

DAMEN SHIPYARDS “ECOLINER”



Co-financed by the European Union
Trans-European Transport Network (TEN-T)

DAMEN

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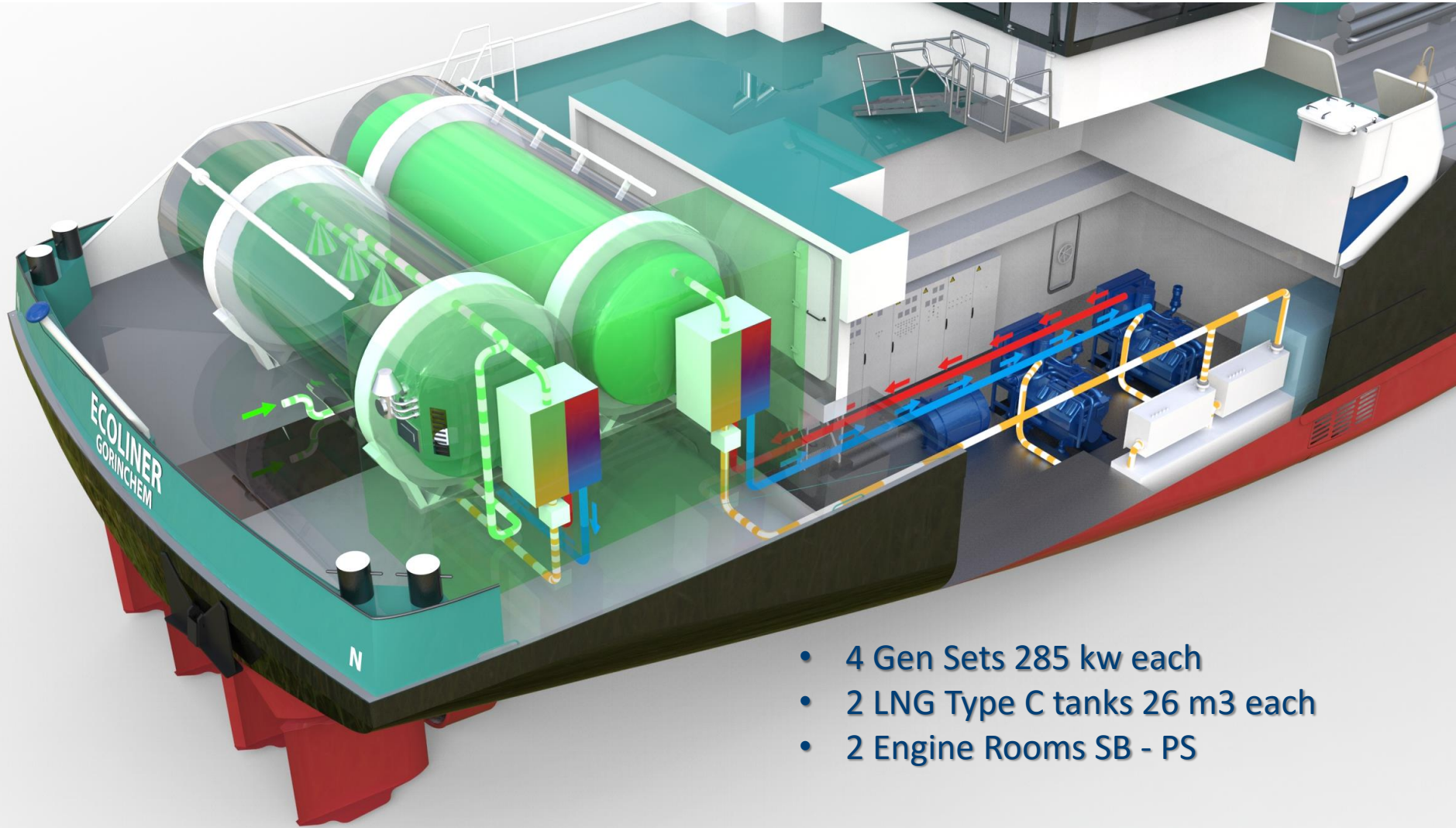
ECOLINER GOALS:

- Low Fuel Costs
- Low Emissions
- Low Operational Cost.

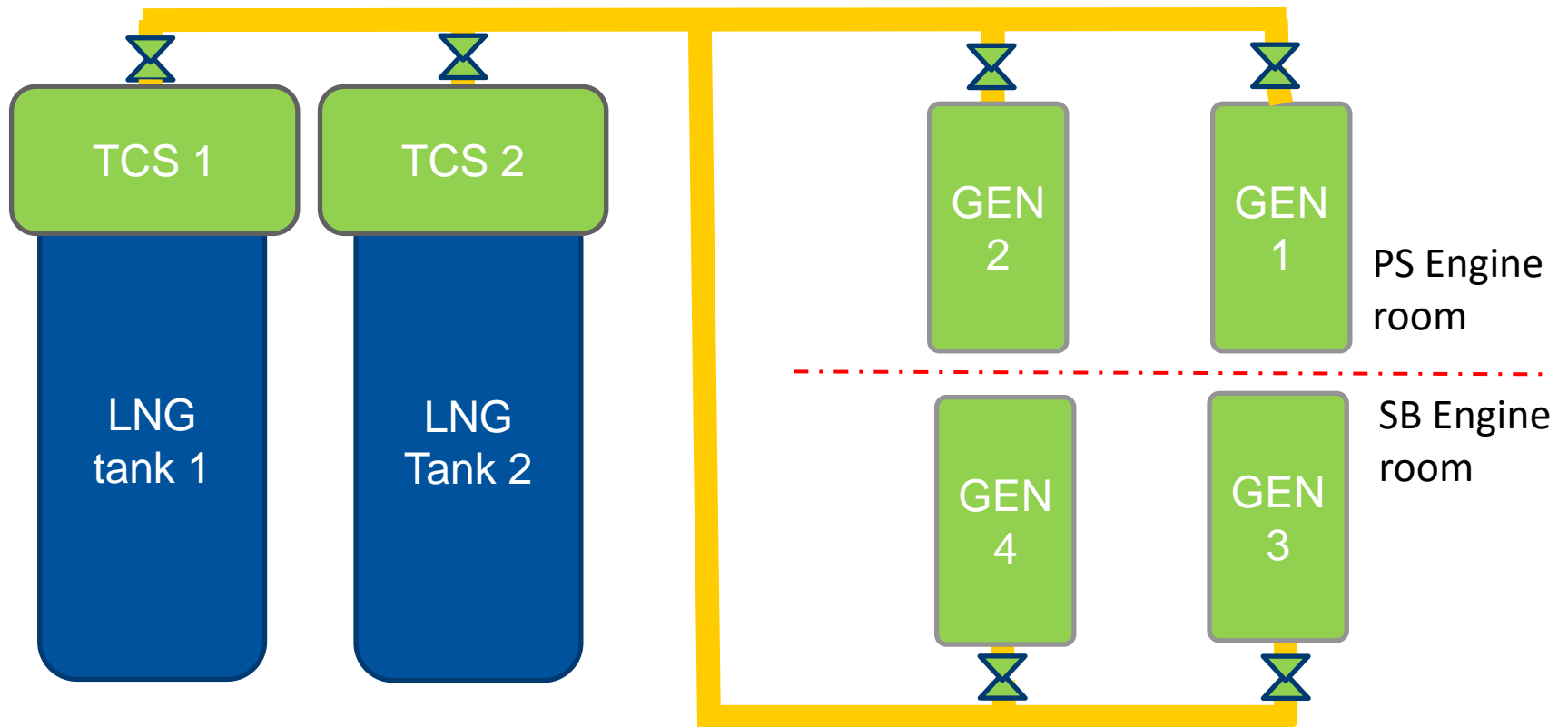
INNOVATIONS:

- 100% LNG Propulsion
- Air Lubrication
- Flex Tunnel (v/d Velden)
- DC system

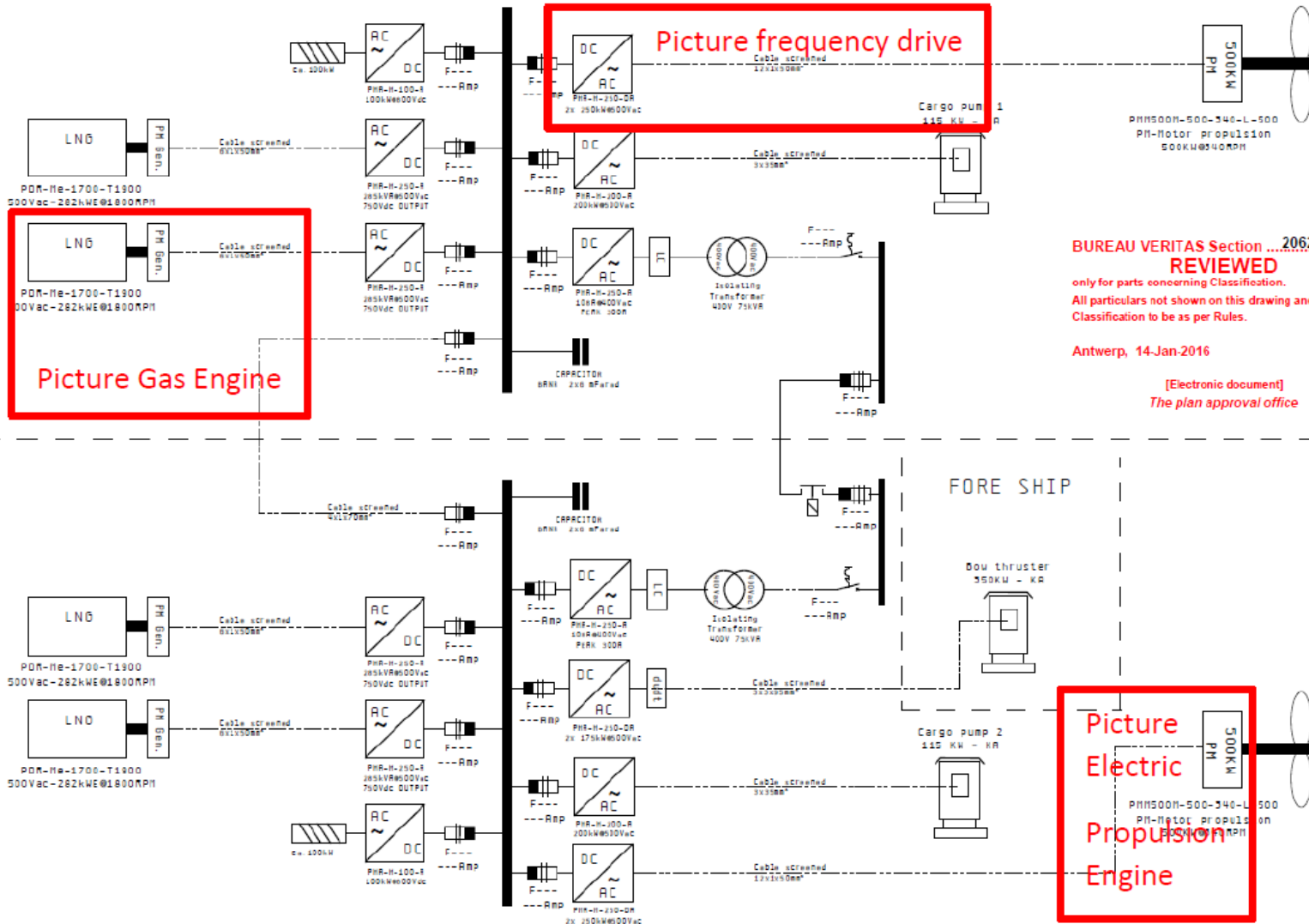




- 4 Gen Sets 285 kw each
- 2 LNG Type C tanks 26 m3 each
- 2 Engine Rooms SB - PS

Normal Operation

Normal operation LNG tank 1 supplies gen 1 and 2 with gas
LNG tank 2 supplies gen 3 and 4 with Gas.

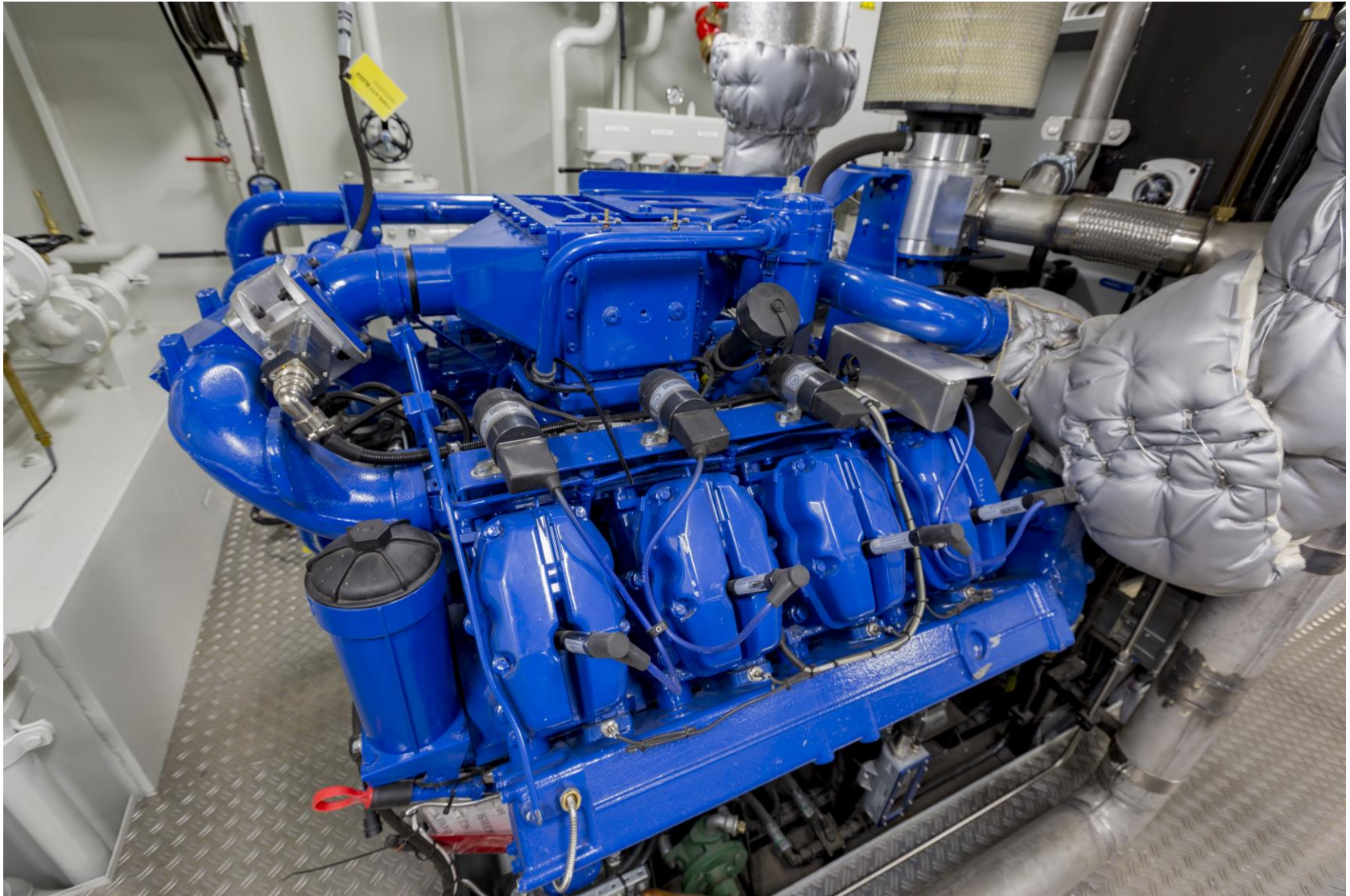


Picture Gas Engine

Picture frequency drive

BUREAU VERITAS Section ...20629A...
REVIEWED
 only for parts concerning Classification.
 All particulars not shown on this drawing and conc
 Classification to be as per Rules.
 Antwerp, 14-Jan-2016
 [Electronic document]
 The plan approval office

Picture
 Electric
 Propulsion
 Engine







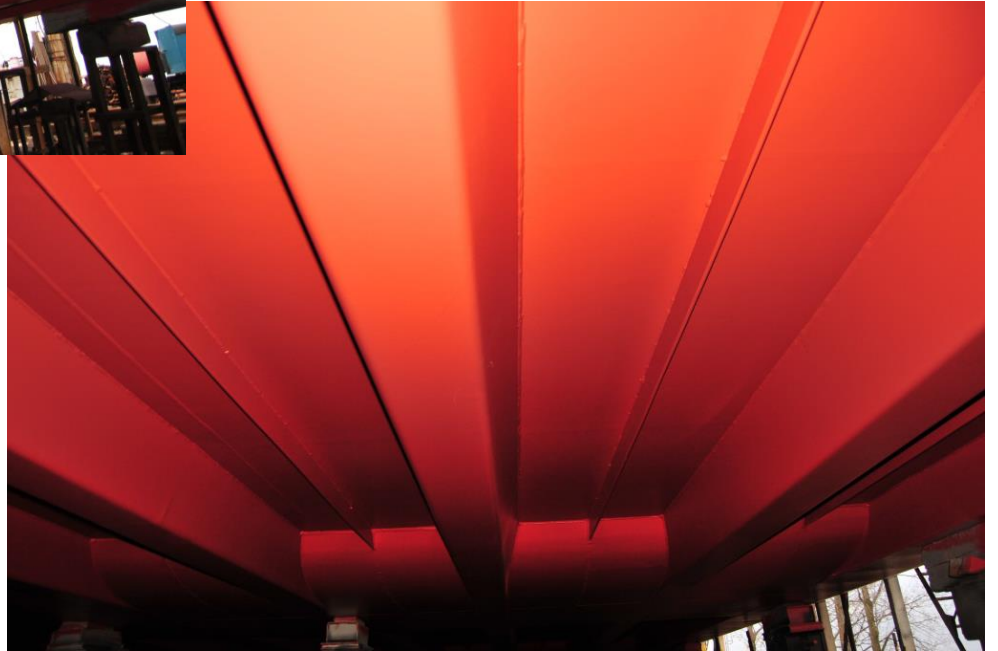
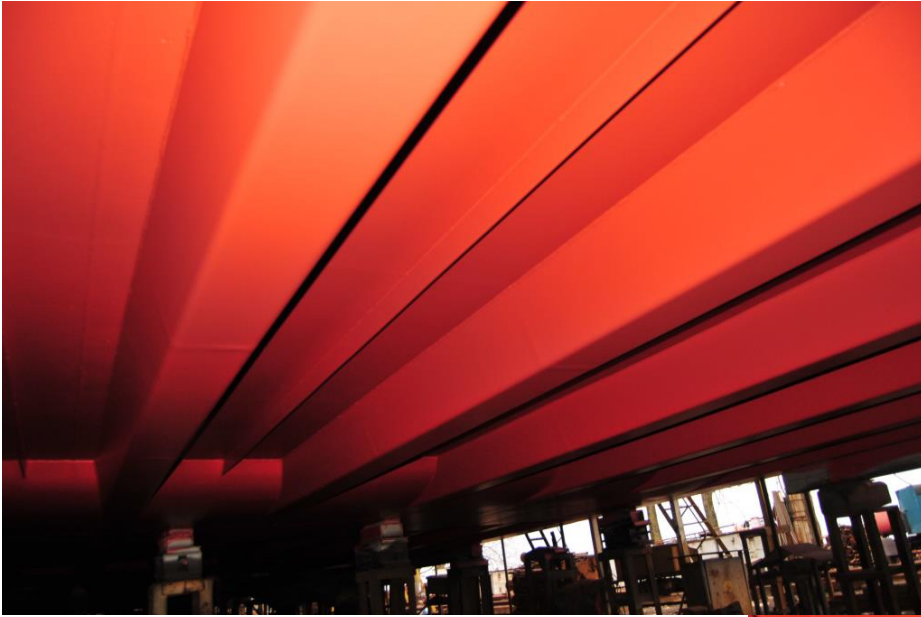






- 64 Air Chambers
 - 2 Air Blowers 5,5 kW 150 m³/hour
0,4 Bar.
- 10 % - 15% Reduction in Resistance.

AIR
LUBRICATION



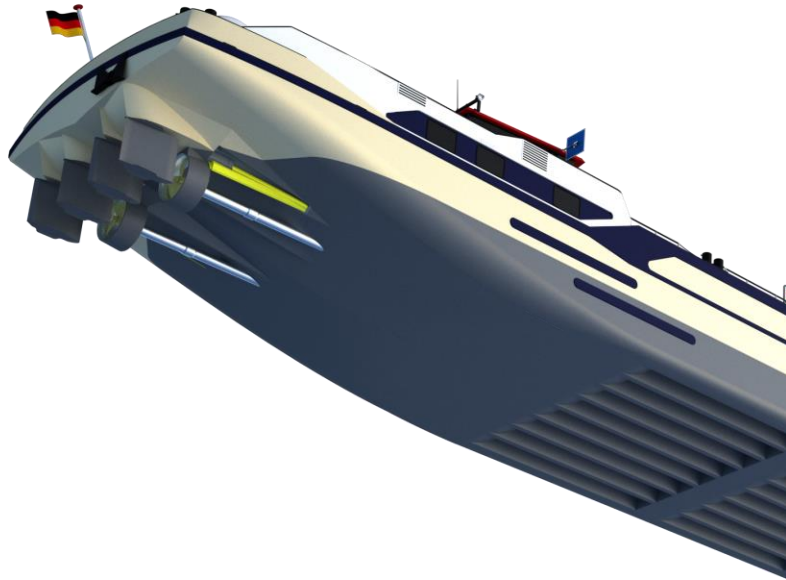


Original design:

- 2 thrusters Diam. 1200 mm

Disadvantage:

- Low efficiency due to small propeller size.
- Expensive repair in case of damage.



Final design:

- 2 Propellers in Nozzle Diam. 1500 mm
- Flextunnel
- Rudders

Results:

- 10% better than thrusters.



- First bunkering operation April 2016
- First Engine start May 2016
- Recommendation No. 9/2012 of the central commission for the Navigation of the Rhine, dated July 13th 2012.
- Ecoliner in operation since July 2016



Ecoliner out of service in October 2016:

Several serious problems:

- Several blackouts and unstable Generators.
- Ice in the Tank Connection Space
- Ice below the tank
- Ice below the aftdeck
- Knocking of the Scania Generator
- Explosion in the inlet manifold of the Generator.

Unsafe situation for the Crew in the Engine room and for the vessel in operation.!!

Ecoliner out of service and back to the yard october 2016.

Ice inside TCS



Ice below the tank



Ice on outside of LNG tank / inside ship



ENGINE EXPLOSION (INLET MANIFOLD DAMAGED)

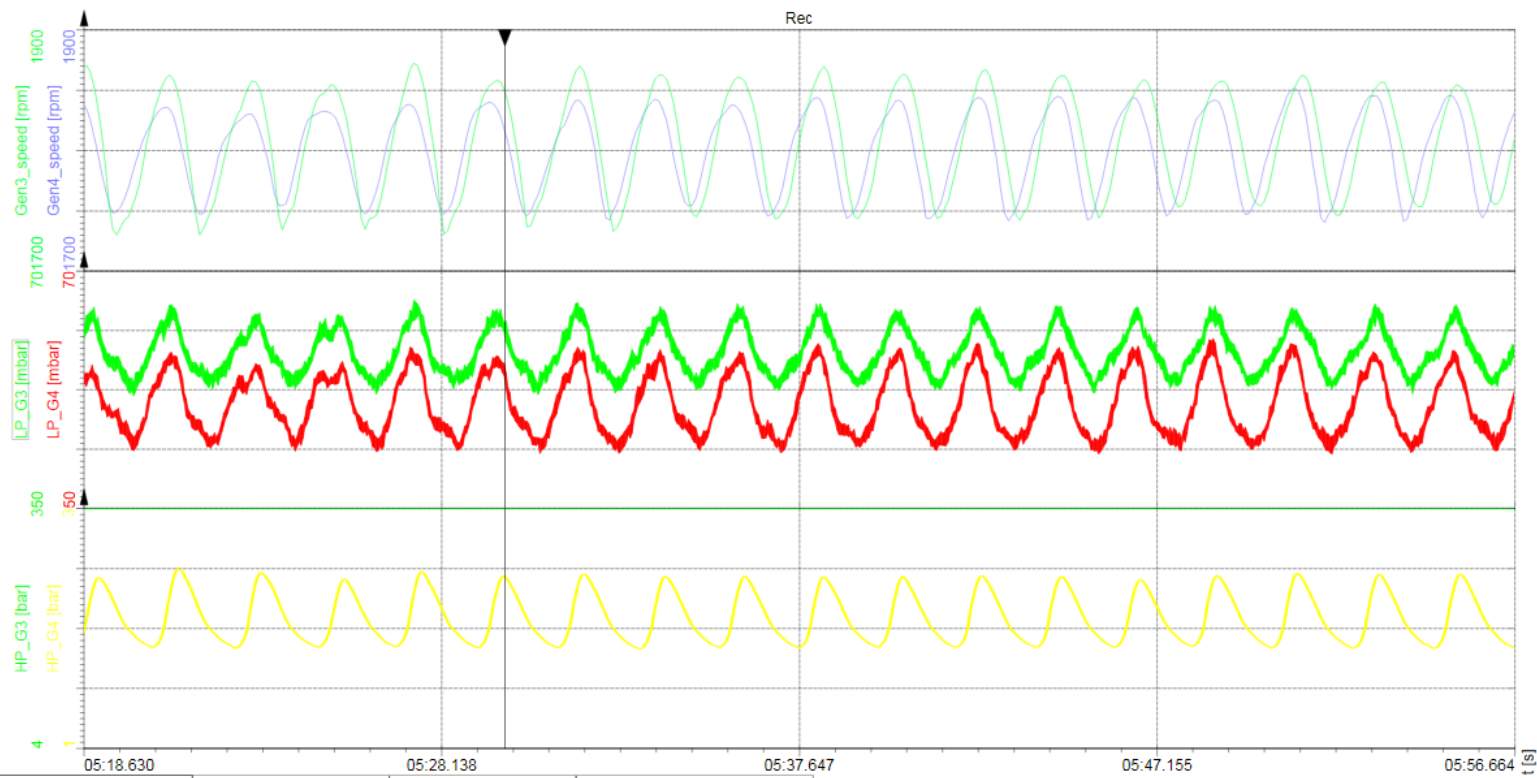
- LNG out of specification (pressure pulses)
 - Knocking
 - Inlet manifold explosion



