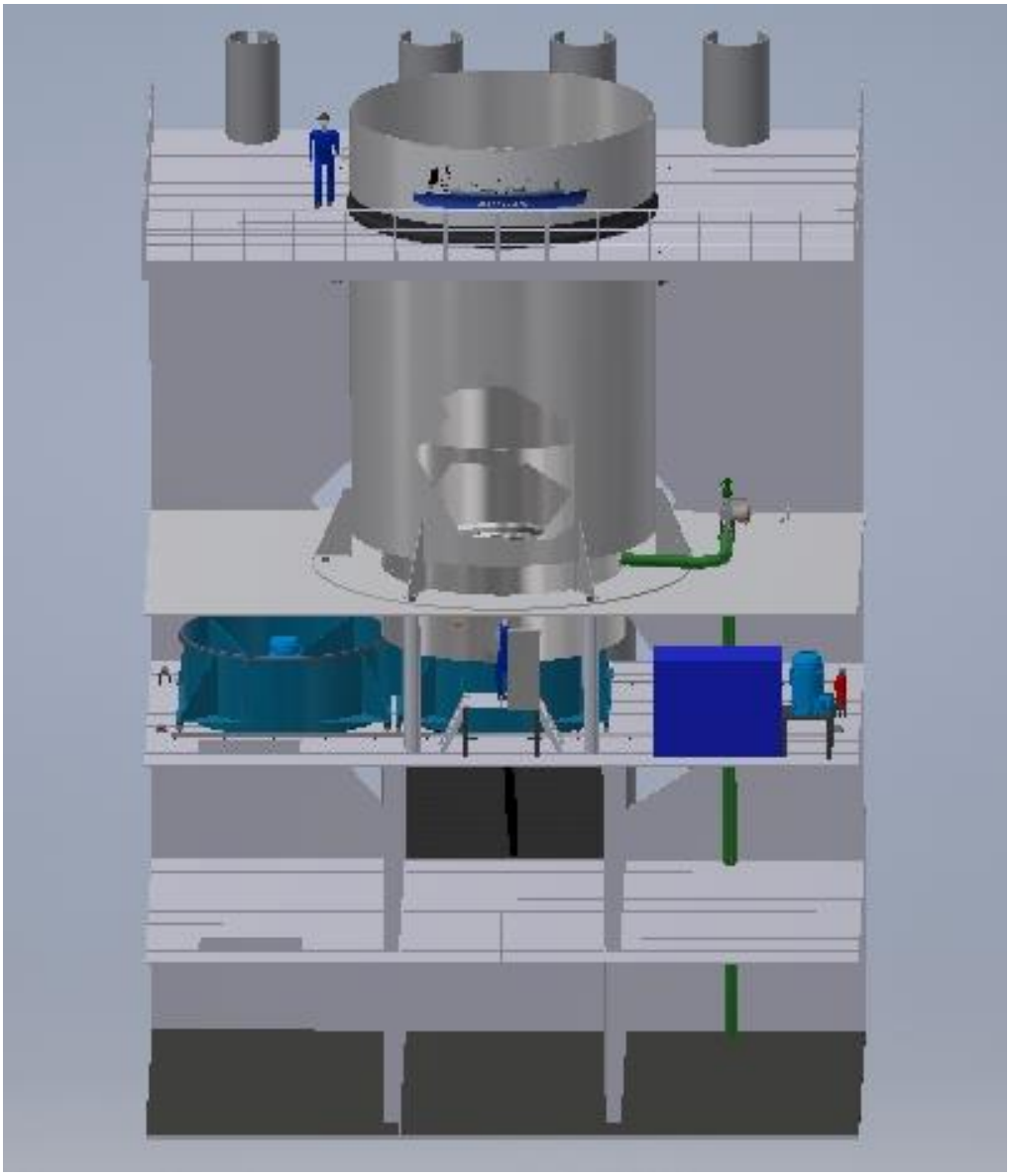
ECOFLARE GAS COMBUSTION UNITS

Some technical facts
Damien Féger



Introduction

As a last resort way to release cargo tank pressure, when the Boil Off Gas cannot be used to cover the vessel's energy needs, Gas Combustion Units (GCU) are mandatory on board Diesel Electric LNG carriers.

The same applies to future LNG fuelled vessels such as container carriers, cruise ship or ROPAX, as identified in the LNG fuelled vessel gas code which is presently in preparation by the industry, if the selected LNG fuel tank technology, such as membrane or prismatic ones, is not compatible with a 15 days pressure build up.

Compared to LNGCs, the main identified differences for LNG fuelled vessels GCUs are that:

- the Boil Off Gas (BOG) flow to be disposed off will be significantly less : typically less than 1t/hour compared to 3 to 4, as the size of the LNG tanks are much less;

- space available for this equipment will be scarce, while noise and exhaust temperature limits will be much more stringent.

To address this challenge, the author proposes a brand new miniaturized ECOFLARE GCU technology and this paper, will present:

-ECOFLARE mains design features;

-ECOFLARE benefits for shipyards;

-ECOFLARE benefits for ship owners;

-ECOFLARE for LNG fueled vessels;

taking, as an illustration, the 3,5 ton/hour capability GCU which is, typically, required for large 170 000 m^3 LNG carriers.

