DELIVERABLE REPORT

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Summary

This briefing note presents an overview of the most important activities in code and standard development in the USA in 2002. It is based on information and drafts received from the International Code Council (ICC), though the International Hydrogen Infrastructure Group (IHIG) network, through contacts with the American Petroleum Institute (API) and on information obtained from the Society of Automotive Engineers (SAE).

The International Code Council has accepted proposals to include hydrogen in the International Fire Code (IFC) and International Mechanical Code (IMC) in its annual meeting on October 4 2002. It has also accepted inclusion of hydrogen in the International Fuel Gas Code (IFGC). Inclusion in the IFGC was not approved in an earlier stage of the approval process, as it was strongly opposed by the American Gas Association (AGA). It is thought that the AGA opposes the inclusion of hydrogen for political reasons, as AGA members are mostly natural gas suppliers. Shell with BP contributed to the ICC code changes by commenting on early drafts. As a result of this active approach the accepted code changes are more in line with the interests of energy companies. These changes will appear in the 2003 IFC.

The SAE is progressing quickly in its efforts to develop standards. The SAE standard J2600 "Connectors for Gaseous Hydrogen" has been balloted and accepted in September and it will be published shortly. It specifies the WEH geometry for the connector. The EIHP has decided to recognize this standard as a base for its activities, and has contributed actively to its development by commenting on draft versions.

In Section 4 of this briefing note we have included a table that lists C&S organizations and contact information. It is based on a table received from Prentiss Searless from the American Petroleum Institute.

1 Introduction

The development of Codes and Standards for hydrogen has been accelerated dramatically over the last year, with the main players in the USA being the ICC and the SAE. This briefing note summarizes the activities of these two organizations. In addition Section 4 of this note contains an overview of US organisations active in code and standard development containing useful contact information on this matter.

2 Hydrogen to be included in ICC building codes.

Recent developments in the US have centred on the proposals of the International Code Council to include hydrogen in its building codes. The current building codes in the US do not address hydrogen. The International Code Council two years ago appointed an Ad Hoc Committee (AHC) on hydrogen. This group of nine individuals, including representatives from the automotive and hydrogen industries, has crafted a package of proposed changes to the ICC Codes. Please note that there are still many states (*e.g.* California) where ICC codes have not been adopted (see http://www.intlcode.org/government/adoptions.htm for map of code adoptions).

Proposals pertaining to hydrogen are included in the following codes:
International Fire Code (IFC)
International Mechanical Code (IMC)
International Residential Code (IRC)
International Fuel Gas Code (IFGC)

The proposed code changes have been voted on April 8-19 2002, at the ICC code development meeting held in Pittsburgh. The ICC has accepted changes to the international fuel code IFC and IMC, however, the exception in the IFC to allow underground storage and indoor refueling, has been eliminated.

All code changes proposed by the Ad Hoc committee to the International Fuel Gas Code I (FGC) had been rejected in this initial meeting. This was mainly because the American Gas Association (AGA) opposes the inclusion of hydrogen into the IFGC, and AGA members make up a majority in the IFGC committee.

On October 4 2002, the ICC final action hearings were held in Fort Worth, TX. All changes to the codes to include hydrogen were approved as defended/supported by the ICC Hydrogen Adhoc Committee. The objections to inclusion on hydrogen in the IFGC have been overruled. This is a big step forward as it provides a basis for local permitting and enforcement within the building code.

The International Fire Code and International Fuel Gas Code were of significant importance and had received strong opposition by the AGA. All code committee disapprovals, made in Pittsburgh in April, have now been officially overturned and accepted. The changes will be included in the 2003 IFC. While it will be some time before the 2003 codes become adopted by local jurisdictions, these codes will most certainly be used to support upcoming activities and will provide local officials strong grounds for considering installations - even if not yet adopted locally (a variance may be needed, and the supporting 2003 code will hopefully make this less difficult).

Shell provided testimony support during the hearings, as did DOE, the HAHC, Honda, Ford, and ChevronTexaco, as well as some other associations and individuals.

