

# Cryoline LNG Transfer solutions

**Cryoline LNG technology  
& Ship to shore applications**

FLNG Global 2017 Conference / Amsterdam / May 8<sup>th</sup>, 2017





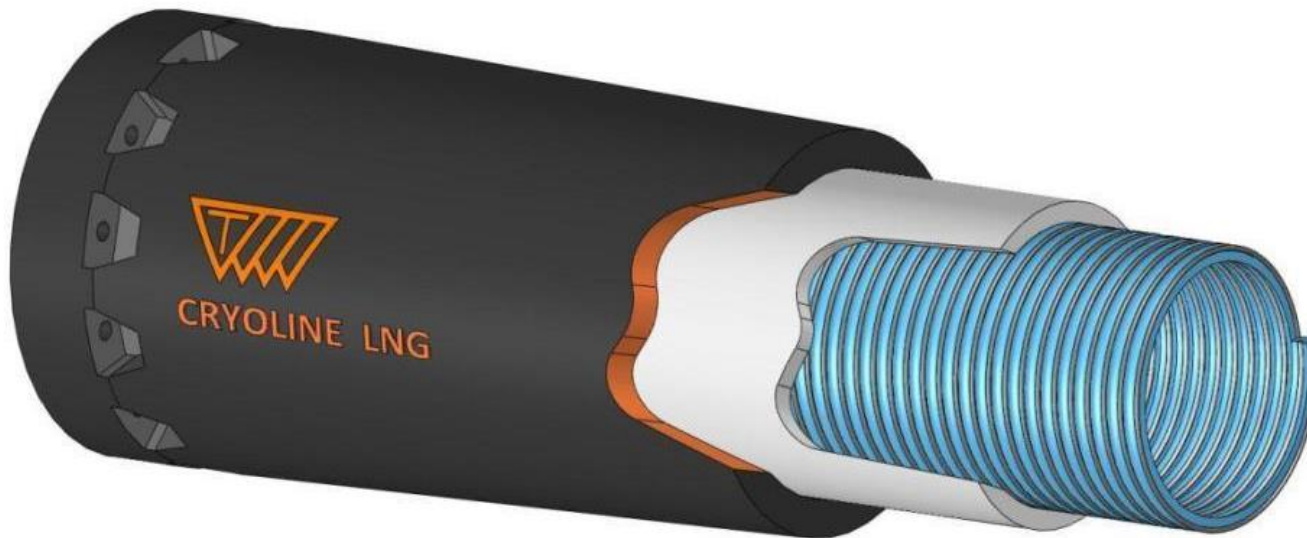
# Cryoline LNG Design presentation

**Re-thinking LNG transfer solutions  
using cryogenic flexible hoses**

# Cryogenic flexible hose-in-hose design

**Qualified according to  
EN 1474-2 standard**

- Combine high flexibility, reliability and long service life
- Minimum BOG generation
- Available from 6" to 20"



**Combination of proven technologies!**

Cryoline LNG – Patent pending application worldwide



# Cryogenic flexible hose-in-hose design

Qualified according to  
EN 1474-2 standard



**Inner hose**  
derived from composite hose



➔ **Combination of proven technologies!**

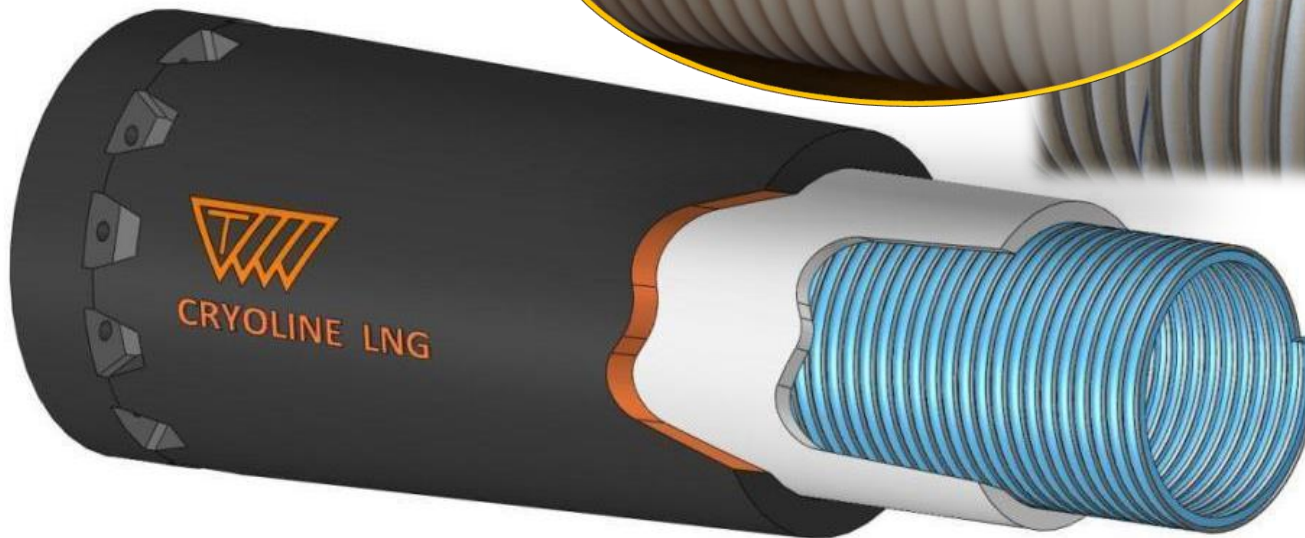
Cryoline LNG – Patent pending application worldwide



# Cryogenic flexible hose-in-hose design

Qualified according to  
EN 1474-2 standard

Continuous sleeve  
100% tight barrier



Combination of proven technologies!

