



# Floating LNG innovation with Electric Marine Loading Arms

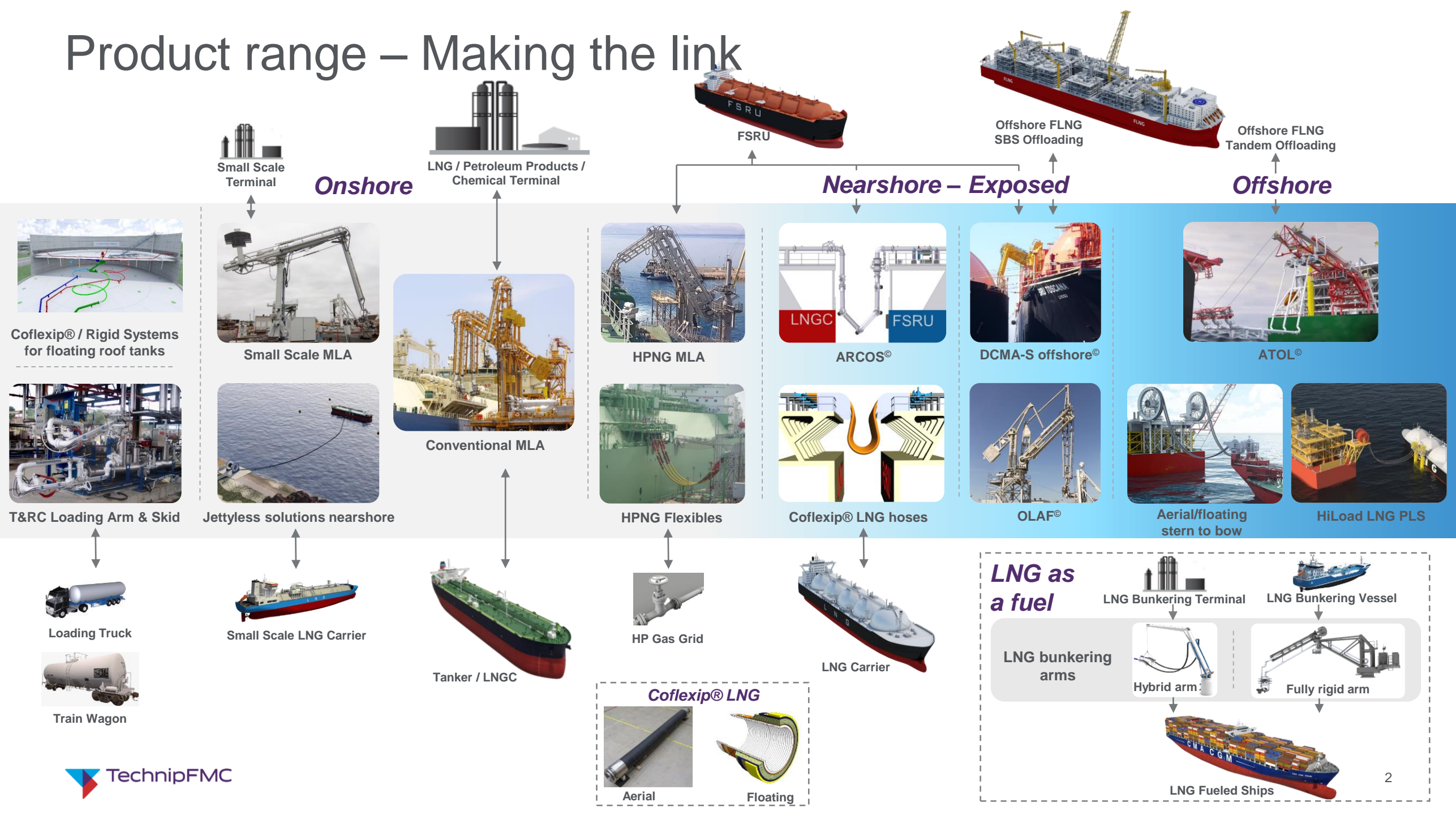
FLNG Global – Amsterdam

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R&D manager Loading Systems

May 15<sup>th</sup>, 2018

