

# LNG – in safety!

RS develops coupling system  
for cryogenic media



The shipping organisation IMO and the EU oblige ship operators to use fuels with a maximum sulphur content of 0.1 percent in the Baltic Sea starting 2015. Today, that would affect up to 2,200 ships per day. On the global level, the emission standards will also become much stricter by 2020. Liquid natural gas (LNG) is considered a more environmentally compatible fuel of the future in the shipping industry. The LNG specialists from Marine Service and the RS coupling experts have jointly developed a highly flexible solution to enable ships to switch over to LNG as a fuel.



## 1 The starting situation

Marine Service GmbH, a Hamburg engineering office, has been implementing projects for the use of liquid natural gas (LNG, Liquefied Natural Gas) as a ship fuel for many years. In 2010, Marine Service developed an innovative concept for using LNG based on a tank container.

The key to the feasibility of this proposal was the connection between the container and the on-board pipework and fittings. It required a coupling system that is safe, easy to operate and handle which could cope with the extreme requirements of the cryogenic medium in the maritime environment. Up to then, no such solution existed anywhere in the world.

## 2 The challenge

Marine Service commissioned RS with the development of the connector systems for the planned LNG tank container – a decisive aspect of the overall project. The requirement was for a flexible connection offering the same level of safety as a fixed pipe fuel line. As the process coupling, it had to be designed for a continuous, one-week fuel flow and to handle the extremely high requirements of the cryogenic temperature range. After all, LNG is loaded and stored at temperatures as low as -165°C; the coupling was tested at -200 °C.

### A coupling for cryogenic temperatures

Cryogenic temperatures are a genuine challenge for the mechanical properties of the coupling system. Safe handling of the low-temperature LNG requires that all coupling processes and the opening and closing of the flow cross-section function absolutely reliably at all times. To accomplish this, the material selection and the design have to be perfectly matched to a temperature range of between -200 °C and 60 °C.

In particular, the sealing system in the coupling had to meet the strictest requirements of the cryogenic application since only minimal leaks are permissible in this area. The previous RS seals based on elastomer O-rings were not suitable. At -165° C, they lose their elasticity and no longer perform any sealing function. So a material with outstanding thermal and mechanical properties in the cryogenic temperature range had to be found.

This is where RS came on board as a coupling expert.

### Safety

#### Safety and LNG

LNG is stored at temperatures of -165 °C. If it escapes into the atmosphere, people and the environment are at risk. Furthermore, chilled LNG poses a danger to the ship's hull. If it touches steel, the steel immediately becomes brittle. Crack formation in steel hulls is the consequence. Therefore, strict safety regulations apply to handling cryogenic media such as LNG.

### Environment

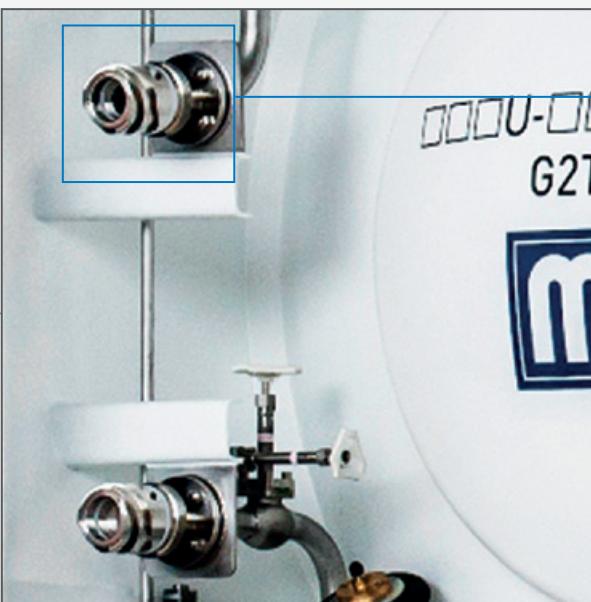
#### LNG as ship's fuel

Compared to previously used heavy fuel oils, the combustion of LNG creates a considerably lower emission of pollutants and CO<sub>2</sub>. In view of stricter environmental provisions and rising heavy fuel oil prices, LNG is considered as the fuel of the future in the shipping industry. Studies assume that LNG use in shipping will increase massively on a global scale up to 2020.