Table 1: ICC International Fire Code Separation: Equipment Or Feature Minimum Separation For Hydrogen Dispensers, Compressors, Generators And Storage Vessel. These drafts are available from the ICC website http://www.intlcode.org/codes/2002forum.htm)

SITE FEATURE	DISTANCE (feet)	*REASON (Origin or Derivation)*
Building—Non-combustible walls, sprinklered or nonsprinklered	***10***	***NFPA 50A—10 ft.***
Building—Combustible walls, sprinklered or nonsprinklered	***25[b, e]***	***NFPA 50A—10 ft. (for greater than 15,000 scfm storage)***
Building—Non-combustible walls, 2-hour fire barrier interrupts line-of-sight	***5***	***—***
Off-site sidewalks and on-site/off-site parked vehicles	***15 [a, b]***	***NFPA 50A—10 ft. (reasonable interpretation)***
Lot line	***10[a]***	***NFPA 50A – 5ft., NFPA 52—10 ft.***
Air intake openings	***25 [c]***	***NFPA 50A—50 ft.***
Wall openings located less than 25 ft. vertically above	***20 [c]***	***NFPA 50 A—10 ft.***
Wall openings located greater than 25 ft. vertically above	***25***	***NFPA 50A—25 ft.***
Outdoor public assembly	***25 [a]***	***NFPA 50A—50 ft.***
Ignition source [d]	***10***	***NFPA 50A—10 ft. Other than "hot work," no other ignition source requirement. People and vehicles are primary ignition sources (i.e., static discharge).***
Flammable or combustible liquid storage—Above ground, diked in accordance with Section 3404.2.9.6.	***20***	***Diking is advantageous.***
Flammable or combustible liquid storage—Above ground, not diked	***50***	***NFPA 50A—50 ft.***
Flammable or combustible liquid storage—Below ground, vent or fill opening	***20***	***NFPA 50A—25 ft.***
Flammable gas storage (non-hydrogen)—Above ground, with common shutoff	***25***	***—***
Flammable gas storage (non-hydrogen)—Above ground, no common shutoff	***50***	***A common shutoff system is advantageous.***
Combustible waste material (see Section 304.1.1)	***50***	***These materials should not be present presuming the code's General Precautions Against Fire are adhered to.***
Liquefied hydrogen storage—Distance to buildings, openings, lot lines, public ways and on-site/off-site parked vehicles	***25[a]***	***NFPA 52 criteria***

3 SAE Fuel Cell Committee

largely taken from the website http://www.sae.org/fuelcells

The "SSA Fuel Cell Initiative Fuel Cell Standards Committee", or "SAE fuel Cell Committee" was set up to establish standards and test procedures for fuel cell powered vehicles. These will cover the safety, performance, reliability and recyclability of fuel cell systems in vehicles. The emphasis lies on efficiency and environmental impact.

The SAE fuel cell committee comprises 6 working Groups:

- Emissions
- Interface
- Performance
- Recyclability (not presently active)
- Safety
- Terminology

The SAE draft documents are only available to group members, or parties who may offer technical input to the development of the document. So far, the draft standards "J2600, Compressed Hydrogen Vehicle Fuelling Connection Devices" and " J2601, Compressed Hydrogen Vehicle Fuelling Communication Devices" have been released to the public for comments. The EIHP2, through WP 3, has actively contributed to these standards. J2600 has recently been approved in ballot and will be published shortly. The SAE standards and documents are listed in Table 2, along with their current status.

Table2: Standards, test procedures and reports under development in the SAE fuel Cell Committee

