
















# MAN CRYO

Part of MAN Energy Solutions

# Member of the Volkswagen Group

MAN Energy Solutions is part of a brand family



Volume		Premium		Super Premium		Truck & Bus	
VW		Audi		Porsche		MAN Truck & Bus	
Skoda		Lamborghini		Bentley		Scania	
Seat		Ducati		Bugatti		MAN Energy Solutions	
VWN	 Nutzfahrzeuge						
MOIA							
				Financial Services			
							

# About us – The History

MAN Cryo is an engineering and manufacturing company with more than 60 years of cryogenic applications. Own products are as example vacuum insulated tanks, coil-wound vaporizers and piping systems. Normally projects are performed as EPC contracts. As of 2019, MAN Cryo has delivered 50 Marine LNG fuelgas systems.

MAN Cryo is located in Gothenburg, Sweden with optimum port access

## History

- Founded as an acetylene company in 1908
- First cryogenic tank built 1956
- Delivery of the 1<sup>st</sup> Marine Fuel Gas System in the world 1999
- Delivery of the 1<sup>st</sup> Shore/Ship bunkering plant in the world 2003
- First liquid helium container delivered 2004, over 100 in total!
- Delivery of Liquid Hydrogen tanks to Kansai 2005 , Iwatani in 2007
- Delivery of the 1<sup>st</sup> LNG bunkering ship in the world 2012
- Delivery of the 1<sup>st</sup> Trailer based Marine Fuel Gas System in the world 2016
- Member of MAN Diesel & Turbo 2016
- Marine LH2 system – Design approval in principle 2018





