Hydrogen Refuelling Stations for the Public Sector

Quality and Safety in the User Interface

Turid Haugerød
Principal Engineer, Hydro Oil & Energy
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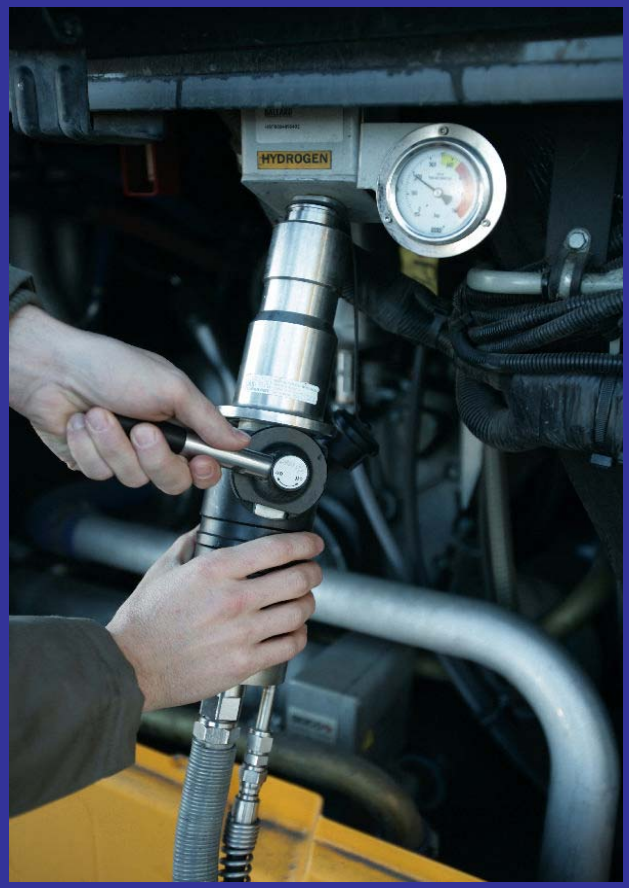
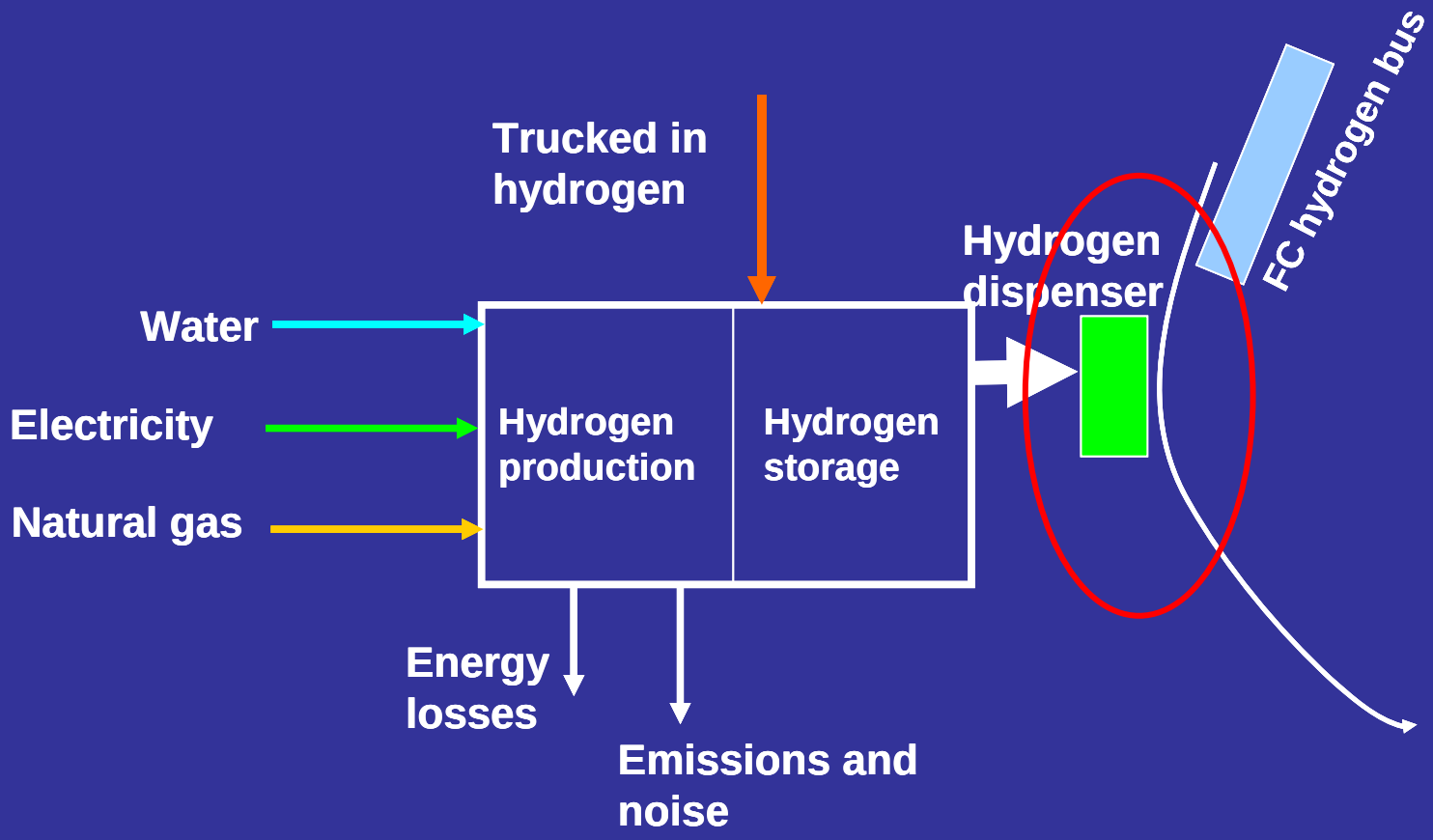
Introduction

