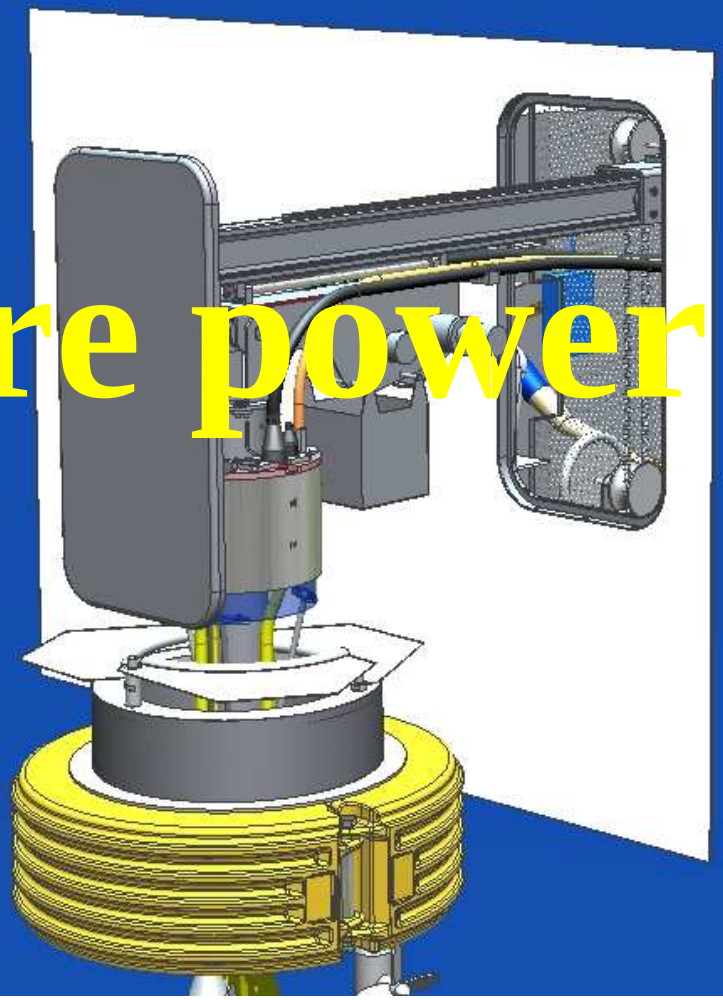
NG² PLUG

Shore power strategy



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What is  ?

- "PLUG" is an acronym for "Power Generation during Loading & Unloading"
- It proposes a game changing solution to connect vessels in ports to the shore power network to reduce their harbour emissions

PLUG is the world first shore power providing a multi MW, High Voltage connection....
...within a minute!

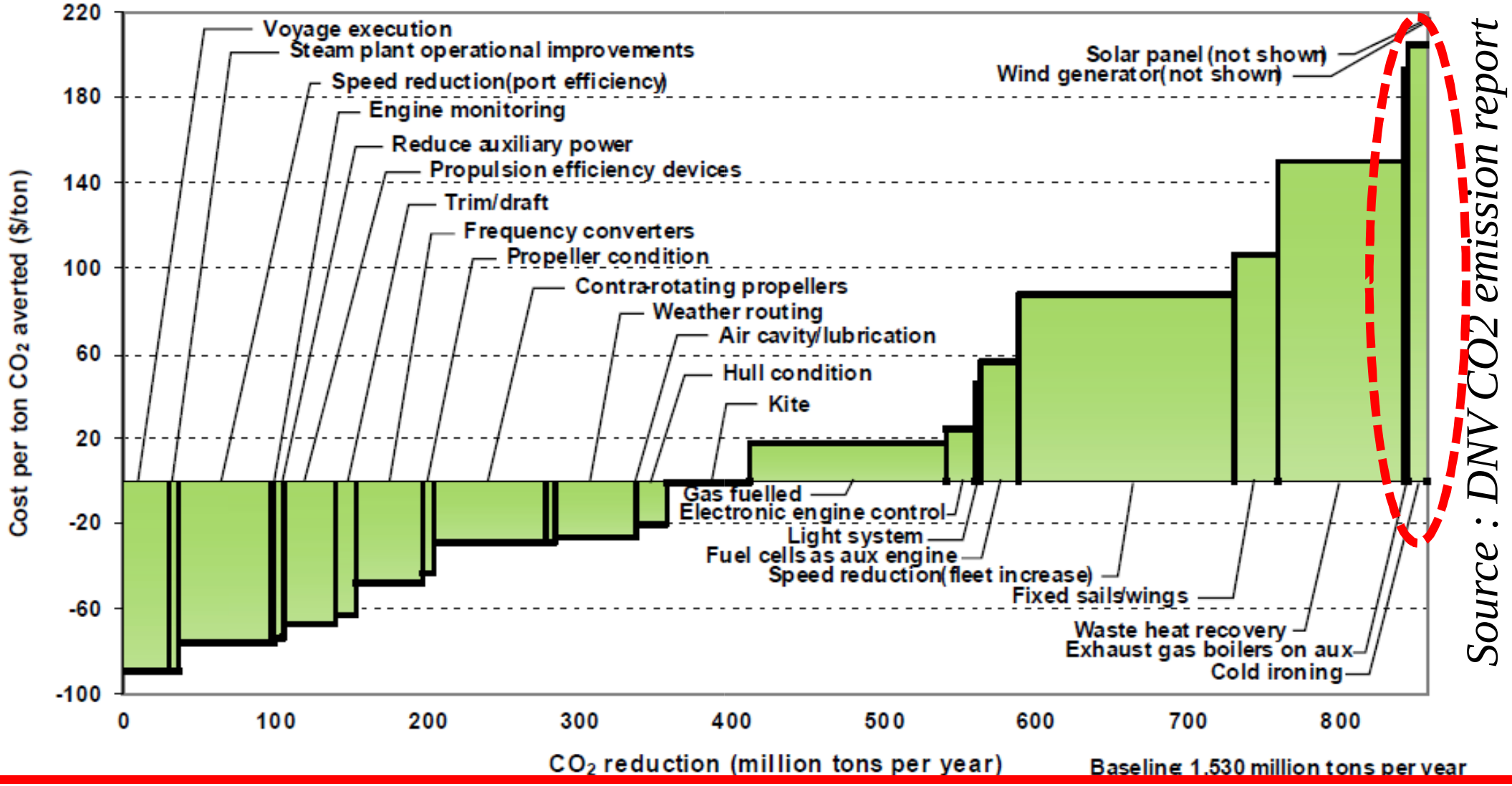
Context (1)