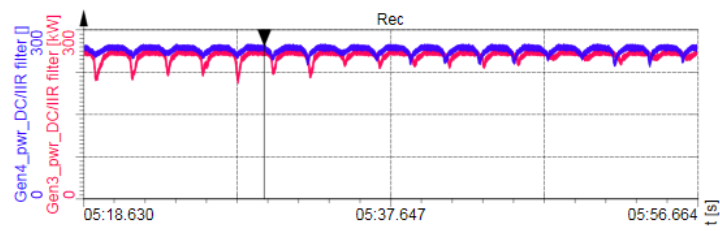
EXPERIENCES ECOLINER

Generators 3 and 4 - 100% Operation on liquid through evaporator

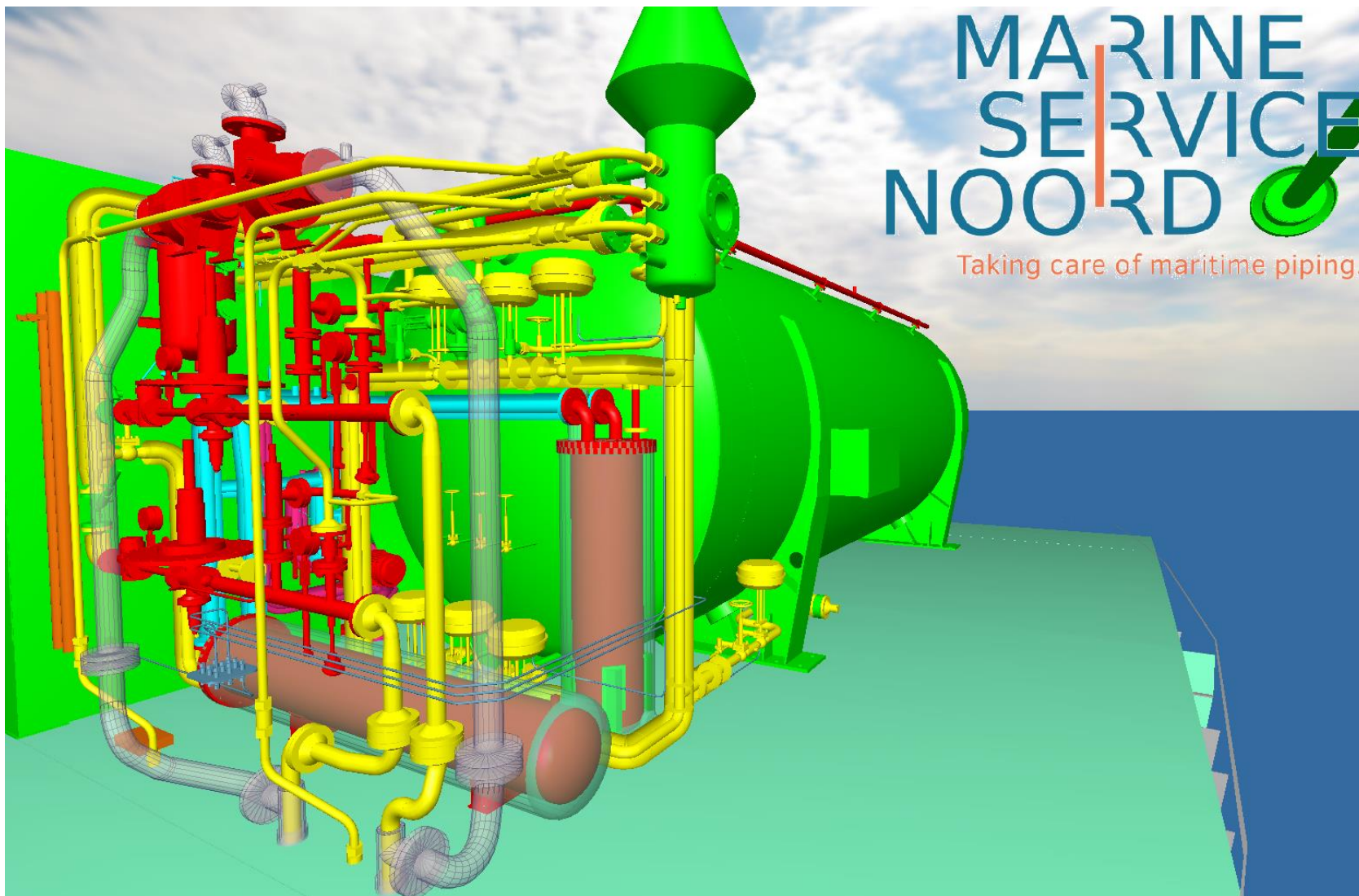
File name: Liq_evap_G3G4_d2.dxd
Date: 01/03/2017; Time: 10:59:09; Show time = 38.034 s f= 0.0263 Hz



LP_G4 [mbar] ACT	Gen4_pwr_DC [kW] AVE	Gen3_pwr_DC [kW] AVE	LP_G3 [mbar] ACT
62.1	268	259	65.6
HP_G4 [bar] ACT	Gen4_speed [rpm] ACT	Gen3_speed [rpm] ACT	HP_G3 [bar] ACT
2.44	1818	1851	2.44



EXPERIENCES
ECOLINER



MARINE SERVICE NOORD

Taking care of maritime piping.