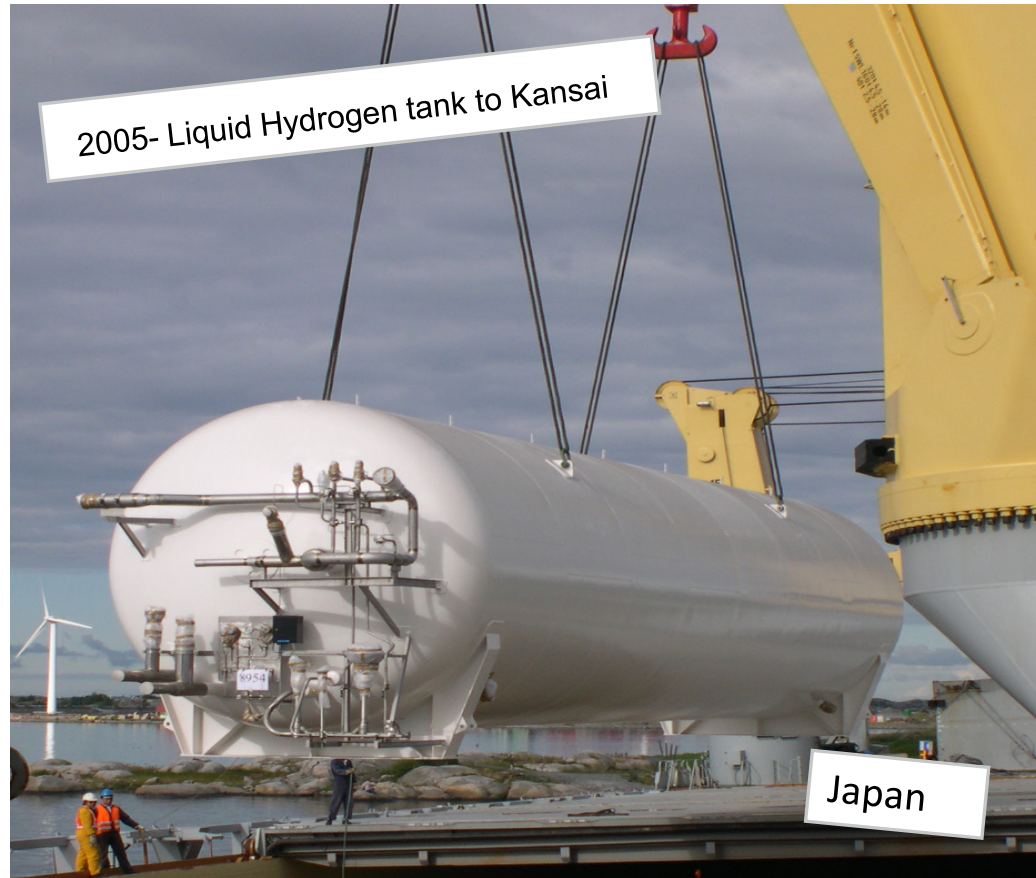
# Pioneers in the LNG market

1999-2012





# LH2 & Liquid Helium storage



# Our Unique Features

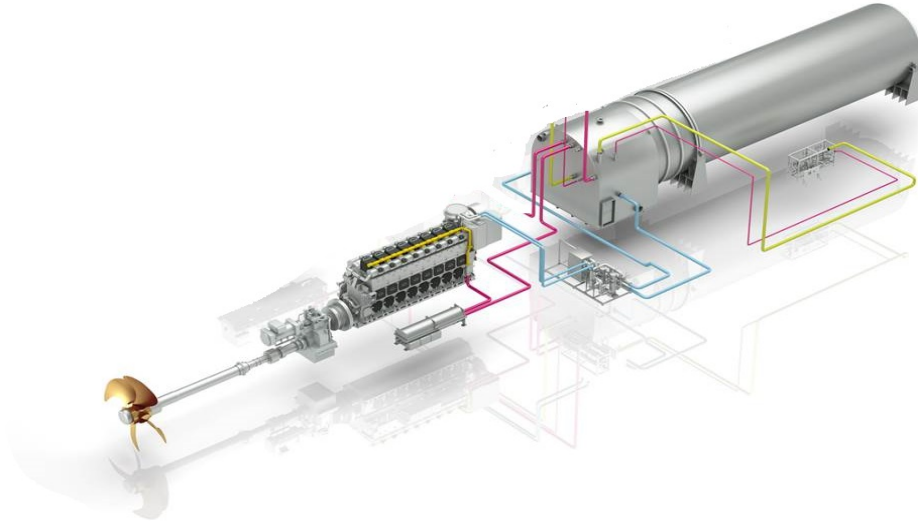
Robust and Reliable system - "Maintenance free system"

Unique Tank design - 15% less weight than competition

In-house engineering & production based on long experience

System supply of complete propulsion system

Global aftermarket services - 120 hubs close to market



# Marine LH2 Applications

# INTRO:

Over the Last year, MAN Cryo have had the pleasure of developing a "Marine Gas Fuel Gas System" for Liquid Hydrogen, in close cooperation with:



**MAN Energy Solutions**

**MAN CRYO**



# Cryogenic hydrogen storage



# Drivers - Liquid hydrogen:

# Traditional Marine Fuels – HFO / MDO & LNG



## Diesel – 100 + Years

- Sulphur (SO<sub>x</sub>)
- Carbon Dioxide (CO<sub>2</sub>)
- Nitrogen Oxides (NO<sub>x</sub>)
- Particulate Matter (PM)

## LNG – app. 15 Years

## Reduced by

- |                                      |       |
|--------------------------------------|-------|
| • Carbon Dioxide (CO <sub>2</sub> )  | 20 %  |
| • Nitrogen Oxides (NO <sub>x</sub> ) | 92 %  |
| • Particulate Matter (PM)            | 98 %  |
| • Sulphur (SO <sub>x</sub> )         | 100 % |

