Hydrogen Codes and Standards Technical Report

Prepared by the *Partnership for Advancing the Transition to Hydrogen*
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Preface

Codes and standards have repeatedly been identified as a major institutional barrier to deploying hydrogen technologies and developing a hydrogen economy. This lack of codes and standards for fuel cells and hydrogen is an issue that is not confined to any one country. It is a global problem. Recent efforts to develop global technical regulations for vehicle components related to on-board storage without developed international standards has added urgency to developing international hydrogen and fuel cell standards. Before an effort of this magnitude is embarked upon one should know the nature of existing codes standards related to hydrogen, identify the gaps in those standards and then determine the adequacy of the existing standards. This report is an attempt to determine the existing standards that apply to hydrogen and fuel cells in the Canada, Japan and the United States. It is also an effort to understand the structure underlying the standards process in each country. Finally, it is a first attempt to identify areas lacking in each country's standards and determine the gaps that are filled when the individual country's standards are combined with other countries' in one matrix. It is left to subsequent activities to fill in the gaps and determine the adequacy and appropriateness of adopting one country's standards by another.

A major advantage of this study was that PATH had access to a codes and standards matrix that NREL in cooperation with the Codes and Standards Coordinating Committee developed for fuel cell and hydrogen standards in the United States. The matrix was arranged by application: stationary, transportation, portable and infrastructure. It included ISO and IEC standards for hydrogen and fuel cells respectively. This application based approach has been applied to codes and standards matrices for Canada and Japan. The matrices for each of these countries are living documents that will be updated as new information is provided. After sufficient changes have been made, it might be desirable to translate the matrices to Japanese or encourage our Japanese PATH member to do so.

Introduction

This technical report grew out of the need to establish PATH by making a significant contribution to our understanding of codes and standards in a way that was unique to the mission of PATH. PATH's purpose is to develop a global community of interest in hydrogen. One way to further that end is to identify an area of common interest and potential benefit to all members which had been and continues to be ignored. Comparative identification of the codes and standards of PATH members was the vehicle chosen for the technical report.

PATH did not come to this project readily or easily. Initial discussions on the origin of PATH with the Japanese led to the need for a technical report. Initially funding for PATH would be by NEDO which required a technical report to justify support for PATH. Discussions then began on what topic would provide the most value to members and be consistent with PATH's mission. During these discussions the European Integrated Energy Project (EIEP) completed Phase 1 of their effort and embarked on Phase 2. The output of Phase 1 were two technical proposed regulations on vehicle hydrogen storage tanks that were being develop by a technical committee of ISO. This action turned our thinking to a codes and standards activities. A similar set of discussions took place at a later date with NREL whose funding largely supported the specific development of the report.

One of the early themes of PATH was reconciling, when differences arose, codes and standards policies among PATH members. The EIEP activity coupled with their desire to turn EIEP output into global technical regulations led us back to consideration of codes and standards policy. As soon as we began to discuss codes and standards policy, the members of PATH realized that they were not that conversant with the state of hydrogen and fuel cell codes and standards in their own country let along other countries. During this same period the United States Department of Energy organized an effort to develop a Coordinating Committee for Codes and Standards. This committee developed a matrix for codes and standards in the hydrogen and fuel cell applications. These factors caused PATH in the spring of 2002 to decide that it needed to use the Coordinating committee matrix and replicate it for Canada and Japan. These matrices would be come the core of developing an understanding of where PATH members collectively stood on codes and standards. This led to identifying the purpose of PATH technical report.

Purpose

This report was created to give a picture of what codes and standards exist and how they may be applied to fuel cell and hydrogen projects in Canada, Japan and the United States at the end of 2002. It also provides a description of the code processes in each country with contact information. Finally it provides a brief identification of the gaps in codes and standards coverage for hydrogen and fuel cell applications in each PATH member country.

It is hoped that the report will lead PATH members to examine the codes and standards of other members to test its applicability. This may be valuable and time saving in areas where one PATH member has a standard where another member has a gap. Finally it is hoped that the report will provide some understanding of each PATH member's standards, processes and initiatives.

Report Structure

The report is divided into four sections and four appendices. The ***Section One: Introduction*** describes the origins of the project, its Purpose and the flow of the report. ***Section Two: Procedure*** documents the steps that were taken in developing the information contained in the report. ***Section Three: Standard Approach by Country*** presents the hierarchy of regulation and

standards and process in each country to develop a code or standard. ***Section Four: Discussion of the Codes and Standards Matrices*** reviews the material contained in each country matrix in terms of standards gaps and presents any information about on-going codes and standards initiatives. ***Section Five: Discussion of the Integrated Codes and Standards Matrix*** reviews the material contained in the integrated matrix in terms of standards gaps.

The four appendices for this report are: ***Appendix A: Country Matrices***, ***Appendix B: Integrated Matrix, Appendix C: Contact information***, and ***Appendix D: References including Internet Sites***. ***Appendix A: Country Matrices*** – contains the fuel cell and hydrogen applications correlated with the applicable codes and standards for Canada, Japan and the United States. ***Appendix B: Integrated Matrix*** contains fuel cell and hydrogen applications correlated with codes and standards from all three countries. ***Appendix C: Contact Information*** – identifies individuals phoned, emailed or interviewed during the course of the developing material for this report along with identifying the codes and standards topics covered. ***Appendix C: References including Internet Sites*** – This is a list of references used in the development of the report along with a number of standards related internet sites in Canada, Japan and the United States.

Codes and Standards in hydrogen are rapidly evolving. Any report on the topic during this period of rapid change has a limited life. Therefore, if this is view as a valuable document that requires expanding and updating, it should be done every couple of years. In the interim the matrices should be regularly modified and kept current on the PATH or related member web sites.

Procedure

The critical component of the *Technical Report* is the Hydrogen Codes and Standards Matrix. Research began with completing the matrix, and the other components of the report were developed from the information gathered for the matrix. PATH staff worked closely with PATH members to develop the *Technical Report* and ensure the accuracy of the information contained in the Matrix.

The National Renewable Energy Laboratory (NREL) developed a draft matrix containing the U.S. codes and standards pertaining to hydrogen. The format of NREL's matrix was modified slightly and used as a template to collect information on PATH member countries' hydrogen codes and standards.

The template and the US matrix were sent to all PATH members along with a request that they fill in the matrix with information on their country's codes and standards. Six categories of codes and standards were identified in the matrix: 1) Stationary Applications 2) Transportation Applications 3) Portable Applications 4) Hydrogen Infrastructure 5) Codes and Standards of Regulatory and Quasi-Regulatory Organizations 6) Other Useful Applications. Each entry in the matrix should include: the name of the law/regulation, a description, technical contact, and the status.

PATH members were also asked to provide contact information for other people or organizations in their countries that may add value to the matrix or to directly pass the matrix on to those people or organizations that could better provide the information. PATH also requested the names of people or organizations that could also contribute information to the matrix.

The initial information received from both Canada and Japan provided a starting point for PATH to conduct further research.

For the codes and standards information from Canada, PATH used the *Hydrogen Source Book*, reviewed in-house materials, and, to a lesser degree, utilized the internet. This provided a substantial amount of information for the Canadian matrix.

Information for the Japanese matrix was much harder to locate, due to the structure of the Japanese regulations and the language barrier. The initial information received from the Japan helped to guide an internet search, which identified additional Japanese laws, regulations, codes and standards pertaining to hydrogen. Appendix D lists websites utilized during the research. The information gathered from the internet helped to verify and enhance the codes and standards material that PATH already had in hand.

The US matrix developed by NREL included many international codes and standards, which PATH incorporated into both the Canadian and Japanese matrices.

PATH compiled the materials for use in filling out the matrix, and used this information to provide descriptions and contact information for existing codes and standards. A file was created for each country's information; this information was then distilled and used to complete the matrix.

Once the initial research was complete, PATH provided each member with a draft matrix of codes and standards for their country for comments and review. Their comments were then incorporated into the matrix included in this report as Appendix A. As each country develops new codes and standards, and as the existing ones change, the matrix will be updated.

PATH then began compiling the information for the Technical Report. As previously stated, most of the information included was collected during the research for the matrix. Additional information was collected through phone calls, interviews, and email PATH gathered information from its member countries on the process and hierarchy of their national codes and standards.

Standards Approaches

Canada

The following is a brief summary of current Canadian activities in the development of codes and standards for hydrogen systems. This summary also provides a short background of the Canadian system and reviews national and international activities in hydrogen standards development.

Many Canadian laws and regulations are governed at the province level, including the regulations of fuels. Currently Canadian law classifies hydrogen is as a dangerous good; however efforts are underway to change the classification of hydrogen in some forms and applications to a fuel. This would ease restrictions somewhat.

The Canadian national standards system is administered by the Standards Council of Canada (SCC). SCC's role includes the accreditation of standards development organizations (SDOs), the accreditation of conformity assessment performers (testing laboratories, certification bodies, quality and environmental systems registrars, etc.) and the coordination of all international conformity assessment and standards development activities.

There are four SCC accredited Canadian SDOs:

- The Canadian General Standards Board (CGSB)
- The Canadian Standards Association (CSA)

- Underwriters' Laboratories of Canada (ULC)
- Bureau de normalisation du Québec (BNQ)

CSA is responsible for a wide range of standards and code development activities, including automotive components and equipment; electrical products, materials and equipment; boilers and pressure vessels; pipeline systems; propane and natural gas vehicles, systems and components; and fuel cells. BNQ develops standards related to hydrogen technologies.

The provincial and territorial safety codes, are based on the six Canadian model safety codes. Three of these are developed and maintained by the Canadian Standards Association (CSA) while the others are maintained by the National Research Council of Canada.

- The Canadian Electrical Code (CSA Standard C22.10-99)
- The National Gas Code (CSA Standards B149.1 and B149.2)
- The National Building Code 1995
- The National Fire Code 1995
- The National Plumbing Code 1995
- The Boiler, Pressure Vessel and Pressure Piping Code (CSA Standard B51-97)

Currently, only the pressure vessel code includes gaseous and liquid hydrogen, while the other model codes do not yet specifically address hydrogen use. Clear, defined procedures exist for model code updates and code committees' liaison as required with Canadian, US and international standards development committees. It has been recognized that the Canadian Electrical Code and the Canadian Gas Code are the key documents requiring update since they are referenced in the other model codes. Under an industry initiative, a process has recently been initiated to work with CSA to update the Canadian Electrical Code by including hydrogen in a similar manner as propane and natural gas are currently included in the code. This will be a relatively simple process that will include the addition of a number of key paragraphs which will be based on existing standards from organizations such as the National Fire Protection Association (NFPA) and current Canadian and US research results on clearance distances and required ventilation rates for the declassification of hazardous zones. The BNQ Committee for Hydrogen Installation is also developing codes pertaining to hydrogen. In the case of the gas codes, the approach to be undertaken is under discussion and will be addressed early in 2003.

The Canadian Transportation Fuel Cell Alliance (CTFCA) is a federal initiative supported by Natural Resources Canada (NRCan) and the Canadian hydrogen industry to demonstrate and evaluate fuelling options for fuel cell vehicles within Canada. Various combinations of fuels and fueling systems for light, medium and heavy duty vehicles, will be demonstrated by 2005. This initiative is also aimed at fostering the development of codes, standards, and technician training requirements related to fuel cell and hydrogen technologies, through its Codes and Standards Working Group. Close liaison is maintained with the US Department of Energy (DOE), National Renewable Energy Laboratory (NREL).

Canada is involved with a number of international activities, promoting the development of international standards for hydrogen systems. In addition to the participation of experts in a number of codes and standards working groups, Canada hosts the Secretariat for ISO/TC 197 *Hydrogen Technologies.* For this committee, Canada provides conveners for WG 1 *Liquid hydrogen – Land vehicle fuel tanks,* WG 2 *Containers for multimodal transport of liquid hydrogen*, WG 8 *Hydrogen generators using water electrolysis process,* and liaison with ISO/TC 220/WG1 *Cryogenic vessels – design and construction* and ISO/TC 22 *Road vehicles.* Canadians

are also active on ISO/TC 58 *Gas cylinders* SC4 WG 2 *Hydrogen embrittlement test methods*; act as Convener for IEC/TC 105 WG 7 *Portable Fuel Cell Systems;* and provided liaison between ISO/TC 220 *Cryogenic vessels* and TC 22 *Road vehicles.*

Through a liaison with ISO/TC 197, Canada provides ISO representation on an ad hoc working group of WP29/GRPE - Working Party on Pollution and Energy, Transport Division of the United Nations Economic Commission for Europe (ECE). This GRPE ad hoc working group is developing European regulations for storage of hydrogen on hydrogen-powered vehicles fueled by both liquid hydrogen and compressed gaseous hydrogen. The ISO representation is to ensure that ISO standards in the same field are compatible with the proposed regulations.

Several cooperative initiatives are underway with the United States. These include participation of experts on codes and standards writing organizations and cooperating with DOE/NREL on parallel complementary studies to determine hazardous location criteria for hydrogen systems and related components and participating on a number of hydrogen vehicle standards development committees such as with the Society of Automotive Engineers and with CSA International. Canadian participation is also active as Chair and participants on the CSA America, Inc. Joint Technical Advisory Group on Standards for Natural Gas Vehicle (NGV) Fuel Containers (ANSI/CSA NGV2) that is being expanded to cover hydrogen. Other activities include participation in the California Fuel Cell Partnership *Codes and Standards Sub Team*, the NFPA *Industrial and Medical Gases Committee* and *Hydrogen Coordinating Group*, various working groups within the US Fuel Cell Council, and as interested observers at International Code Council meetings.

Japan

The goal of Japan's current codes and standards efforts are to deregulate the existing regulations in order to facilitate building hydrogen filling stations. The current laws and regulations make the deployment of hydrogen filling stations difficult. The Japanese government and related associations are working to complete deregulation by 2005. Technical instructions for design, installation, operation, and safety for hydrogen filling stations are being developed. While these efforts to establish hydrogen focused codes and standards are underway, Japan has a number of laws and regulations pertaining to hydrogen. These include the High Pressure Gas Safety Law, Fire Service Law, Industrial Safety and Health Law, Building Standard Law, and Law on the Prevention of Disasters in Petroleum Industrial Complexes and Other Petroleum Facilities, as well as those for hydrogen transportation, including the Road vehicles Act, Road Traffic Law and Harbor Regulation Law. Japan does have additional laws, regulations, codes and standards are also applicable to hydrogen. Refer to Appendix A for a complete list of Japan's guidelines for hydrogen.

The High Pressure Gas Safety Law is intended to regulate the production, storage, sale, transportation and other matters concerning the handling and consumption of high pressure gases, as well as the manufacture and handling of containers therefore, in order to prevent accidents and disasters caused by high pressure gases.

The objective of the Fire Service Law is to prevent, guard against and extinguish fires, thereby protecting life, body and property of the people from fires, and to alleviate damage caused by disasters, including fires and earthquakes, thereby maintaining peace and order and contributing toward promoting the social welfare of the people.

The Industrial Safety and Health Law is intended to promote comprehensive, systematic policies

for industrial accident prevention, including measures to establish injury prevention standards, define responsibilities and encourage autonomous safety activities, thereby ensuring the safety and health of workers in the workplace and developing a comfortable working environment. The Law includes provisions concerning pressure vessels as part of the establishment of injury prevention standards, and demands the appointment of an Operation Chief as a means of defining responsibilities.

The Building Standard Law stipulates building controls for each land-use zone. For hydrogen, a flammable gas, the Law prescribes the maximum storage volume for each land-use zone.

The Law on the Prevention of Disasters in Petroleum Industrial Complexes and Other Petroleum Facilities sets forth fundamental provisions concerning prevention of disasters and accidents relating to special disaster prevention districts such as petroleum complexes, in consideration of special characteristics of such disasters and accidents. The Law introduces two categories regarding mass handling of hydrogen, i.e. Class 1 and Class 2 based on the handling volume, and specifies disaster prevention standards etc. in detail for each class.

The three laws concerning transportation (i.e. moving) of high pressure gas, the Road Vehicles Act, Road Traffic Law and Harbor Regulation Law, provide for the traffic weight control and regulations on vehicles and ships used for transportation, in view of hazardous situations that may occur during transport. The means of transportation of hydrogen gas and liquefied hydrogen are classified into pipeline, general container, cylinder manifold, tank truck, chemical tank ship and others. These transportation means are subject to the control under the High Pressure Gas Safety Law, except for chemical tank ship.

Hydrogen gas and liquefied hydrogen transportation by land is subject to the traffic gross weight and other controls under the Road Vehicles Act, as well as regulations for general vehicles. Since hydrogen gas and liquefied hydrogen are flammable gas, the safety standards of the same Law should also be observed.

Among many laws covering hydrogen gas as mentioned above, the High Pressure Gas Safety Law controls hydrogen gas first through a Law or Cabinet Order, then Ministry of Economy Trade and Industry (METI) Ordinance, METI Notification, and finally Supplementary Standards. Laws are decided by the Diet; Cabinet Orders are decided by the Cabinet; METI Ordinance and Notifications are decided by the Minister of International Trade and Industry; and Supplementary Standards are defined by METI Notices.

In addition to these, there are METI Notices explaining the application and interpretation of Laws, Cabinet Orders, METI Ordinances and Notifications (Basic Notices), those explaining individual matters (Individual Notices), and those explaining the application of functionality standards specified in the Container Safety Regulations (Exemplification Standards)

As statutory control for high pressure gas equipment as a whole, the General High Pressure Gas Safety Regulations, Container Safety Regulations, Designated Equipment Inspection Regulations and METI Notification on Production Details stipulate that materials, pipes, accessories and testing machines that conform to JIS (Japanese Industrial Standards) should be used, and that test methods should also comply with JIS.

With regard to the use of a small amount of hydrogen in low pressure conditions which is outside the scope of the High Pressure Gas Safety Law, some organizations, including local governments, have established their own guidelines for hydrogen gas consumption, although they are not compulsory.

For containers used in filling and storing compressed hydrogen gas or liquefied hydrogen subject to the High Pressure Gas Safety Law, technical and safety standards are stipulated in the General High Pressure Gas Safety Regulations, Industrial Complex Safety Regulations, Designated Equipment Inspection Regulations and Container Safety Regulations.

Some containers which are not subject to the High Pressure Gas Safety Law may be controlled by the Industrial Safety and Health Law as Class 1 or Class 2 pressure vessels. The Hydrogen Industry Council has also established voluntary standards for such containers, which specifically provide control methods etc. for containers.

High pressure gas equipment is controlled by the High Pressure Gas Safety Law in regard to the following items: distance between equipment; safety inspection, periodical self-inspection; and technical standards for equipment. The technical standards include provisions concerning materials used, pressure proof test, air-tightness test, wall thickness, installation of such equipment as manometers, safety valves and check valves, electrical equipment, piping and valves, etc.

Stationary-type production equipment used at designated production works (larger works than the specified scale located in petroleum complex areas, or large-scale works located in other areas) is subject to the controls similar to the above in the scheme of the Industrial Complex Safety Regulations.

United States

In the United States there are over 40,000 local and state authorities that approve and enforce conformity with codes. Most of thse codes are based on model codes developed by the International Code Council (ICC). The ICC is the result of the recent merger of three code organizations; ICBO, SBCCI, and BOCA.

The ICC has developed and made available an impressive inventory of International Codes, including:

- International Building Code
- International Energy Conservation Code
- International Fire Code
- International Fuel Gas Code
- International Mechanical Code
- International Plumbing Code
- International Private Sewage Disposal Code
- International Property Maintenance Code
- International Residential Code
- International Zoning Code
- ICC Electrical Code Administrative Provisions

In addition to ICC, the National Fire Protection Association (NFPA) develops, publishes, and disseminates timely consensus codes and standards intended to minimize the possibility and effects of fire and other risks. It also includes NFPA70, which is the National Electric Code. Virtually every building, process, service, design, and installation in society today is affected by NFPA documents. More than 300 NFPA codes and standards are used around the world.

Codes that are adopted by local and state government bodies have the force of law. Standards do not unless incorporated into an adopted code, typically by reference. ANSI is the standards accrediting body for voluntary standards development organization in the U.S. It also is the certification body for technical advisory groups for Institutional Organizations for Standards (ISO) and the International Electrotechnical Commission (IEC). There are over 270 ANSI accredited standards developers.

In the United States, there are many organizations involved in creating standards and best practices for industry for emerging hydrogen energy systems. In some cases, existing standards for natural gas systems are being revised to include hydrogen. In other cases, new standards are being developed. A short list of some organizations involved and their focus includes:

- SAE - vehicles
- Underwriters Laboratory - safety, hydrogen generation
- CGA – piping, connector valves
- ANSI – fuel cells
- ASME – pressure vessels: fuel cell testing; O&M; piping
- NFPA – fire safety
- CSA – fuel cells

The ANSI standards development process is characterized as:

- Consensus on a proposed standard by a group which includes materially affected and interested parties.
- Broad based public review and comment.
- Consideration of and response to comments from the "consensus body" and public review commentators.
- Incorporation of approved changes in the draft standard.
- Right of appeal by any participant who feels due process was not sufficiently respected.

Codes and standards are developed nationally to assure safety and internationally to promote trade. Nationally the U.S. strives to reach consensus positions on national standards and best practices and take that position forward internationally. Occasionally, the U.S. participated in the development of an international standard for which no U.S. consensus position has been established. In that case, the body representing U.S. interests (typically ANSI) ensures broad, cross-cutting participation from U.S. companies and organizations in the international activity.

It is important to recognize that the hydrogen safety codes and standards activities necessary to support fuel cell cars are not limited to fuel cells or cars. Much of the research, validation, and certification work applies to hydrogen infrastructure (beyond refueling stations) and includes stationary power applications, portable power applications, buses, and other transportation needs. Hydrogen safety is one of the core competencies that transcends applications and is crucial to successfully commercializing hydrogen technologies, including hydrogen fuel cell cars.

The U.S. Department of Energy facilitates the development of consensus codes and standards by supporting technical forums, information dissemination, research and development, and

demonstration and validation projects in support of gaining knowledge regarding hydrogen energy systems.

Areas DOE is currently involved include the following.

1. To coordinate the national development of codes and standards by national standards writing bodies; to identify standards being written, to encourage minimum overlap in standards writing; and to assure that a complete set of necessary standards are written. This is the activity of the DOE Hydrogen Codes & Standards Coordinating Committee.