	SAE document	**Status**[1]
J2572	Recommended Practice for Measuring the Exhaust Emissions, Energy Consumption and Range of Fuel Cell Powered Electric Vehicles Using Compressed Gaseous Hydrogen	Comments from CARB & EPA addressed Ballot expected October, 2002
J2574	SAE Information Report - Fuel Cell Electric Vehicle Terminology	Published
J2578	Recommended Practices for General Fuel Cell Vehicle Safety	Published
J2579	Recommended Practices for Hazardous Fluid Systems in Fuel Cell Vehicles	Draft, Ballot expected Dec. 2002
J2594	Fuel Cell Recyclables Guidelines ·	Draft, Ballot expected Dec. 2002
J2600	Compressed Hydrogen Vehicle Fuelling Connection Devices ·	Balloted Sept. 2002, approved
J2601	Compressed Hydrogen Vehicle Fuelling Communication Devices	Draft
J2615	Performance Test Procedures of Fuel Cell Systems for Automotive Applications ·	Ballot expected Oct, 2002
J2616	Performance Test Procedures for the Fuel Processor Subsystem of Automotive Fuel Cell System ·	Ballot expected Q2, 2003
J2617	Performance Test Procedures of PEM Fuel Cell Stack Subsystem for Automotive Applications	Final draft, ballot expected en 2002

3.1 Safety Working Group

The mission of this working group is to recommend design and construction, operation, emergency response, and maintenance practices for the safe use of fuel cell vehicles by the general public.

Documents:

SAE J2578 – General Fuel Cell Vehicle Safety. This document provides criteria for integration of fuel cell systems into the vehicle.

SAE J2579 – Fuel Systems for Fuel Cell Vehicles
This document, expected to ballot in December this year, is to provide criteria for systems containing or processing fuel or other hazardous materials.

[1] Comments from Joseph Androvski of SAE at EIHP2 MTA workshop, Brussels, Oct 2 2002

3.2 Interface Working Group

The mission of this group is to develop standards to coordinate between fuel suppliers and vehicle manufacturers to ensure safe, efficient and customer friendly delivery of fuel-to-fuel cell powered vehicles.

Scope as defined on their website:

A. Fuel Supply (raw fuel-off vehicle)
- Hydrogen (Liquid & Gaseous)
- Methanol
- Gasoline
- Ethanol

B. Infrastructure (Fuel Dispensing)
- Safe Storage
- Delivery to vehicle

C. Fuel Storage (on-board vehicle)
- Filling Method
- Vapour Recovery
- Storage Tank Characteristics: Volume, Type of Construction, and Temperature Limits.

D. Fuel Processor (if required)
- Reformate purity to Fuel Cell

E. Vehicle Interface
- Power connections
- Communication and control (Electrical)
- Thermal management system (TMS)
- Venting Systems (Venting)
- Air Processing System
- Water Treatment System

The Interface Working Group has drafted two standards:

J2600 Compressed Hydrogen Vehicle Fuelling Connection Devices.
This standard is to be published soon. In September 2002 it has been approved in ballot by 98% of the votes. The geometries of the receptacles for the different pressure levels are defined. The WEH geometry was selected for standardization. The EIHP2, through WP3, has contributed significantly to its development by providing comments on draft versions of this standard.

J2601 Compressed Hydrogen Vehicle Fuelling Communication Devices (draft).
This standard is to define the different fuelling strategies and the advantages and disadvantages with respect to type III and IV tanks will be mentioned. Strategies and protocols for refueling with and without communications are to be defined. The standard will also identify as preferred method of communication that is most effective in an automotive environment.

3.3 Emissions and Fuel Consumption Working Group
This workgroup is to establish standards and test procedures for measuring emissions and fuel consumption for fuel cell powered vehicles.

The standards and test procedures produced in this working group will provide methods for measuring exhaust and evaporative emissions from fuel cell vehicles. It will also standardize fuel consumption measurements for the fuel cell vehicles. The test procedures will identify a method to ensure uniformity in test results for all of fuel cell vehicle designs. These test procedures should also allow fair comparison with conventional vehicles.

Documents:

SAE J2572 is currently in a draft stage. The first draft is contains test procedures for fuel cell vehicles using compressed hydrogen. The procedure includes hybrid (use of a storage battery for traction power) versions of this type of fuel cell vehicle.

3.4 Performance Working Group

The performance working group will develop procedures for testing PEM fuel cell systems and will include its major subsystems for automotive applications.

3.5 Terminology Document

This working group is to utilize the resources of the worldwide fuel cell community, in order to identify commonly used vehicle applicable fuel cell terminology and develop universally acceptable definitions for this terminology.

Documents:

SAE Information Report J2574 has been published. It was established with input from the Japan Electric Vehicle Association (JEVA) and ISO, as well as numerous other references.

