Safety and Security – CUTE / HyFleet CUTE Learnings & recommendations for future Hydrogen Refuelling Stations

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Norsk Hydro – the group

The largest European aluminium company and among the top three world wide

The second largest producer of oil and gas on the Norwegian Continental Shelf

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2001-2006:CUTE, ECTOS, STEP, FCB, CEP Berlin

2006-2009: HyFLEETCUTE:

10 cities, 33 FC buses, 14 ICE buses → 47 buses and 10 hydrogen refuelling stations

HyFLEET:CUTE

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Success criteria - hydrogen buses and fuelling

- No major accidents
- High performance of the fuel cell buses and the hydrogen infrastructure
- Learnings used for development of future stations

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The Basic Safety Philosophy

- **All accidents and injuries can be prevented**
- **Deviations must be corrected promptly**
- **People are the most critical element of the safety programme**

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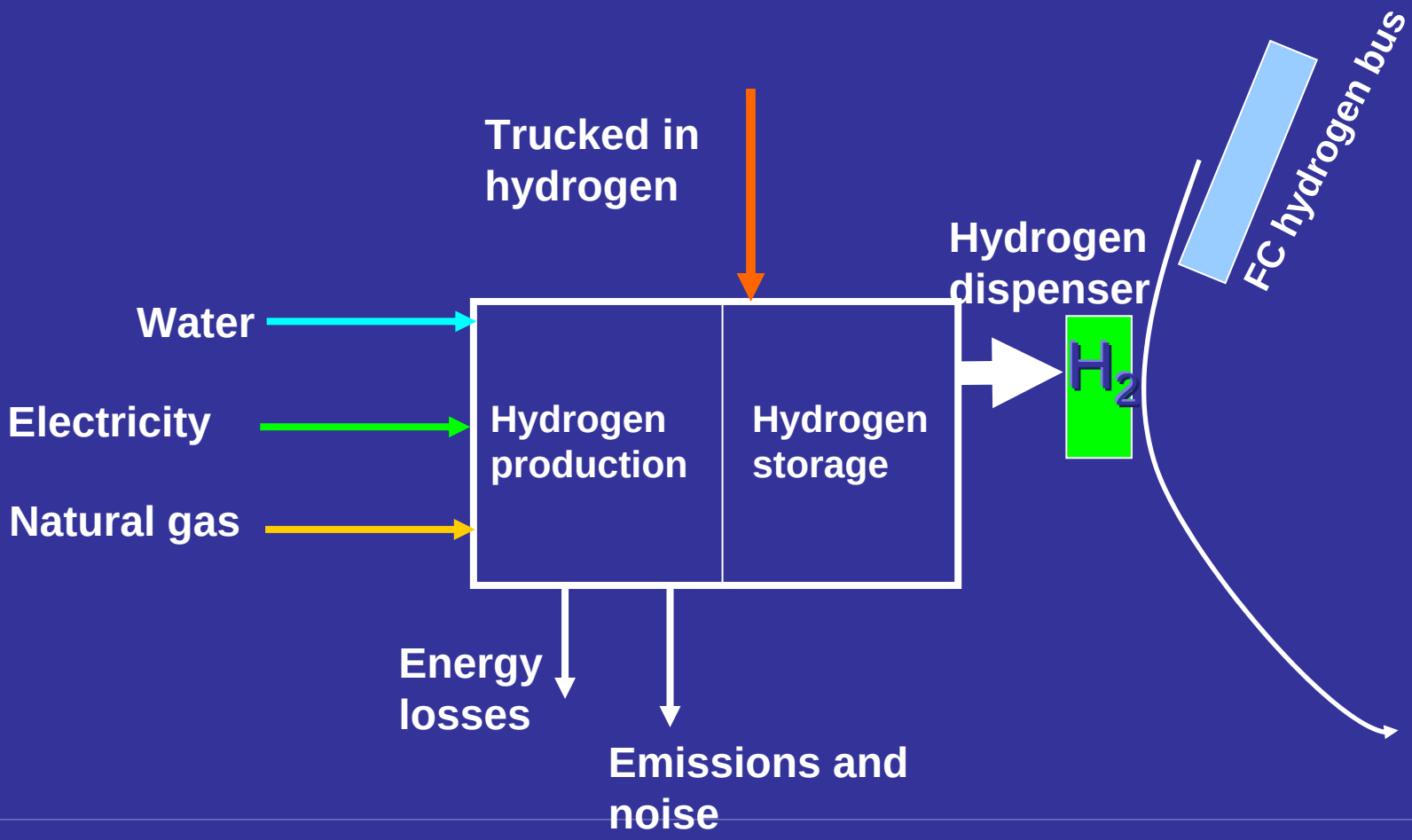
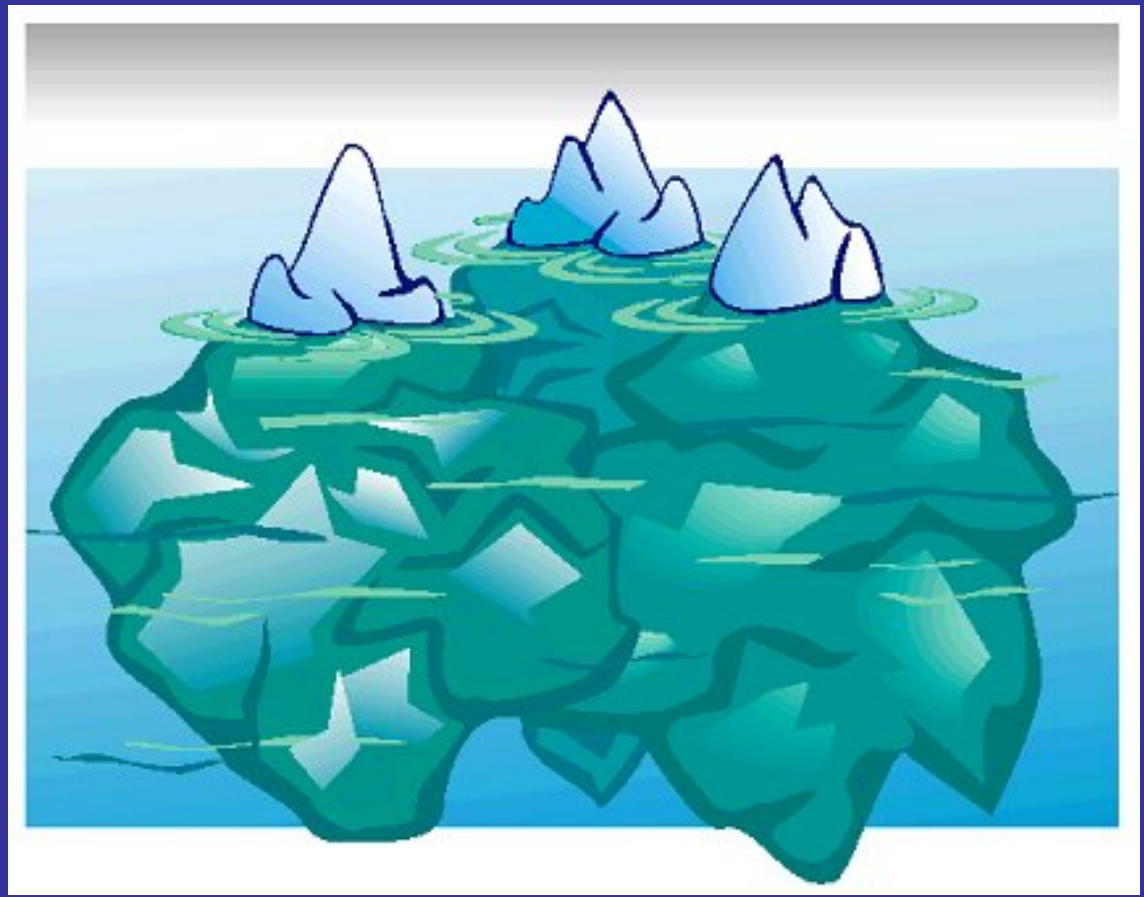
The safety and security task:
what, why and how
Fuel Cell Bus

What : Safety and security scope of CUTE, ECTOS and STEP → HyFLEETCUTE



Why: The basis for the incident reporting

- Statistics shows that for every severe accident:
- 30 minor accidents
- 300 near-misses