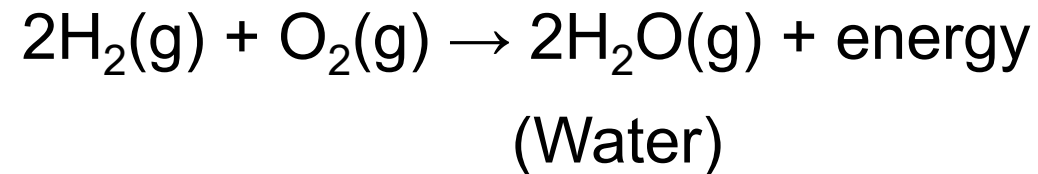


# Liquid Hydrogen - Zero Emission Marine Fuel



<u>LH2 – New</u>	<u>Reduced by</u>
• Carbon Dioxide (CO <sub>2</sub> )	100 %
• Nitrogen Oxides (Nox)	99,5 %
• Particulate Matter (PM)	100 %
• Sulphur (SO <sub>x</sub> )	100 %

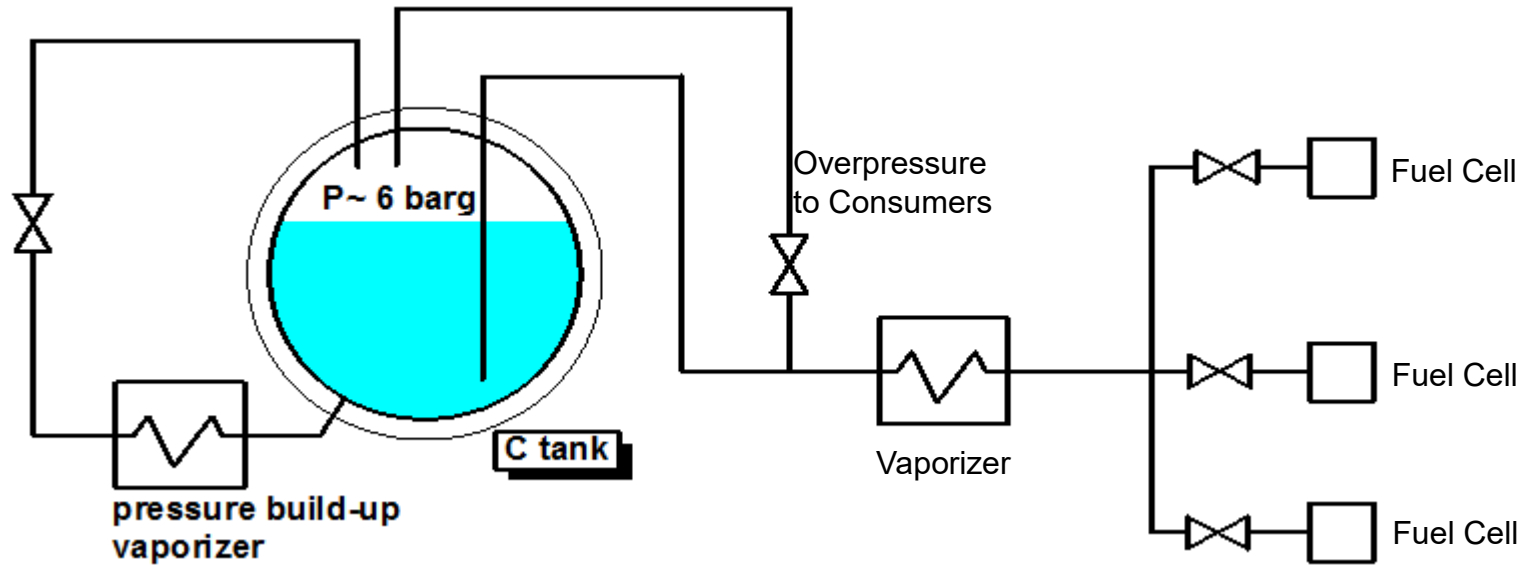
**"None" of above Emissions**



# Marine Fuel Gas System :

# Simple Fuel Gas System, LNG as well as LH2

PFD for Fuel Gas System C-type