4 List of C&S organisations

Based on information received from Prentiss Searless, American Petroleum Institute.

Last updated: March 18, 2002

Note: 1. Codes and standards that have similar scopes but are being developed in different organizations are colour coded the same.
2. Suggested changes/updates should be sent to Prentiss Searles, API searlesp@api.org
3. The original information in this document was compiled from sources including (U.S. DOE, ISO N documents, SAE, NHA, Internet sites and personal communications).

Responsible Organization and Document title	Point of Contact (e.g., Chairman, Convener, etc)	Group, Title and Schedule	Status
CODES			
Iinternational Codes Council			
Gaseous Hydrogen Motor-Vehicle Fuel Dispensing and Generation Stations – Section 2209, Hydrogen Motor-Vehicle Fuel Dispensing and Generation Stations	**Darren Meyers, EIT, CEM Secretariat, ICC AHC for Hydrogen Gas BOCA International, Inc. Tel: 708.799.2300 x307 Fax: 708.799.0310 email: dmeyers@bocai.org**	**Schedule: April 8th - 19th, 2002 -- 2002 ICC Code Development Public Hearings to be held in Pittsburgh, PA**	**Meeting April 8-10, 2002 Pittsburgh Issue still exists with the height requirements for vents. As currently written could require an engineered structure**
National Fire Protection Association			
Vehicular Alternative Fuel Systems WG **NFPA 52 Compressed Nat. Gas (will combine with NFPA 57 Liquefied Natural Gas)**	**Carl Rivkin NFPA 617/984-7418 617/984-7110 fax crivkin@nfpa.org**	**Vehicular Alternative Fuels Committee**	**Document under revision. NFPA is seeking comments Dec. 2001 – NFPA meeting in Desert Palms, CA August 2003 formal comments will be solicited. 2004 NFPA will significantly revise text of 52 and 57 and include H2 in the text. 2005 Publication of the Revised document Nat. Hydrogen Association has submitted comments on NFPA 52**
NFPA 853 – Standard for the Installation of Stationary Fuel Cell Power Plants 2000	**Carl Rivkin, NFPA**		**A revision will address small residential fuel cells in addition to the current design below. Applies to the design, construction, and installation of stationary fuel cell power plants with a gross electrical generation that exceeds 50kW.**
NFPA 50 A – **Standard for Gaseous Hydrogen Systems at Consumer Sites 1999** 50 B **Standard for Liquefied Hydrogen at Consumer Sites (Will be combined into** NFPA 55**, Standard for the Storage, Use, and Handling of Compressed and Liquefied Gases in Portable Cylinders 1998**	**Carl Rivkin, NFPA**		**50A and 50B will be combined into NFPA 55 Storage requirements for storage systems based on a cut-off capacity of 400scf.**

