



A Hess Energy Company



H2 Sensor in Industrial Truck Applications

Needs assessment from field experience

Outline

- What is the industrial truck application today?
- Nuvera Safety Approach to H₂ Leaks
- Where are H₂ Detectors Used?
- What have we experienced?
- Ideal H₂ Sensor Criteria



Industrial Applications

- Fork trucks
- Utility Vehicle
- Airport "Tug"
- Ice Re-surfacer



Hydrogen Warehouse



Hydrogen meets the end-user's goals:

- Increase productivity
- Optimize floor space
- Optimize energy costs
- Improved corporate image

Proven fuel cell advantages:

- Refueling vs. Recharging
- Replace indoor battery charger with outdoor On-Site generation and storage
- On-Site Generation = on-demand generation
- "Green", Retail brand names associated with national energy/security policies



Component Introduction



1. Onsite Hydrogen Generation (Steam Reformer)
2. Outdoor Compression and High Pressure Storage
3. Indoor Dispensing
4. Battery replacement in existing electric forklifts

Safety Approach – H2 Leaks

Hazard:

Small Leak
< Detection

Medium Leak
Detection to EXV Trip Point

Large Leak
EXV Trip Point

Mitigation:

Vent
Natural and
forced

Detection
Natural and
forced

Excess Flow
Valve
Fuel supply

Where are H2 detectors used?

Indoor Dispenser – Typical industrial installation, classified wiring and components

On Board Sensor

- Integral to vehicle safety circuit
- Vibration
- Dust
- Chemical exposures
- Constant use – 24/5 and 24/7 applications



What we have experienced?

Indoor Dispenser – no major issues, concerns with calibration

Onboard Vehicle

Hydrogen overexposure – increased sensitivity

Dust contamination

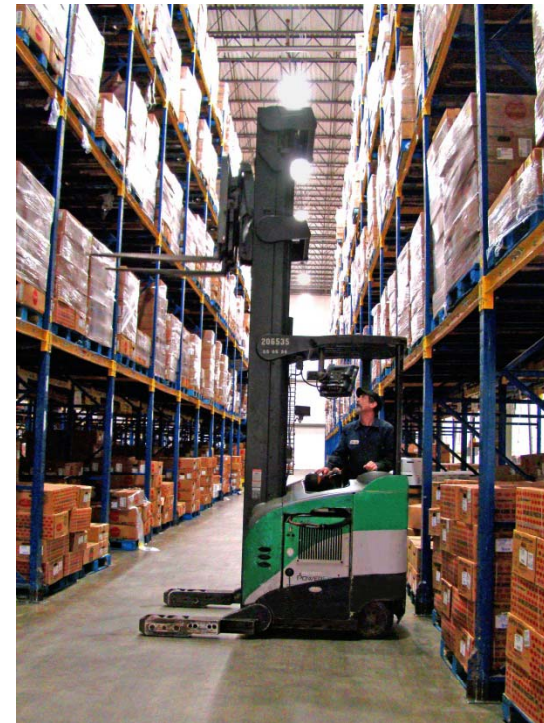
Silicone contamination

Decreased sensitivity over time

Propane exhaust

Battery off-gas – H₂S and Hydrogen

Corrosion – water vapor, corrosives

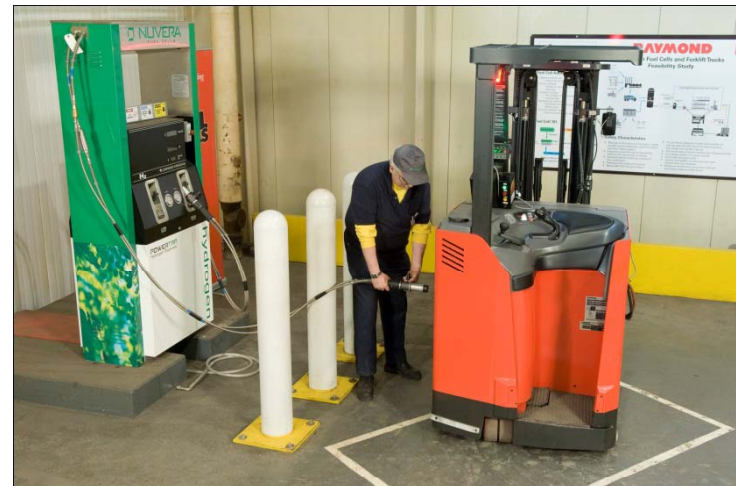


Ideal H2 Sensor by application

Indoor Dispenser – easier calibration, calibration alert, lower cost

Onboard Vehicle

- Operating Temperature range: -30 to 60 deg C
- Low sensitivity to Dust
- No sensitivity to silicone
- No Hydrogen Overexposure
- Supply Voltage: 16-60 VDC
- 10 years or 10,000 hrs
- No decrease in sensitivity
- Alarm Action – Open relay and audible alarm
- Short response time
- *Feedback signal – concentration level





NUVERA

FUEL CELLS

EXPERIENCE

The Future of Energy