

# Roadmap towards safe LH2 fuelled vessels

From MarHySafe to first ever vessel fuelled by LH2

Dalibor Bukarica; Head of Section; Alternative Fuels & Piping Systems, DNV Maritime; Ship Classification

# Introduction: DNV

- Global and independent assurance and risk management company
- 160 years
- ~12000 employees
- 100+ countries
- 5%+ of revenue in R&D

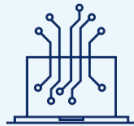
Ship and offshore  
classification and advisory



Energy advisory, certification,  
verification, inspection and  
monitoring



Software, cyber security,  
platforms and  
digital solutions



Management system  
certification, supply chain and  
product assurance




# Introduction: presenter

- Dalibor Bukarica
- M.Sc.
- 24 years of experience in Maritime Industry;
- 13 years in DNV Maritime; Ship Classification;
- Head of Section, Alternative Fuels and Piping Systems;
- Development and maintenance of Classification rules
- Approval of piping systems
- Support to customers and business development

# Experience: The world's first LNG fuelled ships




  
 RULES FOR CLASSIFICATION OF  
**SHIPS**  
 NEWBUILDINGS  
 SPECIAL EQUIPMENT AND SYSTEMS  
 ADDITIONAL CLASS

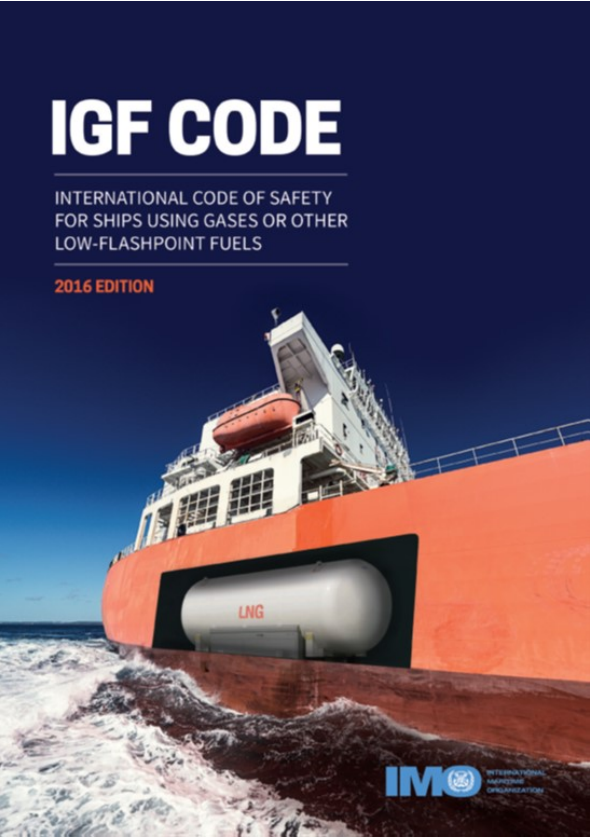
PART 6 CHAPTER 13

**GAS FUELLED ENGINE INSTALLATIONS**

JANUARY 2001

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# IGF Code

## 2.3 Alternative design

2.3.1 This Code contains functional requirements for all appliances and arrangements related to the usage of low-flashpoint fuels.