2. It is necessary to codify hydrogen standards in order to allow the use of hydrogen-related technologies in this society. DOE is supporting and should continue to support efforts incorporate hydrogen into U.S. model codes.

3. Continue to support forums for technical interchange and consensus building, including the annual DOE Fuel Cell Codes and Standards Summit, as well as Hydrogen Safety Codes and Standards Workshops presented semi-annually by the National Hydrogen Association, as well as information dissemination activities such as the Hydrogen Safety Report and others, to ensure interested stakeholders have access to the information and process of standards development.

4. Facilitate flow of U.S. best practices into International Standards, such as the best practices developed by the Society of Automotive Engineers (SAE). SAE activities are very fast moving and they require support and expertise outside of the auto or fuel cell industries to develop standards of the highest quality. Once U.S. consensus is reached on these items, they could become U.S. input into applicable International Standards, such as those developed by ISO/TC 197.

Codes are meaningless unless a state or local jurisdiction adopts them. There are over 44,000 local code enforcement agencies in the U.S.. They have the option of adopting any model code from any year, and may make local code amendments. This leads to the potential for a lot of variation in codes.

Discussion of Matrices

CANADA

Stationary Applications

The Canadians do not have a national standard for fuel cell hardware and installation. IEC TC 105 has a work group developing such a standard based on the current ANSI fuel cell standard Z21.83. There is also no national standard for fuels for fuel cells although there is an international standard for hydrogen which was developed by ISO/TC 197. This standard has come under some question and will be reviewed. The current international standard provides for three grades of hydrogen. The highest grade designated for fuel cell use. The other two areas in which no Canadian standards could be identified for stationary fuel cell applications were reject heat and its use and test and evaluation of fuel cells.

Transportation Applications

There are virtually no national standard in Canada for transportation other than a few CGA standards for tanker trucks, pressure relief valves and safe handling of cryogenic liquids. There are international standards under development for the vehicle fuel cell, on-board storage and

interface between the vehicle and refueling interface. The existing ISO hydrogen fuels standard may require review. There remains development needs on O&M issues, safety systems, and testing and evaluation. The Canadians, Americans or Japanese have no proposed or current standards on hydrogen internal combustion engines.

Portable Applications
There are no Canadian standards for portable fuel cell applications. There is international standards development by IEC TC 105 on portable fuel cells and by ISO/TC 197 on hydride storage containers for hydrogen. A standard exists for fuels for fuel cells and should be evaluated by fuel cell manufacturers as to suitability for their product. Standards or guideline may need to be developed for Interfaces between portable system and end-use, safety systems, and testing and evaluation.

Hydrogen Infrastructure
There are no national standards on hydrogen production other than general requirements such as the Canadian Electrical Code, NFPA 30 and CGA codes. Otherwise there are an extensive set of standards for hydrogen infrastructure. When new work items are developed for refueling stations and service and repair facilities, the current Canadian standards will require review and probably revision. There is code specifically directed at hydrogen refueling stations. It is not clear to what extent the National, Provincial and Municipal building codes take hydrogen into account, if at all. The same comment can be made for fire codes. The Canadian States organizations are currently discussing how to address these issues.

JAPAN
Stationary Applications
The Japanese have begun a fuel cell initiative to address the lack of fuel cell standards particularly as they apply to automobiles. Aspects of the initiative were addressed in a presentation by Dr. Hisashi Ishitani of Keio University. He indicated that one aspect of the FCCJ was to have codes and standards in place for fuel cell vehicles and hydrogen infrastructure by 2007-8. Beyond the refueling facility and vehicle fuel system, on-board storage and fuel cell, the committee will define what else should be covered. The current IEC 105 activities should cover many of the holes that exist in stationary fuel cell applications. Issues relating to fuels for fuel cells, fuel storage and dispensing, safety systems, interfacing and O& M still may need to be addressed. International standards are being developed for reforming natural gas to hydrogen and electrolyzers. The existing ISO standard for fuels must be reviewed to applicability to current fuel cells.

Transportation Applications
The major standards organizations are involved in the FCCJ effort. Japanese Electric Vehicle Association (JEVA) and Japan Automobile Standards Internationalization Center (JASIC) will no doubt be addressing fuel cell, on-board fuel processing, storage, interface, safety, and testing issues. Comments by those organizations on both the European Integrated Hydrogen Project and SAE's vehicle standards writing activities indicate that they have devoted considerable effort to developing the technical foundation from which to write standards. There do not seem to be plans to develop standards for hydrogen internal combustion engines.

Portable Applications
Given Japanese car-makers interest in on-board hydride storage, we expect active participation by the Japanese in development of an international ISO/TC 197 standard for hydride storage portable applications. A similar international standards effort is underway in ISO/TC 105 to write standards for portable fuel cells. Right now outside of the international efforts as far as we can

determine, standards for portable hydrogen or fuel cell devises are lacking in Japan. A recent announcement that in the next couple of years fuel cell powered cell phones and computers will be offered by a major Japanese manufacturer will make standards for portable fuel cells and related portable hydrogen systems inevitable. In addition to hydride storage the Japanese are reported to be looking at carbon nanotube systems for portable applications.

Hydrogen Infrastructure
The Japanese National Fire Service Law should be included to cover Hydrogen Production, Refueling Stations and Storage. The Japanese Fire Service Law, Japanese Industrial Standards under the High Pressure Gas Safety Law and Japanese Electrical Code would cover most industrial facilities that produce hydrogen. Specific codes for hydrogen fueling systems must be developed. There is currently no international effort to develop an international refueling system standard. There are similar needs in the areas of service and repairs, buildings, and emergency response.

UNITED STATES
Stationary Applications
The U.S. has several national efforts in fuel cells. ANSI Z21.83 is being revised to include more types of fuel cells, and will become CSA FC 1, and will include reformer hardware and hydrogen safety systems. CSA also is developing standards for fuel cell modules and residential fuel cell power generators. UL is developing a standard for replacement fuel cell power units for appliances, as well as a standard for inverters, converters, and controllers. NFPA is developing standards for installation of fuel cells, as well as fuels for fuel cells, and includes safety systems. CGA has a published standard for hydrogen piping systems at consumer locations. IEEE has standards for interconnection. ASME PTC 50 is a performance test code for fuel cell power system performance. International efforts that the US is supporting include IEC TC 105, which is developing international standards for fuel cells, and ISO/TC 58 which develops standards on hydrogen tanks and includes embrittlement tests.

Transportation Applications
U.S. efforts in transportation standards are led by SAE, which develops industry best practices for fuel cell electric vehicles, including fuel systems, fuel processors, safety, refueling interfaces, emissions, and recyclability. There are international standards under development for the vehicle fuel cell, on-board storage and interface between the vehicle and refueling interface. The existing ISO hydrogen fuels standard may require review. There remains development needs on O&M issues, safety systems, and testing and evaluation. CSA CAS No. 33 is a published standard on component acceptance service for PEM fuel cell modules. CSA is developing standards for compressed hydrogen gas containers based on CNG requirements. ANSI/CSA have published standards for fueling connection devices, pressure relief devices, dispensing systems, hoses, and breakaway connections for CNG vehicles that may be revised someday for hydrogen vehicles. The Americans have no proposed or current standards on hydrogen internal combustion engines.

Portable Applications
CSA CAS No. 33 contains specifications for providing CSA International component acceptance service for PEM fuel cell stacks. CSA is developing standards on portable fuel cell power generators and portable fuel cell appliances. UL is developing standards for gaseous hydrogen generating appliances, replacement fuel cell power units for appliances as well as an outline investigation for portable PEM fuel cells with or without uninterruptible power and for factory installation in OEM equipment for indoor use. ASME PTC 50 covers testing procedures for fuel cell power system performance. There is international standards development by IEC TC 105 on portable fuel cells and by ISO/TC 197 on hydride storage containers for hydrogen. A standard

exists for fuels for fuel cells and should be evaluated by fuel cell manufacturers as to suitability for their product. Standards or guideline may need to be developed for Interfaces between portable system and end-use and safety systems.

Hydrogen Infrastructure
There are no national standards on hydrogen production other than general requirements such as the National Electrical Code, NFPA 30 and CGA guidelines. UL 2264 is being initiated and will cover gaseous hydrogen generating appliances. Otherwise there are an extensive set of standards for hydrogen infrastructure. ASME has published standards for pipeline distribution. DOT 49 CFR covers transportation of hazardous materials. NFPA and CGA standards include storage. ANSI/CSA have NGV refueling station standards that could be used to develop hydrogen standards. NFPA is revising standards to include hydrogen refueling and service stations and repair garages. ICC has approved changes in the International Fire Code, International Fuel Gas Code, International Residential Code, International Building Code, and International Mechanical Code for hydrogen refueling stations, piping systems, fire safety, and garage ventilation.

INTERNATIONAL
In reviewing the matrix of hydrogen rule-making activities, it is remarkable how many categories of issues are being addressed. The three areas that we have identified as not being addressed are hydrogen internal combustion engines, on-board fuel processors and the interface between the portable system and end-use. It is also worth noting that the U.S. and Canada follow similar standards approaches and have a number of standards such as many from NFPA in common. Japan takes a more comprehensive approach to codes and standards making. There legislation and agency rule-making provide the framework for standards development. In Japan, the High Pressure Gas and Safety Law, Industrial Safety and Health Law, the Road Traffic Law, and Fire Service Law provide the basis for most of the hydrogen related regulations, codes and standards.

Stationary Applications
The international community is dealing in a comprehensive way with stationary fuel cells. ANSI Z21 83 and Japanese standards on phosphoric acid fuel cells will give way to IEC TC 105 activities that are adopting and expanding the ANSI standard. With the anticipated adoption of international standards for fuel cells approved over the next several years, fuel cells of all sizes should be covered for customer applications. As the integrated matrix indicates, there are a number of activities in the U.S. and Canada related to fuel processor and reformer standards. The activities are being mirrored with a joint IEC/ISO activity on hydrogen production from fossil fuels. There exist an international standard for hydrogen and the Japanese are leading the way on safety systems for stationary applications. All countries are working extensively on interface issues. There are significant international or country activities in O&M and Testing and Evaluation procedures to anticipate adequate standards coverage over the next few years.

Transportation Applications
The international community is dealing in a comprehensive way with vehicle fuel cells. The issues of fuel processors and internal combustions engines are not being addressed. An applicable standard for hydrogen fuel does exist. There are international standards being developed for on-board liquid and gaseous storage of hydrogen along with some proposed global technical regulations. There is also an international connector activity. Japan has the largest activity related to vehicle hydrogen safety. The U.S. has a number of standards activities related to O&M and Testing and Evaluation which SAE is developing.

Portable Applications
The major international activities with respect to portable applications are IEC 62282-5 Portable Fuel Cell Power Generators and the new work group established by ISO/TC 197 on hydride storage for portable applications. In the U.S. UL and CSA also have or are working fuel cell and electrolyzer standards.

Hydrogen Infrastructure
In hydrogen infrastructure virtually every category of activity is being addressed. Hydrogen production and storage are being addressed nationally and internationally. Transport of bulk hydrogen is being addressed by the U.S., Canada and Japan, but not internationally. Specifically, there are no international standards being developed for hydrogen pipelines. Hydrogen refueling stations standards have not been addressed internationally. There are also no national standards for hydrogen refueling stations. This is an urgent need. As a first step the U.S., Canada and Japan should look at developing compatible standards for fueling stations jointly with a common connector using natural gas vehicle standards as a starting point for compressed gas. There are no international standards being developed in the areas of buildings and safety and emergency response. There are extensive national activities underway in each of these areas.

Conclusion
The responsible organizations for developing codes and standards in the Canada, the U.S. and Japan are doing a good job of addressing current needs. There are some notable exceptions. The most urgent of which are addressing the development of standards for refueling stations, the development of international standards for hydrogen pipelines and the develop of international standards for the safety systems, O&M and safety issues surrounding the consumer use of portable applications. In addition, there is a need to address and resolve interface issues. Three immediately come to mind.

1. Maximum allowable hydrogen in the exhaust from an operating vehicle in an enclosed structure.
2. The nature of the interface and communications between the vehicle and the refueling station or for emergency power
3. The nature of the interfaces in portable devices between the storage device and the fuel cell, and the fuel cell and the application.

After national standards are developed, they will be proposed as international standards. Therefore, national standards are precursors to international standard development. Once the national standards are developed, it is worth evaluating the effectiveness and breath of their application. For this analysis additional requirements will be determined.

Appendix A: Hydrogen Codes, Standards, and Regulations Matrices for PATH Member Countries

CANADA - HYDROGEN CODES, STANDARDS AND REGULATIONS MATRIX (Nov				
1.0	STATIONARY APPLICATIONS			
	1.1 Fuel Cells	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	1.1.1 Fuel Cell Hardware			
	IEC TC105 Working Group 1: Terminology	The document provides uniform terminology in the form of diagrams, definitions and equations related to fuel cell technologies for all applications. It is intended to be a resource for the other IEC TC 105 working groups.	Kelvin Hecht International Fuel Cells (860) 673-9181	Revised draft of the technical report is in the review process.
	IEC TC105 Working Group 2: Fuel Cell Modules	The Working Group is developing a standard that addresses the safety and performance of fuel cell modules.	Kelvin Hecht International Fuel Cells (860) 673-9181	The draft standard was completed in January and was in the review process from 2 Feb 02 - 10 May 02. The WG will meet in June 2002 to address review comments.
	IEC TC105 Working Group 3: Safety of Stationary Fuel Cell Power Plants	The Working Group is developing a standard that addresses safety requirements (design and performance) for packaged stationary fuel cell power plants. The standard will parallel ANSI Z21.83 and similar standards in Canada, Japan and Germany.	Kelvin Hecht International Fuel Cells (860) 673-9181	The Working group is in the process of developing the initial draft. This is expected to be completed by October 2002.
	IEC TC105 Working Group 5: Installation of Stationary Fuel Cell Power Plants	The Working Group will develop a standard that covers the installation of stationary fuel cell power plants and their integration with the surrounding built environment. It will parallel NFPA 853.	Kelvin Hecht International Fuel Cells (860) 673-9181	The project was recently approved. The Working Group has been established and has started working on the draft. The draft is expected to be completed in 2003.
	1.1.2 Installation			
	1.2 Fuel Processor/Reformer	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	1.2.1 Fuel Processor/Reformer Hardware			
	CSA-B51M - Boilers, Pressure Vessels and Pressure Piping Code	Covers general and specific requirements for the design, fabrication, materials inspection and testing of pressure vehicles. Refers to the ASME Boiler and Pressure Vessel Code (construction of gaseous or liquid hydrogen storage vessels and hydrogen transportation)		
	CSA-B51M	Code for the Construction and Inspection of Boilers and Pressure Vessels		
	ANSI/ASME B31.3 - Code for Chemical Plant and Petroleum Refinery Piping			
	CSA Z 184-M - Gas Pipeline Systems			
	CSA Z18451 - Supplement No. 1 to Z184M (1979)			
	1.2.2 Fuel Processor/Reformer Installation			
	1.3 Fuels for Fuel Cells (Focusing on Hydrogen)	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***

	1.4 Fuel Storage and Dispensing (Focus on Hydrogen)	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	UL Std. 142	Standard for Steel Above Ground Tanks for Flammable and Combustible Liquids		
	ISO-TC 58: Tanks and Hydrogen Embrittlement		Norm Newhouse Lincoln Composites (402) 464-8211	
	1.5 Safety Systems	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	CGA-P-12	Safe Handling of Cryogenic Liquids		
	CGA-S-1	Pressure Relief Device Standards (Parts 1, 2 and 3)		
	1.6 Interfacing (with Building or Utility	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	1.6.1 Piping			
	CGA-V-6	Standard Cryogenic Liquid Transfer Connections		
	UL 842	Standard for Valves for Flammable Fluids		
	1.6.2 Electrical			
	NFPA 497	Recommended Practice for Classification of Class 1 Hazardous Locations for Electrical Installations in Chemical Plants		
	NFPA 77 - Recommended Practice on Sta	Provides recommendations for conductive equipment, bonding and grounding		
	NFPA 78	Lighting Protection Code		
	NFPA 493	Intrinsically Safe Apparatus and Associated Apparatus for Use in Class 1,2 and 3 Division 1 Hazardous Locations		
	NFPA 496	Purged and Pressurized Enclosures for Electrical Equipment in Hazardous (classified) Locations		
	CSA-C22.2 No 145	Motors and Generators for (1972) Use in Hazardous Locations. Class 1, Groups C and D Class 2, Groups E, F and G		
	CSA-C22.2 No 157	Intrinsically Safe and Non Incendive Equipment for Use in Hazardous Location (1979)		
	1.6.3 Controls and Sensors			
	CSA-C22.2 No. 152-1976	Combustible Gas-Detection Instruments		
	1.6.4 Connectors			
	1.6.5 Other			
	1.7 Issues Relating to or Use of Rejected Heat	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	1.8 O&M Issues, Operating Instructions and Safety	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	NFPA 30	Flammable and Combustible Liquid Codes		
	National Fire Code of Canada			
	IEC TC105 Working Group 3: Safety of Stationary Fuel Cell Power Plants	The Working Group is developing a standard that addresses safety requirements (design and performance) for packaged stationary fuel cell power plants. The standard will parallel ANSI Z21.83 and similar standards in Canada, Japan and Germany.	Kelvin Hecht International Fuel Cells (860) 673-9181	The Working group is in the process of developing the initial draft. This is expected to be completed by October 2002.
	1.9 Testing and Evaluation Procedures	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	IEC TC105 Working Group 4: Performance of Fuel Cell Power Plants	The standard describes how to measure the performance of stationary fuel cell power systems from an operational and an environmental standpoint.	Kelvin Hecht International Fuel Cells (860) 673-9181	The Working Grooup completed the draft in January 2002. During the period 8 Feb 02 - 10 May 02, it was in the review process. The WG will meet in June to address review comments.

	1.10 Other Issues	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
2.0	TRANSPORTATION APPLICATIONS			
	2.1 Fuel Cells	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	2.1.1 Fuel Cell Hardware			
	IEC TC105 Working Group 1: Terminology	The document provides uniform terminology in the form of diagrams, definitions and equations related to fuel cell technologies for all applications. It is intended to be a resource for the other IEC TC 105 working groups.	Kelvin Hecht International Fuel Cells (860) 673-9181	Revised draft of the technical report is in the review process.
	IEC TC105 Working Group 2: Fuel Cell Modules	The Working Group is developing a standard that addresses the safety and performance of fuel cell modules.	Kelvin Hecht International Fuel Cells (860) 673-9181	The draft standard was completed in January and was in the review process from 2 Feb 02 - 10 May 02. The WG will meet in June 2002 to address review comments.
	IEC TC105 Working Group 6: Fuel Cell Systems for Propulsion and Auxiliary Power Units	The Working Group will develop a standard regarding the safety and performance of fuel cells for automotive propulsion, automotive auxiliary power units and for non-automotive propulsion applications.	Kelvin Hecht International Fuel Cells (860) 673-9181	The Working Group was recently established and will have its first meeting in June 2002. It is expected that the draft will be completed by January 2003.
	2.1.2 Factory Installation			
	2.2 Fuel Processor/Reformer	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	2.2.1 Vehicle-Installed Reformer Hardware			
	2.2.2 Factory Installation			
	2.3 Internal Combustion Engines (ICEs)	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	2.3.1 ICE Hardware			
	2.3.2 Factory Installation			
	2.4 Fuels for Fuel Cells and Hydrogen ICEs	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	2.5 Fuel Storage and Fueling Equipment (on	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	ISO 13984:1999 Liquid Hydrogen	Land vehicle fueling system interface		
	ISO-TC197 WG2 &WG6On Board Storage			
	CGSB 43-GP-147 - Construction of Tank Car Tanks and Selection and use of Tank Car Tanks, Portable Tanks and Rail Cars for the Transportation of Dangerous Goods by Rail	Requirements for the construction and maintenance of single and multi-unit tank car tanks and for the selection, use, handling and filling of these tanks used in the transportation in bulk, by rail, of dangerous goods, including cryogenic and gaseous hydrogen.		
	CGA-341	Standard for Insulated Tank Truck Specifications for Cryogenic Liquids		
	2.6 Hydrogen System Interfacings with Vehicle	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***

	ISO TC197 Working Group 5: Gaseous Hydrogen Blends and Hydrogen Fuel - Land Vehicle Filling Connectors			
	2.7 Safety Systems			
	CGA-P-12	Safe Handling of Cryogenic Liquids		
	CGA-S-1 Parts 1-3	Pressure Relief Device Standards		
	NFPA 385	Standard for Tank Vehicles for Flammable and Combustible Liquids		
	2.8 O & M Issues, Operating Instructions and Safety	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	ISO TC197 Working Group 8: Hydrogen Generators Using Water Electrolysis Process		Randy Dey ISO TC 197 ((905) 847-7811	
	2.9 Testing and Evaluation Procedures	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	ISO/PWD 17374: Measurement of Hydrogen Emissions During Battery Charging			
	2.10 Other	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
3.0	PORTABLE APPLICATIONS			
	3.1 Fuel Cells (Packaged Systems)	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	3.1.1 Fuel Cell Hardware			
	IEC 62282 - 5 Ed. 1.0 - Portable Fuel Cell Technologies	Fuel Cell Technologies - Part 5: Portable fuel cell appliances - safety and performance requirements		
	IEC TC105 Working Group 1: Terminology	The document provides uniform terminology in the form of diagrams, definitions and equations related to fuel cell technologies for all applications. It is intended to be a resource for the other IEC TC 105 working groups.	Kelvin Hecht International Fuel Cells (860) 673-9181	Revised draft of the technical report is in the review process.
	IEC TC105 Working Group 2: Fuel Cell Modules	The Working Group is developing a standard that addresses the safety and performance of fuel cell modules.	Kelvin Hecht International Fuel Cells (860) 673-9181	The draft standard was completed in January and was in the review process from 2 Feb 02 - 10 May 02. The WG will meet in June 2002 to address review comments.
	IEC TC105 Working Group 7: Portable Fuel Cell Systems	The Working Group is developing a standard that covers the safety and performance of portable fuel cells. It will apply to AC and DC appliances with a rated voltage not exceeding 600 V in non-hazardous locations.	Kelvin Hecht International Fuel Cells (860) 673-9181	The Working Group is working to complete the draft standard by October 2003.
	3.1.2 Installation/ Setup			
	3.2 Fuel Processor/Reformer	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	3.2.1 Reformer Hardware			
	3.2.2 Reformer Setup			
	3.3 Hydrogen Generators	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***