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European Integrated Hydrogen Project – Phase II (http://www.eihp.org/)			
Proposed New draft regulations for Uniform provisions concerning Liquid and Compressed Gaseous Hydrogen			**Their goal is to draft regulations and get them passed using the 1958 ECE Agreement and UN ECE WP.29, which is "the development of worldwide legal requirements for motor vehicles." The 1958 ECE, would then be Global Technical Regulation in accordance with the 1998 Agreement. EIHP has agreed to use/reference J2600, Coupling devices but is now discussing developing their own communications document (equivalent of J2601)**
STANDARDS and RECOMMENDED PRACTICES			
Society of Automotive Engineers (Fuel Cell Website http://forums.sae.org/access/dispatch.cgi/TEVFC_pf)			
Interface WG **J2600, Compressed Hydrogen Surface Vehicle Refuelling Connection Devices (This document covers the geometry and testing requirements for nozzles and receptacles)**	**Frank Niezabytowski Ford TH!NK Technologies 15050 Commerce Dr. Dearborn, MI 48120 (313) 322-9657 Fax: (313) 594-4901 fniezaby@ford.com**	**SAE Jane Hock is SAE Staff for Fuel Cell Committee**	**Version will be balloted to SAE Fuel Cell Committee in March. Document will be submitted to ISO TC22 as a New Work Item**
Interface WG J 2601, Compressed Hydrogen Surface Vehicle Refuelling Communications	**Frank Niezabytowski, Ford See above**	**SAE**	**1. Currently under development. This document will include the physical and electrical requirements for communications and algorithms between the refuelling station and the vehicle. The first draft developed by Air Products will be reviewed April 9-10**
Emissions/Fuel Consumption WG J2572, RP Measuring The Fuel Consumption and Range of Fuel Cell Powered Electric Vehicles Using Compressed Gaseous Hydrogen	**Ron Peltier, Ford (retired) rpeltier@ford.com**		**Sent to CARB and EPA for feedback Ballot targeted in March**
Recyclability WG	**Stella Papasavva, General Motors**		**1. First draft is not complete**
Safety WG J2678 **Recommended Practice for General Fuel Cell Vehicle Safety**	**Glen Scheffler, UTC Fuel Cell Glenn.Scheffler@UTCFuelCells.com**		**Currently out for ballot by SAE Document is part of ISO/TC22/SC21/WG 1 work program**
Safety WG J2679 **RP for Fuel Systems in Fuel Cell Vehicles**	**Glen Scheffler, UTC Fuel Cell See above**	**Purpose is to ID the criteria for the subsystems storing, containing, or processing fuel and other hazardous fluids.**	**Under development Document is part of ISO/TC22/SC21/WG 1 work program**
Terminology WG J2574 Terminology	**Victor Wouk,**		**1. Published and shared with IEC 105 and ISO TC 22/ SC 21**

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Performance WG J2616 Fuel Processor Subsystem Performance Test Standard	**Swathy Swathirajan, GM swathy.swathirajan@gm.com**	**Std applies to three fuels: 1) straight run gasoline (EPA Fuel- CARB reformulated gasoline Tier II, 30 ppm sulfur), 2) a fuel cell friendly fuel such as a fully saturated hydrocarbon (methanol, iso-octane, naptha, etc.) and/or 3) a fuel mutually agreed to by the testing parties."**	**1. Document is approaching balloting**
ISO TC 22/SC 21 Electric road vehicles (http://www.iso.ch/iso/en/stdsdevelopment/tc/tclist/TechnicalCommitteeDetailPage.TechnicalCommitteeDetail?COMMID=902) A Draft agreement between ISO TC22 and TC 197 is written that delineates responsibilities between the two. It establishes a joint coordination group.			
WG 1 ISO 6469 Electric Road Vehicles: Safety Specifications	**Klaus Orchowski, Chairman**		**All three parts have been published 11-15- 2001 see below for list of standards**
Safety standard on fuel cell powered electric road vehicles (This work includes SAE J2578 and J2579)	**Klaus Orchowski, Chairman**	**Doc. Consists of four parts: Part 1: Vehicle functional safety 2: Fuel cell system integration 3: Protection against hydrogen hazards 4: Protection of persons against electrical hazards**	**ISO/PWD 17374 Measurement of hydrogen emissions during battery charging from the mains will be used as basis for part 3 Document ISO/TC 22/SC 21/WG1 N 100 E rev. (minutes from Nov 16, 2001), and from January 2002: N 102 (Part 1), N 103 (Part 2), N 104 (Part 3), N 105 (Part 4). These are the latest revisions of the documents. They will be discussed at the May meeting in Rome and comments are asked for in April. Part 3, could be subject to cooperation with ISO/TC 197, Work is also being done in cooperation with IEC/TC 105/WG 6**
WG 2 Terminology – Definitions and methods of measurement of energy consumption	**M. Francis Martin Francis.martin@utac.com**		**Japanese delegation had action to rewrite the document by end of January 2002. Next meeting is April 2002**
ISO/PWD 17374 Measurement of hydrogen emissions during battery charging from the mains	**Klaus Orchowski, Chairman**		**Applies to cases of possible hydrogen release from components of electric propulsion systems of road vehicles at standstill under fault free and first failure conditions to measure H2 concentration outside the vehicle in an enclosed test chamber**
ECE Regulation 100 Hydrogen emission limitation during procedures of traction battery charging (WG1 N 75)			