Experience from 4 years of operation in demonstration projects:

- Incidents more frequent at the user interface than in other parts of the station
- Further development of the refuelling equipment and systems needs special attention



The User Interface



The User Interface is where the refuelling is done

Characteristics of the user interface

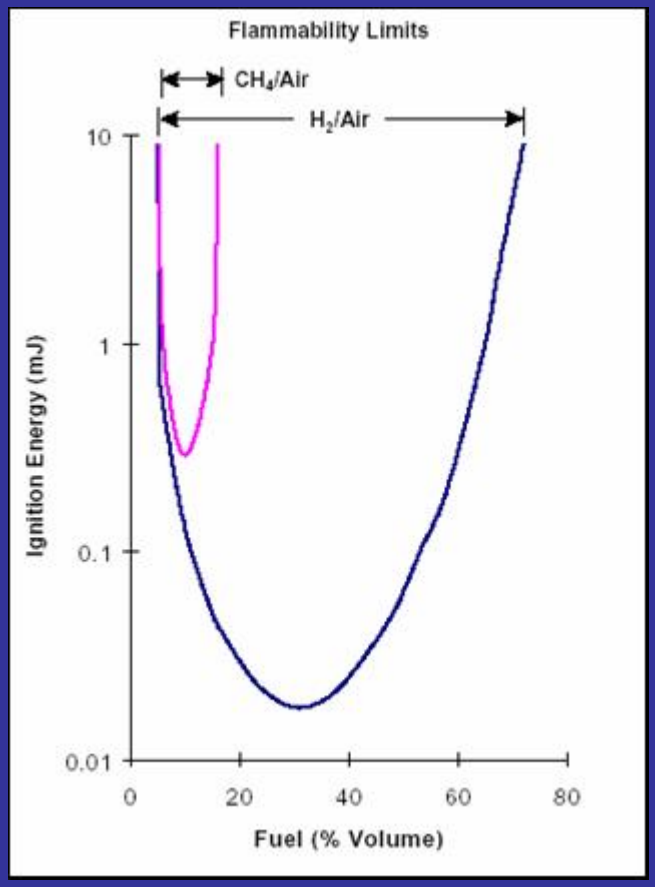
- Safe, robust and reliable equipment and systems
- Simple refuelling procedures easy to understand
- User-friendly design and operation

Safety aspects in the user interface

- The main safety aspects are related to potential ignition of a hydrogen leakage
- Experience from natural gas

BUT

- Hydrogen is different
- Components and systems should be based on hydrogen specific technology