- Many public authorities are asking the shipping industry to find solutions to reduce its environmental footprint
- Shore power is one of these solutions, and has been implemented in a limited scale (less than 200 vessels out of a world fleet of 60 000…)

Context (2)

- Presently all shore power solutions have been derived from existing manual connector technologies which bring :
  - Safety hazards for crew and terminal operators personel
  - High Capital Expense
  - High Operational Expense
  - Low rate of use
- As a consequence, shore power implementation has been very limited

Context (3)



Source : DNV CO2 emission report

Cold ironing is even presently identified as <u>the least efficient</u> CO2 emission abatment solution!

New Generation, Natural Gas,

Context

The challenge to extend shore power solution is to make it not only environmentaly friendly but, as well, safer, cost effective and profitable

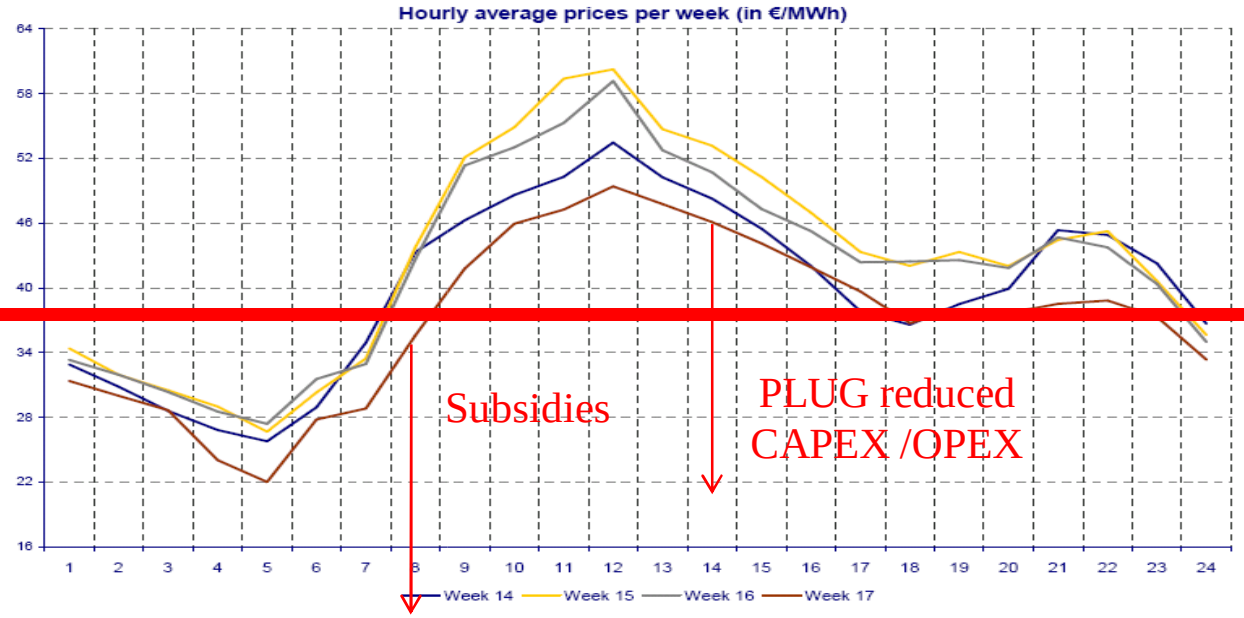
Shore power Profitability