ECOFLARE Key Technologies

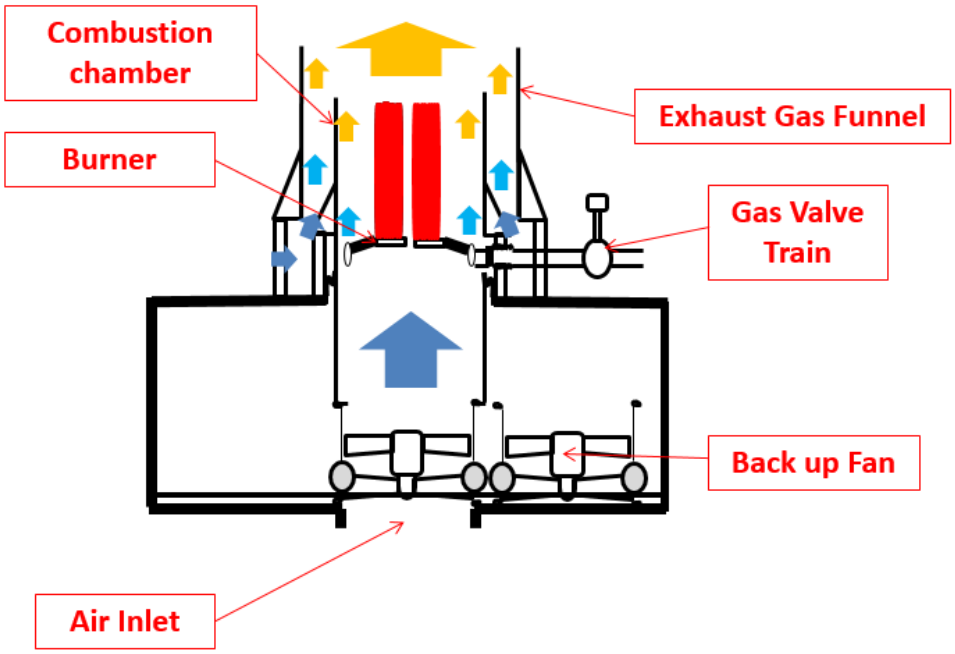
ECOFLARE is based on the following very limited number of optimized components:

An innovative burner technology which provides a distribution of the combustion over the whole central section of the combustion chamber, reducing both gas and air feed pressure drops.

An innovative combustion chamber technology which use the exhaust gas funnel as external envelope, protected by a metallic combustion chamber which is actively cooled on both sides when the system is in operation, avoiding the need for high temperature refractory materials.

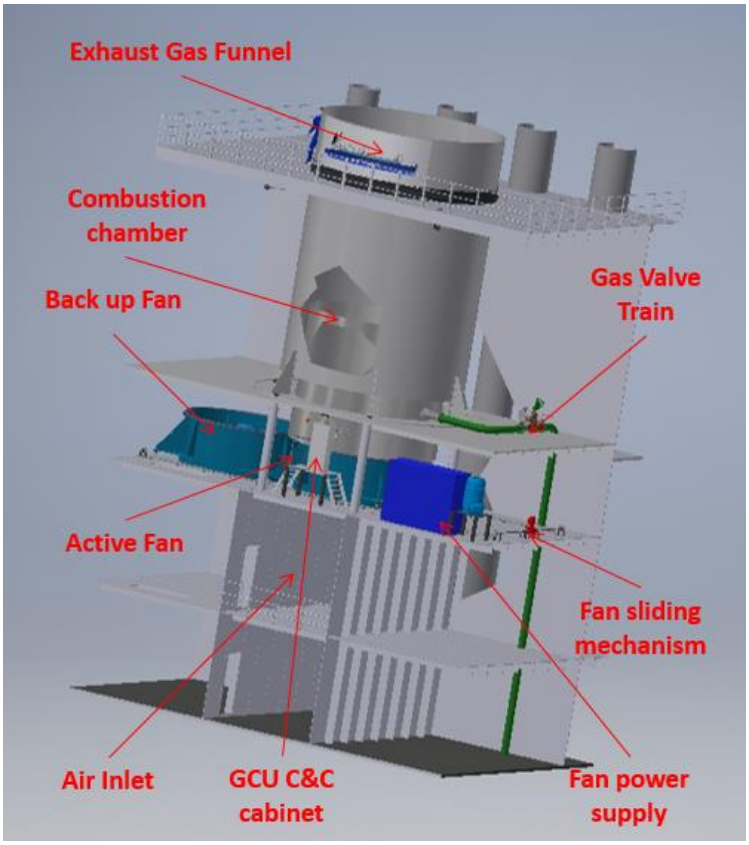
An innovative feed air single motor fan technology which provides high efficiency, while an innovative sliding system provides a back up capability, as required by classification societies.

The following figure gives an overview of ECOFLARE components arrangement.



ECOFLARE main Components and architecture (Patent pending)

The combustion chamber is cylindrical shape, like the exhaust gas funnel and its lower end is interfacing with the fan which provides the air required both to, first to burn the BOG and, second, to cool down the corresponding hot gases. The motor fan sucks ambient air from outside, through large section air inlet duct made in the deck below.



