A smart LNG Offloading to Conventional LNG Carriers in Severe Open Sea Environments

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Technip
take it further®

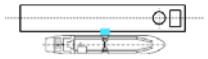
FLNG offloading state of the art

Expected design features

- LNG loading of conventional/unmodified LNG carriers.
- High operability (up to at least Hs = 4 m).
- Large separation between units providing protection against risk of collision & process upsets.
- Minimize LNG transfer lines length (→ minimize pressure drop/BoG).
- Use of proven or qualified technologies.

Current side-by-side and tandem offloading systems do not satisfy all wishes…

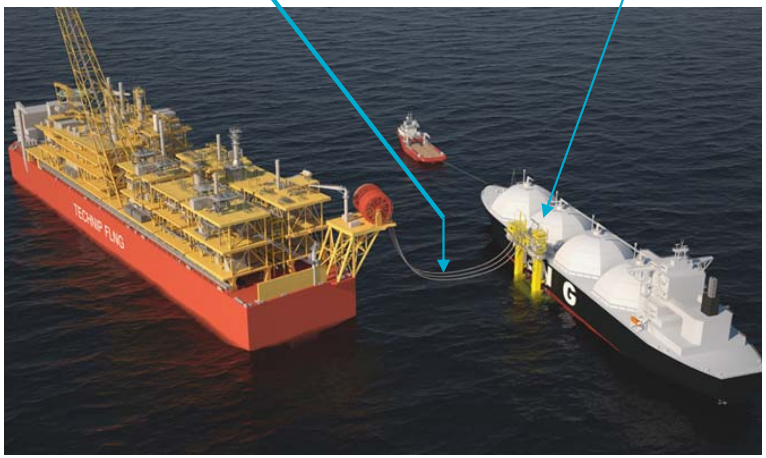
FLNG offloading state of the art

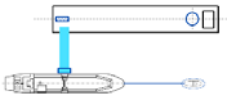
	Side-by-side Midship loading	Tandem Bow loading	HiLoad LNG Tandem Midship loading
			
LNGC Fleet	**Conventional** (no DP, midship manifold)	**Dedicated** (w/ or w/o DP, Bow Loading System)	**Conventional** (w/o DP, midship manifold)
Waves/ Operability	**Up to Hs 2.5 m**	**Up to Hs 5.5 m**	**Up to Hs ≥ 4 m**
Separation Distance (Collision & Process upset)	**Close vicinity**	**Large distance**	**Large distance**
LNG Transfer Length/Efficiency	**≈ 30 m**	**≈ 150 m**	**≈ 350 m**
LNG Transfer Technology	**MLA Qualified**	**Aerial flexible pipe Qualified**	**Floating flexible pipe Under qualification**

Can we Take LNG Offloading Further?