Cryoline LNG – Patent pending application worldwide

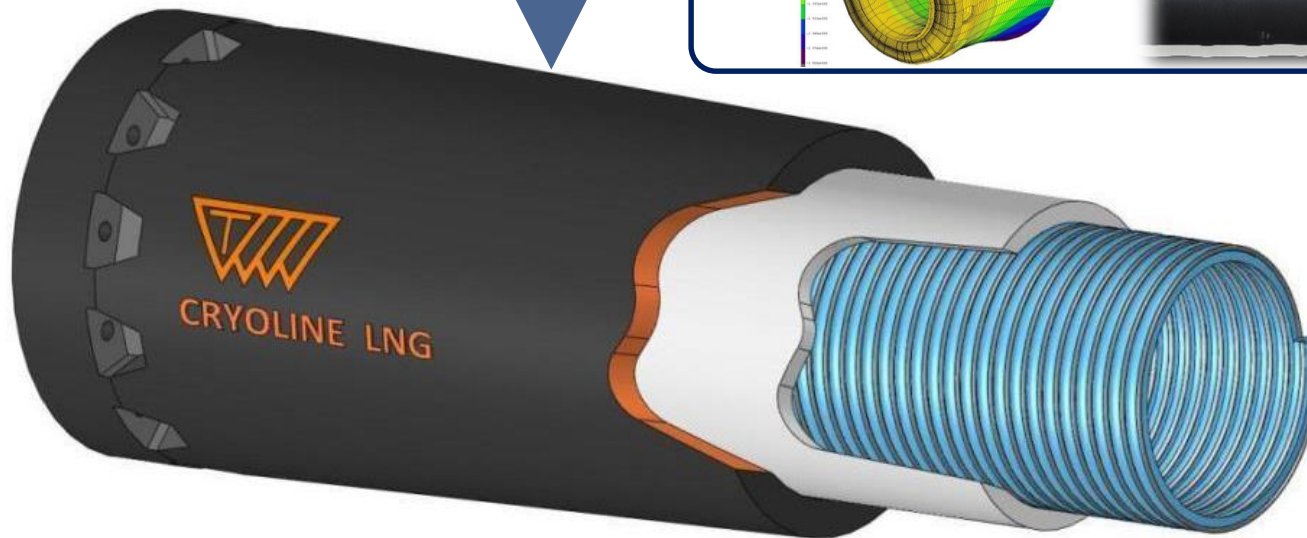
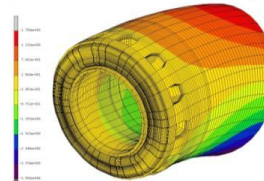


# Cryogenic flexible hose-in-hose design

**Qualified according to  
EN 1474-2 standard**

## Outer hose (API17K)

- Field proven in harsh marine environment
- Rubber reinforced with steel cables and steel rings



**More than 40 years of experience  
in oil transfer lines worldwide**



**Combination of proven technologies!**

Cryoline LNG – Patent pending application worldwide



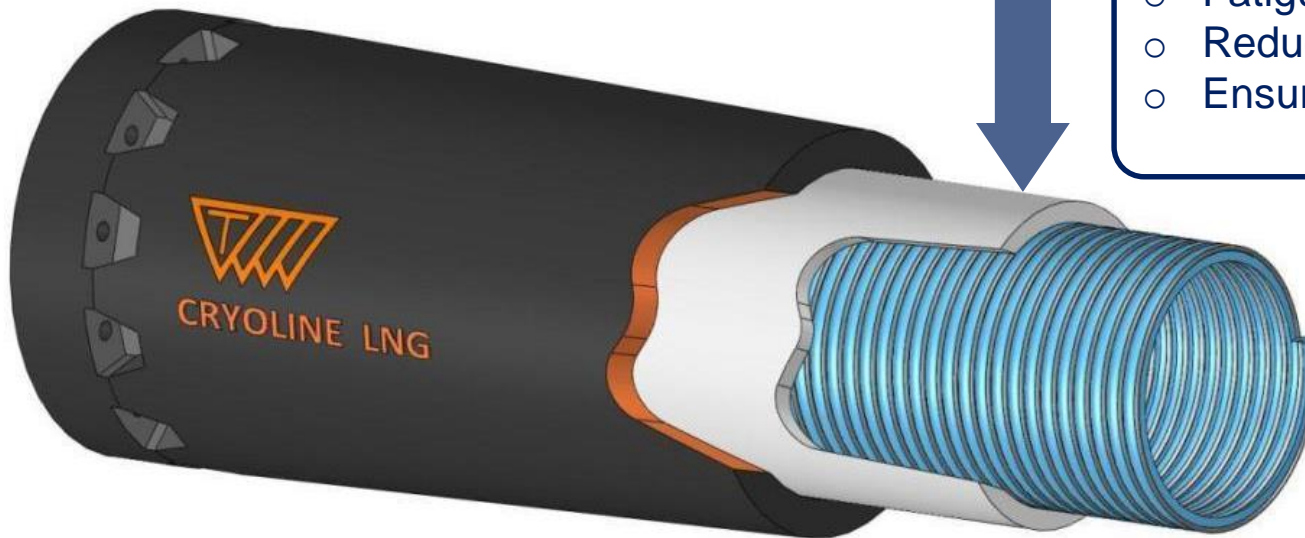
# Cryogenic flexible hose-in-hose design