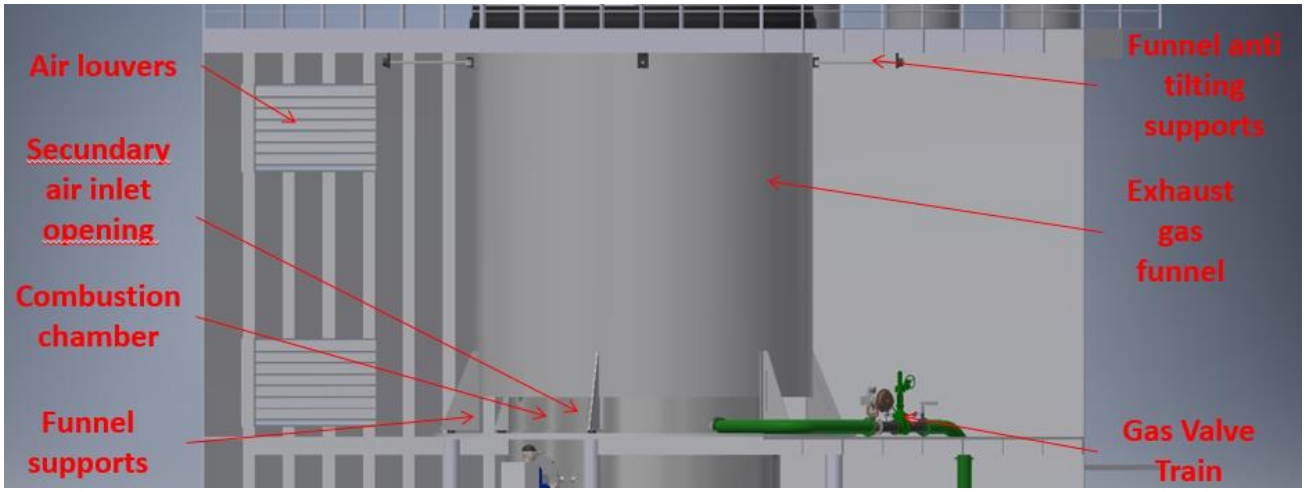
ECOFLARE implementation

The fan is mounted on a set of wheels and rails, so that in case of failure, it can be move side way and be readily replaced by a spare one.

The burner is concentric with funnel, like the combustion chamber, and is at the level of the exhaust gas funnel base. It is made of a set of ramps whose geometries are optimized to spread the combustion over the whole cross section of the incoming air flow.

These ramps are fed with gas coming from the gas valve train. The burner is designed to have a turn down of more than 1 to 10, while providing a low gas pressure drop to dispose of BOG in "free flow mode" when the BOG compressors are not in operations. Mechanically, the burner is suspended to the combustion chamber, in order to provide some flexibility with regard to thermal expansion.

The combustion chamber, which is around the burner is cooled both internally by the layer of fresh air coming from the fan and, externally, by a secondary air flow coming from outside through opening in the funnel base and drawn by the main air flow, by suction (Ventury) effect. This secondary air is coming from the outside, by a set of large louvers in the burner room casing, and then, through the space between the base of the exhaust gas funnel and the burner deck.

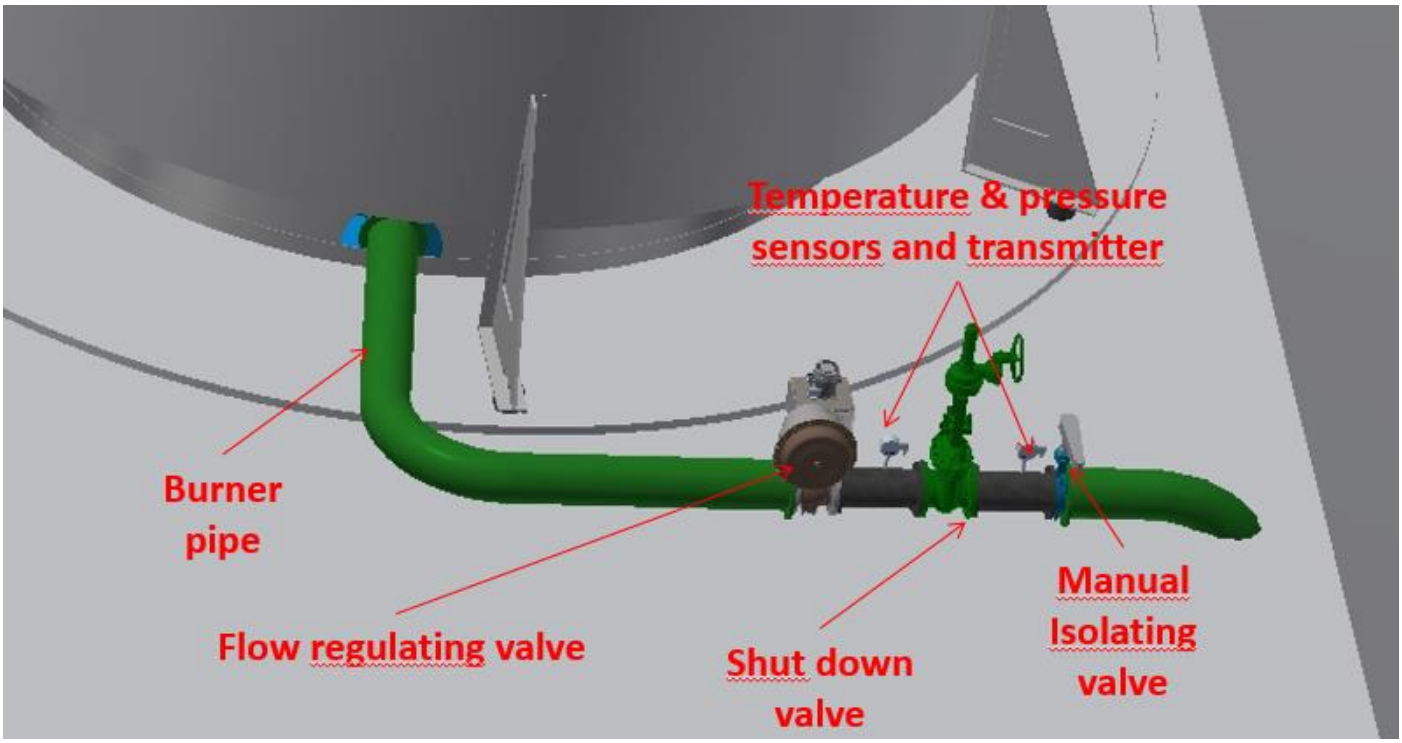


Burner deck arrangement

As required by class, the combustion chamber is equipped with a set of high energy electrical igniters and self checking flame detectors and a set of two temperature sensors monitor the exhaust hot gas temperature at the outlet of the funnel. These two sensors can be maintained from the casing top deck.

