The Commonwealth of Massachusetts
Executive Office of Public Safety and Security
Fire Prevention Regulations Appeals Board
P.O. Box 1025 ~ State Road
Stow, Massachusetts 01775
(978) 567-3181 Fax: (978) 567-3121

CHARLES D. BAKER
GOVERNOR

KARYN E. POLITO
LT. GOVERNOR

DANIEL BENNETT
SECRETARY

ANTHONY P. CAPUTO
CHAIRMAN

Docket # 2017-01
377 Chauncy Street
Mansfield, Massachusetts

FIRE PREVENTION REGULATIONS APPEALS BOARD DECISION

A) Statutory and Regulatory Framework

This matter relates to an application for an administrative appeal filed in accordance with Massachusetts General Laws Chapter 30A and Chapter 22D, section 5. The Appellant is seeking this Board's review of a determination of the Mansfield Fire Department's denial of the Appellant's request to waive certain technical provisions of 527 CMR 1.00: 42.7 as applied to a planned hydrogen fueling station to be located at 377 Chauncy Street, Mansfield, Massachusetts. The owner of the planned facility is Air Liquide Advanced Technologies U.S., LLC (hereinafter referred to as the "Appellant").

B) Procedural History

By a written document dated January 24, 2017 and received by the Appellant's representative, Joseph Rollins of Black & Veatch, Captain Marc Goyette of the Mansfield Fire Department provided a written determination regarding Appellant's proposed plans to build a hydrogen fueling facility to be located at 377 Chauncy Street, Mansfield, MA. In said document Captain Goyette, on behalf of the Fire Department, indicated that the Department would require the planned facility to install a system of automatic fire suppression including a fire alarm system, connected to the municipal fire alarm system, to notify the department in the event of a hydrogen leak and/or fire.

On February 20, 2017, the Appellant filed an appeal of the Fire Department's determination with the Fire Prevention Regulations Appeals Board. The Appeals Board held a hearing on April 6, 2017, at the Department of Fire Services, Stow, Massachusetts.

Appearing on behalf of the Appellant was: Aaron Harris, Technical Director for Air Liquide and Joseph Plate, Project Manager for Code Consultants, Inc. Appearing on behalf of the Mansfield Fire Department was Chief Neal Boldrighini and Captain Marc Goyette.

Present for the Board were: Anthony P. Caputo, Presiding Panel Member, Alfonso Ibaretta and Chief Michael Hazel.

Peter A. Senopoulos, Legal Counsel, Department of Fire Services, (DFS) was the Attorney for the Board and Jennifer Hoyt, Chief Fire Protection Engineer, DFS was also present as a technical advisor to the Appeals Board.

C) Issue(s) to be Decided

Should the Board affirm, reverse or modify the determination of the Mansfield Fire Department denying a variance from the requirement of an automatic fire suppression system, including a fire alarm system connected to the municipal fire alarm system?

D) Evidence Received

1. Application for Appeal filed by Appellant
2. Application for Appeal by Appellant
3. Statement in Support of Appeal (2/8/2017)
4. Decision of Mansfield Zoning Board of Appeals on Application for Special Permit (10/3/2016)
5. Fire Modeling Analysis – Hydrogen Bulk Storage Jet Flame Radiant Exposure Calculations (1/31/2017)
6. Correspondence from Captain Goyette, Mansfield Fire Dept. to Mr. Rollins (1/24/2017)
7. Fire Protection and Life Safety Design Concept Analysis – Mansfield, MA (10/13/2016)
8. Memorandum from Robert Blackman, Mansfield Building Inspector to Shaun Burke, Mansfield Director of Planning and Development re: Project at 377 Chauncey St. (8/9/2016)
9. Document regarding "the effectiveness of automatic fire suppression systems for outdoor storage and dispensing of hydrogen" (undated)
10. Correspondence to Black & Veatch from Code Consultants, Inc. re: Variance List (12/12/2016)
11. Tracking Update E-mail from FedEx to Joseph Rollins (2/17/2017)
12. Incident Heat Flux Calculations (pages 1-4)
13. Plans for Air Liquide Hydrogen Fueling Station (pages 1-58) (stamped 2/9/2017)
14. Notice of Hearing to Appellant (3/9/2017)
15. Notice of Hearing to Mansfield Fire Department (3/9/2017)
16. Copy of Guidance Document that accompanies Hearing Notices
17. Updated Plans for Facility (3 pages) (3/27/2017)
18. Structural Design for Free-Standing CMU Wall Enclosure (REV 1) (3/24/2017)
19. Photographic Simulation of Proposed Hydrogen Hub (pages 1-10) (dated 8/12/2016)