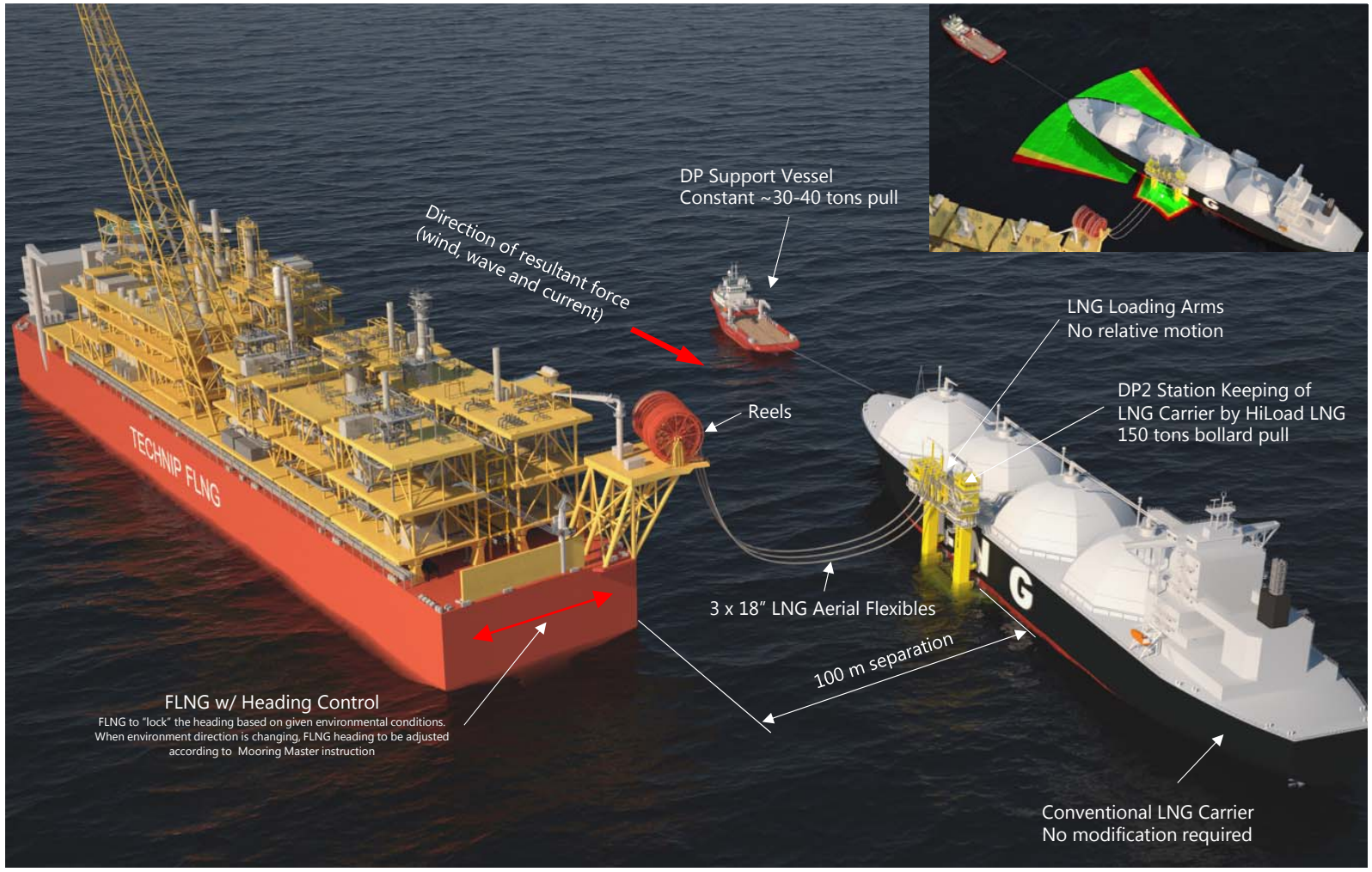
HiLoad LNG Parallel Loading System

A smart solution meetings all expectations

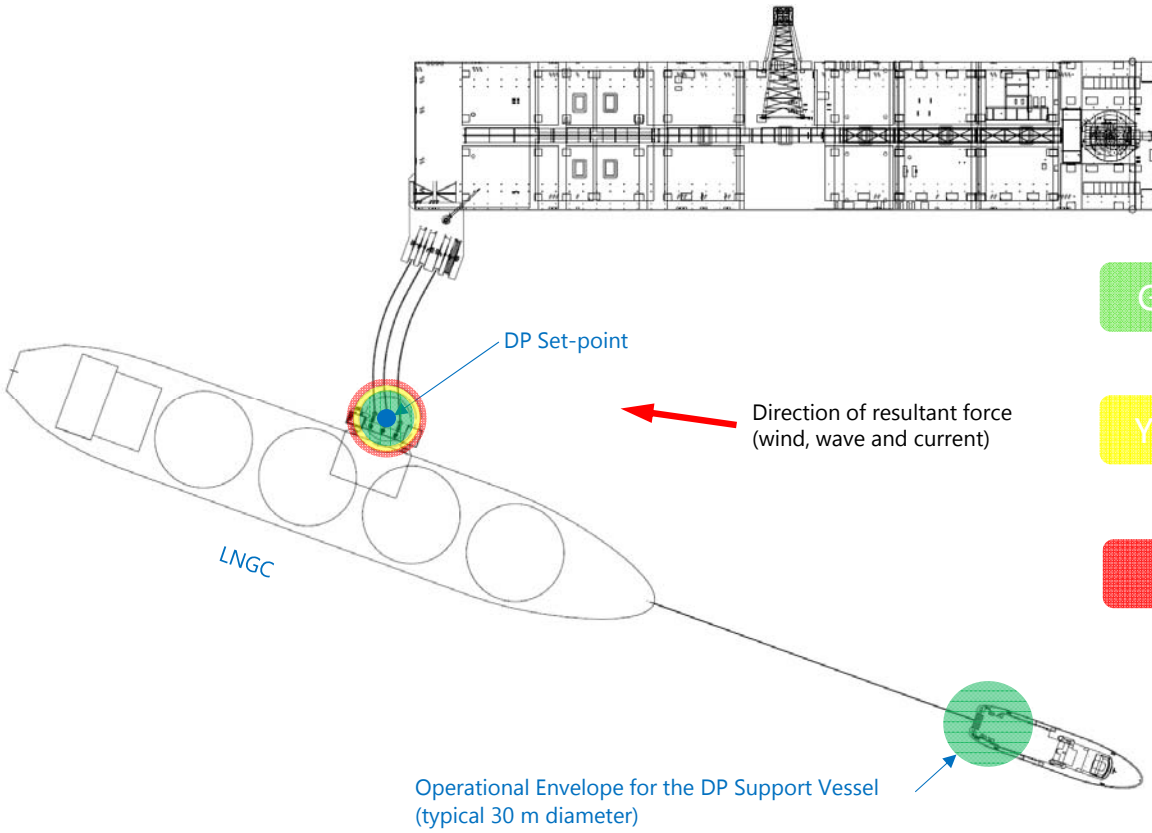


	HiLoad LNG PLS Midship loading
	
LNGC Fleet	Conventional (w/o DP, midship manifold)
Waves/ Operability	At least Hs 4 m
Separation distance (Collision & Process upset)	Large distance
LNG Transfer Length/Efficiency	≈ 100 m
LNG Transfer Technology	Aerial flexible pipe & MLA Qualified

