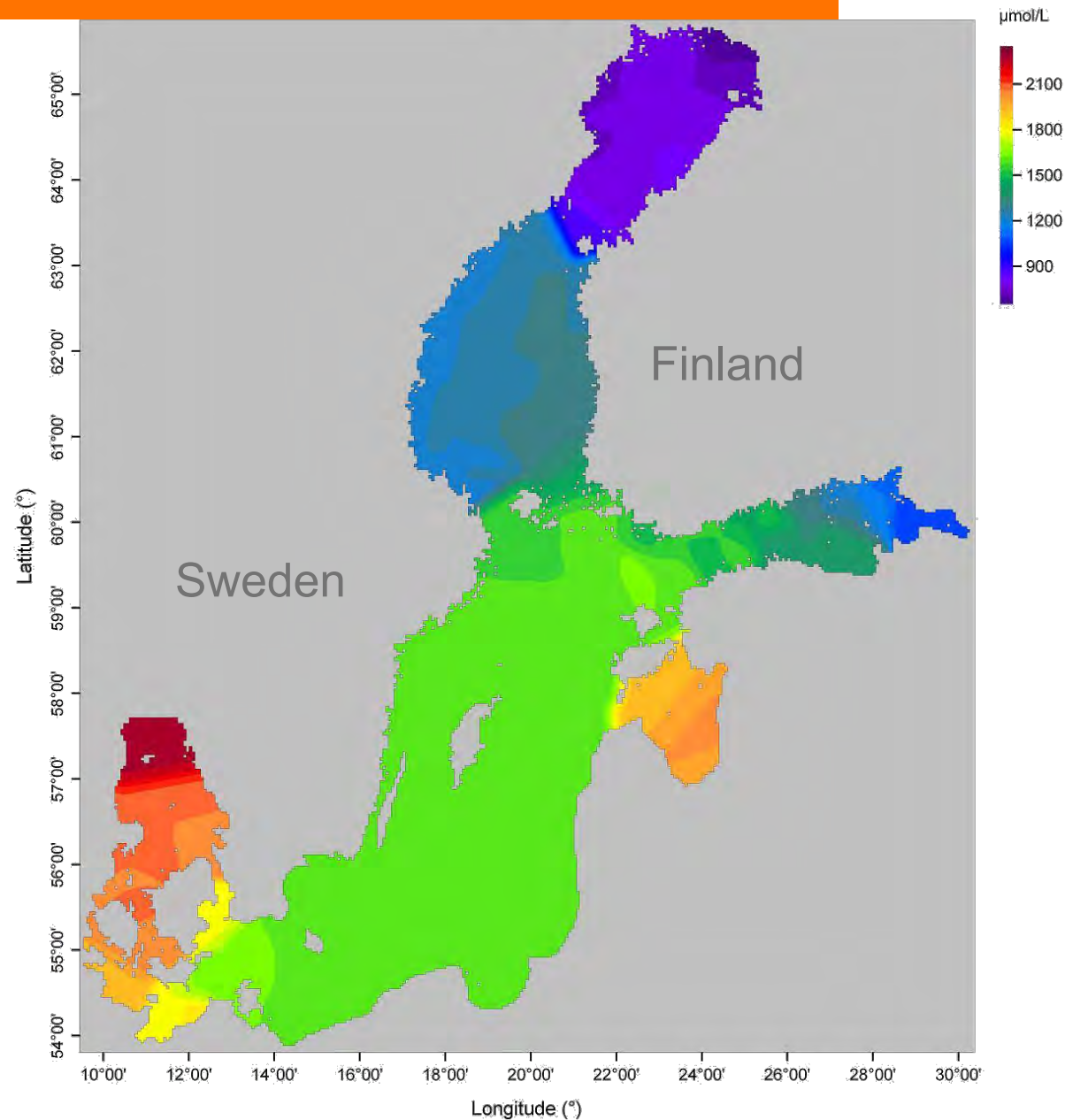
Neutralization takes place with appropriate pH, either by:

- dosing of alkali, or
- by using sufficient amounts of sea water.

SO₂ reduction



Alkalinity in the Baltic Sea



Open sea alkalinity
Surface data (0... 15 m)
Data from 2001-2005

Summary of Wärtsilä scrubbers

	Closed loop	Open loop	Hybrid
Alkaline reactant	NaOH	Sea water	NaOH / SW
Operating modes	Closed loop	Open loop	Closed / open loop
Zero discharge mode	Periodical	No	Periodical
Scrubbing water flow, m ³ /MWh	24	45	23/45
Freshwater consumption, m ³ /MWh	0.1...0.2	zero	zero
Pumping power, % of engine power*	0.5	2.0	0.5/2.0
Suitable certification scheme**	Scheme A or B	Scheme B	Scheme B
Applications	Low-alkalinity waters and for zero discharge	Ocean-going ships	Ships requiring full flexibility of operations

* In case of an Integrated Scrubber additionally fan power, load dependent, 0.1 – 0.5 %

