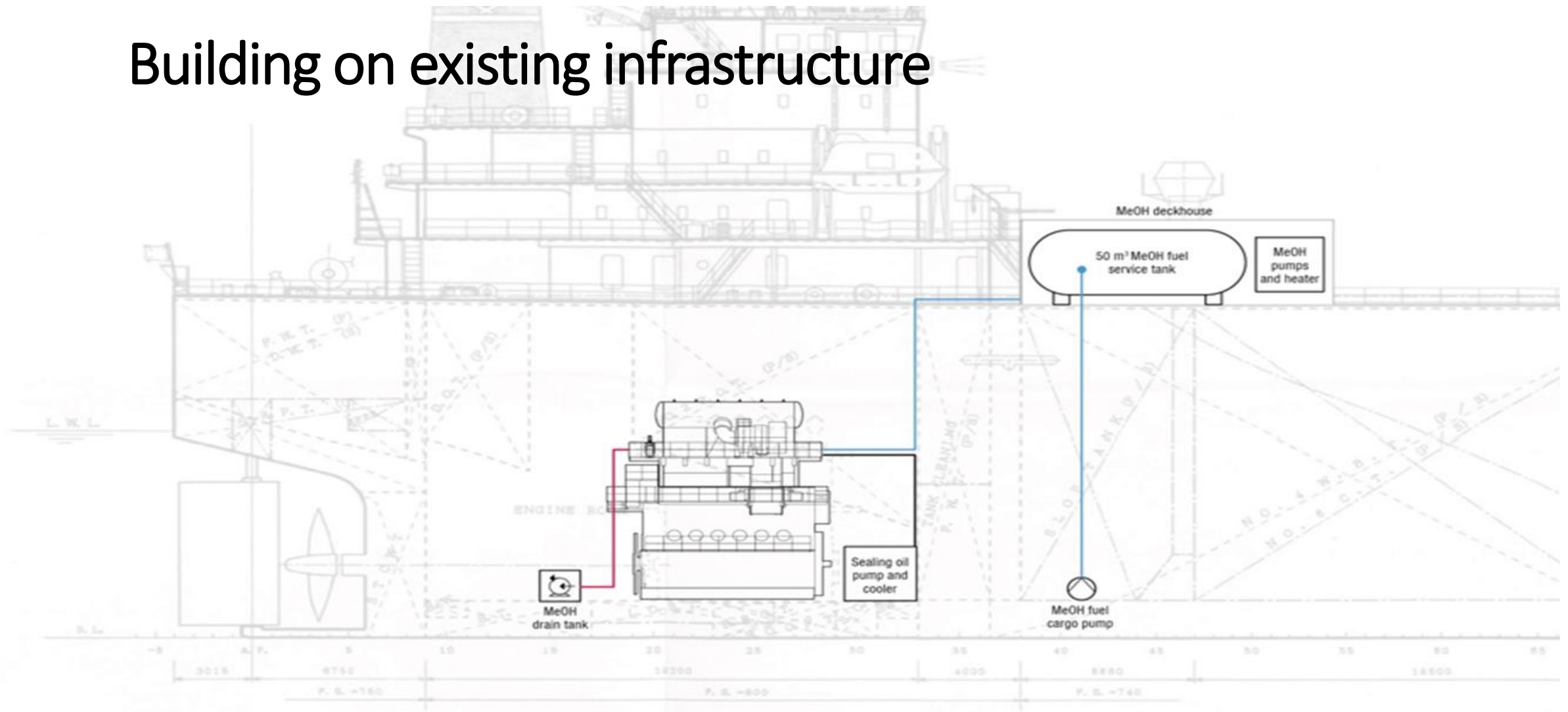




POWERED BY METHANOL

Presented by Fredrik Stubner

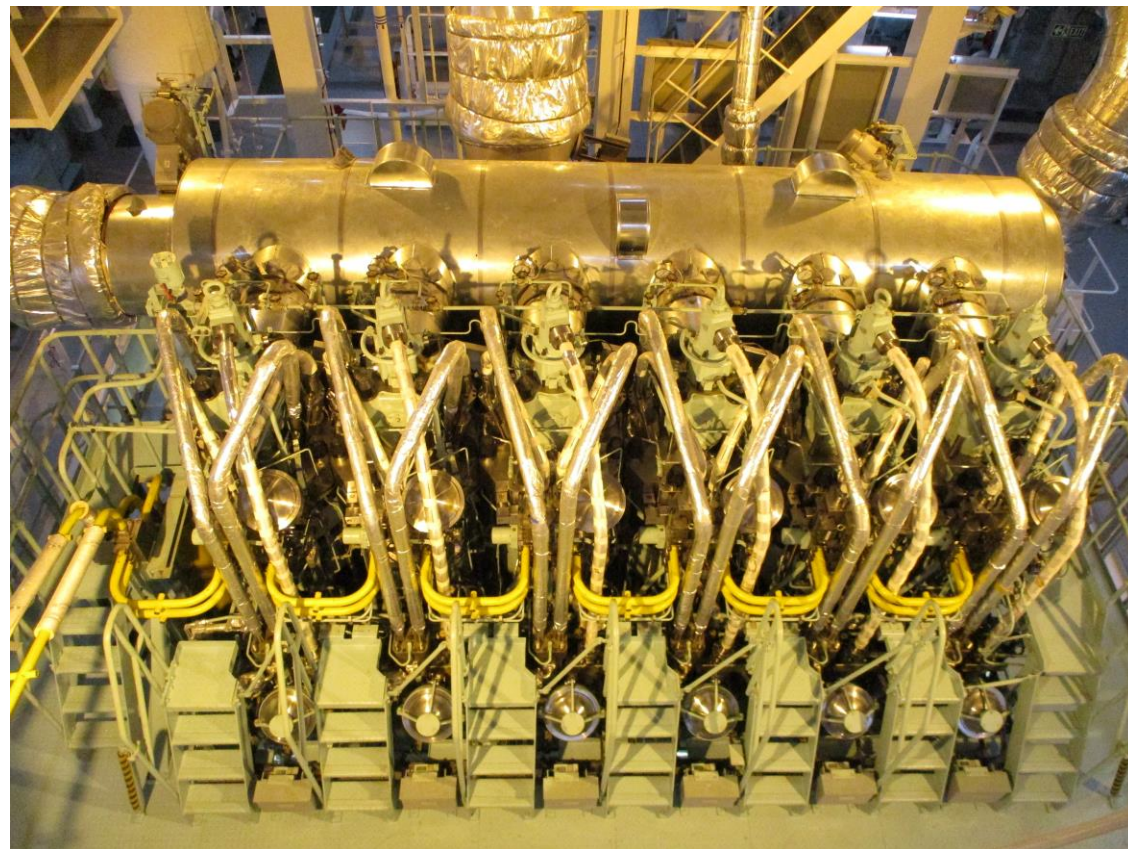
Building on existing infrastructure



What is different?