The gas valve train controlling the gas flow towards the burner is located on the burner deck. Its main components are :

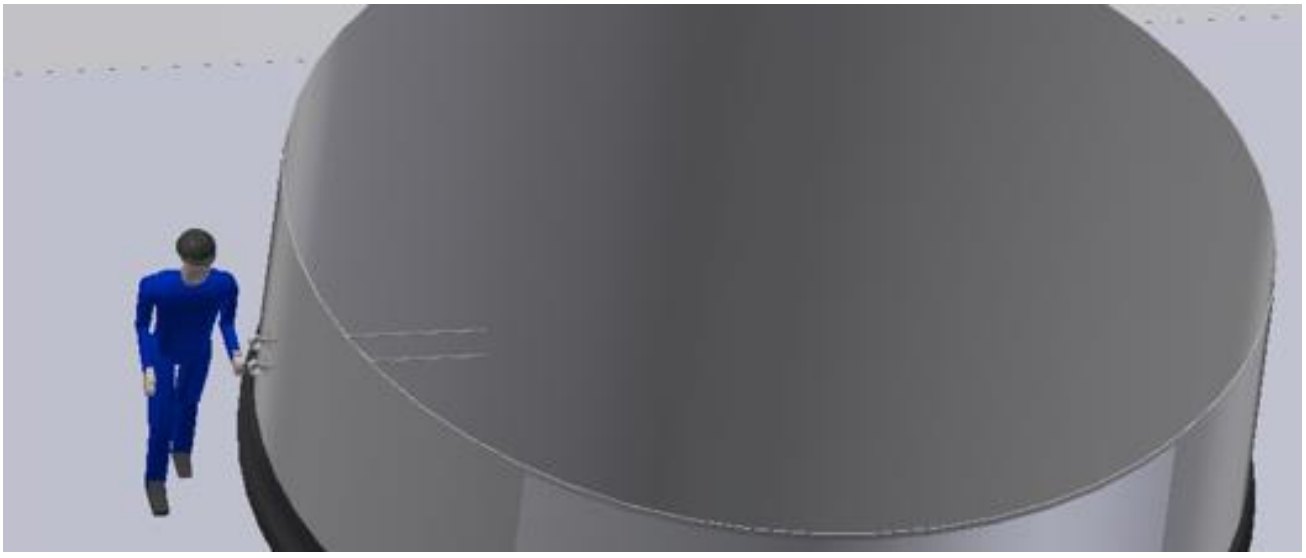
- A gas flow regulating valve whose opening is driven directly by the ship automated system to dispose of the excess BOG whichis not used by the ship engines;
- A automated shut down valve which block the gas flow as soon as there is no more need to burn BOG;
- A manual isolating valve to allow maintenance operations;
- A set of temperature and pressure indicators and sensors to monitor the BOG inlet conditions



Gas valves train

The axial fan is directly driven by a variable speed motor and is mounted on a set of wheels which run on a pair of rails fixed on the GCU deck. The impeller diameter is the same as the combustion chamber lower opening which brings two benefit:

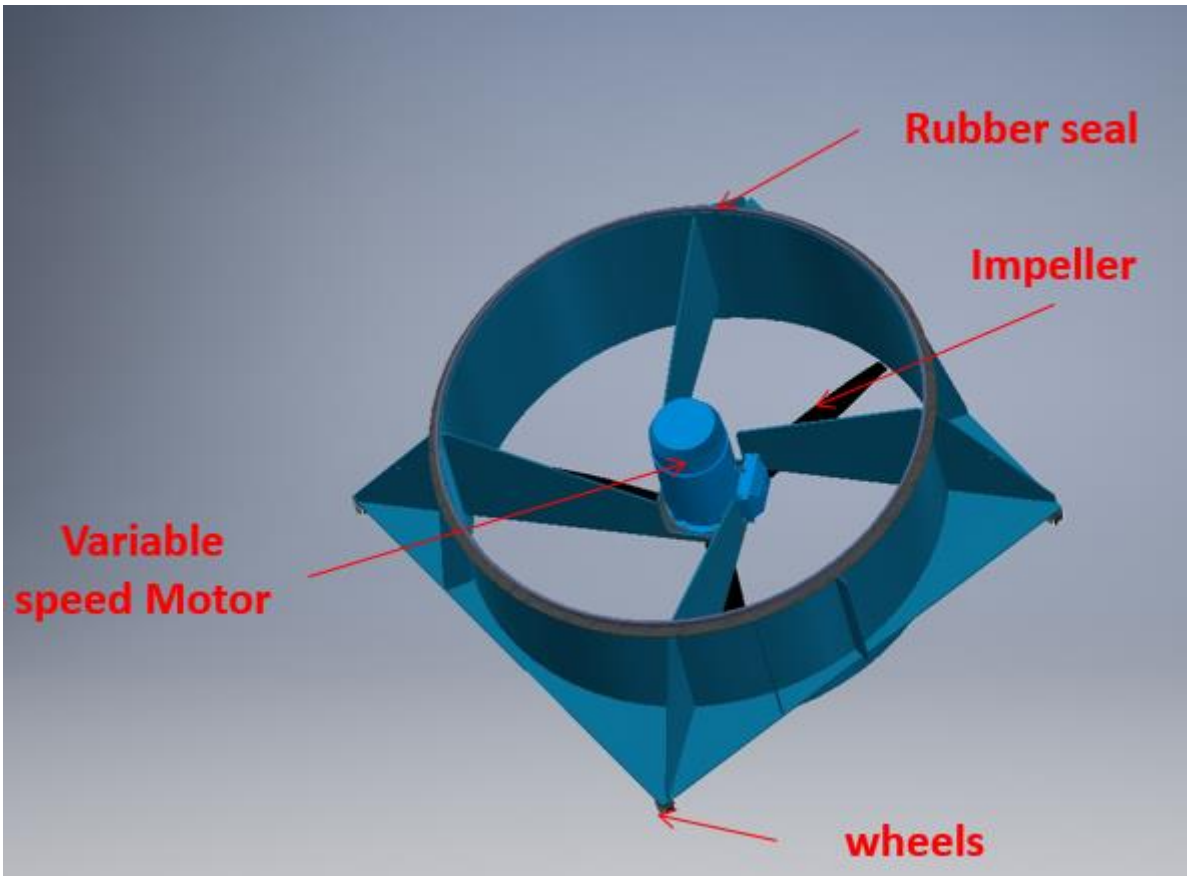
- the fan efficiency is high as there is no restriction between impeller and combustion chamber;
- the air flow is evenly distributed along the whole burner area with a homogeneous velocity.