** Refers to IMO Resolution MEPC.184(59)

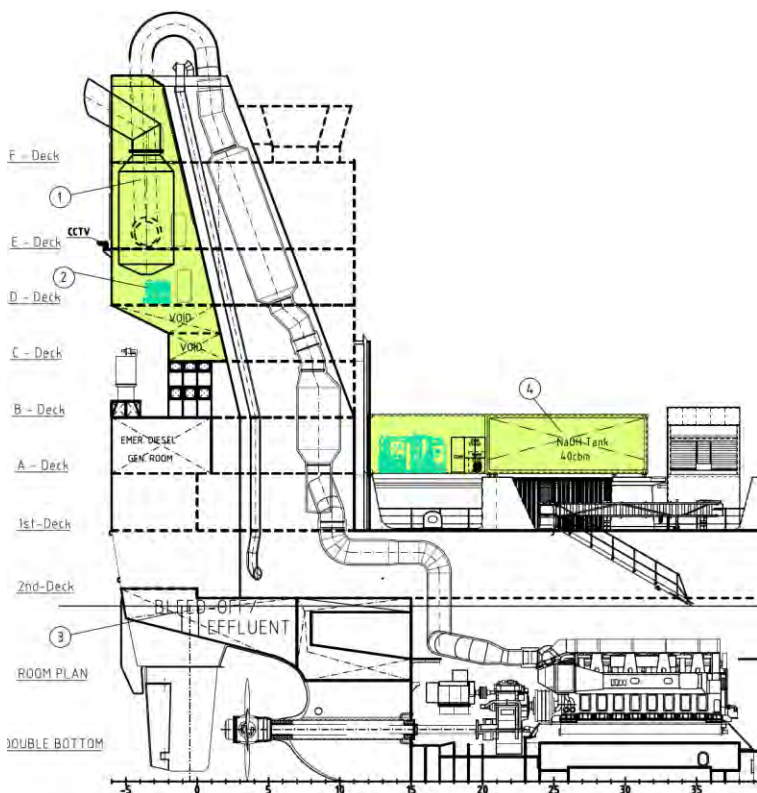
Wärtsilä Main Stream Scrubber

Main features

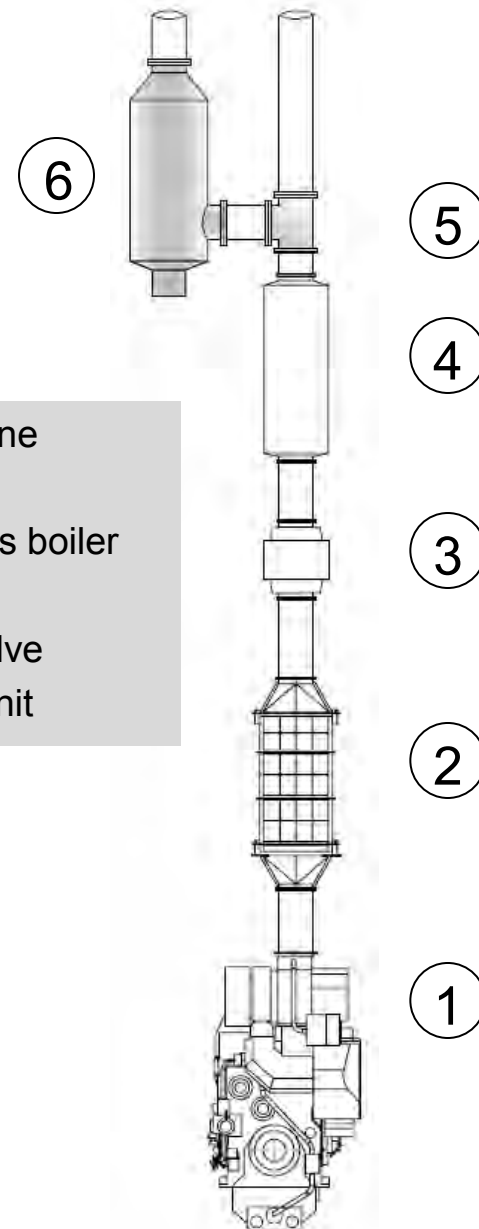
- For diesel engines
- One scrubber unit for each combustion unit
- By-pass valve
- Scrubber unit back pressure 900 Pa

Ideal for

- Single engine cargo ships



1. Diesel engine
2. SCR
3. Exhaust gas boiler
4. Silencer
5. By-pass valve
6. Scrubber unit



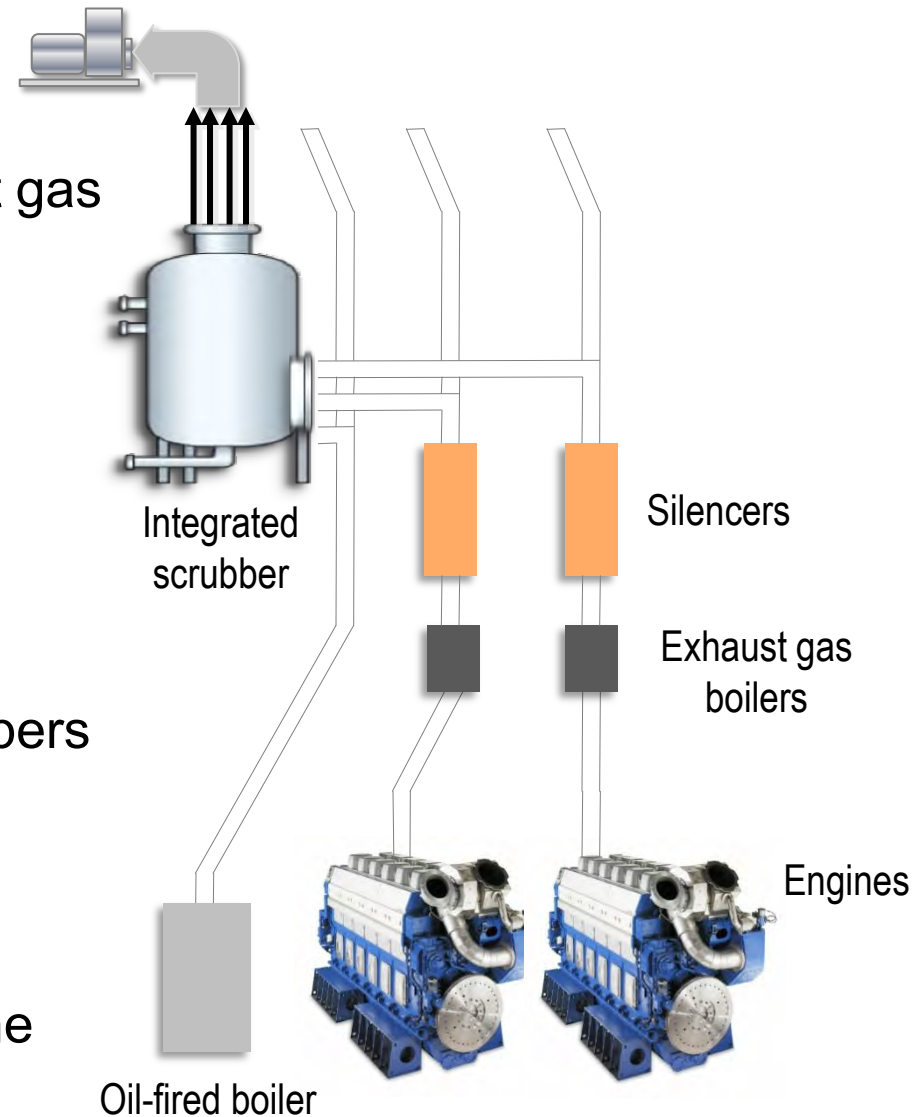
Integrated scrubber

Benefits

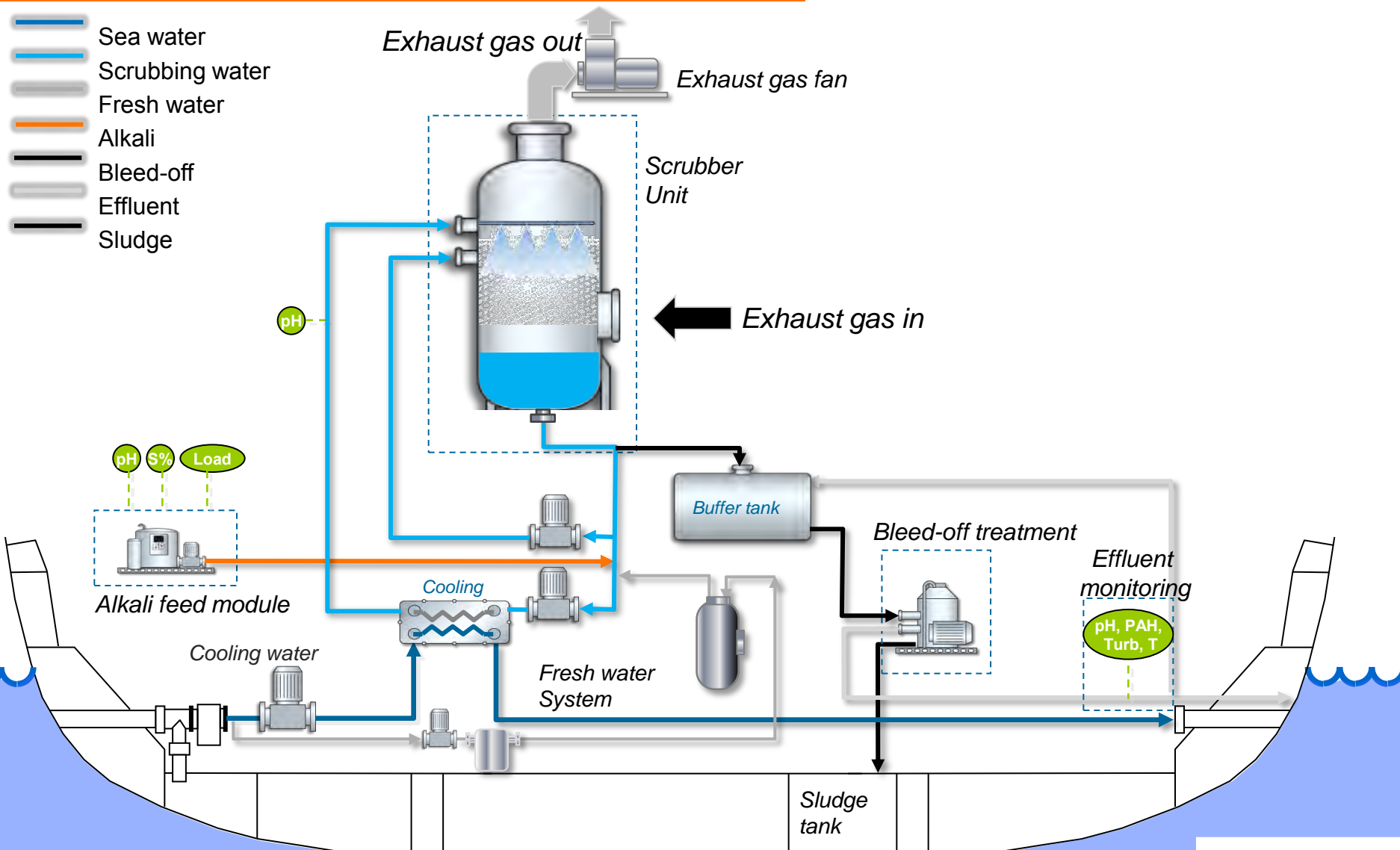
- Completely avoid increased exhaust gas back pressure.
- Minimize the amount of equipment.

Main features

- One common scrubber unit
- Suction fans
- Suction branches with by-pass dampers
- Constant under-pressure prevents undue flow of gases.
- A wet sump minimises the needed vertical lifting height and therefore the power demand of the closed-loop pumps.

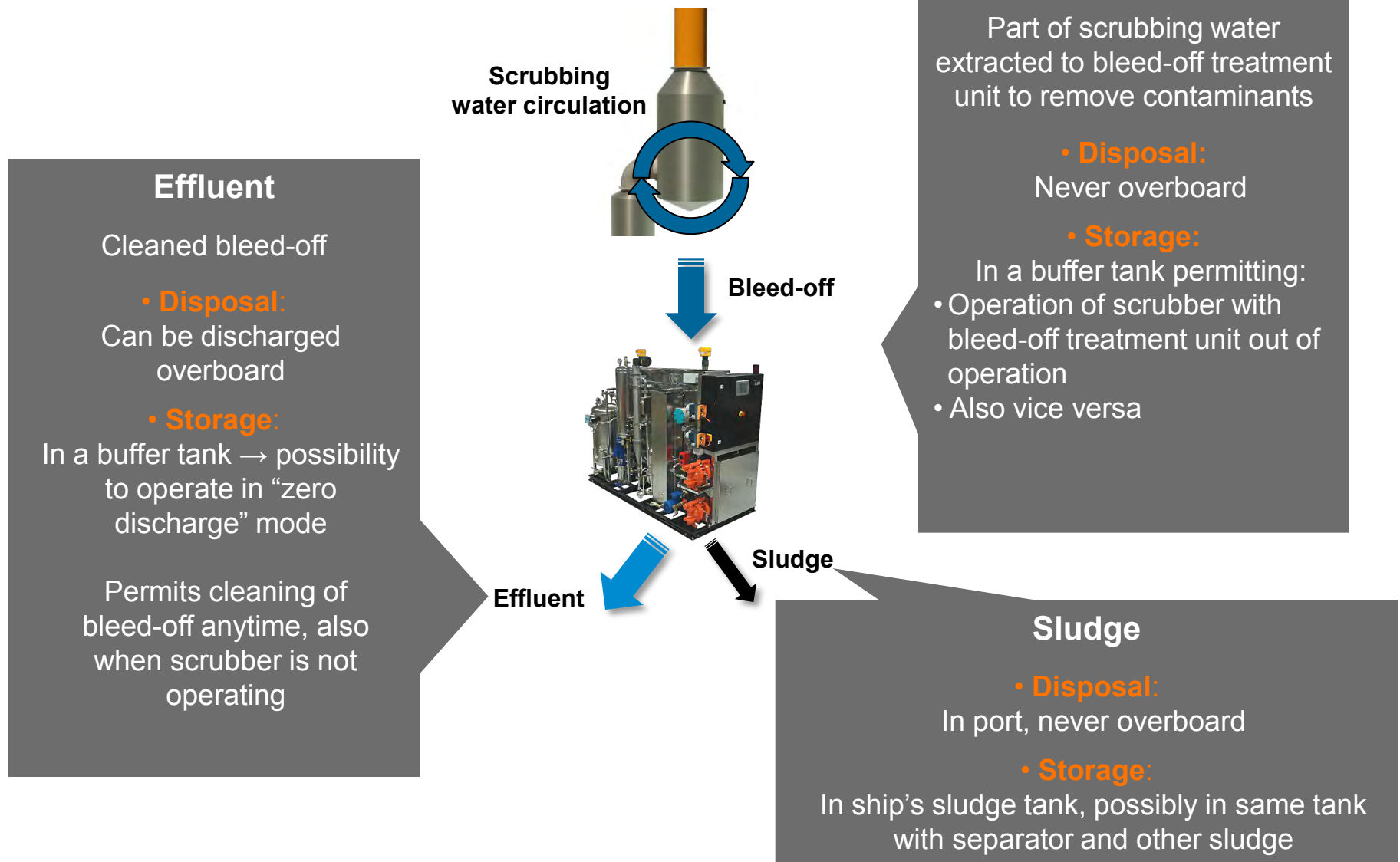


Closed loop scrubber process



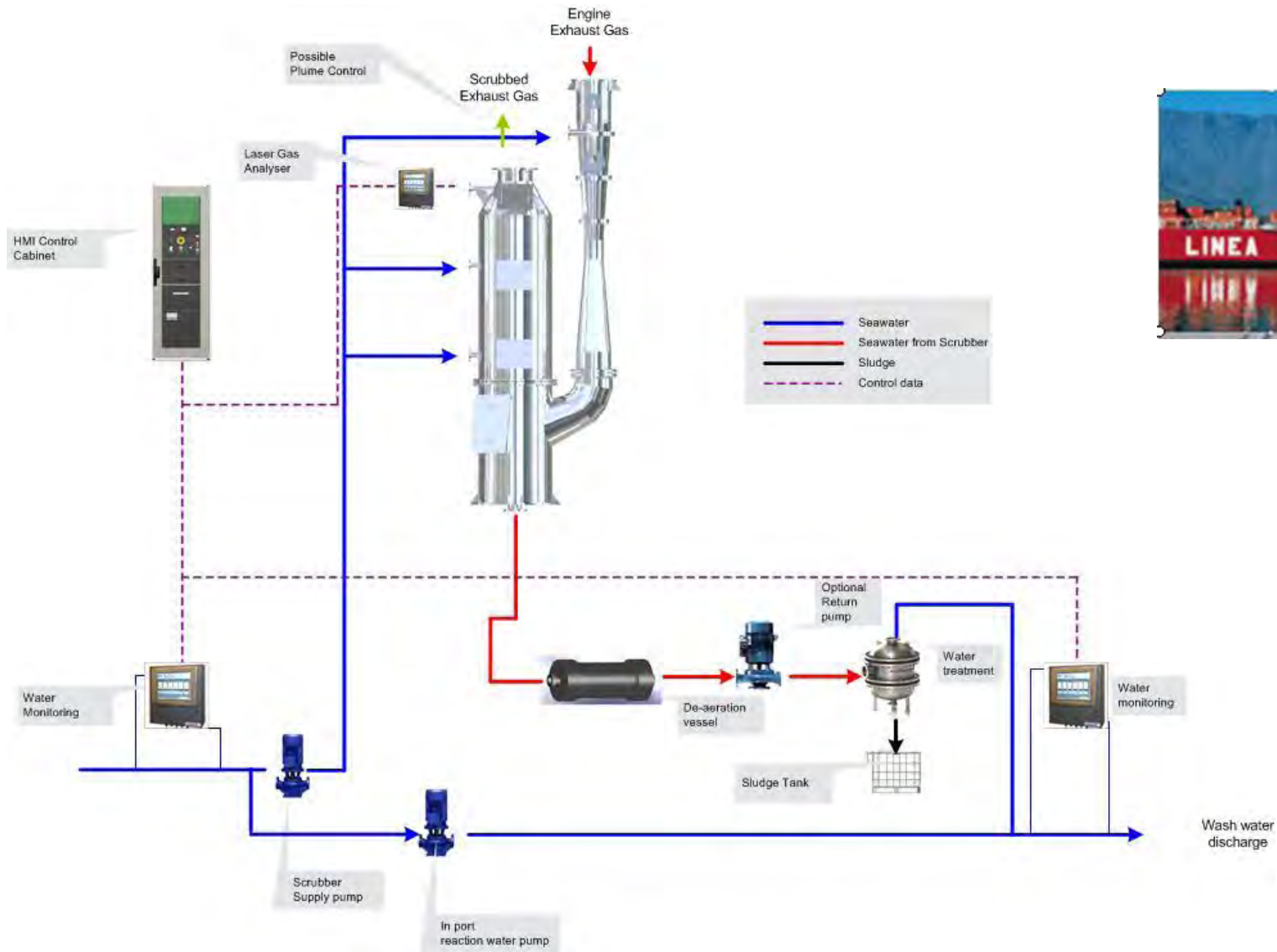
INTERNAL USE ONLY

Bleed-off treatment



Sea water scrubbing

Layout Seawater Scrubbing System – Basic Open Loop System



Marine scrubber milestones

1997: IMO adopts Marpol Annex VI

2004: Ratification of Marpol Annex VI

2005: Wärtsilä Marine Scrubber project started

2005: EU Directive

2005: Hamworthy scrubber on Pride of Kent

2007: Wärtsilä decision to install pilot scrubber

2008: IMO adopts Revised Marpol Annex VI:

- stringent SOx-limits
- scrubber permitted
- effluent regulated

2008: Start of Wärtsilä pilot scrubber

2009: First certificate in the world (DNV, GL)

2010: Hamworthy contract for 20 scrubbers to Ignazio Messina

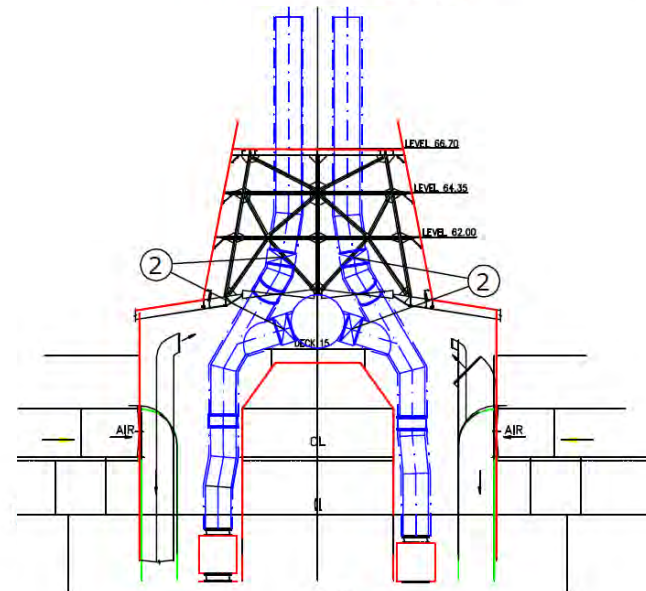
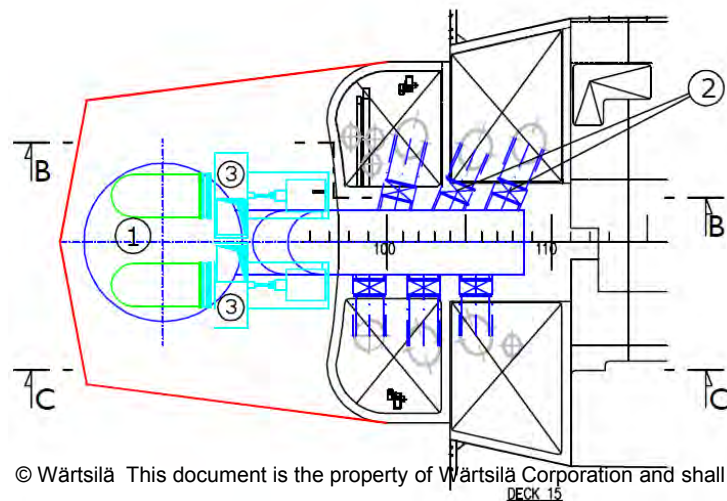
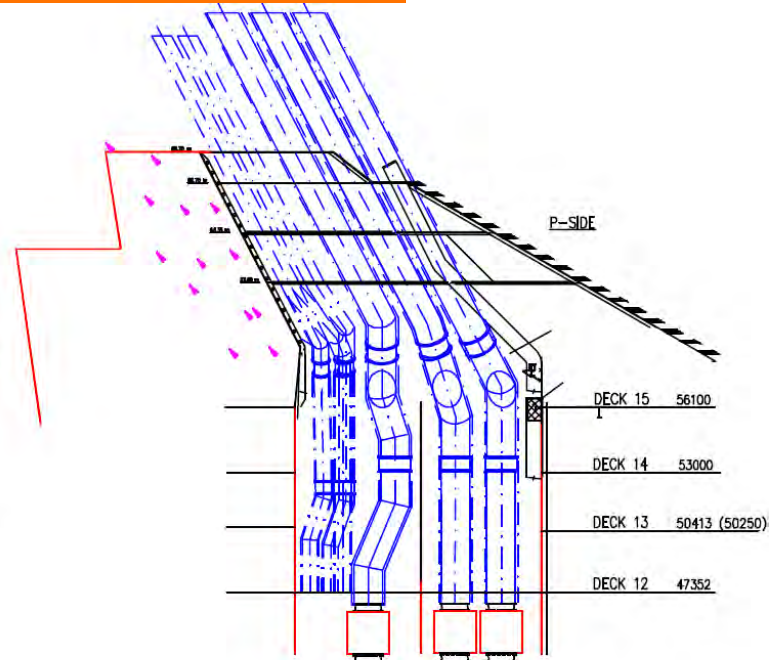
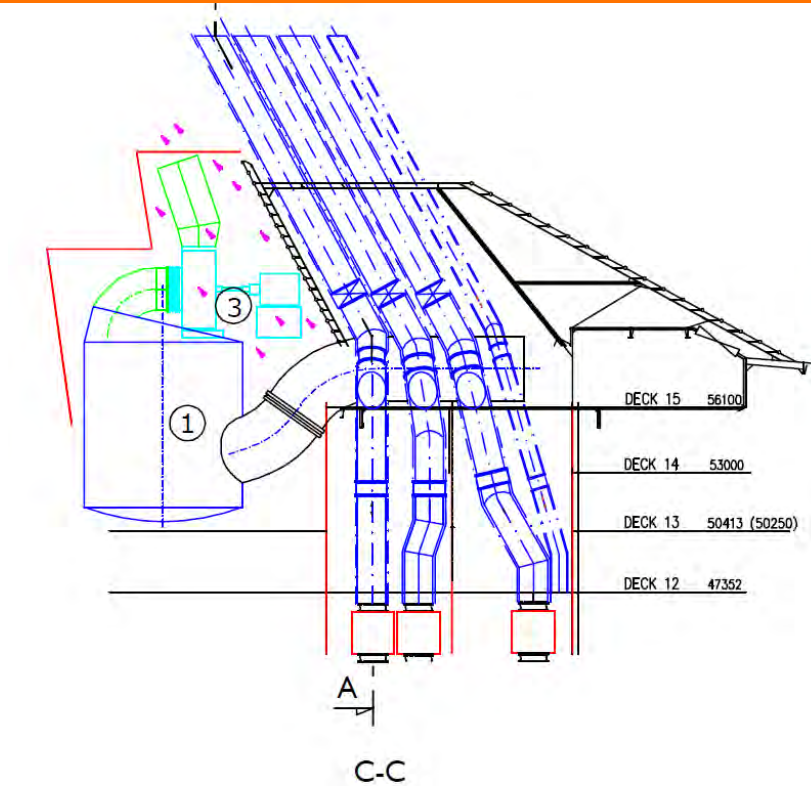
2012: EU Parliament and Council decision