2.3.2 Fuels, appliances and arrangements of low-flashpoint fuel systems may either:

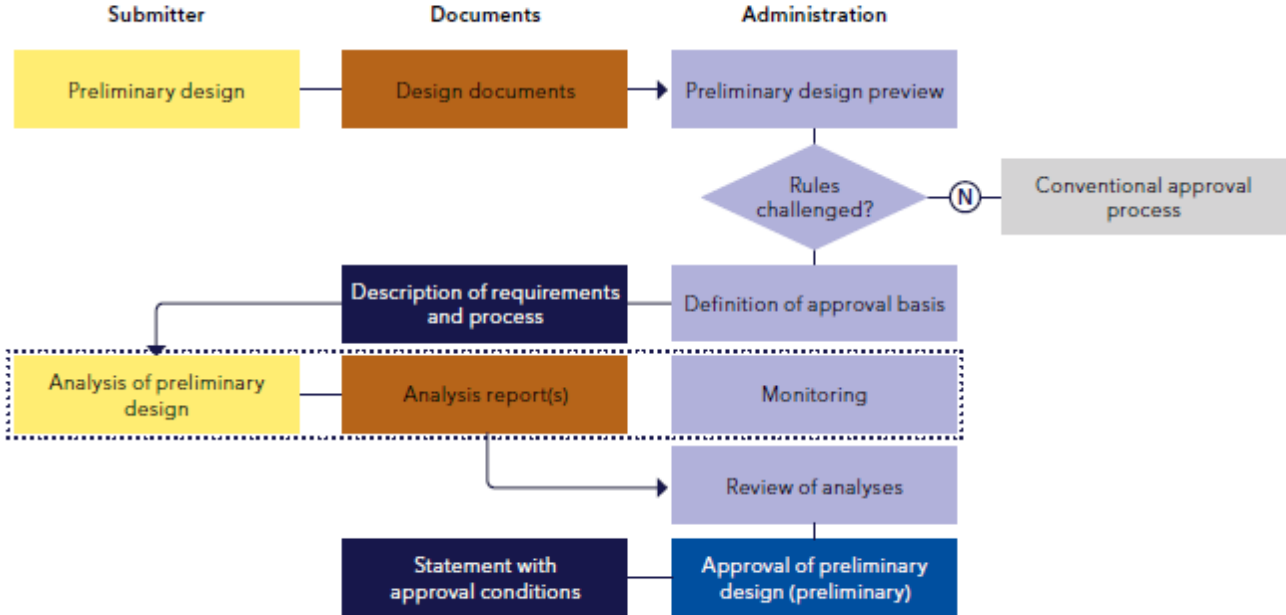
- .1 deviate from those set out in this Code, or
- .2 be designed for use of a fuel not specifically addressed in this Code.

Such fuels, appliances and arrangements can be used provided that these meet the intent of the goal and functional requirements concerned and provide an equivalent level of safety of the relevant chapters.

2.3.3 The equivalence of the alternative design shall be demonstrated as specified in SOLAS regulation II-1/55 and approved by the Administration. However, the Administration shall not allow operational methods or procedures to be applied as an alternative to a particular fitting, material, appliance, apparatus, item of equipment, or type thereof which is prescribed by this Code.

