the Energy to Lead

CODE REQUIREMENTS AND BEST PRACTICES: HYDROGEN

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Best Practices

This section provides information on how to comply with the codes in innovative and cost-effective ways. Best practices based on case studies may be cited when working with a local AHJ during the garage modification process, however, major changes to compliance with the code need to be verifiable by a third party.

Working with Outdated Codes

Your local AHJ may not have adopted the latest versions of the IFC, NFPA 1, or NFPA 30A. Over the past two to three code cycles, the hydrogen industry and stakeholders have been working to improve code requirements for hydrogen, and to harmonize those requirements across the codes. The most recent version of the International Fire Code refers to the Hydrogen Technologies Code, NFPA 2 for repair garages. Additionally, the code language for repair garages in both documents continues to be harmonized.

In recent versions, work that does not involve the fuel tank or hot work (welding), no modifications over and above what exist for liquid fuels (i.e. gasoline) are required. Further, should work need to be done on the fuel system (again without welding), that work can be carried out in a facility without upgrades (minor repair facility) given that the fuel supply container is defueled to 200 scf (IFC) or 400 scf (NFPA 2) and the cylinder is sealed.

If the jurisdiction has not adopted the most recent version of IFC, NFPA 1, or NFPA 30A, there is usually a provision for using alternate means and methods (AMM). This of course is up to the AHJ to allow, and up to the project proponent to have justifiable and verifiable changes based on the most recent version of said code, for example. Some strategies for getting approval for AMMs are:

- Work with the AHJ(s) early; have them be a part of the process
- Do a pre-submittal meeting with the jurisdiction (while it's not a requirement, it is usually an option)
- Completely justify compliance of the plan by documenting how you meet latest codes and submit a complete permitting package (the pre-submittal meeting will aid in this, as well)

Placement of Gas Detectors

Neither NFPA 30A, NFPA 2, nor IFC specify exactly where gas detectors should be located within a facility. A number of factors should be considered so that placement allows maximum coverage with minimum numbers of detectors: hydrogen behavior, detector maintenance, and potential hydrogen sources.

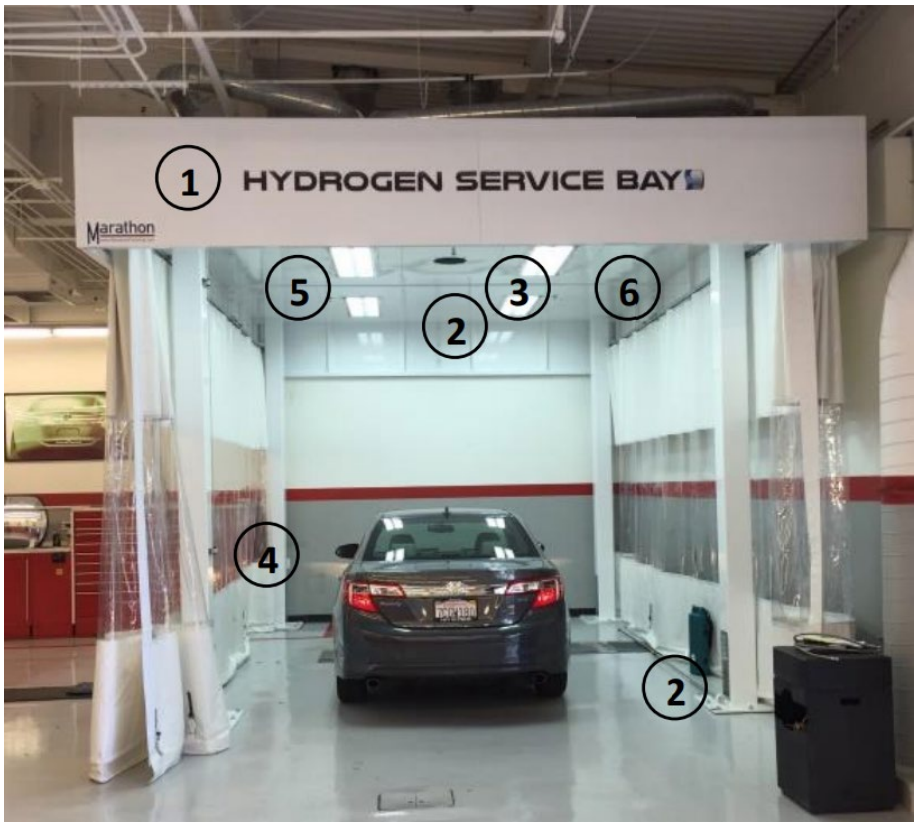
Hydrogen tends to rise unless disturbed by air currents or other obstacles. If placing sensors in an entire facility, it is recommended that gas sensors be placed near the ceiling in a place that is approximately above a hydrogen source. They should be placed away from corners or walls, so that gas can easily be sampled.

It is wise to place above but in between individual vehicle service areas, or in between rows of service areas in larger garages. This avoids placement in walls and corners but still places sensors approximately above the vehicles while they are in the service area, right in the path of migration.

Placing detectors in between individual service areas allows one detector to protect two service areas, reducing the number of detectors by half, and therefore reducing cost. Placing one detector in the middle of four individual service areas reduces the number of detectors by four. This placement also allows for maintenance of the sensors without moving or interrupting vehicle service, as ladders, scissor lifts, or other means of access can fit in between service areas.

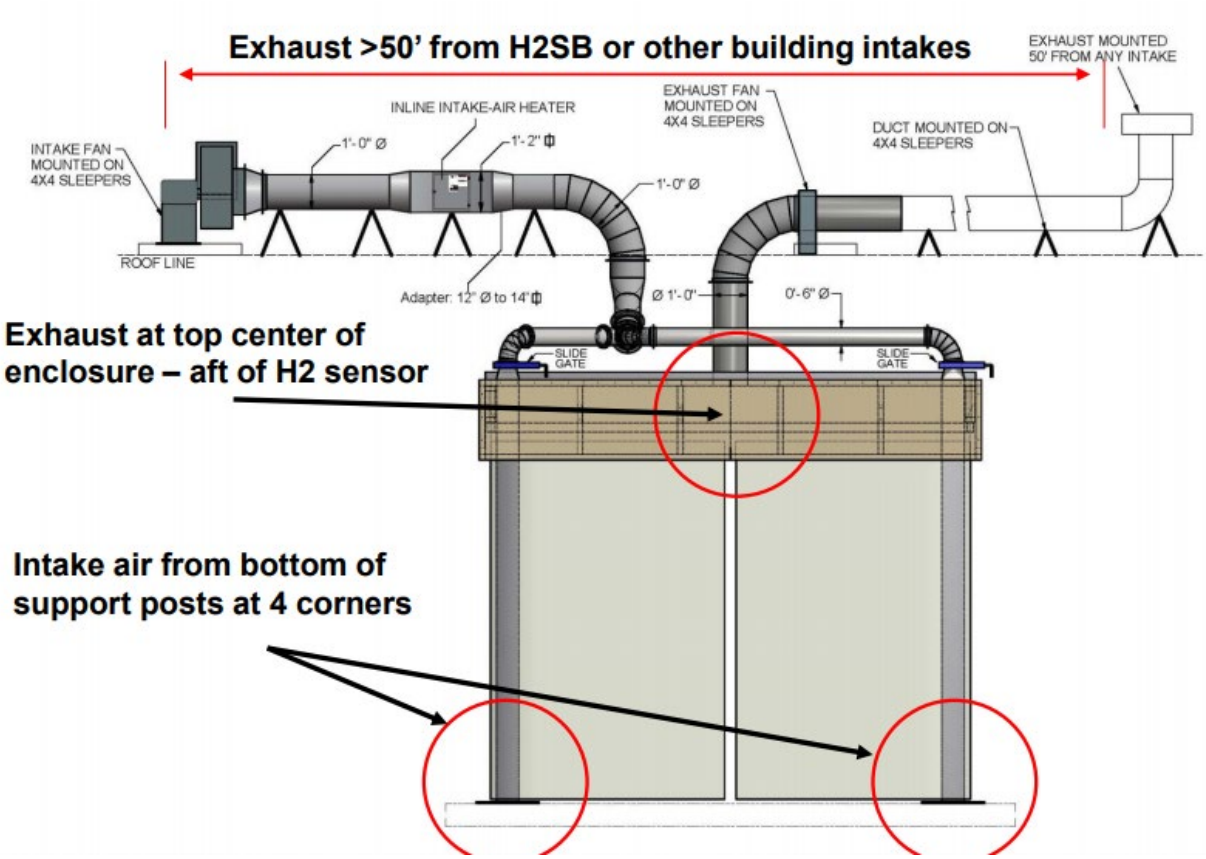
Marathon Hydrogen Service Bay (H2SB)

One strategy for code compliance in a major hydrogen garage is the Hydrogen Service Bay, a product offered by Marathon Finishing Systems. The service bay separates the bulk of a garage volume into an encapsulated service environment through the use fire retardant, retractable vinyl curtains. Each bay is vented independently, with designated air intake and exhaust. For minor repairs, not all features typically included are required by code, but many installations that utilize this system were designed with an abundance of caution.



