This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

Kelvin Hecht, US Fuel Cell Council, requests Approved as Submitted.

Commenter's Reason: This proposal was modified by the committee because NFPA 853 was not submitted due to an oversight. It is attached. This proposal references current existing standards. Note: Both ANSI Z21.83 are undergoing revisions. Z21.83 will be reissued as CSA FC-1 and its scope will be broadened. The 2003 edition of NFPA 853 will address power plants below 50 kw. I will submit proposals to address these changes in the next ICC cycle.

Staff Analysis: NFPA 853, has been reviewed by staff and it is staff's opinion that the standard complies with the ICC policy on referenced standards.

FG41-02

Chapter 7

Proposed Change as Submitted:

Proponent: Guy Tomberlin, Chair, ICC Ad Hoc Committee for Hydrogen Gas

1. Add new text as follows:

SECTION 202 (IFGC)
GENERAL DEFINITIONS

HYDROGEN CUT-OFF ROOM. A room or space which is intended exclusively to house a gaseous hydrogen system.

HYDROGEN GENERATING APPLIANCE. A self-contained package or factory-matched packages of integrated systems for generating gaseous hydrogen. Hydrogen generating appliances utilize electrolysis, reformation, chemical, or other processes to generate hydrogen.

SECTION 416 (IFGC)
GASEOUS HYDROGEN SYSTEMS

401.1.2 General. The installation of gaseous hydrogen systems shall be in accordance with Chapter 7 and the *International Fire Code*.

CHAPTER 7
GASEOUS HYDROGEN SYSTEMS

SECTION 701 (IFGC)
GENERAL

701.1 Scope. The installation of gaseous hydrogen systems shall comply with this chapter and Chapters 30 and 35 of the *International Fire Code*. Compressed gases shall also comply with Chapter 27 of the *International Fire Code* for general requirements. Containers provided with pyrophoric material shall also comply with Chapter 41 of the *International Fire Code*. Containers having residual gaseous hydrogen shall be considered as full for the purposes of the controls required.

701.2 Permits. Permits shall be required as set forth in Section 106 and as required by the *International Fire Code*.

SECTION 702 (IFGC)
GENERAL REQUIREMENTS

702.1 Containers, cylinders and tanks. Compressed gas containers, cylinders and tanks shall comply with Chapters 30 and 35 of the *International Fire Code*.

702.1.1 Limitations for indoor storage and use. Flammable gas cylinders in occupancies regulated by the *International Residential Code* shall not exceed 250 cubic feet at Normal Temperature and Pressure (NTP).

702.1.2 Design and construction. Compressed gas containers, cylinders and tanks shall be designed, constructed and tested in accordance with the Chapter 27 of the *International Fire Code,* ASME Boiler and Pressure Vessel Code (Section VIII) or DOT 49 CFR, Parts 100-180.

702.2 Pressure relief devices. Pressure relief devices shall be provided in accordance with Sections 702.2.1 through 702.2.7. Pressure relief devices shall be sized and selected in accordance with CGA S-1.1, CGA S-1.2 and CGA S-1.3.

702.2.1 Valves between pressure relief devices and containers. Valves including shutoffs, check valves and other mechanical restrictions shall not be installed between the pressure relief device and container being protected by the relief device.

Exception: A locked-open shutoff valve on containers equipped with multiple pressure-relief device installations where the arrangement of the valves provides the full required flow through the minimum number of required relief devices at all times.

702.2.2 Installation. Valves and other mechanical restrictions shall not be located between the pressure relief device and the point of release to the atmosphere

702.2.3 Containers. Containers shall be provided with pressure relief devices in accordance with ASME *Boiler and Pressure Vessel Code, Section VIII*, DOTn and Section 702.2.7.

702.2.4 Vessels other than containers. Vessels other than containers shall be protected with pressure relief devices in accordance with ASME *Boiler and Pressure Vessel Code, Section VIII*, or DOTn.

702.2.5 Sizing. Pressure relief devices shall be sized in accordance with the specifications to which the container was fabricated. The relief device shall be sized to prevent the maximum design pressure of the container or system from being exceeded.

702.2.6 Protection. Pressure relief devices and any associated vent piping shall be designed, installed and located so that their operation will not be affected by water or other debris accumulating inside the vent or obstructing the vent.

702.2.7 Access. Pressure relief devices shall be located such that they are provided with ready access for inspection and repair.

702.2.8 Configuration . Pressure relief devices shall be arranged to discharge unobstructed in accordance with Section 2209 of the *International Fire Code*. Discharge shall be directed to the outdoors in such a manner as to prevent impingement of escaping gas on personnel, containers, equipment and adjacent structures and to prevent introduction of escaping gas into enclosed spaces. The discharge shall not terminate, under eaves or canopies.

Exception: This section shall not apply to DOTn-specified containers with an internal volume of 2 cubic feet (0.057 m3) or less.

702.3 Venting. Relief device vents shall be terminated to an approved location in accordance with Section 2209 of the *International Fire Code*.

702.4 Security. Compressed gas containers, cylinders, tanks and systems shall be secured against accidental dislodgement in accordance with Chapter 30 of the *International Fire Code*.

702.5 Electrical wiring and equipment. Electrical wiring and equipment shall comply with the ICC Electrical Code.

SECTION 703 (IFGC) USE AND HANDLING

703.1 Applicability. Use and handling of containers, cylinders, tanks and hydrogen gas systems shall comply with this section. Gaseous hydrogen systems, equipment and machinery shall be listed or approved.

703.1.1 Controls. Compressed gas system controls shall be designed to prevent materials from entering or leaving process or reaction systems at other than the intended time, rate or path. Automatic controls shall be designed to be fail safe in accordance with accepted engineering practice.

703.1.2 Piping systems. Piping, tubing, valves and fittings conveying gaseous hydrogen shall be designed and installed in accordance with ASME B31.3, Sections 703.1.2.1 through 703.1.2.5 and Chapter 27 of the *International Fire Code*. Cast-iron pipe, valves and fittings shall not be used.

703.1.2.1 Sizing. Gaseous hydrogen piping shall be sized in accordance with approved engineering methods.

703.1.2.2 Design and construction. Piping systems shall be suitable for hydrogen service and the use intended through the full range of pressure and temperature to which they will be subjected. Piping systems shall be designed and constructed to provide allowance for expansion, contraction, vibration, settlement and fire exposure.

703.1.2.2.1 Prohibited locations. Piping shall not be installed in or through a circulating air duct, clothes chute, chimney or gas vent, ventilating duct, dumbwaiter, or elevator shaft.

703.1.2.2.2 Piping in solid partitions and walls. Concealed piping shall not be located in solid partitions and solid walls, unless installed in a ventilated chase or casing.

703.1.2.2.3 Piping in concealed locations. Portions of a piping system installed in concealed locations shall not have unions, tubing fittings, right or left couplings, bushings, compression couplings and swing joints made by combinations of fittings.

Exceptions:

1. Tubing joined by brazing.
2. Fittings listed for use in concealed locations.

703.1.2.2.4 Piping through foundation wall. Underground piping shall not penetrate the outer foundation or basement wall of a building.

703.1.2.2.5 Protection against physical damage. In concealed locations, where piping other than stainless steel piping, stainless steel tubing, or black steel is installed through holes or notches in wood studs, joists, rafters or similar members less than 1 inch (25.4 mm) from the nearest edge of the member, the pipe shall be protected by shield plates. Shield plates shall be a minimum of 1/16-inch-thick (1.6 mm) steel, shall cover the area of the pipe where the member is notched or bored, and shall extend a minimum of 4 inches (102 mm) above sole plates, below top plates and to each side of a stud, joist or rafter.

703.1.2.2.6 Piping in solid floors. Piping in solid floors shall be laid in channels in the floor and covered in a manner that will allow access to the piping with a minimum amount of damage to the building. Where such piping is subject to exposure to excessive moisture or corrosive substances, the piping shall be protected in an approved manner. As an alternative to installation in channels, the piping shall be installed in a casing of schedule 40 steel, wrought iron, PVC or ABS pipe with tightly sealed ends and joints and ventilated to the outdoors. Both ends of such casing shall extend not less than 2 inches (51 mm) beyond the point where the pipe emerges from the floor.

703.1.2.2.7 Piping outdoors. Piping installed aboveground outdoors shall be securely supported and located where it will be protected from physical damage. Piping passing through an exterior wall of a building, shall be encased in a protective pipe sleeve. The annular space between the piping and the sleeve shall be sealed from the inside such that the sleeve is ventilated to the outdoors. Where passing through an exterior wall of a building, the piping shall also be protected against corrosion by coating or wrapping with an inert material. Below-ground piping shall be protected against corrosion.

703.1.2.2.8. Settlement. Piping passing through interior concrete or masonry walls shall be protected against differential settlement.

703.1.2.3 Joints. Joints on piping and tubing shall be listed for hydrogen service, inclusive of welded, brazed, flared, socket, slip or compression fittings. Gaskets and sealants shall be listed for hydrogen service. Threaded or flanged connections shall not be used in areas other than hydrogen cut-off rooms or outdoors..

703.1.2.4 Valves and piping components . Valves, regulators and piping components shall be listed for hydrogen service , shall be provided with access , and shall be designed and constructed to withstand the maximum pressure to which they will be subjected.

703.1.2.4.1 Shutoff valves on storage containers and tanks. Shutoff valves shall be provided on all storage container and tank connections except for pressure relief devices. Shutoff valves shall be provided with ready access.

703.1.2.5 Testing. Testing for physical integrity shall be performed at not less than 150 percent of the maximum allowable working pressure, or in accordance with the requirements of ASME B31.3.