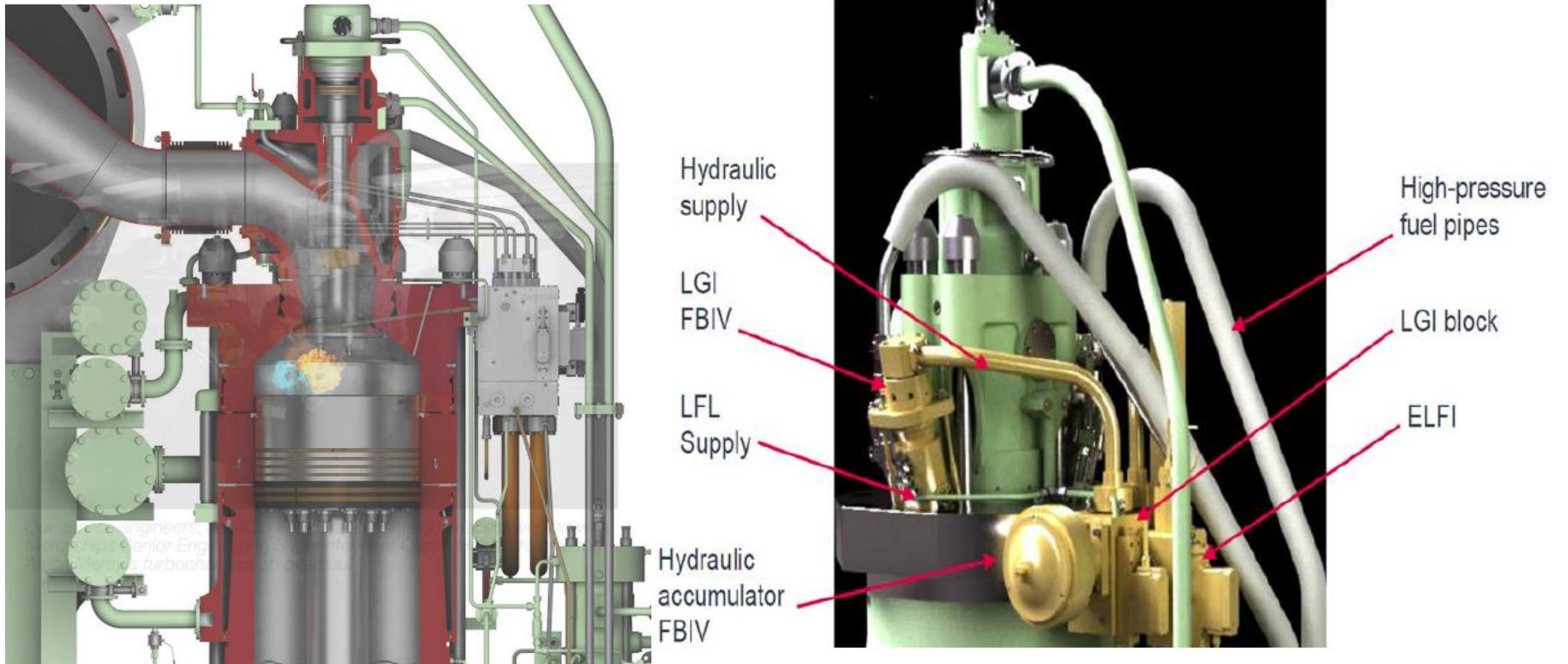


Hyundai MAN B&W 6G50ME-C-LGMI9.5-TIII





Two stand alone fuel supply systems





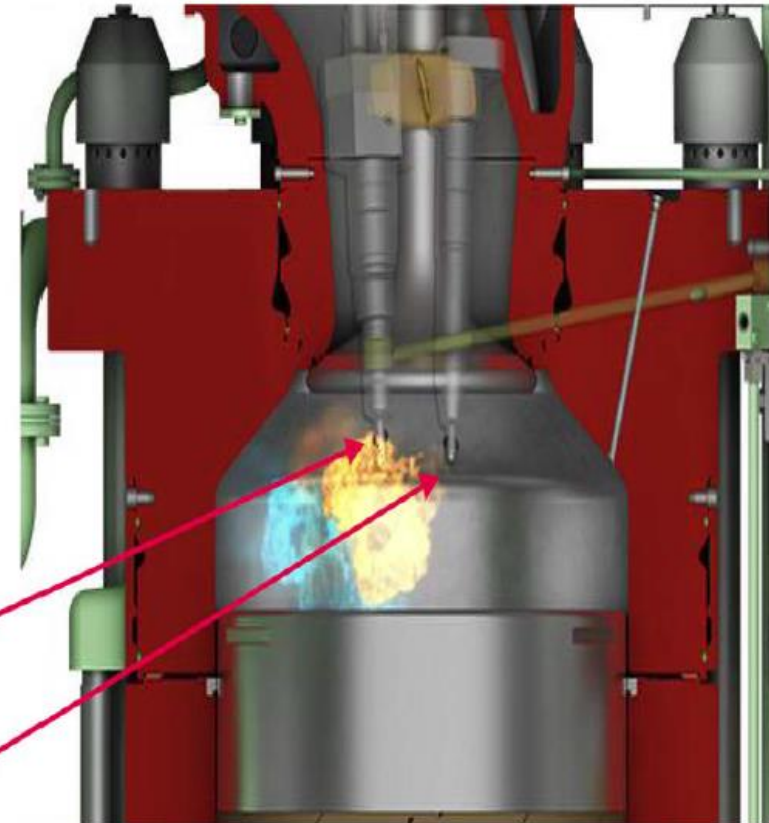
Two stand alone fuel supply systems



Standard Fuel Valve

Methanol Fuel Valve

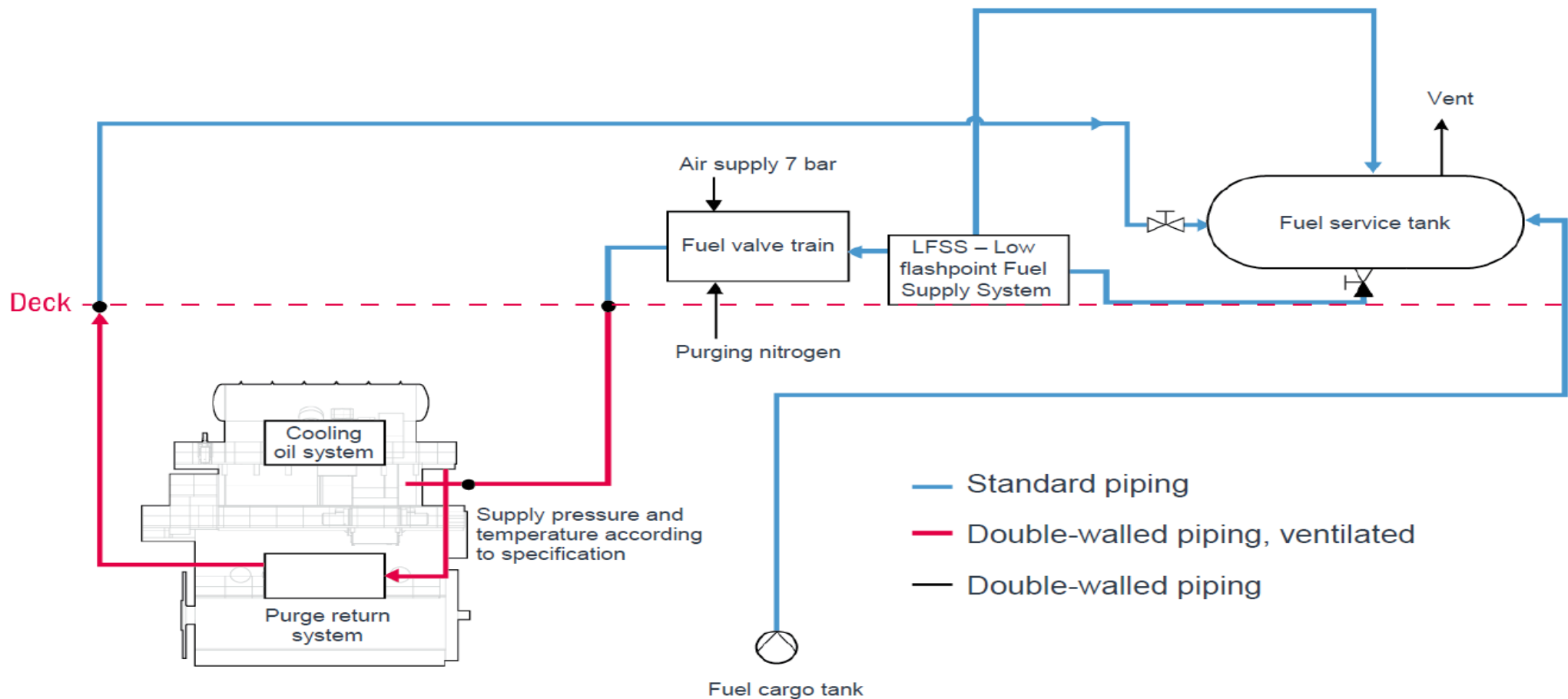
- The ME-LGI engine is a dual fuel engine
- Diesel combustion process →
- High efficiency



Main injection

Pilot injection

LFSS Overview





Safety Features

Fail Safe System - Auto change over from SF to PF

Nitrogen Purging

Double Walled Piping and Components

Leakage Detection

Continuous Ventilation

Intrinsically safe components

Fixed CO2 Extinguishing System

CCTV Monitoring



Introducing two of the world's first!



MARI JONE



MARI BOYLE



49999 DWT OIL TANKERS

CLASS: DNV +1A1, Tanker for Oil Products, Tanker for Chemicals, ESP, Ship Type 3, CSR, E0, TMON, ETC, CLEAN, VCS-2, LFL Fueled

Built in HMD Shipyard South Korea

■ M/T MARI BOYLE

Delivered August 2016

IMO No. 9732979

■ M/T MARI JONE

Delivered April 2016

IMO No. 9725316

MAIN PARTICULARS

Length overall	186.06 m
Length BP	177.00 m
Breadth moulded	32.20 m
Depth moulded	19.10 m
Summer draft	12.87 m
Deadweight at summer draft	49999 mt
Main engine MCR	7580 kW
Trial speed at 85% MCR	14.5 knots
Tonnage International Gross/Net	30945/13107



We call it Secondary Fuel (SF)



But we run our vessels
Primarily on it more
than 80% of the time at
sea.