# Product range – Making the link



# Context & objectives

# Context

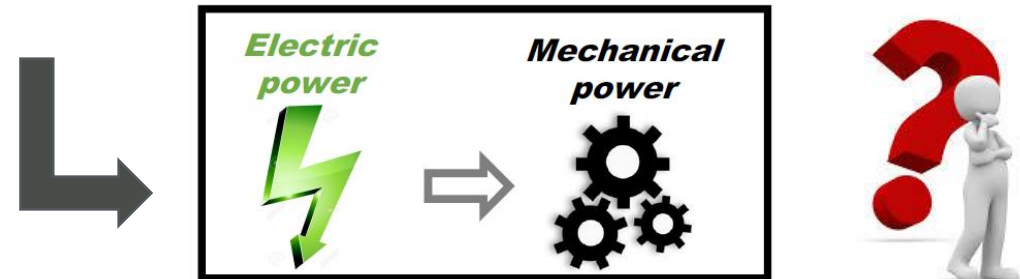
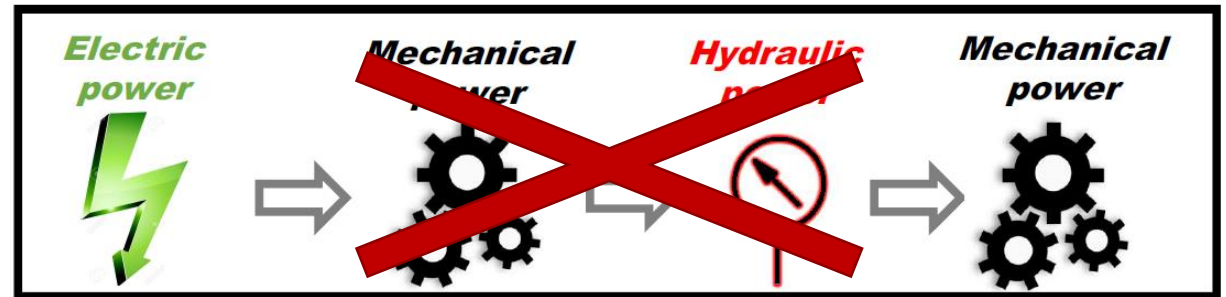
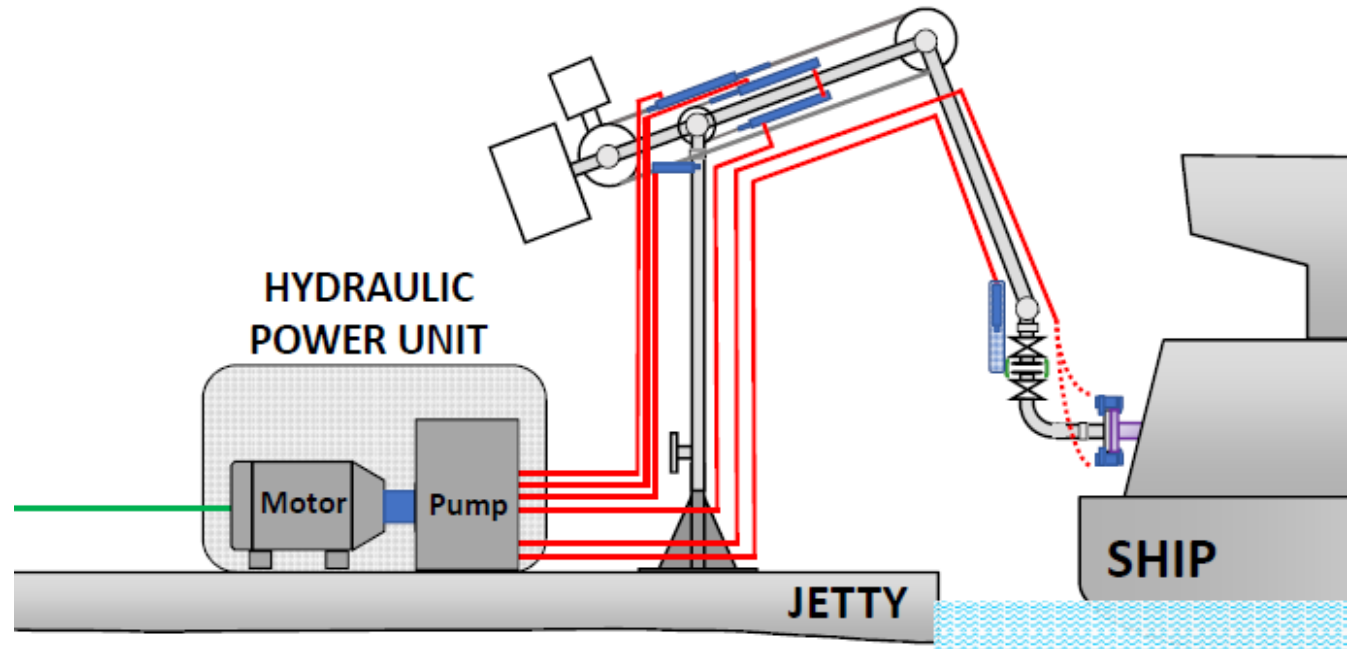
**Hydraulic systems have been the most cost effective power for the last 50 years, however...**