How: Approach

- **Safety and security session at each project meeting**
- **Report back on status frequently**
- **Take action if needed and use the power of the partnership**

HyFLEET:CUTE – INCIDENT REPORT FORM

Near miss ☐
Incident ☐
Accident ☐
LTI ☐

Reported by:	Job title and Company	Station identification:
Date:	Time:	Signature (for hardcopy safety file)

Component category: (mark with x or shadow in the box)

Affected unit:	Device:	Others:
Production: ☐ Storage: ☐ Compressor: ☐ Dispenser: ☐ FC-bus ☐	Connection: ☐ Regulation: ☐ Measurement: ☐	

Event category:

Non-conformance:	Incident/abnormal situation:	Accident:
Off-spec hydrogen gas quality: ☐ FC-bus stop: ☐ Safety system out of order: ☐ Operation interrupted: ☐	Affecting people: ☐ Affecting the environment: ☐ Affecting on-site equipment: ☐ Affecting off-site material: ☐ Emergency shut down: ☐ Leakage:	Minor injury: ☐ First aid injury: ☐ Injury, medical treatment: ☐ Material damage: ☐ Environmental damage: ☐

Event description:

Description:	Discovered	Man.	Aut.
	During operation:	☐	☐
	During inspection:	☐	
	During maintenance:	☐	

Cause:

Accident details:

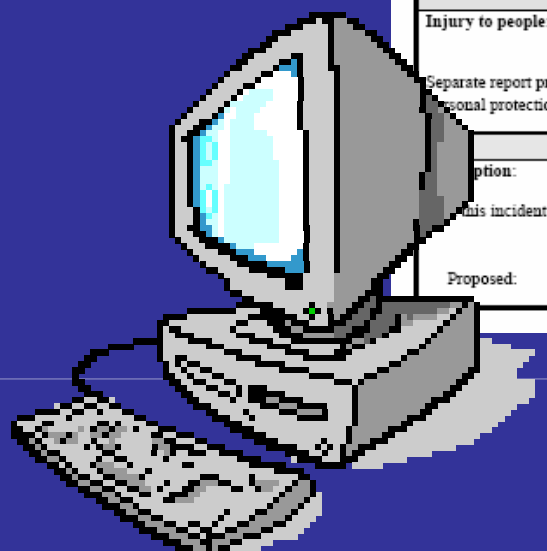
Injury to people:	Environmental damage:	Damaged object:
Separate report prepared: Yes: ☐ No: ☐ …sonal protection equipment: Used: ☐ Not used: ☐		

Immediate Corrective actions if any:

…ption:

…his incident require further investigation and a final report further corrective action: YES ☐ NO ☒

Proposed: ☐ Planned: ☐ Implemented: ☐



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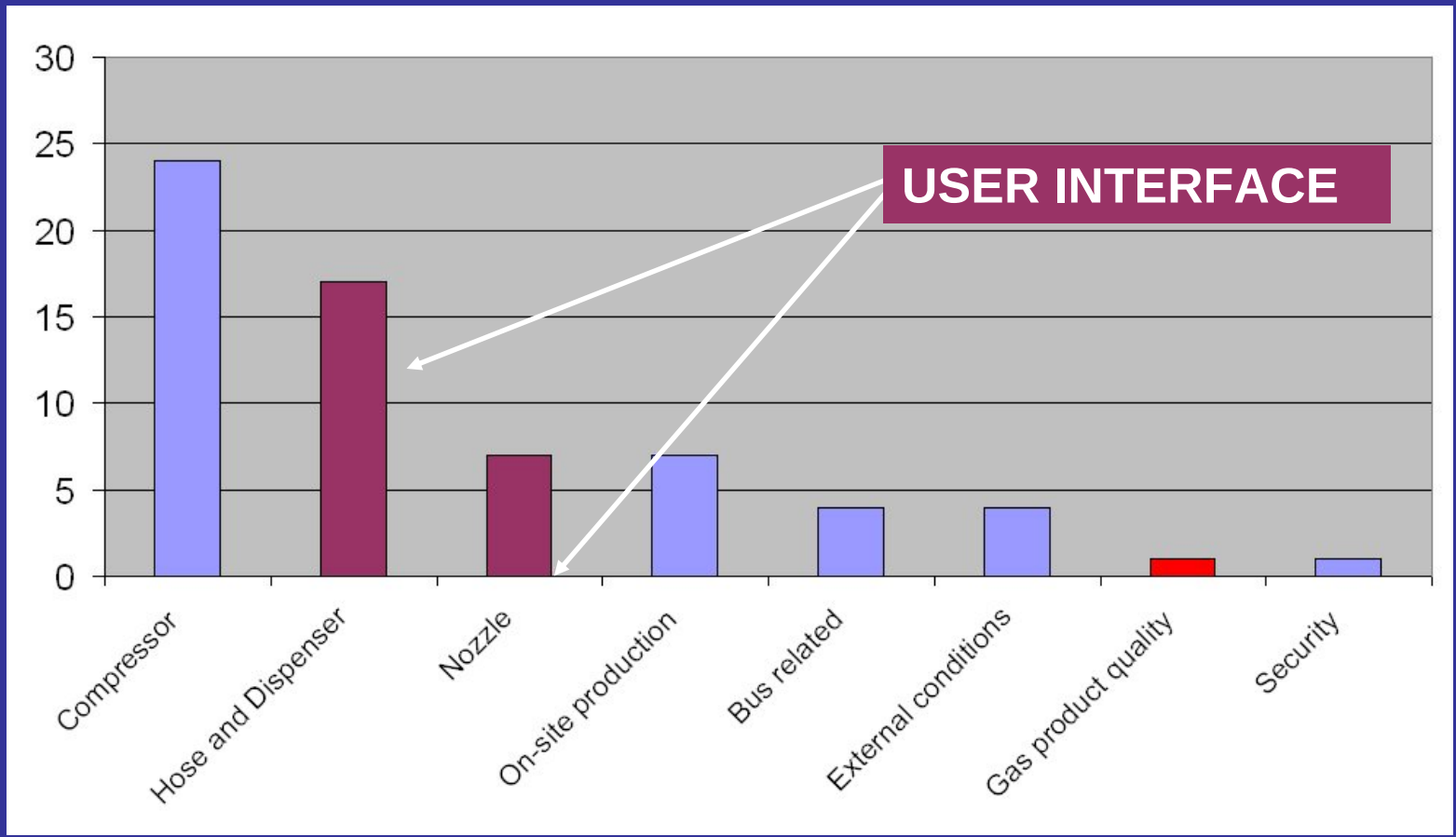
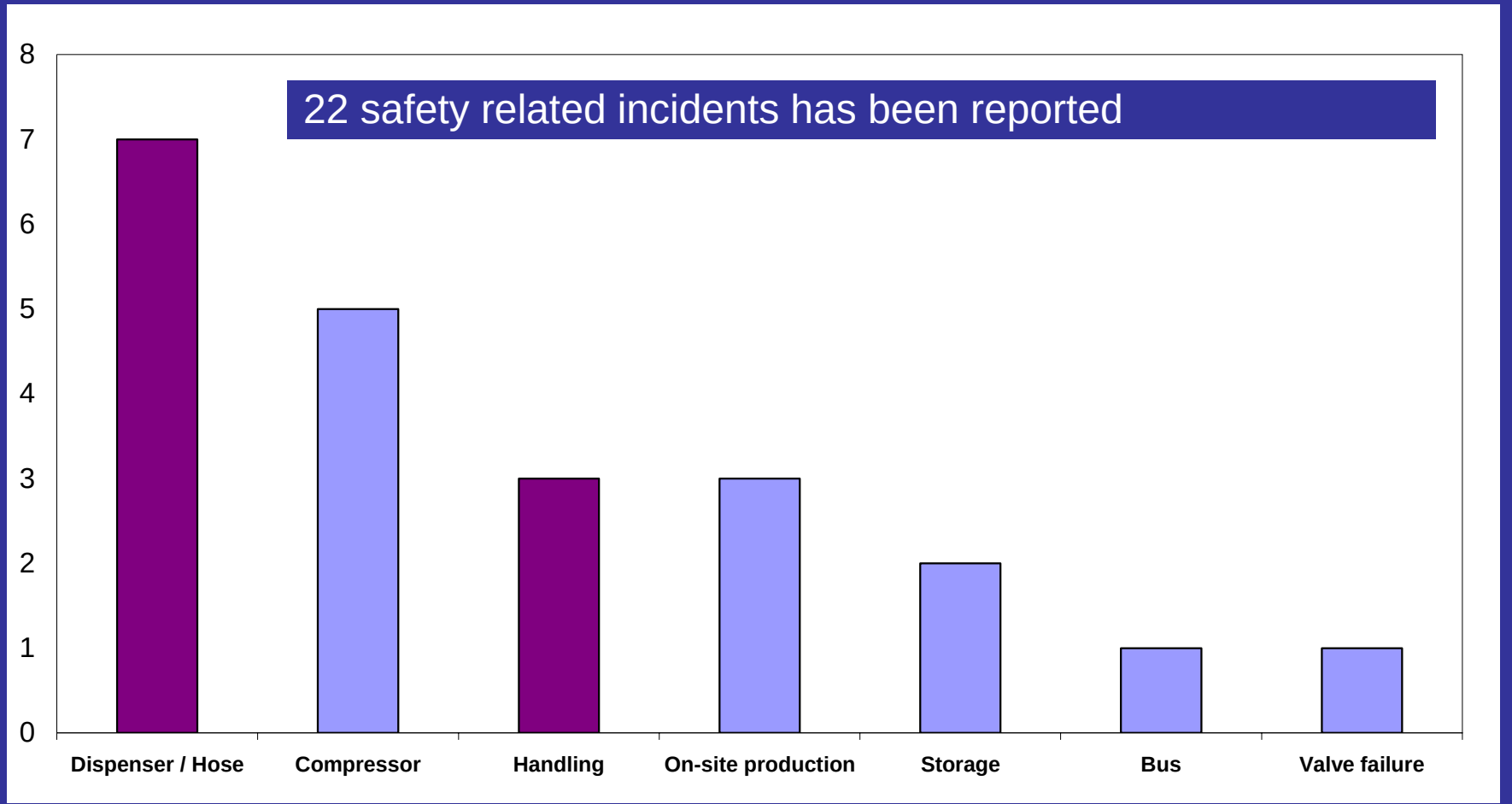
Safety incidents in CUTE, ECTOS and STEP