2nd Generation



M/T MARI COUVA

Delivered August 2019

IMO No. 9848584

M/T MARI KOKAKO

Delivered September 2019

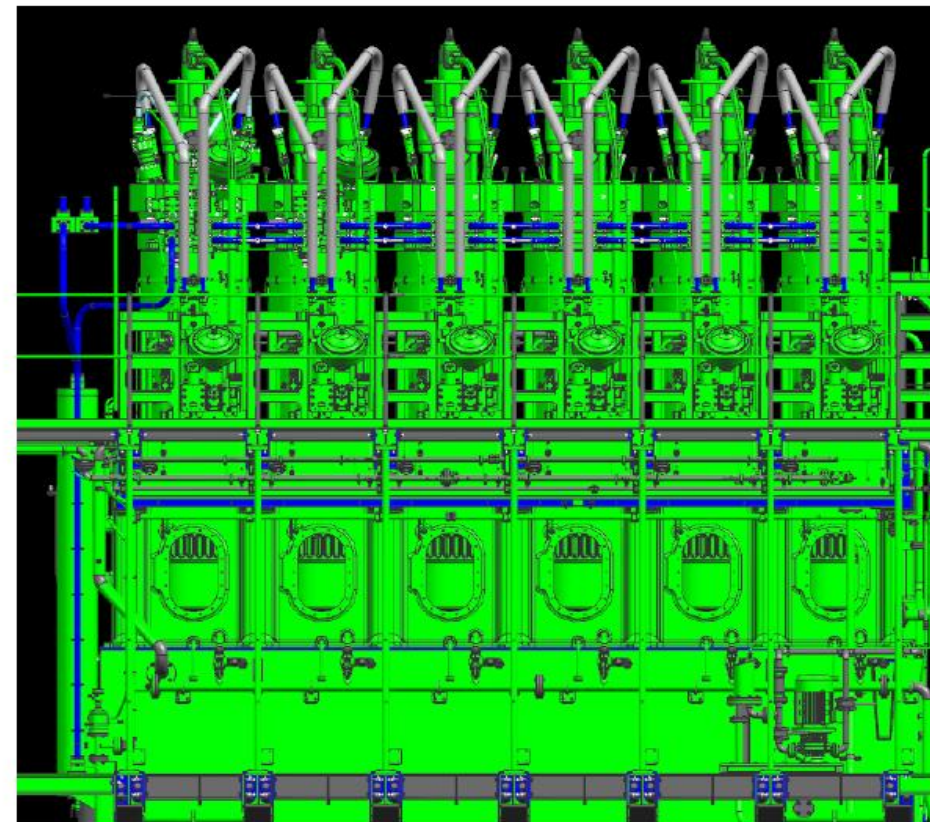
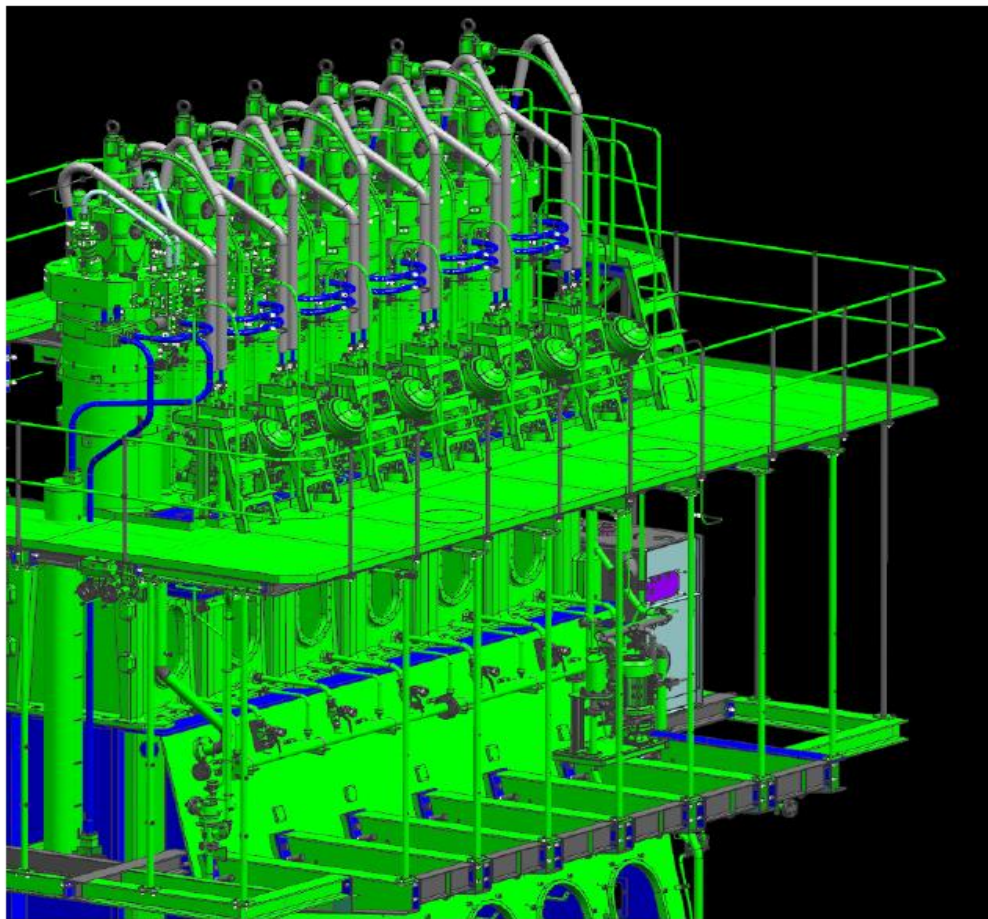
IMO No. 9848687



Promising new features

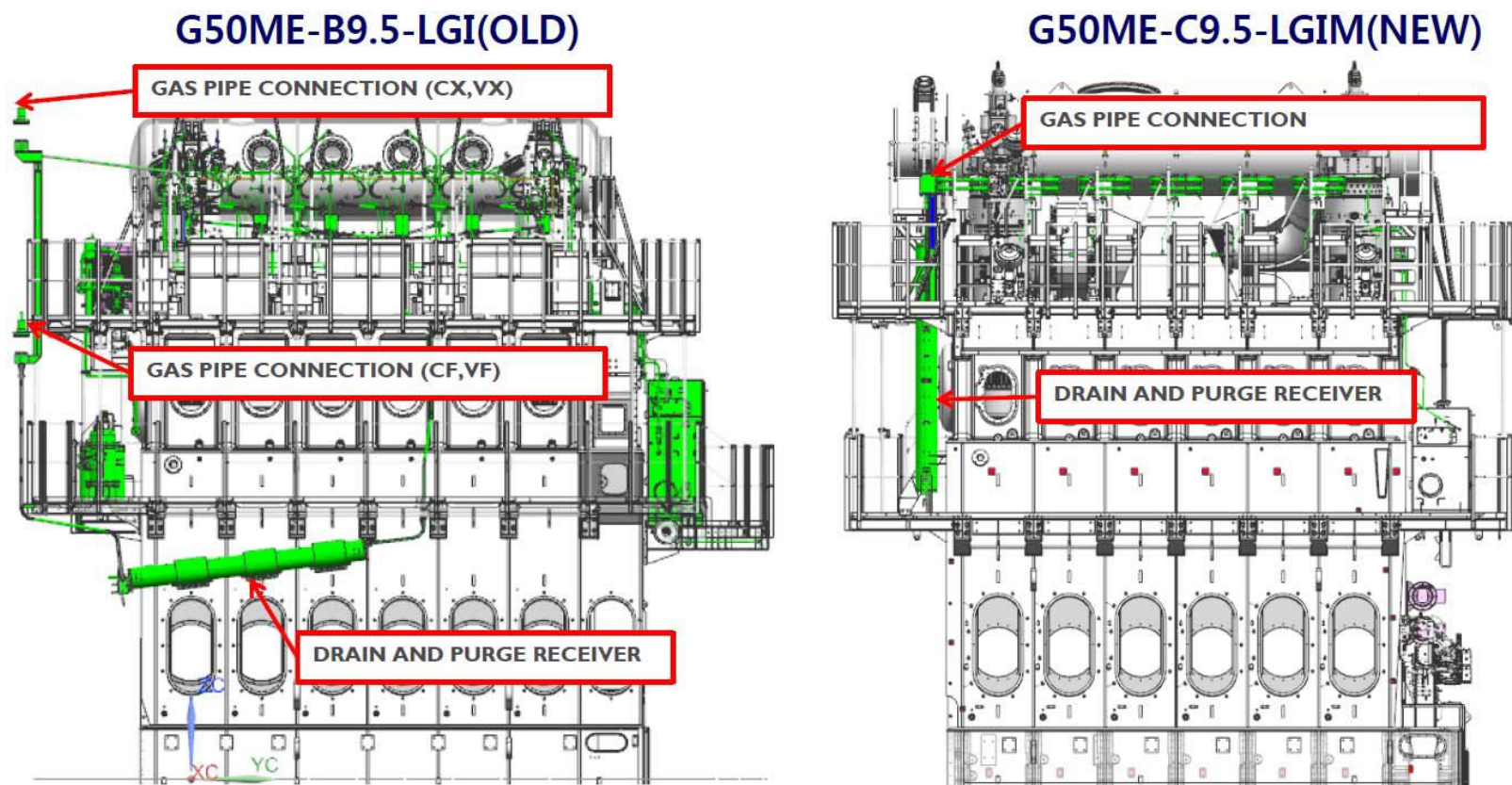
- ✓ IMO Type 2 Tankers
- ✓ Improved engine design eliminating all initial challenges from the 1st generation
- ✓ Equipped with SCR for Tier III compliance (that was before the water technology was tested and proven)
- ✓ **Water + Methanol to meet Tier III**
- ✓ **Tank cleaning with methanol butterworthing (both 1st and 2nd gen)**