Qualified according to  
EN 1474-2 standard



## Annular insulation

- Innovative material
- Orthotropic properties
- Fatigue resistant
- Reduces BOG generation
- Ensures the hose buoyancy



**Combination of proven technologies!**

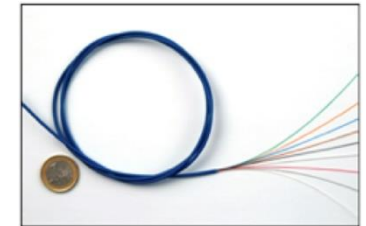
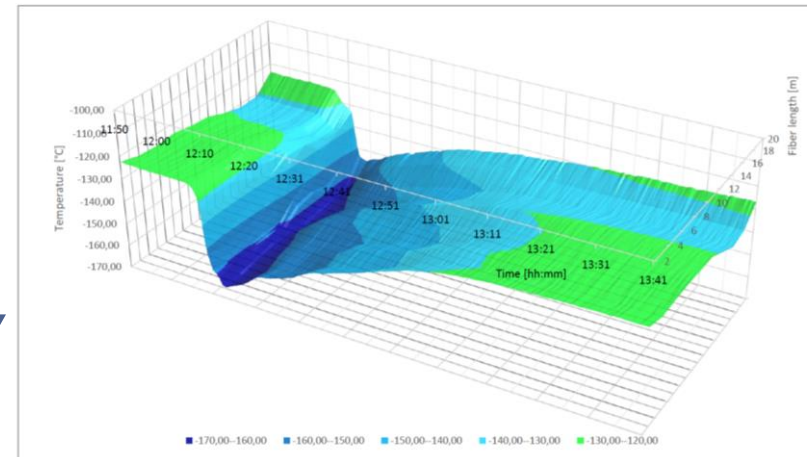
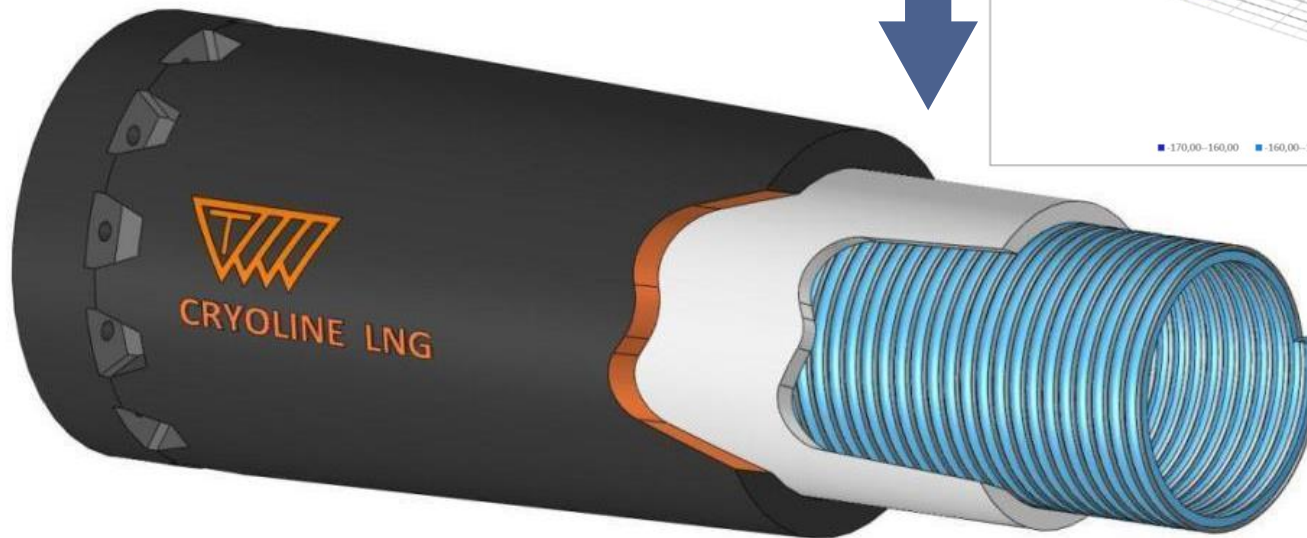
Cryoline LNG – Patent pending application worldwide



# Cryogenic flexible hose-in-hose design

## Monitoring system

- Optical fibers installed in the annulus
- DTS Raman thermal sensing
- Leak detection & Cool down follow-up