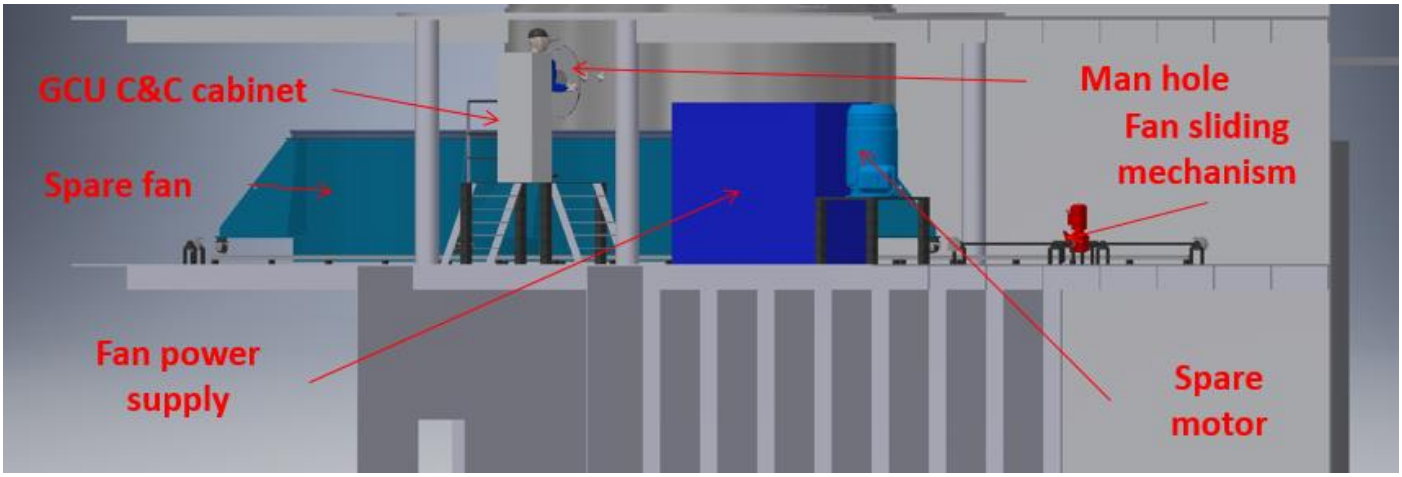
Location of exhaust temperature sensors

A circular opening in the GCU deck allows the fan to directly suck fresh air from the outside through a large cross section air duct, to minimize pressure drops. Ait tightness between the fan and the combustion chamb er is provided by a flexible rubber seal.

To reduce power consumption and noise, the fan impeller is directly driven, at low speed, by a variable speed motor. Impeller is made of light composite construction to reduce inertia and allow fast start up transient from stand by mode to full power operations.



Motor fan

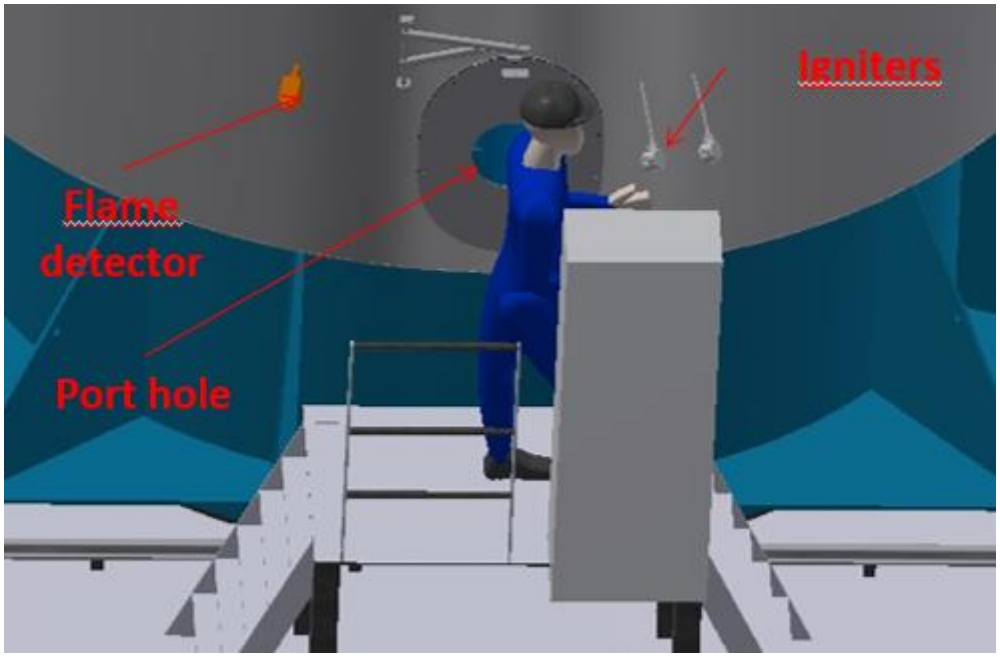


Fan deck arrangement

As required by class, a back up fan is provided, it can replace in case of fan operation failure by sliding it with a motorized mechanism in front of combustion chamber.