HiLoad LNG Parallel Loading System



Operational Envelope – LNGC Position Keeping

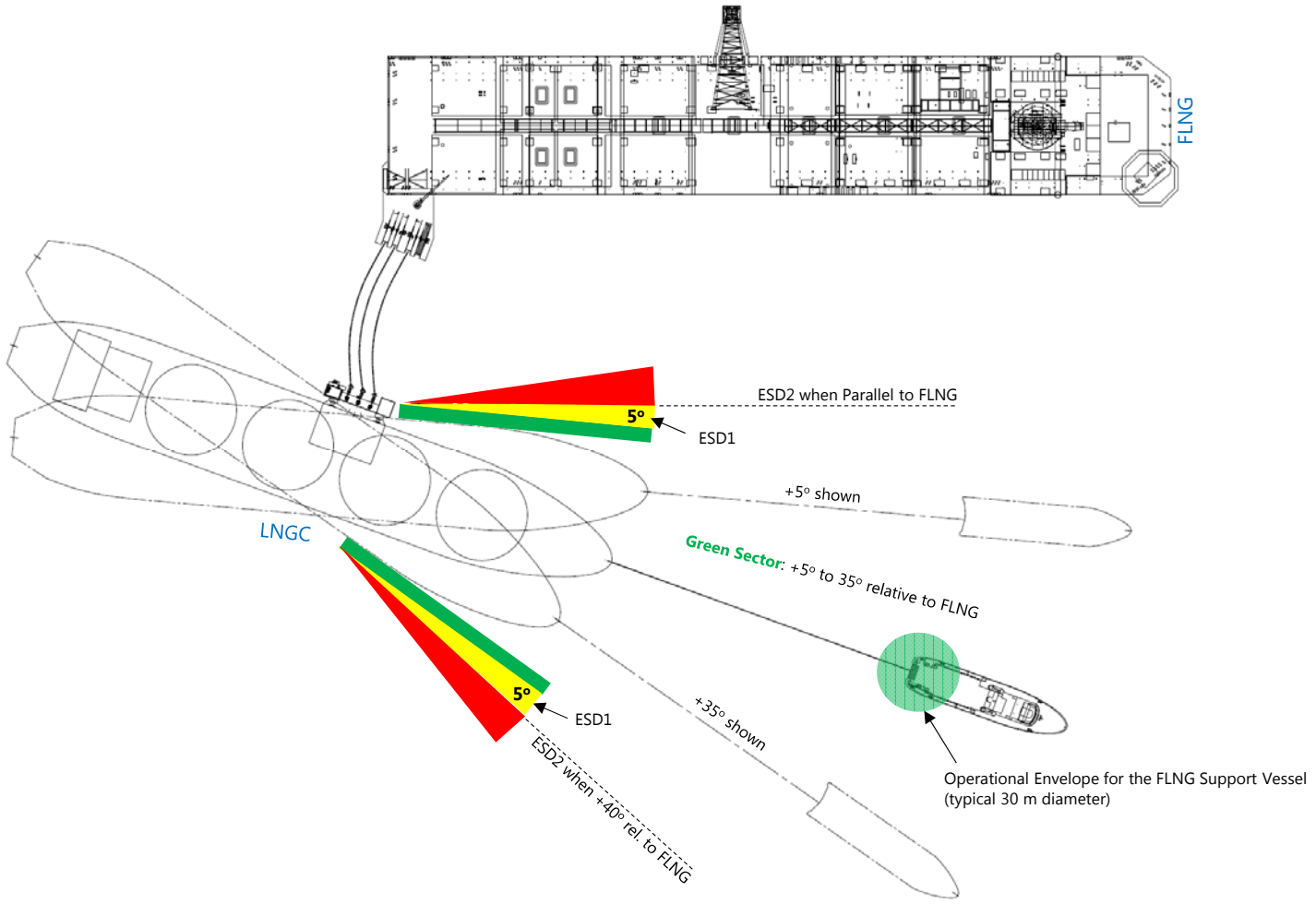


Green — **Normal LNG Transfer Operation**
Diameter: 20 m

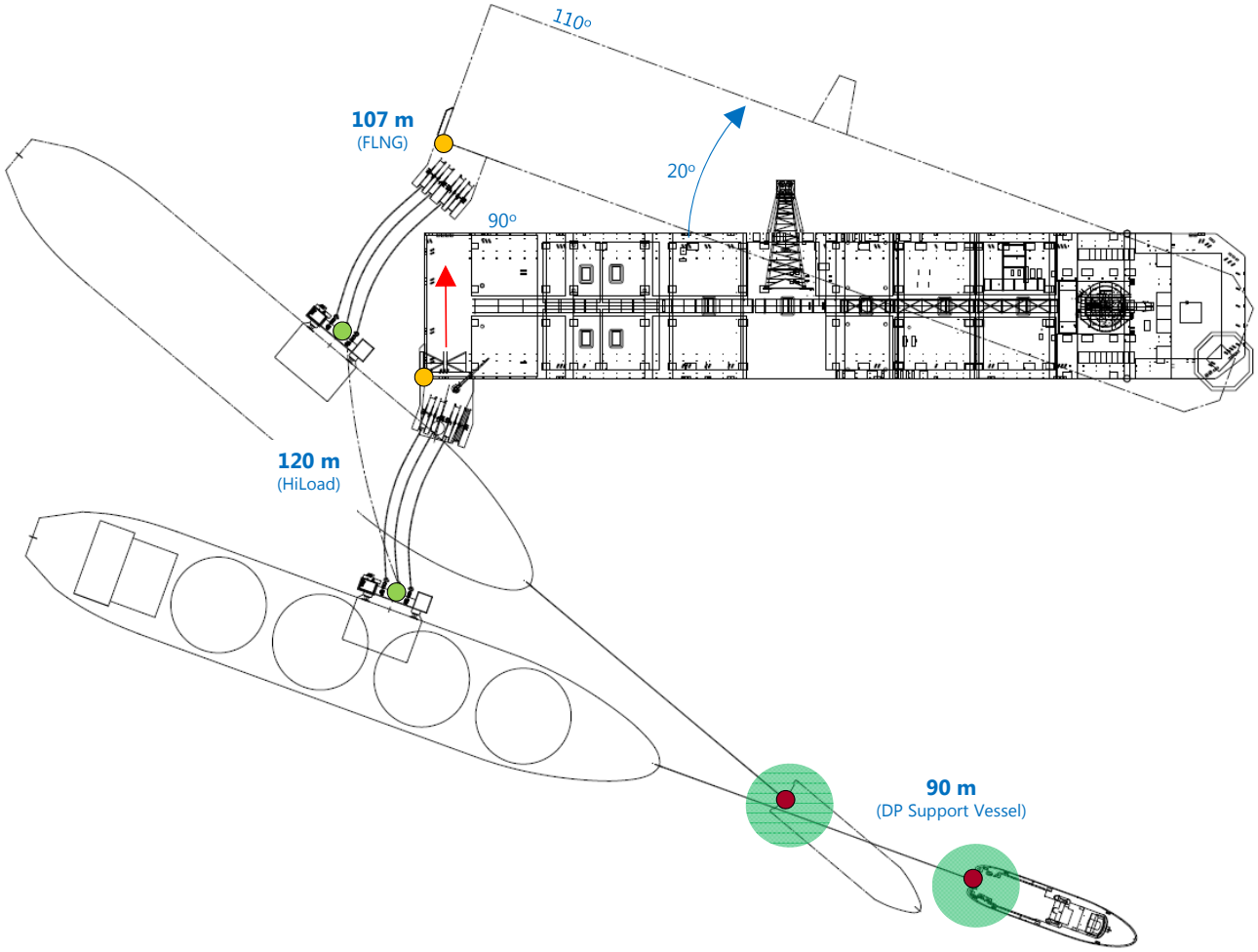
Yellow — **ESD 1:** Stop LNG Transfer and close valves
Width: 2.5 m

Red — **ESD2:** Disconnect the LNG Flexibles and prepare to move LNGC away from the FLNG
Width: 2.5 m