703.3 Upright use. Compressed gas containers, cylinders and tanks, except those with a water volume less than 1.3 gallons (5 L) and those designed for use in a horizontal position, shall be used in an upright position with the valve end up. An upright position shall include conditions where the container, cylinder or tank axis is inclined as much as 45 degrees (0.80 rad) from the vertical.

703.4 Material-specific regulations. In addition to the requirements of this section, indoor and outdoor use of hydrogen compressed gas shall comply with the material-specific provisions of Chapters 30 and 35 of the *International Fire Code.*

703.5 Handling. The handling of compressed gas containers, cylinders and tanks shall comply with Chapter 27 of the *International Fire Code.*

SECTION 704 (IFGC) LOCATION OF GASEOUS HYDROGEN SYSTEMS

704.1 General. This section shall govern the location, and installation of gaseous hydrogen systems.

Exceptions:

1. Dispensing equipment need not be separated from canopies that are constructed in accordance with the International Building Code and in a manner that prevents the accumulation of hydrogen gas.
2. Gaseous hydrogen systems located in a separate building designed and constructed in accordance with the *International Building Code* and NFPA 50A.
3. Gaseous hydrogen systems located inside a building in a hydrogen cut-off room designed and constructed in accordance with Section 704.3 and the *International Building Code*.
4. Gaseous hydrogen systems located inside a building not in a hydrogen cut-off room where the gaseous hydrogen system is listed and labeled for indoor installation and installed in accordance with the manufacturer's installation instructions.
5. Gaseous hydrogen systems installed in vaults constructed in accordance with the applicable requirements of Chapter 34 of the *International Fire Code*. Such locations shall be provided with mechanical ventilation in accordance with the applicable provisions for repair garages in Chapter 5 of the *International Mechanical Code*.
6. Stationary fuel cell power plants in accordance with Section 623.0.

704.2 Location on property. Gaseous hydrogen systems shall be located in accordance with Chapter 22 of the *International Fire Code*.

704.3 Hydrogen cut-off rooms. Hydrogen cut-off rooms shall be designed and constructed in accordance with Sections 704.3.1 through 704.3.8 and the *International Building Code*.

704.3.1 Design and construction. Interior building openings shall be equipped with self-closing devices. Interior openings shall be electronically interlocked with the gaseous hydrogen system to prevent operation of the system when such openings are ajar or the room shall be provided with a mechanical exhaust ventilation system designed with a capture velocity at the opening of not less than 60 fpm. Operable windows are prohibited in interior walls.

704.3.2 Ventilation. Cut-off rooms shall be provided with mechanical ventilation in accordance with the applicable provisions for repair garages in Chapter 5 of the *International Mechanical Code*.

Exception: This section shall not apply to rooms provided with ventilation systems meeting the requirements of Section 704.3.1.

704.3.3 Gas detection system. Hydrogen cut-off rooms shall be provided with an approved flammable gas detection system in accordance with Sections 704.3.3.1 through 704.3.3.3.

704.3.3.1 System design. The flammable gas detection system shall be listed for use with hydrogen and any other flammable gases used in the room. The gas detection system shall be designed to activate when the level of flammable gas exceeds 25 percent of the lower flammability limit (LFL) for the gas or mixtures present at anticipated temperature and pressure.

704.3.3.2 Operation. Activation of the gas detection system shall result in all of the following:

1. Initiation of distinct audible and visual alarm signals both inside and outside the cut-off room.
2. Activation of the mechanical ventilation system.

704.3.3.3 Failure of the gas detection system. Failure of the gas detection system shall result in, activation of the mechanical ventilation system, cessation of hydrogen generation, and a trouble signal to sound in an approved location.

704.3.4 Ignition source control. Open flames, flame-producing devices and other sources of ignition shall be controlled in accordance with Chapter 35 of the *International Fire Code*.

704.3.5 Explosion control. Explosion control shall be provided in accordance with Chapter 9 of the *International Fire Code*.

704.3.6 Standby power. Mechanical ventilation and gas detection systems shall be connected to a standby power system in accordance in accordance with Chapter 27 of the *International Fire Code*.

704.3.7 Smoking. Smoking shall be prohibited in hydrogen cut-off rooms. "No Smoking" signs shall be provided at all entrances to hydrogen cut-off rooms.

704.3.8 Housekeeping. The hydrogen cut-off room shall be kept free from combustible debris and storage at all times.

SECTION 705 (IFGC)
OPERATION AND MAINTENANCE OF GASEOUS HYDROGEN SYSTEMS

705.1 Maintenance. Gaseous hydrogen systems and detection devices shall be maintained in accordance with the *International Fire Code* and the manufacturers installation instructions.

705.2 Purging. Purging of gaseous hydrogen systems shall be in accordance with Section 2210.8 of the *International Fire Code*.

2. IFC 3501.1 Scope. The storage and use of flammable gases shall be in accordance with this chapter. Compressed gases shall also comply with Chapter 30. ~~Gaseous hydrogen systems at consumer sites shall also comply with NFPA 50A.~~

Exceptions:
1. Gases used as refrigerants in refrigeration systems (see Section 606).
2. Liquefied petroleum gases and natural gases regulated by Chapter 38.
3. Fuel gas systems and appliances regulated under the *International Fuel Gas Code*.

3503.1.1 Limitations for indoor storage and use. Flammable gases shall not be stored or used in Group A, B, E, F, I, M, R or S occupancies.

Exceptions:
1. Cylinders not exceeding a capacity of 250 cubic feet (7.08 m^3) each at NTP used for maintenance purposes, patient care or motor fuel dispensing and operation of equipment.
2. Food service operations in accordance with Section 3803.2.1.7.
3. Hydrogen motor fuel dispensing stations designed and constructed in accordance with Chapter 22.

3. IBC

TABLE 302.1.1
INCIDENTAL USE AREAS

ROOM OR AREA	SEPARATION
Hydrogen cut-off rooms	1-hour fire barriers and floor-ceiling assemblies in Group B, F, H, M, S and U occupancies. 2-hour fire barriers and floor ceiling assemblies in Group A, E, I and R occupancies.

Proponent's Reason Item 1:

Introduction. Hydrogen energy safety is based on three primary elements: regulatory requirements, capability of safety technology and the systemic application of equipment and procedures to minimize risks. Groups involved in the industrial scale production of hydrogen (producers) currently implement many successful proprietary methodologies for safely generating and handling large amounts of hydrogen. Hydrogen users (e.g., NASA) depend on cryo-hydrogen as a fuel and have effectively proven the safety of large scale ground and vehicle systems which support the Space Shuttle Program.

The efforts of the International Code Council Ad Hoc Committee for Hydrogen Gas (AHC) intend to address how future building codes can safely cover hydrogen applications in fuel cell vehicles and hydrogen gas motor-vehicle fuel dispensing and generation stations. The AHC consists of a balanced membership of user, producer and regulatory interests working together with a diverse group of technical and advisory interests to propose changes as necessary to the ICC International Codes. This, and other, related proposals is a summation of their work.

Related Revisions to IFGC Section 101.2—Scope. The commercial products industry is moving toward the use of hydrogen in vehicles, generators and equipment to replace petroleum-based fuels in order to reduce atmospheric emissions and facilitate a shift to the use of renewable energy supplies. Furthermore, the commercialization of fuel cells, and the goal of sustainable development has propelled hydrogen supply technology to the forefront of clean energy applications for transportation and distributed and regenerative electric power.

In many cases the hydrogen fuel is utilized, with air, within a fuel cell to produce electricity and in some cases co-generate heat. Typically, building officials will be faced with two classes of equipment – those that generate hydrogen (for use by other devices) and those that utilize hydrogen as their energy input.

In many cases, hydrogen will be utilized in a manner similar to the current use of natural gas. However, there are two important differences that cause the requirement to amend the ICC codes. First, both hydrogen and natural gas are lighter than air, but hydrogen is lighter than natural gas and is both more diffusive and more buoyant than natural gas. This means that in well-ventilated situations (e.g. outdoors) hydrogen will dissipate more quickly than natural gas, and much more quickly than either propane or gasoline, both of which have fumes that are heavier than air and will linger at an accident site. However, hydrogen and natural gas can both accumulate in unventilated pockets at the top of indoor structures and could represent a risk in such situations. Similarly, propane and gasoline fumes can accumulate at the floor level in unventilated spaces, posing a different risk. Thus ignition sources must be averted at the top of any unventilated spaces for hydrogen and natural gas, while ignitions sources must be precluded near the floor for gasoline or propane vehicles indoors. Second, hydrogen is odorless, colorless and burns with a flame that is not visible to the human eye. This means that it is unlikely that people will be able to detect unsafe conditions (without appropriate instrumentation) if they develop (similar to CO accumulation in a structure).

It is important that the ICC provide building officials with the necessary tools so that they can continue to ensure public safety as the public sector begins to adopt sources of hydrogen within the energy infrastructure. Therefore, the AHC has detailed a foundation for code requirements which will allow the safe handling and use of hydrogen as a fuel. Throughout their work, the AHC has sought consistency with existing codes and standards wherever possible. Where hydrogen standards in place today, do not cover the full scope of use or range of available or anticipated technologies, the AHC actively worked with a diverse group of technical and advisory parties from industry to establish criteria in the model codes to cover the installation and integration of these technologies with the building or facilities with which they are associated.

It is important to note that a given volume of natural gas has more than three times the energy of the same volume of hydrogen. Therefore, a given volume of pipe containing natural gas will contain the same energy (potential hazard) as a three times larger volume of hydrogen.