Shore power cost

MDO cost

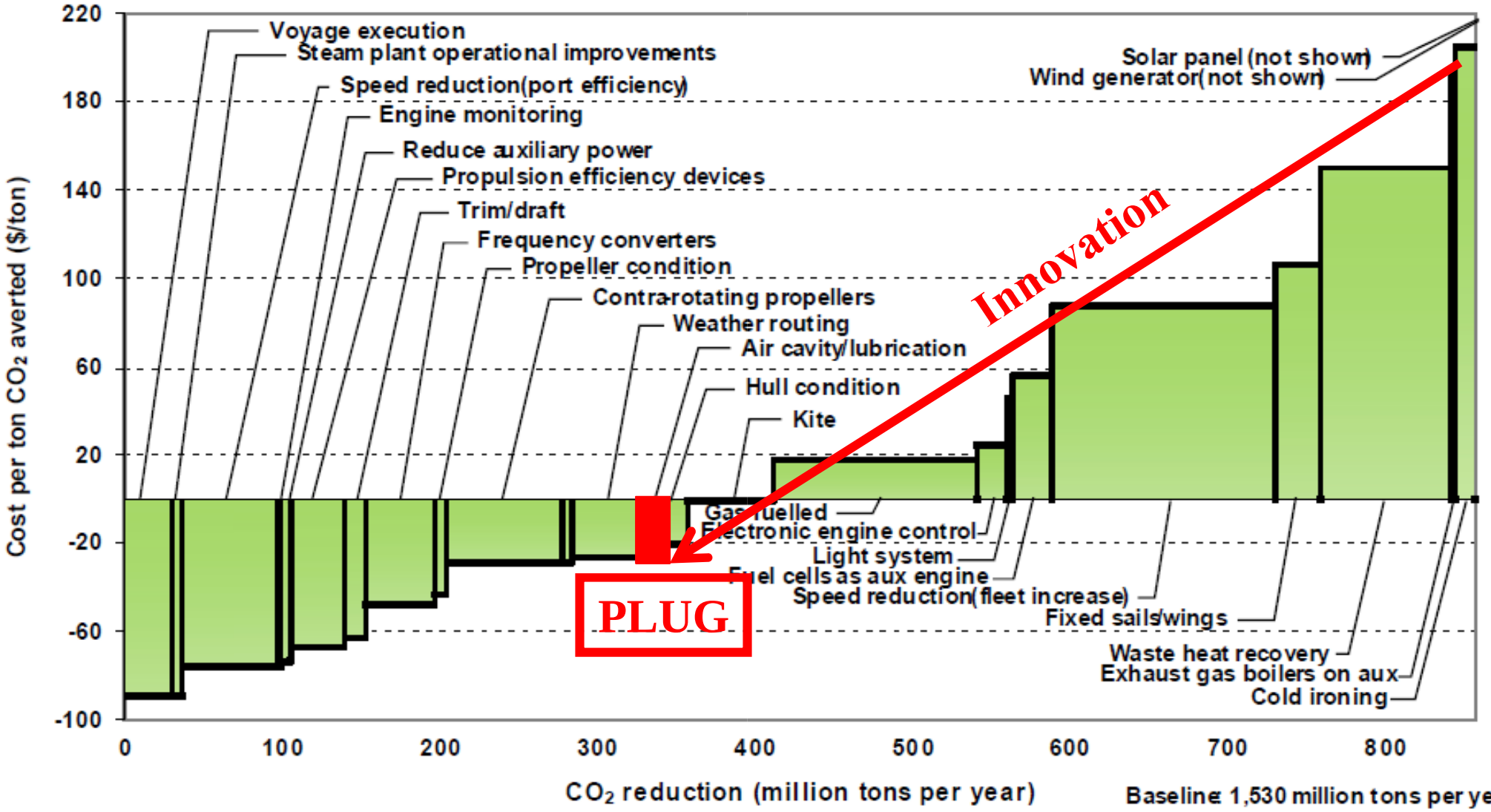
Emissions taxes

On board generation cost



- **Profitability depends on :**
  - **Local power market pricing**
  - **MDO price evolution : coming up!**
  - **Emissions taxes : coming up!**
  - **Subsidies : not a viable long term solution**
  - **Shore Power CAPEX /OPEX : this is where PLUG is bringing an advantage!**

Objective



Source : DNV CO2 emission report

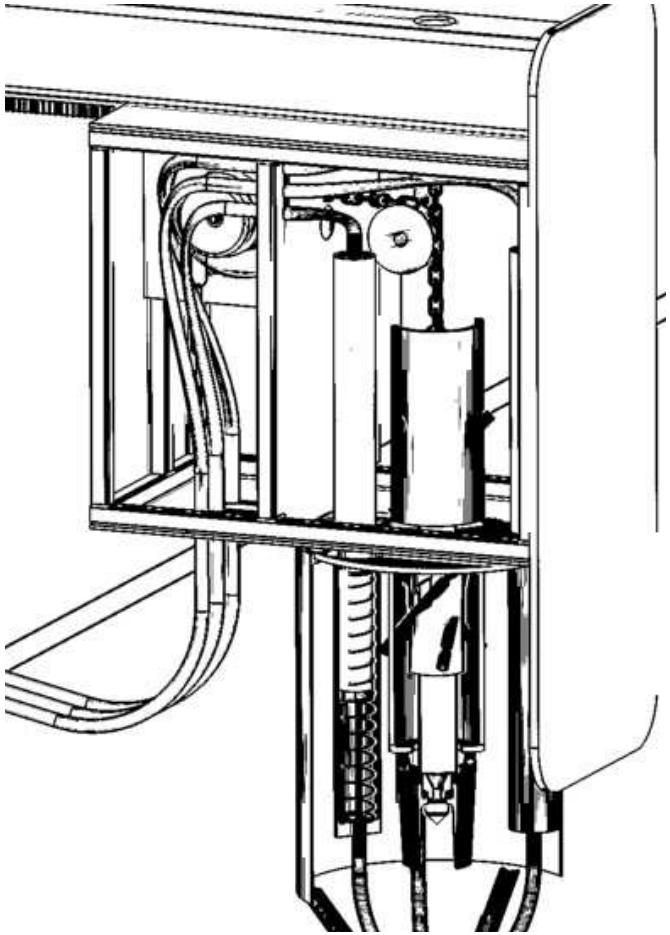
PLUG objective is to drastically reduce shore power costs, making it profitable, while reducing risks

Technical strategy

- PLUG design drivers
- PLUG design features
- PLUG technologies
- PLUG implementation

PLUG design drivers

- « Hands out » to reduce risk and operational cost
- « Fool proof » to reduce risk and safety barrier investment and operational costs
- Keep ship side hardware to the minimun to optimize return on investment and maintenance cost
- Emergency release capability
- No shore personnel required



