

Code Compliance Analysis for Indoor Hydrogen Fueling



**National Hydrogen
Association**

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Project Background

Defense Logistics Agency (DLA) Project to install two indoor hydrogen fueling stations and an outdoor liquefied and gaseous hydrogen storage system

The indoor fueling stations would service a fleet of battery powered forklifts converted to run on hydrogen fuel cells

Warehouse located at Defense Depot Susquehanna, PA (DDSP)

Project intended to demonstrate indoor hydrogen fueling as a safe effective technology

NREL's Role

Construction at facility must comply with Unified Facilities Criteria 3-600-01(UFC)

UFC requires: Projects involving design or modification of, fire rated construction, fire detection, fire suppression, or life safety systems require the services and review of a qualified fire protection engineer.

A registered professional engineer (P.E.) who has passed the fire protection engineering written examination administered by the National Council of Examiners for Engineering and Surveys (NCEES).

A registered P.E. in a related engineering discipline with a minimum of 5 years experience, dedicated to fire protection engineering that can be verified with documentation.

Project Timeline

The regulatory approval portion of the project began in August 2007 when meeting between the applicant Air Products & Chemicals (AP&C), Inc. and the Defense Logistics Agency (DLA)

In spring of 2008 DLA informed AP&C that they were subject to requirements of the UFC

NREL site visit May 2008 and preliminary code review

Code compliance review May -October 2008

Code compliance review complete October 2008 pending submission of fire alarm design drawings

