Implementation of International Standards for Maritime Hydrogen Fuel Cells

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Outline

- Recent interest in using hydrogen and fuel cells for vessel power and propulsion
- Application of the IGF Code to hydrogen and fuel cells
- U.S. implementation of IGF Code and other standards for hydrogen fuel cell vessel projects
Hydrogen Fuel Cell Powered Passenger Ferry

The Water-Go-Round

- Aluminum catamaran
- 70’ / 21 m LOA
- 84 passenger (reconfigurable)
- 22 knot top speed
- 2x 300 kW electric motors
- 360 kW PEM fuel cell
- 100 kWh Li-ion battery
- $H_2$: 264 kg @ 250 bar
IGF Code Development

**International Code of Safety for Ships Using Gases or Other Low-Flashpoint Fuels (IGF Code)**

**Timeline / Key Milestones:**

- **May 2004:** Norway proposes development of international standards for gas-fuelled ships
- **Jun 2009:** IMO adopts “*Interim Guidelines on Safety for Natural Gas-Fuelled Engine Installations on Ships*”
- **Jun 2015:** **IGF Code** adopted at MSC 95
- **Jan 2017:** **IGF Code** entered into force
Safety Considerations

- **Fuel System**
  - Machinery space configuration
  - Tank placement
  - Tank & piping requirements

- **Gas Detection**
  - System certification

- **Hazardous Locations**
  - Classification of areas
  - Electrical equipment

- **Fire Protection**
  - Installed firefighting systems
  - Fire detection
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.
Applying IGF Code to Hydrogen & Fuel Cells

Hydrogen v/s Natural Gas

- characteristics & risks are similar
- differences are known and well-documented
Applying IGF Code to Hydrogen & Fuel Cells

- Risk assessment for vessel design required by IGF Code

- Additional guidance on risk assessments are provided in IACS Recommendation #146: “Risk Assessment as Required by the IGF Code” (Aug 2016)
Design Basis: Equivalency to U.S. Federal Regulations

- U.S. Federal Regulations do not address:
  - hydrogen as a vessel fuel
  - use of fuel cells for vessel power
- Need to establish equivalency to design standards in Title 46, Code of Federal Regulations (CFR) - Shipping
  - Design Basis providing framework of standards & requirements
  - Vessel specific / case-by-case
  - Draw from standards such as IGF Code, ASME, ASTM, IEC & Class Society Rules

Equivalent level of safety to requirements in Title 46 Code of Federal Regulations
Thank You!

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