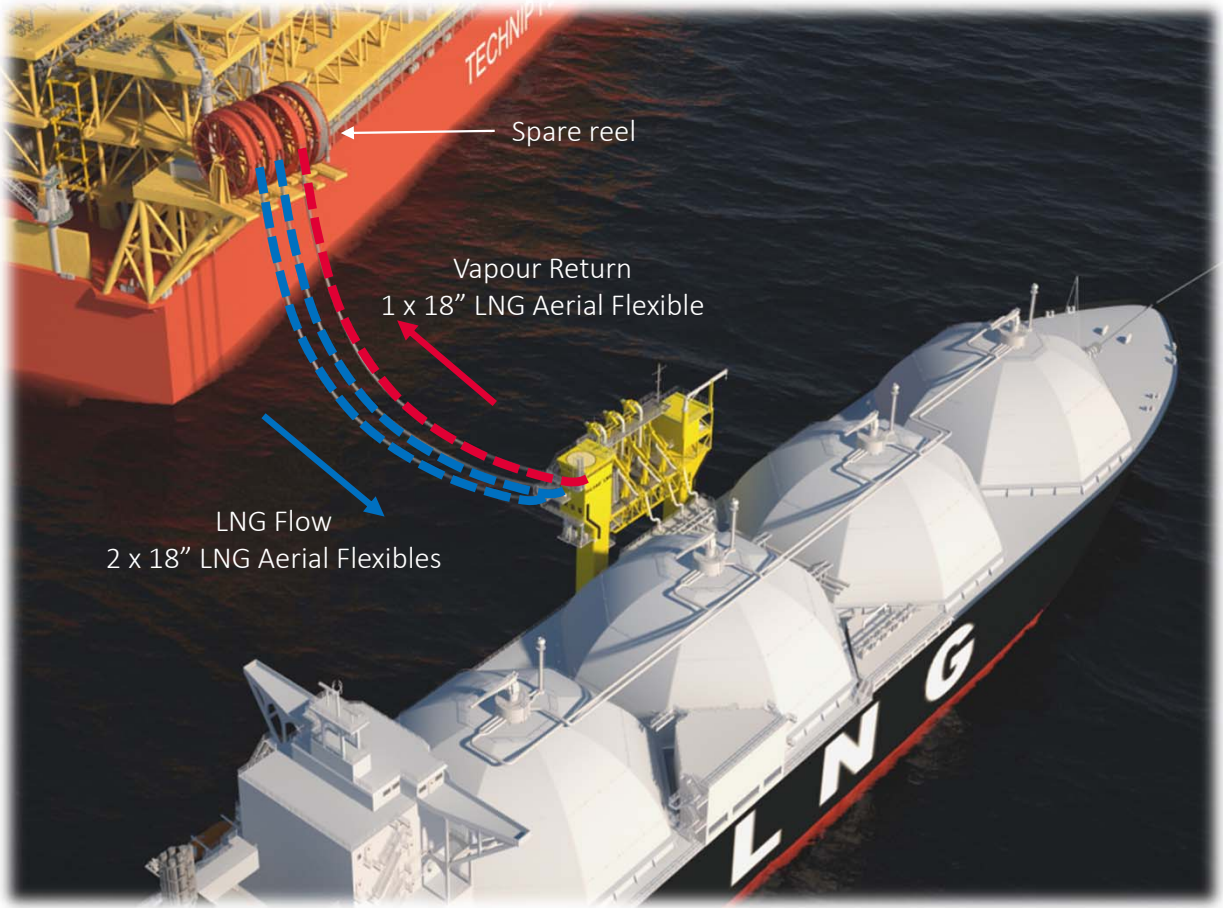
Operational Envelope – LNGC Heading Control



Change of FLNG Heading

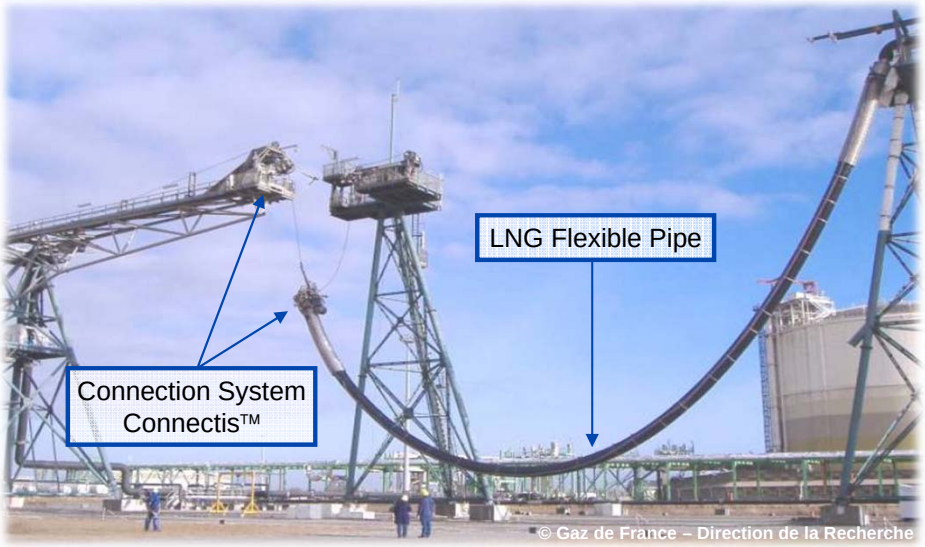


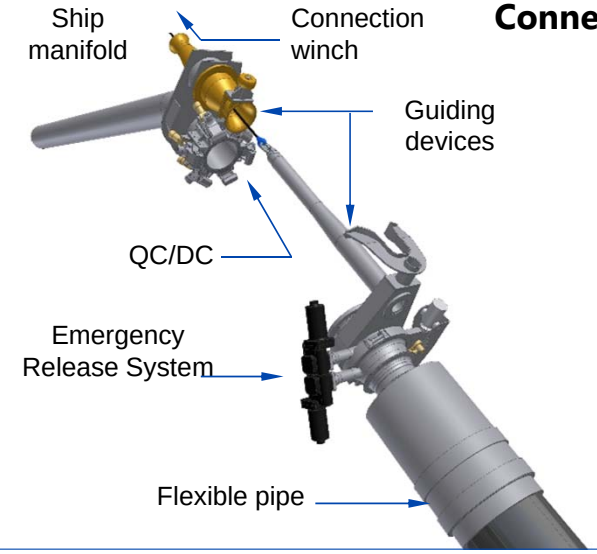
LNG Fluid Transfer with Aerial Flexibles

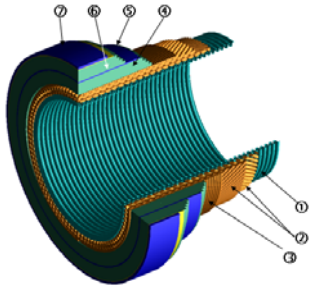


Proven or qualified technologies

LNG transfer – Amplitude-LNG Loading System (ALLS)







