

# Docking, Mooring and Transfer for LNG



# Performance People to support your business performance

**When installing or upgrading docking, mooring and transfer technology for LNG applications, you need to connect with a partner that provides much more than technically superior products and technologies.**

You need to work with a partner that combines best practice expertise, gained through worldwide experience, with a deep understanding of local requirements and regulations. This global reach combined with feet on the ground local presence helps to make Trelleborg the Performance People that continually enhance your operations.

You need to ensure your LNG facility is protected by solutions designed around the needs of you and your customers, with an experienced team that understands your demanding requirements.

It is essential your docking, mooring and transfer systems feature the most technically superior products, to maximize durability and reliability whilst minimizing downtime and whole life costs.

You need to ensure your measurement, communications and safety systems are designed by a world leader, with in-house design, testing and manufacturing capabilities.

Connect with a partner that provides the support you need from conception to completion and beyond.

Connect with the Performance People at Trelleborg Marine Systems for a complete portfolio of LNG docking, mooring and transfer solutions.



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With over 30 years' experience in providing cutting-edge docking, mooring and transfer technology systems all over the world; we understand the LNG market and the demands of the modern terminal.

From offshore applications to FSRUs, we have a pedigree in all LNG applications and can ensure you have the solution you need to optimize your operations.



## Ship-to-Ship Mooring

Trelleborg Marine Systems designs, manufactures and commissions complete FLNG and FSRU ship-to-ship mooring solutions: the typical system configuration includes multiple Quick Release Hooks and capstans with load monitoring and remote release. Enhancements to the mooring system can include the integration of GPS Berthing, Environmental Monitoring, Fenders and Deployment Systems. Trelleborg also provides quick release cables for SSL systems for ship-to-ship transfer.

## FLNG / FSRUs

Taking operational learnings from our vast history of supplying FSRU and FLNG projects, Trelleborg Marine Systems takes a holistic and aligned approach to ensure a seamless integration across the whole solution. Whilst no generic package can be applied to these complex and demanding terminals, Trelleborg will build an integrated docking, mooring, transfer and fendering system that meets the demands of the FSRU, the LNGC and the jetty. 100% of the world's FSRUs are fitted with the SeaTechnik™ Digital SSL systems, which were developed to handle the complex process requirements needed to transfer LNG from the carrier to the FSRU, and then gas from FSRU to shore.



### **LNG Terminals**

From Quick Release Hooks (QRHs) to Ship-Shore Links (SSLs), Trelleborg represents the benchmark in integrated docking, mooring and transfer packages for LNG terminals. We supply over 60% of LNG terminal mooring and monitoring systems, and in excess of 80% of the SSL transfer systems for LNG terminals globally. All our systems comply with the stringent safety requirements for berthing at export/import terminals and SIGTTO guidelines.



### **LNGCs**

As the global market-leader in the design and manufacture of systems for safeguarding the transfer of LNG, our pedigree in engineering for LNGC docking, mooring and transfer systems is unrivalled. In fact, 90% of the world's LNGC fleet is fitted with Trelleborg SeaTechnik™ SSLs. In addition to our measurement, communications and safety solutions, our hardware features technically superior monitoring software to ensure complete oversight of both the LNGC and the facility it will be moored to and communicate with.

### **Small Scale LNG**

Small Scale LNG is growing as the requirements for LNG as a marine fuel grows and the idea of 'small scale' LNG transfer takes off. Trelleborg Marine Systems have developed the Universal Safety Link and the Quick Release Hook Compact Series to address this more cost conscious market while helping to maintain the highest operational standards.

# Project management process

**Our consultative project management process takes the pressure off you because our dedicated in-house team are experienced from the conceptual design stage right the way through to aftersales care.**

## Typical project case studies >

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### The Teekay “Arctic Spirit”

Customer:

Teekay

Trelleborg has the largest and most experienced team of docking and mooring specialized engineers in the world – twice the number of our nearest competitor.

Our Trelleborg SeaTechnik™ product range which features specialized measurement, communications and safety systems specifically for LNG applications is led by a team of engineers who have been developing marine electronic systems for over 25 years. We’re also able to provide valuable consultancy services in the area of SSL compatibility.