Tank containers facilitate flexible retrofitting and use of LNG in the shipping industry.



TCC couplings connect the tank container safely with the LNG line.



The TCC series provides maximum safety and performance from -200 °C to +60 °C.

### 3 The solution

To meet this range of requirements, RS cooperated closely with Marine Service to develop an innovative coupling system specifically for low temperature applications – the TCC series. The innovation turned conventional hose lines into an extremely safe transfer system for cryogenic media.

#### The dry disconnect coupling: The heart of the transfer system

The TCC dry disconnect coupling is at the heart of the LNG transfer system. It must connect the tank container securely to the LNG line throughout the filling and usage process, guaranteeing an optimum media flow rate. In addition, extreme requirements regarding manufacturing precision, surface quality as well as thermal and mechanical properties had to be met. RS managed to do that by using high-precision lathing technology, methods for surface finishing and special low-temperature materials. Cost-effectiveness, performance and user friendliness of the TCC dry disconnect coupling were ensured at the same time. This was made possible by technical characteristics such as flow-optimised coupling geometry, freedom from icing and excellent ergonomics.



#### The breakaway coupling: Secure against overloading

One risk factor of the system was handling the transfer line. Unwanted product leakage had to be excluded here. To maximise mechanical safety, RS integrated an emergency breakaway function into the dry disconnect coupling. For example, if an LNG tank container that is still connected to the ship by the transfer line is lifted off by the crane, the

emergency breakaway coupling is automatically activated. Before the transfer line can tear off, it is disconnected at a defined point. The non-return valves immediately close the flow cross section. The product leakage is prevented and all other components are protected from damage.

#### The hose line: An intelligent connection

Naturally, the hose line itself was a key component in the development of the LNG transfer. In this case, RS used a twin-walled, vacuum-insulated metal hose. This guarantees the best insulation and uncompromising safety.



A constantly monitored vacuum between the exterior hose cover and the medium-carrying interior hose insulates it perfectly. If the interior or exterior hose is damaged, the vacuum immediately collapses. The electronic monitoring instantly detects the collapse of the vacuum and triggers an alarm. Due to the twin-walled structure of the transfer system, the automatically detected damage can be rectified before it leads to product leakage.

#### The design: Durable and robust for the high seas

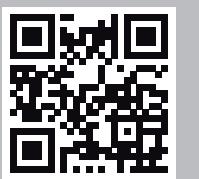
The especially robust structure of the TCC series was designed for a maintenance interval of 2.5 years. As a consequence, it complies with the requirements that apply to commercial shipping operations on the high seas with the associated harsh handling and weather conditions.

#### At a glance

##### The TCC series

Dry disconnect system with integrated breakaway coupling. Suitable for cryogenic applications down to -200°C

- Low pressure/ high flow rate through flow-optimised valves
- Safety-optimised, closed system:
  - Complies with the leak rates required by the regulations
  - No product leakages during coupling or decoupling
  - No leakages during the pumping process
- Can be coupled in every operating condition, even at cryogenic temperatures
- Freezing does not have any influence on the function of the coupling.
- Simple handling, good ergonomics
- Rugged design for extremely harsh conditions



Find out more here



## 4 The result

From the cooperation of Marine Service and RS arose an innovative overall design for LNG supply for the shipping industry - upgradeable, flexible and safe. RS is expanding its portfolio with the TCC series for cryogenic application areas. And it is not merely this project that stands to gain. With the novel coupling system, RS is setting new standards in all fields of application that involve cryogenic fluids.