DAMEN

LNG QUALITY (1ST LNG BUNKERING (APRIL 4TH 2016))

Ticket Datum/Ticket Date:		Ticket Tjld/Ticket Time:	
2016-04-04		06:21:30	
Composite/Composition (Mol %):			
Methane	89.818	mol %	
Ethane	7.941	mol %	
Propane	1.641	mol %	
i-Butane	0.197	mol %	
n-Butane	0.374	mol %	
n-Pentane	0.006	mol %	
i-Pentane	0.023	mol %	
neo-Pentane	0.000	mol %	
C6+	0.000	mol %	
Nitrogen	0.000	mol %	
CO2	0.000	mol %	
GCV (MJ/kg):	wt (Mz/Net):	Dens. (kg/m ³):	Temp. LNG (°C):
54.702	55.630	452.4	-159.7
Total energy loaded/Total energy loaded (MWh):			
182.340			
Weights before/Weight before loading:			
0.514/0.133 2834 22860 kg			
Weights after/Weight after loading:			
0.514/0.133 2834 34860 kg			

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SAMPLING AFTER APPROX. 2 MONTHS TOP CONSUMPTION

■ Gassample top

Calculations according to ISO6974		
Component	Mol%	U(abs)95%
Methane	85.377	0.124
Ethane	12.645	0.118
Propane	1.691	0.023

■ Gassample bottom 1

Calculations according to ISO6974		
Component	Mol%	U(abs)95%
Methane	15.003	0.832
Ethane	44.341	0.550
Propane	25.718	0.341
i-Butane	4.536	0.089
n-Butane	9.507	0.131

■ Gassample bottom 2

Calculations according to ISO6974		
Component	Mol%	U(abs)95%
Methane	13.688	0.869
Ethane	65.864	0.799
Propane	14.980	0.242
i-Butane	1.779	0.034
n-Butane	3.377	0.056

LNG Quality

Component	1st Bunkering 4th april 2016	After 2 months of Top Consumption		
	mol %	Gassample Top	Gassample bottom 1	Gassample bottom 2
Methane	89,818	85,377	15,003	13,688
Ethane	7,941	12,645	44,341	65,864
Propane	1,641	1.691	25,718	14,98
i-Butane	0,197		4,536	1,779
n-Butane	0,374		9,507	3,377

Conclusion:
No stable Gas quality !!!!

Results of unstable Gas quality!!!

- Knocking of Generators
- Damage to Cilinder heads



Results of unstable Gas quality!!!

- Knocking of Generators
- Damage to Pistons



Problems with the Tanks

Tank_1

- No gas trap(s) (Ice between tank and deck, even underneath deck)
- Holding time (>10 weeks \Leftrightarrow 0,5 bar/24h?)
- No tri cock (tank level reference (at max filling level))
- Filling connection (too small, long bunkering time)

Problems with the Tanks

Tank_2

- Not mounted properly (flex on one side) on deck
- Filling, PBU and consumption circuit mixed => Filling+PBU / consumption
- Press relief valves topside tank (2 pcs with 100% capacity each (service every 5 years))
- Tank sloshing (liquid on top)

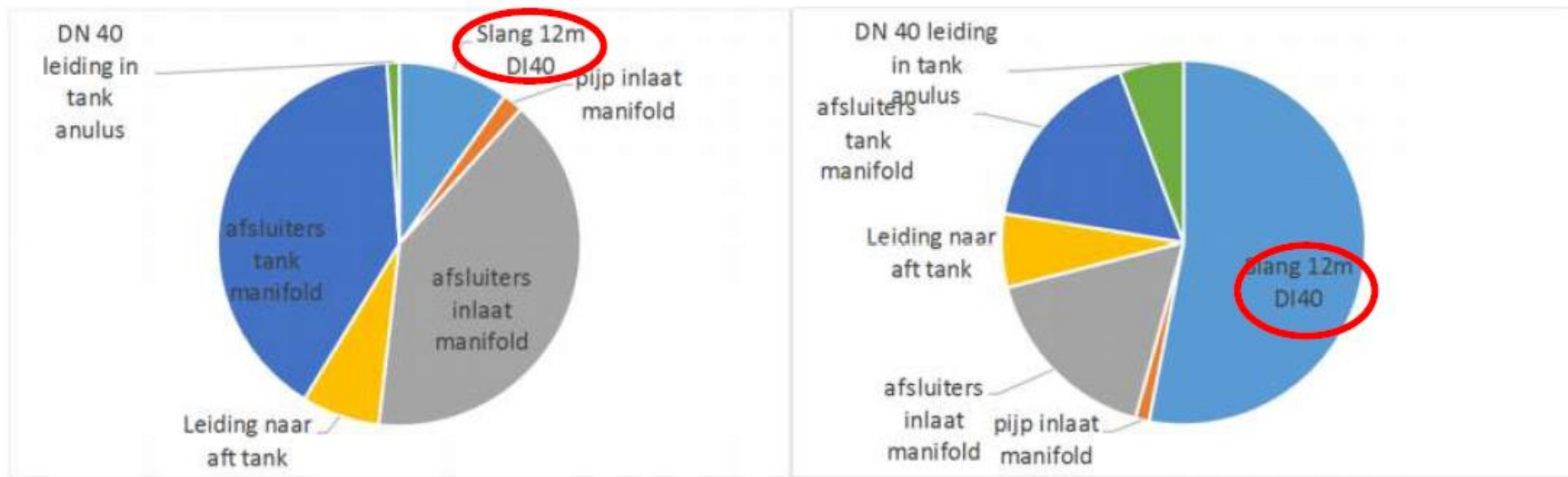
Major Improvements to be achieved at Ecoliner:

- Stable Gas Quality.
- Holdtime Storage Tanks
- Reduction of Bunkering time

How?