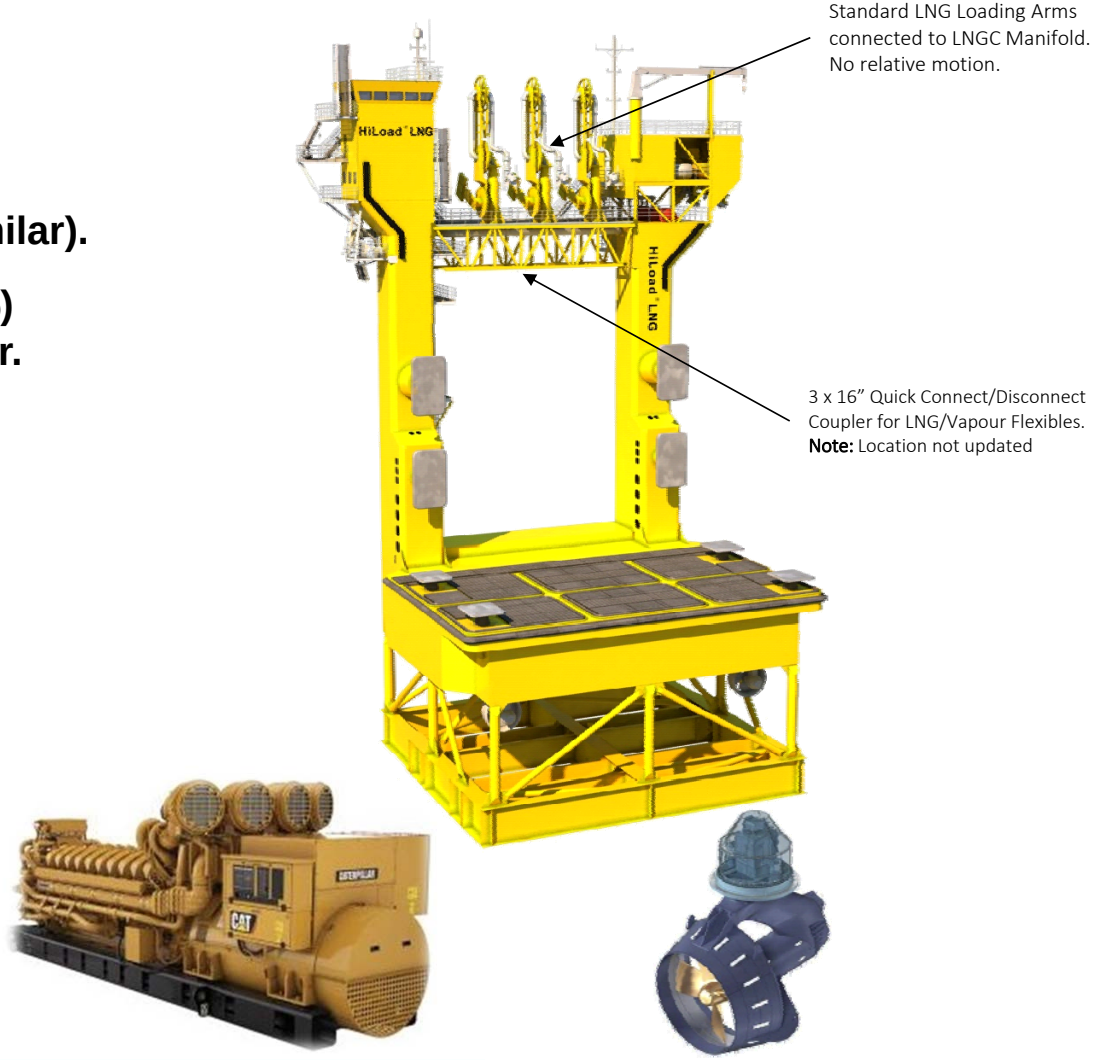
7	External sheath
6	Insulation layer
5	Intermediate sheath
4	Insulation layer
3	Synthetical fibers spiral
2	Synthetical fibers armour
1	Corrugated tube

Emergency Release System based on two field proven high performance butterfly valves by KSB Amri, double offset disc, metal to metal seat, fire safe, long tightness life and strong autoclave characteristics.