With over 30 years of experience providing bespoke solutions for the largest and most complex fendering requirements around the world, we can provide you with the best design and materials to ensure a long, low maintenance service life for your LNG facility.

When you partner with Trelleborg, we allocate a dedicated team to your project who will work with you from design, all the way through to completion.

The concept, design, manufacturing and testing for your project is all done in-house by Trelleborg.

If you have any questions at any stage of the process, your dedicated Trelleborg project manager will provide you with one point of contact and will work with you as your project is developed, built, delivered and commissioned.

- The Teekay vessel “Arctic Spirit” was on a tight schedule for refit
- SeaTechnik™ SSL technology installed during permitted dry dock
- Service team presence upon request to sail from the Philippines to Qatar to complete installation and commission
- Service team presence for supervision of first LNG cargo load and first discharge of cargo to the Excelerate FSRU Vessel “Exemplar”
- This vessel is also covered by Trelleborg Marine Systems 24/7 fleet service cover

## 2

### The Exceleerate Energy “Exemplar”

Customer:

Exceleerate Energy

- SSL Regas system connected to jetty and companion LNGC
- Continual provision of gas to the region whilst receiving LNG from companion LNGC to refill its tanks
- Process data communicated between FSRU and shore through SSL, gas and liquid processes remained independent of each other's Emergency Shutdown Signals (ESD)
- The Exemplar is compatible with any global regas terminal, representing a flexible and significant asset in the Exceleerate Energy fleet

## 3

### The “Golar Frost”

Customer:

OLT Offshore LNG

- LNGC to FSRU conversion at Livorno, Italy
- Ship-to-ship mooring solution including QRHs, load monitoring and GPS OMADS
- Trelleborg SeaTechnik™ SSL system for LNG transfer for replenishment
- Bespoke solution, ensuring compliance with RINA Classification Requirements
- Storage capacity of 137,000 cubic meters of LNG and a production capacity of 3.75 billion standard cubic meters per annum (bscmpa)

## 4

### Yuedong LNG

Customer:

CNOOC  
Yuedong LNG

- Fully integrated large-scale LNG mooring and transfer system
- QRHs, DAS, Environmental and Oceanographic Monitoring, Fibre Optic Ship Shore Link
- Trelleborg SeaTechnik™ SSL protects LNG transfer
- Portable Handheld Unit (PPU) for dual berth installation and a Carry On Board (COB) laptop system for single berth installation
- High-quality aftercare, including equipment testing and operational training
- Hazardous area compliance

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## **Curtis Island LNG**

Customer:

**John Holland Group**

- The world's first project to turn coal seam gas into LNG
- QRHs with load monitoring and remote release, Laser DAS, PPU, MetOcean, SSL and environmental monitoring, integrated marine monitoring systems and workstations
- Data made available to client's DCS systems
- Comprehensive product range, systems integration and support in local regulatory guidelines and hazardous area standards
- Trelleborg SeaTechnik™ SSL protects LNG transfer

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## **Singapore LNG**

Customer:

**Antara Koh/Samsung**

- Integrated docking and mooring, SSL and fender systems
- SCK Cell fenders supplied over two phases, DAS, QRHs and SSL
- Stringent specifications and testing
- SSLs installed on berths one and two

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## **Escobar LNG Terminal**

Customer:

**YPF**

- 175 million cu.m. (6,000 million scf) per day Escobar LNG terminal
- Advanced mooring equipment to ensure ship and terminal safety during critical gas discharge operations
- QRHs with Electric Remote Release and SmartHook® Load Monitoring Systems
- Fast track design and supply for the mooring equipment was essential
- Controlling critical gas output process whilst simultaneously controlling LNG replenishment from LNGC to FSRU



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## Dubai LNG

Customer:

Dubai Supply Authority

- Oversight and supply for both jetty and FSRU
- Double, triple and quadruple QRHs with load monitoring for the jetty mooring
- Trelleborg SeaTechnik™ SSL installed
- Additional work with Golar on design and supply of double 150T Quick Release Hooks, load monitoring, remote release and central computer system
- Critical integration and alignment of the two systems

# 9

## Ras Laffan

Customer:

Multiple Projects

End Users:

RasGas/QatarGas

- Ras Laffan, 80km north of Qatari capital Doha, aims to be the world's leading port for LNG
- Supplied a full suite of fender systems, docking and mooring equipment and gas transfer technology
- The facility now boasts state-of-the-art Parallel Motion Fenders, Quick Release Hooks, Smarthook®, load monitoring with remote release, Smartdock® Docking Aid Systems with customized central integration and Trelleborg SeaTechnik™ Ship Shore Links installed across various condensate and LNG berths within the port

# 10

## Grain LNG

Customer:

Volker Construction

- Docking, mooring and fendering for jetty upgrades: QRHs, SmartHook load monitoring, SmartDock DAS, central integrated monitoring system and SCN super cone fenders
- Further work with main contractor, CB&I to supply monitoring instrumentation
- Trelleborg SeaTechnik™ SSL installed on the two berths
- The Isle of Grain terminal can now facilitate LNGCs with a capacity of up to 266,000m<sup>3</sup>, jetty eight is capable of accommodating the world's largest LNG ship, the Q-Max vessel
- A personal aftersales service, including calibration and commissioning of QRHs at short notice, and operational training at Trelleborg's Melbourne facility

# Quality Management

**Quality Management is at the core of everything we do at Trelleborg Marine Systems. It is integral to our processes and procedures, and controls the way we work with you to approach each engineering challenge. Our business systems are constantly evaluated to drive innovation and value delivery to you as our customer, reflecting national, regional and environmental standards.**

## **An Eye for Documentation**

Documentation is an essential part of today's project deliverable. Your Trelleborg Marine Systems project team will fully manage all documentation, CAD design and QA to ensure complete compliance with specifications, and to provide complete peace of mind to the end-user. We work with a full suite of engineering and design tools and our designers are experienced in all relevant industry standards.

## **Quality Assurance**

Quality Assurance is the priority across our range of products and services for the LNG industry. Both Trelleborg Marine Systems UK and our Melbourne Docking & Mooring group hold accreditation to ISO9001, certified by Lloyd's Register QA. In addition the Melbourne facility holds ISO14001 accreditation.

## **Class and Compliance**

Floating LNG vessels and facilities often require equipment designed and built in line with classification society requirements. Across a variety of LNG assets, both Trelleborg Marine Systems Melbourne and Trelleborg Marine Systems UK businesses have delivered offshore docking, mooring and oil and gas transfer systems fully compliant with, and certified by all major class societies, including DNV, Lloyd's Register, RINA, ABS, BV, KOSHA and ClassNK. Trelleborg Marine Systems UK maintain an ATEX Quality Assurance Notation for the supply of Trelleborg SeaTechnik™ products for use in hazardous areas, as well as ATEX, IECEX and CSA/CSU listing. In addition, Trelleborg SeaTechnik™ Ship Shore Links are 3rd party certified to IEC61508 Safety Integrity Level (SIL 2).

Trelleborg Rubber Fenders are PIANC Type Approved, Pneumatic Fenders produced to meet ISO17357 standards, and Foam Fenders are ABS Type Approved. Trelleborg Factories are certified to ISO9001, ISO14001, and ISO18001 standards.



Certificate Number LRQ4001396





# Engineering Design

## Experienced engineering and rigorous testing.

Not only are we able to design and engineer bespoke solutions for all your LNG docking and mooring specifications, we can test our tailored systems with full scale in-house testing capabilities.

Our Trelleborg SeaTechnik™ product range also undergoes full functional testing prior to installation and our test equipment is fully compatible with other SSL manufacturers.

Our fender systems are designed according to your project needs. Every aspect of the system down to the rubber compound used, will be tailored specifically to your performance requirements.

### The right solution

We take pride in tailoring project proposals to meet your needs, however exacting they are. When the project calls for an innovative, bespoke design, our engineers will present the right solution, not simply pages from a catalog.





# Research and Development

For over 30 years, we've been a world leader in innovation to meet the needs of ports and harbours all over the world. We've remained true to the principle of innovation, with a substantial staff of experts in research and development, ensuring we consistently provide new ways to meet increasingly demanding specifications.



## **Innovation**

Sometimes a more innovative approach is needed. We will assess the requirements of your project holistically and ensure that the solution we supply is the best possible fit for your needs.