Fire alarm design drawings submitted December 2008

Compliance letter submitted February 2009

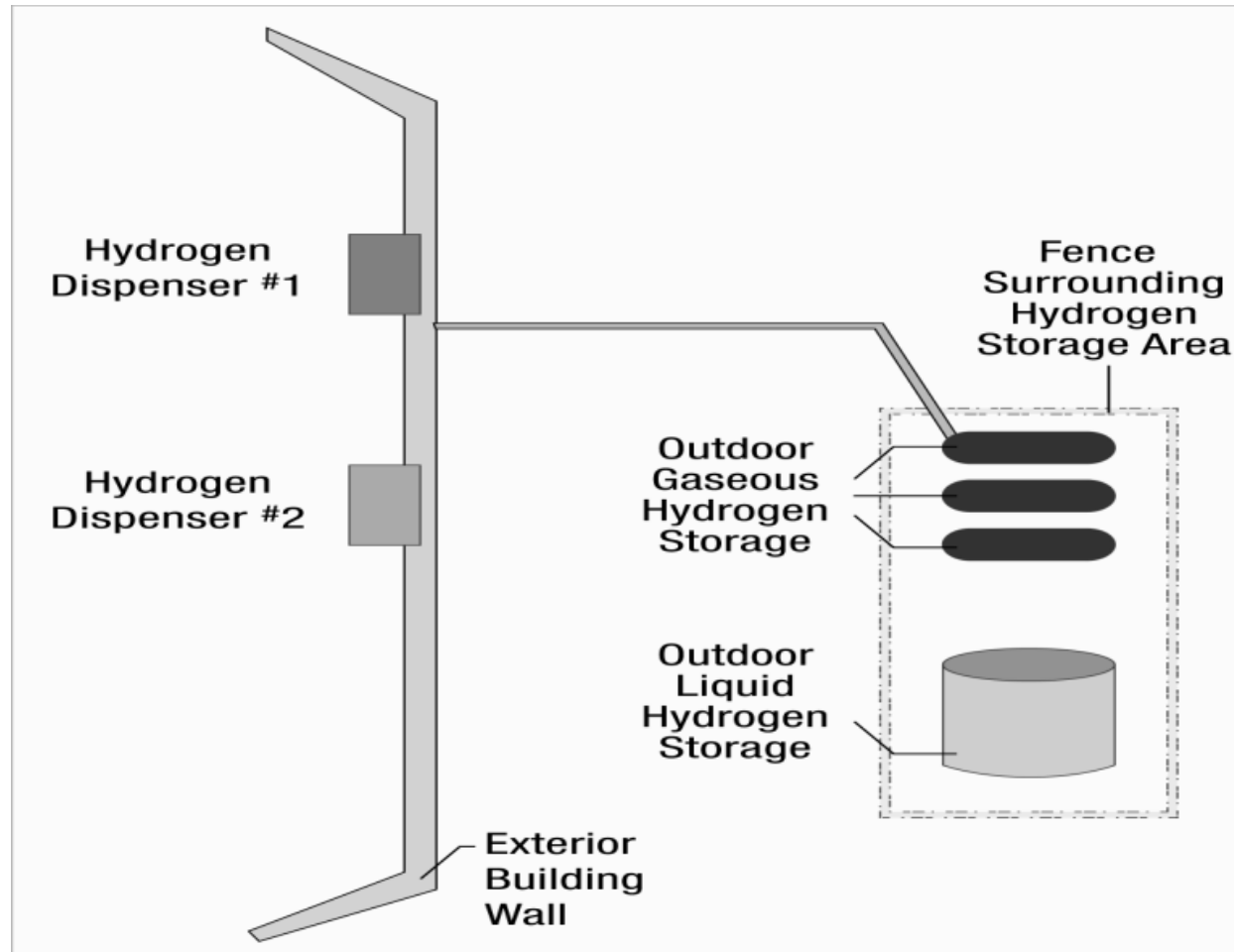
Project opening ceremony February 2009

UFC Compliance

The DLA is the Authority Having Jurisdiction (AHJ)

Fire protection criteria must conform to the requirements of this UFC, the *National Fire Codes*, published by the National Fire Protection Association (NFPA), except as modified by this UFC, and portions of the *International Building Code (IBC)*, published by the International Code Council, as specifically referenced by this UFC.

Process Schematic



Code & Standards

IBC triggers requirements with International Fire Code (IFC), International Mechanical Code (IMC) and International Fuel Gas Code (IFGC)

IFC addresses outdoor and indoor fueling

National Fire Codes include:

NFPA 52 Vehicular Fueling Code 2006 edition

NFPA 55 Standard for the Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks 2005 edition

Codes & Standards

NFPA 101 Life Safety Code

NFPA 72 Fire Alarm Code

CGA S-1.3 Pressure Relief Devices Standards Part 3
Stationary Storage Containers for Compressed
Gases

Note: Both IFC and NFPA 52 indoor fueling
requirements were evaluated

“Table 1 Codes and Standards Requirements for
Proposed Forklift Fueling Operation” summarizes
codes and standards compliance issues

Basic Safety Requirements

System Hazops review

Pressure relief devices

Automatic and manual shut-off devices

Storage system separation from exposures

Electrical classification of dispensing operation

Outdoor bulk hydrogen storage

Basic standards for equipment construction, such as tanks, piping,
and regulators

Gas detection

Signage

Alarm systems

System testing

Fire protection

Maintenance

Indoor Fueling Requirements

IFC 2209.3.2.3 Indoors. Generation, compression, storage, and dispensing equipment shall be located in indoor rooms or areas constructed in accordance with the requirements of the International Building Code, the International Fuel Gas Code, and the International Mechanical Code and one of the following:

2. Inside a building not in a hydrogen cutoff room where the gaseous system is listed and labeled for indoor installation and installed in accordance with the manufacturer's installation instructions

Indoor Fueling Requirements

NFPA 52 9.3.3.13

9.3.3.13 Indoor Fast-Fill Fueling, Outdoor Storage, and

Compression. Fast-fill fueling indoors shall be permitted where storage, gas processing, and compression equipment is located outdoors complying with 9.3.2.1 through 9.3.2.5.

9.3.3.13.1 Where attended fast-fill fueling is performed indoors, the following shall be installed: (1) An emergency manual shutdown device shall be installed as required by Section 9.11.(2) A gas detection system equipped to sound a latched alarm and visually indicate when a maximum of one-quarter of the lower flammable limit is reached shall be installed.

9.3.3.13.2 The actuation of the gas detection system shall shut down the compressor and stop the flow of gas into the structure.

Major Code Requirements

- Sprinkler protection. The hydrogen storage would be entirely outdoors. Therefore, the proposed process would not add any additional storage to the building. Therefore, no new sprinkler system capacity requirements would be triggered.
- Ventilation. The size and number of openings in the building have made it very difficult to measure volumetric flow rate through the building. An analysis by Air products showed the hydrogen would disperse more rapidly with the fans operating
- Life Safety Code. The proposed fueling system would not change the facilities life safety requirements or compliance status. The indoor fueling equipment is not in an egress path.
- Fire Alarm System. NFPA 72 requires that the alarm for the fueling system be tied into the existing system.

Compliance

The applicant was able to show compliance with the UFC

Although the compliance demonstration process took place over an extended period the project was complex and unique

Integrating a new operation into an existing occupancy adds to project complexity

Future issues

Evaluate indoor release scenarios and review code requirements to determine the need for any code modifications

Evaluate the effects of ventilation on indoor releases and review code requirements for any code modifications

Evaluate gas detection systems, particularly placement of sensors, to determine whether codes should contain more specific language for the use of gas detection