**Combination of proven technologies!**

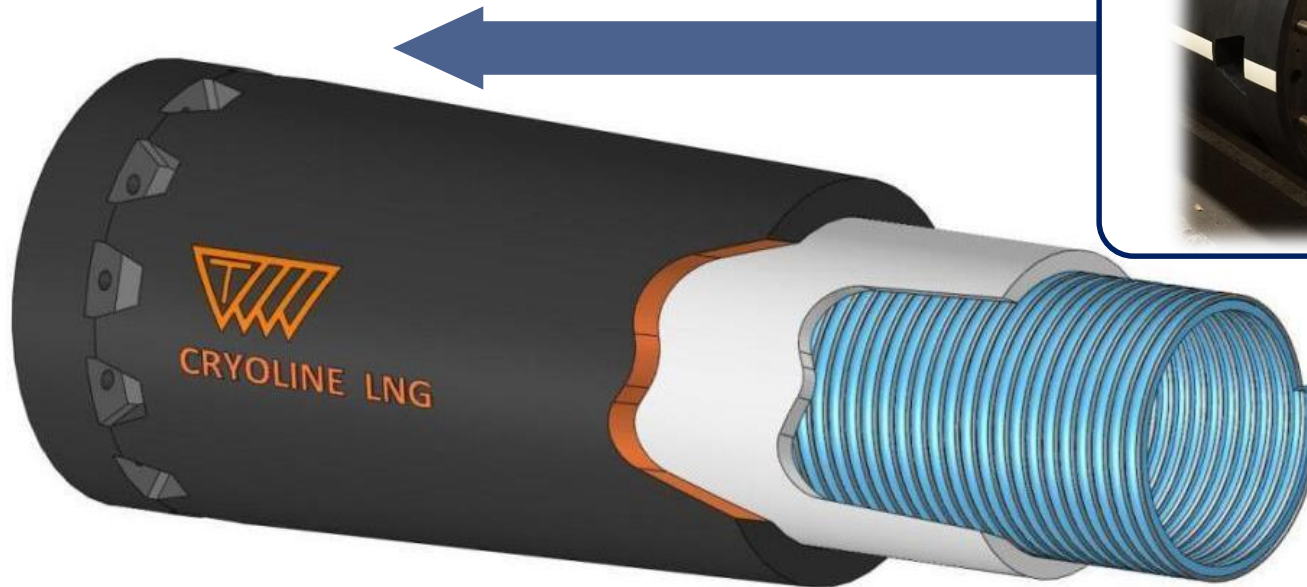
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# Cryogenic flexible hose-in-hose design

Qualified according to  
EN 1474-2 standard

Connection system



Combination of proven technologies!

Cryoline LNG – Patent pending application worldwide



# Cryoline LNG is qualified according to EN1474-2



➔ 90% of the tests performed at Trelleborg facility

Cryoline LNG – Patent pending application worldwide



# Cryoline LNG is qualified according to EN1474-2



**BUREAU VERITAS**  
1828

**CERTIFICATE of COMPLIANCE**  
**QUALIFICATION TEST PROGRAM EN 1474-2**  
**N° E&P11949-C-2016-002 REV. 0**

This is to confirm that the prototype hose tests programme described in the EN 1474-2 standard has been successfully performed and evaluated for:

**Name of Manufacturer:** TRELLEBORG INDUSTRIE SAS  
**Place of Manufacture:** Clermont Ferrand, France  
**Product:** Cryogenic Floating Flexible Pipe Cryoline LNG  
**Description:**

- Internal diameter : 20" (500 mm)
- Hose in hose flexible with multilayer polyfilm composite inner hose (with UHMWPE sleeve), annular with orthotropic insulation layers and rubber bonded outer hose (garage and steel ring), completed with end-fittings and annulus monitoring system
- Detailed layer-by-layer description is given in datasheet ref. 43041 Rev01

**Reference standard:** EN 1474 (2008) Design and testing of marine transfer systems  
Part 2: Design and testing of transfer hoses

**Maximum Allowable Working Pressure:** Up to 2.0 MPa (20 bar)

**Minimum Bending Radius:** 2.8 m

**Design temperature range:**

- 196 °C to +40 °C

**Service:**

- Liquefied Natural Gas (LNG)
- Vapour Gas Return Line

**Application:** Dynamic applications, Floating configuration

In the verification process the prototype fabrication and the tests have been witnessed as well as the dissection of the flexible pipe prototypes. It has been demonstrated that the above Cryogenic Floating Flexible pipe Cryoline LNG has undergone and met EN1474-2 test requirements (refer to table in Appendix A for more details).

The following reservation is made with respect to the ambient burst test:

- The failure during the ambient burst test occurred at 80 bar. The EN 1474-2 required an ambient burst pressure of 5 times the Maximum Allowable Working Pressure (e.g. 100 bar). It is to be noted that the cryogenic burst has reached the EN 1474-2 criteria (leakage occurred at 105.8 bar).

Evaluation of design and limit state prediction methodologies will be evaluated as part of Type Approval activities upon review of design rules and completion of an extended full scale fatigue test program beyond EN 1474-2 requirements (by end of 2016).

In case of changes in the design, conditions of use, manufacture or quality control procedures of the above referenced item, the present Certificate would de facto lose its validity.

Issued in Paris on April, 27<sup>th</sup> 2016

*D. Ameline / F. Migeon*  
Lead engineers

For and on behalf of Bureau VERITAS  
*Veriney*  
MARINE & OFFSHORE DIVISION  
SUNF & Jacket Unit Manager

This certificate is delivered within the scope of the BUREAU VERITAS Marine & Offshore Conditions of Sale.