PLUG first connector concept drawing

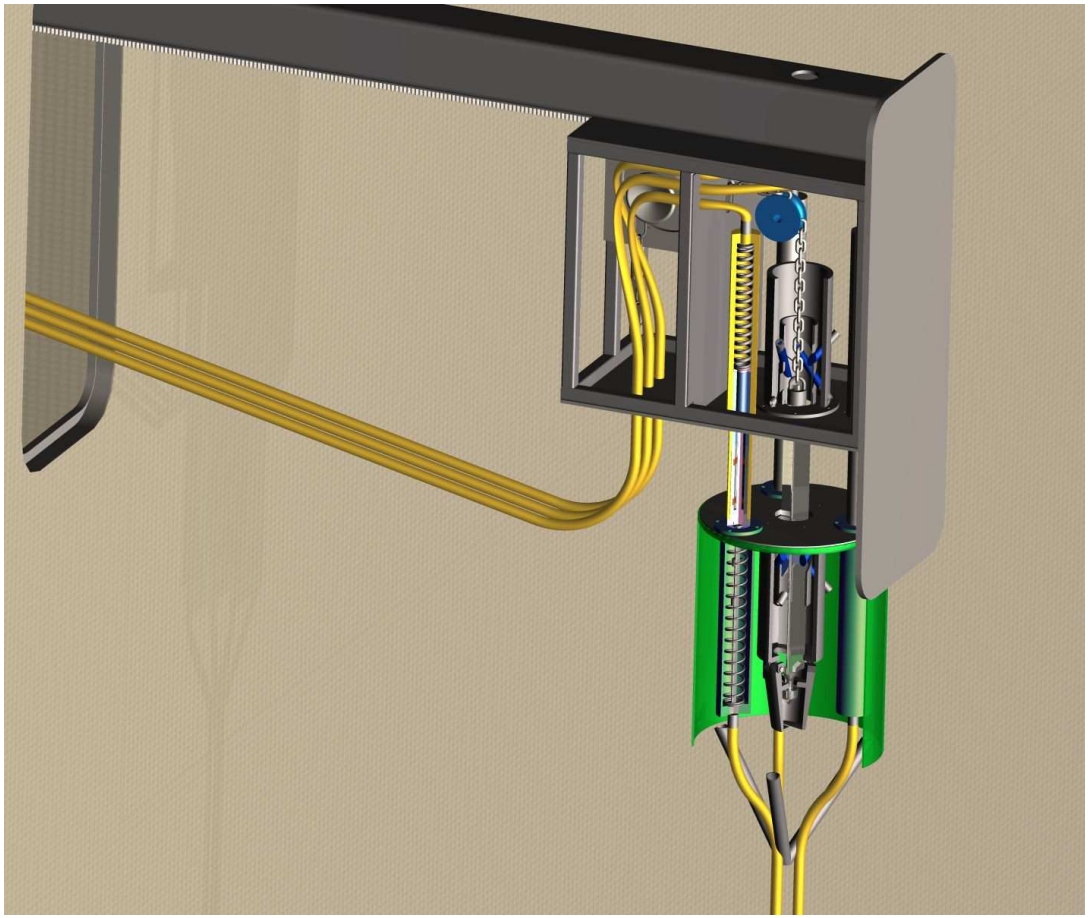
PLUG technologies

- Self mating / demating connector
- Automatic connector locking / unlocking mechanism
- Self sealing connector
- Field proven HV contacts technology

PLUG patented shuttle bar self guiding and locking mechanism

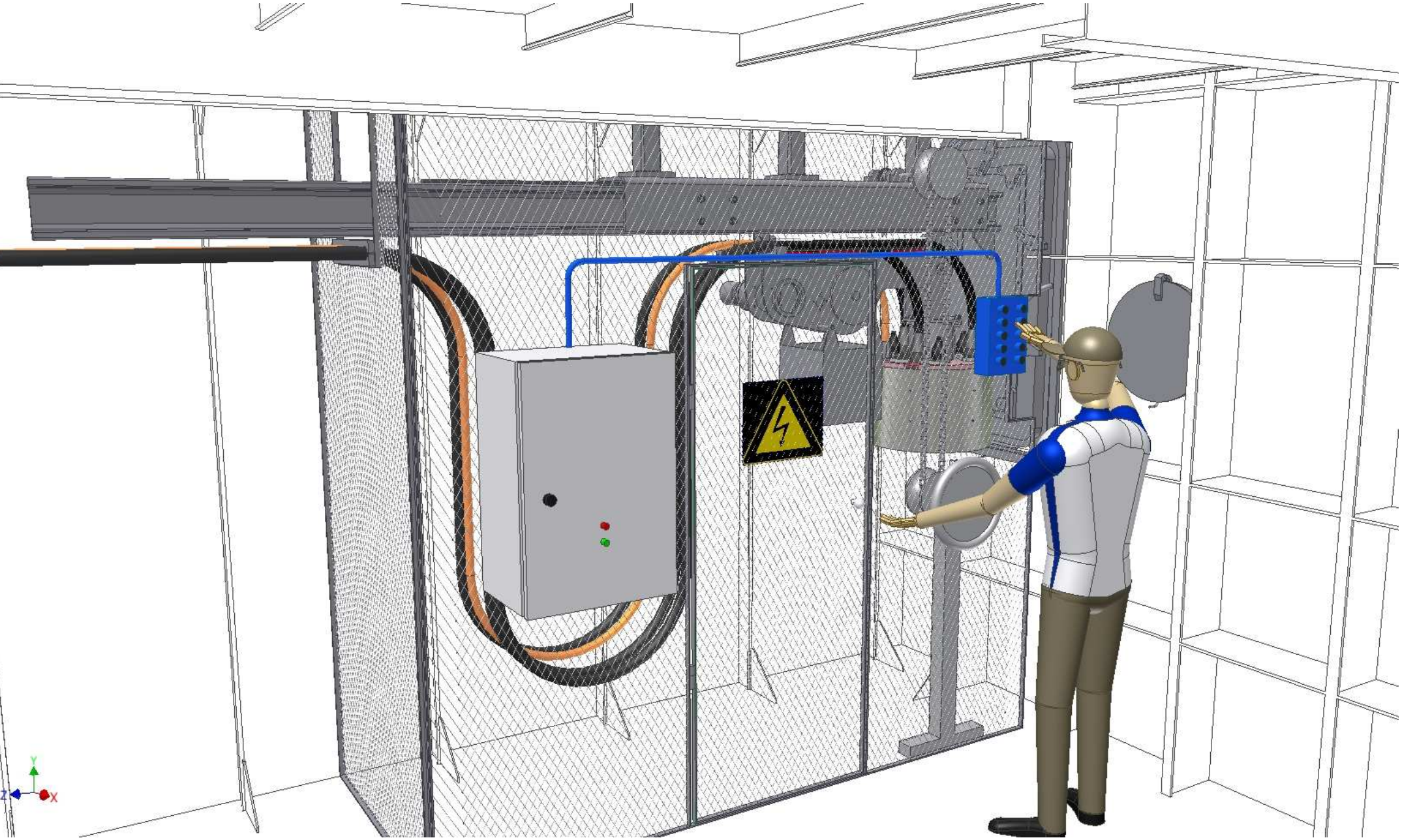
PLUG Implementation on board

- Self sealing, sliding power port
- Fits within one frame space
- Sliding mechanism suspended bewteen two deck beams

