Technical Information Note

018

Launching X-DF2.0 with iCER technology

WinGD Engines: Selected Dual-Fuel Types

Date:	**2020-06-18**
Reference No.:	**21343/GLY101/TIN018**

1 Information

Ensuring continuous improvement of X-DF technology through reductions to both fuel consumption and methane slip in gas mode, WinGD is launching **X-DF2.0** technology with **iCER – Intelligent Control by Exhaust Recycling.**

iCER comprises an add-on system which delivers enhanced combustion control through the use of inert gas. **iCER** technology offers the following customer benefits:

- Reduction of energy consumption in gas mode by 3 %.
- Reduction of fuel consumption in diesel mode by up to 5 %.
- Reduction of methane slip up to 50 %.

Exhaust gas is returned to the cylinder in a low-pressure path while in gas mode. The gas is cooled and then mixed with scavenge air resulting in CO_2 partly replacing the oxygen in the fresh air, acting as an inert gas on the combustion. The amount of returned exhaust gas and the combustion are regulated in a closed loop control.

Please note that all current engines will remain within the WinGD portfolio, however the inclusion of **iCER** in the engine order designates the engine as **X-DF2.0**.

2 iCER System Description

The iCER is designed to cool and recirculate part of the exhaust gas through a low-pressure path during operation in gas mode. Compared to a high-pressure path the main benefit is the ability to use the full turbocharger capacity. It is possible to recirculate exhaust gas up to a maximum rate of 50 % mass flow. This is handled through a system adjacent to the engine that circulates part of the exhaust gas after the turbine, through an exhaust gas cooler (EGC) to the compressor inlet. The exhaust gas and the fresh air are mixed before entering the compressor wheel of the turbocharger.

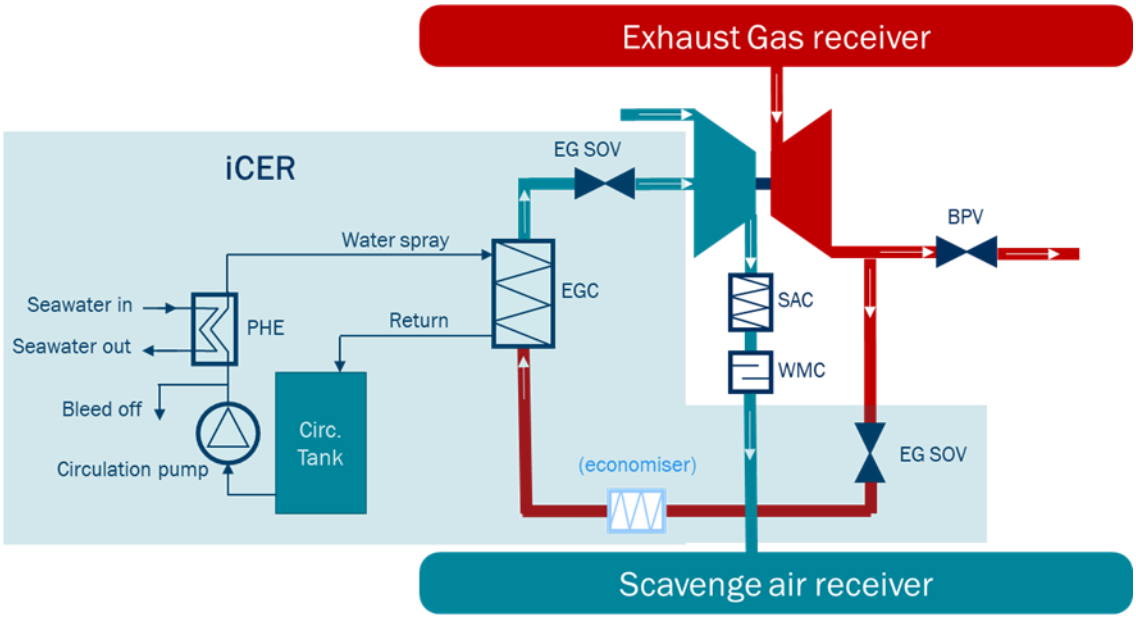


Figure 1: System overview

Abbreviation explanation:

BPV	Back Pressure Valve	EGC	Exhaust Gas Cooler
SOV	Shut Off Valve	SAC	Scavenge Air Cooler
EG	Exhaust Gas	WMC	Water Mist Catcher
PHE	Plate Heat Exchanger		

2.1 Arrangement

The iCER system is placed close to the engine as a stand-alone arrangement. An exhaust gas cooler and demister are installed as part of the system. The cooling process reduces the temperature of the exhaust gas to below its dew point of ~40 °C. Below the dew point water starts to condense out of the exhaust gas which leads to excess water in the system. This is beneficial to avoid an increase of acidity in the recirculated water.

