CENTER FOR Hydrogen SAFETY

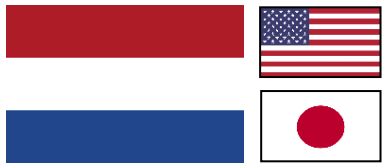
Connecting a Global Community

Global Hydrogen Safety Codes and Standards

Chris LaFleur
Sandia National Labs
July 21, 2021

International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE)

- Two active Working Groups
  - **Education & Outreach –**
    - Aims to share information on hydrogen and fuel cell technologies, including the status, challenges, opportunities, and initiatives (particularly on policies and programs) across countries
  - **Regulations, Codes, Standards, & Safety –**
    - Aims to share information, lessons learned and best practices with a focus on hydrogen safety, as well as the ***harmonization of codes and standards developed by relevant industry code and standards development organizations.***



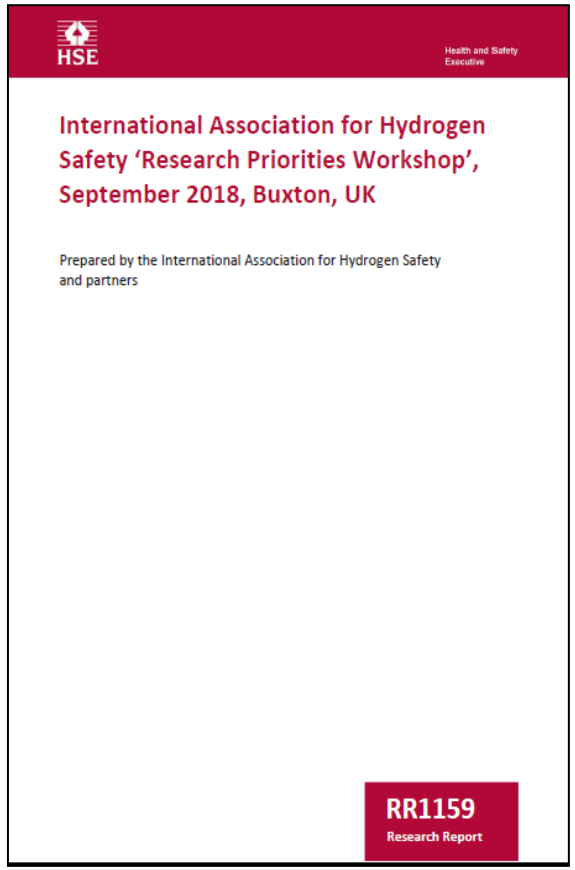
New Chair: Dec 2020: The Netherlands

Vice Chairs: U.S. Japan

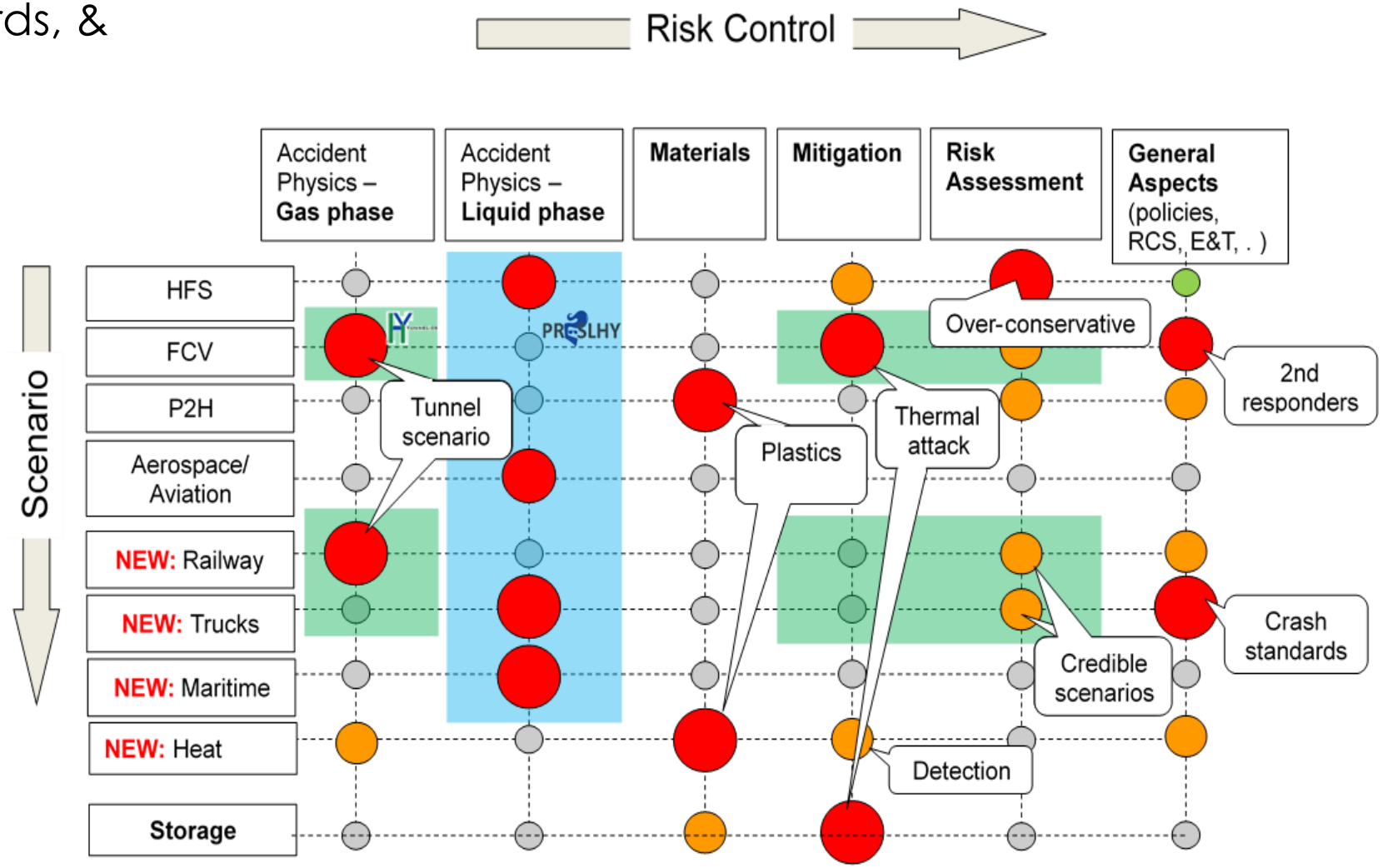
www.IPHE.net

Research Priorities

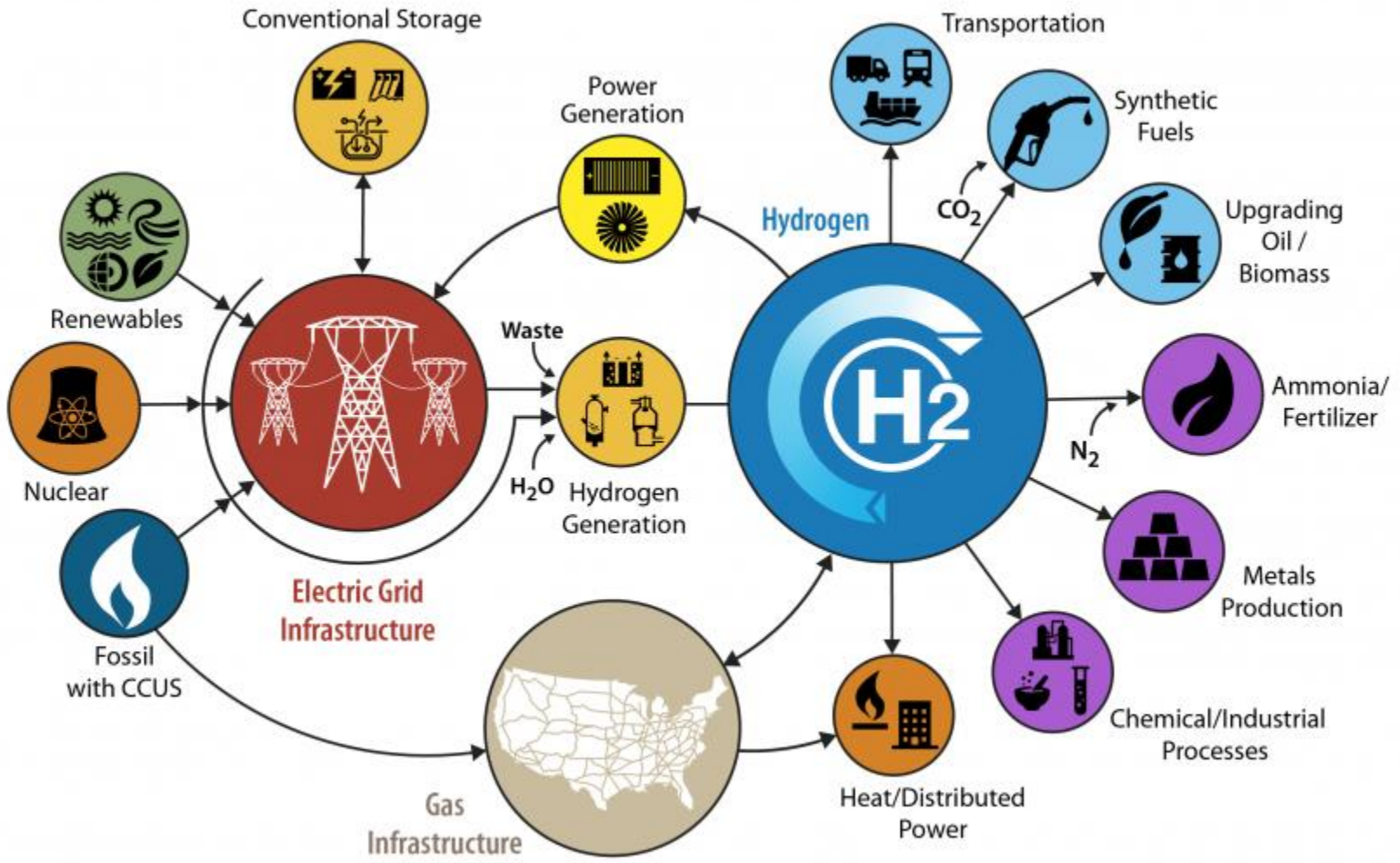
- Regulations, Codes, Standards, & Safety Working Group