# Context

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# Objectives

**TechnipFMC Loading Systems** launched a development program to design and qualify a fully electric marine loading arm, with the objectives of:

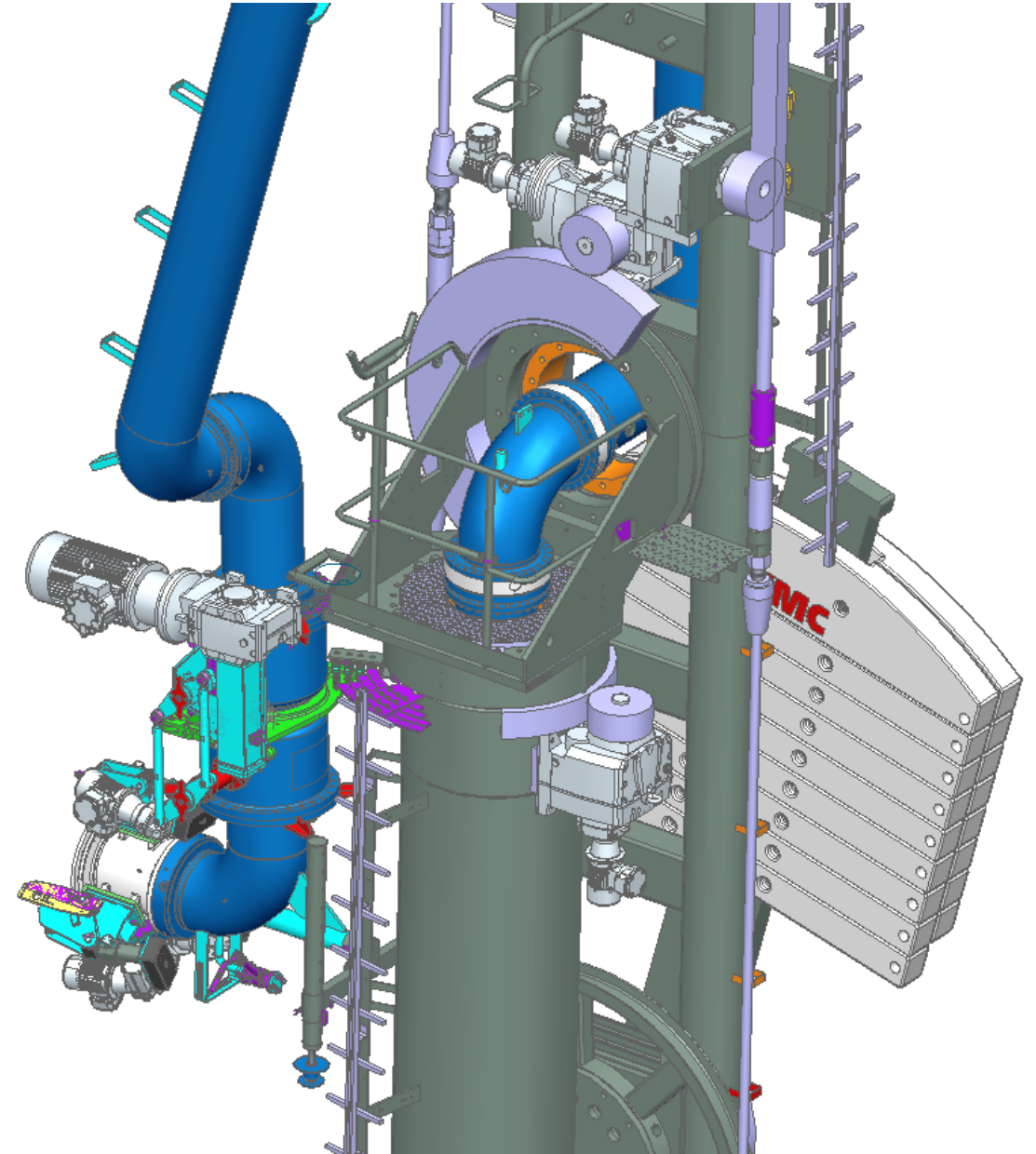
1. Drastically **reduce the OPEX**
2. Simplify and improve **reliability & availability**
3. Eliminate risks of **pollution**  
(no hydraulic oil)
4. Open doors to **predictive maintenance**  
(health monitoring)