➔ Available range from 6" to 20"

Cryoline LNG – Patent pending application worldwide

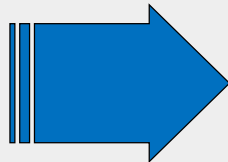




# Ship-to-shore Floating LNG transfer

## Small scale Applications

# Small scale ship to shore system



## Enable safe LNG transfer with floating lines:

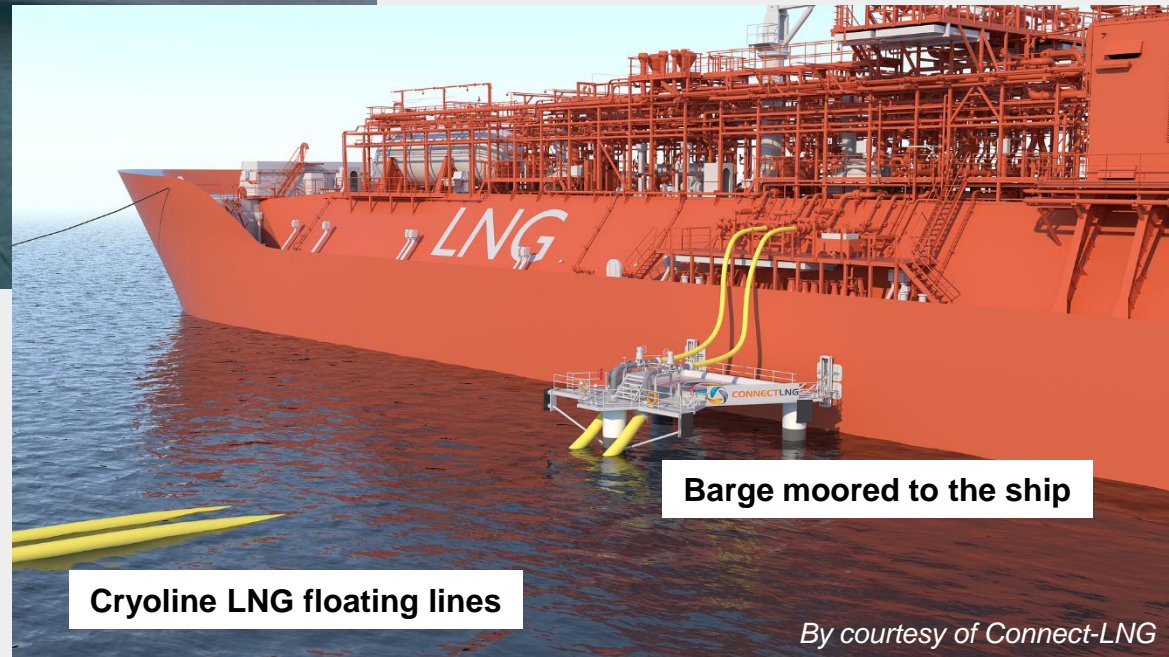
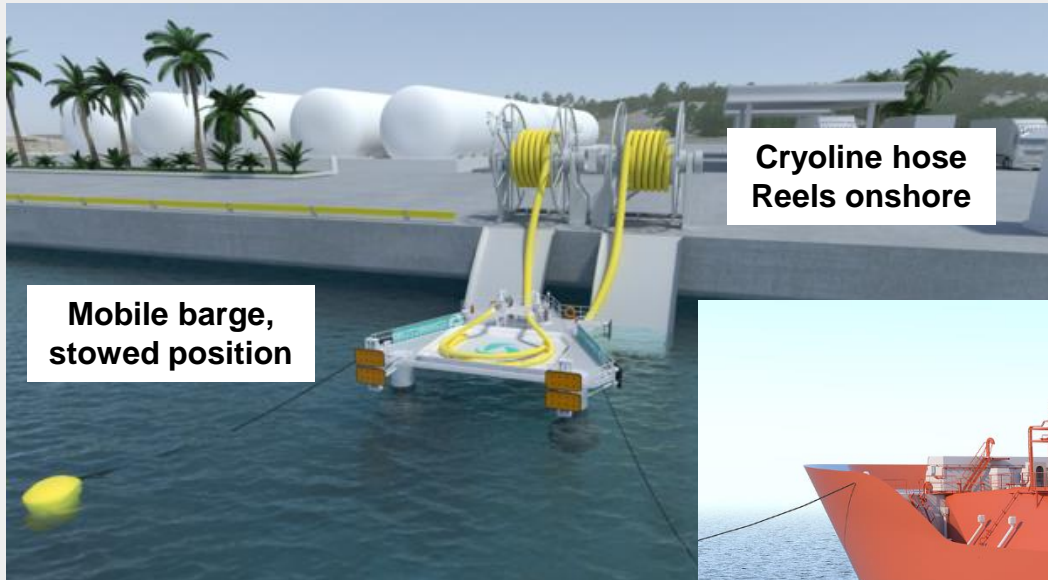
- Reduced CAPEX
- Low environmental footprint
- Full range of bore diameters from 6" to 20"

*By courtesy of Connect-LNG*



# Small scale ship to shore system

## Universal Transfer System

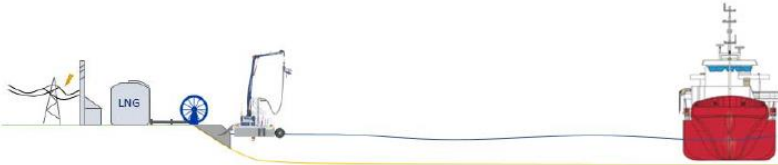




# Small scale ship to shore system



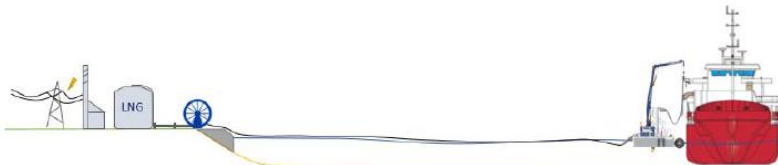
## Floating Transfer Terminal



The FTT is moored at the shore terminal whilst the LNG C moors itself parallel to the shore.

