

# **Opportunities and Challenges for Maritime Transport of Liquefied Hydrogen in Bulk**

IACS Tripartite 17<sup>th</sup> Oct, 2019 Tokyo, Japan

> Mr. Ahmer Saeed, Shell Dr. Yukichi Takaoka, HySTRA

> > HySTRA – KHI & Shell are HySTRA members

Copyright of HySTRA



# Agenda

- Regulatory landscape
- Hydrogen A clean source of energy
- Key challenges for H2 wider uptake
- Project background
- Project Update Design & Construction
- Novel technologies
- Ship Operation in the Coming Years
- Q & A's



17 October 2019 © 2019 HySTRA



HySTRA 3

### Hydrogen – A clean source of energy

Hydrogen is a clean fuel at the point of use Hydrogen can be produced from various sources globally Hydrogen can be produced utilizing renewables with a low well to wake green house gas footprint

H2 consumption in Fuel cell offers higher efficiency and virtually

- Zero CO<sub>2</sub>
- Zero SO<sub>x</sub>
- Zero NO<sub>x</sub>
- Zero Particulates





17 October 2019



#### Key Challenges for Hydrogen wider uptake

17 October 2019

© 2019 HySTRA

HySTRA 5

## **Project Introduction** - CO<sub>2</sub> Hydrogen Energy Supply Chain (HESC)



17 October 2019

## Project Update - 1,250m<sup>3</sup> Liquefied Hydrogen Carrier (LH2C)



CCS	
Capacity	ab. 1,250 m <sup>3</sup> (No. of Tank: 1)
Туре	IMO Independent Tank Type C
Press /Temp	0.4MPaG/20K(-253 degree C)
Insulation	Vacuum Multi-layer Insulation + KPS
BOGM	Pressure Built-up (Retention)

Ship	
L x B x D	ab. 110m x ab. 20m x ab. 11m
GT	ab. 8,000
Speed	ab. 13.0 knots
flag/Class	Japan/ClassNK



17 October 2019

### **Novel technologies & philosophies**



17 October 2019

- Cargo containment system, VIP
- Cargo equipment Compressor, pump, Vaporiser/heater, GCU
- Level measurement / TPS
- Relief valves, bellows, gaskets etc.
- Instrumentation (P,T, Vacuum, fusible plugs, flame sensor)
- Cargo vent mast, Cargo Manifold
- Marine loading arm & connection piece
- Cargo venting & emergency jettisoning
- Ships Ventilation, Gas and fire detection, Fire fighting philosophy
- Purging and sampling philosophy
- Earthing and bonding philosophy
- Hazardous area classification



#### **Project Update**

## - Hull Construction

• Hull construction laid down on 12 June 2019, to be launched on December 2019 at KHI Kobe Shipyard.





17 October 2019 © 2019 HySTRA

## **Ship operation**

Normal Operations
 Loading
 Seagoing
 Unloading

#### Pre/Post dry dock ops

Warm up Inerting (H2 to N2) Aeration (N2 to air) Inerting (Air to N2) Gasification (N2 – H2) Cool down (GH2 to LH2)





17 October 2019

# Ship operation additional considerations & Demo test plan

#### **Existing LNGC Practice**

- Vapour return arrangement
- Emergency shut down 1/2
- Level/temp/pressure
   monitoring
- Manned Cargo Operations

#### Additional considerations (LNGC +)

- No open purging/draining or testing at manifold
- Introduction of double-wall design with monitoring
- Monitoring rate of change of temperature in VIP
- Steps for ensuring VIP integrity prior operations
- Monitoring PSV's and TRV's leaks and/or lifting
- Emergency preparedness for LIN/LOX formation

#### **Demonstration stage test plans**

- Demonstration of safe and sustainable carriage of LH2 in bulk via the pilot LH2C
- Development of LH2 cargo handling operation manual for ship and terminal
- Demonstration of the performance of cargo tank vacuum multi-layer insulation
- Data collection and sharing for Marine rule development

17 October 2019 © 2019 HySTRA







Copyright of HySTRA

17 October 2019