The fan deck accommodates as well:

- A control command platform from where the crew can access though a man hole to the inside of the combustion chamber. This manhole is equipped with a port hole so the crew can from the same position monitor the GCU C&C cabinet and check visually the burner and fan operations. This platform gives access as well, for maintenance, to the igniters and flame detectors;
- A spare motor fan motor;
- The motor fan power supply cabinets.

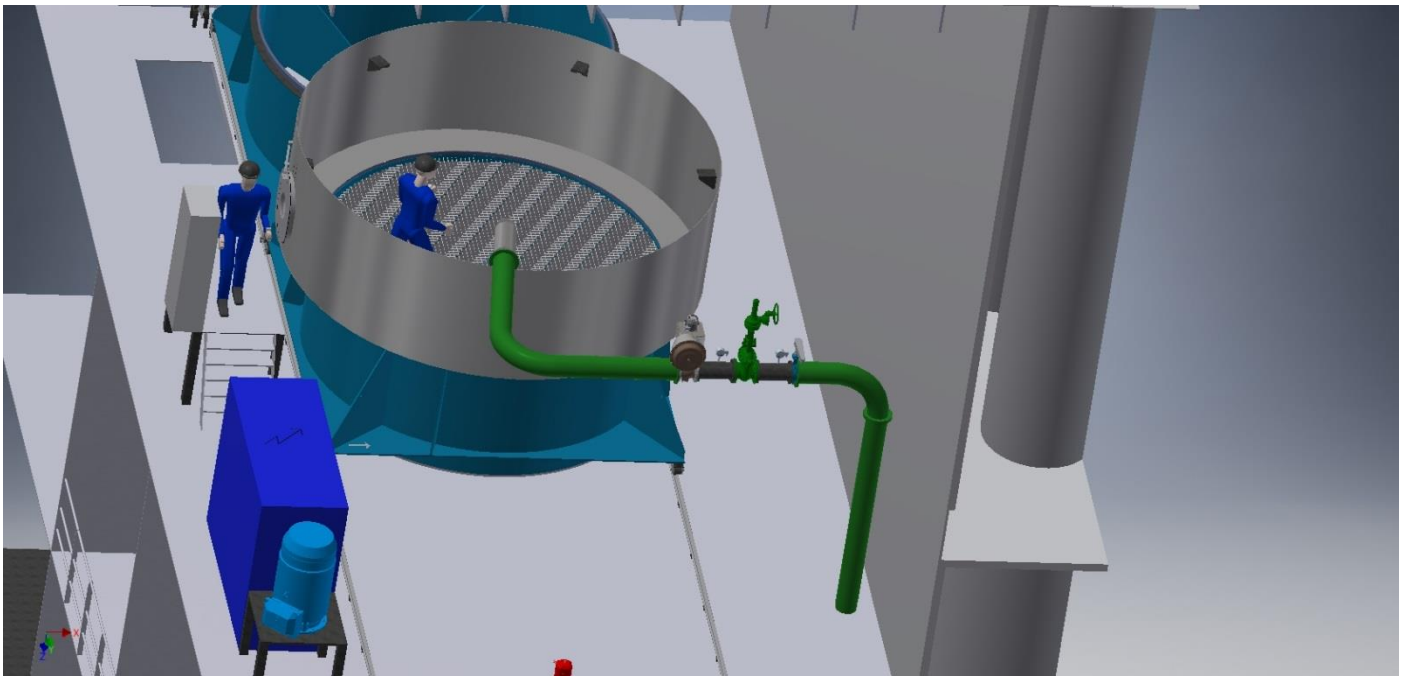


C&C platform

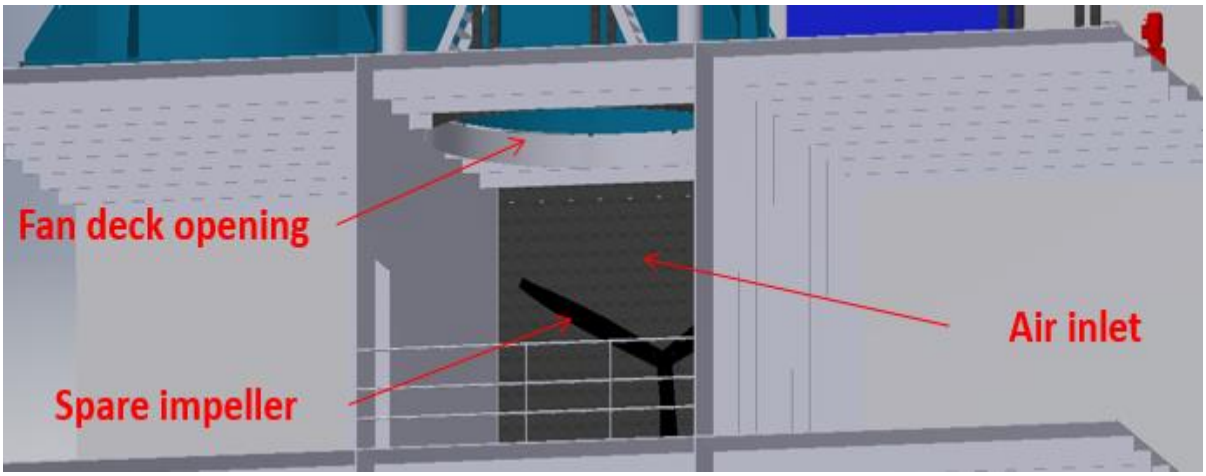
A control command platform from where the crew can access though a man hole to the inside of the combustion chamber. This manhole is equipped with a port hole so the crew can from the same position.