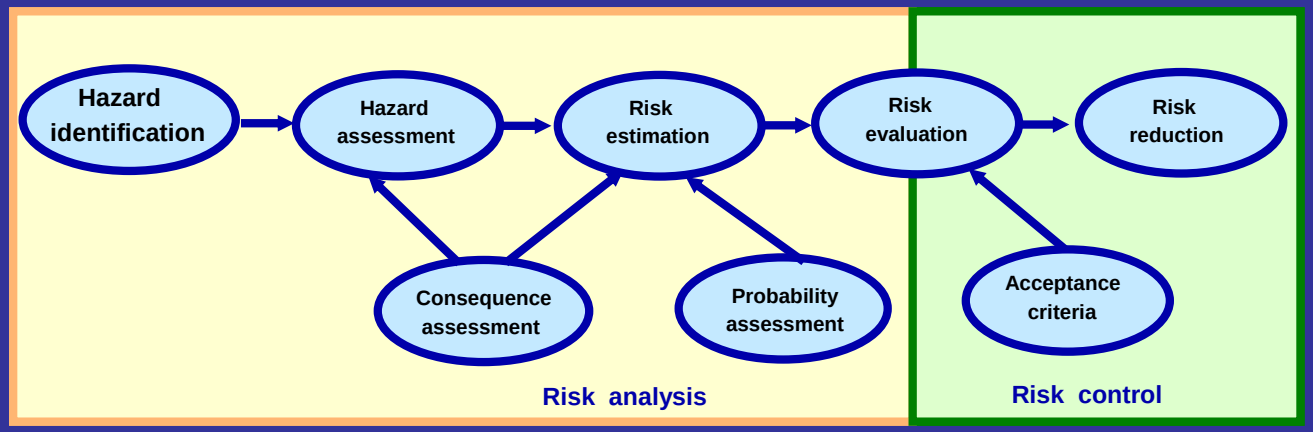
Ref: Alcock, J.L. et. al.

Quality and safety approach to hydrogen stations

- Based on industrial experience

- Transfer of hydrogen technology from the industrial sector to the public sector means new applications and new customers

Risk assessments as design and engineering support



The industrial safety culture emphasizes:

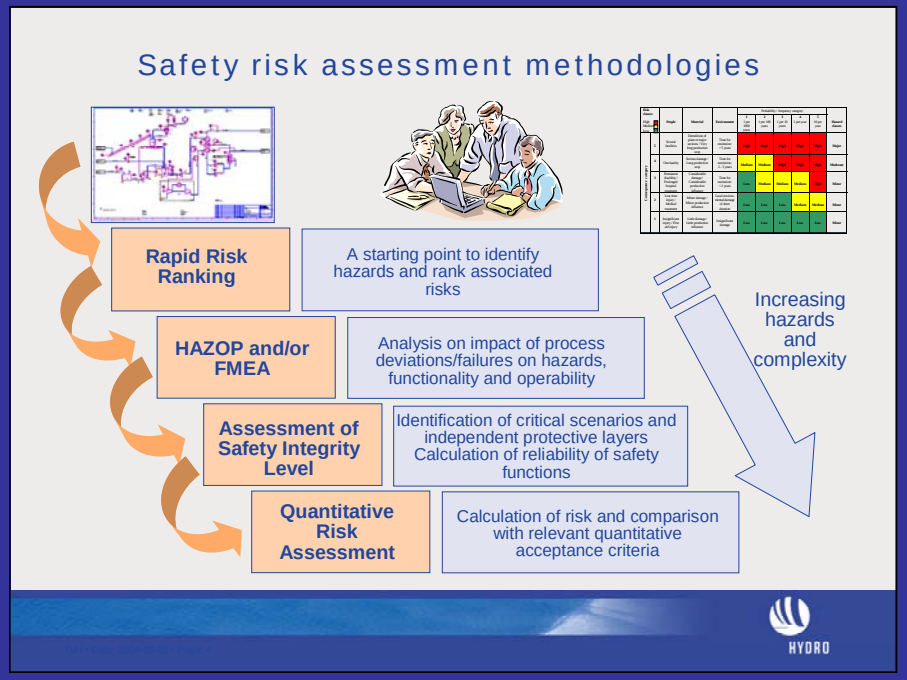
- Inherent safety
- Risk based safety management
- Continuous improvement based on lessons learnt from quality and safety monitoring

Inherent safe hydrogen stations and user interface

- Inherent safe hydrogen stations requires implementation of hydrogen specific know-how
- Different approach and different technical solutions
- Experience and lessons learnt needs to be shared within the “hydrogen family”

Risk assessment of the user interface

- Methodology used must fit the object to be analysed
- The users' tasks and behaviour should be analysed
- Human Factor methodologies should be included in design and operation

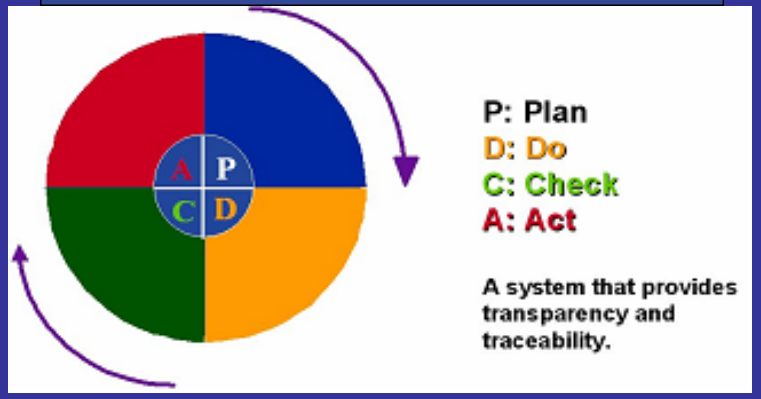


The Human Factor

- Understanding human behaviour and the users' needs is crucial
- Simple instructions fit for the public user is a must
- Work Process Analysis and Job Safety Assessment are useful tools involving the user
- Risk acceptance criteria must support safe and user-friendly design and operation