	3.3.1 Hardware			
	ISO TC197 Working Group 8: Hydrogen Generators Using Water Electrolysis Process		Randy Dey ISO TC 197 ((905) 847-7811	
	3.3.2 Installation and/or Setup			
	3.3.3 Operation and Safety			
	3.4 Fuels for Fuel Cells	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	3.5 Fuel Storage, Ancillary Equipment and Dispensing (At the End Use)	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	NFPA 386	Standard for Portable Shipping Tanks for Flammable and Combustible Liquids		
	3.6 Interfaces Between Portable System and End-	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	3.6.1 Electrical			***STATUS***
	3.6.2 Structural/Attachment			
	3.7 Safety Systems	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	3.8 O&M, Operating Instructions and Safety	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	ANSI Std, Z48.1	American Standard Method of Marking Portable Compressed Gas containers to identify the Material Contained		
	3.9 Testing and Evaluation Procedures	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
4.0	**HYDROGEN INFRASTRUCTURE**			
	CGA G-5: Hydrogen	This document covers the properties, manufacturing, transportation, storage and use of gaseous hydrogen. It also includes a section on liquified hydrogen.		The document is published and available for sale.
	NFPA 30	Flammable and Combustible Liquid Codes		
	Canadian Electrical Code	This code deals with hazardous locations - areas where fire or explosion hazards my exist due to the presence of flammable or ignitable material.		
	4.1 Hydrogen Production	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	ISO 13984:1999 Liquid Hydrogen	Land vehicle fueling system interface		
	ISO/NP 16110 Hydrogen Generators Using Fuel Processing Technologies			
	ISO 14687:1999 Hydrogen Fuel	Hydrogen fuel product specification		
	ISO TC197 Working Group 8: Hydrogen Generators Using Water Electrolysis Process			

	4.2 Hydrogen Transportation and Distribution	*DESCRIPTION*	*TECHNICAL CONTACTS*	*STATUS*
	ISO/CD 11114-4 - Transportable gas cylinders	contents and test method for hydrogen compatibility with metals		
	NFPA 386	Standard for Portable Shipping Tanks for flammable and combustible liquids		
	CAN/CSA B339 - Cylinders, Spheres and Tubes for the Transportation of Dangerous Goods	Provides requirements for the manufacturing, inspection, testing, marking requalification, reheat treatment, repair and rebuilding of containers for the transportation of dangerous goods. It specifies containers used for cryogenic service such as liquid hydrogen as well as containers for gaseous hydrogen.		
	CAN/CSA B340 - Selection and Use of Cylinders, Spheres and Tubes and Other Containers for the Transportation of Dangerous Goods, Class 2	Provides safety requirements for the selection and use and requirements for the handling and filling of containers. It specifies which containers are to be used for the various dangerous goods including refrigerated liquid hydrogen.		
	CAN/CSA B620 - Highway Tanks and Portable Tanks for the Transportation of Dangerous Goods	Requirements for the design, manufacturing, certification, testing, inspection and retesting, maintenance and marking of highway tanks and portable tanks for the transportation of dangerous goods; including specifications for containers used for liquid and gaseous hydrogen.		
	CAN/CSA B622 - Selection and Use of Highway Tanks, Multi-Unit Tank Car Tanks, and Portable Tanks for the Transportation of Dangerous Goods,	Requirements for the selection and use of tanks including those applicable to hydrogen refrigerated liquid		
	CAN/CSA B629 - Recommended Practice on Shipping Documents for Transportation of Dangerous Goods	Applies to all dangerous goods, including hydrogen		
	UN Transport Code	Transport of Dangerous Goods by Committee of Experts		
	CSA Z 184-M	Gas Pipeline Systems		
	CSA Z18451	Supplement No. 1 to Z184M (1979)		
	CGA-V-6	Standard Cryogenic Liquid Transfer Connections		
	UL 842	Standard for Valves for Flammable Fluids		
	ASME Boiler and Pressure Vessel Code	For the construction of gaseous or liquid hydrogen		
	IMDGC or IMCO Code	International Maritime Dangerous Goods Code		
	TERMPOL Code	Code of Recommended Standards for the Safety and Prevention of Pollution for Marine Transportation Systems and related Assessment Procedures		
	CSA B332.B-1978	Series 1 Freight Containers - Specification and Testing - Part III: Tank Containers for Liquids and Gasses (ISO 1596/111-74)		
	IMO, IBC Code	Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk		
	ISO/TC-197 Working Group 2: Tank Containers for for Multimodal Transportation of Liquid Hydrogen			
	CGSB 43-GP-147 - Construction of Tank Car Tanks and Selection and use of Tank Car Tanks, Portable Tanks and Rail Cars	Requirements for the construction and maintenance of single and multi-unit tank car tanks and for the selection, use, handling and filling of these tanks used in the		

	4.3 Hydrogen Storage	*DESCRIPTION*	*TECHNICAL CONTACTS*	*STATUS*
	UL Std. 142	Standard for Steel Above Ground Tanks for Flammable and Combustible Liquids		
	NFPA 50B	Liquefied hydrogen systems at consumer sites		
	ASME Boiler and Pressure Vessel Code Section VIII, Division 1	For the construction of gaseous or liquid hydrogen storage vessels and hydrogen transportation		
	ISO/TC-197 Working Group 2: Tank Containers for for Multimodal Transportation of Liquid Hydrogen			
	ISO-TC 58: Tanks and Hydrogen Embrittlement			
	ISO-TC197 WD16111 - Portable Hydride Storage	Transportable gas storage devices - hydrogen absorbed in reversible metal hydride		
	ISO/TC-220 ASME Boiler and Pressure Vessel Code	The code covers specifications and requirements for storage containers for vehicles and for fueling stations		Published and available for sale
	4.4 Refueling Stations	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	NFPA 497	Recommended Practice for Classification of Class 1 Hazardous Locations for Electrical Installations in Chemical Plants		
	NFPA 77 - Recommended Practice on Sta	Provides recommendations for conductive equipment, bonding and grounding		
	NFPA 78	Lighting Protection Code		
	NFPA 493	Intrinsically Safe Apparatus and Associated Apparatus for Use in Class 1,2 and 3 Division 1 Hazardous Locations		
	NFPA 496	Purged and Pressurized Enclosures for Electrical Equipment in Hazardous (classified) Locations		
	CSA-C22.2 No 145	Motors and Generators for (1972) Use in Hazardous Locations. Class 1, Groups C and D Class 2, Groups E, F and G		
	CSA-C22.2 No 157	Intrinsically Safe and Non Incendive Equipment for Use in Hazardous Location (1979)		
	4.5 Service and Repair Facilities	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	NFPA 77 - Recommended Practice on Sta	Provides recommendations for conductive equipment, bonding and grounding		
	NFPA 78	Lighting Protection Code		
	NFPA 493	Intrinsically Safe Apparatus and Associated Apparatus for Use in Class 1,2 and 3 Division 1 Hazardous Locations		
	NFPA 496	Purged and Pressurized Enclosures for Electrical Equipment in Hazardous (classified) Locations		
	CSA-C22.2 No 145	Motors and Generators for (1972) Use in Hazardous Locations. Class 1, Groups C and D Class 2, Groups E, F and G		
	CSA-C22.2 No 157	Intrinsically Safe and Non Incendive Equipment for Use in Hazardous Location (1979)		

	4.6 Buildings	*DESCRIPTION*	*TECHNICAL CONTACTS*	*STATUS*
	NFPA 50 A	Liquefied Hydrogen Systems at Customer Sites		
	NFPA 50 B	Gaseous Hydrogen Systems at Customer Sites		
	NFPA 68	Guide for Explosion Venting		
	NFPA 220	Standards on Types of Building Construction		
	National Building Code			
	Provincial Building Code			
	Municipal Building Code			
	4.7 Safety, Emergency Response and Other Issues	*DESCRIPTION*	*TECHNICAL CONTACTS*	*STATUS*
	ISO/WD TR 15916 - Hydrogen System Safety	Basic considerations for the safety of hydrogen systems		
	CGA-P-12	Safe Handling of Cryogenic Liquids		
	CGA-S-1	Pressure Relief Device Standards (Parts 1, 2 and 3)		
	CSA-C22.2 No. 152-1976	Combustible Gas-Detection Instruments		
	Provincial Fire Code			
	Municipal Fire Code			
	National Fire Code of Canada			
5.0	CODES AND STANDARDS OF REGULATORY AND QUASI-REGULATORY ORGANIZATIONS			

JAPAN - HYDROGEN CODES, STANDARDS AND REGULATIONS MATRIX

1.0 STATIONARY APPLICATIONS

	1.1 Fuel Cells	*DESCRIPTION*	*TECHNICAL CONTACTS*	*STATUS*
	JIS C8800/TR C001	Glossary of terms for fuel cell power systems in 2000		
	JIS CXXXX	General Rules for Phosphoric Acid Fuel Cell Power		
	TRC 0002	Indication of Fuel Cell Power Facility		
	JIS CXXXX	Sub-system, power plants		
	1.1.1 Fuel Cell Hardware			
	IEC TC105 Working Group 1: Terminology	The document provides uniform terminology in the form of diagrams, definitions and equations related to fuel cell technologies for all applications. It is intended to be a resource for the other IEC TC 105 working groups.	Kelvin Hecht International Fuel Cells (860) 673-9181	Revised draft of the technical report is in the review process.
	IEC TC105 Working Group 2: Fuel Cell Modules	The Working Group is developing a standard that addresses the safety and performance of fuel cell modules.	Kelvin Hecht International Fuel Cells (860) 673-9181	The draft standard was completed in January and was in the review process from 2 Feb 02 - 10 May 02. The WG will meet in June 2002 to address review comments.
	IEC TC105 Working Group 3: Safety of Stationary Fuel Cell Power Plants	The Working Group is developing a standard that addresses safety requirements (design and performance) for packaged stationary fuel cell power plants. The standard will parallel ANSI Z21.83 and similar standards in Canada, Japan and Germany.	Kelvin Hecht International Fuel Cells (860) 673-9181	The Working group is in the process of developing the initial draft. This is expected to be completed by October 2002.
	IEC TC105 Working Group 5: Installation of Stationary Fuel Cell Power Plants	The Working Group will develop a standard that covers the installation of stationary fuel cell power plants and their integration with the surrounding built environment. It will parallel NFPA 853.	Kelvin Hecht International Fuel Cells (860) 673-9181	The project was recently approved. The Working Group has been established and has started working on the draft. The draft is expected to be completed in 2003.
	1.1.2 Installation			
	1.2 Fuel Processor/Reformer	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	1.2.1 Fuel Processor/Reformer Hardware			
	1.2.2 Fuel Processor/Reformer Installation			
	1.3 Fuels for Fuel Cells (Focusing on Hydrogen)	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	1.4 Fuel Storage and Dispensing (Focus on Hydrogen)	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***

	High Pressure Gas Safety Law - Articles 24-25	Controls, as high pressure gas consumers, those storing hydrogen gas of not less than 300m3 for the purpose of consumption or who receive hydrogen gas from other works through pipes for the purpose of consumption. For consumers of smaller quantities of high pressure gas, consumption standards are separately provided.		
	High Pressure Gas Safety Law - Articles 40-56.2	Containers and accessories		
	High Pressure Gas Safety Law - Articles 56.3 - 56.6	Designated Equipment		
	General High Pressure Gas Safety Regulations - Article 6	Technical Standards for Stationary-type Production Equipment		
	ISO-TC 58: Tanks and Hydrogen Embrittlement		Norm Newhouse Lincoln Composites (402) 464-8211	
	1.5 Safety Systems	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	Industrial Safety and Health Regulations			
	Safety Regulations for Boilers and Pressure Vessels			
	Regulations Concerning the Control of Dangerous Substances			
	High Pressure Gas and Safety Law - Article 35	Safety Inspection		
	Industrial Complex Safety Regulations	This regulation applies controls similar to those of the General High Pressure Gas Safety Regulations to stationary-type production equipment used at designated production works (larger works than the specified scale located in petroleum complex areas, or large-scale works located in other areas).		
	Industrial Safety and Health Law	The Law promotes comprehensive, systematic policies for industrial accident prevention, thereby ensuring the safety and health of workers in the workplace and developing a comfortable working environment. This law controls Class 1 and Class 2 containers that are not subject to the High Pressure Gas Safety Law.		
	Fire Service Law	This law provides guidelines to prevent, guard against and extinguish fires; and to alleviate damage caused by disasters, including fires and earthquakes. The law stipulates minimum safety distance between the hydrogen gas facility and the facility for production, storage or handling of designated dangerous substances.		
	1.6 Interfacing (with Building or Utility Interconnection)	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	1.6.1 Piping			
	JIS B2238	General Rules for Cast Iron Flanges		
	JIS B2238	General Rules for Steel Flanges		
	General High Pressure Gas Safety Regulations - Articles 6 and 50	Definitions for Pipe Standards		
	General High Pressure Gas Safety Regulations - Article 53	Defines the notification report of consumption		
	1.6.2 Electrical			
	JEC 156	Japan Electric Codes		
	1.6.3 Controls and Sensors			
	1.6.4 Connectors			
	1.6.5 Other			

	The Building Standard Law	This law was enacted to safeguard the life, health, and property of people by providing minimum standards concerning the site, structure, equipment, and use of buildings and to contribute to the promotion of public welfare. Stipulates building controls for each land-use zone. For hydrogen the Law prescribes the maximum storage volume for each land-use Zone.		
	1.7 Issues Relating to or Use of Rejected Heat	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	JIS S8412	General Safety Code for Industrial Combustion Furnaces		
	1.8 O&M Issues, Operating Instructions and Safety	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	IEC TC105 Working Group 3: Safety of Stationary Fuel Cell Power Plants	The Working Group is developing a standard that addresses safety requirements (design and performance) for packaged stationary fuel cell power plants. The standard will parallel ANSI Z21.83 and similar standards in Canada, Japan and Germany.	Kelvin Hecht International Fuel Cells (860) 673-9181	The Working group is in the process of developing the initial draft. This is expected to be completed by October 2002.
	1.9 Testing and Evaluation Procedures	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	TRC 0003	Test Methods for Performance of Phosphoric Acid Fuel Cell Power Facility		
	TRC 0004	Test Methods for Environment and Maintenance of Phosphoric Acid Fuel Cell Power Facility		
	JIS C1302	Insulation Resistance Testers		
	IEC TC105 Working Group 4: Performance of Fuel Cell Power Plants	The standard describes how to measure the performance of stationary fuel cell power systems from an operational and an environmental standpoint.	Kelvin Hecht International Fuel Cells (860) 673-9181	The Working Grooup completed the draft in January 2002. During the period 8 Feb 02 - 10 May 02, it was in the review process. The WG will meet in June to address review comments.
	1.10 Other Issues	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
2.0	TRANSPORTATION APPLICATIONS			
	2.1 Fuel Cells	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	2.1.1 Fuel Cell Hardware			
	JISC8800/TR C001	Glossary of terms for fuel cell power systems in 2000		
	IEC TC105 Working Group 1: Terminology	The document provides uniform terminology in the form of diagrams, definitions and equations related to fuel cell technologies for all applications. It is intended to be a resource for the other IEC TC 105 working groups.	Kelvin Hecht International Fuel Cells (860) 673-9181	Revised draft of the technical report is in the review process.
	IEC TC105 Working Group 2: Fuel Cell Modules	The Working Group is developing a standard that addresses the safety and performance of fuel cell modules.	Kelvin Hecht International Fuel Cells (860) 673-9181	The draft standard was completed in January and was in the review process from 2 Feb 02 - 10 May 02. The WG will meet in June 2002 to address review comments.

	IEC TC105 Working Group 6: Fuel Cell Systems for Propulsion and Auxiliary Power Units	The Working Group will develop a standard regarding the safety and performance of fuel cells for automotive propulsion, automotive auxiliary power units and for non-automotive propulsion applications.	Kelvin Hecht International Fuel Cells (860) 673-9181	The Working Group was recently established and will have its first meeting in June 2002. It is expected that the draft will be completed by January 2003.
	2.1.2 Factory Installation			
	2.2 Fuel Processor/Reformers	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	2.2.1 Vehicle-Installed Reformer Hardware			
	2.2.2 Factory Installation			
	2.3 Internal Combustion Engines (ICEs)	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	2.3.1 ICE Hardware			
	2.3.2 Factory Installation			
	2.4 Fuels for Fuel Cells and Hydrogen ICEs	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	2.5 Fuel Storage and Fueling Equipment (on Board)	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	ISO 13984:1999 Liquid Hydrogen	Land vehicle fueling system interface		
	ISO-TC197 WG2 &WG6On Board Storage			
	2.6 Hydrogen System Interfacings with Vehicle	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	High Pressure Gas Safety Law - Article 23	Transportation		
	General High Pressure Gas Safety Regulations - Article 8	Technical Standards for Class 2 Producers		
	ISO TC197 Working Group 5: Gaseous Hydrogen Blends and Hydrogen Fuel - Land Vehicle Filling Connectors			
	2.7 Safety Systems			
	Industrial Safety and Health Law	The Law promotes comprehensive, systematic policies for industrial accident prevention, thereby ensuring the safety and health of workers in the workplace and developing a comfortable working environment. This law controls Class 1 and Class 2 containers that are not subject to the High Pressure Gas Safety Law.		
	Safety Regulations for boilers and Pressure Vessels			
	Industrial Safety and Health Regulations			
	TGC 001-1999	A guideline - Safety display of valve regulated lead-acid batteries for electric vehicles		JEVA
	TGZ 002-1999	A guideline - Display of charge information for electric vehicles.		JEVA
	General High Pressure Gas Safety Regulations - Articles 53 and 55			

	2.8 O & M Issues, Operating Instructions and Safety	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	General High Pressure Gas Safety Regulations - Article 53	Notification Report of Consumption Concerning Specific High Pressure Gas Consumers		
	ISO TC197 Working Group 8: Hydrogen Generators Using Water Electrolysis Process		Randy Dey ISO TC 197 ((905) 847-7811	
	2.9 Testing and Evaluation Procedures	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	ISO/PWD 17374: Measurement of Hydrogen Emissions During Battery Charging			
	2.10 Other	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	The Road Vehicles Act	Provide for the traffic weight control and regulations on vehicles and ships used for transportation, in view of hazardous situations that may occur during transport.		
	Road Traffic Law	Provide for the traffic weight control and regulations on vehicles and ships used for transportation, in view of hazardous situations that may occur during transport.		
3.0	PORTABLE APPLICATIONS			
	3.1 Fuel Cells (Packaged Systems)	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	3.1.1 Fuel Cell Hardware			
	IEC 62282 - 5 Ed. 1.0 - Portable Fuel Cell Technologies	Fuel Cell Technologies - Part 5: Portable fuel cell appliances - safety and performance requirements		
	IEC TC105 Working Group 1: Terminology	The document provides uniform terminology in the form of diagrams, definitions and equations related to fuel cell technologies for all applications. It is intended to be a resource for the other IEC TC 105 working groups.	Kelvin Hecht International Fuel Cells (860) 673-9181	Revised draft of the technical report is in the review process.
	IEC TC105 Working Group 2: Fuel Cell Modules	The Working Group is developing a standard that addresses the safety and performance of fuel cell modules.	Kelvin Hecht International Fuel Cells (860) 673-9181	The draft standard was completed in January and was in the review process from 2 Feb 02 - 10 May 02. The WG will meet in June 2002 to address review comments.
	IEC TC105 Working Group 7: Portable Fuel Cell Systems	The Working Group is developing a standard that covers the safety and performance of portable fuel cells. It will apply to AC and DC appliances with a rated voltage not exceeding 600 V in non-hazardous locations.	Kelvin Hecht International Fuel Cells (860) 673-9181	The Working Group is working to complete the draft standard by October 2003.
	3.1.2 Installation/ Setup			
	3.2 Fuel Processor/Reformers	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	3.2.1 Reformer Hardware			
	3.2.2 Reformer Setup			
	3.3 Hydrogen Generators	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	3.3.1 Hardware			

	ISO TC197 Working Group 8: Hydrogen Generators Using Water Electrolysis Process		Randy Dey ISO TC 197 ((905) 847-7811	
	3.3.2 Installation and/or Setup			
	3.3.3 Operation and Safety			
	3.4 Fuels for Fuel Cells	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	3.5 Fuel Storage, Ancillary Equipment and Dispensing (At the End Use)	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	High Pressure Gas Safety Law - Articles 24.2 and 25.2	Controls as high pressure gas consumers, those storing hydrogen gas of not less than 300m3 for the purpose of consumption or who receive hydrogen gas from other works through pipes for the purpose of consumption.		
	The Road Vehicles Act - Articles 2 and 47	Provide standards for vehicles and for flammable gas transportation		
	3.6 Interfaces Between Portable System and End-Use	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	3.6.1 Electrical			***STATUS***
	3.6.2 Structural/Attachment			
	3.7 Safety Systems	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	3.8 O&M, Operating Instructions and Safety Issues	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	General High Pressure Gas Safety Regulations - Article 53	Notification Report of Consumption Concerning Specific High Pressure Gas Consumers		
	General High Pressure Gas Safety Regulations - Article 55	Technical Standards for Specific High Pressure Gas Consumers		
	3.9 Testing and Evaluation Procedures	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
4.0	HYDROGEN INFRASTRUCTURE			
	High Pressure Gas Safety Law	Regulates the production, storage, sale, transportation, and other matters concerning the handling and consumption of high pressure gases, as well as the manufacture and handling of containers in order to prevent disasters caused by high pressure gas.		
	Fire Service Law	This law provides guidelines to prevent, guard against and extinguish fires; and to alleviate damage caused by disasters, including fires and earthquakes. The law stipulates minimum safety distance between the hydrogen gas facility and the facility for production, storage or handling of designated dangerous substances.		

