Perfect Solutions for **FPSO and LNGC**

SAACKE MARINE SYSTEMS
heat generating plants

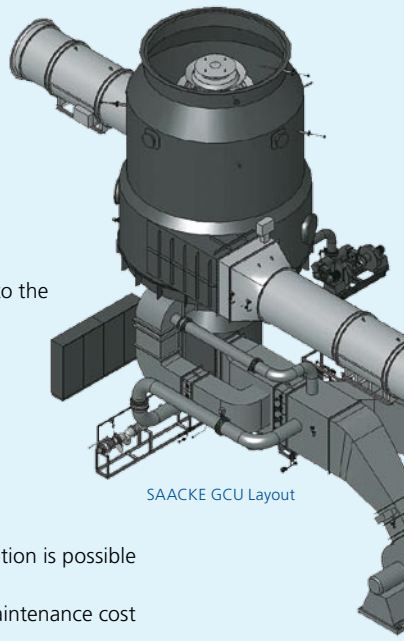
Gas Combustion Units for LNG Carriers:
The SAACKE Invention to Modern Propulsion

British Emerald (BP) 155 K LNGC

Since dual-fuel or two-stroke diesel engines drive LNG carriers gas combustion units (GCU) have become the only capable backup solution for boiloff-gas combustion.

In 2002 SAACKE invented and patented this technique worldwide.

Today the most of LNGC newbuildings features SAACKE GCU on board – precisely optimised to the dimensions and the capacity of the vessel and positioned conveniently above main deck level.



SAACKE GCU Layout

Equipped for the future: SAACKE GCU

SAACKE Typ HRS 450 GCU for British Emerald 4,5 t/h (100% CH_4)

- Rain-proof design to improve corrosion resistance and to avoid wearing of the GCU components, especially the burner and the combustion chamber bottom
- The inner lining in the combustion chamber provides a cold and therefore strong structure of the GCU (see Fig. B)
- High air excess (120%) provides low flame temperature for low heat radiation and Low NOx emissions (see Fig. A and B)
- No flame touching of the combustion chamber wall if the ship is rolling in heavy sea and therefore no wearing or damaging of the combustion chamber
- Vertical and horizontal installation is possible
- No belt driven fans for low maintenance cost
- Oil pilot burner for unlimited continuous operation if required during special circumstance
- Controlled fuel air ratio for safe combustion and low emissions
- For maintenance it is possible to remove or replace inner parts like combustion chamber and burner via funnel