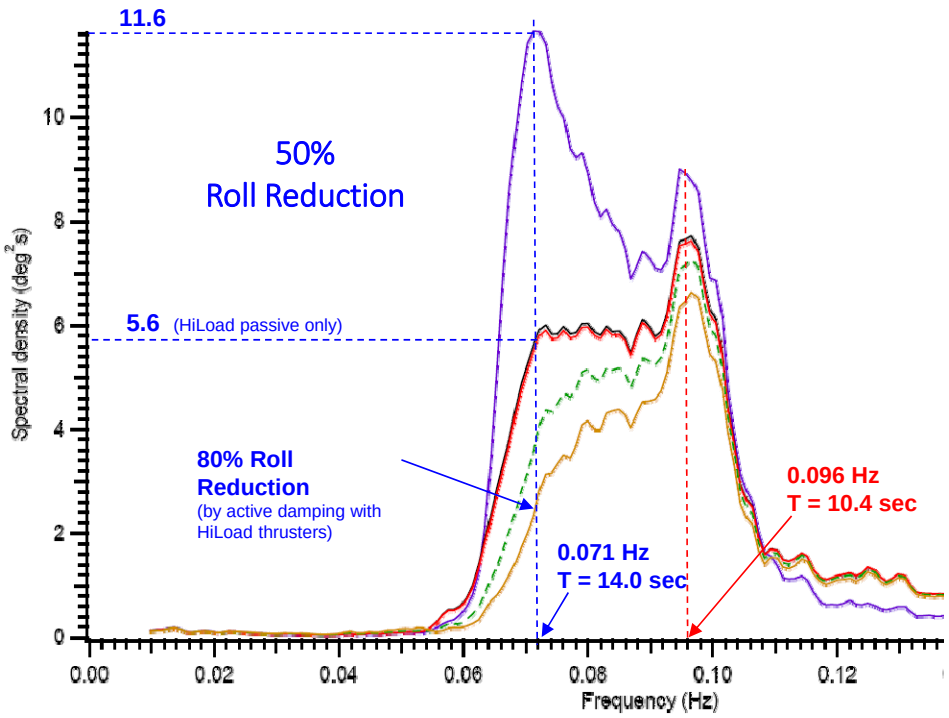
Proven or qualified technologies

DP station keeping by HiLoad DP

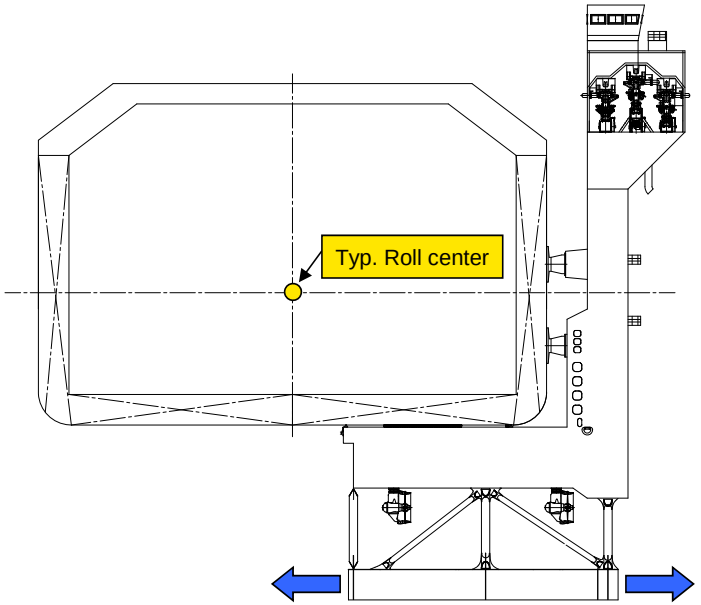
- **4 x 2800 kW diesel engines (CAT C175/60, MTU 20V4000P83, or similar).**
- **4 x 2300 kW azimuth thrusters (4 x 50%) Compact Azipod or mechanical thruster.**



Roll Damping by HiLoad keel = Reduced Sloshing



Case 1 = LNGC without HiLoad
Case 2 = LNGC with HiLoad (passive)
Case 3 = LNGC with HiLoad (constant thrust)
Case 4 = LNGC with HiLoad (thrusters - active)
Case 5 = LNGC with HiLoad (thrusters - active - higher power)



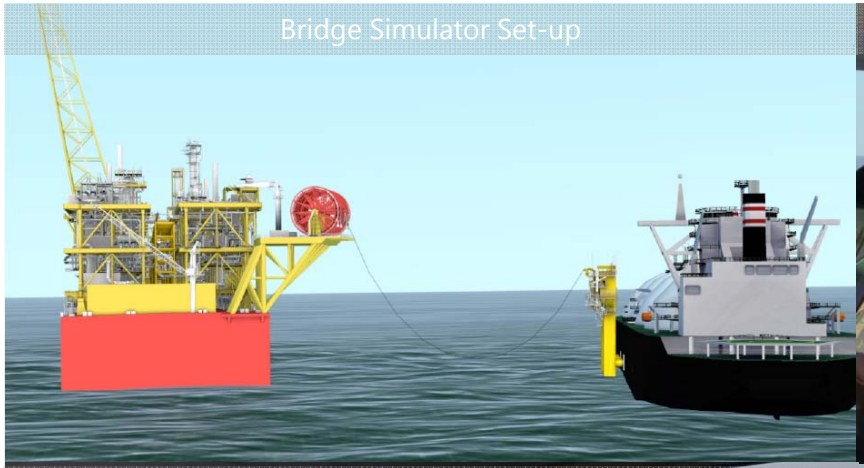
Main roll damping effect for waves with periods in [8s ; 15s]

UP to 50% ROLL REDUCTION
(by passive damping from HiLoad only)

UP to 80% ROLL REDUCTION
(by active damping from HiLoad thrusters)

DEMO at MARIN Simulator – Sept 2015

Bridge Simulator Set-up



LNGC Bridge at MARIN Simulator

View from LNGC Bridge during LNG Transfer

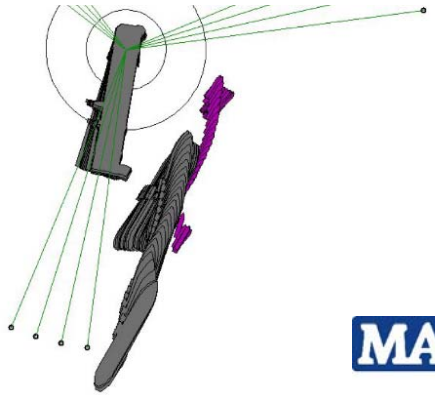
View from LNGC Bridge during Approach to LNGC