2015: Drastic fuel savings with scrubbers in ECA

2020/2025: Drastic fuel savings with scrubbers globally



Large cruise vessel - Retrofit



Wärtsilä marine scrubber references

Vessel/Owner	Newbuilding or retrofit	Open loop	Closed loop	Hybrid	Scrubber delivery
MS Pride of Kent / P&O European Ferries Ltd.	Retrofit	x			2005
MS Zaandam / Carnival Corporation	Retrofit	x			2007
MT Suula / Neste shipping	Retrofit		x		2008
Containerships VII / Containership	Retrofit		x		2011
APL England / APL	Retrofit	x			2011
4 vessels / Ignazio Messina & C.S.p.A	Newbuilding	x			2011 (2 vessels) 2012 (2 vessels)
MV Tarago / Wilh. Wilhelmsen ASA	Retrofit			x	2012
8 vessels / Algoma	Newbuilding		x		2012(4 vessels) 2013(4 vessels)
2 vessels / x*	Newbuilding			x	2013/2014
2 vessel / x*	Newbuilding			x	2013/2014
HHI Hull 2516 and 2517 / Solvang	Newbuilding	x			2012/2013

24 ships

* customer wants to remain anonymous

Compliance with Marpol certified by DNV



DET NORSKE VERITAS SECA COMPLIANCE CERTIFICATE Certificate of Unit Approval for Exhaust Gas-SO_x Cleaning Systems

DNV Id No:
23714
Date of issue:
2009-08-10

Issued under the provisions of the Protocol of 1997 to amend the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 related thereto

under the authority of the Government of

FINLAND

by Det Norske Veritas AS

Particulars of Ship

Name of Ship:

"SUULA"

Distinctive Number or Letters:

OJKZ

Port of Registry:

PORVOO

IMO Number:

9267560

THIS IS TO CERTIFY:

that the Exhaust Gas-SO_x Cleaning System (EGCS-SO_x) unit listed below has been surveyed in accordance with the requirements of the specifications contained under Scheme A in the Guidelines for on-board exhaust gas-SO_x cleaning systems - adopted by resolution MEPC.170(57) in line with regulation 14(4)(b) of MARPOL Annex VI.

This Certificate is valid only for the EGCS-SO_x unit referred to below:

Unit manufacturer	Model/Type	Serial No.	EGC-SO _x Unit and Technical Manual approval number
Wärtsilä Finland Oy	WM 1.25	0001	G-10117

A copy of this Certificate, together with the EGCS-SO_x Technical Manual, shall be carried onboard the ship fitted with this EGCS-SO_x unit at all times.

This Certificate is valid for the life of the EGCS-SO_x unit subject to surveys in accordance with section 2 of the Guidelines and regulation 5 of MARPOL Annex VI, installed in ships under the authority of this Government.

Issued at Høvik (Norway) on 2009-08-10

for Det Norske Veritas AS

Skevig Alf Roger

Head Of Marpol Section
MNBNA843



The first full-scale Wärtsilä SO_x Scrubber

Containerships VII



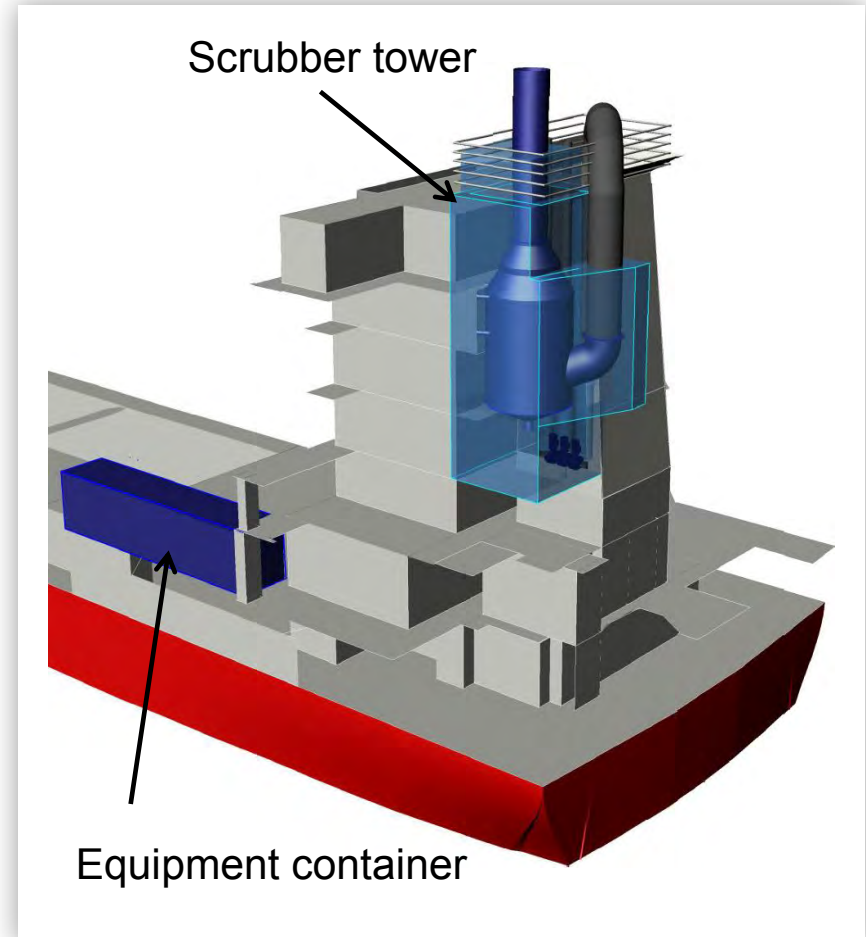
- Containerships VII, scrubber installed in August 2011.
- Main stream scrubber for Wärtsilä 7L64 main engine, 12600kW.
- Vessel built 2002 (Sietas, Hamburg).
- Operating area Baltic Sea and North Sea.
- Finnish flag, classification society GL.