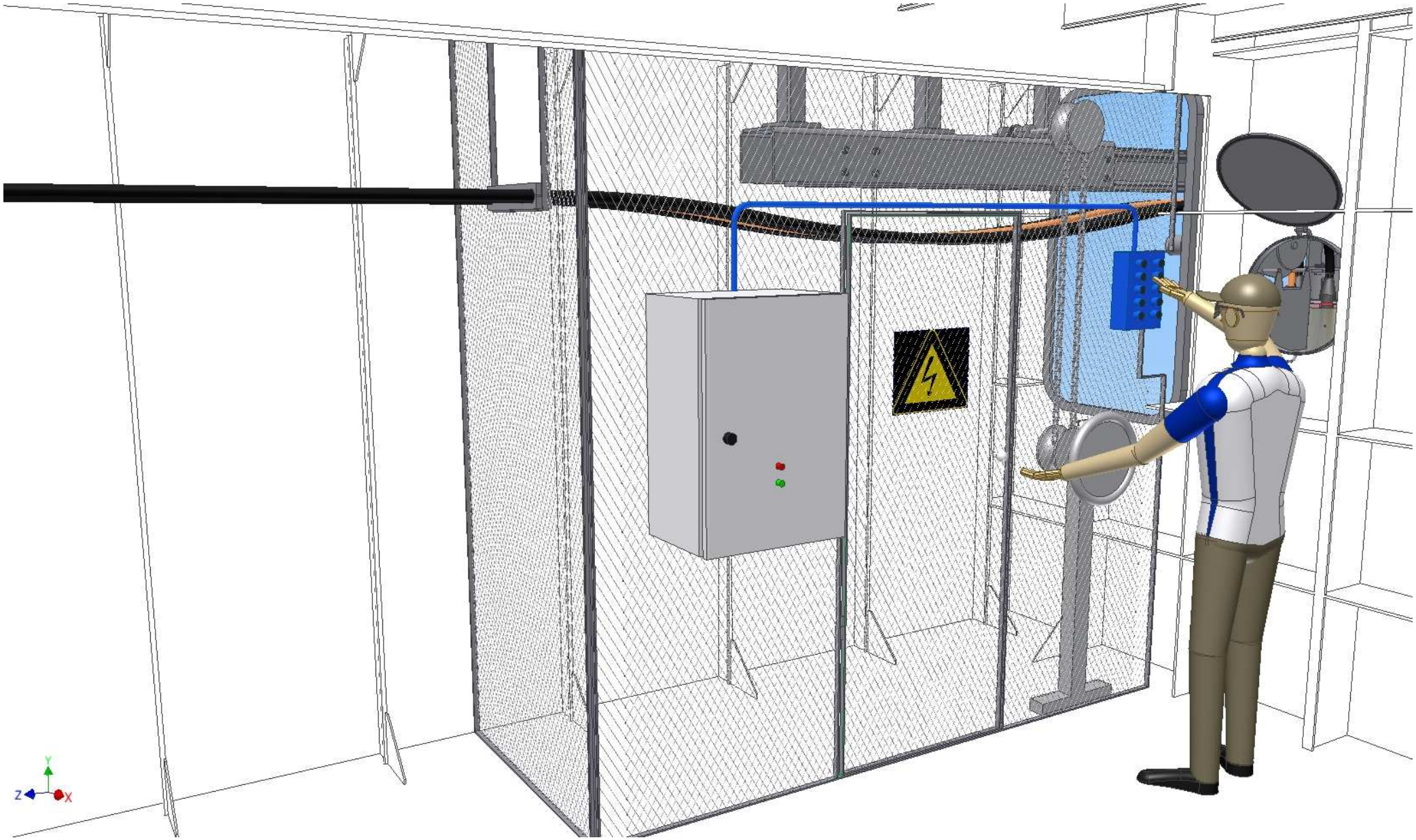


PLUG on board hardware is kept to the minimum to reduce ship side impact on payload volume and cost