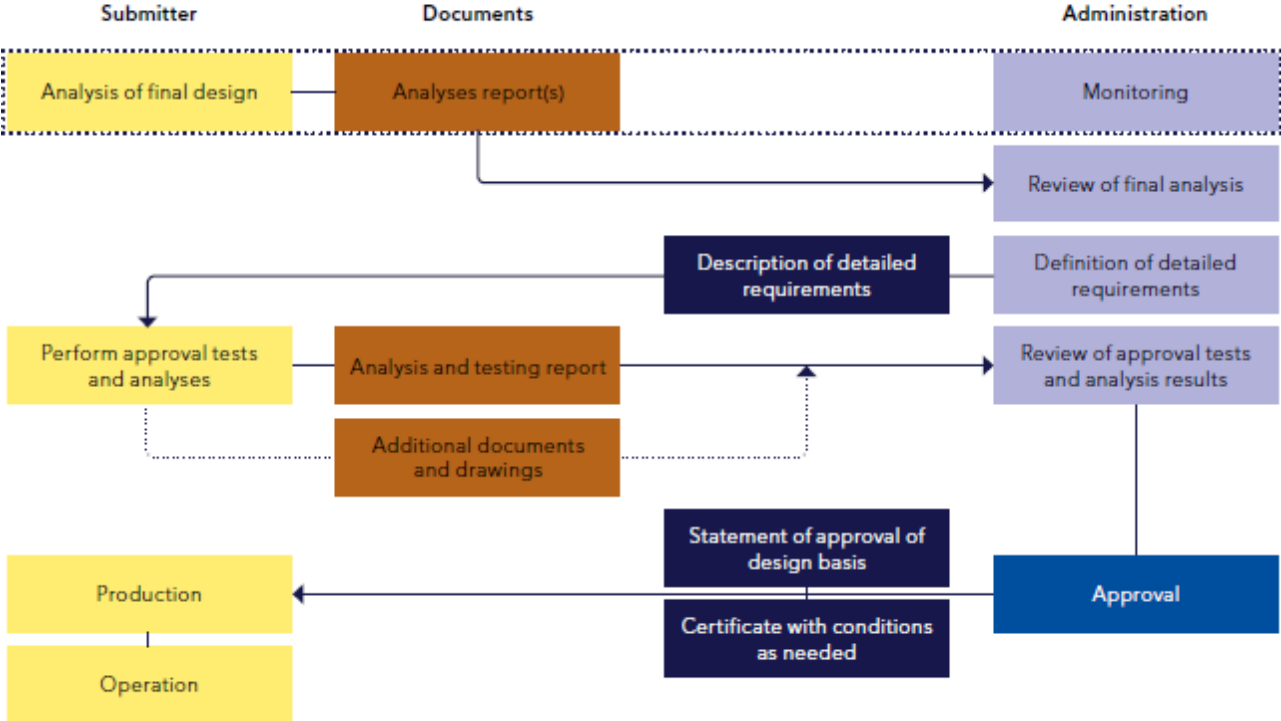
# MSC.1/Circ.1455

Overview of the approval procedure for preliminary design required according to the Alternative Design approach (MSC.1/Circ 1455, 2013), describing the roles of the Administration (Flag State) and the Submitter (Project Owner).



# MSC.1/Circ.1455

Overview of the approval procedure for final design required according to the Alternative Design approach (MSC.1/Circ 1455, 2013), describing the roles of the Administration (Flag State) and the Submitter (Project Owner).



# The beginnings

- Two different worlds: maritime industry and shore-based industry
- MarHySafe JDP Phase 1



WHEN TRUST MATTERS

## HANDBOOK FOR HYDROGEN-FUELLED VESSELS





# Two different worlds: Maritime and Shore

## **MARITIME INDUSTRY:**

A key to safe introduction of hydrogen is to consider the real properties of hydrogen and not assume that its behavior is equal to any other gas or fuel.

## **SHORE-BASED INDUSTRY:**

Change of mindset and adapting to new, more challenging environment with much stricter requirements.

MF Hydra is the world's first liquid hydrogen powered ship.