## **Customized solutions**

Unfamiliar situations are familiar to us. Our in-house research and development facilities mean we can truly tailor a solution that fits your needs. For example, because there is no such thing as a standard rubber compound; we design and manufacture our fenders to meet your required performance, so that our products perform in the harshest conditions.



**Versatility**

Our understanding of the intricacies of docking and mooring, and the complex nature of gas loading and unloading safety systems mean we are constantly evolving our solutions to meet and exceed the specifications of your project, be this a FLNG, small scale or conventional LNG terminal. Our mission is to help you maximize the efficiencies of your operations.

**Compatibility**

We can work with you to integrate new solutions into existing projects, as our products can be used with those of other providers, and integrated seamlessly to provide full-service, bespoke solutions. Our SSLs rationalize the various connectors and communication protocols in a single product to ensure worldwide compatibility.





# A portfolio of LNG products

**Trelleborg Marine Systems designs, manufactures and commissions unique mooring hardware and monitoring software that is specifically configured and matched to your requirements. Our solutions, which are built around the latest field-proven technologies, will be tailored to the needs of your project by our multi-disciplined team of engineers.**

## **1. Quick Release Hooks and Capstans**

Quick Release Hooks are the basis of any advanced integrated mooring system and ensure the vessel is secured fast to the jetty by providing solid, reliable anchor points for mooring lines.

Our Quick Release Hooks are available with several options such as an integral capstan, remote hook release and mooring line monitoring. They can also be adapted to ensure the best solution is delivered for most docking situations.

An electric capstan is usually integrated into the system to remove the need for mooring crews to haul the lines in manually.

## **2. Mooring Instrumentation**

We design and engineer turnkey systems with integrated monitoring and remote release modules, which removes the need for jetty personnel to be close to the hook when a loaded mooring line is released – greatly reducing the risk of injury.

Our SmartHook® load monitoring software provides real-time readings of the load on mooring lines, enabling mooring crew and jetty operators to access essential data from the moment the mooring lines are attached to each hook.

## **3. Docking Aid Systems**

Our SmartDock® family of docking aid systems (DAS) monitor the approach and docking of vessels during berthing operations using lasers, differential GPS or Real Time Kinematic (RTK) GPS technologies.

Various standard and customized designs are available to meet the widest range of berthing situations, including fender impact management.

## **4. Environmental and MetOcean**

According to your needs, we can supply standalone or integrated environmental monitoring systems for both marine and offshore applications.

Systems are designed to allow multi-user access to environmental and MetOcean data, which can be made available to portable devices on the vessel during approach and whilst moored at the berth.

## **5. Integrated Control and Monitoring**

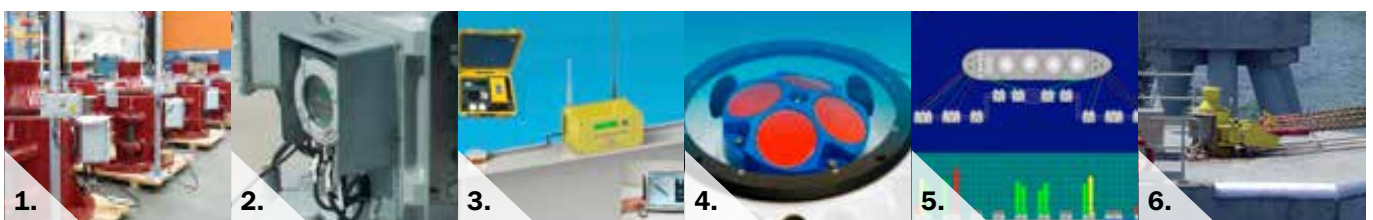
Our specialized systems display LNG carrier-to-LNG facility and/or FSRU interface data through a single marine monitoring system to improve operations, management and control. As all key data is displayed in real time, operators are able to make more informed decisions.