Scrubber “tower”

Equipment container

Engine room

Cargo area



Scrubber tower lifted onboard

Containerships VII





Effluent Monitoring Module

- Dimensions:
 - Height: 1370 mm
 - Width: 810 mm
 - Depth: 650 mm
 - Weight: 300 kg
- Installed in equipment container.



BOTUs installed

Containerships VII

BOTU = Bleed-Off Treatment Unit

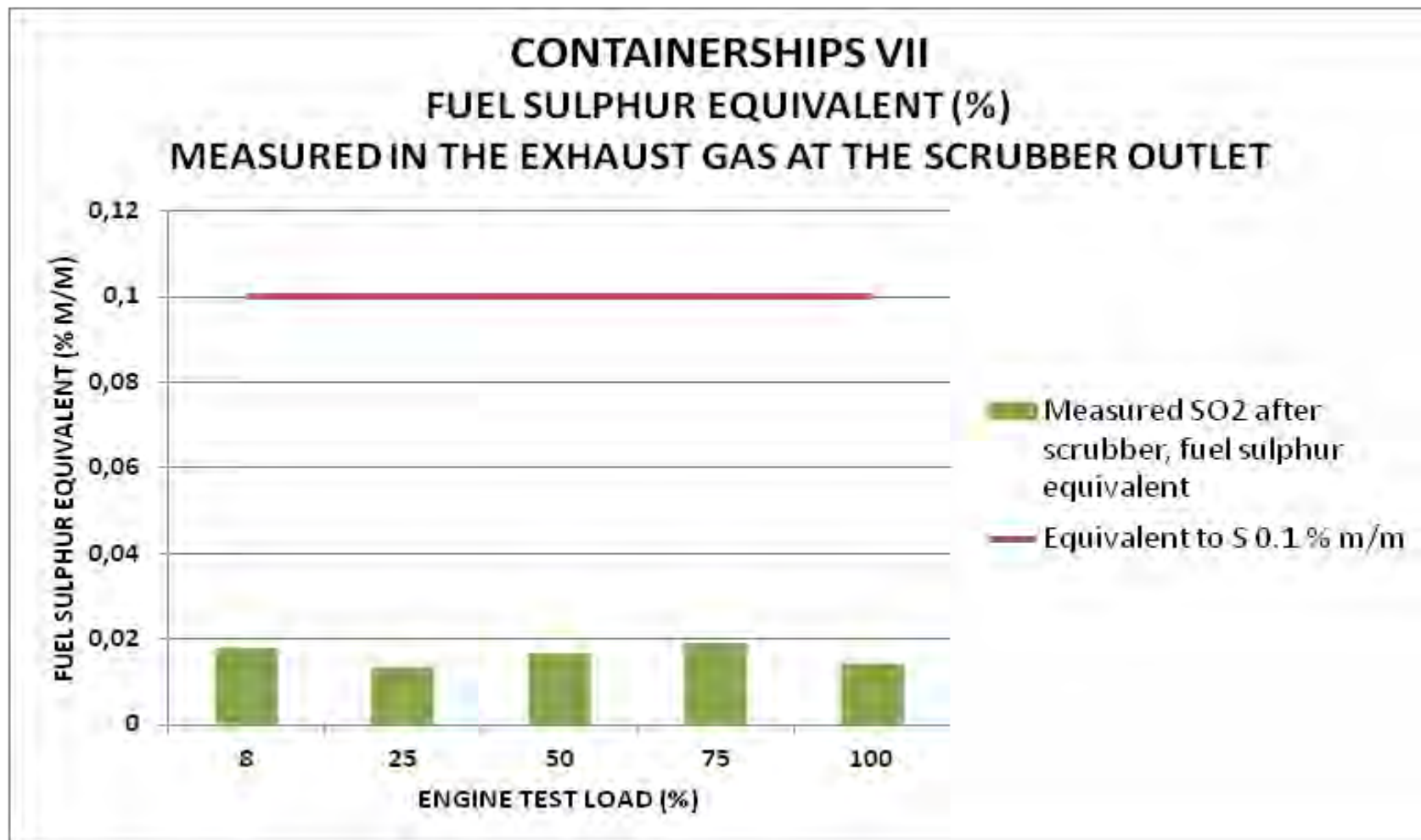
- In equipment container.
- Capacity 2 x 2.5 m³/h.
- 10 m³ holding tank capacity included.

UPGRADING

- New units will reduce effluent turbidity.