The revisions proposed in a related proposal to Section 101.2 along with the more specific requirements detailed in this proposal clearly define gaseous hydrogen within the scope of the International Fuel Gas Code (IFGC), and allow gaseous hydrogen to be stored and generated indoors not unlike natural gas, provided specific safeguards are implemented. All portions of the system are designed to be fail safe to provide adequate safety under "worst case" conditions.

Proposed Definitions to IFGC Section 202, HYDROGEN CUT-OFF ROOM. Section 202 currently does not define HYDROGEN CUT-OFF ROOM. The efforts of the International Code Council Ad Hoc Hydrogen (H2) Committee intend to address how future building codes can safely cover hydrogen applications in fuel cell vehicles and hydrogen gas motor-vehicle fuel dispensing and generation stations. Accordingly, the H2 committee finds it necessary to prescribe requirements for hydrogen gas fuel dispensing and generation stations that are similar in format to existing International Fire Code provisions specific to "lighter-than air" fuels. The proposed language is needed to support the work of the H2 committee as it pertains to the hydrogen infrastructure (i.e., service stations, parking garages, loading areas, on-site generation and refueling applications and similar uses). This definition is derived from the IMC and NFPA 50A definition for SPECIAL ROOM, see §3-2.2.

HYDROGEN GENERATING APPLIANCE. Section 202 currently does not define HYDROGEN GENERATING APPLIANCE. The efforts of the International Code Council Ad Hoc Hydrogen (H2) Committee intend to address how future building codes can safely cover hydrogen applications. Most of the hydrogen now produced in the United States is on an industrial scale by the process of steam reforming, or as a byproduct of petroleum refining and chemicals production. However, there is growing interest in two different types of hydrogen generating appliances to produce hydrogen on-site at the customer's refueling facility or even at a private residence from either electricity or from natural gas, propane or other fuels. Hydrogen Generating Appliances based on electrolyzers separate the elements of water – hydrogen and oxygen- by charging water with an electrical current. Adding an electrolyte such as salt improves the conductivity of the water and increases the efficiency of the process. The electrical charge breaks the chemical bond between the hydrogen and oxygen and splits apart the atomic components. Hydrogen Generating Appliances based on chemical reformers separate out the hydrogen from fossil fuels such as natural gas, propane, gasoline, etc. This is the same high temperature chemical process used at large oil refineries to produce hydrogen. By generating the hydrogen on-site at the fueling station or customer's facility, these Hydrogen Generating Appliances avoid the high cost of either liquefying hydrogen and delivering it by cryogenic tanker truck, or installing a national hydrogen pipeline system that could cost many tens of billions of dollars. In effect, these on-site Hydrogen Generating Appliances take advantage of one of two existing energy infrastructures: either the natural gas distribution system or the electrical grid.

IFGC Section 416. Wherever possible, requirements for hydrogen gas fuel dispensing and generation stations that were similar to existing IFC content for "lighter-than air" fuels were intentionally correlated or reproduced in context. The newly proposed language is necessary to support the work of the H2 committee as it pertains to the hydrogen infrastructure (i.e., service stations, parking garages, loading areas, self-sustaining on-site generation and refueling applications and similar uses), for vehicle applications.

IFGC Section 701.1. Chapters 30 and 35 of the IFC address the hazards of compressed hydrogen gas systems including stored hydrogen gas in pressure vessels. These referenced code provisions are intended to reduce the risk posed by the inadvertent rupture of a pressure vessel and its hydrogen gas component or the leakage of the flammable gas associated with a piping rupture. The AHC felt that a reference to the commensurate IFC provisions appropriately serve to limit the quantities of compressed hydrogen gas present on both commercial and residential sites, and considers indoor and outdoor use aspects adequately. Reference to Chapter 41 covering pyrophoric materials is intended to address emerging technology (now being contemplated by the automotive industry) that allows for storage of higher densities of compressed hydrogen gas in containers with relatively lower applied pressures.

The AHC feels it appropriate to work under the assumption that liquid hydrogen issues related to gaseous hydrogen production are to be covered by a new Chapter 8. Thus, the correlation with a proposed new Chapter 7 for gaseous hydrogen is intentional. Furthermore, since NFPA50A and NFPA50B do not scope all of the issues specific to self-sustained commercial or remote refueling operations, the AHC proposes a new Chapter 7 as a tool for addressing the installation and approval of systems and equipment utilizing gaseous hydrogen as a fuel. For example, there are no system size limitations in the AHC's proposal. NFPA 50A does not cover single systems with a total hydrogen content less than 400 ft^3. Moreover, 50A does not apply to manufacturing plants or establishments other than "consumer premises." That is, plants and bulk distribution sites operated by a hydrogen supplier or the supplier's agent for the purpose of storing hydrogen and refilling portable containers, trailers, mobile supply trucks, tank cars or motor vehicles are beyond the scope of NFPA 50A. See also, the *Source-Book For Hydrogen Applications* (Hydrogen Research Institute and National Renewable Energy Laboratory, 1998), pages 67-69 for detailed explanation.

IFGC Section 702.1. It is not the intent of the AHC to directly or indirectly limit container, cylinder, tank size to no more than 250 scf per tank outside of residential occupancies. The purpose of the reference to Chapter 35 of the IFC is solely for container, cylinder, tank construction criteria and to ensure that bulk cylinders are not stored in residential occupancies. (See proposed revisions to IFC Section 3503.1.1)

IFGC Section 702.1.1. Addition of this language avoids elimination of Section 3501.1, Exception 3 of the IFC. The AHC feels this is a cleaner way to address bulk cylinder size in garages and detached structure associated with occupancies regulated by the IRC and their accessory structures. The IFC does not apply to occupancies regulated by the IRC and their accessory structures. None-the-less, elimination of the exception could be misinterpreted by subjecting occupancies regulated by the IRC to a number of requirements in the IFC that the committee does not necessarily feel are appropriate

IFGC Section 702.1.2. Consistent with NFPA 50A. For the design and construction of compressed hydrogen gas containers, a single reference to current IFC Section 2703.2.1 could be entertained here, but provides only general guidance (i.e., "in accordance with approved standards"). The structure of the proposed language is derived from IFC Section 3203.1.1. The AHC is not aware of any hydrogen containers meeting less than ASME VIII criteria. Provisions for alternative approval would address any nonstandard containers encountered.

The structure of proposed **IFGC Section 702.2** and subsections was derived from current IFC Section 3203.2. Standard CGA S-1.1 does not yet cover relief devices on metal hydride containers. At this point the issue is gaseous hydrogen and the circumstances surrounding container failure. While preliminary, CGA is currently addressing issues of container performance at failure (as similar to a Boiling Liquid, Expanding Vapor Explosion, BLEVE), and the particulate matter that may potentially foul the pressure relief device. However, from the standpoint of the AHC a metal hydride container is considered a gaseous hydrogen source. It is the AHC's intent that metal hydride containers be evaluated under provisions for alternative approval.

IFGC Section 702.2.1. The AHC's intent here is to require a pressure relief device (PRD) providing protection from over-pressure without obstruction. The presumption is that the PRD is sized correctly.

IFGC Section 702.2.3. This section is consistent with NFPA 50A as it requires PRD's only as dictated by the specifications to which the container was fabricated (i.e., ASME or DOTn).

IFGC Section 702.2.7. Regarding accessibility, the AHC did not intend to prohibit PRD's integral to the container or vessel. It is implicit, however, that the container or vessel standard will address the issue of "integral" PRD's]]

IFGC Section 702.3. In developing provisions for the venting of hydrogen systems the AHC consulted with hydrogen producers, and their corresponding gas and equipment group—engineering safety departments. In general, four general hydrogen design considerations are included in the design of all hydrogen process vent piping: 1) Vent to a safe area, 2) Ignition likely, 3) Design for thermal radiation from flame, and 4) Design to prevent (un-ignited) flammable mixtures from reaching personnel areas and ignition sources. While these considerations are general in nature and intended for use by designers, fabricators, installer, users and maintainers of hydrogen piping systems, the AHC also sought consistency with existing codes and standards wherever possible and in the best interest to safety personnel, fire departments, code officials and other emergency personnel. This included a review of the Compressed Gas Association's "Standard for Hydrogen Piping Systems at Consumer Locations," CGA G-5.4. CGA G-5.4 specifies that piping systems should be designed in accordance with ASME B31.3, "Chemical Plant and Petroleum Refinery Piping."

Also a consideration in the AHC's work, is the most modern view of many members of the CGA S-1.1 Committee (CGA S-1.1, Pressure Relief Device Standards—Part 1—Cylinders for Compressed Gases) which will most likely be reflected in te next edition of CGS A-1.1:, and that is: "The 'engulfing fire case' shall not be included in the approach to hydrogen safety." Therefore, the AHC has adopted the intent that it is far more effective to mitigate the risk of an engulfing fire by diking, rather than address the concept of the maximum hypothetical accident directly. Typically the normal sizing of PRD's for other demands (e.g., a runaway hydrogen compressor) is much smaller than the engulfing fire case, hence the height and distances criteria for the vent stack are easier to accommodate without truly sacrificing safety.

Regarding ventilation, proposed **IFGC Section 702.4** requires mechanical exhaust consistent with the applicable provisions for repair garages in Chapter 5 of the *International Mechanical Code*. The exhaust flow rates specified therein must be provided at all times and interlocked to respond to fan failure or hydrogen detection. The goal of these provisions is to never permit the maximum concentration of flammable contaminants in air to exceed more than 25% of the LFL for hydrogen during the period that the credible leak exists. It should be made perfectly clear that the room or space shall be depressurized by means of exhaust rather than pressurized or otherwise diluted to achieve these levels.