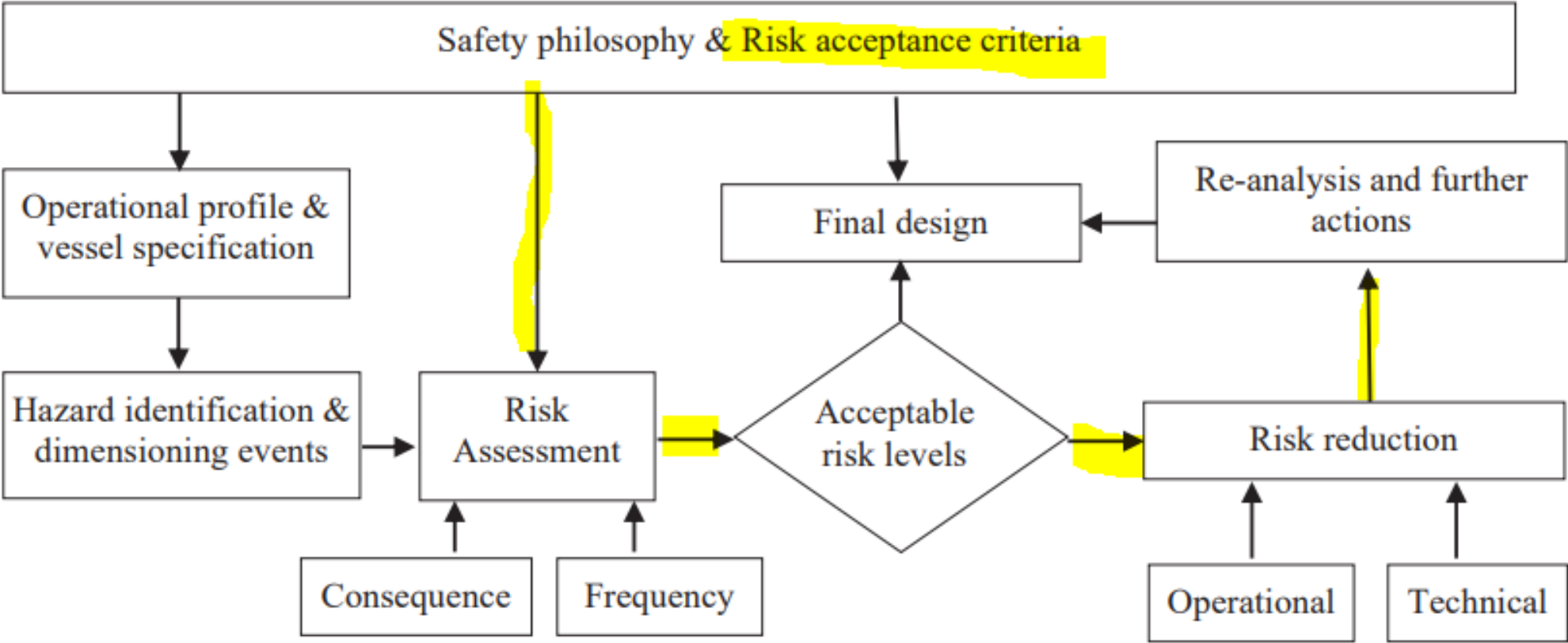
# Alternative design process

- **As there are no prescriptive rules or regulations** in place to guide the design of this ferry, the alternative design process is used to **demonstrate that MF Hydra is equally safe as a diesel-driven ferry.**

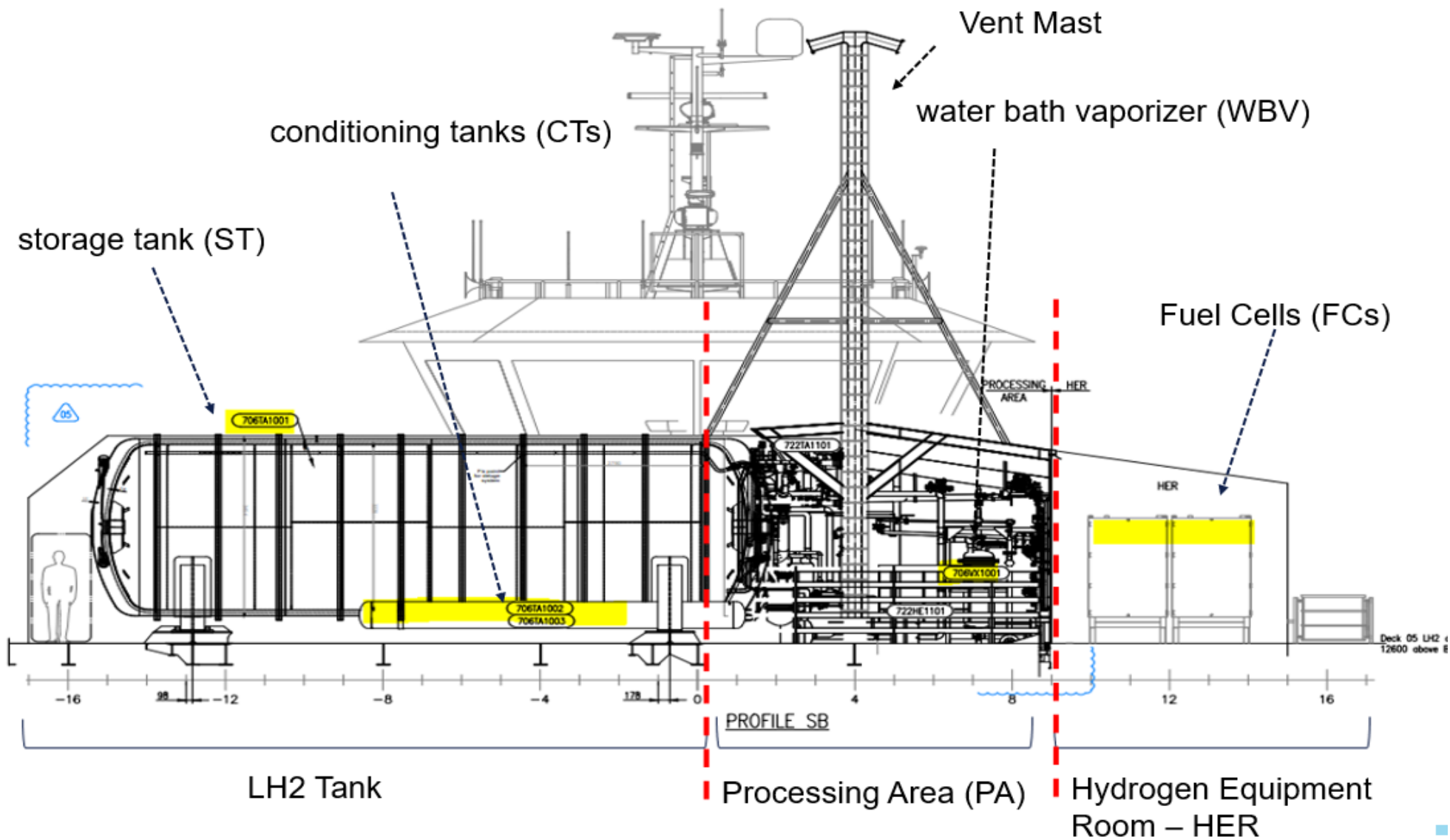
## Process:

- Functional requirements
  - **Part A includes functional requirements that shall be fulfilled through the ship design**
- Risk assessment
  - A risk assessment (incl. HAZID) shall be conducted to ensure that risks arising from the use of low-flashpoint fuels affecting persons on board, the environment, the structural strength or the integrity of the ship are addressed.
- Limitation of explosion consequences
  - Explosion analysis may be required for spaces containing leakage sources and potential ignition sources

# Risk assessment process







# DNV Rules – Gas Fuelled Hydrogen (July 2024)



## RULES FOR CLASSIFICATION

### Ships

Edition July 2024

## Part 6 Additional class notations

### Chapter 2 Propulsion, power generation and auxiliary systems

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## SECTION 16 GAS FUELLED VESSEL INSTALLATIONS - GAS FUELLED HYDROGEN

### 1 General

#### 1.1 Introduction

The introduction of hydrogen as fuel on board vessels requires safety measures different to other gas fuelled vessel installations. These rules reflect available knowledge and build on work ongoing in IMO. The use of hydrogen as fuel is currently not covered by prescriptive requirements in international conventions, hence such installations will require alternative design approval by the flag authorities for the issuance of the statutory certificates.

#### 1.2 Objective

The additional class notation **Gas fuelled hydrogen** provides criteria for the safe and environmentally friendly arrangement and installation of machinery for propulsion and auxiliary purposes, using hydrogen as fuel.

#### 1.3 Scope

The scope for additional class notation **Gas fuelled hydrogen** includes requirements for the vessel's gas fuel system, covering all aspects of the installation, from the vessel's gas fuel bunkering connection up to, but not including, the gas consumers. The rules include requirements for arrangement and location of gas fuel tanks and all spaces with fuel piping and installations, requirements for the entrances to such spaces and defines hazardous areas and spaces accordingly. Requirements for control, monitoring and safety systems for the fuel installations are included.

Bunkering procedures are within scope, as part of the operation manual, whilst the bunkering processes and crew training are not part of the scope for this section of the rules.

This section provides conservative, prescriptive requirements enabling design of hydrogen fuelled vessels without performing an alternative design approval process, i.e. a full quantitative risk assessment (QRA). These requirements are prepared for hydrogen fuel arrangements located on open deck with leakage points protected with suitably arranged secondary enclosures combined with measures to minimize the intensity, duration and likelihood of a hydrogen leakage.

#### 1.4 Application

The additional class notation **Gas fuelled hydrogen** applies to vessels using hydrogen in gaseous or liquefied state as fuel. These rules are not applicable to gas carriers.

#### 1.5 Rule concept

The prescriptive requirements of this section are considered to be in compliance with the goals and functional requirements of the Part A of the IGF code. Alternative designs not compliant with the prescriptive requirements in this section shall provide an equal level of safety to the relevant requirement.

When a design is not compliant with prescriptive requirements in this section, either partly or in full, compliance with the goals and functional requirements of the IGF Code shall be demonstrated by a quantitative risk analysis required in [1.14], for the parts that are not compliant.

Rules for classification: Ships – DNV-RU-SHIP Pt.6 Ch.2, Edition July 2024  
Propulsion, power generation and auxiliary systems

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DNV AS

Part 6 Chapter 2 Section 16



# Near future

- MarHySafe Phase 2
- October 2024 – finalizing of QRA expected (compressed Hydrogen fuel)
- Ongoing work on bunkering processes
- New edition of Handbook expected early 2025.



# Thank you

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