



Codes and Standards

Fuel Cell Seminar Short Course

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Why Codes and Standards?

Example: Cell Phone

- Invention – portable phone using radio waves
- Authority – Federal Communications Commission

Inventor: "Can I use this one phone?"

Authority: "We considered the impact and yes that is fine."

- single use approval

... 3 months later

Inventor: "Can I sell a few phones to some friends to use?"

Authority: "We don't have the capacity to approve each phone individually. What if someone else uses your idea? How will we control it?"

Inventor: "If we make a standard and follow it you could just use that standard as the rule."

- standard based use approval

... Rule: All cell phones must be approved by FCC – open your battery case, should have a sticker with the FCC symbol approving it for use.



Where does authority come from?

Government Authority

- States – Public Safety
 - 10th Amendment of the US Constitution
 - Police and Fire
 - Evolved to Building, Plumbing, Electrical Codes
 - Enforced differently by each state
- Federal – Public Safety (Interstate)
 - Hazardous Materials (US-EPA, US-DOT etc.)
 - Workplace Safety (OSHA)
 - Evolved in 1970's as recognition of larger public safety concerns
 - Enforced by federal authority often granted to qualified state authorities



Private Authority – Insurance and OEM

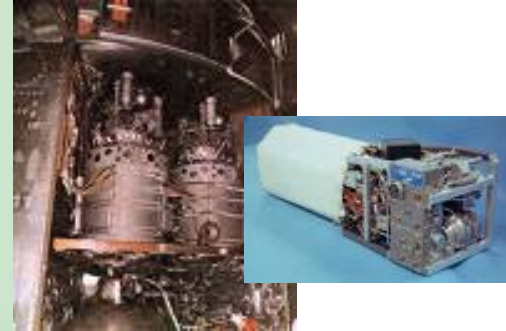
- Insured surrenders authority to insurer through private agreement
- Original Equipment Manufacturer may have authority to approve/disapprove the use of “aftermarket” changes – i.e. fuel cell powered battery replacements

Fuel Cell Industry

Invention to Product

Internal Use Approval

Example - 1960's Space Program



Single Use Approval

Example - 1990's Government Sponsored Demonstrations



Standards Based Approval

Example - 2000's Government Subsidized Public Use



Similar but Different



Shared Activities

Vehicle Safety

Fuel Cell System Components

Technology Advancements

Refueling nozzle/receptacle



Automotive

Outdoor Use

Lightweight

Maximum Speed = 100 mph

Vibration signature – dampened

Maximum Power Req'd = 75 -100kW

Hydrogen Storage pressure - 10,000 psi

< 100 Refueling Cycles per year

Industrial Trucks

Indoor Use

Power Source is counterweight

Max speed = 10 mph

Vibration signature – undampened

Maximum Power Req'd = 7-10 kW

Hydrogen Storage pressure - 5000 psi

> 1000 Refueling Cycles per year

Fuel Cell Powered Industrial Trucks

- All types of forklifts (Class I, II, III) in use
- Several hundred in operation
 - Sponsor, subsidy and incentive assisted deployments
- Most are the battery replacement style
 - Vehicle integrated systems under development
- Other industrial truck applications under development
- Demonstration of early markets: captured fleets
 - Vehicles >> Refueling Stations



Typical Installation

Source



Conversion



Storage



Dispense



Use

WAL*MART



Coca-Cola



Wegmans

ANHEUSER-BUSCH
Company



H-E-B

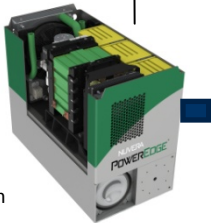
Industrial Vehicle Use

Industrial Vehicle

Forklift
 NFPA 505
 UL 583



Fuel Cell Power System
 UL 2267



Fuel Cell Power System
 (Battery Replacement)

Refueling Guidelines
 NFPA 52

350 Bar Fueling Receptacle/Nozzle Pair
 SAE J2600

Indoor Dispenser

Dispenser
 NFPA 52
 HGV 4.3 (Draft)



Fuel Cell Power System Components

- Tank - HGV 5
- Pressure Relief – HPRD1 (Draft)
- Hydrogen Detectors
- Electric Storage – batteries, ultra-caps
- Embedded controls

Dispenser Component Standards

- Hose – HGV 4.2 (Draft)
- Breakaway – HGV 4.4 (Draft)
- Priority and Sequencing – HGV 4.5 (Draft)
- Manual Valves – HGV 4.6 (Draft)
- Automated Valves - HGV 4.7 (Draft)