The exception is specific to interior spaces harboring "Gaseous hydrogen systems." That is, Section 704.2 does not apply to your typical hydrogen-fueled vehicle parked in a garage, with or without a vehicle fueling appliance located in the garage. Note however, that the same concepts derived from the University of Miami research were utilized as the basis for this natural alternative. (See reason to IFGC Section 305.2).

Regarding the security arrangements required by proposed **IFGC Section 702.5**: The structure of this language was derived from current IFC Section 3003.3. The intent is to require "nesting" or locking of cylinders or cylinder groups. Site-perimeter security could be viewed as an approved alternative.

IFGC Section 703.1.2. The ASME Boiler and Pressure Vessel Code (Section II) discusses issues related to hydrogen service but does not make specific material recommendations. The *Source Book* and the *Safety Standard for Hydrogen and Hydrogen Systems* (NASA, 1997) provide more specific guidelines. The following information is a reasonably conservative summary of these guidelines.

For metallic materials: Aluminum and its alloys, austenitic stainless steels with greater than 7% nickel (such as 304, 304L, 308, 316, 321, 347), copper and its alloys (such as brass, bronze, and copper nickel), and titanium and its alloys are generally satisfactory for hydrogen service. Care must be taken to not over-stress components in systems as some of these materials may lose ductility if stressed beyond yield.

Nickel and nickel steels are generally not recommended. Ordinary carbon steels may be used in gaseous hydrogen service at ambient temperature. Carbon steels, low alloy steels, chromium, molybdenum, niobium, and zinc are not acceptable for cryogenic temperatures. Grey, ductile or cast iron should not be used in hydrogen service (NFPA 50A).

For welds: Welding requirements are given in the ASME Boiler and Pressure Vessel Codes and ANSI/ASME B31.3. Care must be taken as welds of some of the acceptable materials (listed above) are susceptible to hydrogen embrittlement and/or cracking if not properly executed.

For non-metallic materials: Use of elastomers and plastics should be limited in gasketing, packing or other sealing elements where failure as a result of fire could cause hydrogen leakage. Valve seat materials should be the materials of standard industrial practice for gaseous hydrogen near room temperature. Teflon™ or Kel-F™ can be used in cold gaseous hydrogen or liquid hydrogen systems for valve seats (although Fluorogreem™ preferred), coatings on metallic O-rings, gaskets for tongue and groove flanges, or gland packing or seals (only if maintained near ambient temperature). Kel-F™ is preferred rather than Teflon™ for liquid hydrogen service as it has a higher tensile strength and is less brittle. All Teflon™ gaskets must be totally contained to prevent cold flow and subsequent leakage. Valves for liquid service over 2.1 MPa (300 psia) should use metal-to-metal seats.

IFGC Section 703.1.2.5. Pressure testing in the ASME Boiler and Pressure Vessel Code may be either hydro or pneumatic. Hydro-tests are 150% of the maximum allowable working pressure (MAWP) times a temperature correction factor. In some situations, particularly when the hydrogen system contains catalysts or other materials which could be damaged by water, a pneumatic test is preferable to a hydro-test. This flexibility is therefore, intentional. A pneumatic test is typically conducted at 125% rather than 150% of the MAWP.

IFGC Section 704.1 defers to NFPA 50A for installation issues only, and in the absence of any exception. NFPA 50A does not outline requirements for establishments operated by a hydrogen supplier or the supplier's agent for the purpose of storing hydrogen and refilling portable containers, trailers, vehicles, supply trucks or tank cars (i.e., These examples are not considered "Consumer Sites" as referenced by the Standard). However, while both NFPA 50A and the criteria proposed herein for the International Codes are both based on the hazards associated with specific quantities and types of materials at consumer sites, the circumstances addressed here by exception, ensure coverage for the full range of available or anticipated technologies. Moreover, the circumstances addressed by exception are inclusive of the forecasted use of gaseous hydrogen as a fuel, and the quantities stored such that the materials will not represent an undue risk to personnel in the area or to the building or facilities with which they are associated.

IFGC Section 704.2 defers to Chapter 22 of the International Fire Code (IFC) specifically for locating hydrogen systems on property (See AHC's proposal and reason to Chapter 22 of the IFC). The IFC requirements are based on the hazards associated with the specific materials, e.g. compressed, flammable gas. These requirements are framed such that the location on the property is appropriate for use with this class of material, and will not represent an undue risk to personnel in the area or to the building or facilities with which they are associated.

IFGC Section 704.3. In the best interest of consistency, the AHC proposes to defer to the *International Building Code* for building construction requirements. The IBC requirements are based on the hazards associated with material-specific properties. For hydrogen, a flammable gas, there are specific requirements to ensure that the building is appropriate for use with this class of material. Sections 704.3.1 through 704.3.8 deal with fire safety provisions for use with hydrogen. Since the chapter associated with flammable gases in the International Fire Code exempts hydrogen systems which are regulated under the International Fuel Gas Code, these code sections are necessary in the IFGC to ensure the implementation of fire safety systems.

IFGC Section 704.3.1 intends to detail the design and construction criteria for the cut-off room. These requirements are loosely based on NFPA 50A requirements (Gaseous Hydrogen Systems at Consumer Sites) for "Special Rooms." To allow for broader applications (such as emergency generators using fuel cell technology), interior wall openings are allowed for easy access to the systems. The hydrogen generation shall be terminated if an interior door is opened through the use of interlocks to prevent the migration of flammable gas to an area which is not properly ventilated. In applications where it is not appropriate for interlocks to be installed (i.e., emergency generators), significant ventilation is required to ensure that a flammable mixture is not attained within the room.

IFGC Section 704.3.2 intends to prevent a dangerous accumulation of flammable gas in the room through the use of an exhaust ventilation system. The Source-Book for Hydrogen Applications recommends ventilation at the rate of 1 CFM per square foot of floor area, which is relative to the requirements in Chapter 5 of the IMC. The exception in 704.3.2 is provided to allow exhaust systems which are designed with a capture velocity of 60 fpm at the door opening. This capture velocity exceeds the requirements found in Chapter 5 of the IMC. Since hydrogen is non-toxic, if a release can be kept below its flammable limit, there is minimal hazard. The ventilation requirements are designed to perform that function.

There are no requirements for gas detection in NFPA 50A. The AHC believes gas detection appropriate and integral to life safety. Therefore, **IFGC Section 704.3.3** was derived from current IFC Section 2210.7.2, and intends to address the fact that early detection of the presence of a flammable gas will allow adequate safeguards to be taken. Hydrogen fires are not normally extinguished until the supply of hydrogen has been shut off because of the danger of re-ignition or explosion. A gas detection system in the room or space harboring a gaseous hydrogen system provides for early notification of a leak that is occurring before the escaping gas reaches hazardous exposure concentration levels. The required local alarm is intended to alert the occupants to an emerging hazardous condition in the vicinity. The monitor control equipment must also initiate operation of the mechanical ventilation system in the event of a leak or rupture in the gaseous hydrogen system to prevent an accumulation of flammable gas. Systems shall be designed to be "fail-safe" such that all safety systems shall be activated to alert any occupants that a problem exists and to prevent more hydrogen from being generated by any appliances in the room.

IFGC Section 704.3.4 is intended to prevent any flammable gas releases from finding ignition sources. These requirements are identified in the IFC in locations where flammable gases are stored or used. The requirements are consistent with NFPA 50A and the Sourcebook for Hydrogen Applications. The energy required for ignition of hydrogen-air mixtures is extremely small, and every effort must be made to control ignition sources until the area can be properly ventilated, thus removing the hazard.

IFGC Section 704.3.5 is intended to prevent a catastrophic failure of the cut-off room. It is the final safeguard in case other prevention methods fail (ventilation, alarms). An ignited hydrogen mixture produces large quantities of heat causing a rapid expansion of the surrounding air. This can cause a pressure increase in a confined space and a catastrophic failure. Explosion control methods are identified in the IFC to prevent such a catastrophic failure. The explosion control requirements for hydrogen are consistent with the requirements in NFPA 50A, the IFC, and the Sourcebook for Hydrogen Applications.

IFGC Section 704.3.6 intends to ensure that safety systems remain active in the event of a power failure of the primary power supply. Hydrogen is a colorless, odorless gas and a release may go undetected if detection systems are not functioning. The accumulation of hydrogen in an unventilated area can lead to mixtures in the flammable range if safety systems mechanical ventilation systems are not in operation. Chapter 27 of the IFC addresses emergency and standby power requirements for emergency systems. It also allows an exception to the requirement for systems which are fail safe (see IFC Section 2704.7 Exception 4). This exception may be utilized in cut-off rooms where hydrogen is generated, but not stored. Any storage of hydrogen within the cut-off room would not qualify for the exception, because in the event of a power failure, there will be no way to detect or ventilate a release from a storage vessel.

IFGC Section 704.3.7 intends to augment the requirement in Section 704.3.4. The intent is the same as is in the ignition source control section.

IFGC Section 704.3.8 intends to protect the cut-off room from the storage of other materials which may ignite and cause an exposure fire in the room. Preclusion of combustible materials eliminates this hazard and protects the equipment and storage containers.

IFGC Section 705.1. This section refers to the IFC for maintenance of hydrogen systems. More specifically, Section 2703.2.6 of the IFC details required maintenance activities for hazardous materials storage and use. This includes maintenance of alarms, cylinders, ventilation systems and other devices needed to ensure safety of the gaseous hydrogen system. Failure to properly maintain any of these systems increases the likelihood of a hydrogen release and compromises the safety of the operation. This section is also consistent with the general maintenance provision of the IFC identified in Section 107.1.