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ISO TC 197 – Hydrogen technologies **http://www.iso.ch/iso/en/stdsdevelopment/tc/tclist/TechnicalCommitteeDetailPage.TechnicalCommitteeDetail?COMMID=4490**			
WG 1 – Liquid Hydrogen – Land vehicle fuel tanks			
WG 5 **Gaseous hydrogen blends and hydrogen fuel — Service stations and filling connectors**			
WG 6 **Gaseous hydrogen and hydrogen blends — Land vehicle fuel tanks.**			
WG 7 **Basic Considerations for the Safety of Hydrogen Systems**			**Describes hazards associated with the use and presence of hydrogen, discusses the properties of hydrogen relevant to safety, and provides a approaches to mitigate hazards. Goal is to rewrite and reformat document.** **Document to be published as a technical publication**
Japanese Vehicle Standards Association			
JEVA (Japanese Vehicle Standards Association) WG 3 – Interface WG X – Performance	**Mr. Korosu (sp?), Nissan**	**JEVA appears to be working on interface standards as well as performance standards.**	
JEVA	**Mr. Korosu (sp?), Nissan**	**JEVA appears also to be working on hydrogen fuel properties and the type of fuel that can be used**	
IEC TC 105 http://www.iec.ch/cgi-bin/procgi.pl/www/iecwww.p?wwwlang=E&wwwprog=TCboard.p&committee=SC&TC=105 **Fuel cell technologies (US TAG Secretariat, Steve Kazubski, at CSA America (216 524-4990 ext 8303, email steve.kazubski@csa-america.org** (All of this information in this section is directly from the DOE publication, "Fuel Cell Summit, Volume 2, Issue 4")			
WG 1 Terminology	**Kelvin Hecht (project leader)**		**1. Working group is using Oxford Dictionary, the IEC Dictionary, the US Fuel Cell Council Glossary, Japanese Standards Association (JSA) TCR C 0001, and SAE information report J2574 (draft) as resources for the report**
WG 2 Fuel Cell Module	**G. Filip, Germany (project leader)**		**1. Covers the safety and performance of a fuel cell module (e.g., the fuel cell stack alone)**
WG 3 Stationary Safety	**Kelvin Hecht, Project leader**		**1. Will establish performance requirements for the design, construction, testing, and marking of packaged stationary fuel cell power plants. The standard will not cover portable or propulsion fuel cell systems**
WG 4	**O. Yamamoto, Project leader**		**1. WG 4 is identifying the scope,**

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Performance			**a definition of a common diagram, test items, test uncertainty, the base for fuel heat value, and needed definitions. The major testing items are likely to be in the areas of operation, safety, and environmental categories.**
WG 5 **Installation**			**1. Will cover installation as it applies to the interaction of the power plant with the surrounding environment. Will likely use NFPA 853.**
WG 6 **Propulsion**			**1. Focusing on fuel cell systems in transportation, with subgroups covering automotive propulsion or auxiliary power units and other applications outside of auto propulsion…The goal of WG is to ensure no problems exist for the vehicular industry as fuel cells are introduced into marketplace**
WG 7 **Portable Fuel Cells**			**1. New group that will review definitions of portable, nonportable, and transportable applications**
American National Standards Institute			
ANSI Z21.83 **Fuel Cell Power Systems**			**1. Developed by the Canadian Standards Association**
International Hydrogen Infrastructure Group			
Goal is to coordinate standards			**Partners include: Ford, Exxon Mobil, Shell Hydrogen, BP, GM Opel, U.S. DOE**
Canadian Standards Association			
CSA **Residential fuel cell power generators, portable fuel cell power generators, fuel cell modules**			
Underwriters Laboratories			
UL 2265, **Replacement fuel cell power units for appliances**			
UL 2264 **Hydrogen Generators**			
American Society of Mechanical Engineers			
ASME PTC 50 Performance test code for fuel cell power system performance			
Institute of Electric and Electronic Engineers (IEEE)			
IEEE SCC 21 Interconnection standards			
GOVERNMENT			

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Department of Energy			
DOE **$50MM in 2003 for fuel cells**			