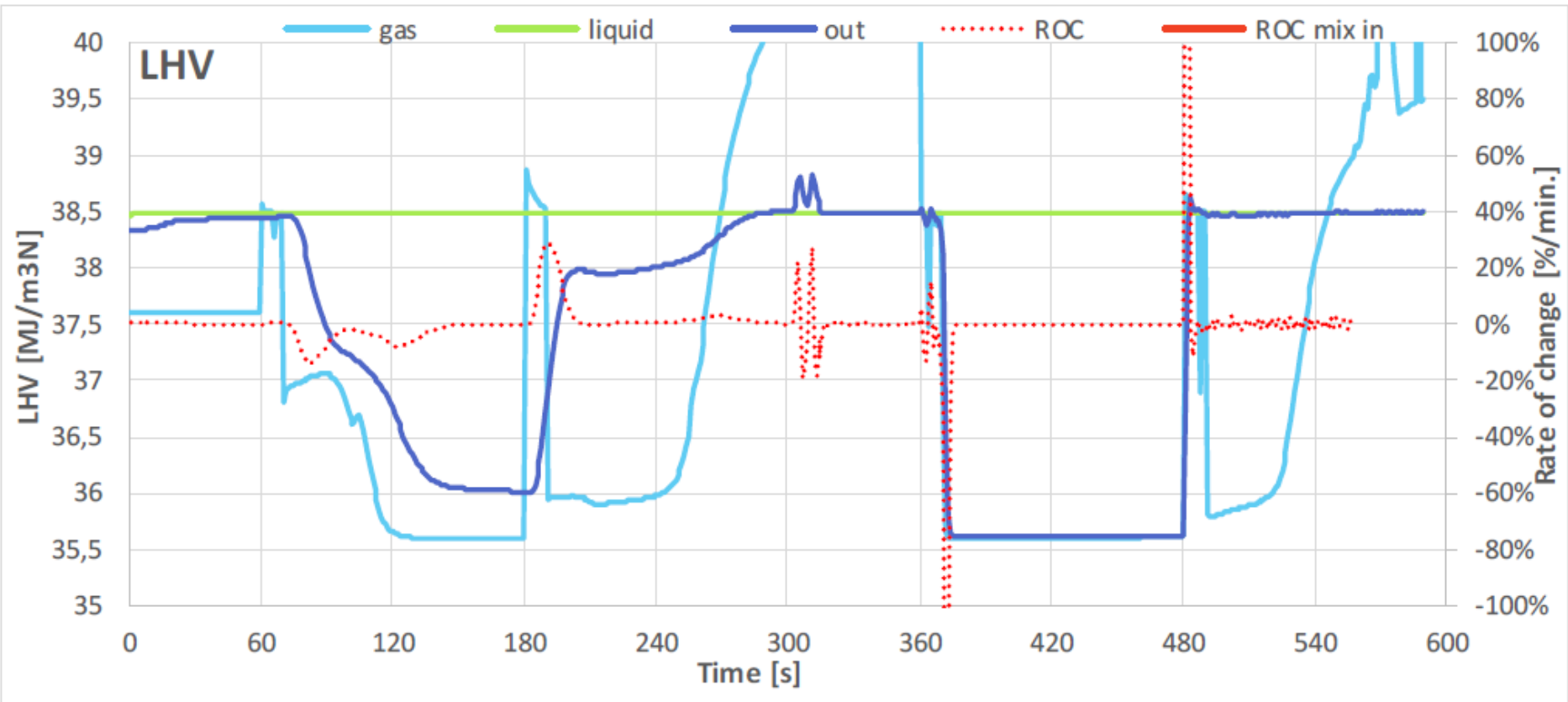
- Simulation of the system in a Computer Model. To understand and predict changes to the Gas system.

