WorldWise Marine

OFFSHORE SHIP DESIGNERS

HOW GREEN CAN YOU MAKE A TUG?

FFCA-East Coast, New York, 8&9 July 2008

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- Hydrogen Tanks
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Introduction

Project Partners:

- WorldWise Marine Engineering BV
- Iskes Towage & Salvage BV
- Smit Nederland BV

How to achieve:

- Limiting emissions (CO_2, SO_x, NO_x, Smut) especially in urban areas
- More efficient energy use

Diesel Engines:

- Run engines always as close as possible to optimal load condition.
- Use clean fuel reducing SO_x.
- Installation of catalyst systems reducing NO_x.
- Installation of smut filters to reduce particle emission.

The Concept

HYDROGEN HYBRID HARBOUR TUG (HHHT)

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All Electric Tug powered by:

- Fuel cells on hydrogen
- Batteries
- Diesel generator sets

Power Supply:

- Diesel – Electric when substantial Bollard Pull is required for berthing & unberthing (15-40%)
- Fuel Cells Stacks fead by Gaseous Hydrogen for mobilisation purpose and electricity supply during inactive condition (60-85%)

Operational Profile Power Supply

	Towing & Escorting 2900 kW	Mobilisation & Demobilisation 300 kW	Stand - By 30 kW
Fuel Cells	(X)	X	X
Batteries	(X)	X	
Generator Sets	X		

Fuel Cell Technology

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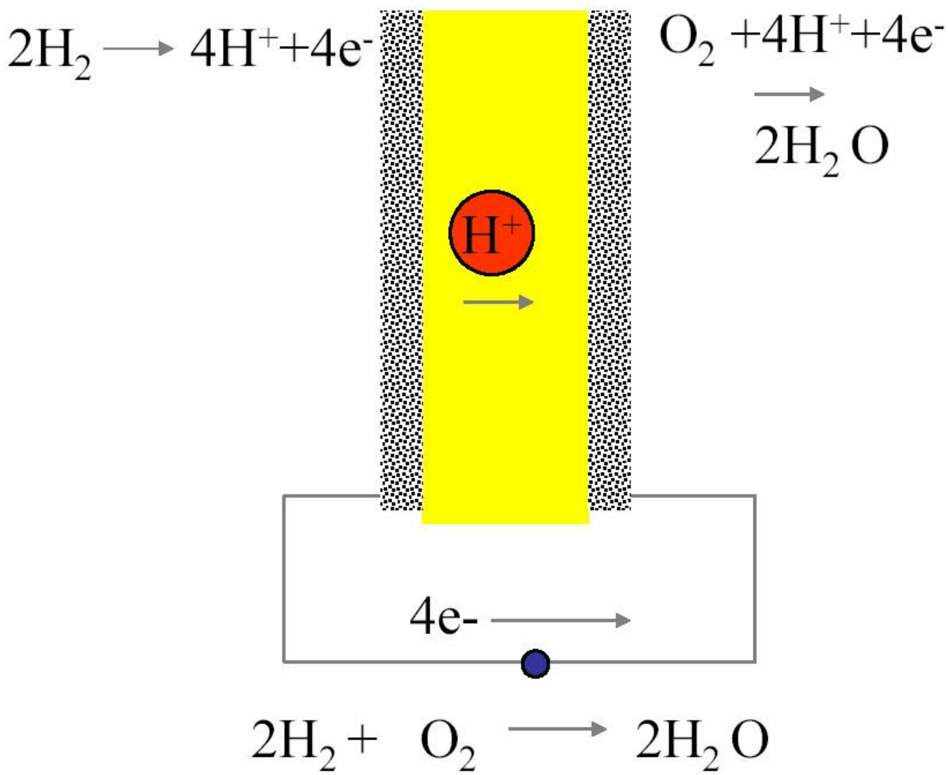
Basics of the PEM fuel cell technology

