ALTERNATIVE ENERGY SOLUTIONS

EMISSION REDUCTION · PRODUCT PRESENTATION

EXHAUST GAS RECIRCULATION

blueEGR – NOx reduction solution for diesel engines

VERSION 2025-05-12 · PUBLIC

WHY blueEGR

- Environment and climate require sustainable solutions for marine exhaust emissions
- Usual solutions (LNG conversions or SCR retrofits) come with high CAPEX and OPEX
- blueEGR fits any marine or stationary diesel application
- Exhaust Gas Recirculation (EGR) in a proven design
- Robust and reliable NOx reduction
- Verified functionality, performance and durability

KEY FIGURE

≈ –80 %

NOx on reference installations, using only water – no urea, no chemicals.

IMO RULES FOR EXISTING SHIPS

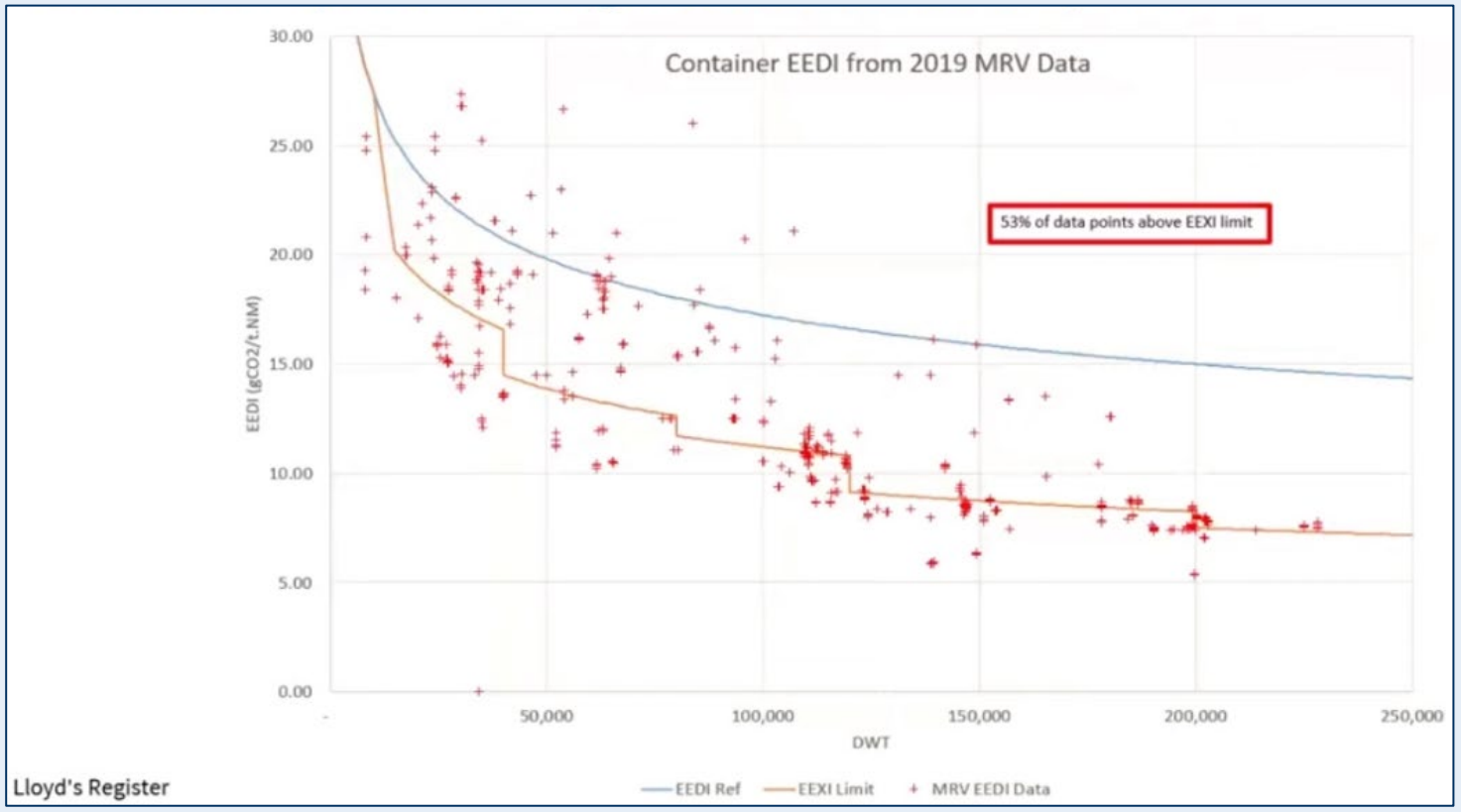
IMO measures

- Mandatory measures approved by MEPC to cut the carbon footprint of all ships
- Two measures: Energy Efficiency Existing Ship Index (EEXI) and Carbon Intensity Indicator (CII)
- In force since 1 January 2023

About the EEXI

- For most ship types, the requirements follow the EEDI phase relevant for new ships in 2023
- All ships have to document EEXI compliance
- EEDI-compliant vessels most likely have to add further documentation
- Pre-EEDI vessels may need further documentation if the EEXI cannot be met

IMPACT ON THE CONTAINER FLEET



Indicative impact on the global container ship fleet. Source: Lloyd's Register webinar, March 2021

EEXI COMPLIANCE RETROFIT

blueEGR

plus Fuel Saving Option (FSO)

from IMO Tier 0+ to Tier II

EEXI CONTAINER SHIP

$$\frac{\text{total emitted } CO_2 \text{ per year}}{\text{transport work (t)}}$$