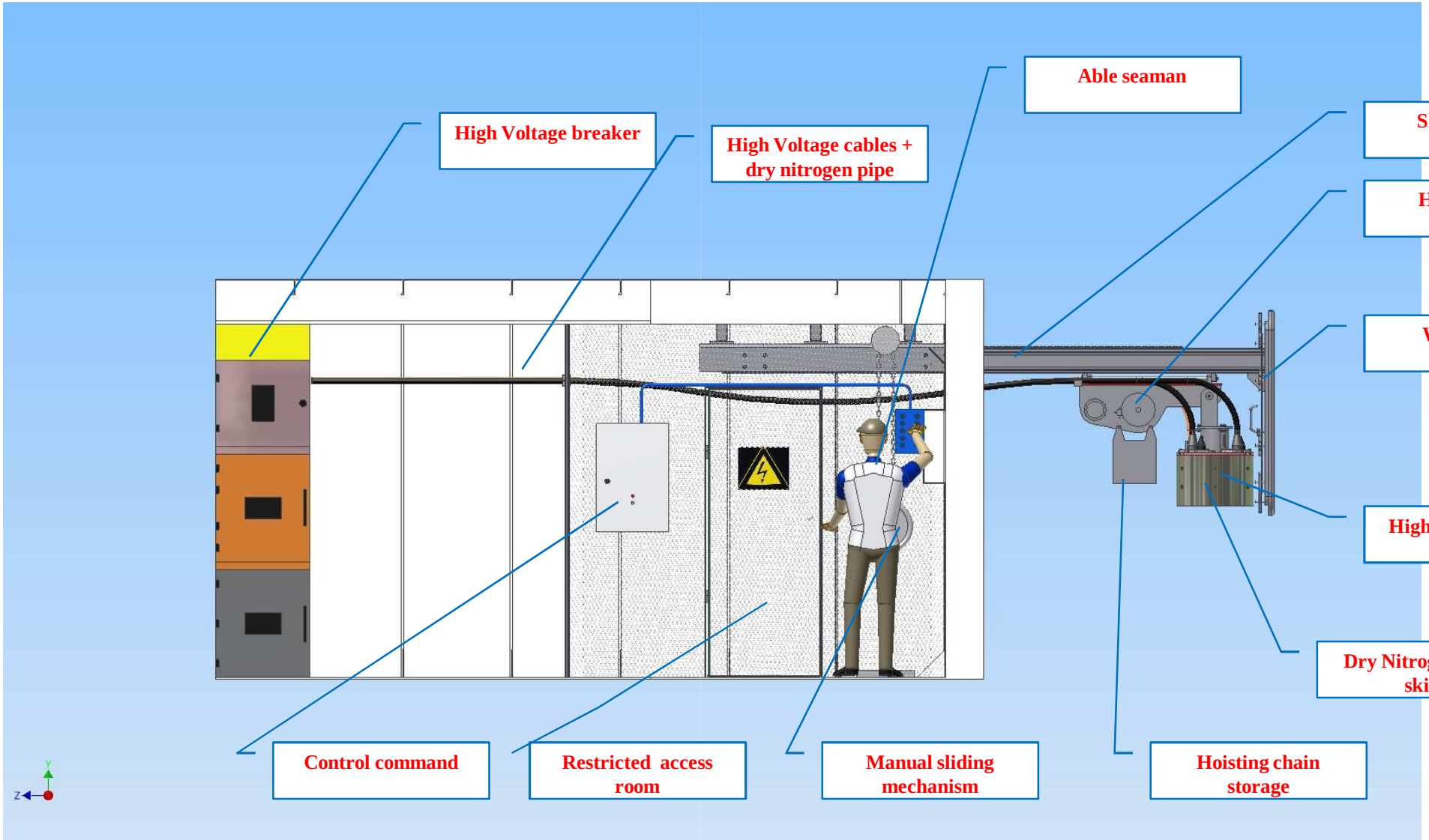
Inside view at sea



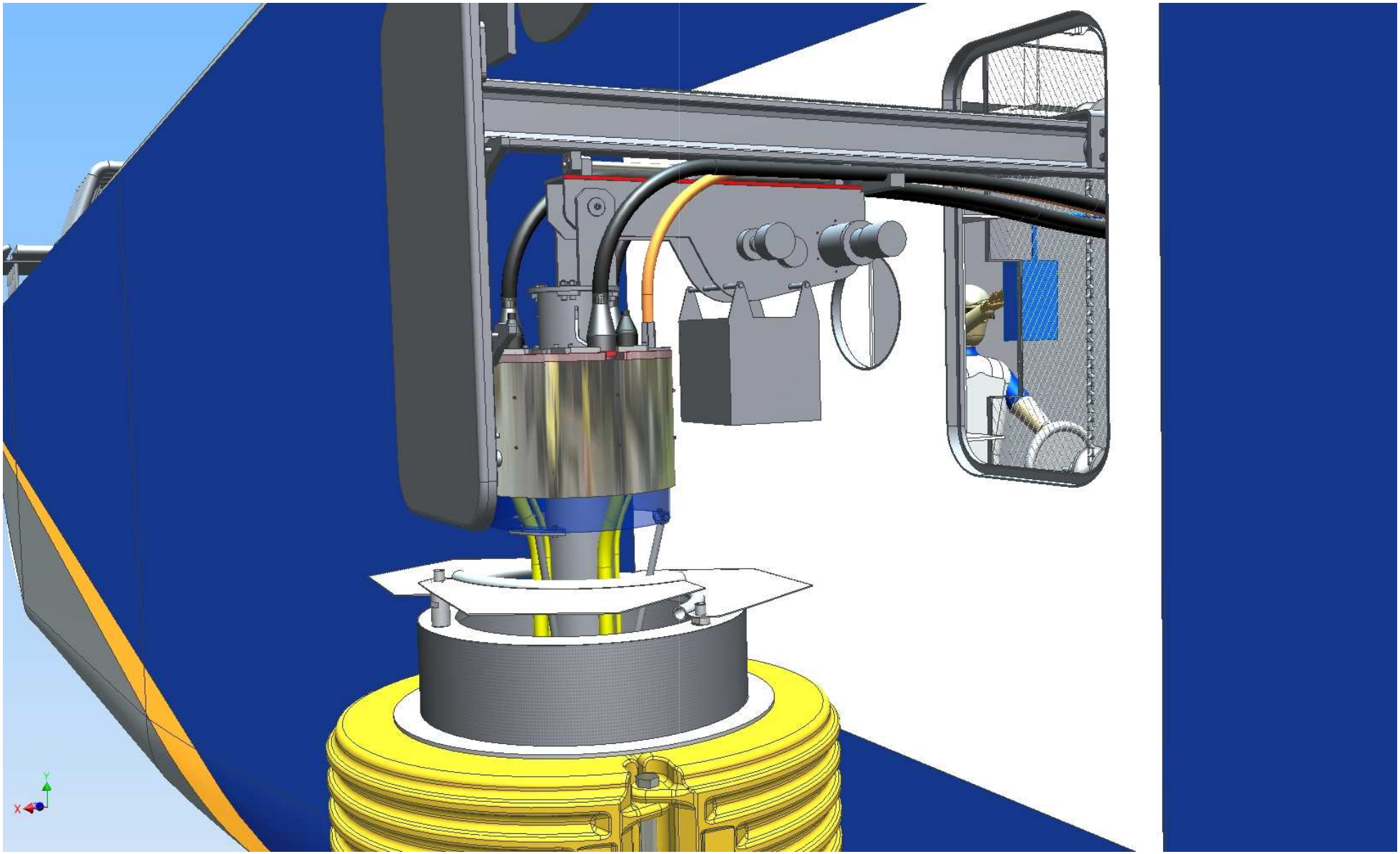
Inside view in operations



On board components

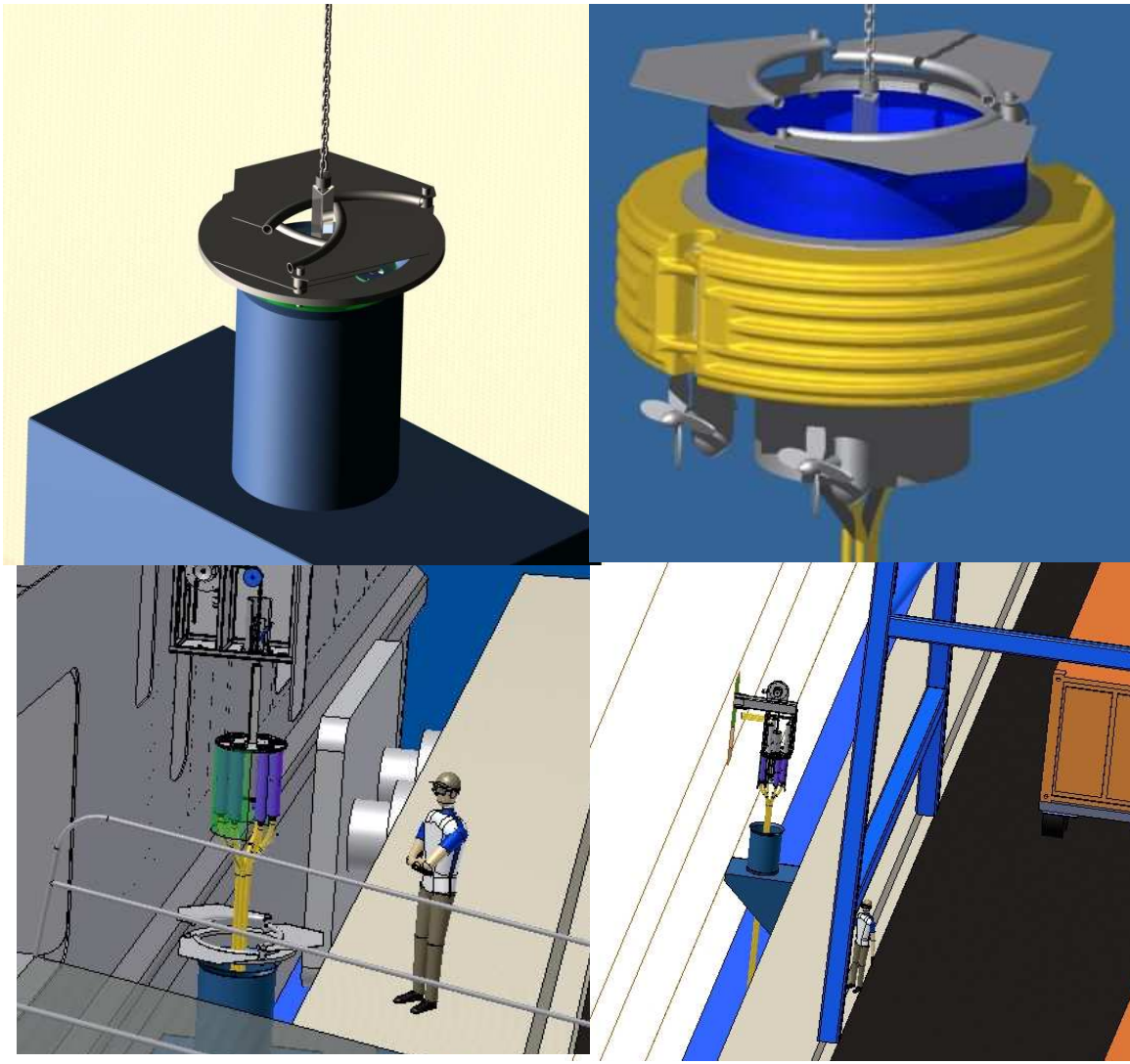


Outside view in operations