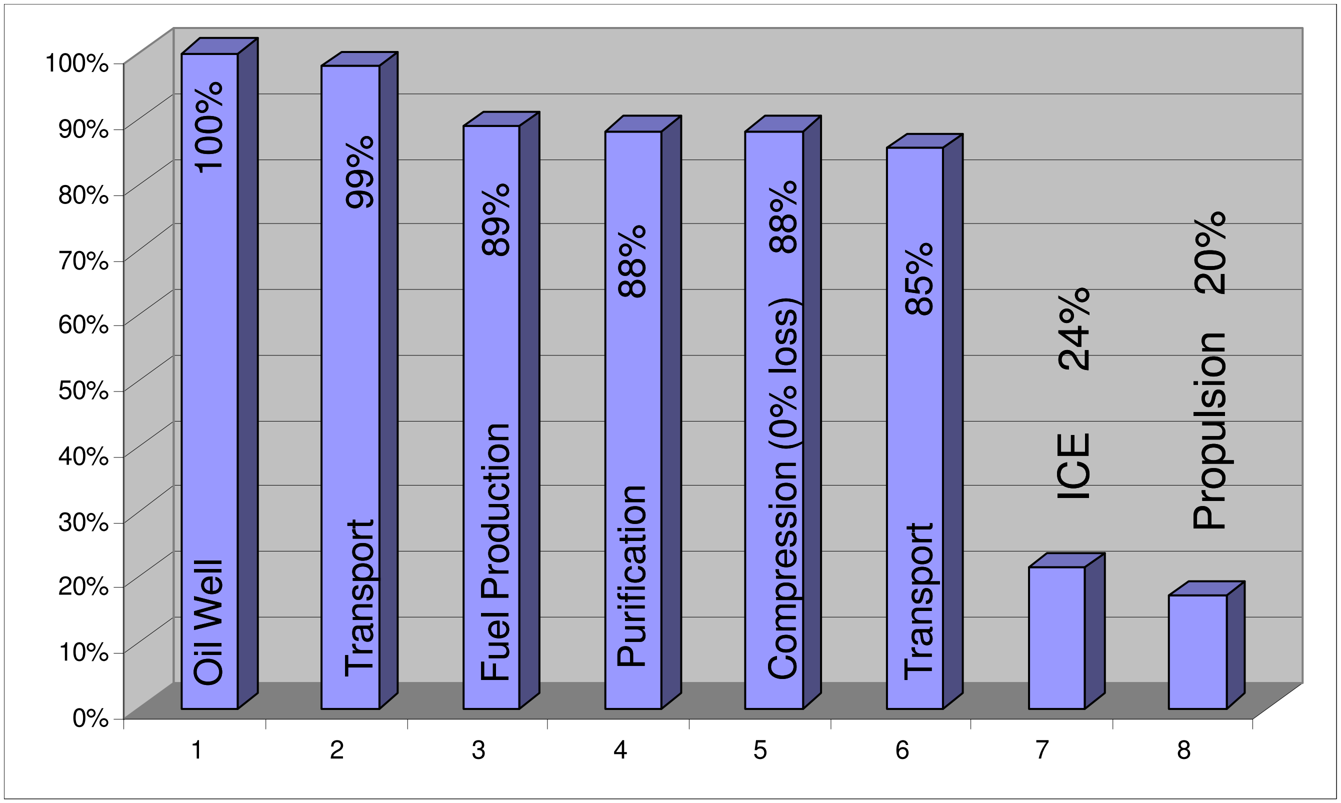


Advantage Hydrogen:

- Zero emissions
- Well to Propulsion efficiency: 34% (in relation to conventional diesel 20%)
- Lower noise levels