HyFLEETCUTE incidents January - August 2006



Results user interface

- **Userinterface challenge has been revealed**
- **Filling nozzles are improved**
- **Hose and dispenser need more attention**

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Recommendations for future H_2 stations

- Use experiences from the successful operation of the buses
- Automated operation should be combined with on-site manning
- User interface needs more attention

The Approval Process experiences from CUTE

	Time	CNG - regulation	Project limited approval	Safety studies	Overall impression
Amsterdam	6 M	Yes	Yes	Hazop, FMEA	Based on CNG
Barcelona	12 M	Yes	Yes	Hazop, QRA	Comprehensive - as expected
Hamburg	12 M	No	Yes	Hazop	Time consuming - complex procedure with TÜV
Luxembourg	9 M	No	No	Hazop, QRA	Based on foreign expertise
London	30+M	No	Yes	Hazop, QRA	Difficult – local resistance – as expected
Madrid	10 M	Yes	Yes	Hazop	Comprehensive – as expected
Porto	6 M	Yes	No	Hazop, QRA	Smooth – based on existing CNG –experience
Stockholm	24 M	Yes	Yes	Hazop, QRA	Complex – as expected
Stuttgart	4 M	Yes	Yes	Hazop, QRA	Easy – demo project

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The RCS dilemma

- **Technology and Systems are not fully developed**
- **Stakeholders need more experience**
- **Authorities needs more knowhow and experience**

- **Component deviations causes safety and quality challenges e.g.:**
  - Fuelling nozzles
  - Fuelling hoses
- **Handling can create safety challenges, e.g.**
  - Fuelling process
  - Unloading of trucked in

Avoid to early RCS

Some standards might reduce these problems

Overall learning

- **Know the risk**
- **Control the risk**
- **Share information**
- **Use experience to make improvements**

Common challenges – common solutions → innovation

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Thank you for your kind attention !

For more information, please contact us

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Progress of a different nature

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