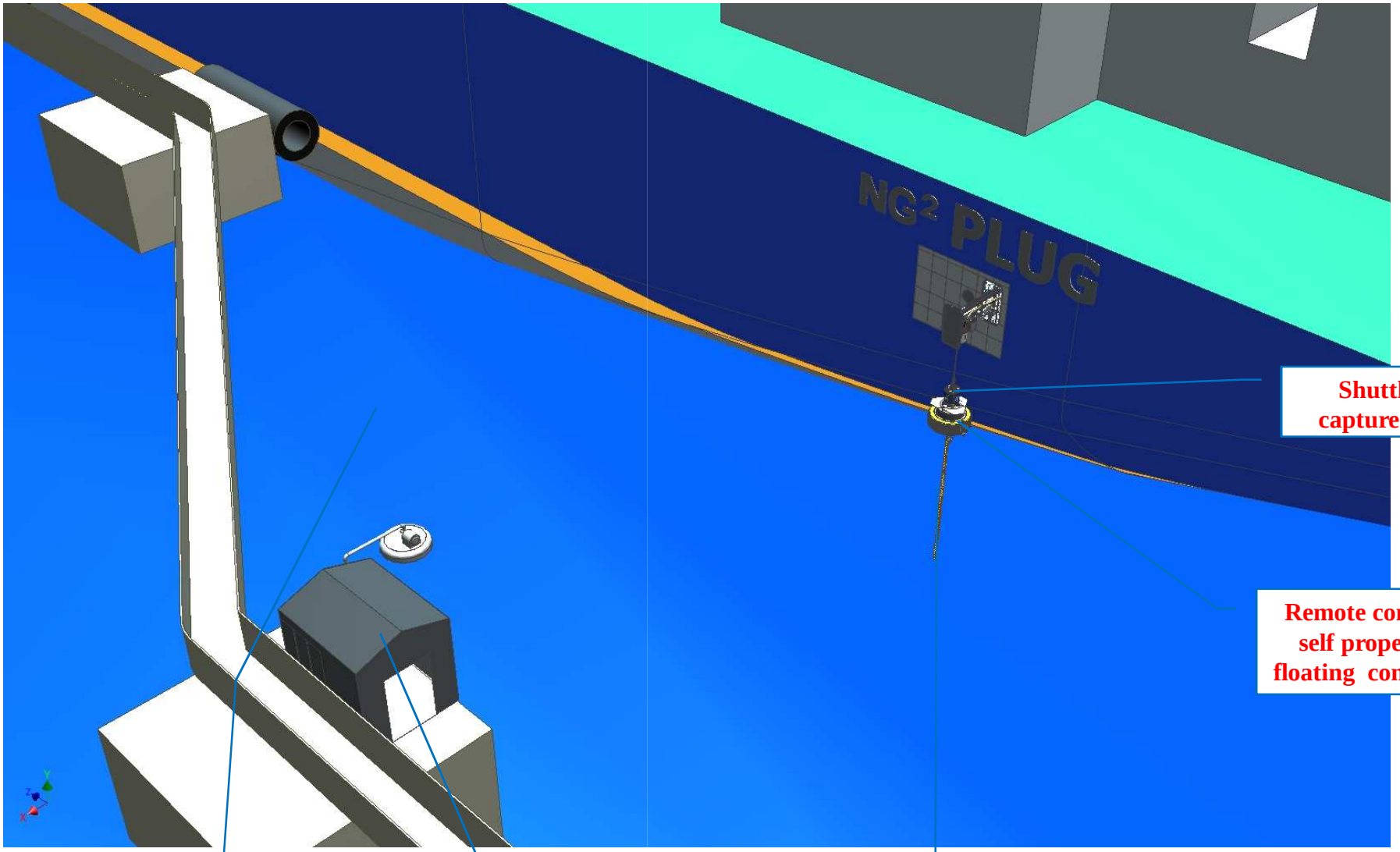
PLUG Shore side Implementation

- Remote control shuttle bar capture mechanism
- Reduced footprint
- Full weather protection when not in use
- No possible unauthorized access to live parts