1. Enclosed space:
    a. Freestanding hood / valence supported by 4 posts
    b. Retractable vinyl curtains (NFPA 701 fire retardant)

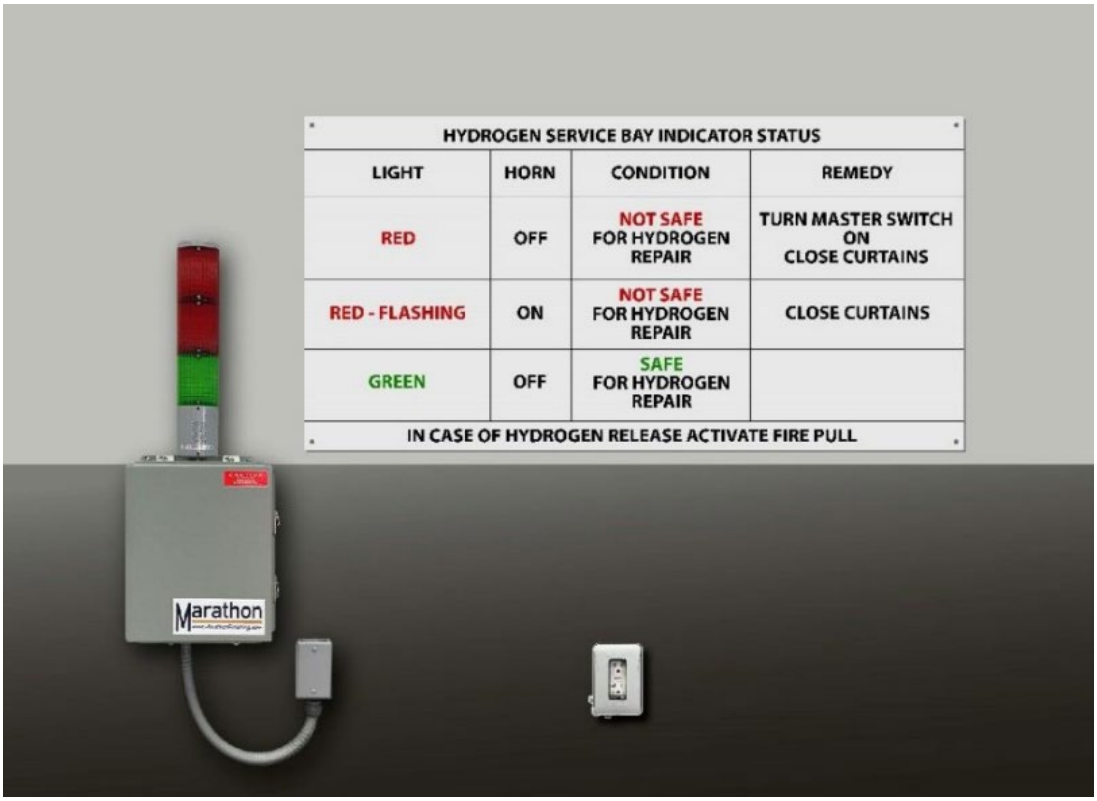
2. Ventilation system with exhaust at ceiling and with make-up air intakes at lower 4 corners
3. Hydrogen sensing with audible and visual alarms
4. Atmospheric hydrogen defueling system coupling
5. Classified electrical appliances within 18” of ceiling (NFPA 30A compliant)
    a. Above ground lift requires Class I, Division 2 limit switch or switch must be located outside of upper 18” zone
    b. Overhead lights; sealed, tempered glass (Class I, Division 2)
6. Fire sprinklers



The graphic above illustrates the ventilation strategy for the service bay. During normal operation, air exchange is continuous; an intake takes outside air and introduces it near the floor of the enclosed area. In the event of a hydrogen alarm, the rate of air exchange is increased dramatically in order to dilute and extract any hydrogen through the exhaust of the enclosure. The exhaust vent is located at least 50 feet away from the ventilation system intake.

In addition to the items outlined in the graphics above, the hydrogen service bay has an alarm system. The table below gives an example of which scenarios will trigger alarms and what actions to take. Signage in the garage should briefly indicate the necessary actions in a clear, easy to read format, like that shown below. Note that this signage lacks any explicit instruction for personnel to evacuate. Evacuation may be included in response plans and may or may not be for a hydrogen-specific event.

ALARM CONDITIONS		
Condition	**Indicator**	**Action**
System, Intake Fan or Exhaust Fan in "OFF"	1) Red panel light, red flashing remote light & siren	Turn System, Intake Fan and Exhaust Fan to "ON"
Curtain is Open	1) Solid Red remote panel light	Close Curtain
Curtain is Open for > 3 min	1) Flashing Red remote Light & siren	Close Curtain
10% LEL Hydrogen reached	1) Fan speed increases to 2,000+ cfm 2) LEL alarm # 1 – **Yellow light & buzzer on Beacon H2 Sensor**	Warning Only upon exit do not re-enter until **yellow light** turns off.
25% LEL Hydrogen reached	1) **Alarm horn** 2) **Red flashing light & siren**	Stop Work, Evacuate Hydrogen Service Bay and surrounding area. Do not re-enter until alarms are silenced and **yellow light** turns off.
LEL System Failure (Hydrogen Detection System Failure)	1) **Alarm bell** 2) **Amber light top of panel** 3) **Remote solid red light** 4) **Fans activate at 2000+ cfm**	Stop work, cease use of Hydrogen Service Bay until repairs can be made.



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