To allow easy and safe access for maintenance operations on the burner and combustion chamber, a removable grid platform can be installed on the spare fan. Once this is done, this fan can be slid sideways below the combustion chamber. Crew can then have access through the combustion chamber man hole to this platform and perform maintenance.

By this approach the pressure drop that a permanent platform would generate are avoided when the GCU is in operation.



Removable fan grid platform for burner and combustion chamber maintenance operations

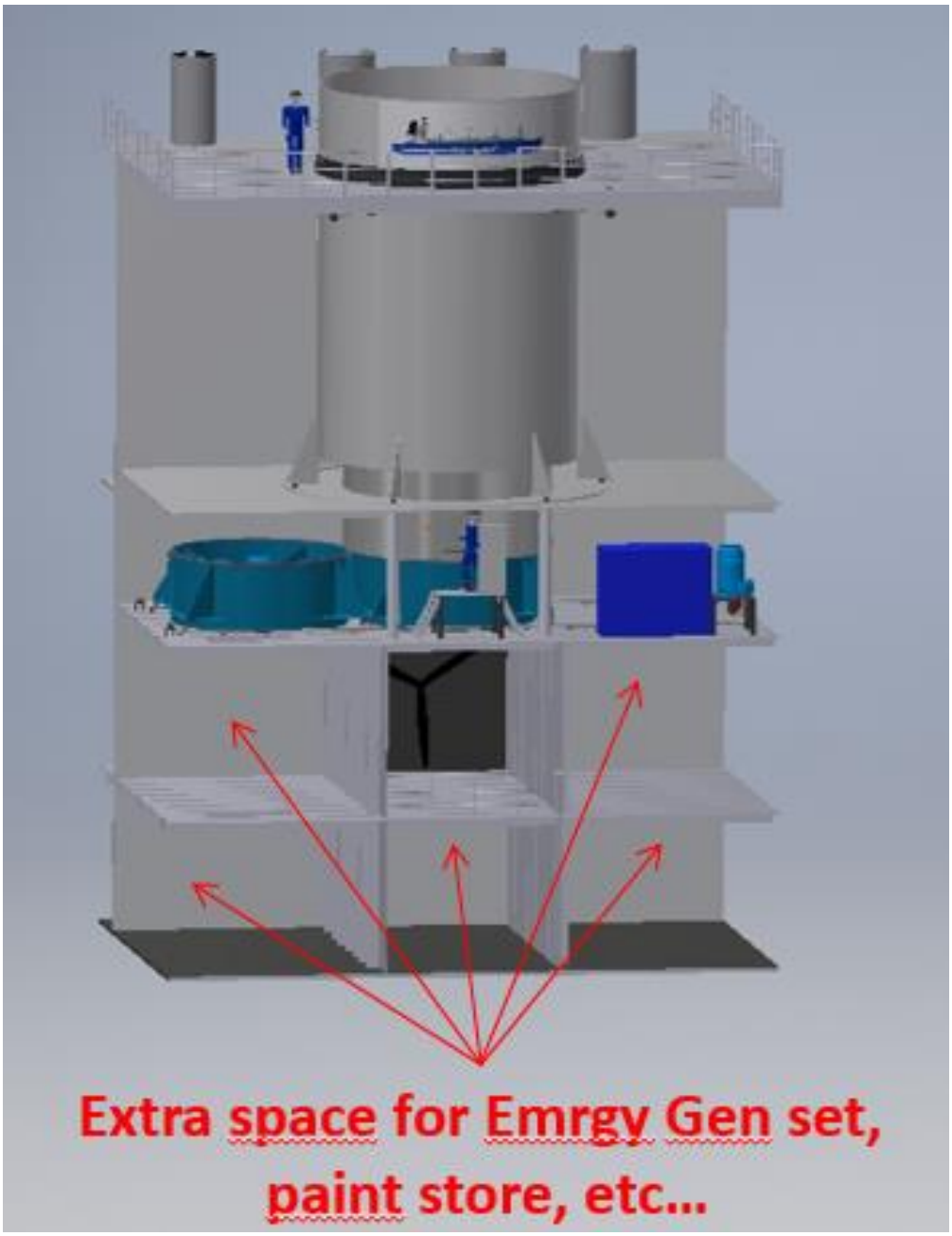


Air inlet arrangement

Combustion and dilution air is coming directly from outside to the fan by a large air inlet which is part of the structure of the ship aft casing. This air in let, accommodates, as well, a spare fan impeller.

Benefits for shipyard

ECOFLARE is typically 30 % more compact than previous GCU design. This reduces by as much the surrounding steel work to accommodate the GCU and allow to install this unit at the very top of the engine room exhaust block, in parallel with main engine exhaust pipes. This makes extra space below the GCU for other equipments such as Emergency generators, Emergency foam system, etc..



ECOFLARE provide extra space for other equipment within the engine block...

A major additional saving for the yard is the drastically reduced part number (typically two to three times less than previous design), reducing the installation work and schedule.