E) Subsidiary Findings of Fact

1. By written document dated January 24, 2017 and received by the Appellant's representative, Joseph Rollins of Black & Veatch, Captain Marc Goyette of the Mansfield Fire Department provided a written determination regarding Appellant's proposed plans to build a hydrogen fueling facility to be located at 377 Chauncy Street, Mansfield, MA. In said document Captain Goyette, on behalf of the Fire Department, indicated that the Department would require the facility to install an automatic fire suppression system and a fire alarm system to be connected to the municipal fire alarm system to notify the department in the event of a hydrogen leak and/or fire.

2. On February 20, 2017, the Appellant filed an appeal of the Fire Department's determination with the Fire Prevention Regulations Appeals Board. The Appeals Board held a hearing on this matter on April 6, 2017, at the Department of Fire Services, Stow, Massachusetts.

3. Based upon the documentation and testimony entered into the record, the Appellant is planning to construct a single pump motor vehicle hydrogen fueling facility at 377 Chauncy Street, Mansfield, MA. The planned facility will be within the general area of an existing Stop and Shop market parking lot and adjacent to an existing Stop and Shop gasoline station. The hydrogen fueling pump will be located approximately 43' feet (measured from the edge of the canopy) from the existing gasoline station. The gasoline station features an attendant and a dry chemical fire suppression system. According to testimony, the planned hydrogen fueling facility will be operationally and physically independent from the gasoline station.

4. Appellant's representatives indicated that the current code, 527 CMR 1.00, lacks specificity with respect to the technical fire protection requirements for such hydrogen fueling facilities. The current code includes amendments to the 2012 edition of NFPA-1 which adopts by reference, certain provisions of the 2010 edition of NFPA 55 relating to *Compressed Gases and Cryogenic Fluids Code* and the 2010 edition of NFPA 52 relating to *Vehicular Gaseous Fuel Systems Code.* However these provisions are not all encompassing and primarily address storage and dispensing of hydrogen in broad, general terms, rather than addressing the technical fire protection considerations for vehicle hydrogen fueling facilities.

5. According to design documents and testimony of the Appellant's representatives, the hydrogen fueling facility will provide all hydrogen gas dispensing by means of a pump and system of pipes and storage tanks. The Appellant has designed the facility with an integrated system of technical safety features in accordance with the 2016 edition of NFPA 2, *The Hydrogen Technology Code* as a condition of the Mansfield Board of Appeals Decision. They indicated that this standard, recently developed by the National Fire Protection Association, provides state of the art technical requirements to prevent hazardous occurrences as a result of leaks, fire and or explosions at vehicle hydrogen fueling facilities. It was noted this standard has not been incorporated by the Board of Fire Prevention Regulations into 527 CMR 1.00. Additionally, the Appellant is seeking relief from some provisions within the 2016 edition of NFPA 2 which are also requirements of the 2010 edition of NFPA 52 which is enforceable through 527 CMR 1.00: 42.8.2.1.

6. The Appellant provided detailed background information about the unique hazards associated with hydrogen use in motor vehicle fueling operations, and the ineffectiveness of traditional automatic fire suppression systems for hydrogen fires. They indicated that the physical properties and combustion characteristics of gaseous hydrogen vary greatly from gasoline. These variations include: physical state (i.e. gaseous form), specific gravity, density, heat of combustion, soot yield, radiative fraction, flammability limits and ignition energy. In the event of a leak, hydrogen (being lighter than air) will rise and disperse into the air. To address the unique risks associated with hydrogen, Appellant's representatives referenced technical studies and findings, reflected in the 2016 edition of NFPA 2 standard, that conclude that eliminating the fuel source via system isolation is the most effective form of hydrogen fire extinguishment. They indicated that the traditional automatic fire suppression systems that involve a dry chemical agent, as required by the current fire code, while appropriate for spilled and/or pooled liquid fuel is not appropriate for the planned hydrogen fueling facility. Additional information was submitted in a document titled, "The effectiveness of automatic fire suppression systems for outdoor storage and dispensing of hydrogen".