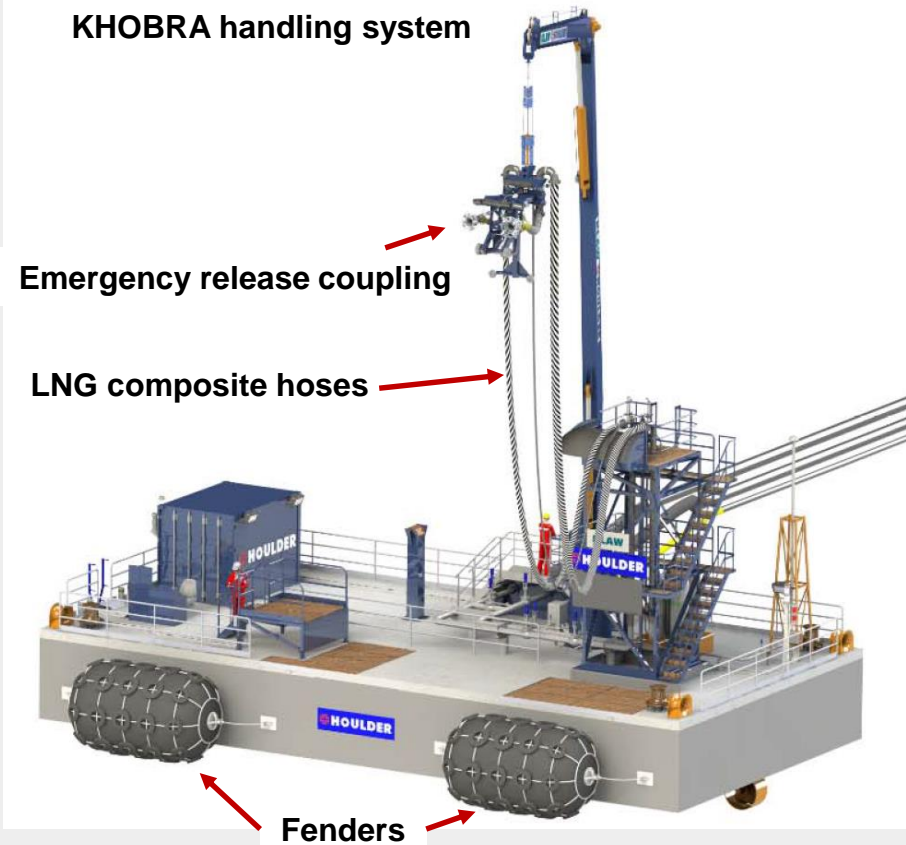


The FTT barge transits out to the LNG C whilst the reel feeds out the Cryoline floating hoses.



The FTT barge moors itself to the LNG C and the KHOBRA connects to the receiving vessel manifold.