DEMO at MARIN Simulator – Sept 2015

HiLoad Master at the Bridge of the HiLoad Vessel

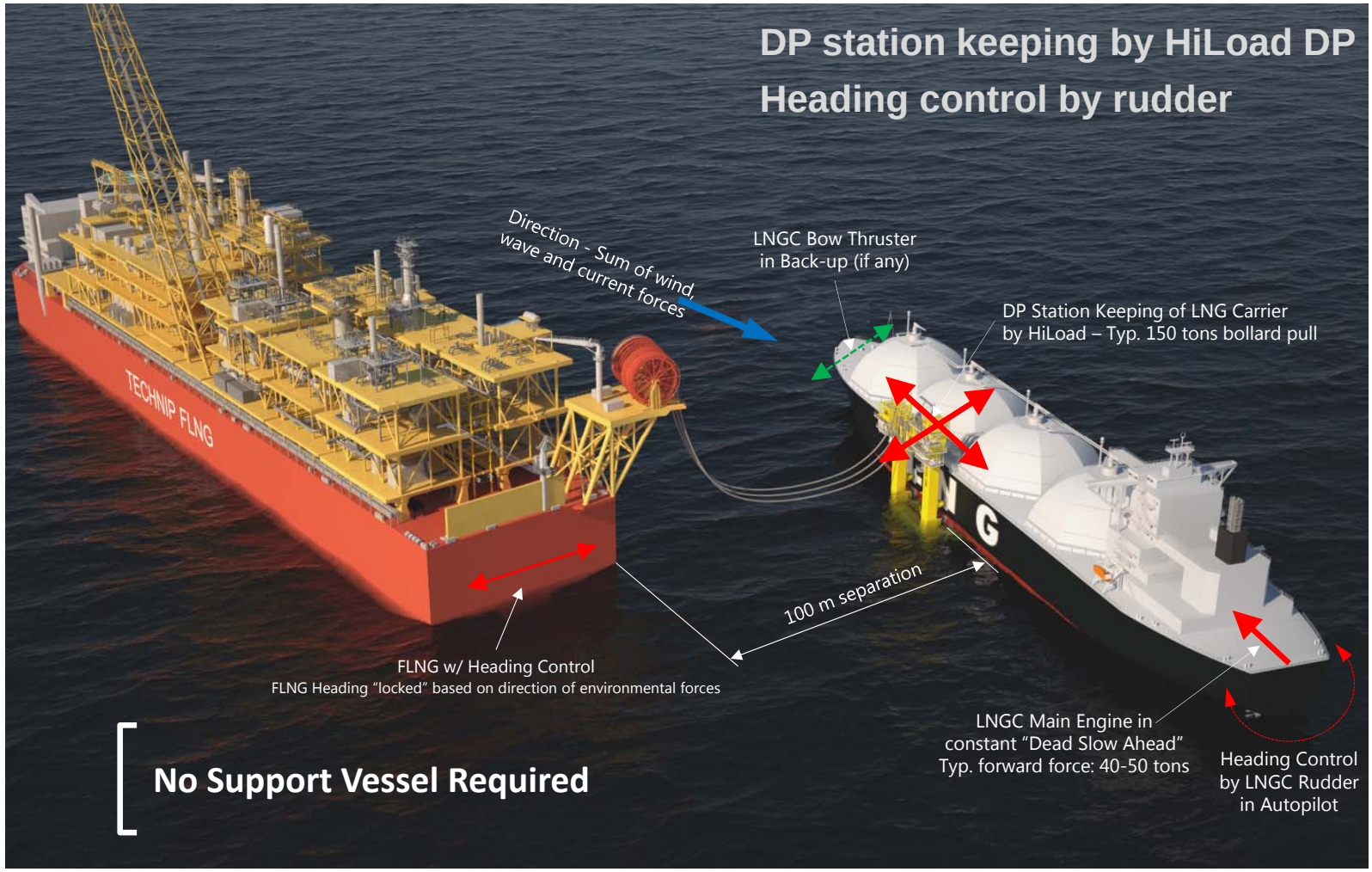
Mooring Master at LNGC Bridge during Approach

Tug Master

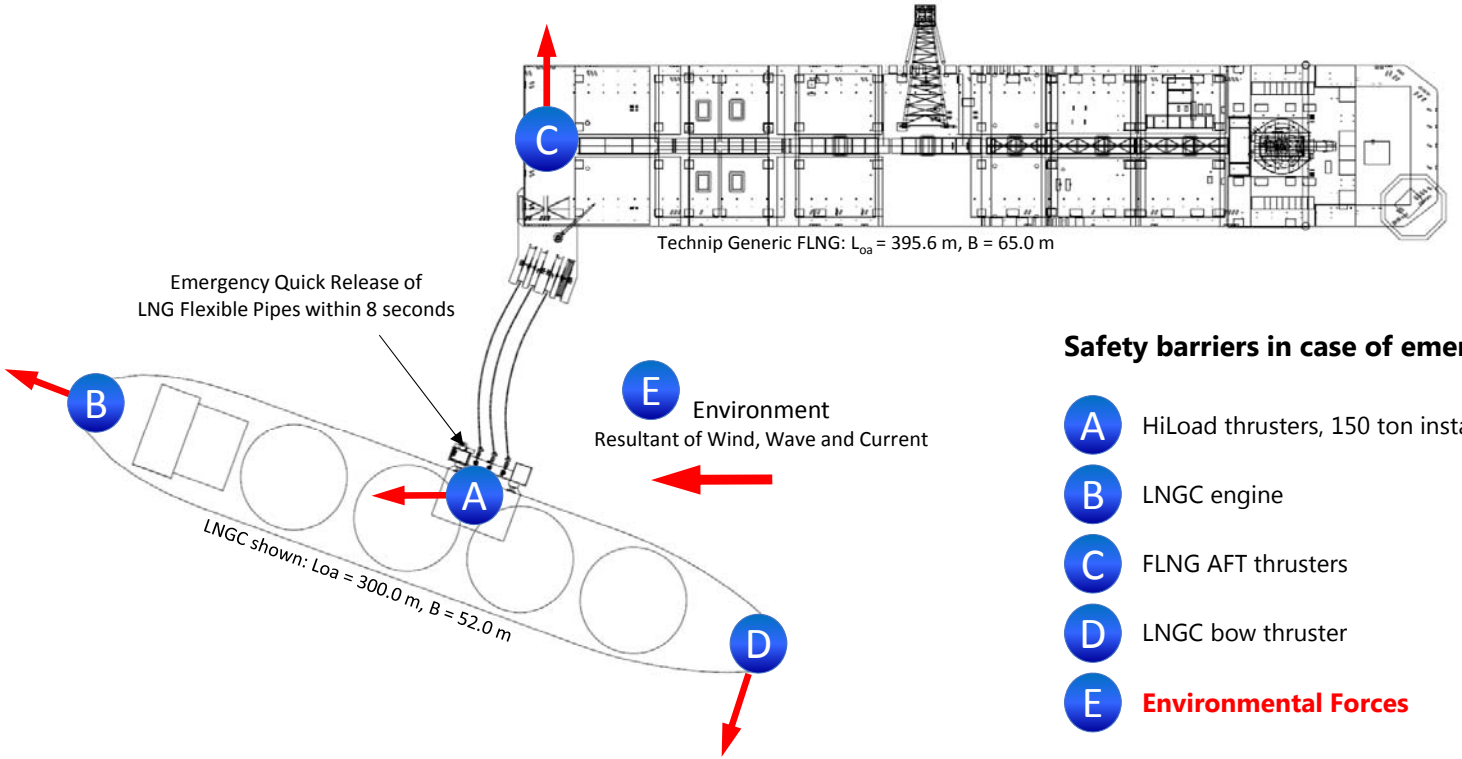


Typ. LNGC Position Trace during Approach

LNGC Heading Control by Rudder



Active & Passive Safety Barriers



Safety barriers in case of emergency escape:

- A — HiLoad thrusters, 150 ton instant bollard pull in any direction
- B — LNGC engine
- C — FLNG AFT thrusters
- D — LNGC bow thruster
- E — **Environmental Forces**