Dry disconnect coupling TC series

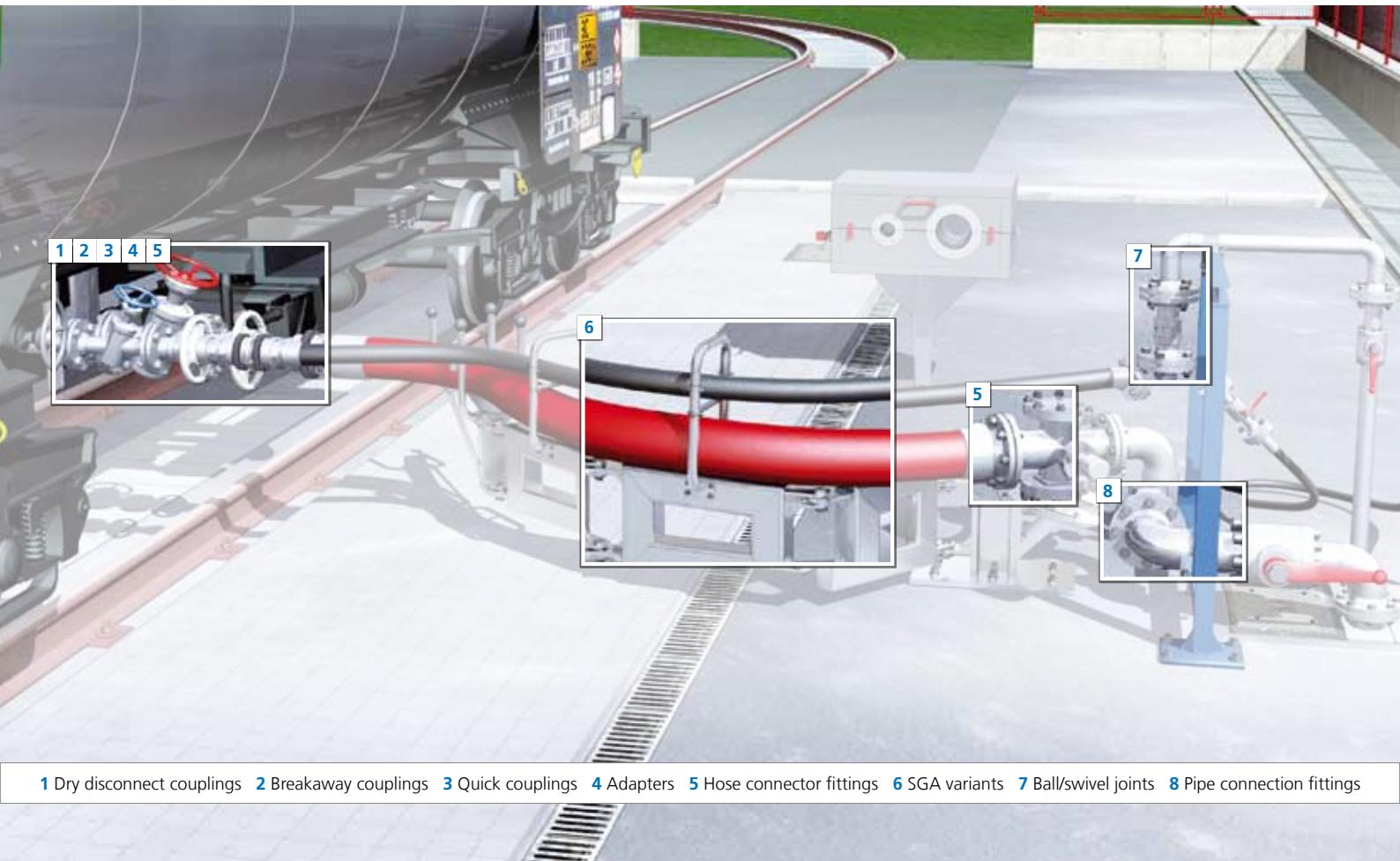
## 5 The outlook

Consumption of LNG will continue to grow. This will open up new potential applications for the TCC coupling system. Future applications for instance lie in energy generation on power barges and external power generation on ferries. Another field of application is loading LNG. RS developed the TC series specifically for these requirements. From vehicle refuelling through to rail tank wagon loading and all the way to ship loading, the TC series optimises the loading process.

Apart from LNG, the TC system can also be expanded to include all technical gases. As a result, RS provides ideal solutions for handling liquid oxygen, nitrogen or argon.

# At a glance

The complete RS product range



1 Dry disconnect couplings 2 Breakaway couplings 3 Quick couplings 4 Adapters 5 Hose connector fittings 6 SGA variants 7 Ball/swivel joints 8 Pipe connection fittings



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