# e-MLA development

# Challenges

- Gas area
- Freewheel vs reduction ratio of gearmotors
- Management of the retraction in emergency release (arm unbalanced)
- e-ERS SIL2
- Ship/shore electrical insulation
- Electromechanical components and drive architecture selection to minimize CAPEX

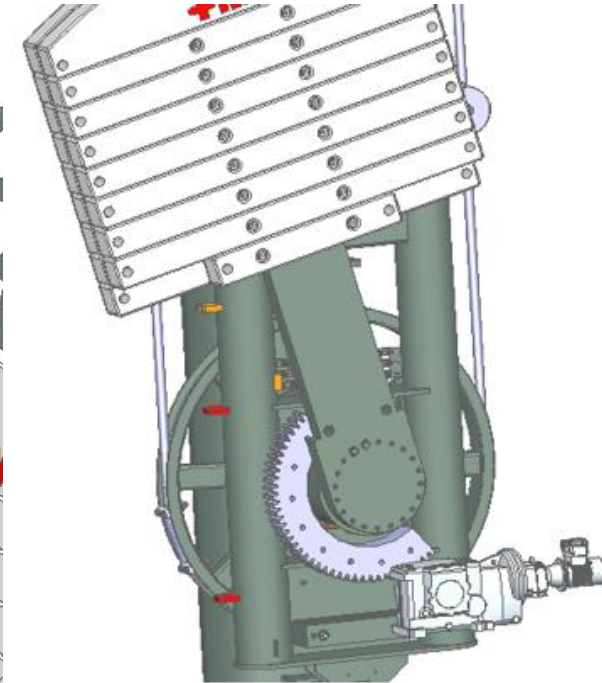
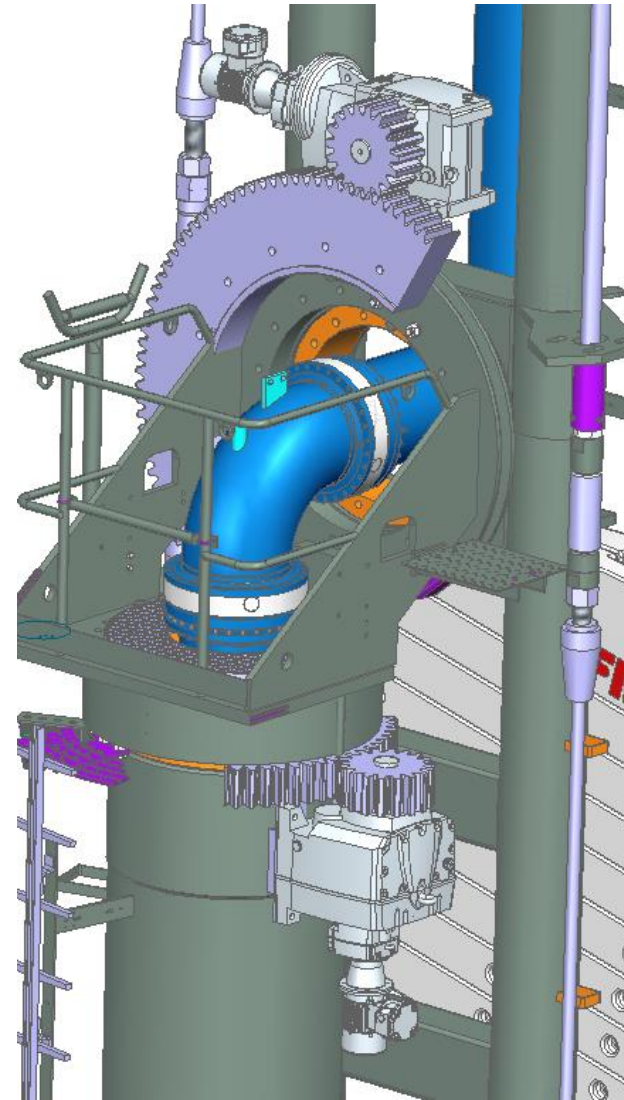