ME-LGI Next Generation "Simplified" piping on engine





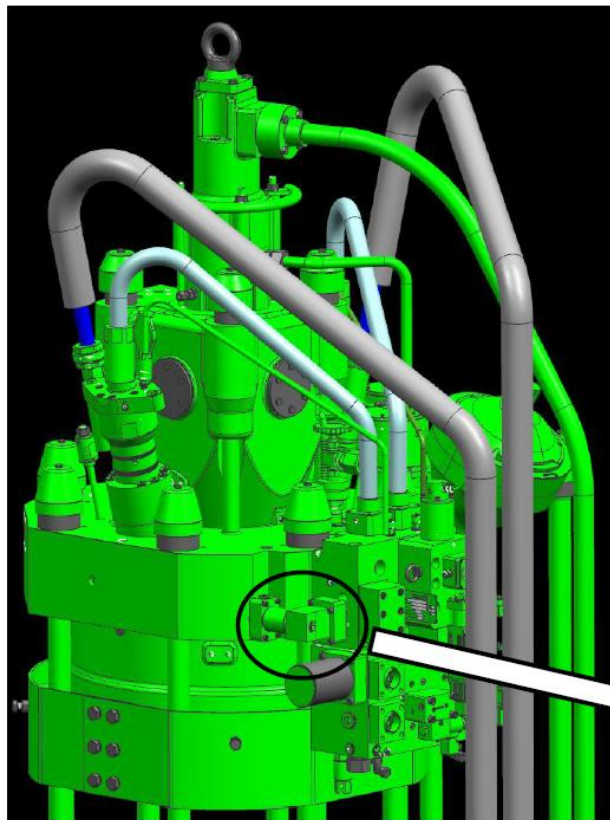
Comparison



- Drain and purge receiver have moved to fore side with vertical

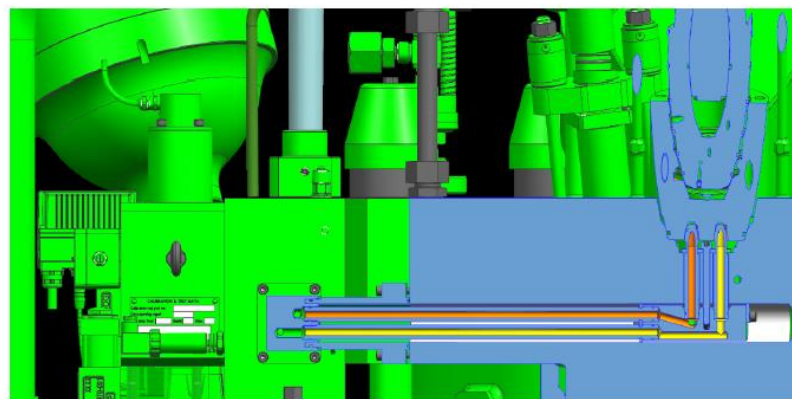


Using cylinder cover as guideway



Preliminary design of LGI cylinder cover

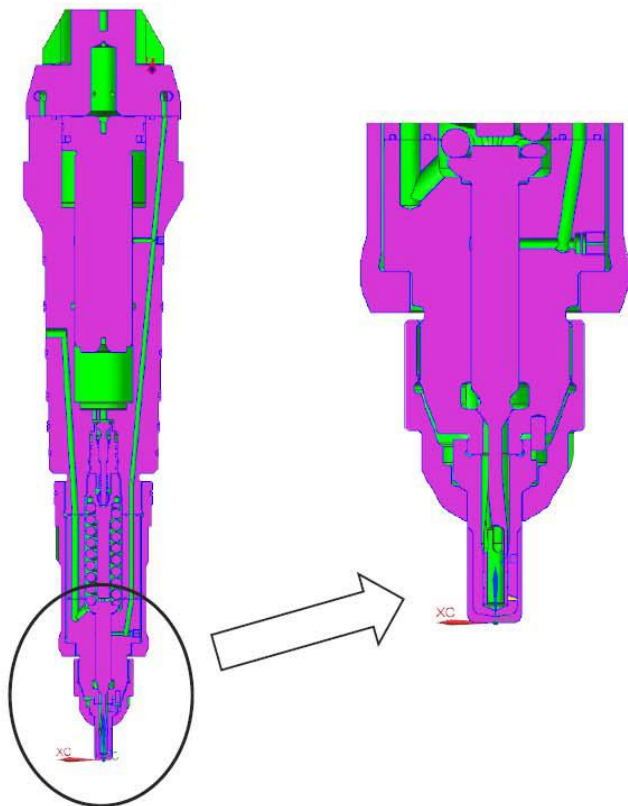
By using the cylinder cover actively
the external amount of pipes can be reduced
and the overhaul of cylinder units easier