	Industrial Safety and Health Law	Promotes comprehensive, systematic policies for industrial accident prevention; defines responsibilities and encourage autonomous safety activities thereby ensuring the safety and health of workers and developing a comfortable working environment. Includes provisions concerning pressure vessels as part of the establishment of injury prevention standards, and demands the appointment of an Operation Chief as a means of defining responsibilities.		
	Designated Equipment Inspection Regulations			
	The Law on the Prevention of Disasters in Petroleum Industrial Complexes and Other Petroleum Facilities	Defines fundamental provisions concerning prevention of disasters and accidents relating to special disaster prevention districts in consideration of special characteristics f such disasters and accidents. The Law introduces two categories regarding mass handling of hydrogen based on handling volume, and specifies disaster prevention standards in detail for each class.		
	4.1 Hydrogen Production	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	ISO 13984:1999 Liquid Hydrogen	Land vehicle fueling system interface		
	ISO/NP 16110 Hydrogen Generators Using Fuel Processing Technologies			
	ISO 14687:1999 Hydrogen Fuel	Hydrogen fuel product specification		
	Industrial Complex Safety Regulations	Apply controls to stationary type production equipment used at designated production works. Also defines technical standards for production equipment, pipes and communication.		
	General High Pressure Gas Safety Regulations - Articles 6 and 8	Article 6 establishes technical standards for stationary-type production equipment. Article 8 establishes technical standards for movable production equipment. These Articles also regulate technical standards for equipment, including provisions concerning materials used, pressure proof test, air tightness test, wall thickness, installation of such equipment as manometers, safety valves and check valves, electrical equipment, piping and valves, etc.		
	Industrial Safety and Health Regulations			
	General High Pressure Gas Safety Regulations - Article 12			
	ISO TC197 Working Group 8: Hydrogen Generators Using Water Electrolysis Process			
	4.2 Hydrogen Transportation and Distribution	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	ISO/CD 11114-4 - Transportable gas cylinders	Compatability of cylinder and valve materials with gas contents and test method for hydrogen compatibility with metals		
	High Pressure Gas Safety Law - Article 23			
	General High Pressure Gas Safety Regulations - Articles 48-50	Technical standards for transportation of high pressure gas. These standards are designed to prevent damage caused by collisions to containers fixed on vehicles.		
	JIS B2238	General Rules for Cast Iron Flanges		
	JIS B2238	General Rules for Steel Flanges		
	The Road Vehicles Act - Articles 2 and 47	Stipulates the transport of hydrogen by land.		

	Regulation on Maritime Transport			
	ISO/TC-197 Working Group 2: Tank Containers for for Multimodal Transportation of Liquid Hydrogen			
	4.3 Hydrogen Storage	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	ISO-TC197 WD16111 - Portable Hydride Storage	Transportable gas storage devices - hydrogen absorbed in reversible metal hydride		
	High Pressure Gas Safety Law - Articles 24-25	Controls, as high pressure gas consumers, those storing hydrogen gas of not less than 300m3 for the purpose of consumption or who receive hydrogen gas from other works through pipes for the purpose of consumption. For consumers of smaller quantities of high pressure gas, consumption standards are separately provided.		
	High Pressure Gas Safety Law - Articles 40 to 56-2	Classifies pressure vessels into those to be filled with high pressure gas for transportation (containers) and those used for production, storage, etc of high pressure gas (equipment).		
	General High Pressure Gas Safety Regulations - Articles 20 and 25	Permission and notification report concerning storage.		
	Industrial Safety and Health Law	The Law promotes comprehensive, systematic policies for industrial accident prevention, thereby ensuring the safety and health of workers in the workplace and developing a comfortable working environment. This law controls Class 1 and Class 2 containers that are not subject to the High Pressure Gas Safety Law.		
	Container Safety Regulations	Regulate the standard of manufacturing method, container inspection, marking on containers, accessory standards, filling, reinspection of Containers/Accessories and Container Inspection Stations.		
	ISO/TC-197 Working Group 2: Tank Containers for for Multimodal Transportation of Liquid Hydrogen			
	ISO-TC 58: Tanks and Hydrogen Embrittlement			
	ISO/TC-220 ASME Boiler and Pressure Vessel Code	The code covers specifications and requirements for storage containers for vehicles and for fueling stations		Published and available for sale
	4.4 Refueling Stations	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	4.5 Service and Repair Facilities	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	4.6 Buildings	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	JEC 156	Japan Electrical Codes		
	4.7 Safety, Emergency Response and Other Issues	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	ISO/WD TR 15916 - Hydrogen System Safety	Basic considerations for the safety of hydrogen systems		
	Container Safety Regulations			
	Designated Equipment Inspection Regulations	These Regulations define the scope of designated equipment, technical standards, design and material, processing, welding, and structure.		
	General High Pressure Gas Safety Regulations Articles 79 to 83-2	These Articles regulate safety inspection and periodical self inspection.		

	JEC 156	Japan Electrical Codes		
	Regulations Concerning Control of Dangerous Substances - Article 12	Stipulates that among hydrogen-related facilities, facilities for production, and storage places should ensure a minimum distance of 20m from the facility for production, storage, or handling of dangerous substances.		
	Explosive Control Law			
	General High Pressure Gas Safety Regulations Articles 48-50	Provide standards to prevent damage of containers caused by collisions for containers fixed on vehicles such as tank trucks and trailers.		
5.0	CODES AND STANDARDS OF REGULATORY AND QUASI-REGULATORY ORGANIZATIONS			
6.0	ANY OTHER USEFUL APPLICATIONS			

US HYDROGEN CODES, STANDARDS AND REGULATIONS MATRIX

1.0	STATIONARY APPLICATIONS			
	1.1 Fuel Cells	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	1.1.1 Fuel Cell Hardware			
	ANSI Z21.83-1998: Fuel Cell Power Plants	The standard applies to packaged, self-contained or factory matched packages of integrated systems of fuel cell power plants for use with natural gas or LP gas and having a maximum output voltage of 600 VAC and power output of 1000 kW	Steven E. Kasubski CSA International (216) 524-4990 X8303	The standard is being revised to more adequately more types of fuel cells and the fuels to be utilized and will become CSA FC 1
	CSA FC 1: Fuel Cell Power Plants (Planned Replacement for ANSI Z21.83-1998)	The document applies to fuel cell systems for stationary applications having maximum output voltage of 600 V and power output up to 10 MW. CSA America Fuel Cell Technical Advisory Committee proposes CSA FC 1 to be the revised, enhanced version of ANSI Z21.83	Steven E. Kasubski CSA International (216) 524-4990 X8303	Draft of CSA FC 1 released for review after the April 2002 meeting of the Committee
	CSA FC 4: Fuel Cell Modules	This is a proposed future new standard for fuel cell modules.	Steven E. Kasubski CSA International (216) 524-4990	Proposed future effort of the CSA Fuel Cell Technical Advisory Committee.
	UL 2265: Replacement Fuel Cell Power Units for Appliances	This standard will cover stand-alone fuel cell power systems that may be connected within the enclosure of an appliance by a flexible cord and plug or other arrangement (auxiliary power supply)	Harry Jones Underwriters Laboratories (847) 664-2948	Underwriter Laboratories is working to develop this standard.
	IEC TC105 Working Group 1: Terminology	The document provides uniform terminology in the form of diagrams, definitions and equations related to fuel cell technologies for all applications. It is intended to be a resource for the other IEC TC 105 working groups.	Kelvin Hecht International Fuel Cells (860) 673-9181	Revised draft of the technical report is in the review process.
	IEC TC105 Working Group 2: Fuel Cell Modules	The Working Group is developing a standard that addresses the safety and performance of fuel cell modules.	Kelvin Hecht International Fuel Cells (860) 673-9181	The draft standard was completed in January and was in the review process from 2 Feb 02 - 10 May 02. The WG will meet in June 2002 to address review comments.
	IEC TC105 Working Group 3: Safety of Stationary Fuel Cell Power Plants	The Working Group is developing a standard that addresses safety requirements (design and performance) for packaged stationary fuel cell power plants. The standard will parallel ANSI Z21.83 and similar standards in Canada, Japan and Germany.	Kelvin Hecht International Fuel Cells (860) 673-9181	The Working group is in the process of developing the initial draft. This is expected to be completed by October 2002.
	CSA U.S. Requirements No. 1.01: Residential Fuel Cell Power Generators	This document supplements the provisions in ANSI Z21.83-1998. It applies to packaged, self-contained fuel cell systems for single-family and two-family dwellings installed outdoors rated at no greater than 50 kW. Plans call for replacing it with CSA FC 2	Todd Strothers CSA International (704) 552-5125	The document has been published and is available for sale.
	1.1.2 Installation			
	NFPA 853: Standard for the Installation of Stationary Fuel Cell Power Plants	The standard covers siting requirements, fuel storage arrangements, exhaust requirements and fire protection requirements for stationary fuel cell plants exceeding 50 kW for non-residential applications	Richard P. Bielen NFPA International (617) 770-3000	The standard is in the process of being revised to include small fuel cell applications for residences
	NFPA 54: National Fuel Gas Code	The Code covers installation of fuel gas piping systems, fuel gas utilization equipment and related accessories. The Code covers fuel gas systems operating at a maximum pressure of 125 psi.	Theodore C. Lemoff NFPA International (617) 984-7434	NFPA 54 is a published code available for purchase.
	IEC TC105 Working Group 5: Installation of Stationary Fuel Cell Power Plants	The Working Group will develop a standard that covers the installation of stationary fuel cell power plants and their integration with the surrounding built environment. It will parallel NFPA 853.	Kelvin Hecht International Fuel Cells (860) 673-9181	The project was recently approved. The Working Group has been established and has started working on the draft. The draft is expected to be completed in 2003.
	1.2 Fuel Processor/Reformer	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***

	1.2.1 Fuel Processor/Reformer Hardware			
	CSA FC 1: Fuel Cell Power Plants	The document applies to fuel cell systems for stationary applications having maximum output voltage of 600 V and power output up to 10 Mw. CSA America Fuel Cell Technical Advisory Committee proposes CSA FC 1 to be the revised, enhanced version of ANSI Z21.83	Steven E. Kasubski CSA International (216) 524-4990 X8303	Draft of CSA FC 1 released for review after the April 2002 meeting of the Committee
	1.2.2 Fuel Processor/Reformer Installation			
	ANSI/ASME B31.3 - Code for Chemical Plant and Petroleum Refinery Piping			
	ANSI Z21.83-1998: Fuel Cell Power Plants	The standard applies to packaged, self-contained or factory matched packages of integrated systems of fuel cell power plants for use with natural gas or LP gas and having a maximum output voltage of 600 VAC and power output of 1000 kW	Steven E. Kasubski CSA International (216) 524-4990 X8303	The standard is being revised to more adequately more types of fuel cells and the fuels to be utilized and will become CSA FC 1
	1.3 Fuels for Fuel Cells (Focusing on Hydrogen)	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	NFPA 853: Standard for the Installation of Stationary Fuel Cell Power Plants	The standard covers siting requirements, fuel storage arrangements, exhaust requirements and fire protection requirements for stationary fuel cell plants exceeding 50 kW for non-residential applications	Richard P. Bielen NFPA International (617) 770-3000	The standard is in the process of being revised to include small fuel cell applications for residences
	NFPA 54: National Fuel Gas Code	The Code covers installation of fuel gas piping systems, fuel gas utilization equipment and related accessories on consumers' premises. The Code covers fuel gas systems operating at a maximum pressure of 125 psi.	Theodore C. Lemoff NFPA International (617) 984-7434	NFPA 54 is a published code available for purchase.
	1.4 Fuel Storage and Dispensing (Focus on Hydrogen)	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	NHA Working Group 2: Containers and Hydrides	The Working Group is developing a standard for hydride contains that is expected to be submitted to ISO TC/197 for adoption.	Karen Miller National Hydrogen Association (202) 223-5547	The Working Group is in the process of developing the first draft.
	ISO-TC 58: Tanks and Hydrogen Embrittlement		Norm Newhouse Lincoln Composites (402) 464-8211	
	CGA G-5.4: Standard for Hydrogen Piping Systems at Consumer Locations	The standard covers materials and components selection to help install a safe, effective hydrogen supply system at a user's site.		The standard is published and available for sale.
	1.5 Safety Systems	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	ANSI Z21.83-1998: Fuel Cell Power Plants	The standard applies to packaged, self-contained or factory matched packages of integrated systems of fuel cell power plants for use with natural gas or LP gas and having a maximum output voltage of 600 VAC and power output of 1000 kW	Steven E. Kasubski CSA International (216) 524-4990 X8303	The standard is being revised to more adequately more types of fuel cells and the fuels to be utilized and will become CSA FC 1
	1.6 Interfacing (with Building or Utility	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	1.6.1 Piping			
	ANSI Z21.83-1998: Fuel Cell Power Plants	The standard applies to packaged, self-contained or factory matched packages of integrated systems of fuel cell power plants for use with natural gas or LP gas and having a maximum output voltage of 600 VAC and power output of 1000 kW	Steven E. Kasubski CSA International (216) 524-4990 X8303	The standard is being revised to more adequately more types of fuel cells and the fuels to be utilized and will become CSA FC 1
	NFPA 853: Standard for the Installation of Stationary Fuel Cell Power Plants	The standard covers siting requirements, fuel storage arrangements, exhaust requirements and fire protection requirements for stationary fuel cell plants exceeding 50 kW for non-residential applications	Richard P. Bielen NFPA International (617) 770-3000	The standard is in the process of being revised to include small fuel cell applications for residences

	NFPA 58: Liquified Petroleum Gas Code	This code applies to the highway transportation of LP gas and to the design, construction, installation and operation of all LP gas systems.	Theodore C. Lemoff NFPA International (617) 984-7434	The code hs been published and is available for sale.
	NFPA 54: National Fuel Gas Code	The Code covers installation of fuel gas piping systems, fuel gas utilization equipment and related accessories on consumers' premises. The Code covers fuel gas systems operating at a maximum pressure of 125 psi.	Theodore C. Lemoff NFPA International (617) 984-7434	NFPA 54 is a published code available for purchase.
	1.6.2 Electrical			
	NFPA 497	Recommended Practice for Classification of Class 1 Hazardous Locations for Electrical Installations in Chemical Plants		
	NFPA 77	Static Electricity		
	NFPA 78	Lighting Protection Code		
	NFPA 493	Intrinsically Safe Apparatus and Associated Apparatus for Use in Class 1,2 and 3 Division 1 Hazardous Locations		
	NFPA 496	Purged and Pressurized Enclosures for Electrical Equipment in Hazardous (classified) Locations		
	ANSI Z21.83-1998: Fuel Cell Power Plants	The standard applies to packaged, self-contained or factory matched packages of integrated systems of fuel cell power plants for use with natural gas or LP gas and having a maximum output voltage of 600 VAC and power output of 1000 kW	Steven E. Kasubski CSA International (216) 524-4990 X8303	The standard is being revised to more adequately more types of fuel cells and the fuels to be utilized and will become CSA FC 1
	NFPA 70: National Electric Code (Article 692)	2002 edition of National Electric Code includes new Article 692 that covers electrical installation requirements for fuel cell systems	Jean O'Conner NFPA International (617) 984-7421	Existing Standard
	UL 1741: Standard for Inverters, Converters and Controllers for Use in Independent Power Systems	This standard covers requirements that distributed generators must satisfy in order to operate properly when interconnected to the utility grid. It is being modified to cover fuel cell systems for stationary and portable applications. In addition, the plan is to adopt the requirements in IEEE P1547.	Tim Zgonena Underwriters Laboratories (847) 272-8800 X4305	Working Group is working to reach a consensus with IEEE P1547. Draft is expected to be available in June 2002.
	IEEE P1547: Standard for Interconnecting Distributed Resources with Electric Power Systems	This standard establishes criteria and requirements for the interconnection of distributed generating systems with electric power systems. It covers requirements regarding performance, operation, testing, safety considerations and maintenance of the interconnection.	Richard DeBlasio NREL (303) 275-3753	Draft 9 of the standard is in the review process.
	IEEE P1608: Application Guide for IEEE Standard 1547 for Interconnecting Distributed resources with Electric Power	The Guide provides technical background and application details to support the understanding of IEEE P1547.	Richard DeBlasio NREL (303) 275-3753	The Guide exists as a working draft.
	IEEE P1614: Guide for Monitoring Information Exchange and Control of Distributed Resources Interconnected with Electric Power Systems	This proposed Guide will provide guidelines for monitoring, information exchange, and control for distributed resources (e.g., fuel cells, PV) interconnected with electric power systems.	Richard DeBlasio NREL (303) 275-3753	Development of the Guide is in progress.
	1.6.3 Controls and Sensors			
	ANSI Z21.83-1998: Fuel Cell Power Plants	The standard applies to packaged, self-contained or factory matched packages of integrated systems of fuel cell power plants for use with natural gas or LP gas and having a maximum output voltage of 600 VAC and power output of 1000 kW	Steven E. Kasubski CSA International (216) 524-4990 X8303	The standard is being revised to more adequately more types of fuel cells and the fuels to be utilized and will become CSA FC 1
	1.6.4 Connectors			
	1.6.5 Other			
	1.7 Issues Relating to or Use of Rejected Heat	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	1.8 O&M Issues, Operating Instructions and Safety	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	IEC TC105 Working Group 3: Safety of Stationary Fuel Cell Power Plants	The Working Group is developing a standard that addresses safety requirements (design and performance) for packaged stationary fuel cell power plants. The standard will parallel ANSI Z21.83 and similar standards in Canada, Japan and Germany.	Kelvin Hecht International Fuel Cells (860) 673-9181	The Working group is in the process of developing the initial draft. This is expected to be completed by October 2002.

	CSA FC1: Fuel Cell Power Plants	The document applies to fuel cell systems for stationary applications having maximum output voltage of 600 V and power output up to 10 Mw. CSA America Fuel Cell Technical Advisory Committee proposes CSA FC 1 to be the revised, enhanced version of ANSI Z21.83	Steven E. Kasubski CSA International (216) 524-4990 X8303	Draft of CSA FC 1 released for review after the April 2002 meeting of the Committee
	ANSI Z21.83-1998: Fuel Cell Power Plants	The standard applies to packaged, self-contained or factory matched packages of integrated systems of fuel cell power plants for use with natural gas or LP gas and having a maximum output voltage of 600 VAC and power output of 1000 kW	Steven E. Kasubski CSA International (216) 524-4990 X8303	The standard is being revised to more adequately more types of fuel cells and the fuels to be utilized and will become CSA FC 1
	1.9 Testing and Evaluation Procedures	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	CSA CAS No. 33: Component Acceptance Service for PEM Fuel Cell Modules	The document contains specifications for providing CSA International component acceptance service for PEM fuel cells stacks using hydogen as the fuel	Todd Strothers CSA International (704) 552-5125	Document published and available for sale
	ASME PTC 50: Performance Test Code for Fuel Cell Power System Performance	Covers testing procedures, methods and definitions for assessing the performance characteristics of all types of fuel cell systems with respect to rated inputs and outputs or any other steady state conditions	Jack Karian ASME (212) 705-8552	Draft submitted to ANSI for 60-day public review period that began on 29 Mar 02. ANSI approval is expected in mid-2002
	NES Evaluation Protocol for Stationary Fuel Cell Power Plants	Protocol used by the NES to facilitate the process of evaluating stationary fuel cell power plants for compliance with US model codes	David Conover NES, Inc. (703) 931-2187	The Protocol exits and is in use
	IEC TC105 Working Group 4: Performance of Fuel Cell Power Plants	The standard describes how to measure the performance of stationary fuel cell power systems from an operational and an environmental standpoint.	Kelvin Hecht International Fuel Cells (860) 673-9181	The Working Grooup completed the draft in January 2002. During the period 8 Feb 02 - 10 May 02, it was in the review process. The WG will meet in June to address review comments.
	IEEE P1589: Standard for Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems	The standard specifies the type, production and commissioning tests that are to be performed to demonstrate that the interconnection functions and that the distributed resource equipment conforms to IEEE P1547	Richard DeBlasio NREL (303) 275-3753	
	1.10 Other Issues	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	UL 2265: Replacement Fuel Cell Power Units for Appliances (Covers an appliance that generates DC from hydrogen for stationary applications)	This standard will cover stand-alone fuel cell power systems that may be connected within the enclosure of an appliance by a flexible cord and plug or other arrangement (auxiliary power supply)	Harry Jones Underwriters Laboratories (847) 664-2948	Underwriter Laboratories is working to develop this standard.
2.0	TRANSPORTATION APPLICATIONS			
	2.1 Fuel Cells	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	2.1.1 Fuel Cell Hardware			
	SAE J2574: Fuel Cell Electric Vehicle Terminology	The standard covers terminology for fuel cell-powered electric vehicles		Published in March 2002 and available for sale
	SAE J2594: Fuel Cell Recyclability Guidelines	The document covers recyclability guidelines only for PEM fuel cell stacks and ancillary components		Working group is expected to complete the document and send it to committee ballot in early October/November 2002
	IEC TC105 Working Group 1: Terminology	The document provides uniform terminology in the form of diagrams, definitions and equations related to fuel cell technologies for all applications. It is intended to be a resource for the other IEC TC 105 working groups.	Kelvin Hecht International Fuel Cells (860) 673-9181	Revised draft of the technical report is in the review process.
	IEC TC105 Working Group 2: Fuel Cell Modules	The Working Group is developing a standard that addresses the safety and performance of fuel cell modules.	Kelvin Hecht International Fuel Cells (860) 673-9181	The draft standard was completed in January and was in the review process from 2 Feb 02 - 10 May 02. The WG will meet in June 2002 to address review comments.