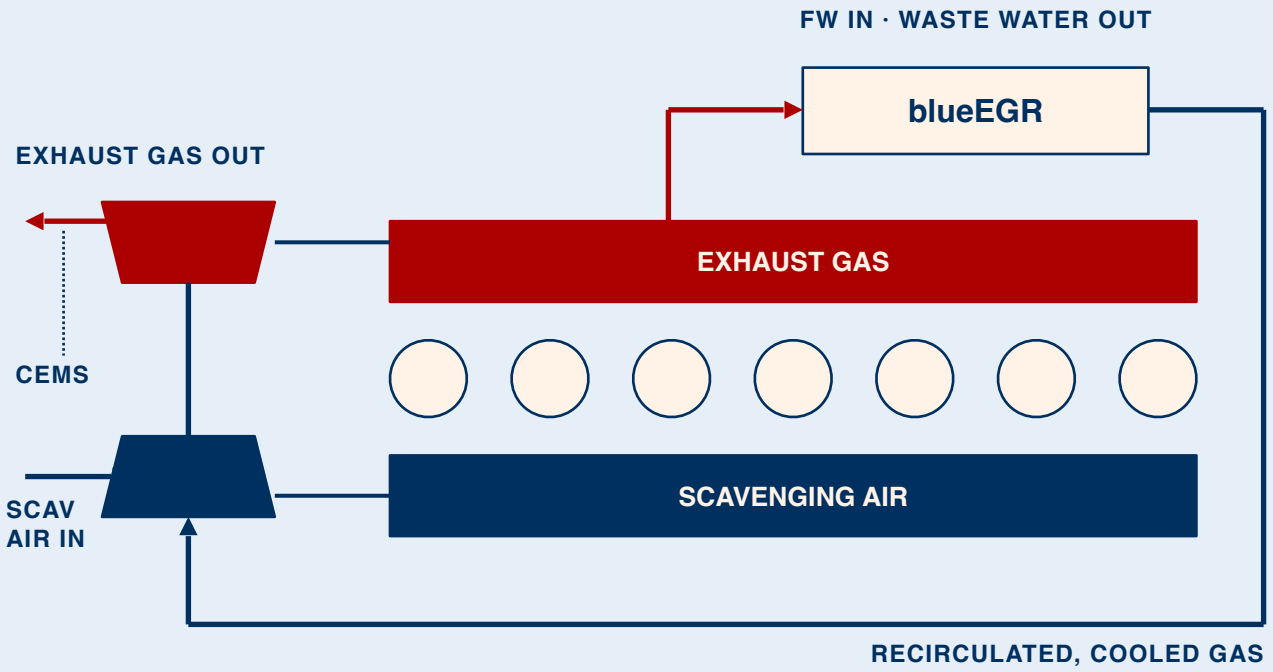
01

TECHNOLOGY

How blueEGR works and how it is sized

TECHNICAL SET-UP

- Installation on top of the engine
- Exhaust gas extraction regulated by engine load
- Exhaust gas cooling and cleaning
- Recirculation to the scavenging air intake
- NOx reduction through lower combustion temperatures
- Continuous Emission Monitoring System (CEMS)



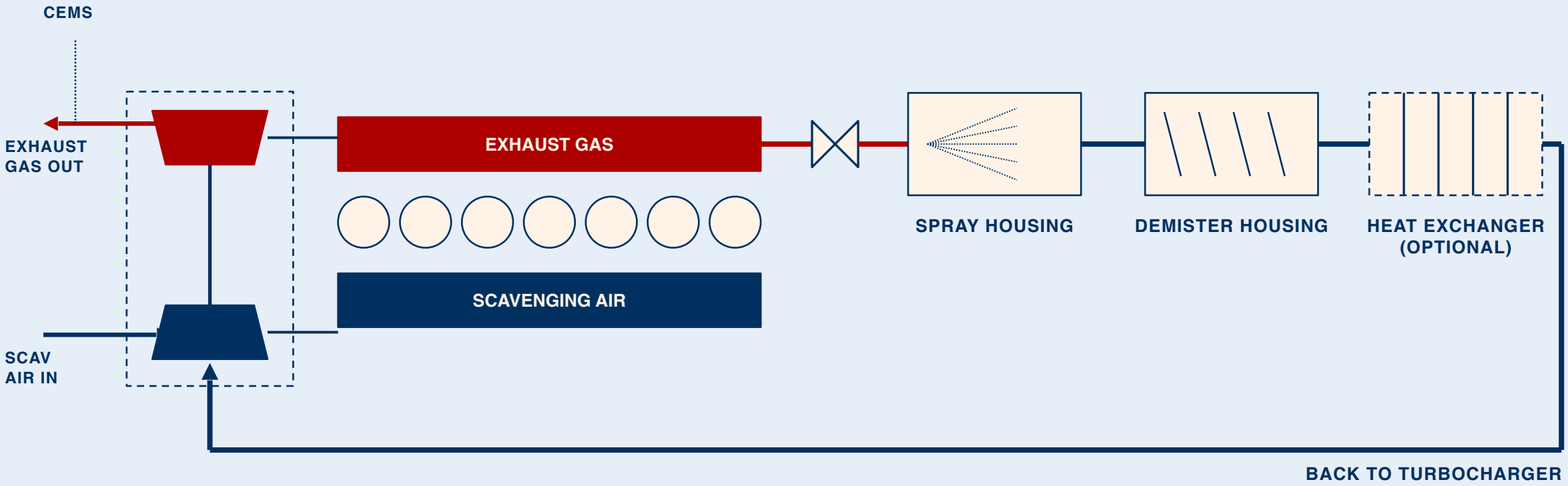
Hot exhaust gas · Air and cooled gas

THREE SYSTEM SIZES

Each blueEGR is designed for **the actual and target IMO Tier level** and **the engine power at MCR.**

SYSTEM SIZE	ENGINE POWER	EXHAUST GAS COOLING	NOX REDUCTION TARGET
blueEGR small	500 kW to 1.5 MW	No water, heat exchanger only	IMO Tier I to II
blueEGR light	500 kW to 1.5 MW	Water cooling with injection nozzles	IMO Tier I to III
blueEGR full	from 1.5 MW	Water cooling with more injection nozzles	up to IMO Tier III