The water used for cooling the exhaust gas is recirculated fresh water, stored in a circulation tank. The recirculated fresh water used in the EGC is cooled by sea water via a plate heat exchanger.

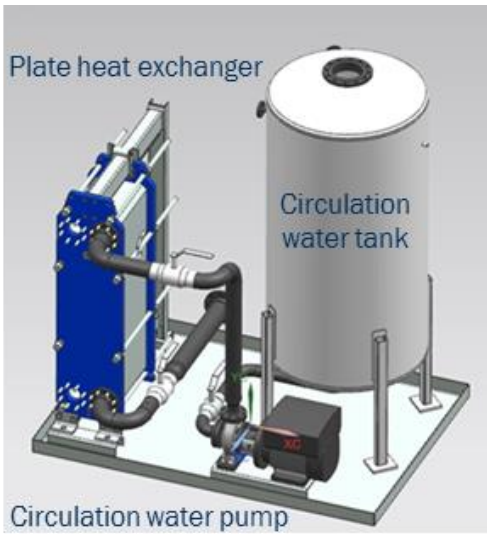


Figure 2: Example of circulation water tank, pump and plate heat exchanger (Source: Alfa Laval)

The excess water generated by cooling the exhaust gas below its dew point is discharged to a drain tank and monitored continually by an oil content meter.

Within this development phase, the iCER is operated only in gas mode so the oil content in the bleed water is compliant for direct discharge to the sea.[1]

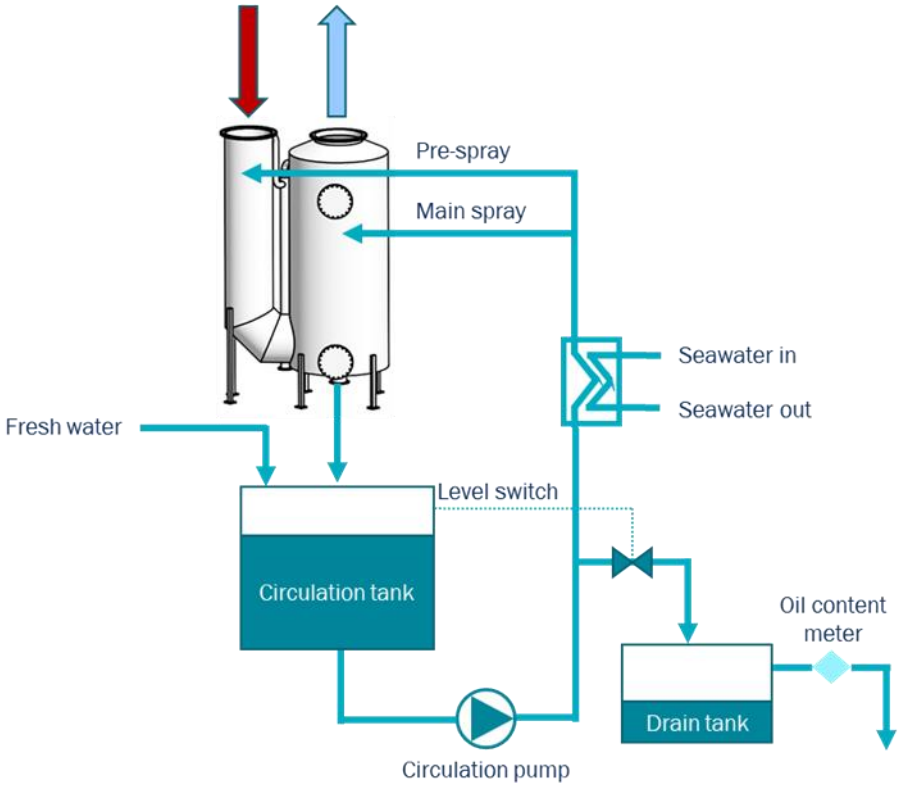


Figure 3: Arrangement of EGC, circulation water and drain

[1] The oil content meter must be approved in accordance with Annex 3 of Resolution MEPC 307(73). This IMO regulation describes the conditions the bleed water must meet prior to discharge to the sea.