	IEC TC105 Working Group 6: Fuel Cell Systems for Propulsion and Auxiliary Power Units	The Working Group will develop a standard regarding the safety and performance of fuel cells for automotive propulsion, automotive auxiliary power units and for non-automotive propulsion applications.	Kelvin Hecht International Fuel Cells (860) 673-9181	The Working Group was recently established and will have its first meeting in June 2002. It is expected that the draft will be completed by January 2003.
	2.1.2 Factory Installation			
	2.2 Fuel Processor/Reformers	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	2.2.1 Vehicle-Installed Reformer			
	2.2.2 Factory Installation			
	2.3 Internal Combustion Engines (ICEs)	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	2.3.1 ICE Hardware			
	2.3.2 Factory Installation			
	2.4 Fuels for Fuel Cells and Hydrogen ICEs	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	SAE J2579: Fuel Systems for Fuel Cell Vehicles	The document provides criteria for systems containing or processing fuel or other hazardous materials		Working Group is expected to complete the document in the November 2002; ballot targeted for December 2002
	2.5 Fuel Storage and Fueling Equipment (on	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	ISO 13984:1999 Liquid Hydrogen	Land vehicle fueling system interface		
	ISO-TC197 WG2 &WG6On Board Storage			
	ANSI/CSA NGV2-2000: Basic Requirements for Compressed Natural Gas Vehicle Fuel Containers	The document specifies requirements for CNG storage systems in addition to requirements in FMVSS304	Julie Cairns CSA International (216) 524-4900	Published and available for sale
	SAE 2600: Compressed Hydrogen Vehicle Fueling Connection Devices	The document defines the geometries of the receptacles for different hydrogen gas pressure levels		The document was successfully balloted in April 2002. It is expected to be published in July/August 2002.
	SAE J2601: Compressed Hydrogen Surface Vehicle Fueling Communication Devices	The document defines the different fueling strategies. It also develops the strategies and protocols for what fueling with and without communications should entail.		Work on the document is in progress. The Working Group expects to cocmplete it in the summer of 2003.
	SEA J1616: Recommended Practices for Compressed Natural Gas Vehicle Fuel	Covers recommendations regarding composition of fuels for CNG vehicles		Published and available for sale
	ANSI/CSA NGV1-1994: CNG Fueling Connection Devices	Covers CNG vehicle fueling connection devices assuring standardized nozzles and receptacles	Julie Cairns CSA International (216) 524-4900	Published and available for sale
	ANSI/CSA PRD1-1998: Basic Requirements for Pressure Relief Devices for NGV Fuel Containers	Covers pressure relief devices for CNG fuel tanks for vehicles	Julie Cairns CSA International (216) 524-4900	Published and available for sale
	ANSI/CSA NGV4.1-1999: NGV Dispensing Systems	Covers fuel dispensing devices for CNG vehicles	Tony Caudillo CSA International (416) 747-2212	Published and available for sale
	ANSI/CSA NGV4.2-1999: Hoses for NGV and Dispensing Systems	Covers CNG dispensers and vehicle hose assemblies for CNG vehicles	Tony Caudillo CSA International (416) 747-2212	Published and available for sale
	ANSI/CSA NGV4.4-1999: Breakaway Devices for Natural Gas Dispensing Hoses and Systems	Covers CNG dispenser shear values and fueling hose emergency breakaway shutoff devices for CNG vehicles	Tony Caudillo CSA International (416) 747-2212	Published and available for sale
	NFPA 52: Compressed Natural Gas Vehicular Fuel Systems Code	Currently, the standard covers design and installation of compressed natural gas engine fuel systems for vehicles of all types	Carl Rivkin NFPA International (617) 984-7418	The 2005 edition of NFPA 52 will be expanded to include hydrogen (requirements will not conflict with Federal or state regulations)
	2.6 Hydrogen System Interfacings with Vehicle	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	SAE FCSC Interface Working Group	Frank Niezabytowski Ford Motor Company (313) 322-9657		
	ISO TC197 Working Group 5: Gaseous Hydrogen Blends and Hydrogen Fuel - Land Vehicle Filling Connectors			

	2.7 Safety Systems			
	NFPA 385	Standard for Tank Vehicles for Flammable and Combustible Liquids		
	2.8 O & M Issues, Operating Instructions and	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	SAE J2578: Recommended Practices for General Fuel Cell Vehicle Safety	The document provides criteria for integration of fuel cell systems into vehicles and defines emergency response and maintenance requirements for safe use of fuel cell vehicles		The document has been approved by committee ballot and is in the pre-publication phase. It is expected to be available for sale in July/August 2002.
	SAE J2579: Recommended Practices for Hazardous Fluid Systems in Fuel Cell Vehicles	The document provides criteria for systems containing or processing fuel or other hazardous materials		Working Group is expected to complete the document in the November 2002; ballot targeted for December 2002
	SAE J2594: Fuel Cell Recyclability Guidelines	The document covers recyclability guidelines only for PEM fuel cell stacks and ancillary components		Working group is expected to complete the document and send it to committee ballot in early October/November 2002
	ISO TC197 Working Group 8: Hydrogen Generators Using Water Electrolysis Process		Randy Dey ISO TC 197 ((905) 847-7811	
	2.9 Testing and Evaluation Procedures	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	SAE J2572: Recommended Practice for Measuring the Exhaust Emissions, Energy Consumption and Range of Fuel Cell Powered Electric Vehicles Using Compressed Gaseous Hydrogen	The document covers recommended practices for fuel cell vehicles using compressed hydrogen gas supplied by an on-board reformer.		Working Group is addressing comments from CARB and EPA. It is expected to be completed and sent to committee ballot in April/May 2002.
	SAE J2615: Performance Test Procedures of Fuel Cell Systems for Automotive Applications	The standard covers procedures for testing complete Polymer Electrolyte Membrane (PEM) fuel cell systems		Working Group expected to complete the document and send it to committee ballot in October 2002
	SAE J2616: Performance Test Procedures for the Fuel Processor Subsystem of Automotive Fuel Cell System	The standard covers performance test procedures for testing fuel processor subsystems for automotive fuel cell systems		Working Group is in final stages of completing the document. It is expected to be sent for committee ballot in October 2002.
	SAE J2617: Performance Test Procedures of PEM Fuel Cell Stack Subsystem for Automotive Applications	The standard covers performance test procedures for testing PEM fuel stack subsystems for automotive applications		Working Group is in final stages of completing the document. It is expected to be sent for committee ballot in October 2002.
	ASME PTC 50: Performance Test Code for Fuel Cell Power System Performance	Covers testing procedures, methods and definitions for assessing the performance characteristics of all types of fuel cell systems with respect to rated inputs and outputs or any other steady state conditions	Jack Karian ASME (212) 705-8552	Draft submitted to ANSI for 60-day public review period that began on 29 Mar 02. ANSI approval is expected in mid-2002
	CSA CAS No. 33: Component Acceptance Service for PEM Fuel Cell Modules	The document contains specifications for providing CSA International component acceptance service for PEM fuel cells stacks using hydogen as the fuel.	Todd Strothers CSA International (704) 552-5125	Document published and available for sale
	ISO/PWD 17374: Measurement of Hydrogen Emissions During Battery Charging			
3.0	PORTABLE APPLICATIONS			
	3.1 Fuel Cells (Packaged Systems)	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	3.1.1 Fuel Cell Hardware			
	IEC 62282 - 5 Ed. 1.0 - Portable Fuel Cell Technologies	Fuel Cell Technologies - Part 5: Portable fuel cell appliances - safety and performance requirements		
	CSA FC 3: Portable Fuel Cell Power Generators	This document is intended to be a standard for portable fuel cell power generators, regardless of technology. It applies to AC and DC portable fuel cell generators with a rated output voltage not exceeding 600 V. It covers generators for commercial, industrial and residential use - indoor and outdoor.	Todd Strothers CSA International (704) 552-5125	Working Group has generated a draft that is in the review process. It is possible that it will be voted on before the end of 2002.

	CSA U.S. Requirements No. 3.01: Portable Fuel Cell Appliances (To be revised as CSA FC 3?)	This document establishes the basis for generation of the standard CSA FC 3: Portable Fuel Cell Power Generators.	Todd Strothers CSA International (704) 552-5125	The document has been published and is available for sale.
	IEC TC105 Working Group 1: Terminology	The document provides uniform terminology in the form of diagrams, definitions and equations related to fuel cell technologies for all applications. It is intended to be a resource for the other IEC TC 105 working groups.	Kelvin Hecht International Fuel Cells (860) 673-9181	Revised draft of the technical report is in the review process.
	IEC TC105 Working Group 2: Fuel Cell Modules	The Working Group is developing a standard that addresses the safety and performance of fuel cell modules.	Kelvin Hecht International Fuel Cells (860) 673-9181	The draft standard was completed in January and was in the review process from 2 Feb 02 - 10 May 02. The WG will meet in June 2002 to address review comments.
	IEC TC105 Working Group 7: Portable Fuel Cell Systems	The Working Group is developing a standard that covers the safety and performance of portable fuel cells. It will apply to AC and DC appliances with a rated voltage not exceeding 600 V in non-hazardous locations.	Kelvin Hecht International Fuel Cells (860) 673-9181	The Working Group is working to complete the draft standard by October 2003.
	UL2265: Replacement Fuel Cell Power Units for Appliances	This standard will cover stand-alone fuel cell power systems that may be connected within the enclosure of an appliance by a flexible cord and plug or other arrangement (auxiliary power supply)	Harry Jones Underwriters Laboratories (847) 664-2948	Underwriter Laboratories is working to develop this standard.
	3.1.2 Installation/ Setup			
	UL2262 Outline of Investigation for Portable PEM Fuel Cells with or without Uninterruptable Power and for Factory	This document will be used by Underwriter Laboratories as an interim protocol for certifying PEM fuel cell units	Harry Jones Underwriters Laboratories (847)	The document is under development by Underwriters Laboratories
	3.2 Fuel Processor/Reformers	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	3.2.1 Reformer Hardware			
	3.2.2 Reformer Setup			
	3.3 Hydrogen Generators	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	3.3.1 Hardware			
	UL 2264: Gaseous Hydrogen Generating Appliances	The standard covers portable, stationary and fixed gaseous hydrogen generating appliances rated at 120 V or greater. The standard includes electrolysis systems and reformers.	Harry Jones Underwriters Laboratories (847) 664-2948	This is a standard that Underwriter Laboratories is preparing to develp
	CSA Requirement No. 5.99 U.S.: Hydrogen Generators	The document establishes specifications for developing standards for hydrogen generators.	Todd Strothers CSA International (704) 552-5125	The document was published in July 2001.
	ISO TC197 Working Group 8: Hydrogen Generators Using Water Electrolysis Process		Randy Dey ISO TC 197 ((905) 847-7811	
	3.3.2 Installation and/or Setup			
	3.3.3 Operation and Safety			
	3.4 Fuels for Fuel Cells	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	3.5 Fuel Storage, Ancillary Equipment and Dispensing	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	(At the End Use)			
	NFPA 386	Standard for Portable Shipping Tanks for Flammable and Combustible Liquids		
	3.6 Interfaces Between Portable System and End-	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	3.6.1 Electrical			***STATUS***
	3.6.2 Structural/Attachment			

	3.7 Safety Systems	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	3.8 O&M, Operating Instructions and Safety	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	ANSI Std, Z48.1	American Standard Method of Marking Portable Compressed Gas containers to identify the Material Contained		
	3.9 Testing and Evaluation Procedures	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	ASME PTC 50: Performance Test Code for Fuel Cell Power System Performance	Covers testing procedures, methods and definitions for assessing the performance characteristics of all types of fuel cell systems with respect to rated inputs and outputs or any other steady state conditions	Jack Karian ASME (212) 705-8552	Draft submitted to ANSI for 60-day public review period that began on 29 Mar 02. ANSI approval is expected in mid-2002
	CSA CAS No. 33: Component Acceptance Service for PEM Fuel Cell Modules	The document contains specifications for providing CSA International component acceptance service for PEM fuel cells stacks using hydogen as the fuel.	Todd Strothers CSA International (704) 552-5125	Document published and available for sale
4.0	HYDROGEN INFRASTRUCTURE			
	NFPA 30	Flammable and Combustible Liquid Codes		
	NFPA 50A - Standard for Gaseous Hydrogen Systems at Consumer Sites	Specifies setback distances relative to other structures, overhead power lines, stores of cumbustible or hazardous materials and places of public assembly.		
	NFPA 52 Compressed Natural Gas Vehicular Fuel Systems	Specifies electrical classifications and setback distances.		
	NFPA 50B - Standards for Liquified Hydrogen Systems at Consumer Sites	Specifies setback distances relative to other structures, overhead power lines, stores of cumbustible or hazardous materials and places of public assembly. Special requirements for liquid H2 vaporizers to handle thermal expansion and contraction, and the potential for excessive pressure buildup.		
	CGA G-5.5 Hydrogen Vent Systems	Presents design guidelines for hydrogen vent systems for gaseous and liquid hydrogen installations at consumer sites; provides recommendations for safe operation.		
	4.1 Hydrogen Production	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	ISO 13984:1999 Liquid Hydrogen	Land vehicle fueling system interface		
	ISO/NP 16110 Hydrogen Generators Using Fuel Processing Technologies			
	ISO 14687:1999 Hydrogen Fuel	Hydrogen fuel product specification		
	UL 2264: Gaseous Hydrogen Generating Appliances	The standard covers portable, stationary and fixed gaseous hydrogen generating appliances rated at 120 V or greater. The standard includes electrolysis systems and reformers.	Harry Jones Underwriters Laboratories (847) 664-2948	This is a standard that Underwriter Laboratories is preparing to develp
	ISO TC197 Working Group 8: Hydrogen Generators Using Water Electrolysis Process			
	CGA G-5: Hydrogen	This document covers the properties, manufacturing, transportation, storage and use of gaseous hydrogen. It also includes a section on liquified hydrogen.		The document is published and available for sale.
	CGA G-5.3: Commodity Specification for Hydrogen	The guide book describes specification requirements for commercially available gaseous and liquid hydrogen. It provides data on quality verification, sampling, analytical procedures, typical uses for various grades and containers.		The document is published and available for sale.
	CGA P-6: Standard Density Data, Atmospheric Gases and Hydrogen	The document provides tables that present standard density data and volumetric conversion factors for atmospheric gases and hydrogen for the benefit of producers and users.		The document is published and available for sale.
	4.2 Hydrogen Transportation and	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***

	ISO/CD 11114-4 - Transportable gas cylinders	Compatability of cylinder and valve materials with gas contents and test method for hydrogen compatibility with metals		
	ASME Boiler and Pressure Vessel Code Section VIII, Division 1	For the construction of gaseous or liquid hydrogen storage vessels and hydrogen transportation		
	NFPA 386	Standard for Portable Shipping Tanks for flammable and combustible liquids		
	ISO/TC-197 Working Group 2: Tank Containers for for Multimodal Transportation of Liquid Hydrogen			
	ASME B31.4: Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids	This Code prescribes requirements for the design, materials, construction, assembly, inspection, and testing of piping transporting liquids such as crude oil, condensate, natural gasoline, natural gas liquids, liquefied petroleum gas, etc. between producers' lease facilities, tank farms, natural gas processing plants, refineries, stations, ammonia plants, terminals (marine, rail and truck) and other delivery and receiving points.		Published in 1998 and available for sale
	ASME B31.8: Gas Transmission and Distribution Piping Systems	This Code covers the design, fabrication, installation, inspection, testing, and safety aspects of operation and maintenance of gas transmission and distribution systems, including gas pipelines, gas compressor stations, gas metering and regulation stations, gas mains, and service lines up to the outlet of the customers meter set assembly.		Published in 2000 and available for sale
	DOT 49 Code of Federal Regulations (CFR) Transportation Equipment and Transport of Hazardous Materials			
	CGA G-5.4: Standard for Hydrogen Piping Systems at Consumer Locations	The standard covers materials and components selection to help install a safe, effective hydrogen supply system at a user's site.		The standard is published and available for sale.
	NFPA 58: Liquified Petroleum Gas Code	This code applies to the highway transportation of LP gas and to the design, construction, installation and operation of all LP gas systems.	Theodore C. Lemoff NFPA International (617) 984-7434	The code hs been published and is available for sale.
	4.3 Hydrogen Storage	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	NFPA 50B	Liquefied hydrogen systems at consumer sites		
	ISO-TC197 WD16111 - Portable Hydride Storage	Transportable gas storage devices - hydrogen absorbed in reversible metal hydride		
	ISO/TC-197 Working Group 2: Tank Containers for for Multimodal Transportation of Liquid Hydrogen			
	ISO-TC 58: Tanks and Hydrogen Embrittlement			
	ISO/TC-220 ASME Boiler and Pressure Vessel Code	The code covers specifications and requirements for storage containers for vehicles and for fueling stations		Published and available for sale
	NFPA 50A: Standard for Gaseous Hydrogen Systems at Consumer Sites (50A and 50B will be combined into NFPA 55)	Covers bulk gaseous hydrogen systems at user installations. Sets design criteria and sets separation distances from installations for 14 types of exposures	Carl Rivkin NFPA International (617) 984-7418	Existing Standard (Plans call for incorporating NFPA 50A and 50B into NFPA 55: Standard for Storage, Use and Handling of Compressed and Liquified Gases in Portable Cylinders)
	NFPA 50B: Standard for Liquified Hydrogen Systems at Consumer Sites (50A and 50B will be combined into NFPA 55)	Covers bulk liquified hydrogen systems at user installations. Sets design criteria and separation distances from installations for 12 types of exposures	Carl Rivkin NFPA International (617) 984-7418	Existing Standard (Plans call for incorporating NFPA 50A and 50B into NFPA 55: Standard for Storage, Use and Handling of Compressed and Liquified Gases in Portable Cylinders)
	ASME Boiler and Pressure Vessel Code Section VIII, Division 1	For the construction of gaseous or liquid hydrogen storage vessels and hydrogen transportation		
	CGA G-5: Hydrogen	This document covers the properties, manufacturing, transportation, storage and use of gaseous hydrogen. It also includes a section on liquified hydrogen.		The document is published and available for sale.

	4.4 Refueling Stations	*DESCRIPTION*	*TECHNICAL CONTACTS*	*STATUS*
	ANSI/CSA NGV4.1-1999: NGV Dispensing Systems	Standard for fuel dispensing devices for CNG vehicles	Tony Caudillo CSA International (416) 747-2212	Published and available for sale
	ANSI/CSA NGV4.3: Temperature Compensation Devices for Natural Gas Dispensing Systems	Standard for temperature compensating systems for NG dispensing systems	Tony Caudillo CSA International (416) 747-2212	Standard being developed by Natural Gas Vehicle Coalition
	ANSI/CSA NGV4.5: Priority and Sequencing for Natural Gas Dispensing Systems	Standard for prioritizing and sequencing NG dispensing systems	Tony Caudillo CSA International (416) 747-2212	Standard being developed by Natural Gas Vehicle Coalition
	4.5 Service and Repair Facilities	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	NFPA 77	Static Electricity		
	NFPA 78	Lighting Protection Code		
	NFPA 493	Intrinsically Safe Apparatus and Associated Apparatus for Use in Class 1,2 and 3 Division 1 Hazardous Locations		
	NFPA 496	Purged and Pressurized Enclosures for Electrical Equipment in Hazardous (classified) Locations		
	4.6 Buildings	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	NFPA 50 A	Liquefied Hydrogen Systems at Customer Sites		
	NFPA 50 B	Gaseous Hydrogen Systems at Customer Sites		
	NFPA 68	Guide for Explosion Venting		
	NFPA 220	Standards on Types of Building Construction		
	ICC International Residential Code (Mechanical and Plumbing)	The code covers requirements for the construction of one- and two-family dwellings and townhouses up to three stories in height. The code also covers the plumbing and mechanical systems. It is being modified to include hydrogen systems.	Darren Meyers BOCA International (708) 799-2300 X307	The proposed changes to the IRC developed by the ICC Hydrogen Ad Hoc Committee that address hydrogen received final approbval at the ICC Code Change Final Actions Hearings in Oct 02 and will be incoroporated into the next edition of the Code.
	ICC International Fire Code	The code documents national standards that address fire safety comprehensively in new and existing buildings. The code is being modified to include hydrogen safety issues.	Darren Meyers BOCA International (708) 799-2300 X307	The proposed changes to the IFC developed by the ICC Hydrogen Ad Hoc Committee that address hydrogen received final approbval at the ICC Code Change Final Actions Hearings in Oct 02 and will be incoroporated into the next edition of the code.
	ICC International Fuel Gas Code	The document contains requirements for fuel gas piping system equipment and accessories. It contains combustion air requirements and sizing tables for venting Category I appliances. The code is being modified to include hydrogen as a fuel gas.	Darren Meyers BOCA International (708) 799-2300 X307	The proposed changes to the IFGC developed by the ICC Hydrogen Ad Hoc Committee that address hydrogen received final approbval at the ICC Code Change Final Actions Hearings in Oct 02 and will be incoroporated into the next edition of the Code.
	ICC International Mechanical Code	The document contains regulations regarding mechanical systems and equipment in the build enviornment -- including HVAC, exhaust systems, chimneys and vents, ducts, appliences, boilers, water ehaters, refrigeration, hydronic piping and solar systems. It is being updated to include Hydrogen	Darren Meyers BOCA International (708) 799-2300 X308	The proposed changes to the IBC developed by the ICC Hydrogen Ad Hoc Committee that address hydrogen received final approbval at the ICC Code Change Final Actions Hearings in Oct 02 and will be incoroporated into the next edition of the Code.
	ICC International Building Code	The Code addresses design and installation of building ssytems with requirements that emphasisze performance. It is being updated to include hydrogen systems.	Darren Meyers BOCA International (708) 799-2300 X309	The proposed changes to the IMC developed by the ICC Hydrogen Ad Hoc Committee that address hydrogen received final approbval at the ICC Code Change Final Actions Hearings in Oct 02 and will be incoroporated into the next edition of the Code.