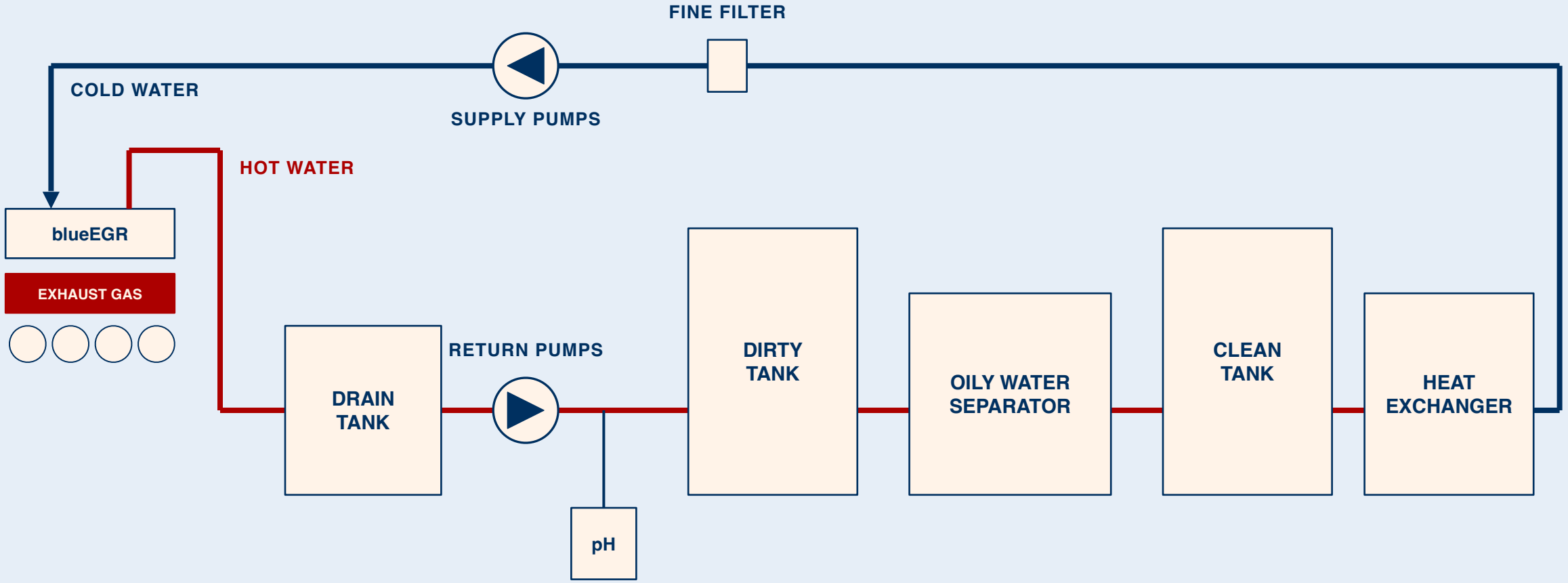
EXHAUST GAS CYCLE



Hot exhaust gas · Cooled and cleaned gas

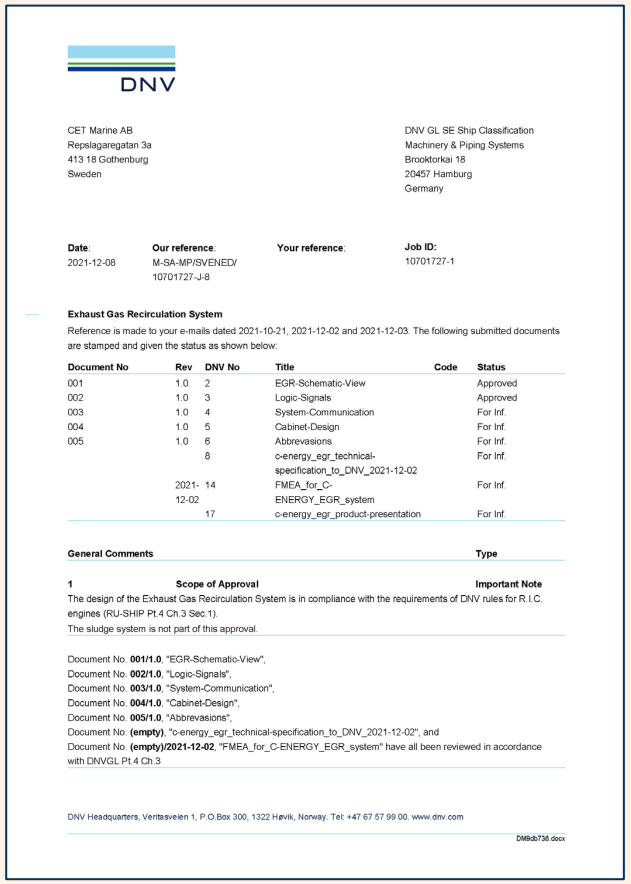
AES Holding GmbH

SUPPLY AND RETURN WATER CYCLE



Hot water · **Cold water** · Closed-loop example

APPROVED DESIGN



DNV

CET Marine AB
Repslagaregatan 3a
413 18 Gothenburg
Sweden

DNV GL SE Ship Classification
Machinery & Piping Systems
Brooktorkai 18
20457 Hamburg
Germany

Date:	Our reference:	Your reference:	Job ID:
2021-12-08	M-SA-MP/SVENED/ 10701727-J-8		10701727-1

Exhaust Gas Recirculation System

Reference is made to your e-mails dated 2021-10-21, 2021-12-02 and 2021-12-03. The following submitted documents are stamped and given the status as shown below:

Document No	Rev	DNV No	Title	Code	Status
001	1.0	2	EGR-Schematic-View		Approved
002	1.0	3	Logic-Signals		Approved
003	1.0	4	System-Communication		For Inf.
004	1.0	5	Cabinet-Design		For Inf.
005	1.0	6	Abbrevasions		For Inf.
		8	c-energy_egr_technical-specification_to_DNV_2021-12-02		For Inf.
	2021-12-02	14	FMEA_for_C-ENERGY_EGR_system		For Inf.
		17	c-energy_egr_product-presentation		For Inf.

General Comments	Type
1 Scope of Approval The design of the Exhaust Gas Recirculation System is in compliance with the requirements of DNV rules for R.I.C. engines (RU-SHIP Pt.4 Ch.3 Sec.1). The sludge system is not part of this approval.	Important Note

Document No. **001/1.0**, "EGR-Schematic-View",
Document No. **002/1.0**, "Logic-Signals",
Document No. **003/1.0**, "System-Communication",
Document No. **004/1.0**, "Cabinet-Design",
Document No. **005/1.0**, "Abbrevasions",
Document No. **(empty)**, "c-energy_egr_technical-specification_to_DNV_2021-12-02", and
Document No. **(empty)/2021-12-02**, "FMEA_for_C-ENERGY_EGR_system" have all been reviewed in accordance with DNVGL Pt.4 Ch.3

DNV Headquarters, Veritasveien 1, P.O.Box 300, 1322 Høvik, Norway. Tel: +47 67 57 99 00. www.dnv.com

DM8db736.docx

- DNV has issued an Approval in Principle (AiP) for blueEGR on diesel engines
- The design complies with the DNV rules for R.I.C. engines (RU-SHIP Pt.4 Ch.3 Sec.1)
- We support our customers with all class questions

APPROVAL IN PRINCIPLE
DNV
DNV RULES / STANDARDS

ON TOP OF THE ENGINE





Typical installation on the exhaust pipe on top of the engine. Engine maintenance stays accessible.

02

CASE STUDY

1,000 TEU container feeder: Tier II to Tier III

COSTS AND TIME COMPARED

Standard 1,000 TEU container feeder with one main engine of about 9 MW, upgraded from IMO Tier II to Tier III.

1,000 TEU container ship	Dual-fuel conversion for natural gas	SCR catalyst installation	blueEGR installation	
			with FSO	without FSO
Engine update costs	2.600.000 €	50.000 €	960.000 €	915.000 €
LNG fuel gas & tank 500 m³	2.400.000 €	n.a.	n.a.	n.a.
SCR cat / mixing unit / comp. air	n.a.	350.000 €	n.a.	n.a.
Shipyard complete	4.550.000 €	1.020.000 €	160.000 €	95.000 €
Project management	30.000 €	15.000 €	5.000 €	5.000 €
Sea trial cost	75.000 €	40.000 €	20.000 €	10.000 €
Off-hire (10.000 €/day)	560.000 €	280.000 €	140.000 €	70.000 €
Total costs	**10.215.000 €**	**1.755.000 €**	**1.285.000 €**	**1.095.000 €**
Conversion time in shipyard	6 weeks	2 weeks	1 week	0.25 week
Commissioning (cold / hot)	1 week	1 week	0.5 week	0.25 week
Sea trial	1 week	1 week	0.5 week	0.5 week
Total time	**8 weeks**	**4 weeks**	**2 weeks**	**1 week**
OPEX	medium	high	**very low**	**low**



SSW Super 1000 type, approx. 13,000 dwt

–38 %

TOTAL COST VS. SCR, WITHOUT FSO

Values and time frames are estimates and vary with shipyard, location and engine availability. FSO = Fuel Saving Option.

ADVANTAGES OVER SCR

DNV APPROVAL IN PRINCIPLE

Listed supplier for NOx-reducing technologies at the Norwegian NOx Fund

SHORT SHIPYARD TIME

No dry docking; 0.25 to 1 week in the yard instead of 2 to 6 weeks

ONLY WATER

No urea and no additional compressed air needed

NO LOSS OF SPACE

No funnel extension, no loss of space, e.g. for cabins

MAINTENANCE STAYS FREE

Installed on the exhaust pipe on top of the engine; the engine is needed only a few hours for the connection

LOW CAPEX, VERY LOW OPEX

Fuel Saving Option (FSO) available in special cases

03

REFERENCES

Single installations – every plant is individual

RO-RO FERRY



4 × Sulzer 8L ZA40S main engines, 5.7 MW each (510 rpm, diesel-mechanical)

blueEGR on one engine:

- Emission level from IMO Tier 0+ to Tier II
- Additional Fuel Saving Option by retarding fuel injection timing (possible from Tier 0+ to Tier II)

–78 %

NOX

≈ 11 %

FUEL SAVING WITH FSO

–11 %

CO_2 AND PM WITH FSO

CRUISE LINER MS ARTANIA



1,200 passengers · 4 × Wärtsilä 12V W32E main engines, 7 MW each (750 rpm, diesel-mechanical)

- Installed on all four engines in 2023
- NOx emissions upgraded from IMO Tier II to Tier III
- New Technical File and EIAPP certificate issued by Lloyd's Register in July 2024
- No chemicals, only water
- No increase in backpressure or fuel consumption
- Low OPEX



≈ –80 % NOX ON ALL FOUR ENGINES

AES Holding GmbH

BENEFITS AT A GLANCE

NOx emission reduction	→	Better IMO Tier level
Less installation effort and time	→	Lower CAPEX
Only technical water	→	Lower OPEX; no urea, chemicals or ammonia slip
No backpressure increase	→	No increase in fuel consumption
Small installation space	→	No loss of space, e.g. for cabins

ALTERNATIVE ENERGY SOLUTIONS

CONTACT

THANK YOU

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