2.2 Waste Heat Recovery

To increase the total steam production, an optional economiser can be placed on the top of the jet tube of the EGC. By applying a small economiser, the energy of the recirculated exhaust gas can be used. The economiser can be connected directly to the steam line.

The outlet temperature could be lowered to below 160-170 °C because the exhaust gas is essentially sulphur free (iCER is active only in gas mode).

Figure 4: Arrangement of micro economiser (Source: Alfa Laval)

The tests and simulations with iCER technology show increased exhaust gas temperatures. In combination with the installation of a small economiser as shown above the total steam production is expected to increase compared to standard X-DF engines.

3 Development Status

The iCER initial test phase on WinGD's RTX-5 dual-fuel test engine allowed the complete system to be commissioned and tested under a variety of different applicable conditions to assess the capabilities of the system in terms of performance, reliability and robustness. The final test phase for optimisation of the system parameters will be concluded by the end of Q2 2020.

The specification containing the requirements, boundaries and limitations of the relevant system components is in preparation and will be finished by the end of Q3 2020.

4 Portfolio Rollout

iCER will be rolled out to the X-DF engine portfolio after completion of the development phase at the end of Q3 2020. It is an off-engine solution and WinGD will provide the required specifications to enable engine builders to select components from approved suppliers according to WinGD's parts sourcing procedure.

4.1 Introduction Timeline

(MIM = Marine Installation Manual, GTD = General Technical Data)

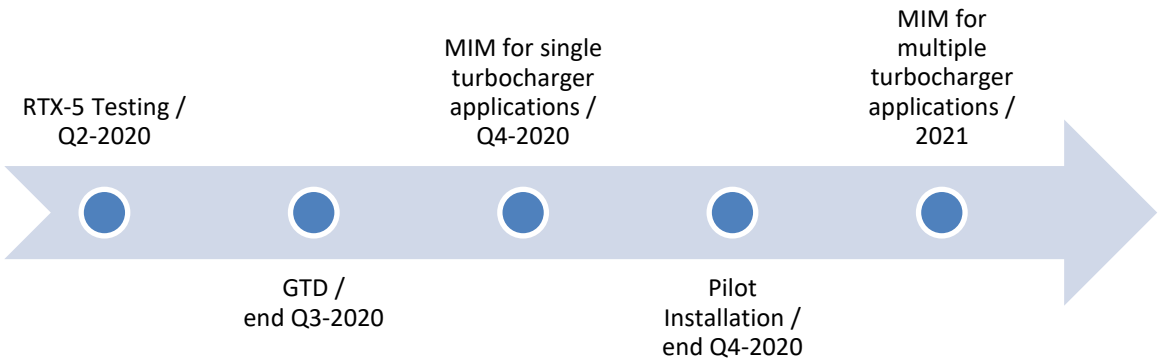


Figure 5: Introduction timeline

Following the release of this TIN and based on the above introduction timeline the first engine delivery with iCER can be expected approximately 12 months after engine order.