# Design and qualification

## Maneuvering actuators

- Fully passive once connected thanks to the freewheeling capability
- ATEX certified
- **Unique smoothness of operation thanks to variable speed actuators**
- Minimized maintenance



# Design and qualification

## Maneuvering actuators

Prototype testing of a **brushless** gearmotor

- Normal & emergency driving tests,
- Reversibility test (“freewheel mode”)

Next step:

Prototype testing of an **induction** gearmotor to reduce CAPEX



# Design and qualification

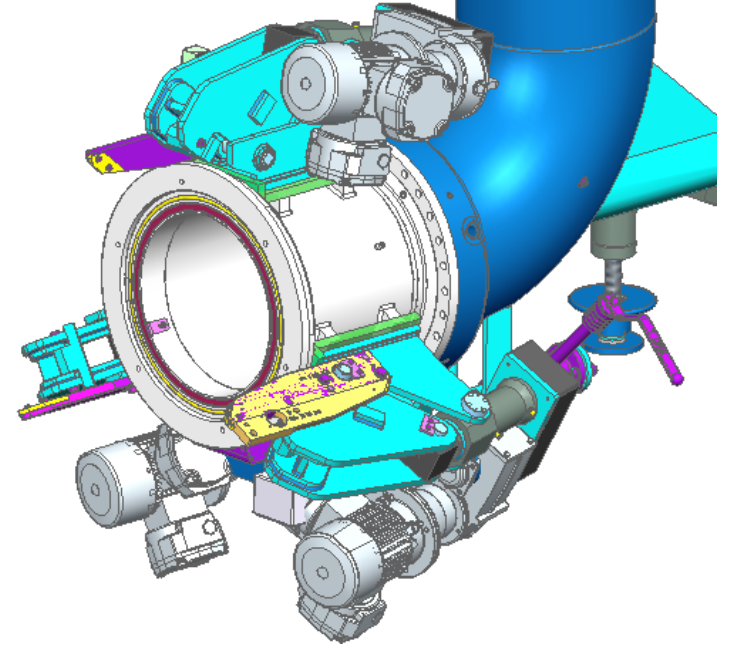
## Electric Quick Connect/Disconnect Coupler (e-QCDC)

### Highlights

- Same kinematic & mechanical design than hydraulic version  $\Rightarrow$  field proven
- Standard electric actuator without encoder