PLUG shore side solutions are flexible enough to meet any site specific requirement using the same connector technology

Typical Shore side components



Standardisation strategy

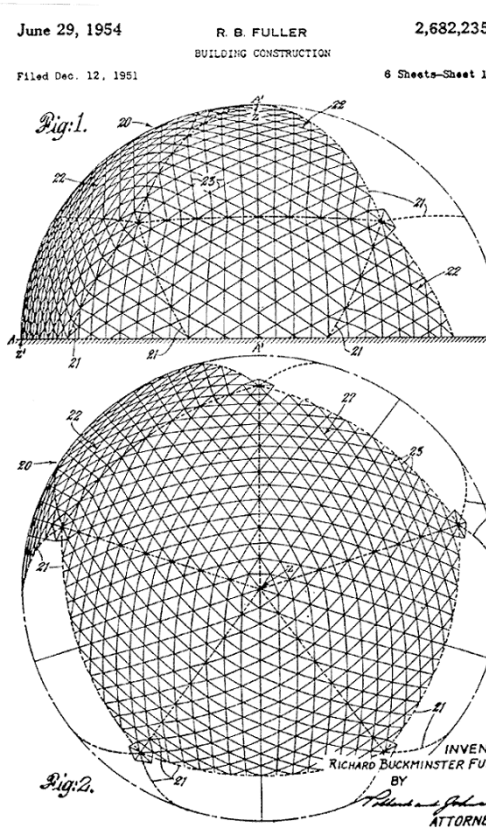
- Standardisation context
- PLUG proposed standard
- Example of other shipping industries standards…

Standardisation context

- POLB has been very proactive to address cold ironing standardisation, especially for CCs promoting the « AMP » (Alternative Marine Power) solution
- Several standardisation working groups have been set up to establish a shore power « standard » norm, converging towards a proposed ISO norm

…but

- ISO forbids itself to build standards based on patented technologies
- This prevent innovative solutions, such as PLUG, for the connector technology…
- …leading, for the shipping industry to a ***non optimized , obsolete*** solution!



« You never change things by fighting the existing reality . To change something , build a new model that makes the existing model obsolete »

Richard Buckminster Fuller

The other way round…

History teaches us about successfull shipping industry standardisation attempts based on innovation such as :

- The shipping container invented and patented in 1956 by Malcolm Mc Lean..
- The Chiksan loading arm invented and patented in 1956 by FMC loading systems…

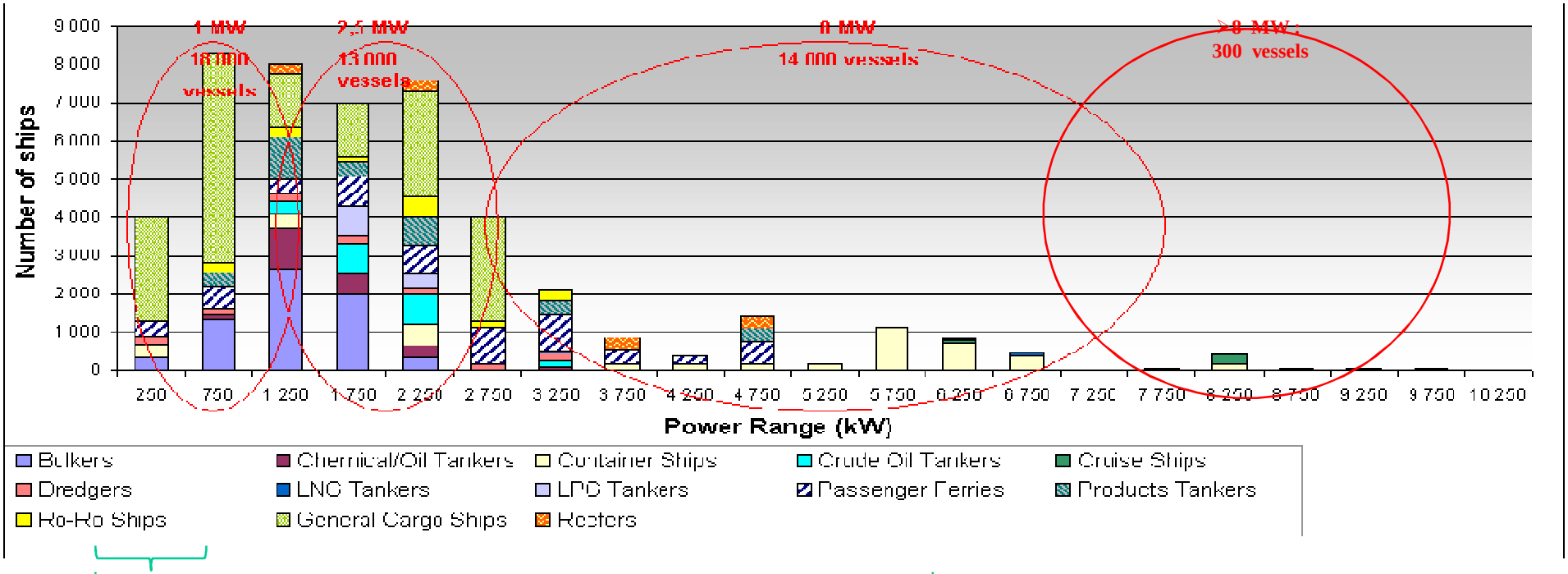
…both became world wide industry standards…

To meet shore power cost and operational challenge a similar approach is likely for shore power!

PLUG proposed shore power standard

- PLUG designed to meet all ISO norm functional requirement's…but :
- ….proposes a game changing solution for the connector technology
- ….proposes a single, « one fits all », connector to cover the industry shore power needs..

PLUG « one fits all » standard



PLUG 0.44 KV 1 Unit

PLUG 6.6 KV 1 Unit

PLUG 6.6 KV 2 Units

PLUG 11 KV 1 Unit

The same PLUG 300 mm^2 contact technology can be used under different voltages, to cover efficiently the whole market with the same standard hardware,optimising investments and operations…

PLUG innovation makes simple, cost effective shore power exchange operations …a reality