Continuous improvement of the user interface

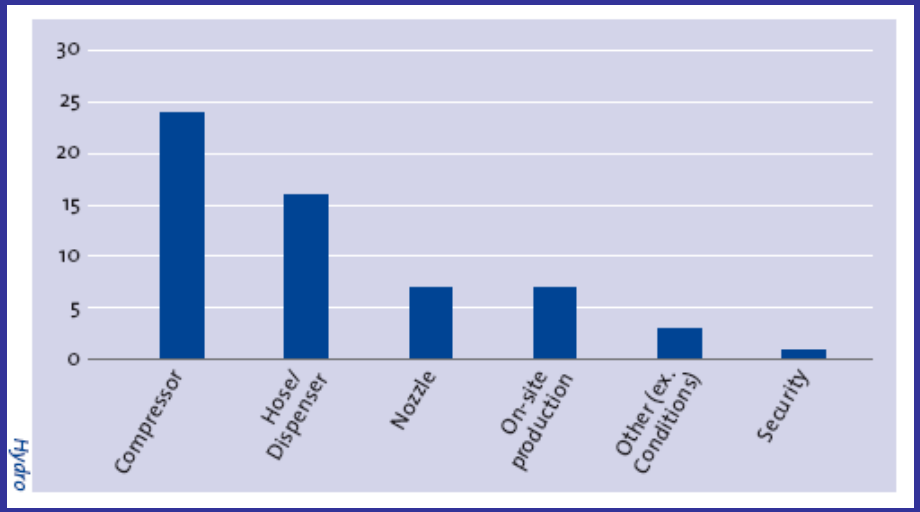
- Quality and safety monitoring a systematic approach to continuous improvement
- The PDCA methodology a most effective tool
- PDCA used in CUTE and HyFLEET:CUTE



Ref: CUTE

Incident reporting – experience from CUTE

- Some 65 incidents reported in detail – about 1/3 related to the user interface
- Dispenser and filling equipment challenging – still unsolved issues
- Human errors were hardly reported



Ref: CUTE

Incident reporting – lessons learnt in CUTE

- Sharing experience makes improvement happen
- Incidents must be scrutinized with respect to root causes
- Operators must be involved in investigation and follow-up
- Suppliers must be heavily involved

The user interface at future hydrogen stations

How is hydrogen refuelling done at future stations ?

How is the user interface designed?

Do we need to copy the petrol refuelling procedure ?

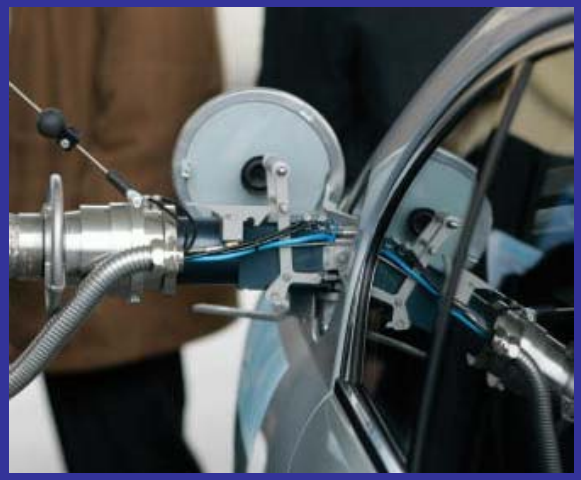
Do we need dedicated personnel ?

Further development

- Hydrogen refuelling stations must be at least as safe and user-friendly as petrol stations
- Simple access to the station
- Simple, reliable and robust equipment and systems
- Shorter refuelling time and higher pressures

Completely new design of the user interface?

- Does 700 bar and wireless communication motivate for completely new solutions?
- Risk increases with humans close to the dispensing process
- Systems and technologies that minimise manual handling should be developed



Conclusion

- High quality and safe user interface requires close cooperation between all parties
- Risk based approach
- Continuous improvement based quality and safety monitoring
- Equipment and systems based on hydrogen specific technology
- The human factor important

Thank you for your attention

Turid.Haugerod @hydro.com