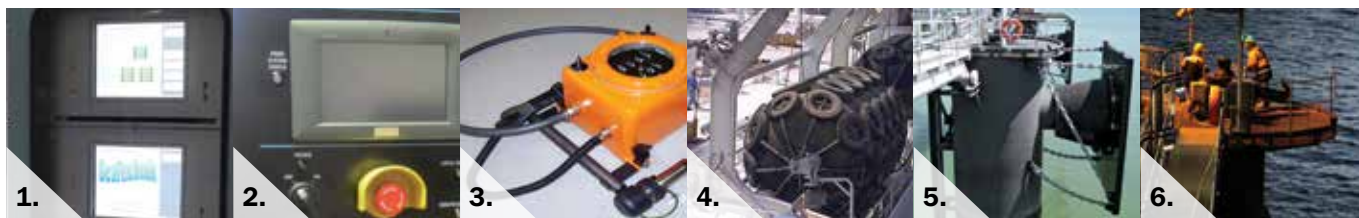
SmartHook® load monitoring, remote release, SmartDock® DAS and environmental modules are integrated into the Marine Control Room and the data can be networked or sent over wireless communications to other locations as required.

## **6. Quick Release Hook Compact Series**

Trelleborg has launched a brand new Quick Release Hook (QRH). The Quick Release Hook Compact Series combines the knowledge of Trelleborg's vastly experienced engineering team with FEA software, providing an optimized solution for small scale mooring applications.

The Quick Release Hook Compact Series features a compact design, which means a reduced footprint, minimizing the amount of deck space consumed. The Quick Release Hook Compact Series improves safety in mooring operations, featuring the capability to include remote release, which enables a controlled release of the mooring lines.





### **1. Smart LNGC Ship-Shore Safety Link System (SSL)**

Our Smart SSL system is the most advanced on the market, with simple electronic configuration to match any terminal and ensure worldwide compatibility. Our philosophy of continuous development means that compatibility isn't just ensured in the here and now, but with future systems too.

The Smart Fibre Optic and Electric modules provide a significant change to the operator interface and simplify control and set-up. Fibre optic, Electric and Pneumatic modules are totally independent to conform with ISO 28460.

The Smart Fibre Optic and Electric modules are both 6U in size and housed in a single 19" 6U rack module with a touchscreen user interface.

### **2. Universal Safety Link for Small Scale LNG transfer and LNG fuelling**

Our Universal Safety Link features integrated main and back-up safety link systems for LNG transfers as both fuel and cargo. Employing our Trelleborg SeaTechnik™ digital fibre optic technology, the system is compatible with large-scale Trelleborg SeaTechnik™ LNG SSL systems via adaptor and features a configurable system link for the transfer of other plant process control data. We can also offer an optional ESD control system for fuelling vessels, fuelled vessels and terminal applications.

### **3. Fibre Optic Active Test Unit (ATU)**

With potential damage to revenue and reputation incurred as a result of delays in loading and discharging LNG, our Fibre Optic ATU provides a portable way to verify the Fibre Optic Safety Link System on-board a ship, or installed on a shore terminal. The ATU gives you full assurance that systems are fully operational prior to docking.

### **4. Pneumatic Fenders and Fender Deployment Systems**

We specialize in the turnkey supply of fenders and fender deployment systems, purposely designed for FSRU and FLNG applications where deck space restriction applies.

### **5. High Performance Fenders**

All of Trelleborg's high-performance fenders including Super Cone and Parallel Motion fenders are Type Approved by PIANC and come in a range of compounds to suit various applications.

Trelleborg Marine Systems is a world leader in the design and manufacture of advanced fender systems. Our high-performance solutions combine low reaction force and hull pressure with good angular performance and rugged construction.

### **6. Spares and Service**

To gain the most benefit from our sophisticated systems, it is important that equipment is correctly maintained and that system operators are adequately trained in all aspects.

We have developed four levels of maintenance program for our mooring systems, designed to help our clients get the best performance, safety, reliability and longevity from their mooring systems.

Our entire range of Trelleborg SeaTechnik™ products is also supported by the Trelleborg SeaTechnik™ global service team, ready to support your operation 24/7.

Our unrivalled aftersales care means global support with local reach and knowledge. With staffed offices across the world, working to local time zones and languages, you'll never struggle to get in touch with us, wherever and whenever you need us.

**Learn more about the complex systems integration requirements for docking, mooring and transfer in FSRUs.**

**Download our whitepaper “Avoid the Disconnect” at <http://ow.ly/ugFqv> to find out more.**



Trelleborg Marine Systems designs, manufactures and installs bespoke fender systems, docking and mooring equipment, oil and gas transfer technology and vessel efficiency technology for marine environments all over the world. Our polymer engineering expertise also extends to our range of general marine products, including navigation aids and buoys.

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