In Summary. The AHC has developed these changes through the consultation of a diverse group of technical and advisory parties from various parties in the hydrogen community, inclusive of industry, professional associations, testing laboratories, agencies of government, academic and research institutions and believes it important to provide a template for thorough coverage in the International Codes of equipment, appliances and vehicles that will utilize hydrogen as a fuel such that regulators have a sound technical basis on which to verify installation and to uphold the standard of health and safety for the citizens of their jurisdictions.

Industry is ready to commercialize hydrogen energy systems. The AHC urges your APPROVAL of this proposal "as submitted".

Proponent's Reason Item 2: The development of hydrogen fueled vehicles and equipment is a rapidly developing area. Making gaseous hydrogen available as motor vehicle fuel will likely require storage of that fuel gas in quantities beyond what is currently allowed by this section. In order to facilitate the continued technological developments, a safe means of handling and storage, the fuel must be manufactured some how. To address this, a new section of code is concurrently proposed to Chapter 22 of the IFC which addresses hydrogen gas refueling stations. It has specific details as to requirements for the safe storage, use and handling of the flammable gas. These details include vehicle protection, exposure set-backs, electrical area classifications and other pertinent requirements. Since specific code language is proposed for both the International Fuel Gas Code for systems using hydrogen as a fuel gas, and the International Fire Code addressing the hazards associated with the refueling stations, the AHC feels the more general language of Chapter 35 and the reference to NFPA 50a now need not apply.

Exception 3 to Section 3503.1.1 is necessary to enable commercial refueling stations designed for that purpose, but also to address remote storage and refueling operations affiliated with buildings designed and constructed in accordance with Section R102.7 of the IRC (i.e., One- and Two-Family Dwellings and Town homes).

Proponent's Reason Item 3: HYDROGEN CUT-OFF ROOM. Revisions proposed to the IFGC intend to define both HYDROGEN CUT-OFF ROOM and HYDROGEN GENERATING APPLIANCES. The Ad Hoc Committee for Hydrogen Gas finds it necessary to prescribe requirements for the location of HYDROGEN GENERATING APPLIANCES in an around buildings that are similar in format to existing provisions specific to "lighter-than air" gases and fuels. The proposed language is needed to support the work of the AHC as it pertains to hydrogen infrastructure (i.e., service stations, parking garages, loading areas, on-site generation and refueling applications and similar uses). This definition is derived from the IMC and NFPA 50A definition for SPECIAL ROOM, see §3-2.2 of NFPA 50A.

ITEM 1
Committee Action: Disapproved

Committee Reason: Disapproval is consistent with the action taken on FG2-02, FG15-02 and FG48-02. The IFGC is not the appropriate location for hydrogen coverage. Such coverage belongs in the IFC or a separate code dedicated to hydrogen. The proposed text is not of the quality necessary for inclusion in an ICC code because of the numerous technical flaws, such as lack of coverage for something as fundamental as leak testing of piping.

Assembly Action: Approved as Submitted

ITEM 2
Committee Action: Approved as Submitted

Committee Reason: The IFC is the proper location for such coverage.

Assembly Action: No Motion

ITEM 3
Committee Action: Disapproved

Committee Reason: Cut-off rooms need to coordinate with the provisions of NFPA 50 A. It is not clear what is being addressed in the proposed text relative to gaseous hydrogen systems.

Assembly Action: No Motion

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted and an assembly action was successful.

Public Comment 1:

Gilbert Gonzales, Murray City Corp., requests Approved as Submitted for Item 1 only.

Commenter's Reason: The proposed text does not address every possible scenario nor is it a perfect document. However, as with any new technology the industry must have a reasonable and enforceable base from which to regulate the safe installation and delivery of hydrogen gas. The Ad Hoc Committee for Hydrogen Gas has made every conceivable attempt to provide the Fuel Gas Code Committee and the ICC membership with just that. The comment made in the committee reasoning that states the ad hoc committee had no members in tune with fuel gas issues is incorrect. The original proposal noted that "The AHC consists of a balanced membership of user, producer and regulatory interests working together with a diverse group of technical and advisory interests to propose changes as necessary to the ICC International Codes." The fact that hydrogen is a fuel gas, would make the Fuel Gas Code the logical choice for these requirements. To address the code requirements for hydrogen gas through a separate code is both unreasonable and impractical.

Public Comment 2:

Kevin H. Scott, Kern County Fire Department, requests Approved as Modified by this comment for Item 2 only.

Modify proposal as follows:

Part 2
IFC 3501.1 Scope. The storage and use of flammable gases shall be in accordance with this chapter. Compressed gases shall also comply with Chapter 30. <u>Gaseous hydrogen systems at consumer sites shall also comply with NFPA 50A.</u>

Exceptions:
1. Gases used as refrigerants in refrigeration systems (see Section 606).
2. Liquefied petroleum gases and natural gases regulated by Chapter 38.
3. Fuel gas systems and appliances regulated under the *International Fuel Gas Code.*
4. <u>Hydrogen motor fuel dispensing stations designed and constructed in accordance with Chapter 22.</u>

IFC 3513.1.1 Limitations for indoor storage and use. Flammable gases shall not be stored or used in Group A, B, E, F, I, M, R or S occupancies.

Exceptions:
1. Cylinders not exceeding a capacity of 250 cubic feet (7.08 m3) each at NTP used for maintenance purposes, patient care ~~or motor fuel dispensing~~ and operation of the equipment.
2. Food service operation in accordance with Section 3803.2.1.7.
3. ~~Hydrogen motor fuel dispensing stations designed and constructed in accordance with Chapter 22.~~

Commenter's Reason: This comment is intended to relocate the exception for hydrogen motor fuel dispensing. The exception will still be allowed but will now be applicable to the entire Chapter because it will be in the scope. The change will retain the current text in Section 3501.1 and 3503.1.1, plus add a new exception to 3501.1.

Additionally, this comment will create a correlation between Item F167-02 which the Fire Code Committee approved. In the process of approving F167, the committee disallowed indoor dispensing. This is a new technology and should be proven first before it is allowed indoors, especially in A, E, I occupancies where there is a high potential for life loss or in B, M, or S occupancies where there is a high potential for property loss.

This comment acknowledges the hydrogen fuel technology, but refers the code user back to Sections 2209 and 2210 for the specific provisions for its use.

Public Comment 3:

ICC Ad Hoc Committee for Hydrogen Gas, requests Approved as Modified by this comment for Item 1 and Approved as Submitted for Item 2 and 3.

Modify proposal as follows:

Proponent: ICC Ad Hoc Committee for Hydrogen Gas

~~**SECTION 416 (IFGC)**~~
~~**GASEOUS HYDROGEN SYSTEMS**~~

~~**401.1.2 General.** The installation of gaseous hydrogen systems shall be in accordance with Chapter 7 and the *International Fire Code*.~~

CHAPTER 7
GASEOUS HYDROGEN SYSTEMS

SECTION 701 (IFGC)
GENERAL

701.1 Scope. The installation of gaseous hydrogen systems shall comply with this chapter and Chapters 30 and 35 of the *International Fire Code*. Compressed gases shall also comply with Chapter 27 of the *International Fire Code* for general requirements. Containers provided with pyrophoric material shall also comply with Chapter 41 of the *International Fire Code*. Containers having residual gaseous hydrogen shall be considered as full for the purposes of the controls required.

701.2 Permits. Permits shall be required as set forth in Section 106 and as required by the *International Fire Code*.

SECTION ~~202~~ 702 (IFGC)
GENERAL DEFINITIONS

702.1 Definitions. The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

HYDROGEN CUT-OFF ROOM. A room or space which is intended exclusively to house a gaseous hydrogen system.

HYDROGEN GENERATING APPLIANCE. A self-contained package or factory-matched packages of integrated systems for generating gaseous hydrogen. Hydrogen generating appliances utilize electrolysis, reformation, chemical, or other processes to generate hydrogen.

GASEOUS HYDROGEN SYSTEM. An assembly of piping, devices and apparatus designed to generate, store, contain, distribute or transport a nontoxic, gaseous hydrogen containing mixture having at least 95% hydrogen gas by volume and not more than 1% oxygen by volume. Gaseous hydrogen systems consist of items such as compressed gas containers, reactors and appurtenances, including pressure regulators, pressure relief devices, manifolds, pumps, compressors and interconnecting piping and tubing and controls.

SECTION ~~702~~ 703 (IFGC)
GENERAL REQUIREMENTS

703.1 Hydrogen Generating and Refueling Operations. Ventilation shall be required in accordance with Section 703.1.1, 703.1.2 or 703.1.3 in public garages, private garages, repair garages, automotive service stations and parking garages which contain hydrogen generating appliances or refueling systems. Such spaces shall be used for the storage of not more than three hydrogen-fueled passenger motor vehicles and have a floor area not exceeding 850 square feet. The maximum rated output capacity of hydrogen generating appliances shall not exceed 4 SCFM of hydrogen for each 250 square feet of floor area in such spaces. Such equipment and appliances shall not be installed in Group H occupancies unless the occupancy is specifically designed for hydrogen use, or in control areas where open-use, handling or dispensing of combustible, flammable or explosive materials occurs. For the purpose of this section, rooms or spaces that are not part of the living space of a dwelling unit and that communicate directly with a private garage through openings shall be considered to be part of the private garage.