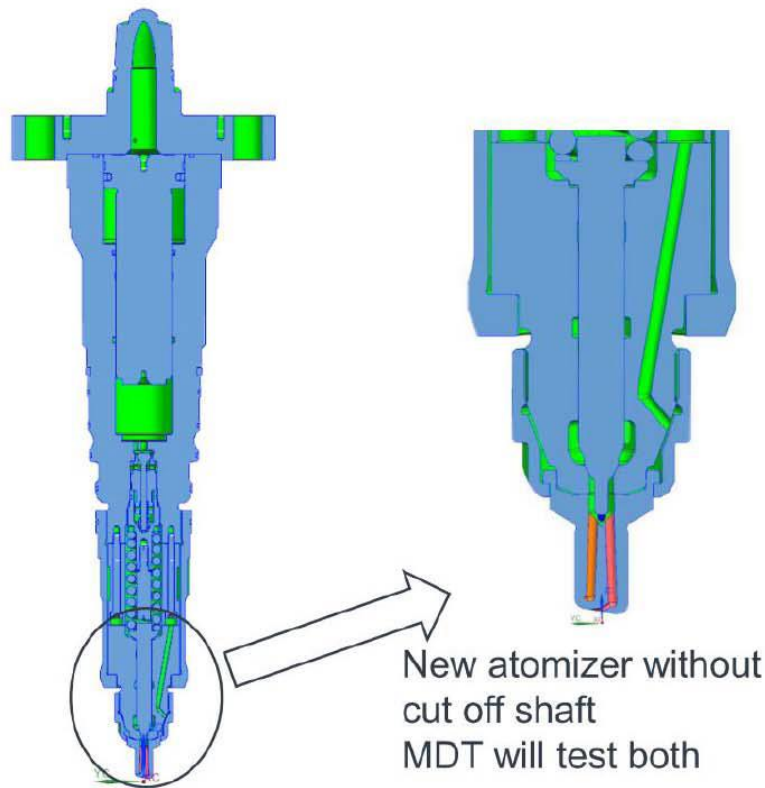
Cylinder cover -cut away

Fuel Booster Injection Valve Improved Design

FBIV-M (OLD)



FBIV-M (Mk.1.2)





Hyundai B&W 6G50ME-B9.3-LGI-M
Operational Experience

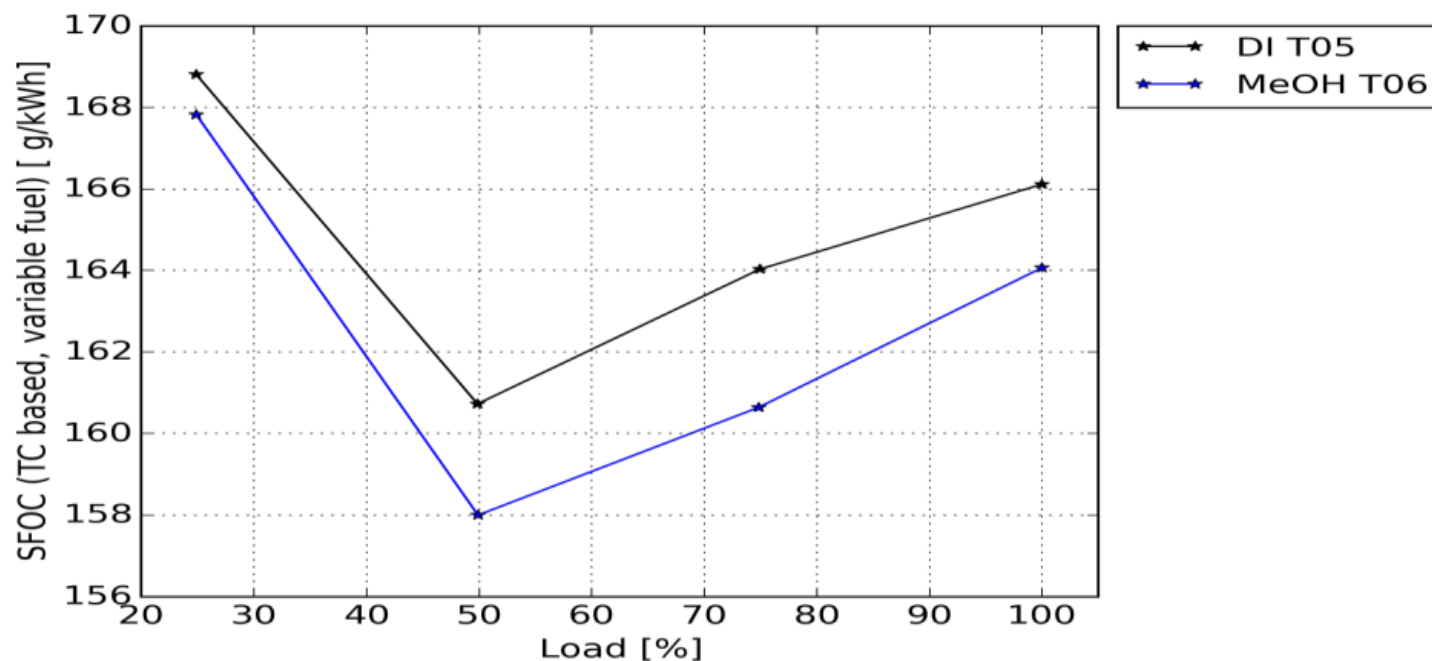


On the road to 32000 hours on methanol

Vessel	Mari Jone	Mari Boyle	Mari Couva	Mari Kokako
Total Engine RH	26 610	23 765	6 334	5 628
Total Engine RH on Methanol	15 129	14 341	1 049	1 464
Total Methanol Consumed	22 597	21 753	1 411	2 410