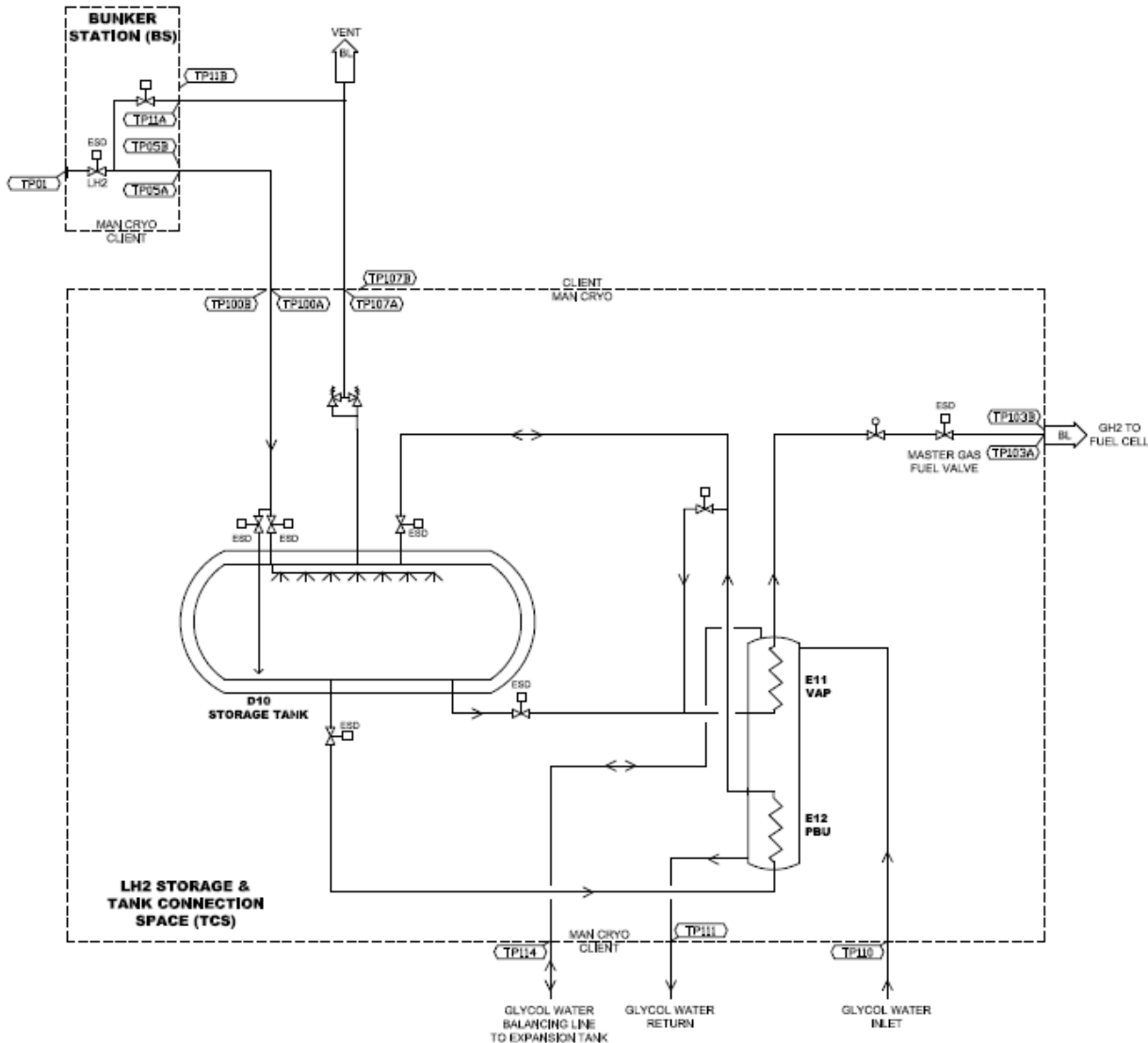
- Easy BOG Handling
- Minimize Rotating Equipment
- Own Vaporizer & PBU Design
- Outer vessel function as secondary barrier

## TANK MAIN PURPOSES

- Contain & Store Cryogenic Liquid
- Contain Liquid / Gas safe from surrounding environment
- Preserve Liquid Temperature Low
- Maintain pressure < MARVS
- Maximize Holding Time
- IGF min.15 days