703.1.1 Natural Ventilation. Indoor locations intended for hydrogen generating or refueling operations shall communicate with the outdoors in accordance with Sections 703.1.1.1 through 703.1.1.2. The minimum cross-sectional dimension of air openings shall be 3 in. (76 mm). Where ducts are used, they shall be of the same cross-sectional area as the free area of the openings to which they connect. In such locations, equipment and appliances having an ignition source shall be located such that the source of ignition is not less than 12 inches (228 mm) below the ceiling.

703.1.1.1 Two openings. Two permanent openings, one located entirely within 12 inches (305 mm) of the ceiling of the garage, and one located entirely within 12 inches (305 mm) of the floor of the garage, shall be provided in the same exterior wall. The openings shall communicate directly with the outdoors. Each opening shall directly communicate with the outdoors horizontally, and have a minimum free area of ½ square foot per 1,000 cubic feet of garage volume.

703.1.1.2 Louvers and grilles. In calculating free area required by Section 703.1.1.1, the required size of openings shall be based on the net free area of each opening. If the free area through a design of louver or grille is known, it shall be used in calculating the size opening required to provide the free area specified. If the design and free area are not known, it shall be assumed that wood louvers will have 25 percent free area and metal louvers and grilles will have 75 percent free area. Louvers and grilles shall be fixed in the open position.

703.1.2 Mechanical ventilation. Indoor locations intended for hydrogen generating or refueling operations shall be ventilated in accordance with Section 502.15 of the *International Mechanical Code*.

703.1.3 Specially engineered installations. As an alternative to the provisions of Section 703.1.1 and 703.1.2 the necessary supply of air for, ventilation and dilution of flammable gases shall be provided by an approved engineered system.

~~**702.1**~~ **703.2 Containers, cylinders and tanks.** Compressed gas containers, cylinders and tanks shall comply with Chapters 30 and 35 of the *International Fire Code*.

~~**702.1.1**~~ **703.2.1 Limitations for indoor storage and use.** Flammable gas cylinders in occupancies regulated by the *International Residential Code* shall not exceed 250 cubic feet at Normal Temperature and Pressure (NTP).

~~**702.1.2**~~ **703.2.2 Design and construction.** Compressed gas containers, cylinders and tanks shall be designed, constructed and tested in accordance with the Chapter 27 of the *International Fire Code,* ASME Boiler and Pressure Vessel Code (Section VIII) or DOT 49 CFR, Parts 100-180.

~~**702.2**~~ **703.3 Pressure relief devices.** Pressure relief devices shall be provided in accordance with Sections 703.3.1 through 703.3.8. Pressure relief devices shall be sized and selected in accordance with CGA S-1.1, CGA S-1.2 and CGA S-1.3.

~~**702.2.1**~~ **703.3.1 Valves between pressure relief devices and containers.** Valves including shutoffs, check valves and other mechanical restrictions shall not be installed between the pressure relief device and container being protected by the relief device.

Exception: A locked-open shutoff valve on containers equipped with multiple pressure-relief device installations where the arrangement of the valves provides the full required flow through the minimum number of required relief devices at all times.

~~702.2.2~~ <u>703.3.2</u> **Installation.** Valves and other mechanical restrictions shall not be located between the pressure relief device and the point of release to the atmosphere.

~~702.2.3~~ <u>703.3.3</u> **Containers.** Containers shall be provided with pressure relief devices in accordance with ASME *Boiler and Pressure Vessel Code, Section VIII*, DOTn and Section <u>703.3.7</u>.

~~702.2.4~~ <u>703.3.4</u> **Vessels other than containers.** Vessels other than containers shall be protected with pressure relief devices in accordance with ASME *Boiler and Pressure Vessel Code, Section VIII*, or DOTn.

~~702.2.5~~ <u>703.3.5</u> **Sizing.** Pressure relief devices shall be sized in accordance with the specifications to which the container was fabricated. The relief device shall be sized to prevent the maximum design pressure of the container or system from being exceeded.

~~702.2.6~~ <u>703.3.6</u> **Protection.** Pressure relief devices and any associated vent piping shall be designed, installed and located so that their operation will not be affected by water or other debris accumulating inside the vent or obstructing the vent.

~~702.2.7~~ <u>703.3.7</u> **Access.** Pressure relief devices shall be located such that they are provided with ready access for inspection and repair.

~~702.2.8~~ <u>703.3.8</u> **Configuration .** Pressure relief devices shall be arranged to discharge unobstructed in accordance with Section 2209 of the *International Fire Code*. Discharge shall be directed to the outdoors in such a manner as to prevent impingement of escaping gas on personnel, containers, equipment and adjacent structures and to prevent introduction of escaping gas into enclosed spaces. The discharge shall not terminate, under eaves or canopies.

Exception: This section shall not apply to DOTn-specified containers with an internal volume of 2 cubic feet (0.057 m3) or less.

~~702.3~~ <u>703.4</u> **Venting.** Relief device vents shall be terminated to an approved location in accordance with Section 2209 of the *International Fire Code*.

~~702.4~~ <u>703.5</u> **Security.** Compressed gas containers, cylinders, tanks and systems shall be secured against accidental dislodgement in accordance with Chapter 30 of the *International Fire Code*.

~~702.5~~ <u>703.6</u> **Electrical wiring and equipment.** Electrical wiring and equipment shall comply with the ICC Electrical Code.

SECTION ~~703~~ <u>704</u> (IFGC)
<u>PIPING,</u> USE AND HANDLING

~~703.1~~ **704.1 Applicability.** Use and handling of containers, cylinders, tanks and hydrogen gas systems shall comply with this section. Gaseous hydrogen systems, equipment and machinery shall be listed or approved.

~~703.1.1~~ **704.1.1 Controls.** Compressed gas system controls shall be designed to prevent materials from entering or leaving process or reaction systems at other than the intended time, rate or path. Automatic controls shall be designed to be fail safe in accordance with accepted engineering practice.

~~703.1.2~~ **704.1.2 Piping systems.** Piping, tubing, valves and fittings conveying gaseous hydrogen shall be designed and installed in accordance with ASME B31.3, Sections 704.1.2.1 through 704.1.2.5 and Chapter 27 of the *International Fire Code*. Cast-iron pipe, valves and fittings shall not be used.

~~703.1.2.1~~ **704.1.2.1 Sizing.** Gaseous hydrogen piping shall be sized in accordance with approved engineering methods.

<u>**704.1.2.2 Identification.** Piping used to convey Gaseous Hydrogen shall be identified and marked, "HYDROGEN", at intervals not exceeding 10 feet. Letters of such marking shall be in color other than the piping. Piping shall be identified a minimum of one time in each room or space through which it extends.</u>

~~703.1.2.2~~ <u>**704.1.2.3 Piping**</u> **design and construction.** Piping systems shall be <u>Type 304, Type 304L or Type 316 stainless steel tubing listed or approved</u> ~~suitable~~ for hydrogen service and the use intended through the full range of pressure and temperature to which they will be subjected. Piping systems shall be designed and constructed to provide allowance for expansion, contraction, vibration, settlement and fire exposure.

~~703.1.2.2.1~~ <u>704.1.2.3.1</u> **Prohibited locations.** Piping shall not be installed in or through a circulating air duct, clothes chute, chimney or gas vent, ventilating duct, dumbwaiter, or elevator shaft.

~~703.1.2.2.2~~ <u>704.1.2.3.2</u> **Piping in solid partitions and walls.** Concealed piping shall not be located in solid partitions and solid walls, unless installed in a ventilated chase or casing.

~~703.1.2.2.3~~ <u>704.1.2.3.3</u> **Piping in concealed locations.** Portions of a piping system installed in concealed locations shall not have unions, tubing fittings, right or left couplings, bushings, compression couplings and swing joints made by combinations of fittings.

Exceptions:
1. Tubing joined by brazing.

2. Fittings listed for use in concealed locations.

~~703.1.2.2.4~~ <u>704.1.2.3.4</u> **Piping through foundation wall.** Underground piping shall not penetrate the outer foundation or basement wall of a building.

~~703.1.2.2.5~~ <u>704.1.2.3.5</u> **Protection against physical damage.** In concealed locations, where piping other than stainless steel piping, stainless steel tubing, or black steel is installed through holes or notches in wood studs, joists, rafters or similar members less than 1 inch (25.4 mm) from the nearest edge of the member, the pipe shall be protected by shield plates. Shield plates shall be a minimum of 1/16-inch-thick (1.6 mm) steel, shall cover the area of the pipe where the member is notched or bored, and shall extend a minimum of 4 inches (102 mm) above sole plates, below top plates and to each side of a stud, joist or rafter.

~~703.1.2.2.6~~ <u>704.1.2.3.6</u> **Piping in solid floors.** Piping in solid floors shall be laid in channels in the floor and covered in a manner that will allow access to the piping with a minimum amount of damage to the building. Where such piping is subject to exposure to excessive moisture or corrosive substances, the piping shall be protected in an approved manner. As an alternative to installation in channels, the piping shall be installed in a casing of schedule 40 steel, wrought iron, PVC or ABS pipe with tightly sealed ends and joints and ventilated to the outdoors. Both ends of such casing shall extend not less than 2 inches (51 mm) beyond the point where the pipe emerges from the floor.

~~703.1.2.2.7~~ <u>704.1.2.3.7</u> **Piping outdoors.** Piping installed aboveground outdoors shall be securely supported and located where it will be protected from physical damage. Piping passing through an exterior wall of a building, shall be encased in a protective pipe sleeve. The annular space between the piping and the sleeve shall be sealed from the inside such that the sleeve is ventilated to the outdoors. Where passing through an exterior wall of a building, the piping shall also be protected against corrosion by coating or wrapping with an inert material. Below-ground piping shall be protected against corrosion.