HiLoad LNG PLS is a Fail Safe solution

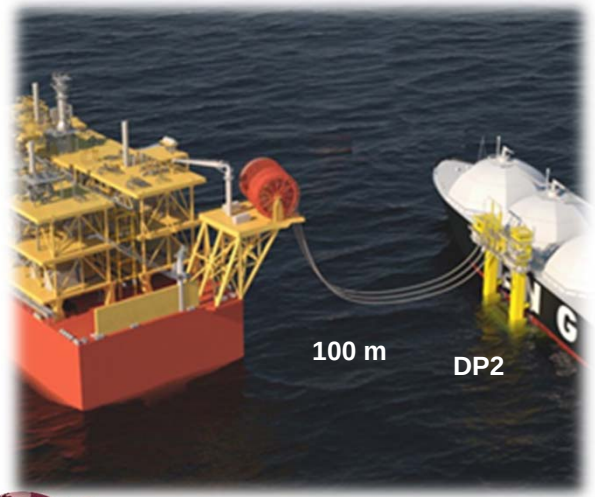
Conclusion

HiLoad LNG PLS Combines the advantages of Side by Side and Tandem

SAFETY

Large separation distance: 100 m

No personnel transfer via crew boat all travels safely to LNGC with HiLoad



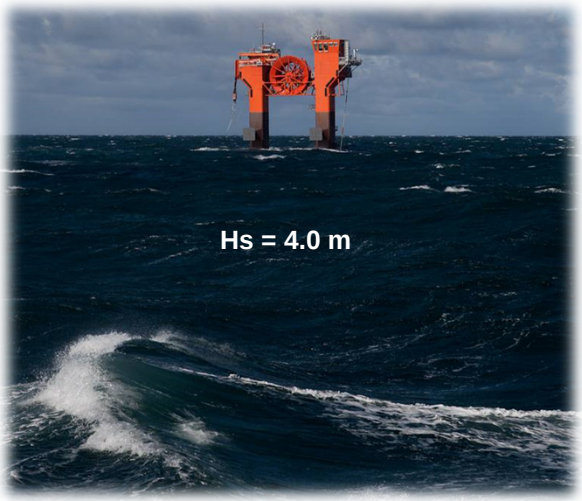
EFFICIENCY

Operation in up to Hs 4.0 m

Increased offloading operability

Roll Reduction of LNGC

DP2 Station Keeping of LNGC by HiLoad



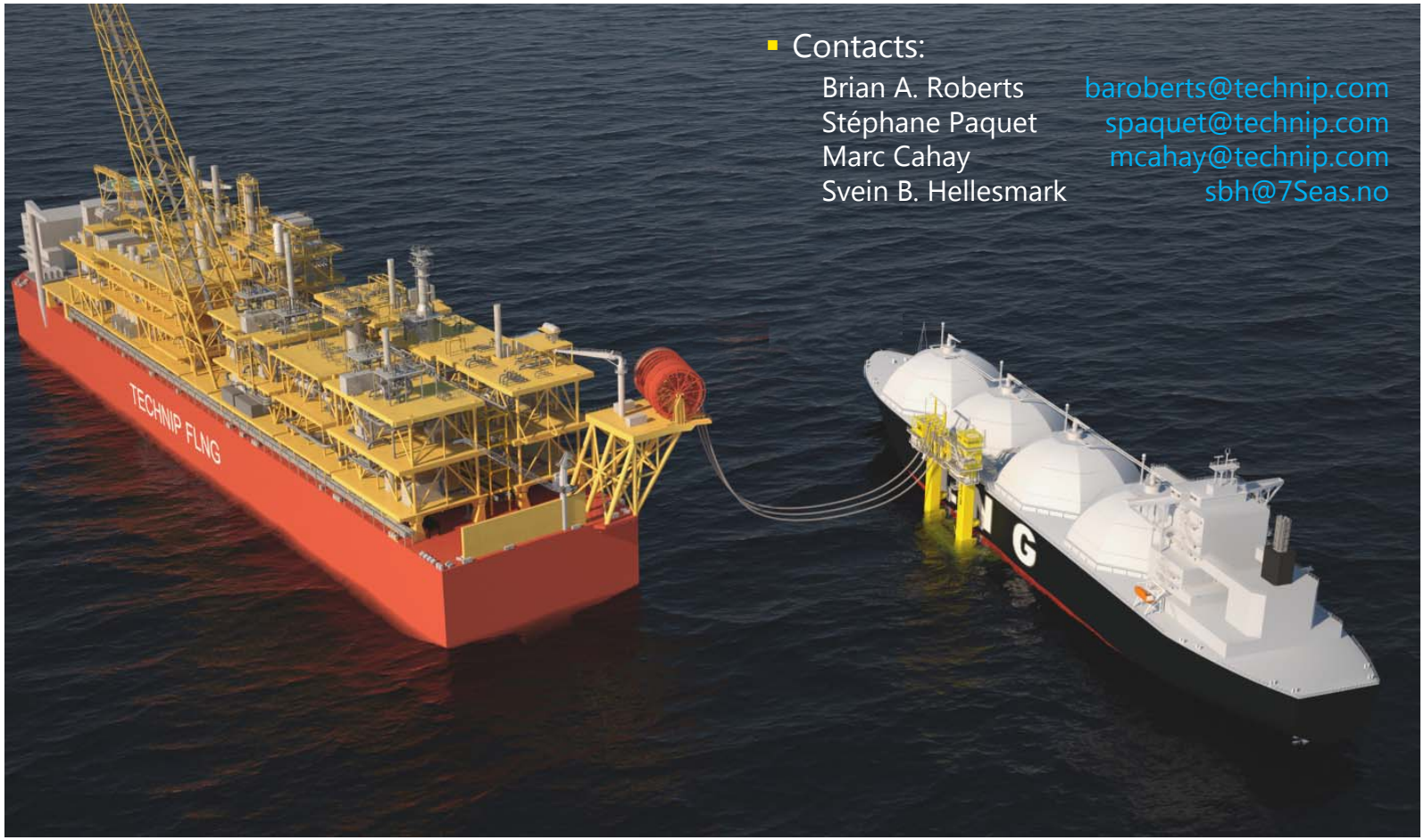
FLEXIBILITY

Enables use of any conventional LNGC

Even non-DP LNGC

Tug is not strictly required (efficient heading control with rudder)

Thank you



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