- Reduction of Bunkeringtime

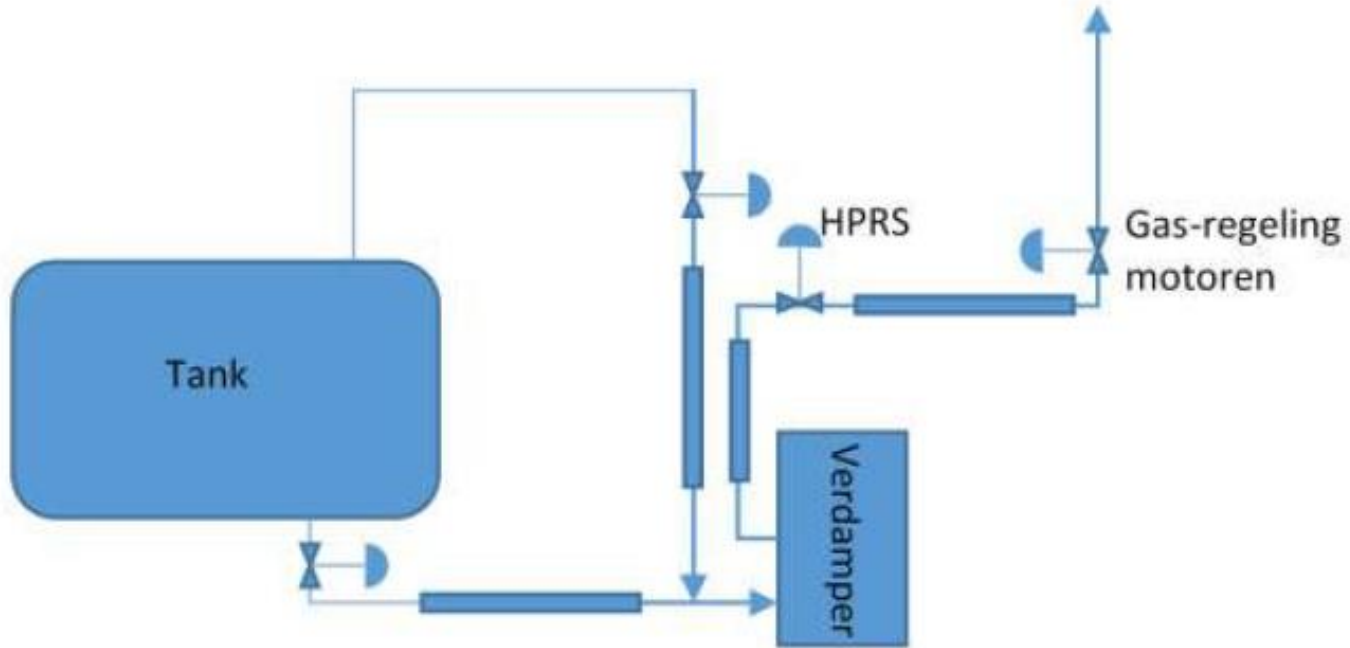


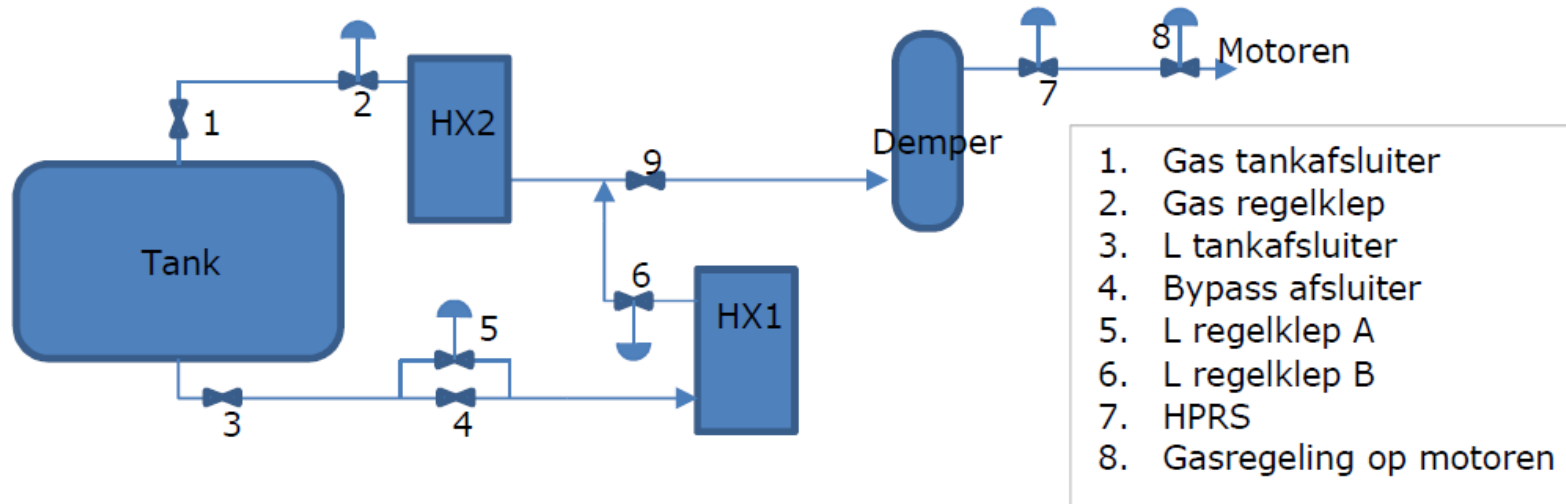
Shown is % of de bottlenecks

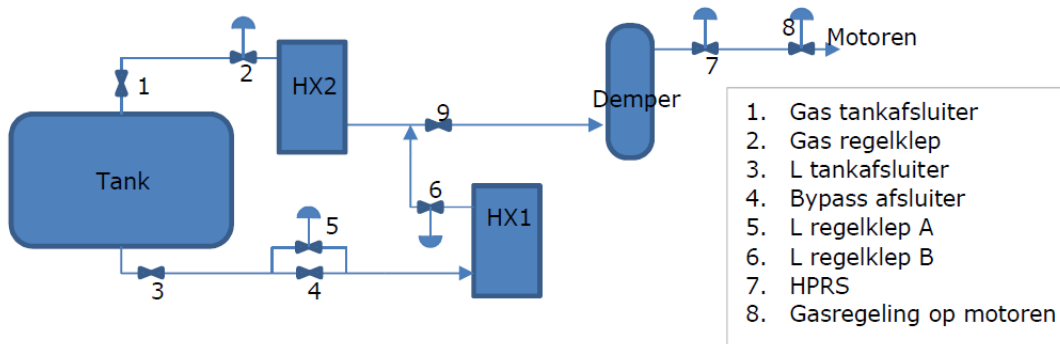
Model analyses of Lower Heating Value during operation
5% change per minute is the max for the generators



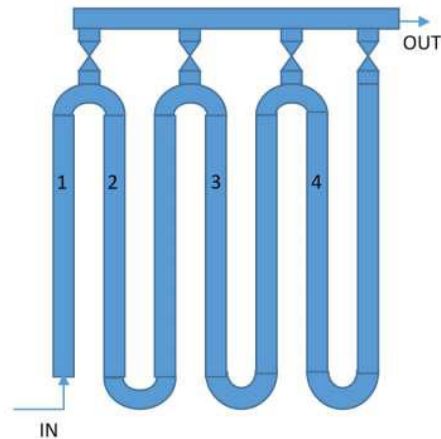
Actual system

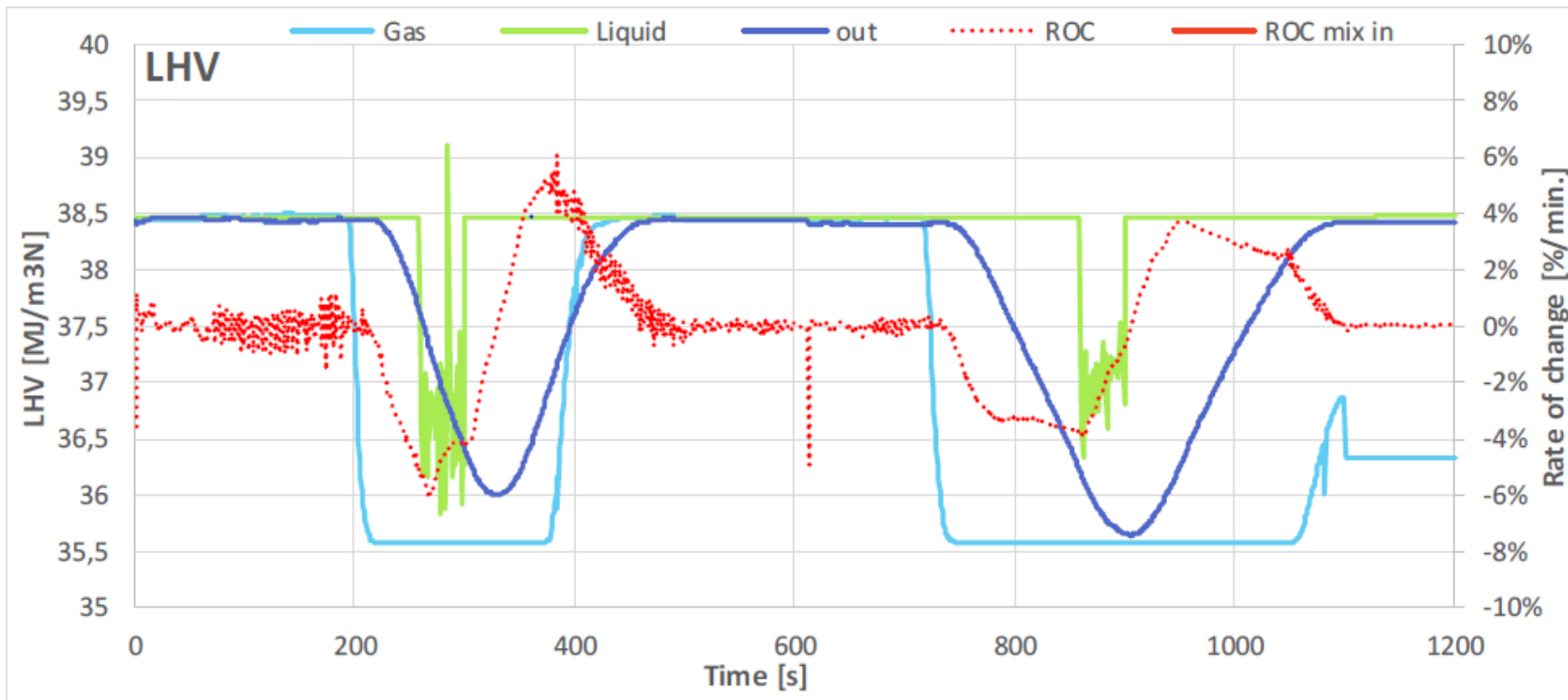






Demper





Planning:

- Conversion of the bottom outlet of the tank.
- Conversion of the Tank Connection Spance

Ready Mid 2018

It's not
easy being

GREEN



THANK YOU
FOR YOUR
ATTENTION



Co-financed by the European Union
Trans-European Transport Network (TEN-T)