~~703.1.2.2.8~~ <u>704.1.2.3.8</u> **Settlement.** Piping passing through interior concrete or masonry walls shall be protected against differential settlement.

~~703.1.2.3~~ <u>704.1.2.4</u> **Joints.** Joints on piping and tubing shall be listed for hydrogen service, inclusive of welded, brazed, flared, socket, slip or compression fittings. Gaskets and sealants shall be listed for hydrogen service. Threaded or flanged connections shall not be used in areas other than hydrogen cut-off rooms or outdoors..

~~703.1.2.4~~ 704.1.2.5 Valves and piping components . Valves, regulators and piping components shall be listed or approved for hydrogen service , shall be provided with access , and shall be designed and constructed to withstand the maximum pressure to which they will be subjected.

~~703.1.2.4.1~~ 704.1.2.5.1 Shutoff valves on storage containers and tanks. Shutoff valves shall be provided on all storage container and tank connections except for pressure relief devices. Shutoff valves shall be provided with ready access.

~~**703.1.2.5 Testing.** Testing for physical integrity shall be performed at not less than 150 percent of the maximum allowable working pressure, or in accordance with the requirements of ASME B31.3.~~

~~703.3~~ 704.2 Upright use. Compressed gas containers, cylinders and tanks, except those with a water volume less than 1.3 gallons (5 L) and those designed for use in a horizontal position, shall be used in an upright position with the valve end up. An upright position shall include conditions where the container, cylinder or tank axis is inclined as much as 45 degrees (0.80 rad) from the vertical.

~~703.4~~ 704.3 Material-specific regulations. In addition to the requirements of this section, indoor and outdoor use of hydrogen compressed gas shall comply with the material-specific provisions of Chapters 30 and 35 of the *International Fire Code.*

~~703.5~~ 704.4 Handling. The handling of compressed gas containers, cylinders and tanks shall comply with Chapter 27 of the *International Fire Code.*

SECTION 705 (IFGC)
TESTING OF HYDROGEN PIPING SYSTEMS

705.1 General. Prior to acceptance and initial operation, all piping installations shall be inspected and pressure tested to determine that the materials, design fabrication, and installation practices comply with the requirements of this code.

705.2 Inspections. Inspection shall consist of a visual examination of the entire piping system installation and a pressure test, prior to system operation. Engineered systems shall be designed using approved engineering methods, utilize the inspection procedures of ASME B31.3, and such inspections shall be verified by the code official.

705.3 Pressure test. The test pressure to be used shall be not less than 1 ½ times the proposed maximum working pressure, but not less than 5 psig, irrespective of the design pressure. Where the test pressure exceeds 125 psig, the test pressure shall not exceed a value that produces hoop stress in the piping greater than 50% of the specified minimum yield strength of the pipe. Testing of engineered systems shall utilize the testing procedures of ASME B31.3 provided that test duration and gauge accuracy are included in the procedures as specified in 705.3.1 and 705.3.2.

705.3.1 Test duration. The test duration shall not be less than ½ hour for each 500 cubic feet of pipe volume. For piping systems having a volume of more than 24,000 cubic feet, the duration of test shall not be required to exceed 24 hours.

705.3.2 Test gauges. Test gauges used for testing shall be as follows:

1. Test requiring a pressure of 10 psi or less shall utilize a testing gauge having increments of 0.10 psi or less.
2. Test requiring a pressure of greater than 10 psi but less than or equal to 100 psi shall utilize a testing gauge having increments of 1 psi or less.
3. Test requiring a pressure test greater than 100 psi shall utilize a testing gauge having increments of 2 psi or less.

Exception: Measuring devices shall be permitted having equivalent level of accuracy as listed above, when approved by the design engineer and the code official.

705.4 Detection of leaks and defects. The piping system shall withstand the test pressure specified without showing any evidence of leakage or other defects.

705.4.1 Corrections. Where leakage or other defects are located, the affected portion of the piping system shall be repaired and retested.

SECTION ~~704~~ 706 (IFGC)
LOCATION OF GASEOUS HYDROGEN SYSTEMS

~~704.1~~ 706.1 General. This section shall govern the location, and installation of gaseous hydrogen systems.

Exceptions:
1. Dispensing equipment need not be separated from canopies that are constructed in accordance with the *International Building Code* and in a manner that prevents the accumulation of hydrogen gas.
2. Gaseous hydrogen systems located in a separate building designed and constructed in accordance with the *International Building Code* and NFPA 50A.
3. Gaseous hydrogen systems located inside a building in a hydrogen cut-off room designed and constructed in accordance with Section 706.3 and the *International Building Code*.
4. Gaseous hydrogen systems located inside a building not in a hydrogen cut-off room where the gaseous hydrogen system is listed and labeled for indoor installation and installed in accordance with the manufacturer's installation instructions.
5. ~~Gaseous hydrogen systems installed in vaults constructed in accordance with the applicable requirements of Chapter 34 of the *International Fire Code*. Such locations shall be provided with mechanical ventilation in accordance with the applicable provisions for repair garages in Chapter 5 of the *International Mechanical Code*.~~
5. Stationary fuel cell power plants in accordance with Section 623.0.

~~704.2~~ 706.2 Location on property. Gaseous hydrogen systems shall be located in accordance with Chapter 22 of the *International Fire Code*.

~~704.3~~ 706.3 Hydrogen cut-off rooms. Hydrogen cut-off rooms shall be designed and constructed in accordance with Sections 706.3.1 through 706.3.8 and the *International Building Code*.

~~704.3.1~~ 706.3.1 Design and construction. Interior building openings shall be equipped with self-closing devices. Interior openings shall be electronically interlocked with the gaseous hydrogen system to prevent operation of the system when such openings are ajar or the room shall be provided with a mechanical exhaust ventilation system designed with a capture velocity at the opening of not less than 60 fpm. Operable windows are prohibited in interior walls.

~~704.3.2~~ 706.3.2 Ventilation. Cut-off rooms shall be provided with mechanical ventilation in accordance with the applicable provisions for repair garages in Chapter 5 of the *International Mechanical Code.*

Exception: This section shall not apply to rooms provided with ventilation systems meeting the requirements of Section 706.3.1.

~~704.3.3~~ 706.3.3 Gas detection system. Hydrogen cut-off rooms shall be provided with an approved flammable gas detection system in accordance with Sections 706.3.3.1 through 706.3.3.3.

~~704.3.3.1~~ 706.3.3.1 System design. The flammable gas detection system shall be listed for use with hydrogen and any other flammable gases used in the room. The gas detection system shall be designed to activate when the level of flammable gas exceeds 25 percent of the lower flammability limit (LFL) for the gas or mixtures present at anticipated temperature and pressure.

~~704.3.3.2~~ 706.3.3.2 Operation. Activation of the gas detection system shall result in all of the following:

1. Initiation of distinct audible and visual alarm signals both inside and outside the cut-off room.

2. Activation of the mechanical ventilation system.

~~704.3.3.3~~ 706.3.3.3 **Failure of the gas detection system.** Failure of the gas detection system shall result in, activation of the mechanical ventilation system, cessation of hydrogen generation, and a trouble signal to sound in an approved location.

~~704.3.4~~ 706.3.4 **Ignition source control.** Open flames, flame-producing devices and other sources of ignition shall be controlled in accordance with Chapter 35 of the *International Fire Code*.

~~704.3.5~~ 706.3.5 **Explosion control.** Explosion control shall be provided in accordance with Chapter 9 of the *International Fire Code*.

~~704.3.6~~ 706.3.6 **Standby power.** Mechanical ventilation and gas detection systems shall be connected to a standby power system in accordance in accordance with Chapter 27 of the *International Fire Code*.

~~704.3.7~~ 706.3.7 **Smoking.** Smoking shall be prohibited in hydrogen cut-off rooms. "No Smoking" signs shall be provided at all entrances to hydrogen cut-off rooms.

~~704.3.8~~ 706.3.8 **Housekeeping.** The hydrogen cut-off room shall be kept free from combustible debris and storage at all times.

SECTION ~~705~~ 707 (IFGC)
OPERATION AND MAINTENANCE OF GASEOUS HYDROGEN SYSTEMS

~~705.1~~ 707.1 **Maintenance.** Gaseous hydrogen systems and detection devices shall be maintained in accordance with the *International Fire Code* and the manufacturers installation instructions.

~~705.2~~ 707.2 **Purging.** Purging of gaseous hydrogen systems shall be in accordance with Section 2210.8 of the *International Fire Code*.

SECTION 708 (IFGC)
DESIGN OF LIQUIFIED HYDROGEN SYSTEMS ASSOCIATED WITH HYDROGEN VAPORIZATION OPERATIONS

708.1 General. The design of liquefied hydrogen systems shall comply with Chapter 32 of the *International Fire Code*.

2. IFC 3501.1 Scope. The storage and use of flammable gases shall be in accordance with this chapter. Compressed gases shall also comply with Chapter 30.

Exceptions:
1. Gases used as refrigerants in refrigeration systems (see Section 606).
2. Liquefied petroleum gases and natural gases regulated by Chapter 38.
3. Fuel gas systems and appliances regulated under the *International Fuel Gas Code*.

3503.1.1 Limitations for indoor storage and use. Flammable gases shall not be stored or used in Group A, B, E, F, I, M, R or S occupancies.