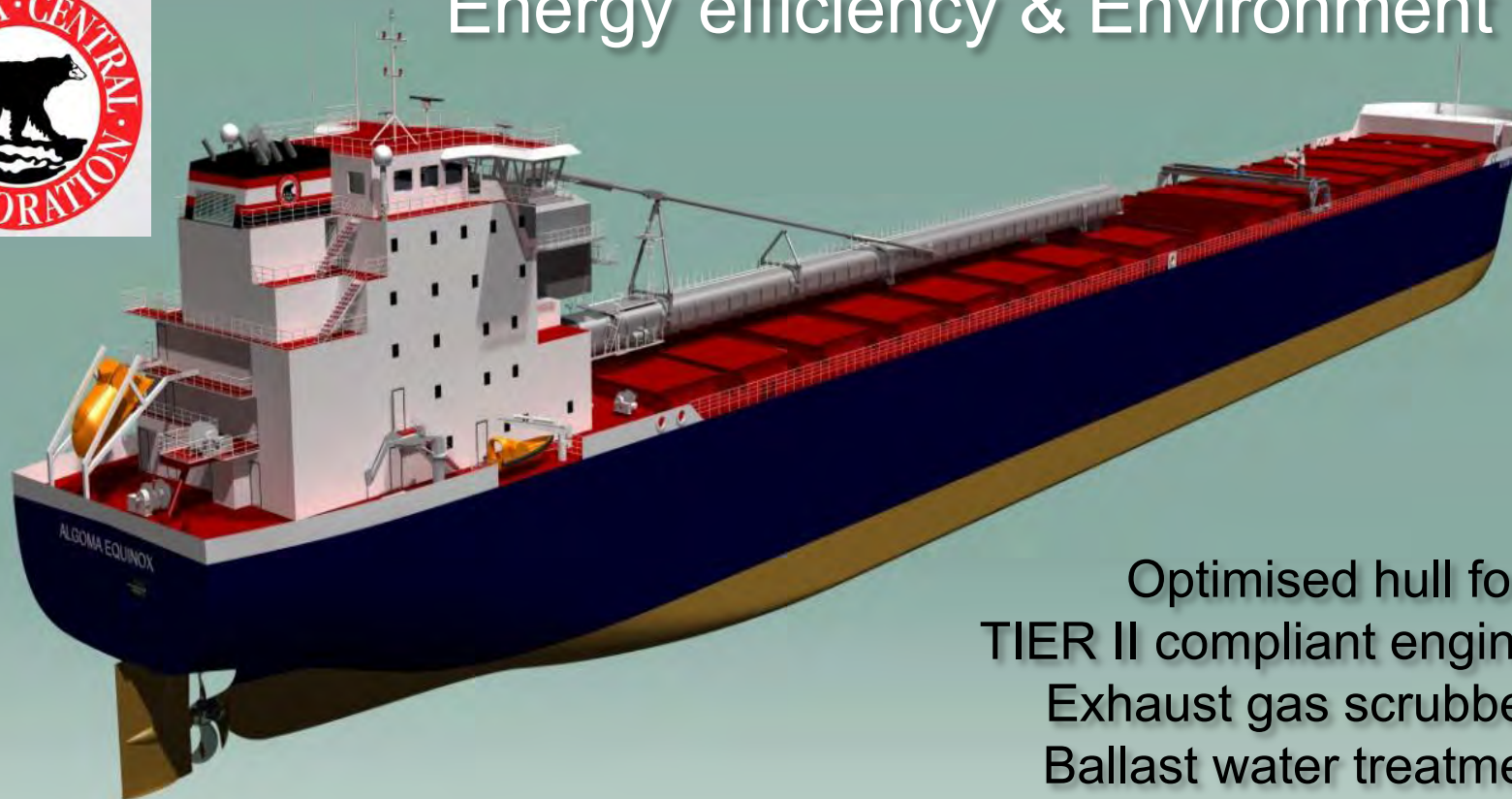


- Fuel sulphur content 1.84 %.
- Measurement by accredited third party 2.12.2011.



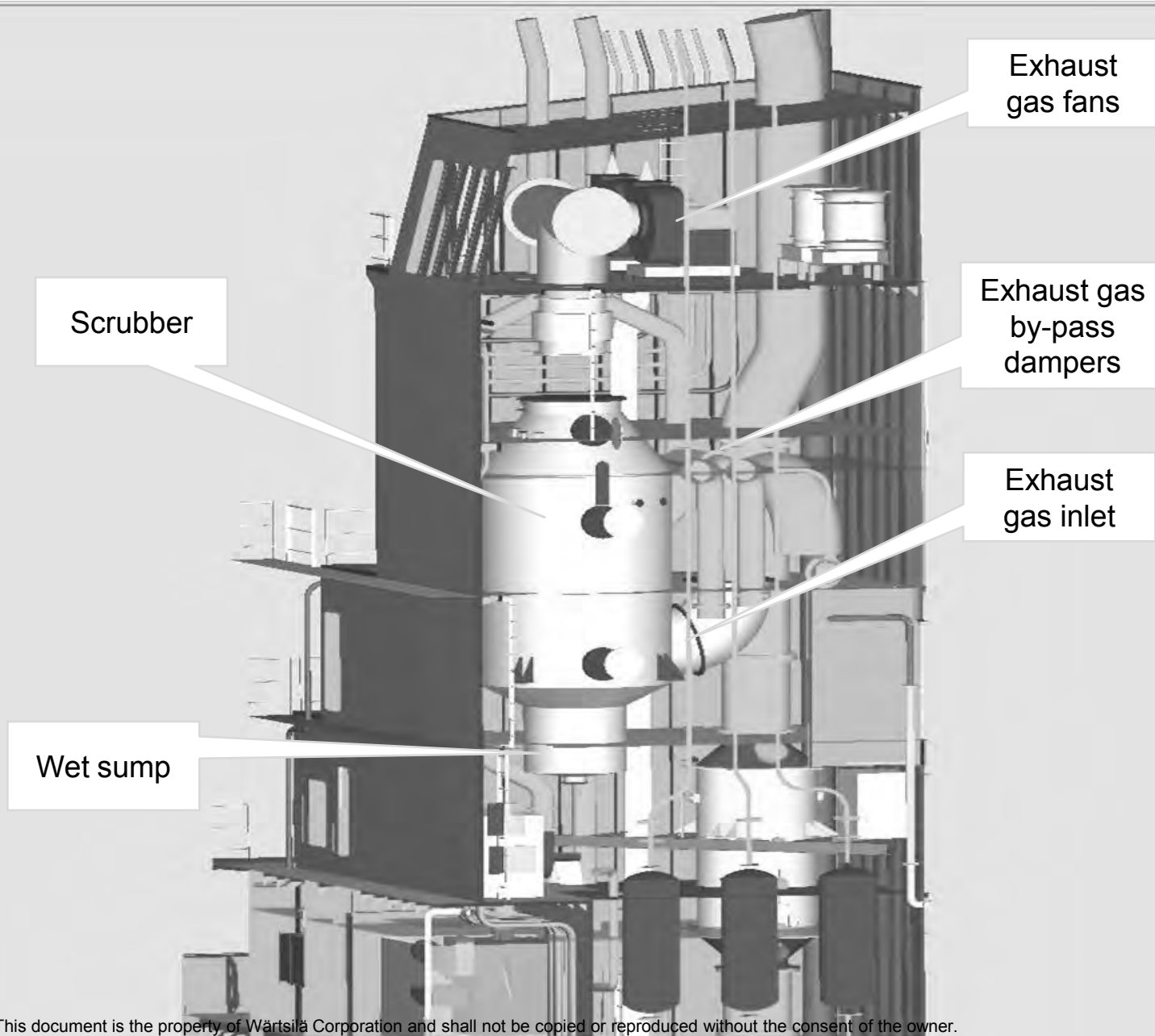
New generation for Great Lakes Bulk Carriers