### Prototype testing (as per EN1474-1)

- Strength tests at ambient and cryogenic temperatures
- Release performance tests at ambient and cryogenic temperatures





# Design and qualification

## Electric Emergency Release System (e-ERS)

### Highlights

- Unchanged kinematics principle i.e. mechanical interlock between valves closing and PERC opening
- SIL2

### Prototype testing (as per EN1474-1)

- Functional, operation and release performance tests at cryogenic temperature
- Multi-cycles test campaign
- Fire test on electric actuator fire protection



# Application and benefits

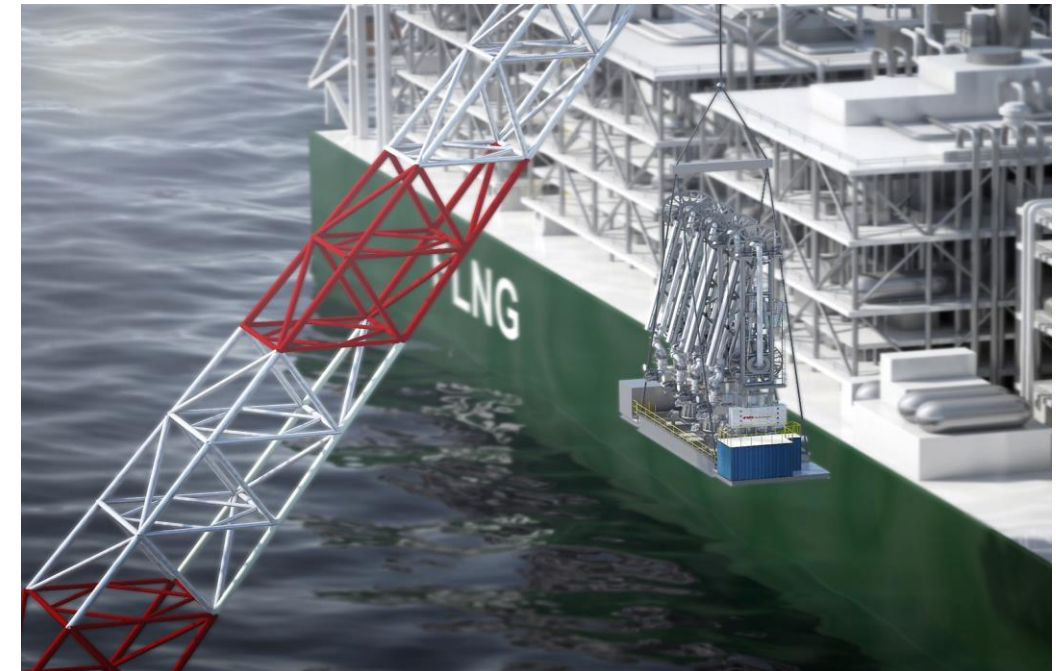


# Application & benefits

**The full range** of offloading solutions has been studied and **is eligible to be electrically powered**

**Applicable for retrofit** of hydraulically powered loading arms

**“Plug & play” module** for MLA integration on FLNG/FSRU or jetties.



# Application & benefits

## Cost analysis – CAPEX

- Electric actuators are more expensive than hydraulic cylinders/motors
- But counterbalanced by savings on auxiliaries installed on the jetty:
  - No more hydraulic power unit, selector assemblies, accumulator pack, hydraulic routing on site, flushing, etc.
  - Replaced by actuator drives and UPS (potentially shared)

## Cost analysis – OPEX

- Higher reliability of electric actuators and electric components
- Eliminate the need for complex in-situ hydraulic troubleshooting
- 30% estimated savings on maintenance costs
- Potential for higher saving thanks to predictive maintenance capabilities



# Conclusion

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**The e-MLA is the game changer for the loading arm industry to answer the market cost saving expectations:**

- Significant savings on OPEX
- High reliability and availability
- Greener

**Maximize savings on CAPEX with engagement at early stage of the project**

**Applicable to new projects and upgrade of existing installations**