Another benefit for yards is the reduced number of decks and room to be dedicated to the GCU installation. In the case of ECOFLARE, a single room is needed, to accommodate the motor fans, which accommodates as well the Control Command and power supply cabinets.

Benefits for ship owners

For ship owners, ECOFLARE bring several major benefits. First of all, the reduced “stand by” motor fan power when the GCU is not burning any gas, but has to be ready to do so in a few seconds. In this mode the variable speed motor fan operates at very low speed, typically 10 % of its maximum speed, which means negligible power consumption

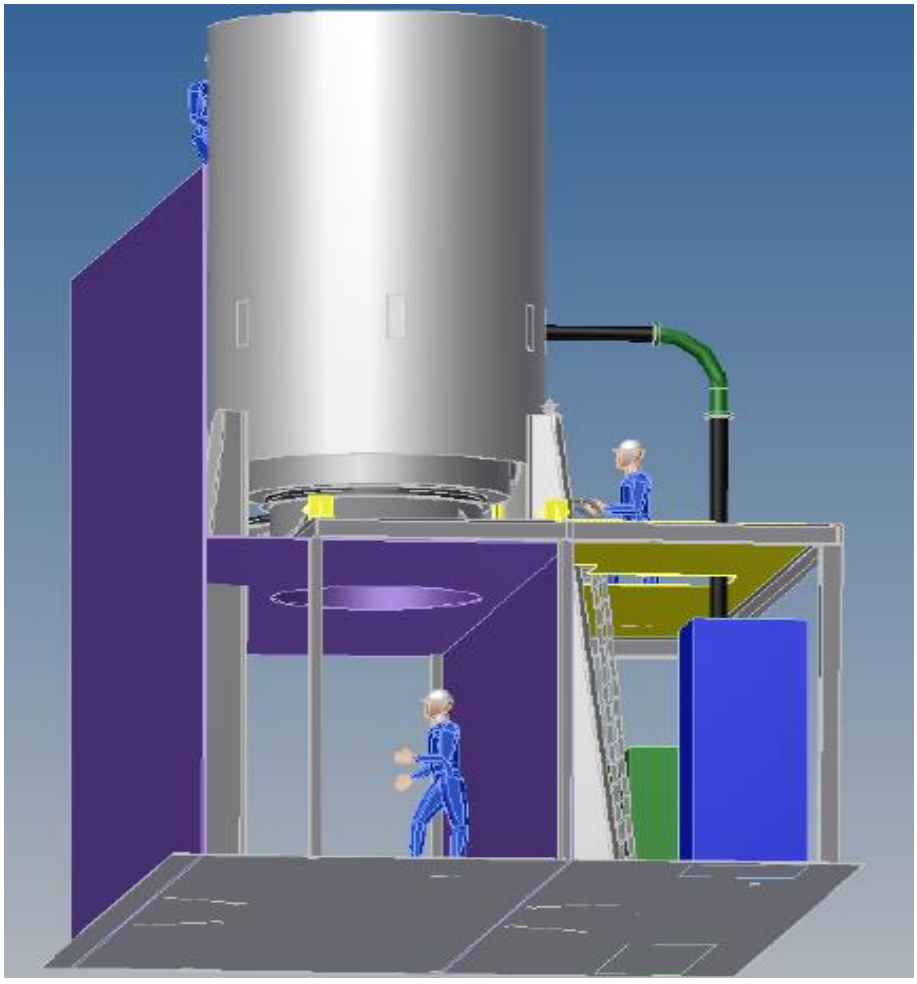
(typically 0 times less power than previous design) and noise. If needs to burn excess BOG appears, due to the impeller low inertia, transient from stand by to full capacity mode, can be made in a few seconds..

Additionally, ECOFLARE presents superior benefits in terms of maintenance costs: the number of parts is very limited, the use of a fully static burner and of a direct drive fan motor (no motor fan belt replacement) reduces the corresponding maintenance activities.

For crew, ECOFLARE, beyond less maintenance, means lower noise as due to the overall system low pressure drops the motor fan , the motor fan operates at lower speed and lower input power than previous design.

ECOFLARE for LNG fuelled vessels

For LNG fuelled vessels which requires less BOG disposal capability, the ECOFLARE solution can be scaled down accordingly, allowing to implement the whole system within the upper M/E exhaust casing.



ECOFLARE implementation on LNG fuelled vessels

First ECOFLARE ORDER for MSC LNG fuelled Cruise ship

In November 2018, partnership with Eiffage Metal, NG3 has won the contract to equip with ECOFLARE 4 MSC World class LNG fueled cruise ship ordered at Chantiers de L'Atlantique, (hull number W34,X34,Y34,Z34).

Main requirement's fulfilled by ECOFLARE was a very limited noise, footprint and weight. First unit to be delivered in 2020 at St Nazaire.

In December 2019, another order was placed by Chantiers de l'Atlantique for V34 hull number.

ECOFLARE to equip 5 world class LNG fuelled vessels built at Chantiers de L'Atlantique

For further information, please contact:

In France :

Damien Féger, d.feger.NG3@gmail.com

In South Korea :

Daniel Roh , daniel.roh@ng3korea.com

In Germany :

Caroline, Consulting@mkecb.com

In Scandinavia:

Dag Hoy , sales@scanvi-interyards.no

In Netherlands and Flanders :

Vincent Deken, vincent.deken@e-energystorage.nl

In Turkey :

Tugay Zorba, tugayzorba@oczmarin.com

In India :

Partha Talekar,partha@parikhpower.in

In Italy :

Matteo Orlandi Matteoorlandi@rig.it

In China :

Gu Linchun linchun_gu2013@163.com