H2ME/ H2ME2 project

Hydrogen refuelling stations

Online workshop on

Safe Storage of Compressed Gas Hydrogen

in road transport applications

and related infrastructure

Nick Hart, ITM Power

Compliance Officer

18 November 2021

H2ME / H2ME2

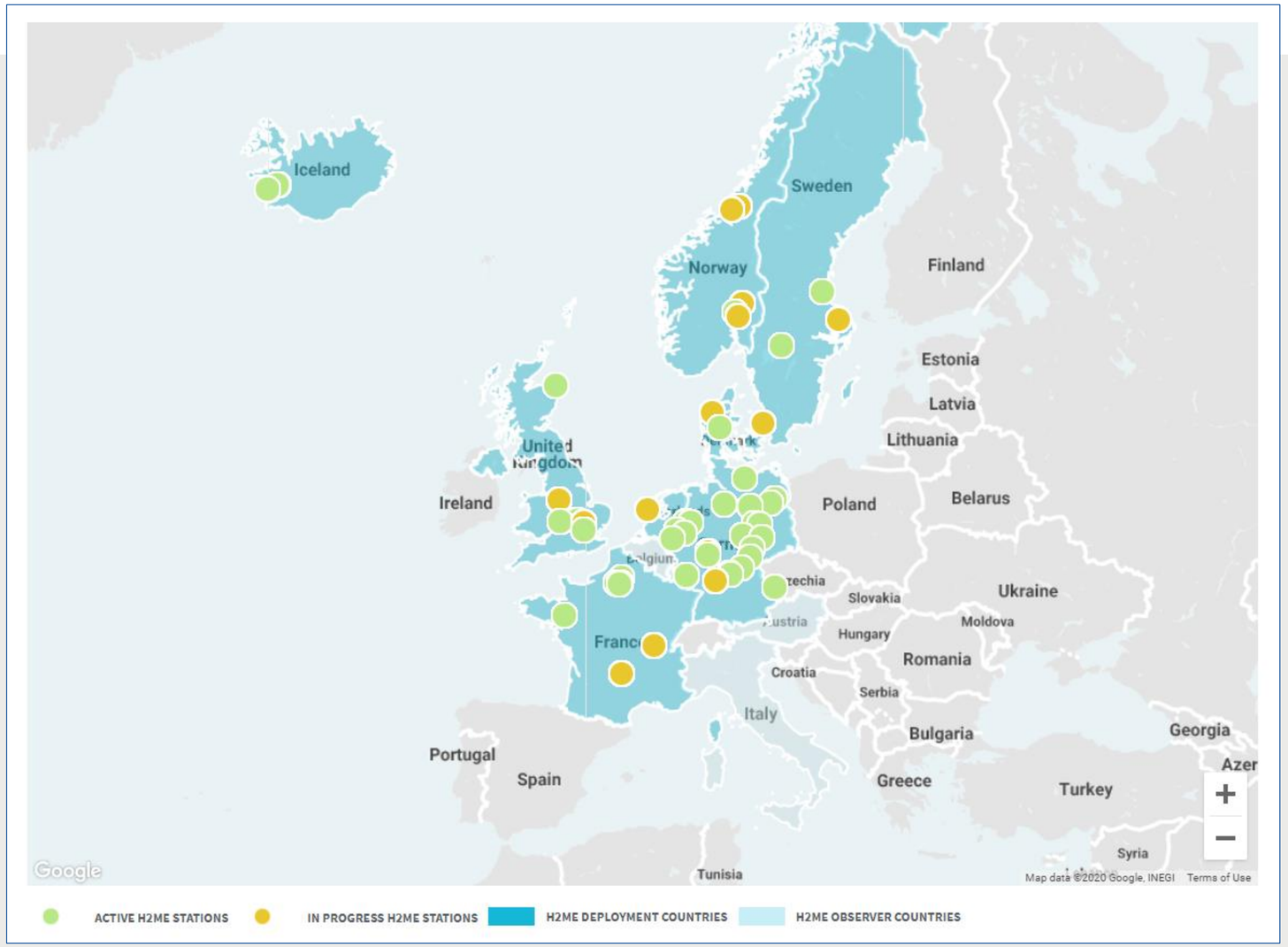
Workshop on Safe Storage of Hydrogen

Project Brief

- Consortium: Large, and mixed – all have safety expertise in their own field
- Other than an RCS report(s), no deliverables within the project require the consortium members to work together on safety
- Only RCS activity where learnings transfer into ISO, CEN, etc.. standardisation work, on a voluntary basis
- Safety Responsible Person: Nothing defined, other than CENEX collating the reports (safety left to responsible individuals in each company)
- Description: Deployment of 49 stations, and >1400 cars and vans over course of H2ME and H2ME2
- Max Inventory, Consumption, Flow: Dependent on location, but all <5 tonnes
- Location: Across Europe – see website: https://h2me.eu/