Well to Propulsion Efficiency

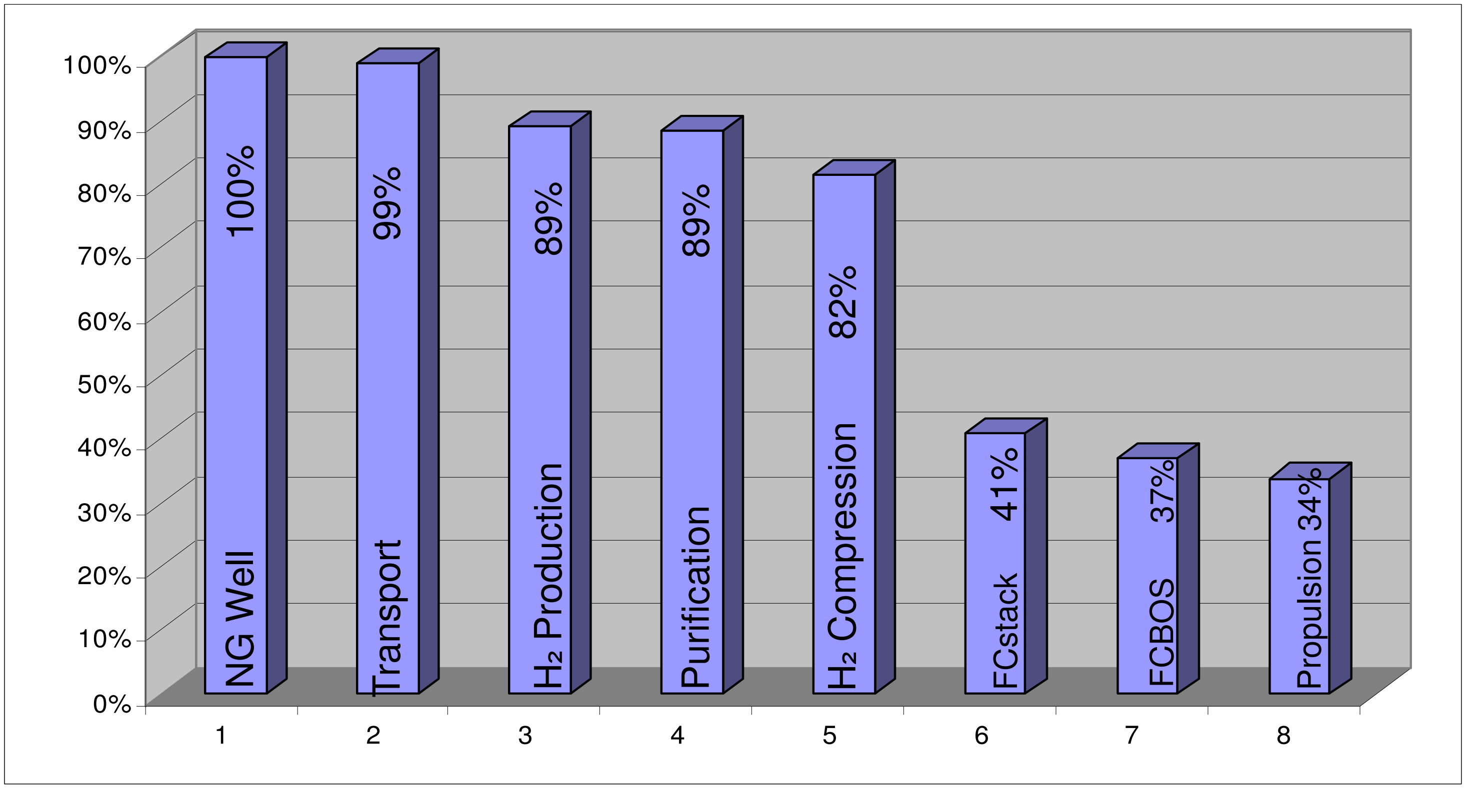
The Petrol and ICE Chain



* In accordance with JRC WTW report 2007

Well to Propulsion Efficiency

The Hydrogen and Fuel Cell Chain



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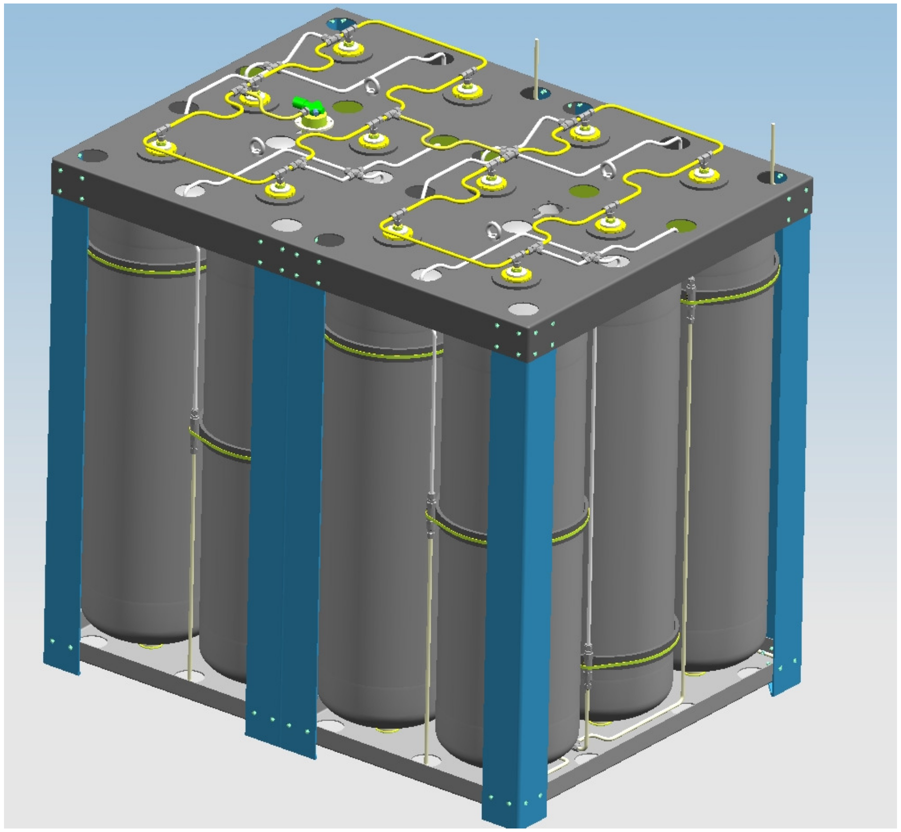
Hydrogen Tanks

Storage Hydrogen:



- 12 cylinder modules
- 2700 L
- 430 bar

Endurance Calculation

24 / (200 * 0.65 / 430) = 79.4 hours

- 06 – 07m³ hydrogen at atmospheric pressure to generate 1 kW
- Storage at 430 bar pressure
- 9 modules of 12 cilinders total 24m³

Achievable Results

Possible reductions total concept:

- CO_2: 15-40% (dependent on operational profile)
- SO_x: ≥ 90%
- NO_x: ≥ 90%
- Smut: ≥ 90%

The Design

Design Features:

- VOITH inline retractable bow thruster for mobilisation/demobilisation
- Four diesel generator sets to achieve optimal load factors
- Electro motors directly on top stern main propulsion units

Concept Design 50 tBP HHHT:

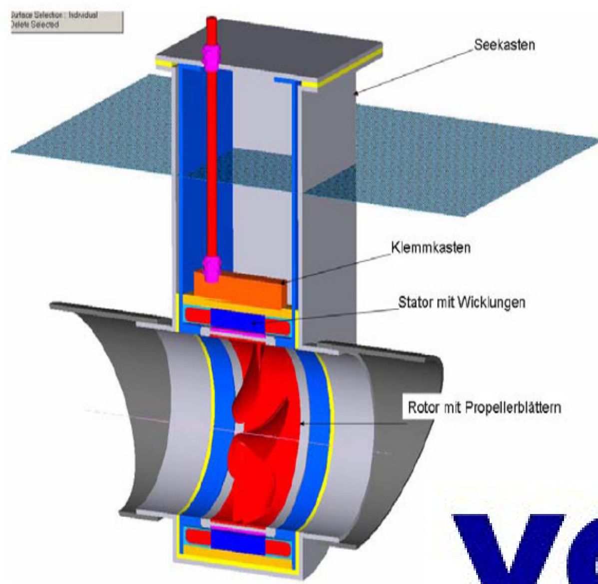
- Loa: 30,20 mtr.
- B: 10,70 mtr.
- T: 4,20 mtr.
- D: 5,30 mtr.

- Fuel Oil: 75m^3
- Hydrogen: 24m^3
- Water Ballast: 40m^3
- Fresh Water: 30m^3

Design 50 tBP HHHT:

- Main Propulsion units: 2x1300 kW
- Bow Unit: 1x Voith Inline Thruster ILT 850-300, 300 kW
- Generator sets: 4x650 kW
- Fuel Cells: 2x Nedstack PS100, 100kW

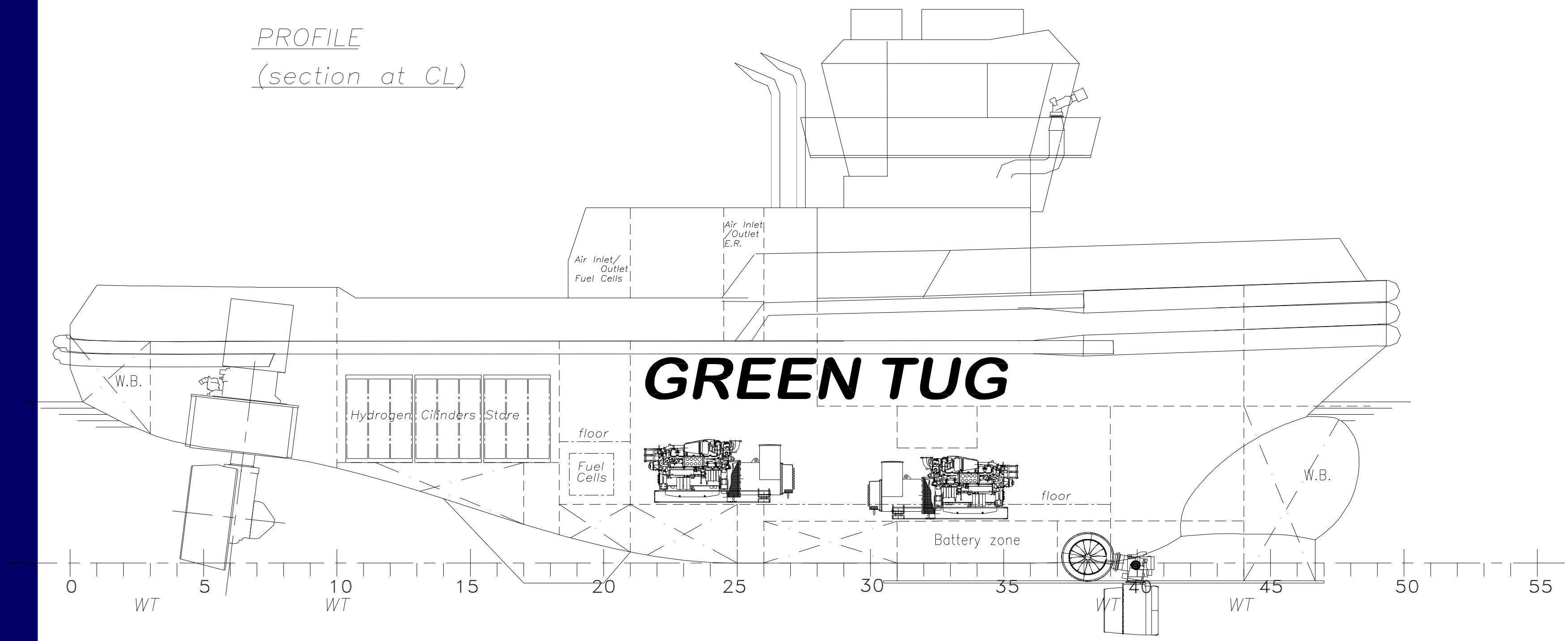
VOITH Inline Thruster:



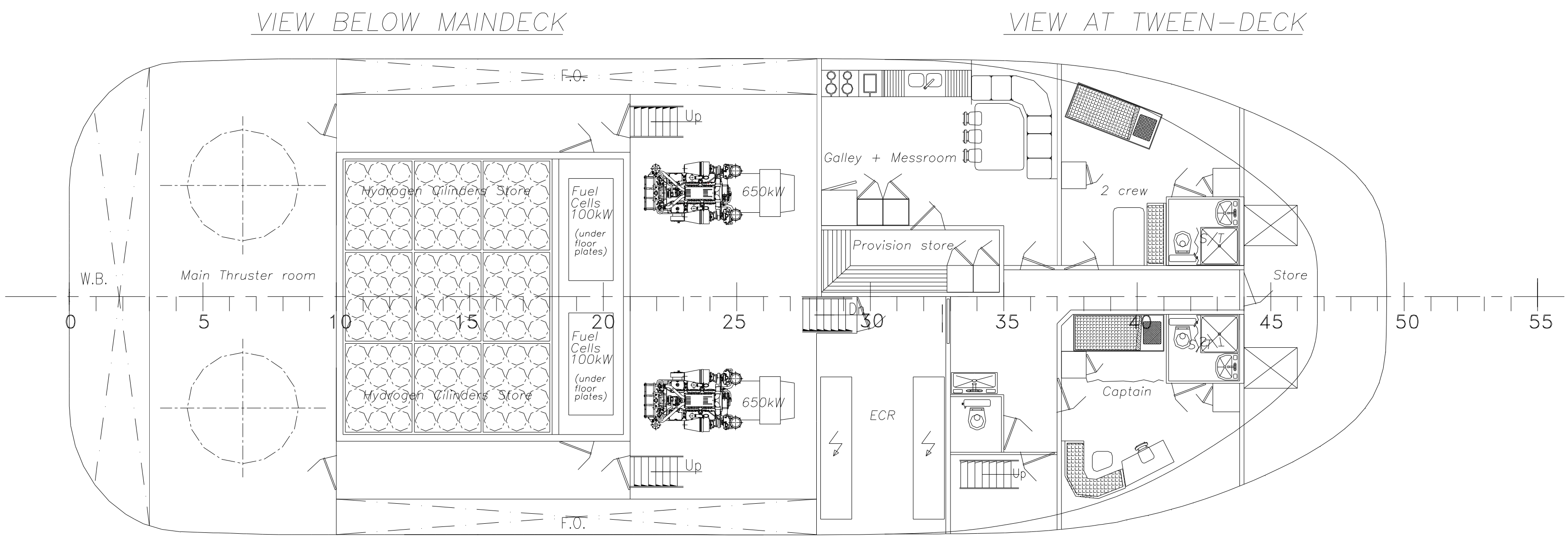
- Stator & Rotor integrated in nozzle
- No Gearing = more efficiency
- Water cooled

VOITH
Engineered reliability.®

Design 50 tBP HHHT:



Design 50 tBP HHHT:



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Further Development

- In depth analysis operational profiles
- Development Electronic Power Management System
- Development power regenerating features winch and propellers
- Manoeuvrability on bow unit only
- Development full basic and detailed design
- Selection electrical deck equipment, etc.
- Investment operational cost

Project Supported by: