

THE KJØRBO INCIDENT

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Press conference
June 28, 2019

- Hydrogen technology company
- Roots going back to technology developed by Norsk Hydro in 1927
- World's largest electrolyzer manufacturer with more than 3500 units delivered in over 80 countries since 1927
- World leading manufacturer of hydrogen fueling stations; approximately 50 stations delivered to 9 countries



Alkaline and PEM electrolyzers

Converting water and electricity to hydrogen and oxygen – for industry and energy purposes



Compact hydrogen fueling stations

Hydrogen fueling stations capable of fueling any kind of vehicle. World's most compact – simple to integrate with other fuels and standardized

World-leading hydrogen technology provider

Kjørbo incident

Background



Wallingford, USA

PEM electrolyzers



Notodden, Norway

Alkaline electrolyzers



Herning, Denmark

Hydrogen refuelling stations

Clear ambition: no accidents at sites with Nel technology

Background

All hydrogen solutions from Nel are certified by third parties and comply with all relevant international standards, including directives for HRS in Europe below:

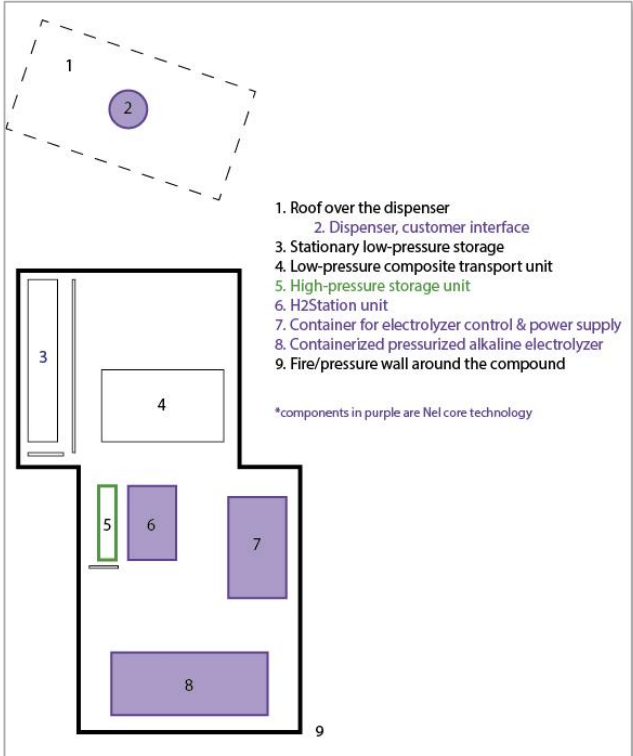
- Mechanical and Safety Instrumented System IEC61511
- DIRECTIVE 2014/68/EU Safety of pressure vessel equipment and material
- DIRECTIVE 2014/34/EU Equipment used in potentially explosive atmospheres (ATEX)
- DIRECTIVE 2014/30/EU Electromagnetic compatibility
- DIRECTIVE 2014/35/EU Low-voltage electrical equipment
- DIRECTIVE 2006/42/EC Machinery Directive
- ISO/TS 19880-1:2016 Gaseous hydrogen -- Fueling stations -- Part 1: General requirements
- SAE J2601_201407 Fueling Protocols for Light Duty Gaseous Hydrogen Surface Vehicles



The Kjørbo site

Background

- Opened 2016
- Owned by Uno-X Hydrogen
 - JV between Uno-X, Nel, and Nippon Gases (formerly Praxair)
- Nel H2Station® with on-site hydrogen production from electrolysis
 - Product family: CAR-200 Europe



Drawing for illustrative purposes only. Not to scale.

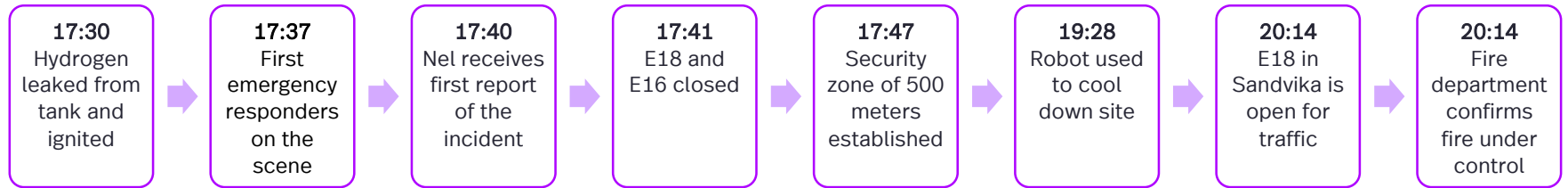
First news of incident

Background



The incident on June 10

Background



Nel's first line response: immediately mobilize all available resources

Background

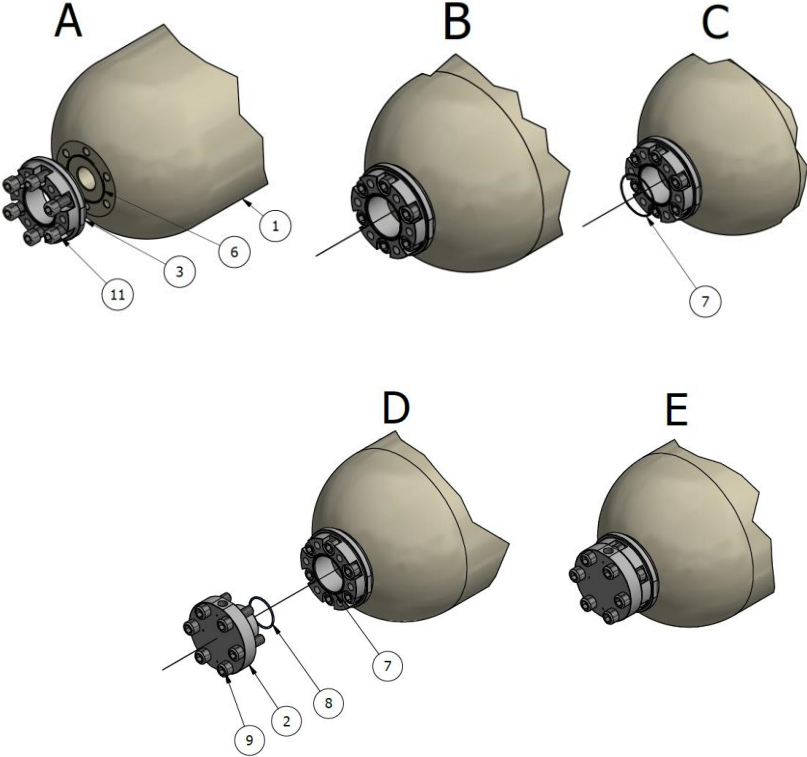
- Assembled crisis management team, Norway and Denmark
 - Coordinated with Uno-X team
- Technical support for emergency response services
- Customer update: Recommended that 10 stations in same product family be put on temporary stand-by
- Nel technical experts flown in from Denmark overnight
- Close cooperation with authorities
- Safety consultancy Gexcon retained, along with Bureau Veritas and SINTEF
- Interfaced closely with customers, suppliers, car vendors, business partners and other stakeholders
- Updated market as information on incident became available
- Started planning of short-term and long-term actions

Preliminary conclusions

Root cause

Non-core Nel technology

- Assembly error in high-pressure storage unit
- Unit consists of steel tanks and other components by third parties, some of which are designed by Nel



Root cause - failure mechanisms of plug assembly

Kjørbo incident

Non-core Nel technology

1. Starting condition

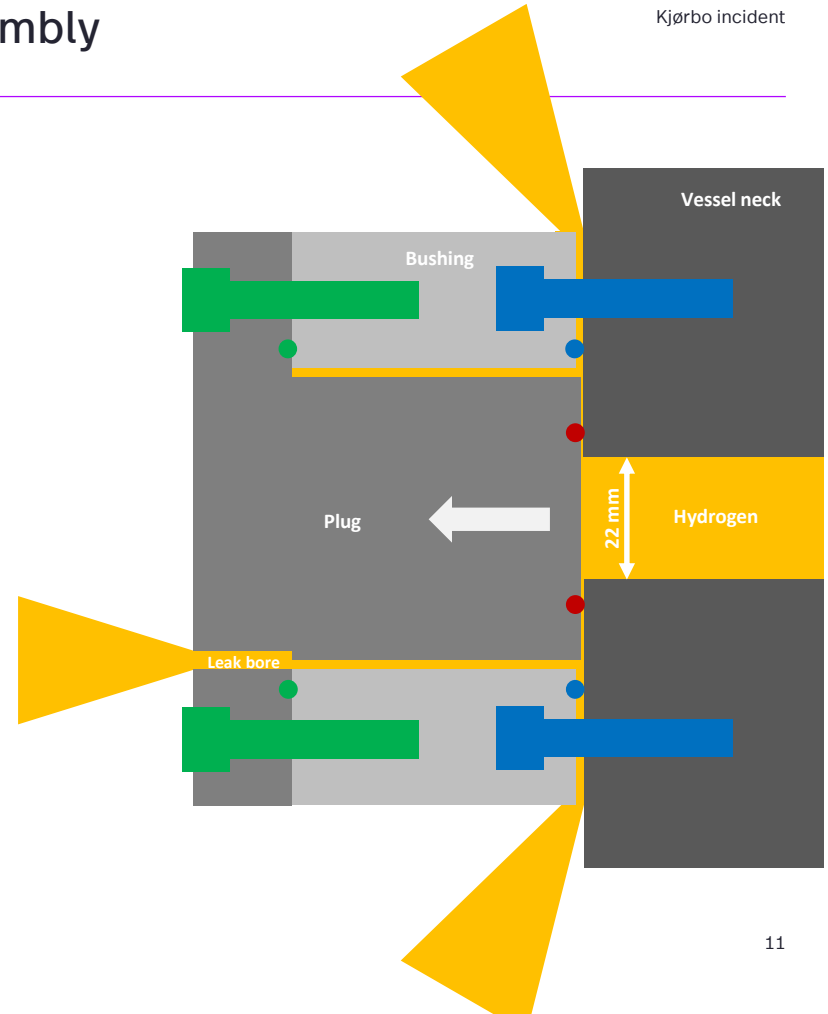
- Green bolts torqued properly
- Blue bolts not torqued properly

2. Red sealing fails

- Starting with small leak on red sealing area
- Small leak wears red sealing out and escalates
- Large leak exceeding capacity of leak bore, causing pressure increases inside blue sealing area

3. Bushing with Plug lifts and the blue seal fails

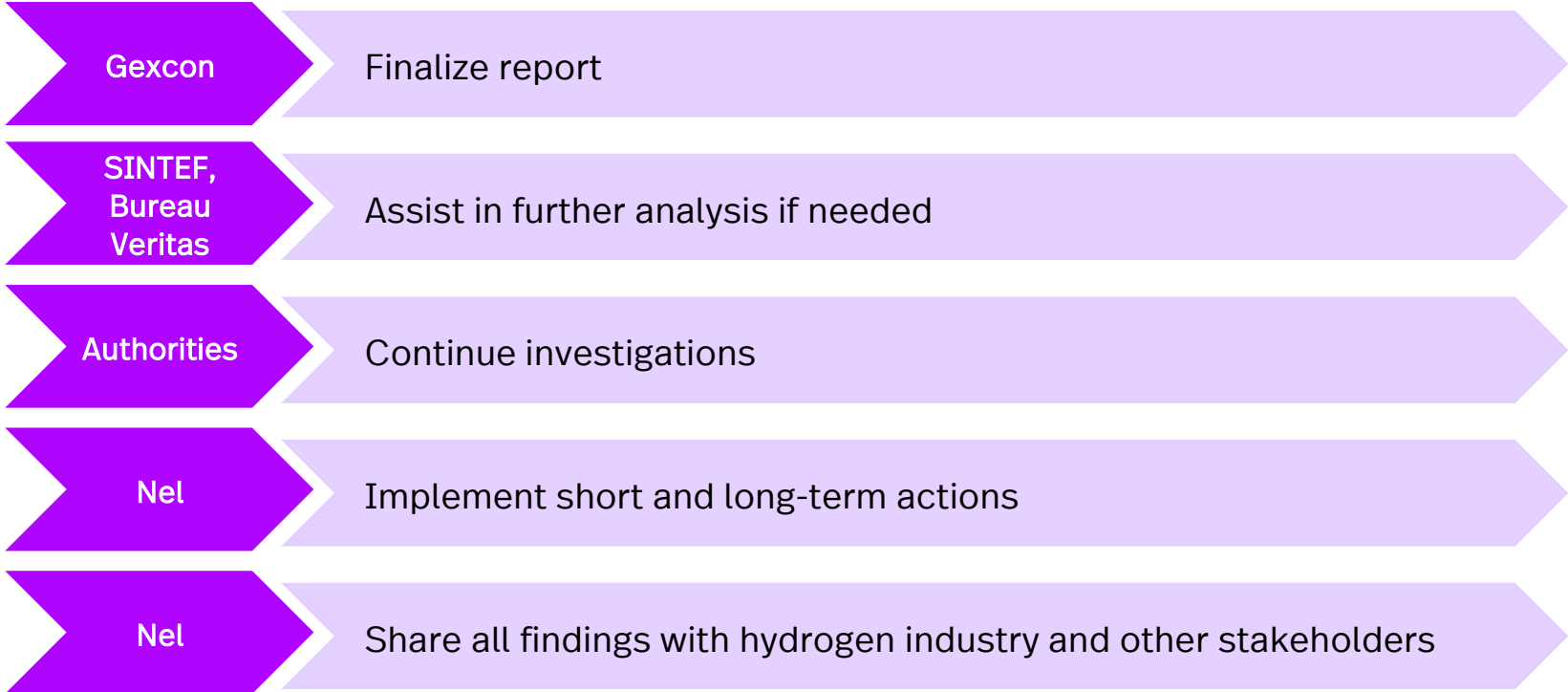
- Insufficient pre-tension of bolts leads to lift of the plug and blue sealings fail immediately
- Spread of Hydrogen leaks out in uncontrolled way



Process and actions

Process moving forward

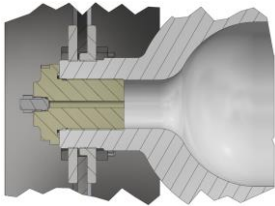
Process and actions



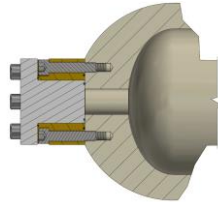
Plug design, unique to Europe

Certified by third parties

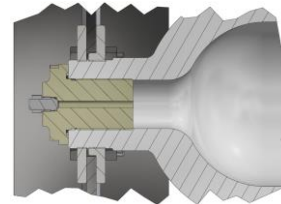
US stations



European stations



Korean stations

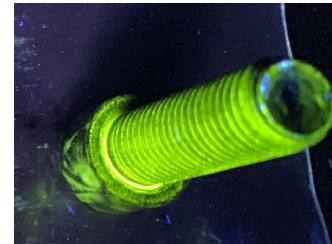
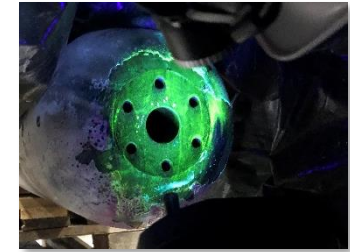


Number of stations:

- Norway – 3
- Iceland – 3
- Germany – 3
- ASKO – 1

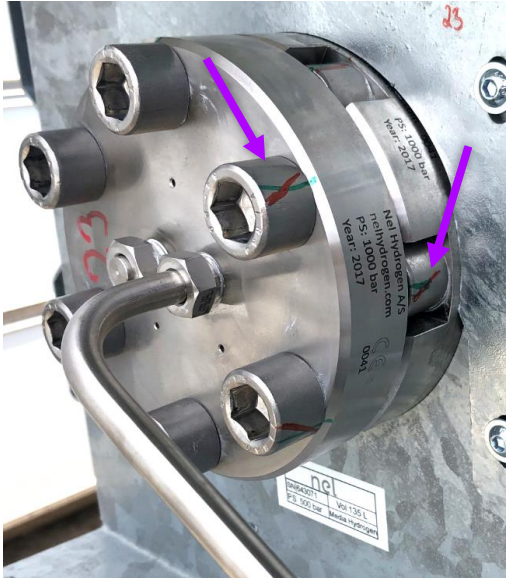
- **Materials - OK**
 - Magnetic particle inspection
 - Penetrant testing
 - Verification of materials
- **Design - OK**
 - 1,000,000 cycle accelerated test
- **Assembly - NOT OK**
 - Bolt analysis
 - Physical gap
 - Opening torque

Plug assembly analysis & testing



Actions to be taken by Nel

Process and actions



- 1 With verified plug solution**
 - Inspect all high-pressure storage units in Europe
 - Check/re-torque all plugs

- 2 Updated routines for assembly of high-pressure storage units**
 - Introduce new safety system/routines (aerospace standard)
 - Torque verification, double witness and documentation/markings

- 3 Improved leak detection**
 - Software update to increase leak detection frequency
 - Consider additional detection hardware/modifications

- 4 Ignition control measures (site dependent)**
 - Smooth surface/no gravel around high-pressure storage unit
 - Additional ventilation in compound & higher extent of EX-equipment

Timeline for various market segments

Kjørbo incident

Process and actions

Segment	Action Check site	Action Update site	Action Component update	Action Root cause correction	Action Green light from Nel to operators
CAR-100	✓				First half July
CAR-200 US	✓	✓			July
CAR-200 Korea	✓	✓			July
CAR-200 Europe incl. Norway	✓	✓	✓	✓	Third quarter

Financial impact

Process and actions

Nel's priority: Identify root cause and making sure stations are safe to reopen as soon as possible

- Nel has deployed all relevant resources for the Kjørbo incident
 - Will entail extraordinary costs during 2019; too early to conclude on net financial implications
 - The costs are related to investigations, stations inspections, site clean-up, station replacement and other extraordinary costs
 - The final decision and extent of insurance coverage and other issues may impact the final costs
- Further details to be published along with Q2 report on August 28

Investor inquiries:

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Summary

Hydrogen & safety

Summary

- Hydrogen has a high energy density and can be hazardous, just like gasoline, diesel, natural gas, and batteries
- Hydrogen has been used for industrial purposes for nearly a century
 - Around 150,000 tons of hydrogen is being used every day around the globe in various applications
- Hydrogen is crucial for decarbonizing industry as well as transportation
- Together with the rest of the hydrogen industry, Nel will implement key learnings from the Kjørbo incident to further improve on already high safety standards



Our unwavering ambition: No accidents at sites with Nel technology

Kjørbo incident

Summary

Kjørbo was a very serious incident

Strong response by emergency services and hydrogen community

Root cause of leak determined

Short-term and long-term actions started immediately

Hydrogen remains a key energy carrier for the future

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Q&A