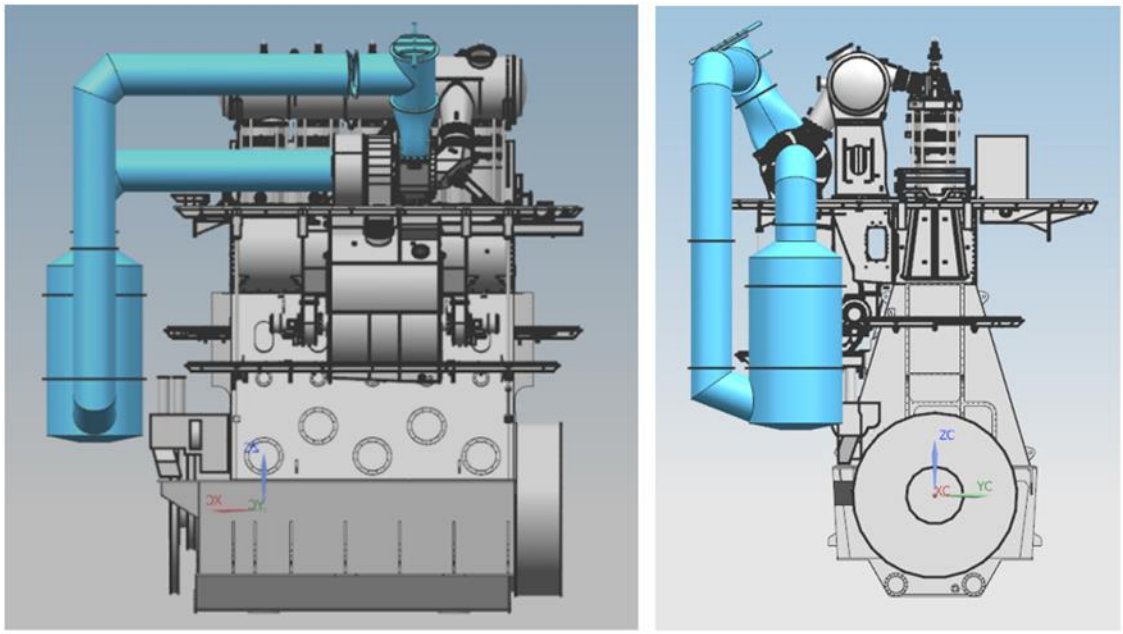
4.2 GTD Data

GTD data for X-DF engines with iCER will be published end of Q3 2020. Until then, to estimate the appropriate size of the EGC (Exhaust Gas Cooler) required for potential projects the total turbine flow shown in current GTD versions for X-DF engines can be used.

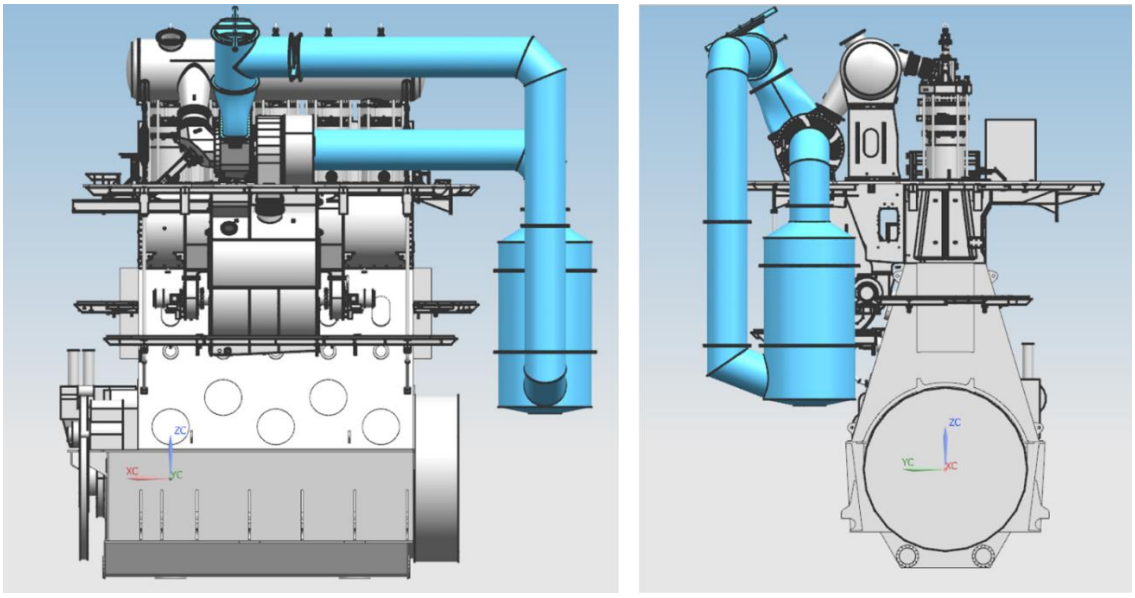
Appendix A - Preliminary Additional Information