Exceptions:
1. Cylinders not exceeding a capacity of 250 cubic feet (7.08 m^3) each at NTP used for maintenance purposes, patient care or motor fuel dispensing and operation of equipment.
2. Food service operations in accordance with Section 3803.2.1.7.
3. Hydrogen motor fuel dispensing stations designed and constructed in accordance with Chapter 22.

3. IBC

TABLE 302.1.1
INCIDENTAL USE AREAS

ROOM OR AREA	SEPARATION
Hydrogen cut-off rooms	1-hour fire barriers and floor ceiling assemblies in Group B, F. H. M, S and U occupancies. 2-hour fire barriers and floor ceiling assemblies in Group A, E, I and R occupancies.

Commenter's Reason: The AHC has addressed and resolved the technical issues identified by the Code Development Committee directly as modified by this and other coordinated public comments to all hydrogen-related proposals (F176, M7, FG2, FG15, FG41 & FG48). The supporting Reason to FG2-02 provides a brief explanation of each solution.

This proposal specifically, represents a compromise of sorts—consolidating all provisions associated with gasified hydrogen applications into a single, new Chapter 7 in the Fuel Gas Code.

The ICC AHC for Hydrogen Gas requests your Approval as Modified by this Public Comment (AMPC).

Public Comment 4:

Robert J. Davidson, South Brunswick Township Fire Safety Bureau, requests Disapproved for Item 2 only.

Commenter's Reason: Hydrogen motor fuel is a new technology with no consumer site refueling experience. The IFC Development Committee voted to approve the new section of code in chapter 22 for this new technology, but specifically amended the proposal to restrict the operations to the exterior of structures in the interest of fire safety.

The IFG Code Development Committee action on this item eliminated an important reference to NFPA 50A that applied to all hydrogen systems at consumer sites including numerous activities unrelated to the hydrogen fuel technology. This action appears to have been done without an understanding of the effect of the change on these other operations and with no technical basis for the change's effect on other hydrogen system operations included in the submitted proposal.

The Committee action on this item needs to be overturned by Disapproving the proposal to provide for correlation with the action taken by the IFC Development Committee and to restore an important reference to NFPA 50A that is needed for regulation of hydrogen systems at all consumer sites.

Public Comment 5:

Jim Ranfone, American Gas Association, requests Disapproved for Item 1 only.

Commenter's Reason: The American Gas Association (AGA) supports the IFGC Committee action for disapproval. In addition to the Committee Reason for disapproval documented in the Report on the Public Hearing, additional reasons addressed in the public hearing testimony by AGA and others include the following:

1.) The scope of the IFGC does not include hydrogen as a fuel gas and, based on existing coverage under IFGC Section 101.2, hydrogen proposals should be submitted to the *International Mechanical Code* (IMC).

2.) Provisions cited in the proposal referring to the *International Fire Code* (IFC) would be most appropriate to that code instead of the IFGC. Code coverage that simply refers to other code sections is redundant coverage.

3.) All proposed coverage of containers, cylinders, and vessels are outside the scope of the IFGC. The IFGC scope covers "fuel gas piping systems, fuel gas utilization equipment, and related accessories" as listed in Section 101.2. The proposal does not seek to modify the scope to add these components. Container and cylinder coverage needs to be proposed to the IFC, Chapter 35, which currently covers flammable gases containers and cylinders.

4.) The IFGC scope does not include coverage of ventilation systems for mitigating gaseous release hazards. Such systems, proposed as Section 702.1, should be covered under the IMC, may require unique requirements to address flammable concentrations and ignition source control within these ventilation systems.

5.) Requirements for design and installation of hydrogen piping systems to ASME B31.3 are unenforceable. While titled as a "code," ASME B31.3 is, in fact, an engineering standard that presents numerous engineering options for design of process piping. This standard, according to its handbook is intended for chemical plants, oil refineries, loading terminals, bulk processing plants, and cryogenic piping and is an industrial standard intended to cover a wide variety of liquids and gases, hazardous and non-hazardous, at a variety of pressures. The standard provides no clear requirements of gaseous hydrogen systems. Likewise, it provides no clear requirements against which a code official can inspect a hydrogen piping system and judge it acceptable. The AHC should provide specific piping design and installation requirements for hydrogen systems in its proposal. It could then use ASME B31.3 to justify these requirements. There should be no requirement for code officials to secure copies of ASME B31.3 (currently costing $225 from ASME) to evaluate hydrogen piping systems and assume the role of a process engineer in an attempt to determine code compliance. It should be noted that industrial applications intended for ASME B31.3 were never covered by the IFGC or the NFGC for natural gas. Those documents were targeted at code enforcement within residential and commercial applications. Industrial gas system requirements are conventionally the responsibility of process engineers working on plant design. Trying to apply an industrial standard to non-industrial installations is going the wrong direction.

6.) In addition, it is unclear whether ASME B31.3 is referenced in accordance with Section 3.6 of the Code Development Process for the International Codes maintained by the ICC. In particular, this standard appears to be referenced without an edition citation for specificity (Section 3.6.1). It also appears to include non-mandatory language, has insufficient description of test procedures and materials, and lacks clearly defined measurement of performance for leak testing (Section 3.6.2). Finally, AGA has found that the standard is not readily available (Section 3.6.3), except through purchase from ASME.

7.) The accompanying section on piping design and construction is, itself, unenforceable by requiring that the piping systems be "suitable for hydrogen service…through the full range of pressure and temperature to which they will be subjected." This language, and language that following is the section, is performance language that requires engineering knowledge and judgment concerning behavior of the piping systems under operating and environmental conditions and the relative risk of failure. In other words, it requires a professional engineer to determine the applicability of a specific installation, not a typical code official.

8.) Requirements for joints, valves, gaskets, sealants and piping components to be "listed for hydrogen service" include no references to listing standards. As a result, these provisions are unenforceable and do not meet the requirements of the ICC for reference standards.

9.) Reference to ASME B31.3 for testing and inspection of hydrogen piping systems is ambiguous, unenforceable, and inappropriate. ASME B31.3 presents various options for pressure testing piping systems. It is unclear which method of test is preferred and whether all of the alternatives are equivalent for hydrogen systems. The pneumatic test, likely to be default method in the field, only requires pressurization to 110% of operating pressure and a piping inspection at this pressure. No information is provided on how the inspection is to be performed. If visual inspection is all that is required, the test might amount to a simple soap bubble test, but ASME B31.3 provides no information on this (presumably because of the wide range of applicability of the standard). Such interpretation of the requirement would be ironically lax, given the exhaustive deliberations over the IFGC coverage of pressure testing of natural gas and LP piping systems.

AGA supports the development of sound code or standards coverage of hydrogen and hydrogen systems under the ICC. AGA advocates the expeditious development of a separate, stand-alone code or standard for hydrogen systems. In order to maintain the integrity of ICC documents as model codes, proponents of code coverage for hydrogen and hydrogen systems need to address deficiencies identified in the current proposals.

Public Comment 6:

Larry Fluer, Fluer, Inc., requests Disapproved for Item 2 only.

Commenter's Reason: The proposed code change deletes NFPA 50A *Standard for Gaseous Hydrogen Systems at Consumer Sites,* from the scope section of IFC Chapter 35. NFPA 50A was originally developed as a regulatory document in 1961. It has been used as a nationally recognized standard for more than forty years.

In substantiating the reason for the deletion of the requirements the proponent indicates that "Making gaseous hydrogen available, as motor vehicle fuel will likely require storage of that fuel gas in quantities beyond what is currently allowed by this section."

Chapter 35 does not limit the quantity of hydrogen that can be stored or used. NFPA 50A provides standards for the installation of systems of various sizes including those (a) less than 3,500 cubic feet, (b) from 3,500 to 15,000 cubic feet and to ©) systems exceeding 15,000 cubic feet. There is no upper limit on the amount of hydrogen that is regulated by NFPA 50A. It should also be noted that liquefied hydrogen systems are regulated by IFC Chapter 32, and that Section 3201.1 requires liquid hydrogen systems to be in accordance with NFPA 50B *Standard for Liquefied Hydrogen Systems at Consumer Sites.* NFPA 50B applies to systems as large as 75,000 liquid gallons or approximately 8.5 million cubic feet of hydrogen gas. The reason to delete NFPA 50A as postulated by the proponent is not substantiated by the facts.

Further justification is offered by the proponent to indicate that IFC Chapter 22 *Service Stations and Repair Garages* should be used as the basis for regulating all hydrogen installations. The view taken by the Hydrogen Ad Hoc Committee (AHC) overlooks the fact that there are many hydrogen users within the industrial community. Hydrogen is commonly used by those engaged the electronics industry, semiconductor manufacturing, aerospace and allied industries, metal treating and others. While vehicle fueling may have special needs, provisions related to the use of hydrogen, as a vehicle fuel should not be used to regulate all other uses; and NFPA 50A should be retained.

IFC Section 3503.1 regulates the storage or use of hydrogen in quantities less than the Maximum Allowable Quantity per control area as listed in Section 2703.1. As proposed, Exception 3 to Section 3503.1.1 allows for the use of hydrogen motor fuel dispensing stations in quantities not exceeding the exempt amounts in Group A, B, E, F, I, M, R or S occupancies.

The exception is in conflict with the action taken by the IFC Code Change Committee on F176-02 which in Section 2209.3 requires generation, compression, storage and dispensing equipment to be located outdoors and above ground. One has to question the wisdom of allowing fuel dispensing stations in assembly, educational, institutional or other people intensive uses regardless of the quantities of gas involved. It may be appropriate to allow vehicle refueling limited to service stations and/or certain residential uses depending on the controls to be developed; however, as drafted the provisions are not properly focused.