7. As proposed, the Appellant's facility will employ, in accordance with the 2016 edition of NFPA 2, multiple means to protect the outdoor hydrogen storage and processing by installing an integrated system of automatic and manual shut-off features. Thus providing a means to segregate system elements with valves and thereby limiting the potential dangers in the event of hydrogen leaks. With respect to protection of the related hydrogen storage tank and related piping, the Appellant has proposed the installation of a water spray fixed system in accordance with the 2012 edition of NFPA 15 within the same lot at 377 Chauncy Street and the erection of 2 hour rated fire barrier walls. The Appellant also agreed to install a fire alarm system to be connected to the municipal fire alarm system to be approved by the Mansfield Fire Department. It was the Appellant's contention that the proposed "holistic" integrated design features, described in greater detail in their submissions at the hearing, will be the most effective means of fire suppression for this particular facility taking into consideration the characteristics at this location.

8. It was also noted that the Massachusetts amendments to the 2012 edition of NFPA 1 add additional requirements to the national code language by only allowing self service fueling stations if they are monitored by an attendant during fueling operations (see 527 CMR 1.00: 42.7.4.2). It was Appellant's position, which was not opposed by representatives of the Fire Department, that such an attendant should not be required at this facility. They indicated that the intent of this requirement is to limit the hazard potential in the event of an unintended spill at traditional liquid fueling stations by means of the human activation of a manual emergency shutdown. They stated that that due to the nature and characteristics of the hydrogen and related hydrogen fueling methods, such attendant activated shutdown is not warranted, as reflected in the 2016 edition NFPA 2, that integrates a system of automatic release protection and shutdown procedures that automatically activates without human intervention. The design standard includes systems to prevent hydrogen storage from exceeding the prescribed system temperature and pressure limits, and includes gas detection, fire detection, heat and flame detection and emergency isolation. The dispensing unit will also include user friendly written and audible pictoral refueling procedures and specially designed nozzles to prevent accidental use of incompatible fuel receptacles. The Appellant stated that they will provide continuous remote monitoring that will monitor alerts and station malfunctions by a central station. The central station monitoring service will have the capacity to activate the Appellant's internal emergency response system simultaneous with notification to the local emergency dispatch to better coordinate response.

9. The Mansfield Fire Department representatives testified that the planned facility is a refueling facility and is within the scope of the Comprehensive Fire Safety Code, 527 CMR 1.00:42.7.2.5.3, which requires a fire suppression system in self service fueling facilities. Accordingly, the fire department is reluctant to waive such a requirement, particularly due to their specific concerns about the characteristics particular to this location. One concern is the location of the hydrogen storage tank approximately 11 feet from a busy roadway and the nearby intersections of Route 140 and Route 106 and near US Route 495. The representatives stated that the two lane roadway is reduced into one lane on that portion of the roadway which abuts the facility and that last year there were approximately 43 motor vehicle accidents in this general area. Traffic and pedestrian congestion in the nearby Stop and Shop parking lot, as well as the nearby gas station were also important considerations. Current staffing levels at the department and a lack of training for response to a hydrogen refueling site were additional concerns noted by the representatives.

10. The Fire Department representatives indicated general support of the Appellant's facility and did not contest or provide any evidence of substance to refute Appellant's technical assertions about the unique nature and characteristics of the hydrogen fueling facility, including the Appellant's position to follow the more specific standards applicable to hydrogen refueling found in the 2016 edition of NFPA 2. They acknowledged that the current provisions of 527 CMR 1.00 do not fully or accurately address the unique technical fire safety considerations of this planned facility.

F) Ultimate Findings of Fact and Conclusions of Law

1. The use of hydrogen as a motor vehicle fuel source is a relatively new technology and the particular requirements for fire protection aspects of hydrogen fueling dispensing facilities have not been thoroughly developed or applied in most states, including the Commonwealth of Massachusetts.

2. The current code, 527 CMR 1.00, lacks specificity with respect to the technical fire protection requirements for hydrogen re-fueling facilities planned by the Appellant. The code adopts by reference, certain provisions of the 2010 edition of NFPA 55, *Compressed Gases and Cryogenic Fluids Code* and the 2010 edition of NFPA 52, *Vehicular Gaseous Fuel Systems Code* . However these provisions are not all encompassing and primarily address only the general storage and dispensing of hydrogen, rather than hydrogen fueling facilities with greater detail.