A.1 System Arrangement Examples

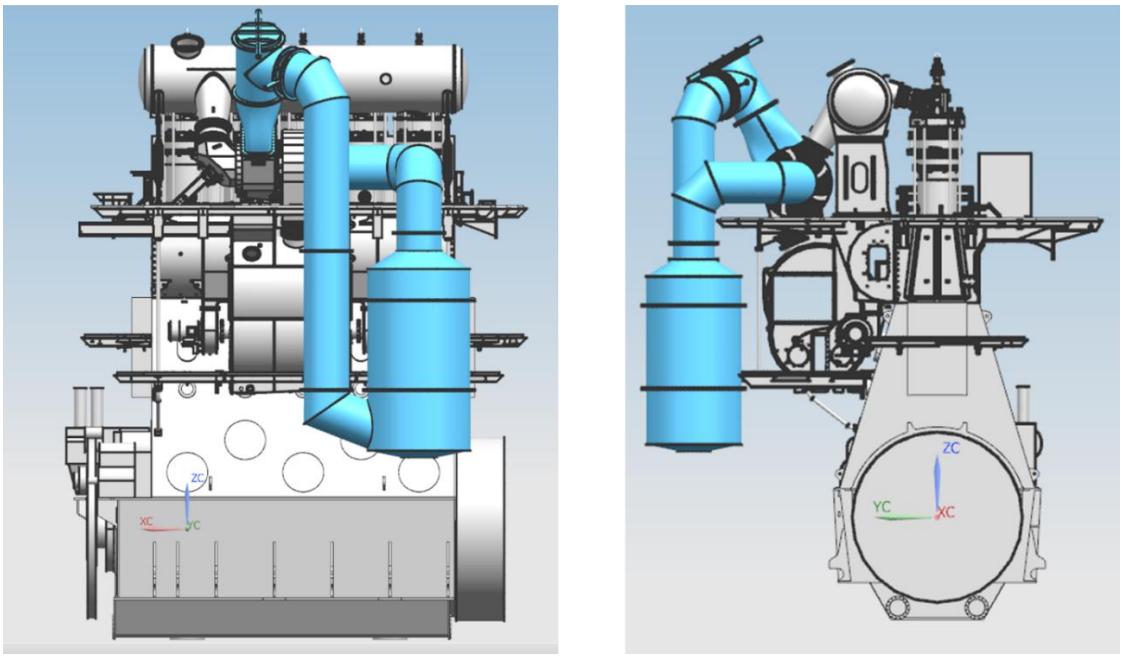
The below 3D images show examples of how the EGC (Exhaust Gas Cooler) can be arranged close to the engine. These images are only for illustration purposes because the final arrangement will depend on the available space in the engine room based on the vessel design. The images do not reflect all the details of the system pending completion of the system's component specification.