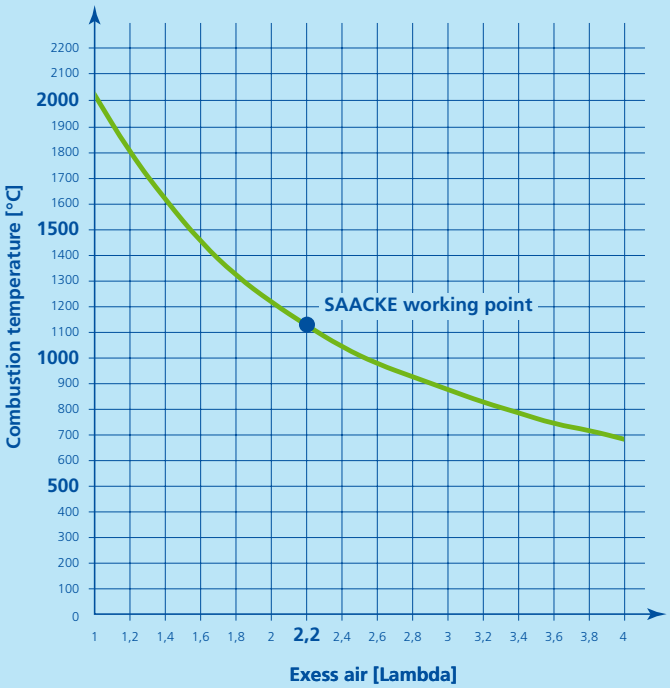


Fig. A: Combustion temperature v/s exess air

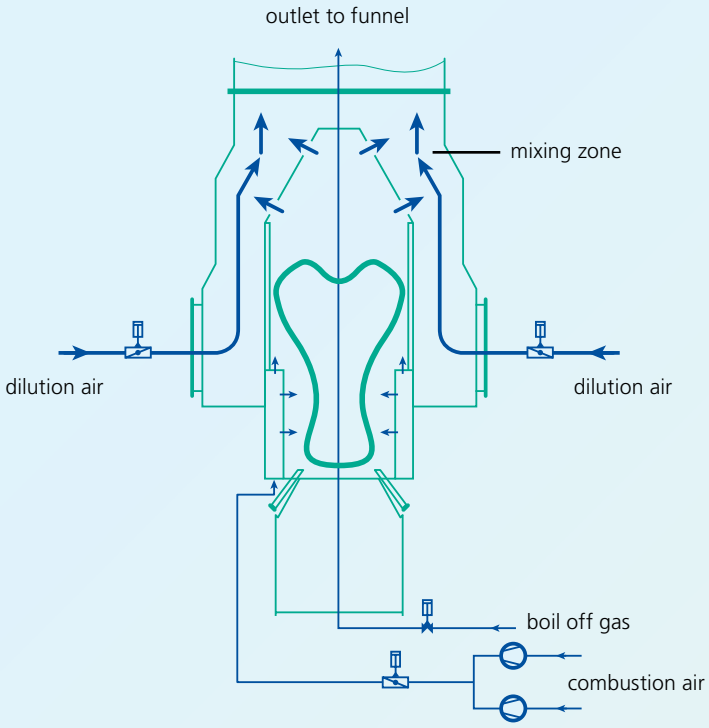


Fig. B: Basic functionality of SAACKE GCU

Reference projects **GCU for LNG carrier**

BP
155 000 cbm LNGC
Capacity of 4.5 t/h (63 MW)

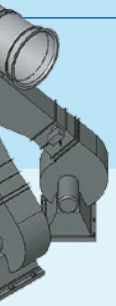
GCU for each LNGC with dual fuel electric propulsion system.
- Free flow mode
- Gas freeing mode
- Fan redundancy 2 x 100 % / 3 x 50 %
- Double controls and gas supply trains

Qatar Gas
266 000 cbm LNGC
Capacity of 6.27 t/h (87 MW)

GCU for each LNGC with two-stroke diesel propulsion system combined with a reliquifaction plant.
- Integrated off-gas (not condensable gases from the reliquefaction plant) burning system
- Free flow mode
- Gas freeing mode
- Fan redundancy 2 x 60 %

Skaugen ASA
10 000 cbm LNGC
Capacity of 0.8 t/h (11 MW)

GCU for LNGC with diesel engine propulsion system.
Redundant GCU combined with a reliquifaction plant.
- Multi gas combustion system



Benefit from Worldwide Unique Capacities at SAACKE MARINE SYSTEMS:

- Comprehensive **engineering** – precisely designed to your application
- Inventive **ingenuity** – to meet all requirements and future challenges
- Tailor-made **fulfilment** – from start to operation
- Perfect **sustainability** – by combining on- and offshore know how
- Fail-proof **reliability** – due to marine experience for generations

Reference projects **FPSO**

Red Band (Fred Olsen)

Conversion of an auxiliary boiler from oil to dual fuel combustion equipment.
Replacement of old combustion plant including controls.
Installation and Commissioning
Boiler: Foster Wheeler 30 t/h 16 bar(g) · Burner: 2 x SAACKE steam atomising burners

Bergesen World Wide Offshore

Conversion of a main boiler from oil to dual fuel combustion equipment on 3 sister ships.
Replacement of old combustion plant including controls.
Commissioning
Integration of the boiler and boiler auxiliaries with SAACKE control system
Boiler: Foster Wheeler 110 t/h, 65 bar(g) superheated steam · Burner: 4 x SAACKE steam atomising burners

Dalia Consortium
Total, Sonangol, ExxonMobil, BP, Statoil, Hydro

Newbuilding, delivery of 3 x 35 MW hot water heaters including controls and combustion.
Equipment and commissioning
Boiler: 3 x SAACKE 35 MW D-type hot water heater · Burner 1 x steam atomising burner per boiler

Dalia FPSO

Boiler Set for Dalia FPSO

FPSO/FSO/FSRU - Turnkey Solutions:

One-Stop Procurement – from Concept to Trial Run.

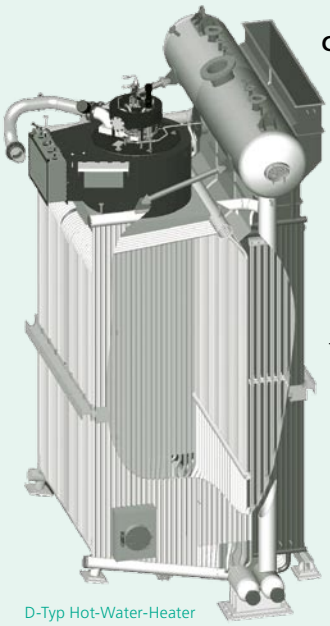
The heat generation demand for offshore facilities is generated by both new buildings and conversions. SAACKE is the primary boiler system provider for both requirements.

The same team of experts pursues the project from the initial idea straight through to the final commissioning and trial run. Clockwork coordination ensures that the turnkey system is designed precisely for your specific application at top speed. The result is always a fail-safe boiler management system – by means of:

Boiler upgrades for firing gas after conversion. Consult SAACKE for an inspection of your existing plant and advice on the scope of replacement including an expert boiler recalculation.

Tailor-made boiler engineering and manufacturing for new buildings. With our experience in the marine engineering sector, we offer the full range of different types of heating systems: boilers, providing saturated or superheated steam, hot water heaters and thermal oil heaters.

Dual-fuel burner engineering and manufacturing including the oil and gas supply units.



D-Typ Hot-Water-Heater

Control system engineering – the key to the success of your project. SAACKE puts your plant philosophy first as the operator or owner of the facility to make sure your daily operations are patterned to your requirements, including the integration into the ship main control system.

Commissioning by a SAACKE engineer to guarantee optimum performance.

Preparing for new marine emission requirements. Based on our experience with land based emission standards we have adopted the know how to the marine field.

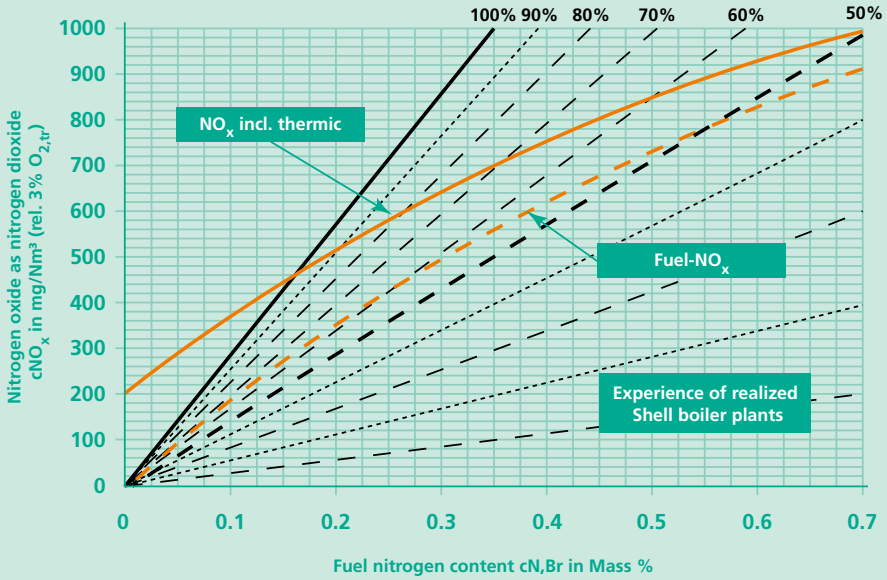


Fig. C: NO_x generation during combustion completly without NO_x reducing measures

Production facilities

Portsmouth, UK

Bremen, GER

Zagreb, HR

Qingdao, CN

SAACKE MARINE SYSTEMS: **Excellence in Practice on Board**

More than 75 years of experience and over 10 000 combined oil and gas plants for land and marine industry provides the synergy effects placing us in a unique position in providing a comprehensive package for the marine industry. Heat generating plants from SAACKE are intelligent modular systems consisting of burner, boiler, control and pipe-line systems

- Designed precisely according to our customers' application specifications,
- In line with the high quality requirements of our own manufacturing facilities,
- Certified in compliance with all of the international norms,
- Manufactured and assembled as a highly efficient unit to fulfil the given task completely, reliably and safely,
- Confirmed by our own test rig and backed by worldwide references.

At the same time our unique concept of customisation leaves room for adaptation and optimisation – to keep abreast of changing market, environmental and technological requirements. Right now clean combustion from optimal flame geometry, Low-NOx emission rates are standard features even of our offshore plants. Either they are already geared to stricter regulations and norms or will minimise the expenditures involved. This protects our environment and safe-guards your investment – from day one, and for years to come.

Our engineering facilities and project teams enable us to offer a comprehensive project management, installation services along with a worldwide service and spare parts network.

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