	UL 1741: Standard for Inverters, Converters and Controllers for Use in Independent Power Systems	This standard covers requirements that distributed generators must satisfy in order to operate properly when interconnected to the utility grid. It is being modified to cover fuel cell systems for stationary and portable applications. In addition, the plan is to adopt the requirements in IEEE P1547.	Tim Zgonena Underwriters Laboratories (847) 272-8800 X4305	Working Group is working to reach a consensus with IEEE P1547. Draft is expected to be available in June 2002.
	IEEE P1547: Standard for Interconnecting Distributed Resources with Electric Power Systems	This standard establishes criteria and requirements for the interconnection of distributed generating systems with electric power systems. It covers requirements regarding performance, operation, testing, safety considerations and maintenance of the interconnection.	Richard DeBlasio NREL (303) 275-3753	Draft 9 of the standard is in the review process.
	NFPA Building Code			
	WFCA Uniform Fire Code			
	International Association of Plumbing and Mechanical Officials (IAPMO) Plumbing Code	The code covers plumbing engineering criteria and requirements for plumbing fixtures and fuel gas piping for new and existing residences.	Michael Kobel, IAPMO Director of Standards	
	International Association of Plumbing and Mechanical Officials (IAPMO) Mechanical Code	The code covers requirements for mechanical systems for new and existing homes.	Michael Kobel, IAPMO Director of	
	NFPA 70: National Electric Code	2002 edition of National Electric Code includes new Article 692 that covers electrical installation requirements for fuel cell systems	Jean O'Conner NFPA International (617) 984-7421	Existing Standard
	CGA G5.5: Hydrogen Vent Systems	The standard presents guidelines for hydrogen vent systems for gaseous and liquid hydrogen installations at consumer sites. It also provides recommendations regarding safe operation.		The standard has been published and is available for sale.
	4.7 Safety, Emergency Response and Other	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	NFPA 49 - Hazardous Chemicals Data			
	NFPA 325 - Guide to Fire Hazard Properties of Flammable Liquids, Gases and Volatile Solids			
	NFPA 491 - Guide ot Hazardous Chemical Reactions			
	NFPA 704 - Standard System for the Identification of the Hazards of Materials for Emergency Response			
	ISO/WD TR 15916 - Hydrogen System Safety	Basic considerations for the safety of hydrogen systems		
	NFPA 69 - Standard on Explosion Prevention Systems	Provides guidance for hydrogen vent systems		
	CGA P-1-1991:Safe handling of Compressed Gases in Containers			
	NFPA 70: National Electric Code	2002 edition of National Electric Code includes new Article 692 that covers electrical installation requirements for fuel cell systems	Jean O'Conner NFPA International (617) 984-7421	Existing Standard
	Part 1910 of 29 Code of Federal Regulations (CFR) Occupational Safety and Health Standards			
5.0	CODES AND STANDARDS OF REGULATORY AND QUASI-REGULATORY ORGANIZATIONS			
	5.1 US Department of Transportation	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	DOT 49 Code of Federal Regulations (CFR) Transportation Equipment and Transport of Hazardous Materials			

	DOT Emergency Response Guidebook (Guidebook for First Responders During the Initial Phase of A Dangerous Goods/Hazardous Materials Incident)			
	5.2 Occupational Health and Safety Administration	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	Part 1910 of 29 Code of Federal Regulations (CFR) Occupational Safety and Health Standards			
	5.3 European Integrated Hydrogen Project	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	EIHP Regulation: Approval of: Specific Components of Moter Vehicles Using Liquied Hydrogen; and vehicles with Regard to Installation of Specific Components for the Use of Liquid Hydrogen (Draft)	The scope of the regulation is: (1) specific components of motor vehicles using liquid hydrogen; and (2) vehicles with respect to the installation of specific componets for the use of liquid hydrogen. The regulation is for Europe.		The regulation exists as a draft (Revision 10)
	EIHP Regulation: Approval of: Specific Components of Moter Vehicles Using Compressed Gaseous Hydrogen; and Vehicles with Regard to the Installation of Specific Components for the Use of Compressed Gaseous Hydrogen (Draft)	The scope of the regulation is: (1) specific components of motor vehicles using compressed gaseous hydrogen; and (2) vehicles with respect to the installation of specific componets for the use of compressed gaseous hydrogen. The regulation is for Europe.		The regulation exists as a draft (Revision 7)
	5.4 Other Organizations	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	California Air Resources Board (CARB)	CARB Emissions Regulations		
6.0	ANY OTHER USEFUL APPLICATIONS			
	ISO/CD PAS 15594 - Airport hydrogen fueling facility			

Appendix B: Integrated Hydrogen Codes, Standards, and Regulations Matrix

INTERNATIONAL HYDROGEN CODES, STANDARDS AND REGULATIONS MATRIX

1.0	STATIONARY APPLICATIONS (Residential, Commercial and Government Buildings and Utility Applications)			
COUNTRY	**1.1 Fuel Cells**	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
Japan	JIS C8800/TR C001	Glossary of terms for fuel cell power systems in 2000		
Japan	JIS CXXXX	General Rules for Phosphoric Acid Fuel Cell Power Generating Systems		
Japan	TRC 0002	Indication of Fuel Cell Power Facility		
Japan	JIS CXXXX	Sub-system, power plants		
	1.1.1 Fuel Cell Hardware			
United States	ANSI Z21.83-1998: Fuel Cell Power Plants	The standard applies to packaged, self-contained or factory matched packages of integrated systems of fuel cell power plants for use with natural gas or LP gas and having a maximum output voltage of 600 VAC and power output of 1000 kW	Steven E. Kasubski CSA International (216) 524-4990 X8303	The standard is being revised to more adequately more types of fuel cells and the fuels to be utilized and will become CSA FC 1
United States	CSA FC 1: Fuel Cell Power Plants (Planned Replacement for ANSI Z21.83-1998)	The document applies to fuel cell systems for stationary applications having maximum output voltage of 600 V and power output up to 10 MW. CSA America Fuel Cell Technical Advisory Committee proposes CSA FC 1 to be the revised, enhanced version of ANSI Z21.83	Steven E. Kasubski CSA International (216) 524-4990 X8303	Draft of CSA FC 1 released for review after the April 2002 meeting of the Committee
United States	CSA FC 4: Fuel Cell Modules	This is a proposed future new standard for fuel cell modules.	Steven E. Kasubski CSA International (216) 524-4990 X8303	Proposed future effort of the CSA Fuel Cell Technical Advisory Committee.
United States	UL 2265: Replacement Fuel Cell Power Units for Appliances	This standard will cover stand-alone fuel cell power systems that may be connected within the enclosure of an appliance by a flexible cord and plug or other arrangement (auxiliary power supply)	Harry Jones Underwriters Laboratories (847) 664-2948	Underwriter Laboratories is working to develop this standard.
International	IEC TC105 Working Group 1: Terminology	The document provides uniform terminology in the form of diagrams, definitions and equations related to fuel cell technologies for all applications. It is intended to be a resource for the other IEC TC 105 working groups.	Kelvin Hecht International Fuel Cells (860) 673-9181	Revised draft of the technical report is in the review process.
International	IEC TC105 Working Group 2: Fuel Cell Modules	The Working Group is developing a standard that addresses the safety and performance of fuel cell modules.	Kelvin Hecht International Fuel Cells (860) 673-9181	The draft standard was completed in January and was in the review process from 2 Feb 02 - 10 May 02. The WG will meet in June 2002 to address review comments.
International	IEC TC105 Working Group 3: Safety of Stationary Fuel Cell Power Plants	The Working Group is developing a standard that addresses safety requirements (design and performance) for packaged stationary fuel cell power plants. The standard will parallel ANSI Z21.83 and similar standards in Canada, Japan and Germany.	Kelvin Hecht International Fuel Cells (860) 673-9181	The Working group is in the process of developing the initial draft. This is expected to be completed by October 2002.
International	CSA U.S. Requirements No. 1.01: Residential Fuel Cell Power Generators	This document supplements the provisions in ANSI Z21.83-1998. It applies to packaged, self-contained fuel cell systems for single-family and two-family dwellings installed outdoors rated at no greater than 50 kW. Plans call for replacing it with CSA FC 2	Todd Strothers CSA International (704) 552-5125	The document has been published and is available for sale.
International	IEC TC105 Working Group 5: Installation of Stationary Fuel Cell Power Plants	The Working Group will develop a standard that covers the installation of stationary fuel cell power plants and their integration with the surrounding built environment. It will parallel NFPA 853.	Kelvin Hecht International Fuel Cells (860) 673-9181	The project was recently approved. The Working Group has been established and has started working on the draft. The draft is expected to be completed in 2003.
	1.1.2 Installation			

United States	NFPA 853: Standard for the Installation of Stationary Fuel Cell Power Plants	The standard covers siting requirements, fuel storage arrangements, exhaust requirements and fire protection requirements for stationary fuel cell plants exceeding 50 kW for non-residential applications	Richard P. Bielen NFPA International (617) 770-3000	The standard is in the process of being revised to include small fuel cell applications for residences
United States	NFPA 54: National Fuel Gas Code	The Code covers installation of fuel gas piping systems, fuel gas utilization equipment and related accessories. The Code covers fuel gas systems operating at a maximum pressure of 125 psi.	Theodore C. Lemoff NFPA International (617) 984-7434	NFPA 54 is a published code available for purchase.
International	IEC TC105 Working Group 5: Installation of Stationary Fuel Cell Power Plants	The Working Group will develop a standard that covers the installation of stationary fuel cell power plants and their integration with the surrounding built environment. It will parallel NFPA 853.	Kelvin Hecht International Fuel Cells (860) 673-9181	The project was recently approved. The Working Group has been established and has started working on the draft. The draft is expected to be completed in 2003.
COUNTRY	**1.2 Fuel Processor/Reformer**	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	1.2.1 Fuel Processor/Reformer Hardware			
United States	CSA FC 1: Fuel Cell Power Plants	The document applies to fuel cell systems for stationary applications having maximum output voltage of 600 V and power output up to 10 Mw. CSA America Fuel Cell Technical Advisory Committee proposes CSA FC 1 to be the revised, enhanced version of ANSI Z21.83	Steven E. Kasubski CSA International (216) 524-4990 X8303	Draft of CSA FC 1 released for review after the April 2002 meeting of the Committee
Canada	CSA-B51M - Boilers, Pressure Vessels and Pressure Piping Code	Covers general and specific requirements for the design, fabrication, materials inspection and testing of pressure vehicles. Refers to the ASME Boiler and Pressure Vessel Code (construction of gaseous or liquid hydrogen storage vessels and hydrogen transportation)		
Canada	CSA-B51M	Code for the Construction and Inspection of Boilers and Pressure Vessels		
Canada/United States	ANSI/ASME B31.3 - Code for Chemical Plant and Petroleum Refinery Piping			
Canada	CSA Z 184-M - Gas Pipeline Systems			
Canada	CSA Z18451 - Supplement No. 1 to Z184M (1979)			
	1.2.2 Fuel Processor/Reformer Installation			
United States	ANSI Z21.83-1998: Fuel Cell Power Plants	The standard applies to packaged, self-contained or factory matched packages of integrated systems of fuel cell power plants for use with natural gas or LP gas and having a maximum output voltage of 600 VAC and power output of 1000 kW	Steven E. Kasubski CSA International (216) 524-4990 X8303	The standard is being revised to more adequately more types of fuel cells and the fuels to be utilized and will become CSA FC 1
COUNTRY	**1.3 Fuels for Fuel Cells (Focusing on Hydrogen)**	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
United States	NFPA 853: Standard for the Installation of Stationary Fuel Cell Power Plants	The standard covers siting requirements, fuel storage arrangements, exhaust requirements and fire protection requirements for stationary fuel cell plants exceeding 50 kW for non-residential applications	Richard P. Bielen NFPA International (617) 770-3000	The standard is in the process of being revised to include small fuel cell applications for residences
United States	NFPA 54: National Fuel Gas Code	The Code covers installation of fuel gas piping systems, fuel gas utilization equipment and related accessories on consumers' premises. The Code covers fuel gas systems operating at a maximum pressure of 125 psi.	Theodore C. Lemoff NFPA International (617) 984-7434	NFPA 54 is a published code available for purchase.
COUNTRY	**1.4 Fuel Storage and Dispensing (Focus on Hydrogen)**	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***

United States	NHA Working Group 2: Containers and Hydrides	The Working Group is developing a standard for hydride contains that is expected to be submitted to ISO TC/197 for adoption.	Karen Miller National Hydrogen Association (202) 223-5547	The Working Group is in the process of developing the first draft.
International	ISO-TC58: Tanks and Hydrogen Embrittlement		Norm Newhouse Lincoln Composites (402) 464-8211	
United States	CGA G-5.4: Standard for Hydrogen Piping Systems at Consumer Locations	The standard covers materials and components selection to help install a safe, effective hydrogen supply system at a user's site.		The standard is published and available for sale.
Canada	UL Std. 142	Standard for Steel Above Ground Tanks for Flammable and Combustible Liquids		
Japan	High Pressure Gas Safety Law - Articles 24-25	Controls, as high pressure gas consumers, those storing hydrogen gas of not less than 300m3 for the purpose of consumption or who receive hydrogen gas from other works through pipes for the purpose of consumption. For consumers of smaller quantities of high pressure gas, consumption standards are separately provided.		
Japan	High Pressure Gas Safety Law - Articles 40-56.2	Containers and accessories		
Japan	High Pressure Gas Safety Law - Articles 56.3 - 56.6	Designated Equipment		
Japan	General High Pressure Gas Safety Regulations - Article 6	Technical Standards for Stationary-type Production Equipment		
COUNTRY	**1.5 Safety Systems**	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
United States	ANSI Z21.83-1998: Fuel Cell Power Plants	The standard applies to packaged, self-contained or factory matched packages of integrated systems of fuel cell power plants for use with natural gas or LP gas and having a maximum output voltage of 600 VAC and power output of 1000 kW	Steven E. Kasubski CSA International (216) 524-4990 X8303	The standard is being revised to more adequately more types of fuel cells and the fuels to be utilized and will become CSA FC 1
Canada	CGA-P-12	Safe Handling of Cryogenic Liquids		
Canada	CGA-S-1	Pressure Relief Device Standards (Parts 1, 2 and 3)		
Japan	Industrial Safety and Health Regulations			
Japan	Safety Regulations for Boilers and Pressure Vessels			
Japan	Regulations Concerning the Control of Dangerous Substances			
Japan	High Pressure Gas and Safety Law - Article 35	Safety Inspection		
Japan	Industrial Complex Safety Regulations	This regulation applies controls similar to those of the General High Pressure Gas Safety Regulations to stationary-type production equipment used at designated production works (larger works than the specified scale located in petroleum complex areas, or large-scale works located in other areas).		
Japan	Industrial Safety and Health Law	The Law promotes comprehensive, systematic policies for industrial accident prevention, thereby ensuring the safety and health of workers in the workplace and developing a comfortable working environment. This law controls Class 1 and Class 2 containers that are not subject to the High Pressure Gas Safety Law.		
Japan	Fire Service Law	This law provides guidelines to prevent, guard against and extinguish fires; and to alleviate damage caused by disasters, including fires and earthquakes. The law stipulates minimum safety distance between the hydrogen gas facility and the facility for production, storage or handling of designated dangerous substances.		
COUNTRY	**1.6 Interfacing (with Building or Utility Interconnection)**	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	1.6.1 Piping			

United States	ANSI Z21.83-1998: Fuel Cell Power Plants	The standard applies to packaged, self-contained or factory matched packages of integrated systems of fuel cell power plants for use with natural gas or LP gas and having a maximum output voltage of 600 VAC and power output of 1000 kW	Steven E. Kasubski CSA International (216) 524-4990 X8303	The standard is being revised to more adequately more types of fuel cells and the fuels to be utilized and will become CSA FC 1
United States	NFPA 853: Standard for the Installation of Stationary Fuel Cell Power Plants	The standard covers siting requirements, fuel storage arrangements, exhaust requirements and fire protection requirements for stationary fuel cell plants exceeding 50 kW for non-residential applications	Richard P. Bielen NFPA International (617) 770-3000	The standard is in the process of being revised to include small fuel cell applications for residences
United States	NFPA 58: Liquified Petroleum Gas Code	This code applies to the highway transportation of LP gas and to the design, construction, installation and operation of all LP gas systems.	Theodore C. Lemoff NFPA International (617) 984-7434	The code hs been published and is available for sale.
United States	NFPA 54: National Fuel Gas Code	The Code covers installation of fuel gas piping systems, fuel gas utilization equipment and related accessories on consumers' premises. The Code covers fuel gas systems operating at a maximum pressure of 125 psi.	Theodore C. Lemoff NFPA International (617) 984-7434	NFPA 54 is a published code available for purchase.
Canada	CGA-V-6	Standard Cryogenic Liquid Transfer Connections		
Canada	UL 842	Standard for Valves for Flammable Fluids		
Japan	JIS B2238	General Rules for Cast Iron Flanges		
Japan	JIS B2238	General Rules for Steel Flanges		
Japan	General High Pressure Gas Safety Regulations - Articles 6 and 50	Definitions for Pipe Standards		
Japan	General High Pressure Gas Safety Regulations - Article 53	Defines the notification report of consumption		
	1.6.2 Electrical			
United States	ANSI Z21.83-1998: Fuel Cell Power Plants	The standard applies to packaged, self-contained or factory matched packages of integrated systems of fuel cell power plants for use with natural gas or LP gas and having a maximum output voltage of 600 VAC and power output of 1000 kW	Steven E. Kasubski CSA International (216) 524-4990 X8303	The standard is being revised to more adequately more types of fuel cells and the fuels to be utilized and will become CSA FC 1
United States	NFPA 70: National Electric Code (Article 692)	2002 edition of National Electric Code includes new Article 692 that covers electrical installation requirements for fuel cell systems	Jean O'Conner NFPA International (617) 984-7421	Existing Standard
United States	UL 1741: Standard for Inverters, Converters and Controllers for Use in Independent Power Systems	This standard covers requirements that distributed generators must satisfy in order to operate properly when interconnected to the utility grid. It is being modified to cover fuel cell systems for stationary and portable applications. In addition, the plan is to adopt the requirements in IEEE P1547.	Tim Zgonena Underwriters Laboratories (847) 272-8800 X4305	Working Group is working to reach a consensus with IEEE P1547. Draft is expected to be available in June 2002.
United States	IEEE P1547: Standard for Interconnecting Distributed Resources with Electric Power Systems	This standard establishes criteria and requirements for the interconnection of distributed generating systems with electric power systems. It covers requirements regarding performance, operation, testing, safety considerations and maintenance of the interconnection.	Richard DeBlasio NREL (303) 275-3753	Draft 9 of the standard is in the review process.
United States	IEEE P1608: Application Guide for IEEE Standard 1547 for Interconnecting Distributed resources with Electric Power Systems	The Guide provides technical background and application details to support the understanding of IEEE P1547.	Richard DeBlasio NREL (303) 275-3753	The Guide exists as a working draft.
United States	IEEE P1614: Guide for Monitoring Information Exchange and Control of Distributed Resources Interconnected with Electric Power Systems	This proposed Guide will provide guidelines for monitoring, information exchange, and control for distributed resources (e.g., fuel cells, PV) interconnected with electric power systems.	Richard DeBlasio NREL (303) 275-3753	Development of the Guide is in progress.
Canada/United States	NFPA 497	Recommended Practice for Classification of Class 1 Hazardous Locations for Electrical Installations in Chemical Plants		
Canada	NFPA 77 - Recommended Practice on Sta	Provides recommendations for conductive equipment, bonding and grounding		
Canada/United States	NFPA 78	Lighting Protection Code		
Canada/United States	NFPA 493	Intrinsically Safe Apparatus and Associated Apparatus for Use in Class 1,2 and 3 Division 1 Hazardous Locations		
Canada/United States	NFPA 496	Purged and Pressurized Enclosures for Electrical Equipment in Hazardous (classified) Locations		
Canada	CSA-C22.2 No 145	Motors and Generators for (1972) Use in Hazardous Locations. Class 1, Groups C and D Class 2, Groups E, F and G		
Canada	CSA-C22.2 No 157	Intrinsically Safe and Non Incendive Equipment for Use in Hazardous Location (1979)		
Japan	JEC 156	Japan Electric Codes		
	1.6.3 Controls and Sensors			

United States	ANSI Z21.83-1998: Fuel Cell Power Plants	The standard applies to packaged, self-contained or factory matched packages of integrated systems of fuel cell power plants for use with natural gas or LP gas and having a maximum output voltage of 600 VAC and power output of 1000 kW	Steven E. Kasubski CSA International (216) 524-4990 X8303	The standard is being revised to more adequately more types of fuel cells and the fuels to be utilized and will become CSA FC 1
Canada	CSA-C22.2 No. 152-1976	Combustible Gas-Detection Instruments		
	1.6.4 Connectors			
	1.6.5 Other			
Japan	The Building Standard Law	This law was enacted to safeguard the life, health, and property of people by providing minimum standards concerning the site, structure, equipment, and use of buildings and to contribute to the promotion of public welfare. Stipulates building controls for each land-use zone. For hydrogen the Law prescribes the maximum storage volume for each land-use Zone.		
COUNTRY	**1.7 Issues Relating to or Use of Rejected Heat**	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
Japan	JIS S8412	General Safety Code for Industrial Combustion Furnaces		
COUNTRY	**1.8 O&M Issues, Operating Instructions and Safety**	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
International	IEC TC105 Working Group 3: Safety of Stationary Fuel Cell Power Plants	The Working Group is developing a standard that addresses safety requirements (design and performance) for packaged stationary fuel cell power plants. The standard will parallel ANSI Z21.83 and similar standards in Canada, Japan and Germany.	Kelvin Hecht International Fuel Cells (860) 673-9181	The Working group is in the process of developing the initial draft. This is expected to be completed by October 2002.
United States	CSA FC1: Fuel Cell Power Plants	The document applies to fuel cell systems for stationary applications having maximum output voltage of 600 V and power output up to 10 Mw. CSA America Fuel Cell Technical Advisory Committee proposes CSA FC 1 to be the revised, enhanced version of ANSI Z21.83	Steven E. Kasubski CSA International (216) 524-4990 X8303	Draft of CSA FC 1 released for review after the April 2002 meeting of the Committee
United States	ANSI Z21.83-1998: Fuel Cell Power Plants	The standard applies to packaged, self-contained or factory matched packages of integrated systems of fuel cell power plants for use with natural gas or LP gas and having a maximum output voltage of 600 VAC and power output of 1000 kW	Steven E. Kasubski CSA International (216) 524-4990 X8303	The standard is being revised to more adequately more types of fuel cells and the fuels to be utilized and will become CSA FC 1
Canada	NFPA 30	Flammable and Combustible Liquid Codes		
Canada	National Fire Code of Canada			
COUNTRY	**1.9 Testing and Evaluation Procedures**	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
United States	CSA CAS No. 33: Component Acceptance Service for PEM Fuel Cell Modules	The document contains specifications for providing CSA International component acceptance service for PEM fuel cells stacks using hydogen as the fuel		Document published and available for sale
United States	ASME PTC 50: Performance Test Code for Fuel Cell Power System Performance	Covers testing procedures, methods and definitions for assessing the performance characteristics of all types of fuel cell systems with respect to rated inputs and outputs or any other steady state conditions	Jack Karian ASME (212) 705-8552	Draft submitted to ANSI for 60-day public review period that began on 29 Mar 02. ANSI approval is expected in mid-2002
United States	NES Evaluation Protocol for Stationary Fuel Cell Power Plants	Protocol used by the NES to facilitate the process of evaluating stationary fuel cell power plants for compliance with US model codes	David Conover NES, Inc. (703) 931-2187	The Protocol exits and is in use
International	IEC TC105 Working Group 4: Performance of Fuel Cell Power Plants	The standard describes how to measure the performance of stationary fuel cell power systems from an operational and an environmental standpoint.	Kelvin Hecht International Fuel Cells (860) 673-9181	The Working Grooup completed the draft in January 2002. During the period 8 Feb 02 - 10 May 02, it was in the review process. The WG will meet in June to address review comments.
United States	IEEE P1589: Standard for Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems	The standard specifies the type, production and commissioning tests that are to be performed to demonstrate that the interconnection functions and that the distributed resource equipment conforms to IEEE P1547	Richard DeBlasio NREL (303) 275-3753	