https://www.hse.gov.uk/research/rrhtm/rr1159.htm

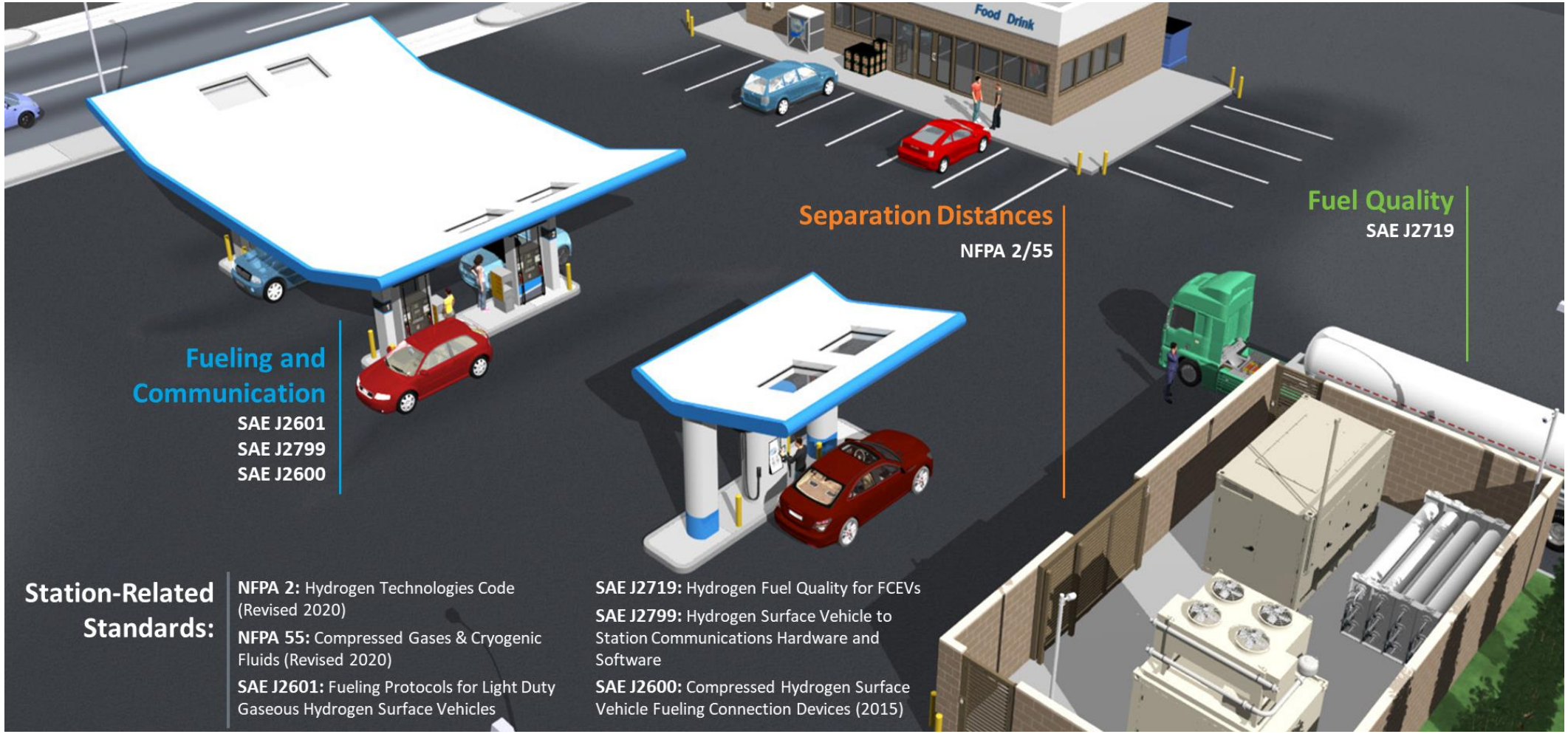


Standards Affecting H2 Applications are Industry -Specific



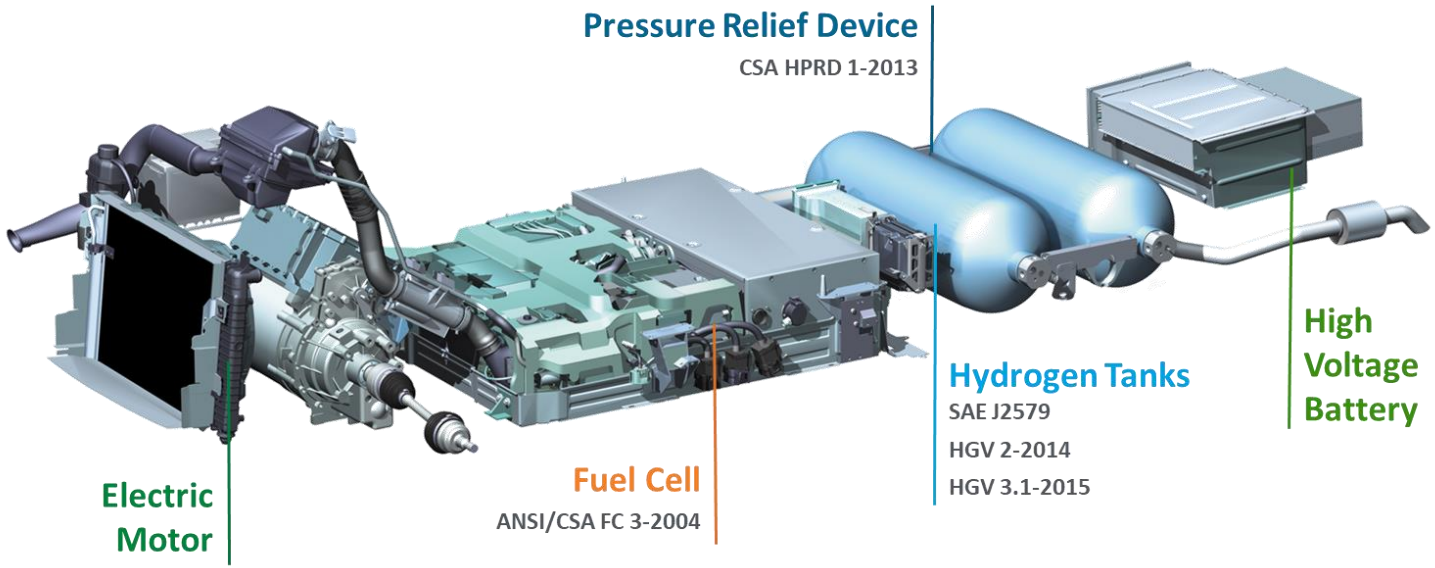
North American-Based Codes & Standards

- Examples of Standards Impacting Refueling Infrastructure



North American-Based Codes & Standards

- Examples of Standards Impacting Vehicles



Other Vehicle-Related Standards:

SAE J2578: Recommended Practice for General Fuel Cell Vehicle Safety (Revised 2014)

SAE J2601: Fueling Protocols for Light Duty Gaseous Hydrogen Surface Vehicles (Revised 2020)

SAE J2719: Hydrogen Fuel Quality for Fuel Cell Vehicles (Revised 2020)

SAE J2574: Fuel Cell Vehicle Terminology (2011)

SAE J2799: Hydrogen Surface Vehicle to Station Communications Hardware and Software (Revised 2019)

SAE J2600: Compressed Hydrogen Surface Vehicle Fueling Connection Devices (Revised 2015)

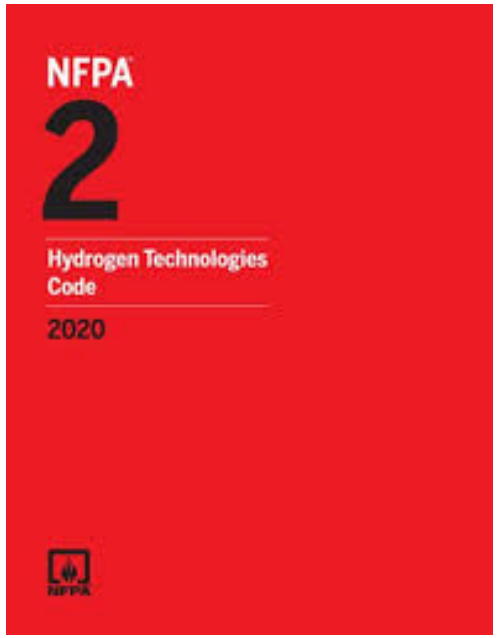
North American-Based Standards

- National Fire Protection Association (NFPA) – Fire safety topical documents
- American Association of Mechanical Engineers (ASME) –Design requirements for piping, pressure vessels, tanks
- American Society for Testing Materials (ASTM) – Standard test methods for materials that come in contact with hydrogen/hydrogen embrittlement
- Canadian National Standards (CAN) – Installation , fuel cells (portable and stationary)
- Compressed Gas Association (CGA group) – Publication on H2 storage, piping, venting, labeling, etc.
- Canadian Standards Association (CSA)/American National Standards Institute (ANSI/ Underwriters Laboratory (UL)– Product certification and development of safety standards for electrical appliances, medical devices, machinery, equipment, etc.
- Others: Electrical standards and guidance documents (IEEE), Society of Automotive Engineers (SAE)

Incorporated by reference in many countries and across many relevant documents

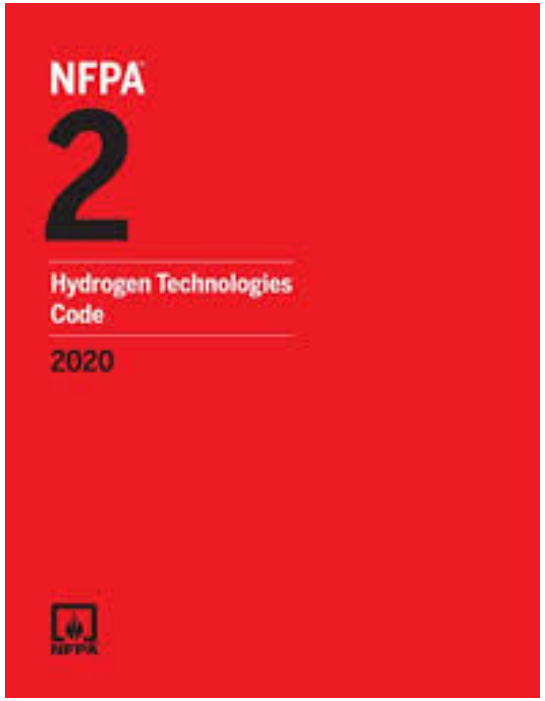
NFPA 2 – *Hydrogen Technologies Code*

- Consensus standard – Technical Committee Members categorized into classifications based on the roles their funding organization playing in the industry
- Balance Requirement: no more than one-third of the voting members shall represent any one interest category
  - Manufacturer
  - User: A representative of an entity that is subject to the provisions of the standard or that voluntarily uses the standard.
  - Installer/Maintainer
  - Labor
  - Applied Research/Testing Laboratory
  - Enforcing Authority
  - Insurance
  - Consumer
  - Special Expert (SE): A person not representing any other category, and who has special expertise in the scope of the standard.