KHOBRA handling system



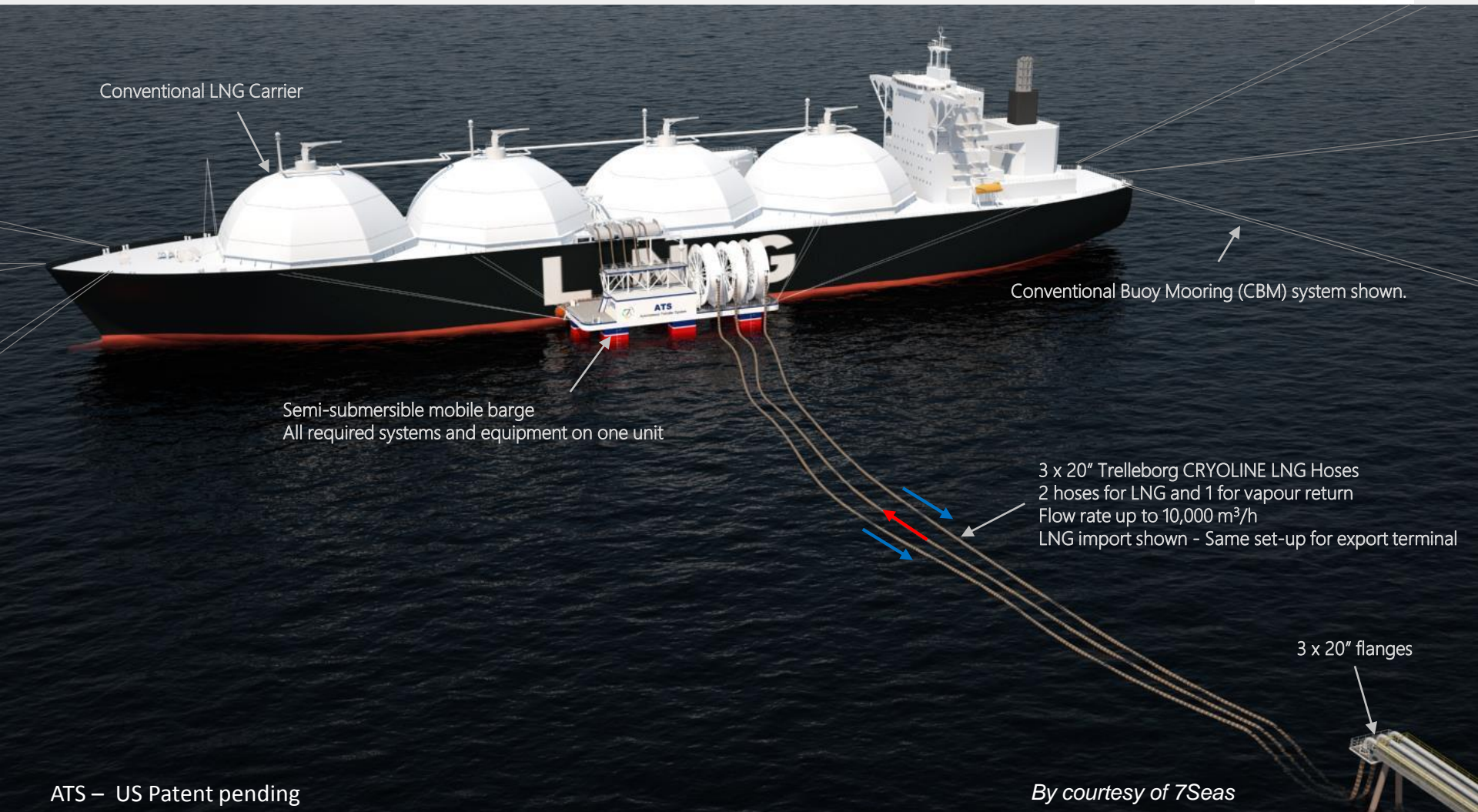
*By courtesy of Houlder*



# Ship-to-shore Floating LNG transfer

## Large scale applications

# Autonomous Transfer System

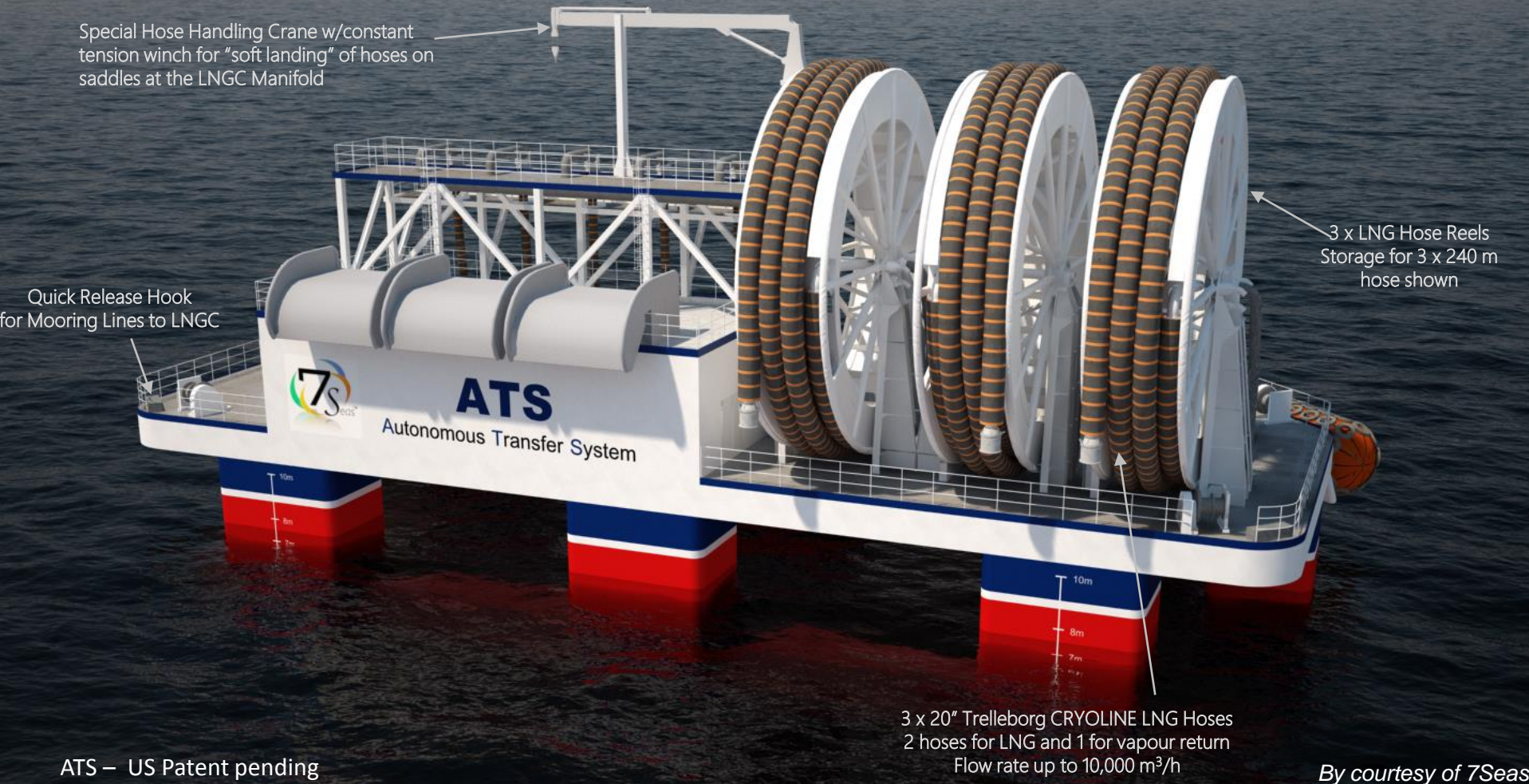


ATS – US Patent pending

By courtesy of 7Seas



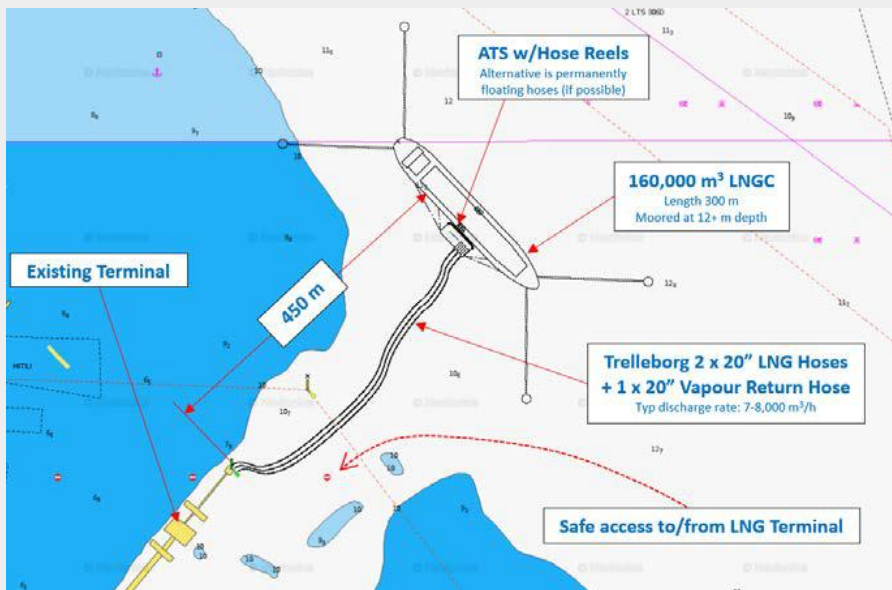
# Autonomous Transfer System



# Case studies using cryogenic flexible hose

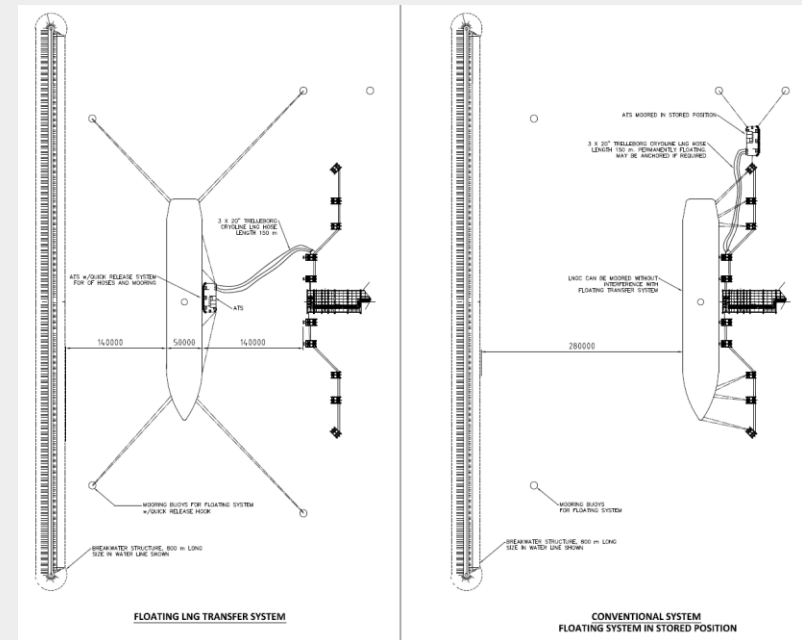
## Existing LNG Import Terminal in Europe

- Terminal dredging limited to receiving 70,000 m<sup>3</sup> LNGCs
- Client would like to upgrade terminal to receive up to 130,000 m<sup>3</sup> LNGCs



## Existing LNG Export Terminal

- Terminal exposed to long period swell creating LNGC motions and reduced uptime
- Floating solution increases the operating window



# Multiple applications...

- Increase operability of existing import / export LNG terminal
- Upgrade existing LNG import / export terminal (small to large scale)
- Transfer LNG on regasification or liquefaction facilities
- Fuel onshore gas power generation units with LNG

...based on a qualified scalable technology





# Small scale LNG transfer systems

Trelleborg small-scale LNG hose-in-hose transfer systems enable:

- **COST SAVINGS** **Major CAPEX & OPEX saving** compared with traditional transfer solutions
- **QUICK INSTALLATION** **Significant reduction** of engineering, construction and installation lead time
- **SIMPLE TO OPERATE** **Improved operability** up to 80%, leading to less downtime and higher productivity
- **SAFETY** **Designed for fatigue resistance** in even the most hazardous conditions

*Trelleborg's game-changing Cryoline Small-Scale LNG hose-in-hose transfer systems enable re-thinking of conventional wisdom in small-scale LNG transfer solutions for ship-to-shore applications.*



[www.trelleborg.com/fluidhandling](http://www.trelleborg.com/fluidhandling)