3. The Massachusetts Comprehensive Fire Safety Code, in 527 CMR 1.00: 42.7.2.5.3*: Fire Suppression Systems* states: "For attended self serve facilities, automatic fire suppression systems shall be installed in accordance with the appropriate NFPA standard, manufacturers' instructions, and the listing requirements of the systems".

4. The Board notes that the general provisions of 527 CMR 1.00: Section 4 entitled *Equivalencies, Alternatives and Modifications* states: "the provisions of this code shall not prevent the use of equivalencies, alternatives or modifications unless specifically prohibited herein".

5. 527 CMR 1.00: Section 1.4.2 relative to *Alternatives* states, "The specific requirements of this Code shall be permitted to be altered by the AHJ upon application in writing to allow alternative methods that will secure equivalent fire safety, but in no case shall the alternative afford less fire safety, in the judgment of the AHJ which would be provided by compliance with the provisions contained in this Code"."

6. The Board finds that a waiver of the traditional fire suppression system required by the Mansfield Fire Department as per 527 CMR 1.00: 42.7.2.5.3, as applied to the Appellant's planned hydrogen fueling facility is justified. The Board finds that the alternative system of fire suppression measures proposed at the hearing is appropriate based upon a holistic analysis of this particular facility, taking into consideration the site specific characteristics of this location, as outlined by the representatives of the Mansfield Fire Department.

7. The physical properties and combustion characteristics of gaseous hydrogen and gasoline vary greatly. These variations include, but are not limited to: physical state (i.e. gaseous form), specific gravity, density, heat of combustion, soot yield, radiative fraction, flammability limits and ignition energy. Based on the above, the most effected means to protect the outdoor

hydrogen storage and processing, is by means of the proposed automatic and manual shut-off features. By segregating system elements with valves, and limiting the potential for hydrogen leaks, the most effective means of fire suppression is being implemented. This is supported by both the physical and thermodynamic properties of hydrogen as presented by the Appellant and included in the hearing record.

8. With respect to protection of the related hydrogen storage tank and related piping, the Board finds that the Appellant's suggested installation of a water spray fixed system in accordance with the 2012 edition of NFPA 15 within the same lot at 377 Chauncy Street and the erection of proposed 2 hour rated fire barrier walls is an important and required aspect of this alternative integrated design approach.

G) Decision and Order

Based upon the evidence presented and for the reasons stated herein, the Fire Prevention Regulations Appeals Board hereby **modifies** the Order of the Mansfield Fire Department. The requirements are as follows:

1. Waive the self service attendant requirements of 527 CMR 1.00: 42.7.4.2.

2. Waive the requirements of 527 CMR 1.00: 42.7.2.5.3 and modify the self service requirement relative to suppression through the installation of a manually supplied and activated water spray fixed system installed in accordance with the 2012 edition of NFPA 15 within the same lot at 377 Chauncy Street. The Fire Department connection will be no closer than 50 feet from the storage tank. The output of the system shall be in accordance with the 2012 edition of NFPA 15 for the appropriate hazard classification.

3. A fire alarm system shall be installed as acceptable to the Mansfield Fire Department.

4. The number of fire barrier walls, the angles of the walls, and the height of walls shall be the same as described in the Appellant's exhibits.

5. Fire separation distances to lot lines and public ways shall be approved by the Mansfield Fire Department.

Lastly, the determination of this Board is **site specific** to the property located at 377 Chauncy Street, Mansfield, Massachusetts.

REMAINDER OF THIS PAGE LEFT BLANK INTENTIONALLY

H) Vote of the Board

Anthony P. Caputo, Presiding Panel Member	In Favor
Alfonoso Ibaretta	In Favor
Chief Michael Hazel	In Favor

I) Right of Appeal

You are hereby advised you have the right, pursuant to section 14 of chapter 30A of the General Laws, to appeal this decision, in whole or in part, within thirty (30) days from the date of receipt of this order.

SO ORDERED,

_____

Anthony P. Caputo, Presiding Panel Member
Fire Prevention Regulations Appeals Board

Dated: May 16, 2017

A COPY OF THIS DECISION AND ORDER WAS FORWARDED BY CERTIFIED MAIL, RETURN RECEIPT REQUESTED TO:

Joseph M. Rollins, Sr. Site Acquisition Specialist
Black & Veatch
197 Wood Hill Road
Narragansett, RI 02882

Captain Marc Goyette
Mansfield Fire Department
10 Plymouth Street
Mansfield, MA 02048