Japan	TRC 0003	Test Methods for Performance of Phosphoric Acid Fuel Cell Power Facility		
Japan	TRC 0004	Test Methods for Environment and Maintenance of Phosphoric Acid Fuel Cell Power Facility		
Japan	JIS C1302	Insulation Resistance Testers		
COUNTRY	**1.10 Other Issues**	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
United States	UL 2265: Replacement Fuel Cell Power Units for Appliances (Covers an appliance that generates DC from hydrogen for stationary applications)	This standard will cover stand-alone fuel cell power systems that may be connected within the enclosure of an appliance by a flexible cord and plug or other arrangement (auxiliary power supply)	Harry Jones Underwriters Laboratories (847) 664-2948	Underwriter Laboratories is working to develop this standard.
2.0	TRANSPORTATION APPLICATIONS			
COUNTRY	**2.1 Fuel Cells**	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	2.1.1 Fuel Cell Hardware			
Japan	JISC8800/TR C001	Glossary of terms for fuel cell power systems in 2000		
United States	SAE J2574: Fuel Cell Electric Vehicle Terminology	The standard covers terminology for fuel cell-powered electric vehicles		Published in March 2002 and available for sale
United States	SAE J2594: Fuel Cell Recyclability Guidelines	The document covers recyclability guidelines only for PEM fuel cell stacks and ancillary components		Working group is expected to complete the document and send it to committee ballot in early October/November 2002
International	IEC TC105 Working Group 1: Terminology	The document provides uniform terminology in the form of diagrams, definitions and equations related to fuel cell technologies for all applications. It is intended to be a resource for the other IEC TC 105 working groups.	Kelvin Hecht International Fuel Cells (860) 673-9181	Revised draft of the technical report is in the review process.
International	IEC TC105 Working Group 2: Fuel Cell Modules	The Working Group is developing a standard that addresses the safety and performance of fuel cell modules.	Kelvin Hecht International Fuel Cells (860) 673-9181	The draft standard was completed in January and was in the review process from 2 Feb 02 - 10 May 02. The WG will meet in June 2002 to address review comments.
International	IEC TC105 Working Group 6: Fuel Cell Systems for Propulsion and Auxiliary Power Units	The Working Group will develop a standard regarding the safety and performance of fuel cells for automotive propulsion, automotive auxiliary power units and for non-automotive propulsion applications.	Kelvin Hecht International Fuel Cells (860) 673-9181	The Working Group was recently established and will have its first meeting in June 2002. It is expected that the draft will be completed by January 2003.
	2.1.2 Factory Installation			
COUNTRY	**2.2 Fuel Processor/Reformers**	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	2.2.1 Vehicle-Installed Reformer Hardware			
	2.2.2 Factory Installation			
COUNTRY	**2.3 Internal Combustion Engines (ICEs)**	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	2.3.1 ICE Hardware			
	2.3.2 Factory Installation			

COUNTRY	2.4 Fuels for Fuel Cells and Hydrogen ICEs	DESCRIPTION	TECHNICAL CONTACTS	STATUS
United States	SAE J2579: Fuel Systems for Fuel Cell Vehicles	The document provides criteria for systems containing or processing fuel or other hazardous materials		Working Group is expected to complete the document in the November 2002; ballot targeted for December 2002
COUNTRY	**2.5 Fuel Storage and Fueling Equipment (on Board)**	**DESCRIPTION**	**TECHNICAL CONTACTS**	**STATUS**
International	ISO 13984:1999 Liquid Hydrogen	Land vehicle fueling system interface		
United States	ANSI/CSA NGV2-2000: Basic Requirements for Compressed Natural Gas Vehicle Fuel Containers	The document specifies requirements for CNG storage systems in addition to requirements in FMVSS304	Julie Cairns CSA International (216) 524-4900	Published and available for sale
United States	SAE 2600: Compressed Hydrogen Vehicle Fueling Connection Devices	The document defines the geometries of the receptacles for different hydrogen gas pressure levels	0	The document was successfully balloted in April 2002. It is expected to be published in July/August 2002.
United States	SAE J2601: Compressed Hydrogen Surface Vehicle Fueling Communication Devices	The document defines the different fueling strategies. It also develops the strategies and protocols for what fueling with and without communications should entail.	0	Work on the document is in progress. The Working Group expects to cocmplete it in the summer of 2003.
United States	SEA J1616: Recommended Practices for Compressed Natural Gas Vehicle Fuel	Covers recommendations regarding composition of fuels for CNG vehicles	0	Published and available for sale
United States	ANSI/CSA NGV1-1994: CNG Fueling Connection Devices	Covers CNG vehicle fueling connection devices assuring standardized nozzles and receptacles	Julie Cairns CSA International (216) 524-4900	Published and available for sale
United States	ANSI/CSA PRD1-1998: Basic Requirements for Pressure Relief Devices for NGV Fuel Containers	Covers pressure relief devices for CNG fuel tanks for vehicles	Julie Cairns CSA International (216) 524-4900	Published and available for sale
United States	ANSI/CSA NGV4.1-1999: NGV Dispensing Systems	Covers fuel dispensing devices for CNG vehicles	Tony Caudillo CSA International (416) 747-2212	Published and available for sale
United States	ANSI/CSA NGV4.2-1999: Hoses for NGV and Dispensing Systems	Covers CNG dispensers and vehicle hose assemblies for CNG vehicles	Tony Caudillo CSA International (416) 747-2212	Published and available for sale
United States	ANSI/CSA NGV4.4-1999: Breakaway Devices for Natural Gas Dispensing Hoses and Systems	Covers CNG dispenser shear values and fueling hose emergency breakaway shutoff devices for CNG vehicles	Tony Caudillo CSA International (416) 747-2212	Published and available for sale
United States	NFPA 52: Compressed Natural Gas Vehicular Fuel Systems Code	Currently, the standard covers design and installation of compressed natural gas engine fuel systems for vehicles of all types	Carl Rivkin NFPA International (617) 984-7418	The 2005 edition of NFPA 52 will be expanded to include hydrogen (requirements will not conflict with Federal or state regulations)
Canada	CGSB 43-GP-147 - Construction of Tank Car Tanks and Selection and use of Tank Car Tanks, Portable Tanks and Rail Cars for the Transportation of Dangerous Goods by Rail	Requirements for the construction and maintenance of single and multi-unit tank car tanks and for the selection, use, handling and filling of these tanks used in the transportation in bulk, by rail, of dangerous goods, including cryogenic and gaseous hydrogen.	0	0
Canada	CGA-341	Standard for Insulated Tank Truck Specifications for Cryogenic Liquids	0	0
International	ISO-TC197 WG2 &WG6On Board Storage			
COUNTRY	**2.6 Hydrogen System Interfacings with Vehicle**	**DESCRIPTION**	**TECHNICAL CONTACTS**	**STATUS**
Japan	High Pressure Gas Safety Law - Article 23	Transportation		
Japan	General High Pressure Gas Safety Regulations - Article 8	Technical Standards for Class 2 Producers		
United States	SAE FCSC Interface Working Group	Frank Niezabytowski Ford Motor Company (313) 322-9657		
International	ISO-TC197 Working Group 5: Gaseous Hydrogen Blends and Hydrogen Fuel - Land Vehicle Filling Connectors			

COUNTRY	**2.7 Safety Systems**			
Canada	CGA-P-12	Safe Handling of Cryogenic Liquids		
Canada	CGA-S-1 Parts 1-3	Pressure Relief Device Standards		
Canada/United States	NFPA 385	Standard for Tank Vehicles for Flammable and Combustible Liquids		
Japan	Industrial Safety and Health Law	The Law promotes comprehensive, systematic policies for industrial accident prevention, thereby ensuring the safety and health of workers in the workplace and developing a comfortable working environment. This law controls Class 1 and Class 2 containers that are not subject to the High Pressure Gas Safety Law.		
Japan	Safety Regulations for boilers and Pressure Vessels			
Japan	Industrial Safety and Health Regulations			
Japan	TGC 001-1999	A guideline - Safety display of valve regulated lead-acid batteries for electric vehicles		JEVA
Japan	TGZ 002-1999	A guideline - Display of charge information for electric vehicles.		JEVA
Japan	General High Pressure Gas Safety Regulations - Articles 53 and 55			
COUNTRY	**2.8 O & M Issues, Operating Instructions and Safety**	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
United States	SAE J2578: Recommended Practices for General Fuel Cell Vehicle Safety	The document provides criteria for integration of fuel cell systems into vehicles and defines emergency response and maintenance requirements for safe use of fuel cell vehicles		The document has been approved by committee ballot and is in the pre-publication phase. It is expected to be available for sale in July/August 2002.
United States	SAE J2579: Recommended Practices for Hazardous Fluid Systems in Fuel Cell Vehicles	The document provides criteria for systems containing or processing fuel or other hazardous materials		Working Group is expected to complete the document in the November 2002; ballot targeted for December 2002
United States	SAE J2594: Fuel Cell Recyclability Guidelines	The document covers recyclability guidelines only for PEM fuel cell stacks and ancillary components		Working group is expected to complete the document and send it to committee ballot in early October/November 2002
International	ISO-TC197 Working Group 8: Hydrogen Generators Using Water Electrolysis Process		Randy Dey ISO TC 197 ((905) 847-7811	
Japan	General High Pressure Gas Safety Regulations - Article 53	Notification Report of Consumption Concerning Specific High Pressure Gas Consumers		
COUNTRY	**2.9 Testing and Evaluation Procedures**	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
United States	SAE J2572: Recommended Practice for Measuring the Exhaust Emissions, Energy Consumption and Range of Fuel Cell Powered Electric Vehicles Using Compressed Gaseous Hydrogen	The document covers recommended practices for fuel cell vehicles using compressed hydrogen gas supplied by an on-board reformer.		Working Group is addressing comments from CARB and EPA. It is expected to be completed and sent to committee ballot in April/May 2002.
United States	SAE J2615: Performance Test Procedures of Fuel Cell Systems for Automotive Applications	The standard covers procedures for testing complete Polymer Electrolyte Membrane (PEM) fuel cell systems		Working Group expected to complete the document and send it to committee ballot in October 2002
United States	SAE J2616: Performance Test Procedures for the Fuel Processor Subsystem of Automotive Fuel Cell System	The standard covers performance test procedures for testing fuel processor subsystems for automotive fuel cell systems		Working Group is in final stages of completing the document. It is expected to be sent for committee ballot in October 2002.
United States	SAE J2617: Performance Test Procedures of PEM Fuel Cell Stack Subsystem for Automotive Applications			

United States	ASME PTC 50: Performance Test Code for Fuel Cell Power System Performance			
United States	CSA CAS No. 33: Component Acceptance Service for PEM Fuel Cell Modules	The document contains specifications for providing CSA International component acceptance service for PEM fuel cells stacks using hydogen as the fuel.	Todd Strothers CSA International (704) 552-5125	Document published and available for sale
International	ISO-PWD17374: Measurement of Hydrogen Emissions During Battery Charging			
COUNTRY	**2.10 Other**	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
Japan	The Road Vehicles Act	Provide for the traffic weight control and regulations on vehicles and ships used for transportation, in view of hazardous situations that may occur during transport.		
Japan	Road Traffic Law	Provide for the traffic weight control and regulations on vehicles and ships used for transportation, in view of hazardous situations that may occur during transport.		
3.0	PORTABLE APPLICATIONS			
COUNTRY	**3.1 Fuel Cells (Packaged Systems)**	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
	3.1.1 Fuel Cell Hardware			
International	IEC 62282 - 5 Ed. 1.0 - Portable Fuel Cell Technologies	Fuel Cell Technologies - Part 5: Portable fuel cell appliances - safety and performance requirements		
United States	CSA FC 3: Portable Fuel Cell Power Generators	This document is intended to be a standard for portable fuel cell power generators, regardless of technology. It applies to AC and DC portable fuel cell generators with a rated output voltage not exceeding 600 V. It covers generators for commercial, industrial and residential use - indoor and outdoor.	Todd Strothers CSA International (704) 552-5125	Working Group has generated a draft that is in the review process. It is possible that it will be voted on before the end of 2002.
United States	CSA U.S. Requirements No. 3.01: Portable Fuel Cell Appliances (To be revised as CSA FC 3?)	This document establishes the basis for generation of the standard CSA FC 3: Portable Fuel Cell Power Generators.	Todd Strothers CSA International (704) 552-5125	The document has been published and is available for sale.
International	IEC TC105 Working Group 1: Terminology	The document provides uniform terminology in the form of diagrams, definitions and equations related to fuel cell technologies for all applications. It is intended to be a resource for the other IEC TC 105 working groups.	Kelvin Hecht International Fuel Cells (860) 673-9181	Revised draft of the technical report is in the review process.
International	IEC TC105 Working Group 2: Fuel Cell Modules	The Working Group is developing a standard that addresses the safety and performance of fuel cell modules.	Kelvin Hecht International Fuel Cells (860) 673-9181	The draft standard was completed in January and was in the review process from 2 Feb 02 - 10 May 02. The WG will meet in June 2002 to address review comments.
International	IEC TC105 Working Group 7: Portable Fuel Cell Systems	The Working Group is developing a standard that covers the safety and performance of portable fuel cells. It will apply to AC and DC appliances with a rated voltage not exceeding 600 V in non-hazardous locations.	Kelvin Hecht International Fuel Cells (860) 673-9181	The Working Group is working to complete the draft standard by October 2003.
United States	UL2265: Replacement Fuel Cell Power Units for Appliances	This standard will cover stand-alone fuel cell power systems that may be connected within the enclosure of an appliance by a flexible cord and plug or other arrangement (auxiliary power supply)	Harry Jones Underwriters Laboratories (847) 664-2948	Underwriter Laboratories is working to develop this standard.
	3.1.2 Installation/ Setup			
United States	UL2262 Outline of Investigation for Portable PEM Fuel Cells with or without Uninterruptable Power and for Factory Installation in OEM Equipment for Indoor Use	This document will be used by Underwriter Laboratories as an interim protocol for certifying PEM fuel cell units	Harry Jones Underwriters Laboratories (847) 664-2948	The document is under development by Underwriters Laboratories

COUNTRY	3.2 Fuel Processor/Reformers	DESCRIPTION	TECHNICAL CONTACTS	STATUS
	3.2.1 Reformer Hardware			
	3.2.2 Reformer Setup			
COUNTRY	**3.3 Hydrogen Generators**	**DESCRIPTION**	**TECHNICAL CONTACTS**	**STATUS**
	3.3.1 Hardware			
United States	UL 2264: Gaseous Hydrogen Generating Appliances	The standard covers portable, stationary and fixed gaseous hydrogen generating appliances rated at 120 V or greater. The standard includes electrolysis systems and reformers.	Harry Jones Underwriters Laboratories (847) 664-2948	This is a standard that Underwriter Laboratories is preparing to develp
United States	CSA Requirement No. 5.99 U.S.: Hydrogen Generators	The document establishes specifications for developing standards for hydrogen generators.	Todd Strothers CSA International (704) 552-5125	The document was published in July 2001.
International	ISO-TC197 Working Group 8: Hydrogen Generators Using Water Electrolysis Process		Randy Dey ISO TC 197 ((905) 847-7811	
	3.3.2 Installation and/or Setup			
	3.3.3 Operation and Safety			
COUNTRY	**3.4 Fuels for Fuel Cells**	**DESCRIPTION**	**TECHNICAL CONTACTS**	**STATUS**
COUNTRY	**3.5 Fuel Storage, Ancillary Equipment and Dispensing (At the End Use)**	**DESCRIPTION**	**TECHNICAL CONTACTS**	**STATUS**
International	ISO-TC197 WD16111 - Portable Hydride Storage	Transportable gas storage devices - hydrogen absorbed in reversible metal hydride		
Canada/United States	NFPA 386	Standard for Portable Shipping Tanks for Flammable and Combustible Liquids		
Japan	High Pressure Gas Safety Law - Articles 24.2 and 25.2	Controls as high pressure gas consumers, those storing hydrogen gas of not less than 300m3 for the purpose of consumption or who receive hydrogen gas from other works through pipes for the purpose of consumption.		
Japan	The Road Vehicles Act - Articles 2 and 47	Provide standards for vehicles and for flammable gas transportation		
COUNTRY	**3.6 Interfaces Between Portable System and End-Use**	**DESCRIPTION**	**TECHNICAL CONTACTS**	**STATUS**
	3.6.1 Electrical			**STATUS**
	3.6.2 Structural/Attachment			
COUNTRY	**3.7 Safety Systems**	**DESCRIPTION**	**TECHNICAL CONTACTS**	**STATUS**

COUNTRY	3.8 O&M, Operating Instructions and Safety Issues	DESCRIPTION	TECHNICAL CONTACTS	STATUS
Canada/United States	ANSI Std, Z48.1	American Standard Method of Marking Portable Compressed Gas containers to identify the Material Contained		
Japan	General High Pressure Gas Safety Regulations - Article 53	Notification Report of Consumption Concerning Specific High Pressure Gas Consumers		
Japan	General High Pressure Gas Safety Regulations - Article 55	Technical Standards for Specific High Pressure Gas Consumers		
COUNTRY	**3.9 Testing and Evaluation Procedures**	**DESCRIPTION**	**TECHNICAL CONTACTS**	**STATUS**
United States	ASME PTC 50: Performance Test Code for Fuel Cell Power System Performance	Covers testing procedures, methods and definitions for assessing the performance characteristics of all types of fuel cell systems with respect to rated inputs and outputs or any other steady state conditions	Jack Karian ASME (212) 705-8552	Draft submitted to ANSI for 60-day public review period that began on 29 Mar 02. ANSI approval is expected in mid-2002
United States	CSA CAS No. 33: Component Acceptance Service for PEM Fuel Cell Modules	The document contains specifications for providing CSA International component acceptance service for PEM fuel cells stacks using hydogen as the fuel.	Todd Strothers CSA International (704) 552-5125	Document published and available for sale
4.0	HYDROGEN INFRASTRUCTURE			
United States	NFPA 50A - Standard for Gaseous Hydrogen Systems at Consumer Sites	Specifies setback distances relative to other structures, overhead power lines, stores of cumbustible or hazardous materials and places of public assembly.		
United States	NFPA 52 Compressed Natural Gas Vehicular Fuel Systems	Specifies electrical classifications and setback distances.		
United States	NFPA 50B - Standards for Liquified Hydrogen Systems at Consumer Sites	Specifies setback distances relative to other structures, overhead power lines, stores of cumbustible or hazardous materials and places of public assembly. Special requirements for liquid H2 vaporizers to handle thermal expansion and contraction, and the potential for excessive pressure buildup.		
United States	CGA G-5.5 Hydrogen Vent Systems	Presents design guidelines for hydrogen vent systems for gaseous and liquid hydrogen installations at consumer sites; provides recommendations for safe operation.		
Canada	CGA-G-5 Hydrogen	A complete monograph with physical properties is included, as well as how hydrogen is made, used, contained and transported.		
Canada/United States	NFPA 30	Flammable and Combustible Liquid Codes		
Canada	Canadian Electrical Code	This code deals with hazardous locations - areas where fire or explosion hazards my exist due to the presence of flammable or ignitable material.		
Japan	High Pressure Gas Safety Law	Regulates the production, storage, sale, transportation, and other matters concerning the handling and consumption of high pressure gases, as well as the manufacture and handling of containers in order to prevent disasters caused by high pressure gas.		
Japan	Fire Service Law	This law provides guidelines to prevent, guard against and extinguish fires; and to alleviate damage caused by disasters, including fires and earthquakes. The law stipulates minimum safety distance between the hydrogen gas facility and the facility for production, storage or handling of designated dangerous substances.		