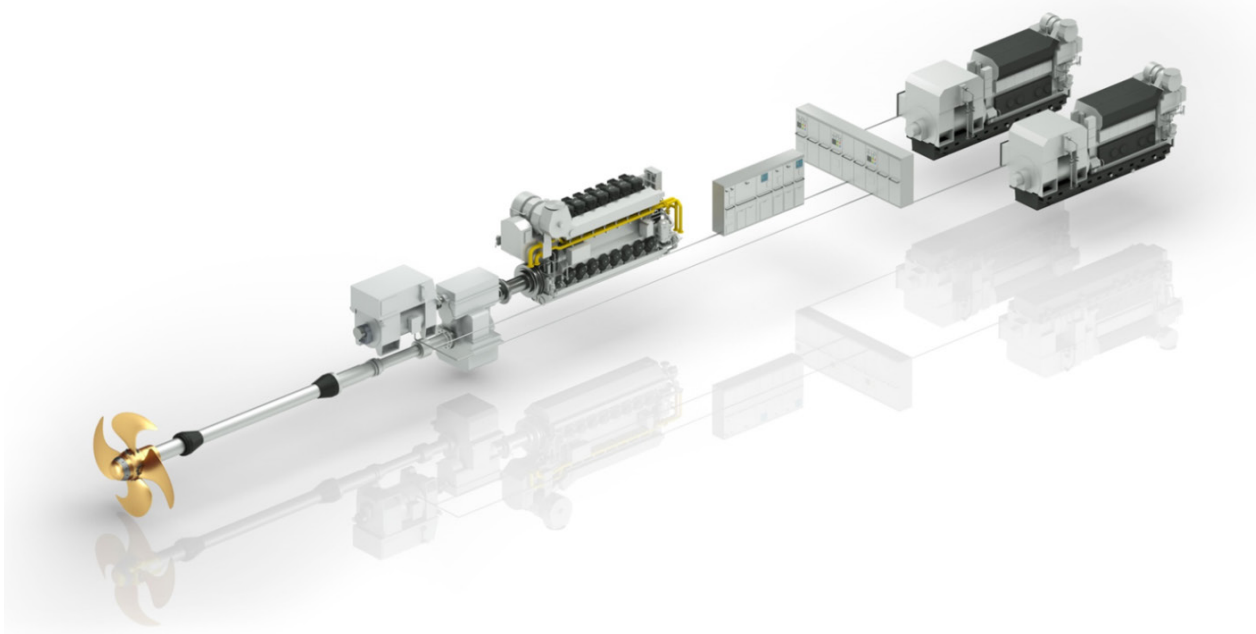
# Hydrogen Fuel Gas system – Typical scope



- Bunker station
- Tank
- Tank Connection space
- Vaporizer
- Vent system
- Fuel cell output