NFPA 2 – *Hydrogen Technologies Code*

- Established in 2006 as an all-encompassing document to establish the necessary requirements for the storage, use, and handling of H2
- Scope: This code shall apply to the production, storage, transfer and use of hydrogen.
- Recent Activity
  - Currently in the 2023 version revision cycle
  - First Draft issued March 2021
  - Public Comment closing date July 14, 2021
  - Second Draft meeting will be held in Fall 2021
  - 2023 Version will be issued in Fall 2022



NFPA 2 – *Hydrogen Technologies Code*

- Contents

Standards referenced by the Code

Other NFPA docs
ANSI
ASME
ASTM
CGA
CSA Group
ICC
SAE
UL

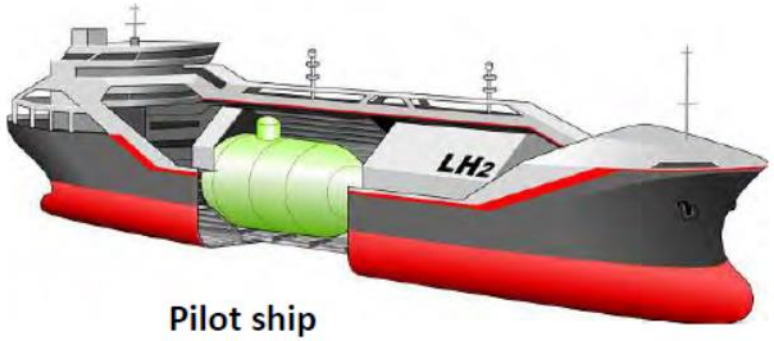
Hydrogen Systems in Canada

- Canadian Hydrogen Installation Code: CAN/BNQ 1784-0000
- Sets the installation requirements for hydrogen generating equipment, hydrogen-powered equipment, hydrogen dispensing equipment, hydrogen storage containers, hydrogen piping systems and their related accessories.
- Applies to gaseous and liquid hydrogen
- Exceptions
  - Petroleum refineries and chemical plants as feedstock
  - Industrial facilities with mass flow greater than 21 kg/hr
  - New edition expected December 2021
- https://www.bnq.qc.ca/en/standardization/hydrogen/canadian-hydrogen-installation-code.html

Bureau de normalisation du Québec

Maritime (IMO) Hazardous Goods

- Sub-Committee on Carriage of Cargoes and Containers (CCC), under the Maritime Safety and Marine Environment Protection Committees, covers:
  - Effective implementation of codes and standards dealing with cargo operations, including packaged dangerous goods, solid bulk cargoes, bulk gas cargoes, and containers;
  - Evaluation of safety and pollution hazards of packaged dangerous goods, solid bulk cargoes and gas cargoes;
  - Survey and certification of ships carrying hazardous cargoes;
  - Enhancement of the safety, security culture and environmental consciousness in all cargo and container operations; and
  - Cooperation with other relevant UN bodies, IGOs and NGOs
- Relevant sections
  - Fuel – IGF Code – International Code of Safety for Ships using Gases or other Low-flashpoint Fuels (Mandatory under SOLAS)
  - Cargo – IGC Code - International Code of the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk



Pilot ship

Codes and Standards Database

Codes and standards provide the information needed to safely build, maintain, and operate equipment, systems, and facilities. They help ensure uniformity of safety requirements and give local inspectors and safety officials the information they need to approve systems and installations.

Who is keeping track of all this??

This resource tracks the world-wide development of about 400 hydrogen and fuel cell standards.

Screenshot of the codes and standards database

URL: https://h2tools.org/fuel-cell-codes-and-standards?search_api_fulltext=

Thanks for Your Attention!

CENTER FOR Hydrogen SAFETY
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http://energy.sandia.gov/programs/sustainable-transportation/hydrogen/hydrogen-safety-codes-and-standards/

CHS… Bringing together individuals and organizations to develop and share best safety practices and learnings