Japan	Industrial Safety and Health Law	Promotes comprehensive, systematic policies for industrial accident prevention; defines responsibilities and encourage autonomous safety activities thereby ensuring the safety and health of workers and developing a comfortable working environment. Includes provisions concerning pressure vessels as part of the establishment of injury prevention standards, and demands the appointment of an Operation Chief as a means of defining responsibilities.		
Japan	Designated Equipment Inspection Regulations			
Japan	The Law on the Prevention of Disasters in Petroleum Industrial Complexes and Other Petroleum Facilities	Defines fundamental provisions concerning prevention of disasters and accidents relating to special disaster prevention districts in consideration of special characteristics f such disasters and accidents. The Law introduces two categories regarding mass handling of hydrogen based on handling volume, and specifies disaster prevention standards in detail for each class.		
COUNTRY	**4.1 Hydrogen Production**	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
International	ISO 13984:1999 Liquid Hydrogen	Land vehicle fueling system interface		
International	ISO/NP 16110 Hydrogen Generators Using Fuel Processing Technologies			
United States	UL 2264: Gaseous Hydrogen Generating Appliances	The standard covers portable, stationary and fixed gaseous hydrogen generating appliances rated at 120 V or greater. The standard includes electrolysis systems and reformers.	Harry Jones Underwriters Laboratories (847) 664-2948	This is a standard that Underwriter Laboratories is preparing to develp
International	ISO-TC197 Working Group 8: Hydrogen Generators Using Water Electrolysis Process			
Canada/United States	CGA G-5: Hydrogen	This document covers the properties, manufacturing, transportation, storage and use of gaseous hydrogen. It also includes a section on liquified hydrogen.		The document is published and available for sale.
United States	CGA G-5.3: Commodity Specification for Hydrogen	The guide book describes specification requirements for commercially available gaseous and liquid hydrogen. It provides data on quality verification, sampling, analytical procedures, typical uses for various grades and containers.		The document is published and available for sale.
International	ISO 14687:1999 Hydrogen Fuel	Hydrogen fuel product specification		
Japan	Industrial Complex Safety Regulations	Apply controls to stationary type production equipment used at designated production works. Also defines technical standards for production equipment, pipes and communication.		
Japan	General High Pressure Gas Safety Regulations - Articles 6 and 8	Article 6 establishes technical standards for stationary-type production equipment. Article 8 establishes technical standards for movable production equipment. These Articles also regulate technical standards for equipment, including provisions concerning materials used, pressure proof test, air tightness test, wall thickness, installation of such equipment as manometers, safety valves and check valves, electrical equipment, piping and valves, etc.		
Japan	Industrial Safety and Health Regulations			
Japan	General High Pressure Gas Safety Regulations - Article 12			
United States	CGA P-6: Standard Density Data, Atmospheric Gases and Hydrogen	The document provides tables that present standard density data and volumetric conversion factors for atmospheric gases and hydrogen for the benefit of producers and users.		The document is published and available for sale.
COUNTRY	**4.2 Hydrogen Transportation and Distribution**	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***

International	ISO/CD 11114-4 - Transportable gas cylinders	Compatability of cylinder and valve materials with gas contents and test method for hydrogen compatibility with metals		
International	ISO-TC197 Working Group 2: Tank Containers for for Multimodal Transportation of Liquid Hydrogen			
United States	ASME B31.4: Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids	This Code prescribes requirements for the design, materials, construction, assembly, inspection, and testing of piping transporting liquids such as crude oil, condensate, natural gasoline, natural gas liquids, liquefied petroleum gas, etc. between producers' lease facilities, tank farms, natural gas processing plants, refineries, stations, ammonia plants, terminals (marine, rail and truck) and other delivery and receiving points.		Published in 1998 and available for sale
United States	ASME B31.8: Gas Transmission and Distribution Piping Systems	This Code covers the design, fabrication, installation, inspection, testing, and safety aspects of operation and maintenance of gas transmission and distribution systems, including gas pipelines, gas compressor stations, gas metering and regulation stations, gas mains, and service lines up to the outlet of the customers meter set assembly.		Published in 2000 and available for sale
United States	DOT 49 Code of Federal Regulations (CFR) Transportation Equipment and Transport of Hazardous Materials			
United States	CGA G-5.4: Standard for Hydrogen Piping Systems at Consumer Locations	The standard covers materials and components selection to help install a safe, effective hydrogen supply system at a user's site.		The standard is published and available for sale.
United States	NFPA 58: Liquified Petroleum Gas Code	This code applies to the highway transportation of LP gas and to the design, construction, installation and operation of all LP gas systems.	Theodore C. Lemoff NFPA International (617) 984-7434	The code hs been published and is available for sale.
Canada/United States	NFPA 386	Standard for Portable Shipping Tanks for flammable and combustible liquids		
Canada	CAN/CSA B339 - Cylinders, Spheres and Tubes for the Transportation of Dangerous Goods	Provides requirements for the manufacturing, inspection, testing, marking requalification, reheat treatment, repair and rebuilding of containers for the transportation of dangerous goods. It specifies containers used for cryogenic service such as liquid hydrogen as well as containers for gaseous hydrogen.		
Canada	CAN/CSA B340 - Selection and Use of Cylinders, Spheres and Tubes and Other Containers for the Transportation of Dangerous Goods, Class 2	Provides safety requirements for the selection and use and requirements for the handling and filling of containers. It specifies which containers are to be used for the various dangerous goods including refrigerated liquid hydrogen.		
Canada	CAN/CSA B620 - Highway Tanks and Portable Tanks for the Transportation of Dangerous Goods	Requirements for the design, manufacturing, certification, testing, inspection and retesting, maintenance and marking of highway tanks and portable tanks for the transportation of dangerous goods; including specifications for containers used for liquid and gaseous hydrogen.		
Canada	CAN/CSA B622 - Selection and Use of Highway Tanks, Multi-Unit Tank Car Tanks, and Portable Tanks for the Transportation of Dangerous Goods, Class 2, by road	Requirements for the selection and use of tanks including those applicable to hydrogen refrigerated liquid		
Canada	CAN/CSA B629 - Recommended Practice on Shipping Documents for Transportation of Dangerous Goods	Applies to all dangerous goods, including hydrogen		
Canada	UN Transport Code	Transport of Dangerous Goods by Committee of Experts on the Transport of Dangerous Goods of the United Nations		
Canada	CSA Z 184-M	Gas Pipeline Systems		
Canada	CSA Z18451	Supplement No. 1 to Z184M (1979)		
Canada	CGA-V-6	Standard Cryogenic Liquid Transfer Connections		
Canada	UL 842	Standard for Valves for Flammable Fluids		
Canada/ United States	ASME Boiler and Pressure Vessel Code Section VIII, Division 1	For the construction of gaseous or liquid hydrogen storage vessels and hydrogen transportation		
Canada	IMDGC or IMCO Code	International Maritime Dangerous Goods Code		
Canada	TERMPOL Code	Code of Recommended Standards for the Safety and Prevention of Pollution for Marine Transportation Systems and related Assessment Procedures		
Canada	CSA B332.B-1978	Series 1 Freight Containers - Specification and Testing - Part III: Tank Containers for Liquids and Gasses (ISO 1596/111-74)		
Canada	IMO, IBC Code	Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk		

Canada	CGSB 43-GP-147 - Construction of Tank Car Tanks and Selection and use of Tank Car Tanks, Portable Tanks and Rail Cars for the Transportation of Dangerous Goods by Rail	Requirements for the construction and maintenance of single and multi-unit tank car tanks and for the selection, use, handling and filling of these tanks used in the transportation in bulk, by rail, of dangerous goods, including cryogenic and gaseous hydrogen.		
Japan	High Pressure Gas Safety Law - Article 23			
Japan	General High Pressure Gas Safety Regulations - Articles 48-50	Technical standards for transportation of high pressure gas. These standards are designed to prevent damage caused by collisions to containers fixed on vehicles.		
Japan	JIS B2238	General Rules for Cast Iron Flanges		
Japan	JIS B2238	General Rules for Steel Flanges		
Japan	The Road Vehicles Act - Articles 2 and 47	Stipulates the transport of hydrogen by land.		
Japan	Regulation on Maritime Transport			
COUNTRY	**4.3 Hydrogen Storage**	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
International	ISO-TC197 Working Group 2: Tank Containers for for Multimodal Transportation of Liquid Hydrogen			
International	ISO-TC58 Tanks and Hydrogen Embrittlement			
International	ISO-TC220 ASME Boiler and Pressure Vessel Code	The code covers specifications and requirements for storage containers for vehicles and for fueling stations		Published and available for sale
United States	NFPA 50A: Standard for Gaseous Hydrogen Systems at Consumer Sites (50A and 50B will be combined into NFPA 55)	Covers bulk gaseous hydrogen systems at user installations. Sets design criteria and sets separation distances from installations for 14 types of exposures	Carl Rivkin NFPA International (617) 984-7418	Existing Standard (Plans call for incorporating NFPA 50A and 50B into NFPA 55: Standard for Storage, Use and Handling of Compressed and Liquified Gases in Portable Cylinders)
United States	NFPA 50B: Standard for Liquified Hydrogen Systems at Consumer Sites (50A and 50B will be combined into NFPA 55)	Covers bulk liquified hydrogen systems at user installations. Sets design criteria and separation distances from installations for 12 types of exposures	Carl Rivkin NFPA International (617) 984-7418	Existing Standard (Plans call for incorporating NFPA 50A and 50B into NFPA 55: Standard for Storage, Use and Handling of
Canada/United States	CGA G-5: Hydrogen	This document covers the properties, manufacturing, transportation, storage and use of gaseous hydrogen. It also includes a section on liquified hydrogen.		The document is published and available for sale.
Canada	UL Std. 142	Standard for Steel Above Ground Tanks for Flammable and Combustible Liquids		
Canada/United States	NFPA 50B	Liquefied hydrogen systems at consumer sites		
Canada/United States	ASME Boiler and Pressure Vessel Code Section VIII, Division 1	For the construction of gaseous or liquid hydrogen storage vessels and hydrogen transportation		
Japan	High Pressure Gas Safety Law - Articles 24-25	Controls, as high pressure gas consumers, those storing hydrogen gas of not less than 300m3 for the purpose of consumption or who receive hydrogen gas from other works through pipes for the purpose of consumption. For consumers of smaller quantities of high pressure gas, consumption standards are separately provided.		
Japan	High Pressure Gas Safety Law - Articles 40 to 56-2	Classifies pressure vessels into those to be filled with high pressure gas for transportation (containers) and those used for production, storage, etc of high pressure gas (equipment).		
Japan	General High Pressure Gas Safety Regulations - Articles 20 and 25	Permission and notification report concerning storage.		
Japan	Industrial Safety and Health Law	The Law promotes comprehensive, systematic policies for industrial accident prevention, thereby ensuring the safety and health of workers in the workplace and developing a comfortable working environment. This law controls Class 1 and Class 2 containers that are not subject to the High Pressure Gas Safety Law.		
Japan	Container Safety Regulations	Regulate the standard of manufacturing method, container inspection, marking on containers, accessory standards, filling, reinspection of Containers/Accessories and Container Inspection Stations.		

COUNTRY	4.4 Refueling Stations	DESCRIPTION	TECHNICAL CONTACTS	STATUS
United States	ANSI/CSA NGV4.1-1999: NGV Dispensing Systems	Standard for fuel dispensing devices for CNG vehicles	Tony Caudillo CSA International (416) 747-2212	Published and available for sale
United States	ANSI/CSA NGV4.3: Temperature Compensation Devices for Natural Gas Dispensing Systems	Standard for temperature compensating systems for NG dispensing systems	Tony Caudillo CSA International (416) 747-2212	Standard being developed by Natural Gas Vehicle Coalition
United States	ANSI/CSA NGV4.5: Priority and Sequencing for Natural Gas Dispensing Systems	Standard for prioritizing and sequencing NG dispensing systems	Tony Caudillo CSA International (416) 747-2212	Standard being developed by Natural Gas Vehicle Coalition
Canada	NFPA 497	Recommended Practice for Classification of Class 1 Hazardous Locations for Electrical Installations in Chemical Plants		
Canada	NFPA 77 - Recommended Practice on Sta	Provides recommendations for conductive equipment, bonding and grounding		
Canada	NFPA 78	Lighting Protection Code		
Canada	NFPA 493	Intrinsically Safe Apparatus and Associated Apparatus for Use in Class 1,2 and 3 Division 1 Hazardous Locations		
Canada	NFPA 496	Purged and Pressurized Enclosures for Electrical Equipment in Hazardous (classified) Locations		
Canada	CSA-C22.2 No 145	Motors and Generators for (1972) Use in Hazardous Locations. Class 1, Groups C and D Class 2, Groups E, F and G		
Canada	CSA-C22.2 No 157	Intrinsically Safe and Non Incendive Equipment for Use in Hazardous Location (1979)		
COUNTRY	4.5 Service and Repair Facilities	DESCRIPTION	TECHNICAL CONTACTS	STATUS
Canada	NFPA 77 - Recommended Practice on Sta	Provides recommendations for conductive equipment, bonding and grounding		
Canada/United States	NFPA 78	Lighting Protection Code		
Canada/United States	NFPA 493	Intrinsically Safe Apparatus and Associated Apparatus for Use in Class 1,2 and 3 Division 1 Hazardous Locations		
Canada/United States	NFPA 496	Purged and Pressurized Enclosures for Electrical Equipment in Hazardous (classified) Locations		
Canada	CSA-C22.2 No 145	Motors and Generators for (1972) Use in Hazardous Locations. Class 1, Groups C and D Class 2, Groups E, F and G		
Canada	CSA-C22.2 No 157	Intrinsically Safe and Non Incendive Equipment for Use in Hazardous Location (1979)		
COUNTRY	4.6 Buildings	DESCRIPTION	TECHNICAL CONTACTS	STATUS
United States	ICC International Residential Code (Mechanical and Plumbing)	The code covers requirements for the construction of one- and two-family dwellings and townhouses up to three stories in height. The code also covers the plumbing and mechanical systems. It is being modified to include hydrogen systems.	Darren Meyers BOCA International (708) 799-2300 X307	The proposed changes to the IRC developed by the ICC Hydrogen Ad Hoc Committee that address hydrogen received final approbval at the ICC Code Change Final Actions Hearings in Oct 02 and will be incoroporated into the next edition of the Code.
United States	ICC International Fire Code	The code documents national standards that address fire safety comprehensively in new and existing buildings. The code is being modified to include hydrogen safety issues.	Darren Meyers BOCA International (708) 799-2300 X307	The proposed changes to the IFC developed by the ICC Hydrogen Ad Hoc Committee that address hydrogen received final approbval at the ICC Code Change Final Actions Hearings in Oct 02 and will be incoroporated into the next edition of the code.

United States	ICC International Fuel Gas Code	The document contains requirements for fuel gas piping system equipment and accessories. It contains combustion air requirements and sizing tables for venting Category I appliances. The code is being modified to include hydrogen as a fuel gas.	Darren Meyers BOCA International (708) 799-2300 X307	The proposed changes to the IFGC developed by the ICC Hydrogen Ad Hoc Committee that address hydrogen received final approbval at the ICC Code Change Final Actions Hearings in Oct 02 and will be incoroporated into the next edition of the Code.
United States	ICC International Mechanical Code	The document contains regulations regarding mechanical systems and equipment in the build enviornment -- including HVAC, exhaust systems, chimneys and vents, ducts, appliences, boilers, water ehaters, refrigeration, hydronic piping and solar systems. It is being updated to include Hydrogen	Darren Meyers BOCA International (708) 799-2300 X308	The proposed changes to the IBC developed by the ICC Hydrogen Ad Hoc Committee that address hydrogen received final approbval at the ICC Code Change Final Actions Hearings in Oct 02 and will be incoroporated into the next edition of the Code.
United States	ICC International Building Code	The Code addresses design and installation of building ssytems with requirements that emphasisze performance. It is being updated to include hydrogen systems.	Darren Meyers BOCA International (708) 799-2300 X309	The proposed changes to the IMC developed by the ICC Hydrogen Ad Hoc Committee that address hydrogen received final approbval at the ICC Code Change Final Actions Hearings in Oct 02 and will be incoroporated into the next edition of the Code.
United States	UL 1741: Standard for Inverters, Converters and Controllers for Use in Independent Power Systems	This standard covers requirements that distributed generators must satisfy in order to operate properly when interconnected to the utility grid. It is being modified to cover fuel cell systems for stationary and portable applications. In addition, the plan is to adopt the requirements in IEEE P1547.	Tim Zgonena Underwriters Laboratories (847) 272-8800 X4305	Working Group is working to reach a consensus with IEEE P1547. Draft is expected to be available in June 2002.
United States	IEEE P1547: Standard for Interconnecting Distributed Resources with Electric Power Systems	This standard establishes criteria and requirements for the interconnection of distributed generating systems with electric power systems. It covers requirements regarding performance, operation, testing, safety considerations and maintenance of the interconnection.	Richard DeBlasio NREL (303) 275-3753	Draft 9 of the standard is in the review process.
United States	NFPA Building Code			
United States	WFCA Uniform Fire Code			
United States	International Association of Plumbing and Mechanical Officials (IAPMO) Plumbing Code	The code covers plumbing engineering criteria and requirements for plumbing fixtures and fuel gas piping for new and existing residences.	Michael Kobel, IAPMO Director of Standards (909) 595-8449	
United States	International Association of Plumbing and Mechanical Officials (IAPMO) Mechanical Code	The code covers requirements for mechanical systems for new and existing homes.	Michael Kobel, IAPMO Director of Standards (909) 595-8449	
United States	NFPA 70: National Electric Code	2002 edition of National Electric Code includes new Article 692 that covers electrical installation requirements for fuel cell systems	Jean O'Conner NFPA International (617) 984-7421	Existing Standard
United States	CGA G5.5: Hydrogen Vent Systems	The standard presents guidelines for hydrogen vent systems for gaseous and liquid hydrogen installations at consumer sites. It also provides recommendations regarding safe operation.		The standard has been published and is available for sale.
Canada/United States	NFPA 50 A	Liquefied Hydrogen Systems at Customer Sites		
Canada/United States	NFPA 50 B	Gaseous Hydrogen Systems at Customer Sites		
Canada/United States	NFPA 68	Guide for Explosion Venting		
Canada/United States	NFPA 220	Standards on Types of Building Construction		
Canada	National Building Code			
Canada	Provincial Building Code			
Canada	Municipal Building Code			
Japan	JEC 156	Japan Electrical Codes		
COUNTRY	**4.7 Safety, Emergency Response and Other Issues**	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
United States	NFPA 49 - Hazardous Chemicals Data			

United States	NFPA 325 - Guide to Fire Hazard Properties of Flammable Liquids, Gases and Volatile Solids			
United States	NFPA 491 - Guide ot Hazardous Chemical Reactions			
United States	NFPA 704 - Standard System for the Identification of the Hazards of Materials for Emergency Response			
International	ISO/WD TR 15916 - Hydrogen System Safety	Basic considerations for the safety of hydrogen systems		
United States	NFPA 69 - Standard on Explosion Prevention Systems	Provides guidance for hydrogen vent systems		
United States	CGA P-1-1991:Safe handling of Compressed Gases in Containers			
United States	NFPA 70: National Electric Code	2002 edition of National Electric Code includes new Article 692 that covers electrical installation requirements for fuel cell systems	Jean O'Conner NFPA International (617) 984-7421	Existing Standard
United States	Part 1910 of 29 Code of Federal Regulations (CFR) Occupational Safety and Health Standards			
Canada	CGA-P-12	Safe Handling of Cryogenic Liquids		
Canada	CGA-S-1	Pressure Relief Device Standards (Parts 1, 2 and 3)		
Canada	CSA-C22.2 No. 152-1976	Combustible Gas-Detection Instruments		
Canada	Provincial Fire Code			
Canada	Municipal Fire Code			
Canada	National Fire Code of Canada			
Japan	Container Safety Regulations			
Japan	Designated Equipment Inspection Regulations	These Regulations define the scope of designated equipment, technical standards, design and material, processing, welding, and structure.		
Japan	General High Pressure Gas Safety Regulations Articles 79 to 83-2	These Articles regulate safety inspection and periodical self inspection.		
Japan	JEC 156	Japan Electrical Codes		
Japan	Regulations Concerning Control of Dangerous Substances - Article 12	Stipulates that among hydrogen-related facilities, facilities for production, and storage places should ensure a minimum distance of 20m from the facility for production, storage, or handling of dangerous substances.		
Japan	Explosive Control Law			
Japan	General High Pressure Gas Safety Regulations Articles 48-50	Provide standards to prevent damage of containers caused by collisions for containers fixed on vehicles such as tank trucks and trailers.		
5.0	CODES AND STANDARDS OF REGULATORY AND QUASI-REGULATORY ORGANIZATIONS			
COUNTRY	**5.1 US Department of Transportation**	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
United States	DOT 49 Code of Federal Regulations (CFR) Transportation Equipment and Transport of Hazardous Materials			
United States	DOT Emergency Response Guidebook (Guidebook for First Responders During the Initial Phase of A Dangerous Goods/Hazardous Materials Incident)			
COUNTRY	**5.2 Occupational Health and Safety Administration**	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
United States	Part 1910 of 29 Code of Federal Regulations (CFR) Occupational Safety and Health Standards			

COUNTRY	**5.3 European Integrated Hydrogen Project**	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
United States	EIHP Regulation: Approval of: Specific Components of Moter Vehicles Using Liquied Hydrogen; and vehicles with Regard to Installation of Specific Components for the Use of Liquid Hydrogen (Draft)	The scope of the regulation is: (1) specific components of motor vehicles using liquid hydrogen; and (2) vehicles with respect to the installation of specific componets for the use of liquid hydrogen. The regulation is for Europe.		The regulation exists as a draft (Revision 10)
United States	EIHP Regulation: Approval of: Specific Components of Moter Vehicles Using Compressed Gaseous Hydrogen; and Vehicles with Regard to the Installation of Specific Components for the Use of Compressed Gaseous Hydrogen (Draft)	The scope of the regulation is: (1) specific components of motor vehicles using compressed gaseous hydrogen; and (2) vehicles with respect to the installation of specific componets for the use of compressed gaseous hydrogen. The regulation is for Europe.		The regulation exists as a draft (Revision 7)
COUNTRY	**5.4 Other Organizations**	***DESCRIPTION***	***TECHNICAL CONTACTS***	***STATUS***
United States	California Air Resources Board (CARB)	CARB Emissions Regulations		
6.0	ANY OTHER USEFUL APPLICATIONS			
International	ISO/CD PAS 15594 - Airport hydrogen fueling facility			

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Engineering Advancement Association of Japan
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Japan Electric Power Information Center
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Japan Electrical Manufacturers' Association
http://www.jema-net.or.jp/
http://www.jema-net.or.jp/English/index.html

Japan Energy Research Center
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Hydrogen Research Institute
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ISO - International Organization for Standardization
http://www.iso.org/iso/en/ISOOnline.frontpage

Japan Automobile Manufacturers' Association
http://www.japanauto.com/

Japan Automobile Standards Internationalization Center
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Japan Electric Power Information Center
http://www.jepic.or.jp/

Japan Electric Vehicle Association
http://www.jeva.or.jp/top.html

Japan Electrical Manufacturers' Association
http://www.jema-net.or.jp/
http://www.jema-net.or.jp/English/index.html

Japan Energy Research Center
http://www.jerc.co.jp/com.html

Japan Gas Association
http://www.gas.or.jp/indexe.html

Japan International Center for Occupational Safety and Health
http://www.jicosh.gr.jp/
http://www.jicosh.gr.jp/english/

Japanese Standards Association
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KHK – The High Pressure Gas Safety Institute of Japan
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Ministry of Foreign Affairs of Japan
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National Hydrogen Association
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Natural Resources Canada
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