H2ME / H2ME2

Workshop on Safe Storage of Hydrogen



DISCLAIMER
ALL INFORMATION SHOULD BE TREATED AS ITM POWER SPECIFIC, AND DOES NOT COVER OTHER HRS OPERATORS INVOLVED IN H2ME OR H2ME2

Regulations, Codes and Standards

- CE marking Directives / Regulations:
  - The Pressure Equipment Directive, *European Directive 2014/68/EU (PED)*;
    - PD5500 (low pressure buffer)
    - EN 12257 (high pressure storage)
  - The Machinery Directive, *European Directive 2006/42/EC*;
  - Elements of the „ATEX Equipment Directive“, *European Directive 2014/34/EU*
- ISO 19880-1 – recently published (2020)
- EN 17533 (was ISO 19884) – recently published (2020)
- Refuelling station documents:
  - BCGA CP 41 - *The design, construction, maintenance and operation of filling stations dispensing gaseous fuels*
  - Energy Institute - *Guidance on hydrogen delivery systems for refuelling of motor vehicles. Public use, co-located with petrol filling stations.* (Supplement to the Blue Book)

Regulations, Codes and Standards

- General legislation, for example:
  - Dangerous Substances and Explosive Atmospheres Regulations, DSEAR *(The UK implementation of the European ATEX "Workplace Directive")*
  - Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres (EPS) Regulations *(The UK implementation of the European ATEX "Equipment Directive")*
  - The Pressure Systems Safety Regulations (PSSR)
    - Inspection according to ISO 11623 (5 yr internal inspection, 10 yr hydrostatic test)
  - The Provision and Use of Work Equipment Regulations (PUWER)
  - Control of Substances Hazardous to Health Regulations (COSHH)
  - Regulatory Reform (Fire Safety) Order

- Safety rules of Shell (stakeholder / landlord) adopted where HRS deployed on their sites

Identification of Safety Vulnerabilities ISV

- Main hazards are as follows:
  - Pressure – failure of vessels, components etc.
  - Flammable gas (hydrogen) – release to air to form flammable / potentially explosive atmosphere
- Involvement of bodies outside of ITM:
  - PED Notified Body
  - PSSR Competent Person

Risk Assessments

Differs depending on location of system:

- Non-Shell sites – internal ITM risk assessment:
  - HazId, HazOp and LOPA
  - DSEAR risk assessment (ATEX 137)
  - General risk assessment to summarise more detailed HazOp etc, but also capture hazards that aren‘t related to the process equipment
- Shell sites – additional steps to above (in conjunction with Shell Hydrogen):
  - Bow-tie style Desktop Safety Review (DSR) – however – performed with Shell by manufacturer and not available to ITM
  - Pre Start-up Safety Review (PSSR)
- Additional risk assessments (and PTW where appropriate) for individual activities that aren‘t covered by the design risk assessment:
  - Installation / commissioning
  - Maintenance
  - Others (e.g. sampling, unusual refuelling events etc.)

Prevention and mitigation

- Pressure control
- Natural ventilation / Intermittent forced ventilation combined with H2 sensor
- Hazardous area classification
- Minimisation of flammables in vicinity
- Separation distances (location in non-publicly accessibly compound)
- Prevention of direct impingment from jet fires onto storage vessels
- Commissioning testing (leak test + pressure test if not already performed)
- Maintenance regime
- Emergency stop & isolation etc / alarms / flame sensors
- Training of local first responders (i.e. Security staff / Shell shop staff)
  - Development of site specific emergency plan for fire services, also assistance in developing National Operations Guidance (NOG) through BCGA
  - Training of local first responders – around time of putting into operation
  - Occasional refresher training (or for new staff) when requested (e.g. Shell on annual basis), or „train the trainer“

Safety issues observed so far

- General safety related problems encountered so far:
  - Leaks from fitting connections to storage vessels
  - Observation: area of weakness when it comes to legislation for pressure equipment)
  - Vessels pressure tested without final fittings attached – does this lead to higher likeilhood of leaks?
- Challenges:
  - Lack of clear separation distances / consistent hazardous area classification approach for HP hydrogen
  - Balancing fire walls to reduce separation distances with confinement
  - When minor leaks arise, at what point does this become unacceptable and necessitate significant maintenance activity?
  - Hazardous areas / separation distances necessary for venting stored hydrogen (e.g. for maintenance)
  - Appropriate maximum quantity of hydrogen to be stored inside enclosures
  - (Refuelling of vehicles with larger inventory of onboard storage)
- Possibly present also related lessons learnt
  - Need for regular monitoring of potential leak points – standardised methodology could be beneficial

FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING

Nick Hart
Compliance Officer
njh@itm-power.com

For futher information
www.fch.europa.eu
www.hydrogeneurope.eu
www.nerghy.eu

@fch_ju

Fch-ju@fch.europa.eu

FCH JU