Efficiency



Average Price USD/MT

Methanol	\$245
HFO	\$297
VLSFO	\$351
MGO	\$418

Reference

<https://shipandbunker.com/prices#MGO>

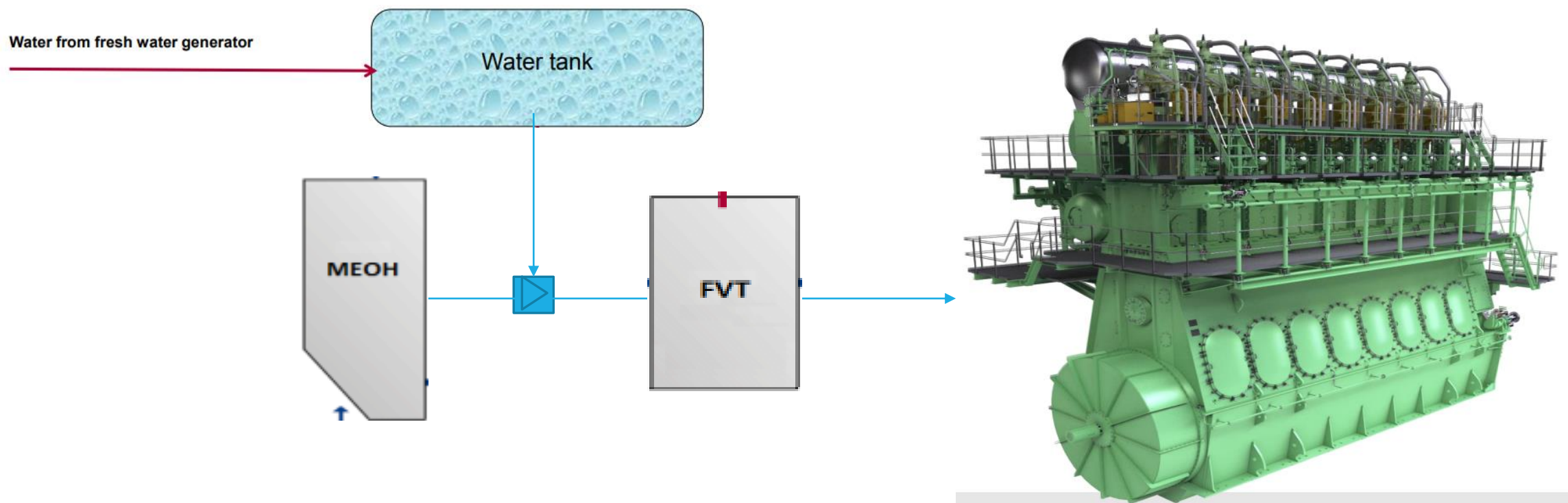
<https://www.methanol.org/methanol-price-supply-demand/>



2% lower consumption per kWh

MAN Diesel & Turbo

Tier III compliance using water blending





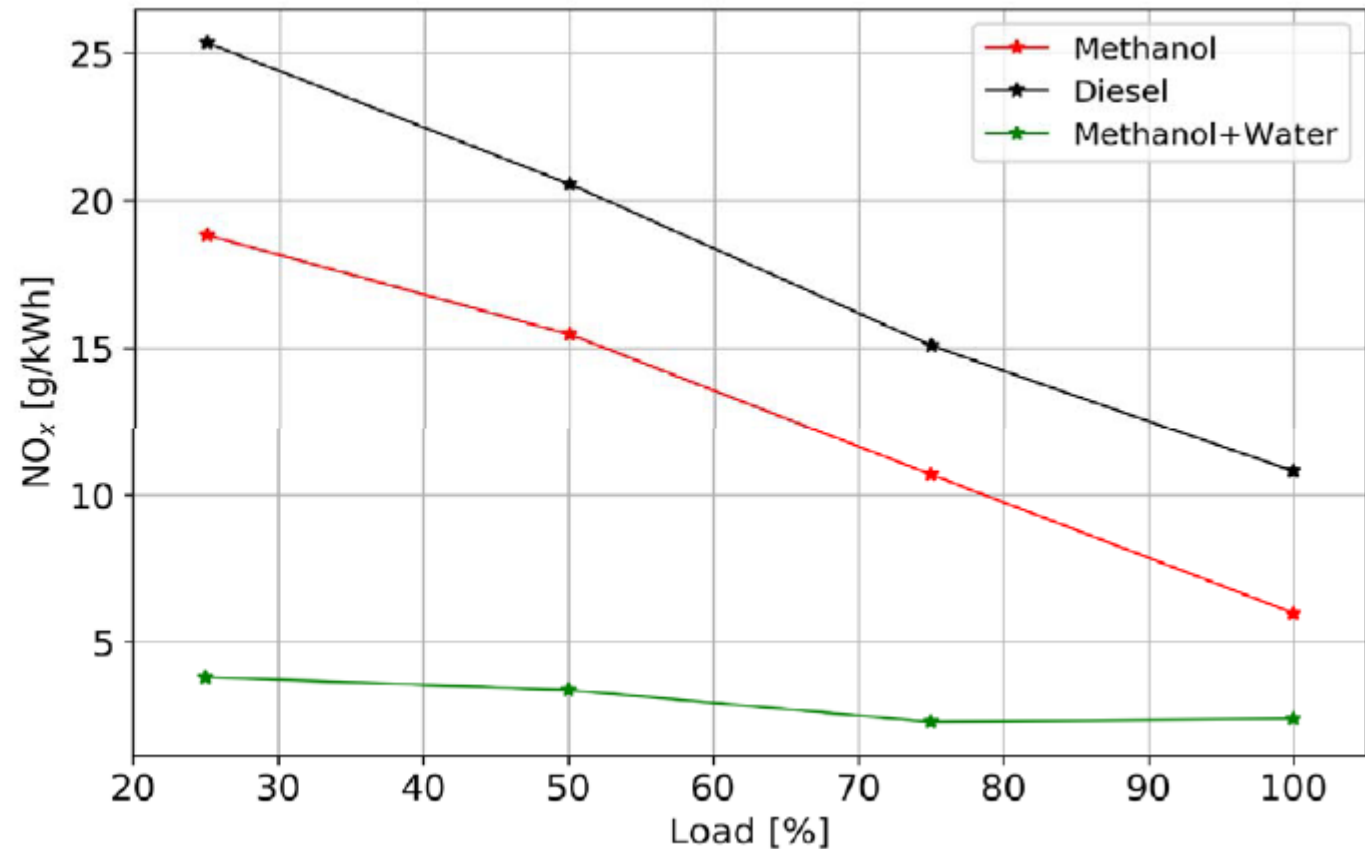
Methanol + Water

- Adding water to the fuel reduces the flame temperature due to vaporization cooling and addition of inert media.
- This reduces the engine out NOx emissions and can be used to meet IMO Tier-III NOx regulations for large two stroke diesel engines.
- Methanol has a lower combustion temperature than diesel, and thus lower NOx emissions, even without adding water.*
- Adding Water to Methanol is easy. The two mixes readily and do not separate in the system afterwards.
- The LGIM methanol system is capable of handling mixtures of Methanol and water without modifications.
- A diesel pilot is necessary to ignite the methanol and water mixture, as it is for pure methanol.



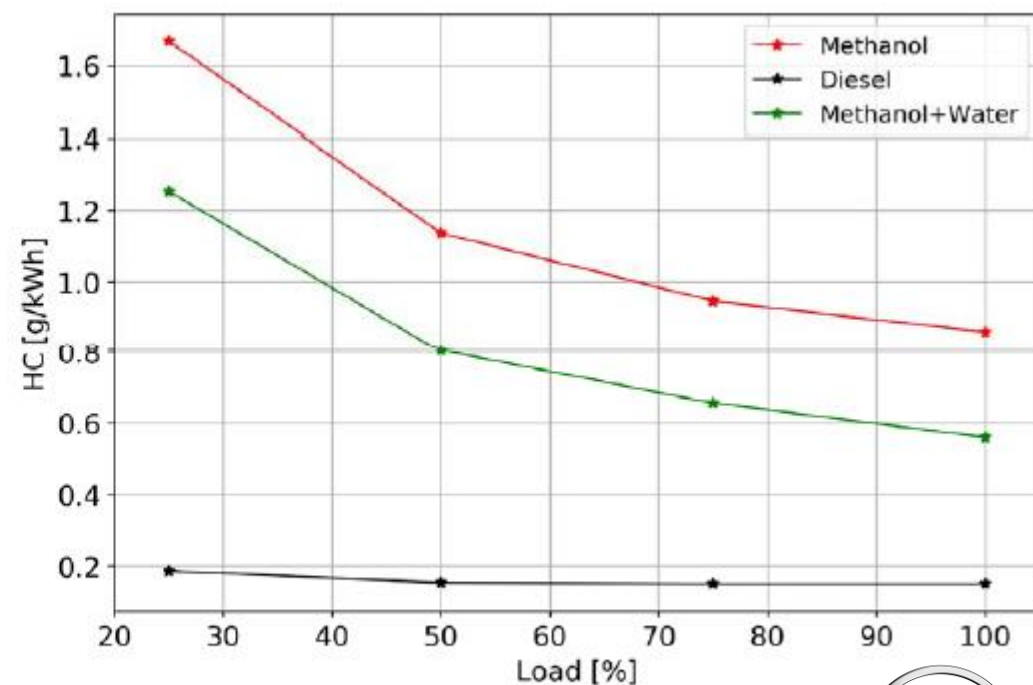
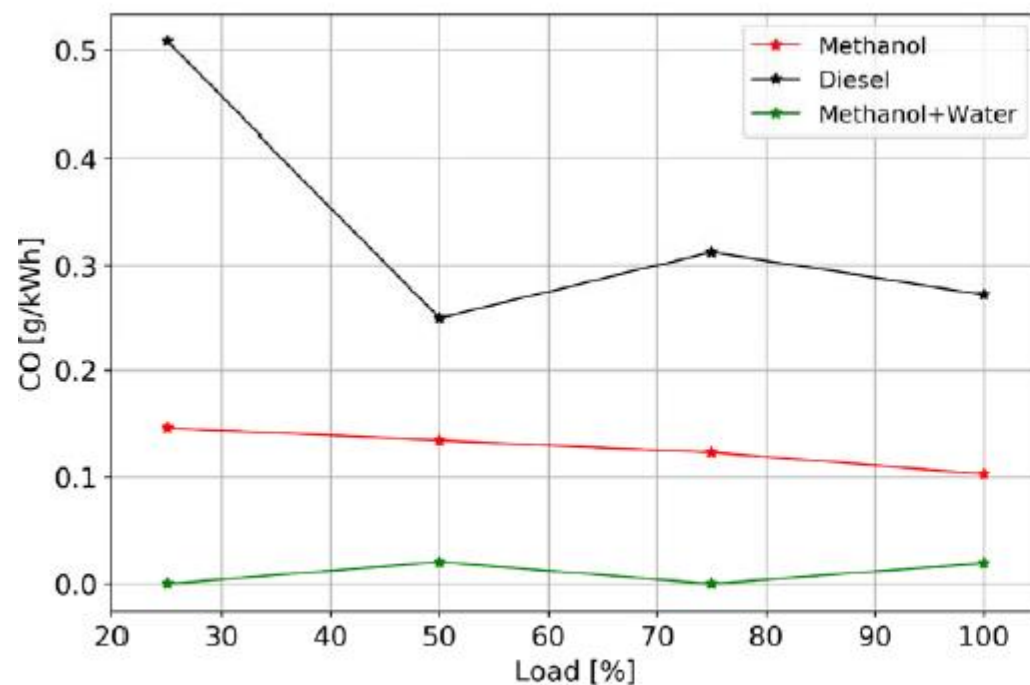
NO_x Emmission

The NO_x emissions are compliant with Tier-III limits for Methanol + Water.





CO & HC Emissions





Operating and bunkering



- Engine runs on HFO, LSFO, MGO and MEOH. Pilot fuel 3% required.
- Seamless switching
- Water mixing. Tier III compliant without SCR.
- No soot, improved efficiency.
- Bunkering as MGO bunkering
- No cryogenic infrastructure
- Methanol at ambient temperature is liquid, stable, clean and easy to handle



Cost competitive and future proof



- Dual fuel capex is offset by no SCR investment and running cost.
- Flexibility to run on the most cost competitive fuel where available.
- Methanol is already available in +80 ports worldwide. Existing bunker infrastructure can be used.

IMO 2020, 30 & 50 compliance



- IMO2020 compliant
- With a base or blend of green methanol the fuel will be 2030 and 2050 compliant, without further investment by Owner



Other Advantages with Methanol



Methanol Butterworthing

- ✓ Class approved procedure
- ✓ Significantly reduced cleaning time
- ✓ Eliminating TC fatigue to the crew
- ✓ Reduced commercial washing water and chemicals
- ✓ Eliminates the risks involved with Man tank entry for wall wash test as no longer needed.
- ✓ Used methanol will be burned as fuel = nothing overboard and no residues.



Summary: Methanol as Fuel



EASY TO TRANSPORT
AND AVAILABLE ALREADY
TODAY AT 88 PORTS



EASY TO STORE ON
BOARD. NO CRYOGENICS
INVOLVED.



PROVEN FUEL USED IN
TRANSPORTATION SINCE
1970



MINOR MODIFICATION
NEEDED COMPARED TO
OTHER ALTERNATIVE
FUEL



TIER III COMPLIANT
WITHOUT USE OF ECR
AND SCR



VARIED FEEDSTOCK
INCLUDING BIOMASS
AND RECYCLED CO2 FOR
FUTURE COMPLIANCE



Thank you! Questions?