EGC at driving end



EGC at free end



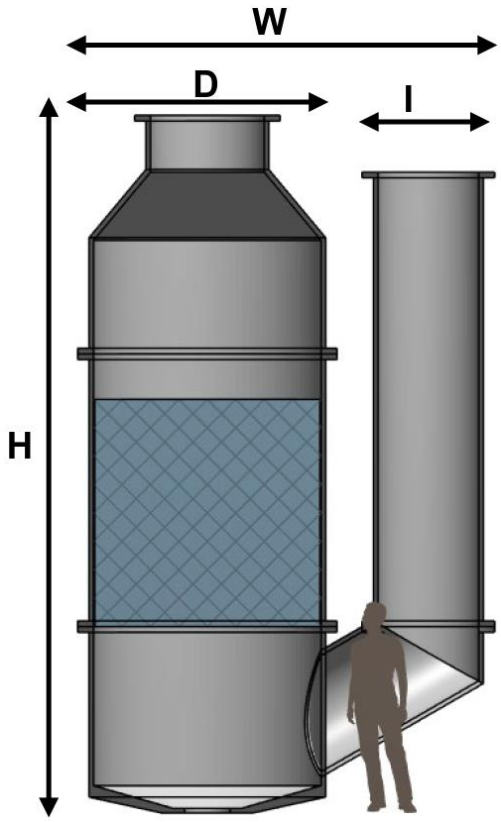
EGC at exhaust side

A.2 Exhaust Gas Cooler (EGC) Overview and Estimated Dimensions

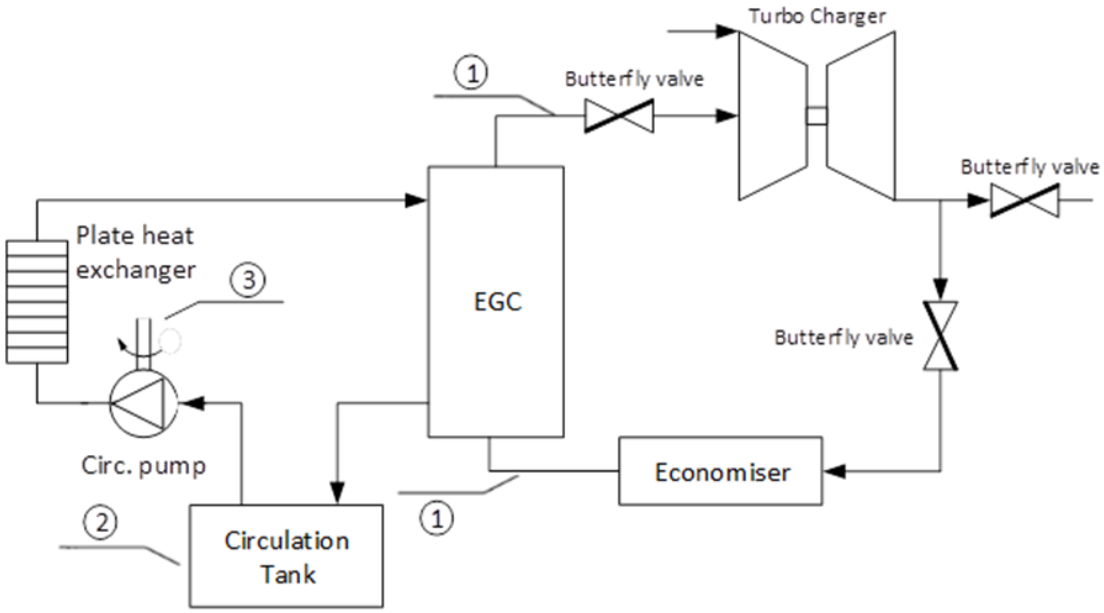
The main hardware of the iCER system consists of the EGC, circulation tank, plate heat exchanger and (optional) micro economiser. The table below provides an overview and estimated dimensions of the planned EGC sizes from the initial approved supplier (Alfa Laval) that cover the X-DF portfolio. The EGC size can be selected by the engine builder based on the turbine flow from GTD.

Table 1: EGC overview and estimated dimensions

Exhaust Gas flow engine (Turbine flow from GTD) [kg/s]		11.5 - 14.4	14.4 - 18.3	18.3 - 22.8	22.8 - 30	30 - 38.3	38.3 - 51.2
EGC size #		**EGC 14**	**EGC 18**	**EGC 23**	**EGC 30**	**EGC 38**	**EGC 51**
EGC absorber diameter [mm]	D	1600	1800	2000	2300	2600	3000
EGC flange size [DN]	I	700	800	900	1000	1200	1400
EGC height [mm]	H	4400	5000	4800	5500	5800	6300
EGC width [mm]	W	2800	3100	3500	3700	4300	5200
Weight wet [kg]		2600	3200	3780	4600	5600	7100
Pipe diameter [DN]	1	700	800	900	1000	1200	1400
Circulation tank size [m³]	2	3.0	3.0	5.0	5.0	8.0	8.0
Circulation pump [kW]	3	18	23	26	43	39	52



(Source: Alfa Laval)



The numbers in the above schematic refer to the corresponding size of the items shown in Table 1.

A.3 iCER Part List

Table 2 provides a preliminary overview of the parts required for the iCER system. The approved suppliers will be informed when the requirement specifications are completed.

Table 2: Part list

System	Parts	Supplier
Exhaust cooling unit	Exhaust gas cooler (EGC): • Filling material • Demister • Spray nozzles quench • Spray nozzles absorber • 2 x compensators (inlet/outlet)	Approved supplier
Circulation water system	Circulation tank with: • Water level measurement • Automatic drain (with or without pump) 2 x circulation water pump: • Frequency drive (VFD) for circulation pumps	Approved supplier
Circulation water cooling	• Plate heat exchanger for circulation water cooling • Sea water temperature control valve	Approved supplier
Miscellaneous	• Control System with HMI (PLC by EGC approved supplier) • Valves, sensors and transmitters • Nuts, bolts and gaskets	Approved supplier
Piping	• Piping from exhaust gas pipe to iCER plant (material same as exhaust duct)) • Piping from EGC to TC-silencer (Inox or coated steel) • Compensator with inner protection tube (connection to TC silencer) • Shut-off valve before quench section • Shut-off valve before TC-silencer • Controlled back-pressure valve	Shipyard Shipyard Engine builder Approved Supplier Approved Supplier Approved Supplier Approved Supplier
Electrical	• Cabling according PID	Shipyard
Sea water pump	• 2 x sea water pumps	Shipyard
Bleed water	• Bleed water tank • Bleed water monitoring	Shipyard
Engine Control	• Automation hardware and software	WinGD
Turbocharger connection	• Connection piece to turbocharger compressor inlet **Note**: No additional forces are allowed on the engine platforms from external equipment.	TC maker
Waste Heat Recovery (Optional)	• Economiser for recirculated exhaust gas before quench section	Approved supplier