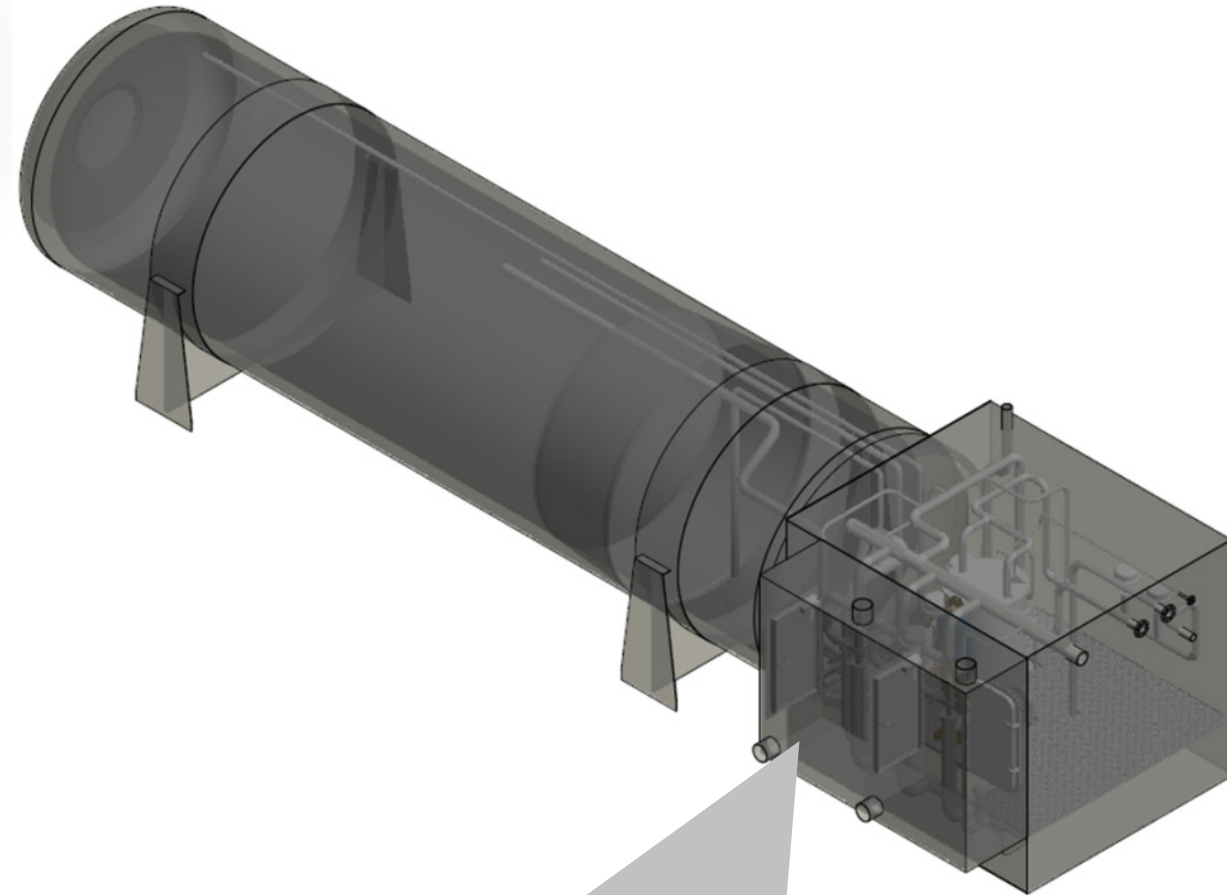
# 4 Design Considerations

# System solution provider – Fuel Cell feed



## Hydrogen System

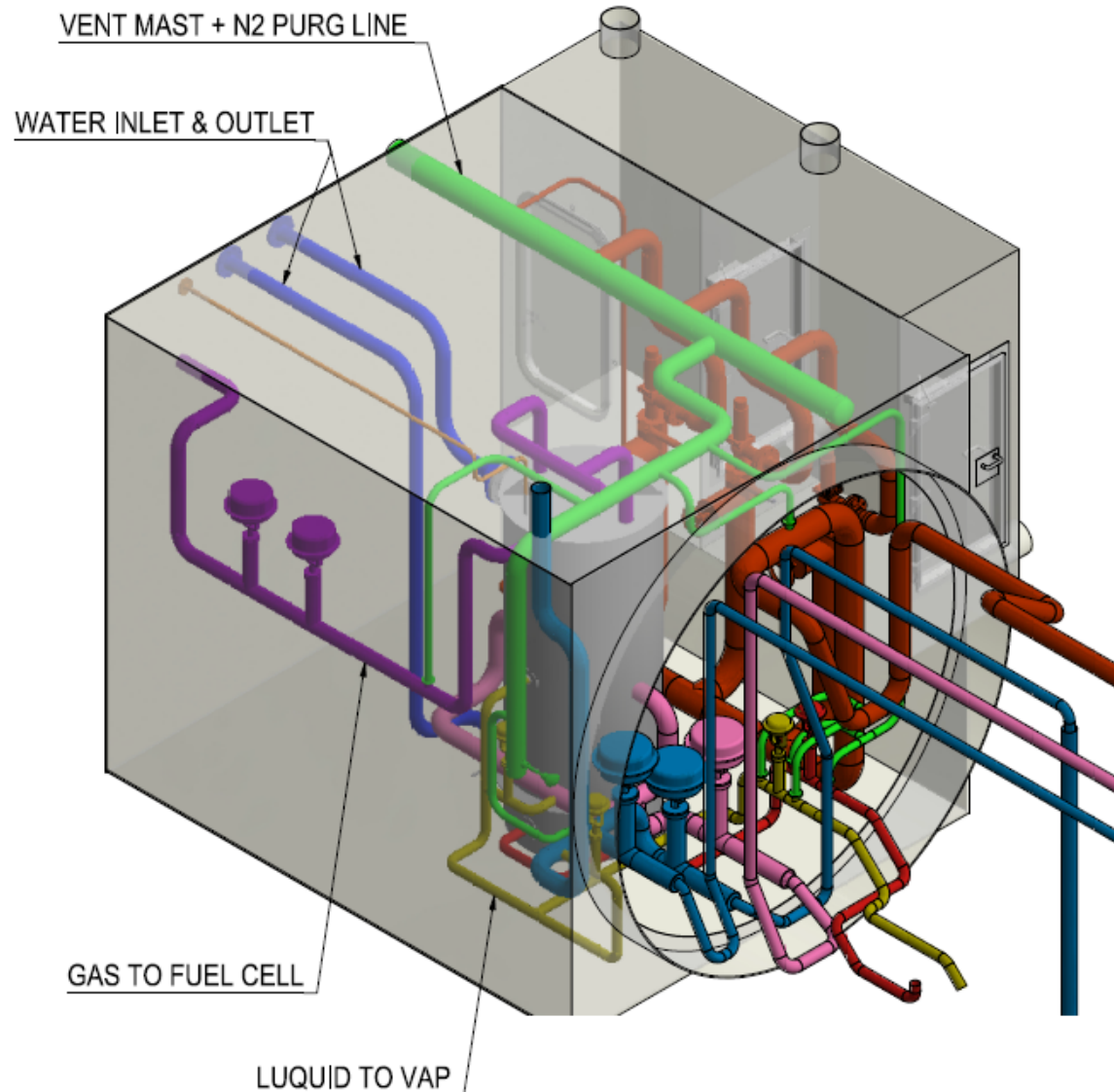
- For fuel cell feed
- Approval in principal by class
- Tank size 10 – 400 m<sup>3</sup>
- Pre-engineered and designed
- Design pressure 9 bar
- PBU design – No rotating equipment



- Forced ventilation
- Airlock & Entrance room
- Multi layer insulated



# Hydrogen challenge



1. TEMPERATURE – 252 deg. C
  - Insulation type, thickness, vacuum requirements, purity & cleanliness
  - Previous experience of Hydrogen tanks, helium tanks
2. VOLATILE GAS
  - Seal's / Confinement
3. EXPLOSIVE / COMBUSTABLE
  - Very willing to reach combustible mix
  - Venting to mast – Safe area

# MAN Cryo LNG Fuel System

Key Component – Tank Connection Space, TCS

## Tank Connection Space

Most complex item for both engineering and production

### Contains

- Vaporizers (1-3)
- PBU (normally 1)
- Valves & Safety Valves
- Piping
- Instrumentation & detection

### Why Complex?

- Limited Space (operation, maintenance, function)
- Requirements from Class on pipe stress (all pipes < -105°C).
- Pipe temperature varies between -252°C to ambient





# Global System Supply

- Project Management, procurement and IGF + Class approved design in Sweden
- Network of subcontractors for cost effective and “close to shipyard” prefabrication
- Close cooperation with local MAN hubs for smooth project execution
- Delivery in time from MAN Energy solutions approved by class





# Contact details

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**THANK YOU VERY MUCH  
FOR YOUR ATTENTION!**