Energy efficiency & Environment

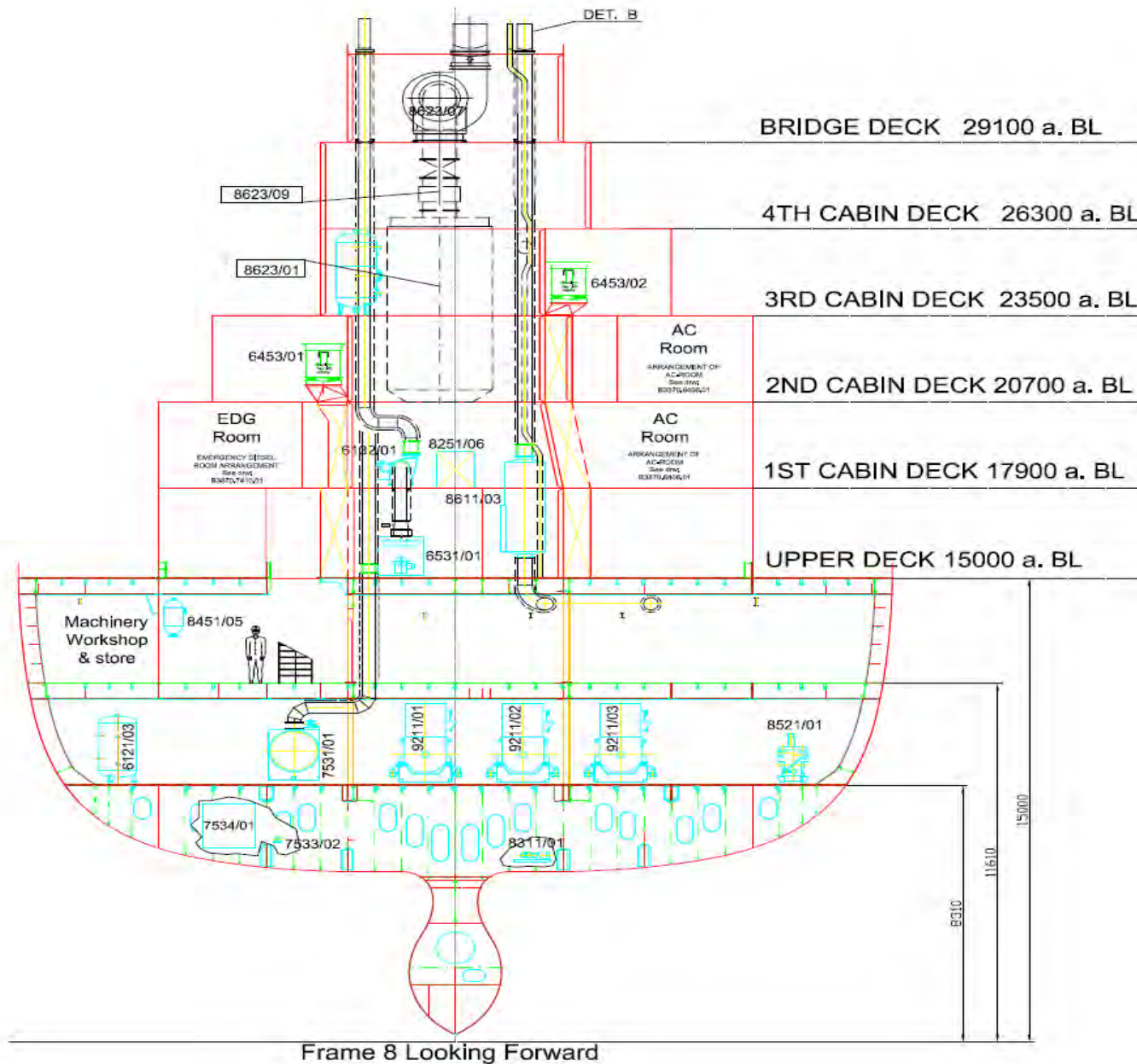


Optimised hull form
TIER II compliant engines
Exhaust gas scrubbers
Ballast water treatment
Advanced waste water management
Official Green Passport

Algoma Scrubber arrangement



Algoma Equinox class



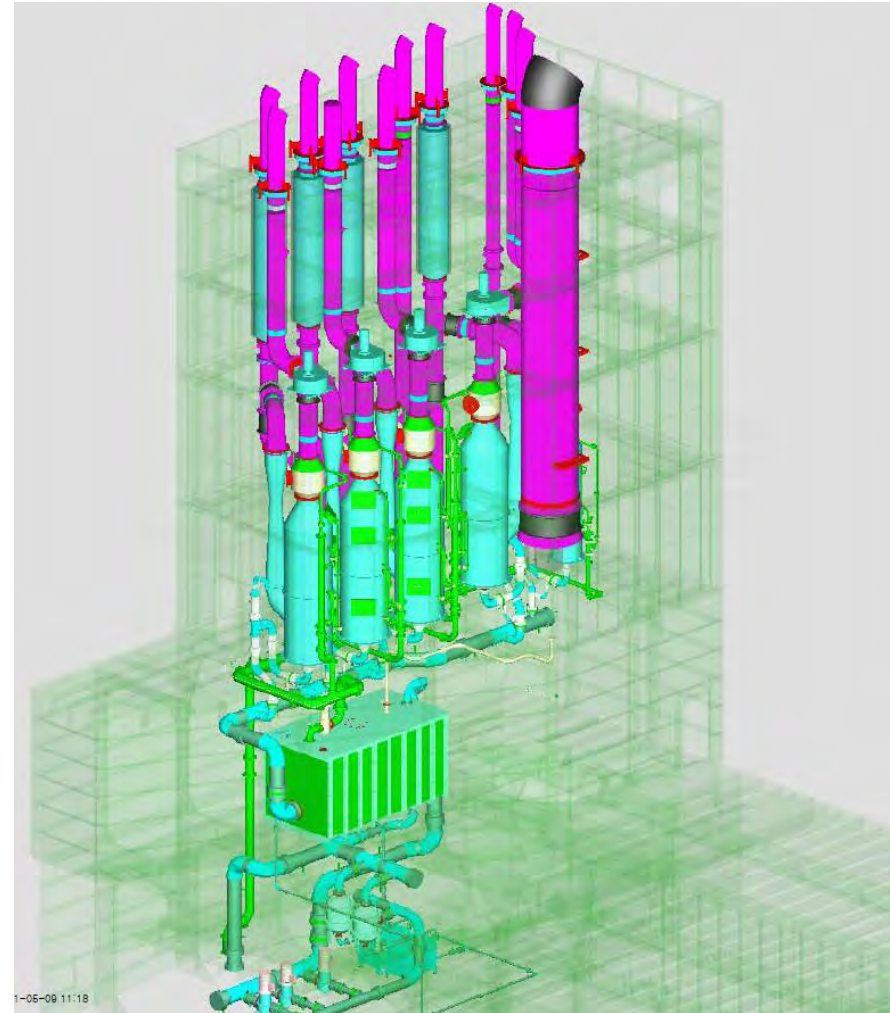
Lessons learnt – Containerships VII

#	ISSUE	CORRECTIVE ACTION
1	Scrubbing water pump jam	Pump modified
2	Scrubbing water pump cavitation	Sump level modified
3	Vibrations from ship hull	Sensitive equipment elastically mounted
4	Effluent turbidity sensor fouling	Automatic cleaning installed
5	Several other minor challenges	Corrected
6	Effluent turbidity	New Bleed-Off Treatment System

Yard	DSME
Vessel	Hull 4465/66/67/68
Size of SWS	4 x 2 MW auxiliary engine 1 x 1 MW boiler
Installation type	New building
Delivery	January 2011 July 2011 January 2012 June 2012

Performance :

- 98% SOx Removal
- 60-80% Particulate Removal
- Up to 4,5% fuel sulphur content
- Prepared for main engine scrubbing



Hamworthy Krystallon Ltd – Scrubbing Technology

Test station at Hamworthy Moss

- **1 MW Exhaust Gas Cleaning installation**
- **Tests run continuously**
- **Training for ships crew on Inert Gas Systems**
- **Future training on Exhaust Gas Cleaning Systems**
- **Demonstration for potential customers**



An underwater photograph of a humpback whale and its calf swimming near the surface. The whale's head and eye are visible, and its long, wrinkled baleen is prominent. The calf is swimming below it. The water is a deep blue, and the surface is visible at the top with some light reflections.

Thank You!